RETURN BRIEF

CESSNOCK CORRECTIONAL CENTRE

240 BED MINIMUM SECURITY EXPANSION

ELECTRICAL SERVICES

JHA

CONSULTING ENGINEERS

DOCUMENT CONTROL SHEET

Project Number	180147
Project Name	Cessnock Correctional Centre, 240 bed Minimum Security Expansion
Description	Return Brief
Key Contact	Con Serban

Prepared By

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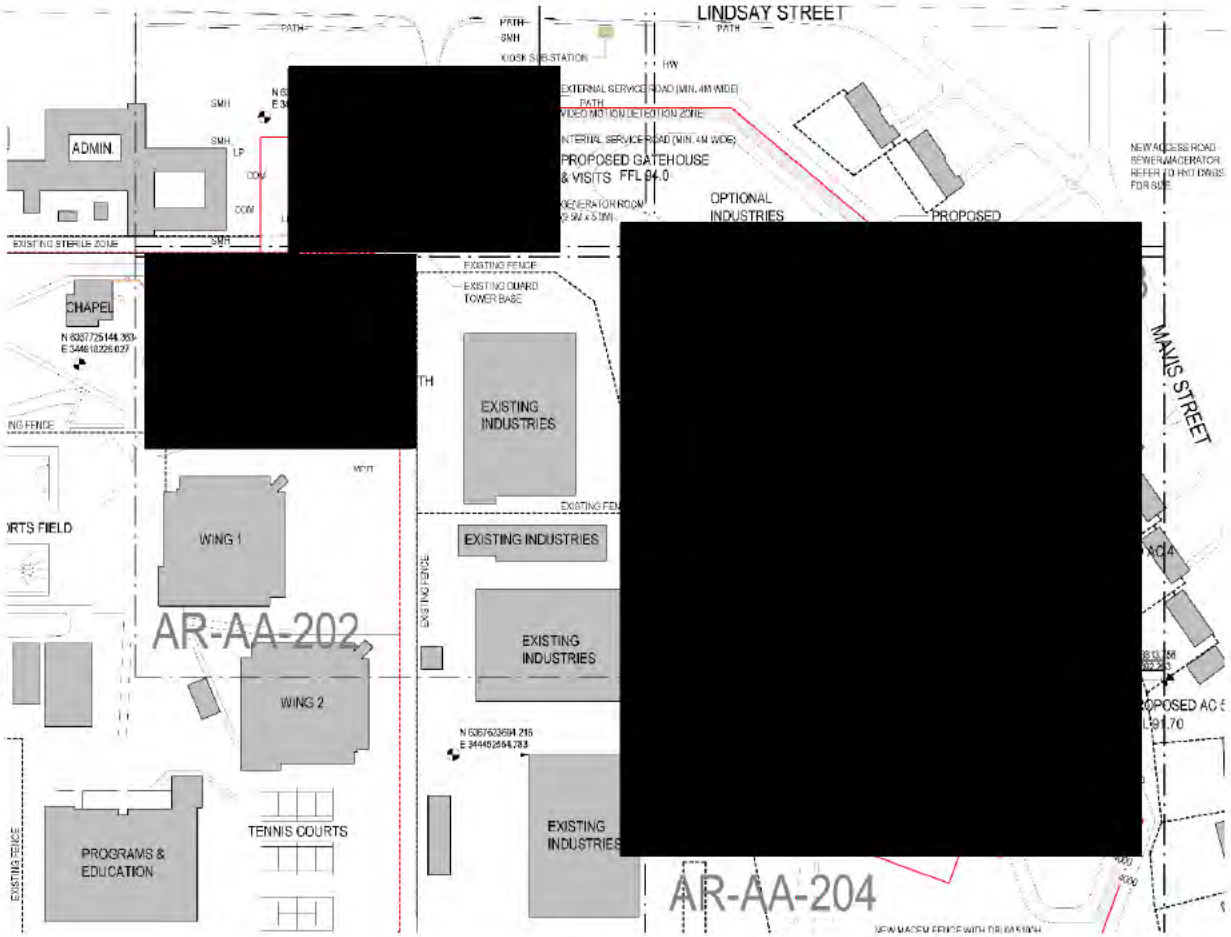
	REV	
	DATE	

CONTENTS

1 PROJECT DESCRIPTION

1.1 PROJECT SCOPE



Site plan

It is proposed that a 240 bed minimum security expansion be constructed on a site directly bounding the existing industries zone, which currently serves as part of the existing Cessnock Correctional Centre. These new expansion works will incorporate a new gatehouse, entry and linking zone and common facilities to serve and form a larger minimum security centre of approximately 760 beds.

The works proposed are identified on the above site plan and are further described as follows:

- A new purpose-designed Gatehouse (with new MCR and Security Server) constructed outside the perimeter of the currently operating prison which incorporates a new minimum security visits centre capable of serving the whole 760 bed minimum security centre;
- A new Inmate Reception & Health (Clinic) building to be constructed within the existing site in place of the existing visits building serving the whole 760 bed minimum security centre;
- A new + upgraded secure perimeter configured to suit the proposed new 280 bed minimum security expansion, the new Gatehouse location, new Reception / Clinic building location and the integration with the existing remand centre and industries precinct to form a single centre;
- Construction of 240 additional beds, consisting of five (5) minimum security residential accommodation units each consisting of 48 beds with future capacity for construction of a 6th unit;
- A New Programs building with movement control Officer Post to service the bed expansion zone;
- New recreational spaces, central field, fitness stations, landscape elements and courtesy fencing;

- New internal service road(s) configured to provide emergency and maintenance vehicle access for the combined centre site;
- New and upgraded internal pedestrian links to provide access and inmate movement control across the new centre configuration;
- A new visitors car park providing access to the new gatehouse;
- Demolition of the existing minimum security Visits building and surrounding external spaces

The CSNSW Functional Design Brief requested additional architectural master planning consideration be given to;

- Future expansion provision for 1 additional 48 bed accommodation building in the new minimum precinct;
- Industry Unit(s) future expansion

2 INTRODUCTION/ ROLES & RESPONSIBILITIES

JHA have been engaged by Lend Lease to progress the concept design to a schematic design level to assist design resolution during the Early Contractor Involvement (ECI) phase of the project. JHA's specific role over the duration of the project can be summarised as follows:

ECI Phase: JHA and the services Contractors will jointly undertake the schematic design of electrical services to a level suitable for the Contractors to reasonably price on a design & construct basis, plus allow the Principal to understand the scope of services offered. JHA will further serve as an advisor and representative to the overall Lend Lease team on all technical items.

Delivery Phase (Post ECI): JHA's specific role during the delivery phase is to provide technical advice to the Contractors (and the general Lend Lease team) on all electrical services throughout the proposed new works. JHA's further role is to review all electrical design, documentation and installation to ensure that they are fully compliant with Lend Lease's contractual obligations and that they are consistent with a Correctional Centre of this nature and scale.

The Contractors have been engaged by Lend Lease and is responsible for the design, documentation, certification, installation, commissioning and warranty of the electrical services throughout the proposed new works.

JHA and the Contractors will be working collaboratively, along with the broader Lend Lease team, to ensure that a fully compliant Correctional Centre is delivered.

3 PURPOSE OF DOCUMENT

This return brief is a document which captures the design decisions that have been made during the ECI phase of the project. This return document should be read in conjunction with the developed JHA drawings and performance specifications.

This brief does not intend to repeat in detail the contents of the contract documents, rather, the brief looks to offer the following:

- A summary of decisions and departures reached during the ECI phase as the design evolves into schematic design
- Give a summarised overview of the contact requirements
- Clarify/ expand on briefing requirements as developed with the CNSW
- Clearly identify departures to the contract documents (additions and deletions) and the rationale as to why
- Clearly identify issues which require further resolution with the CNSW

It is important to note that the purpose of this report is to 'de-risk' the electrical scope and provide certainty for all parties as the project progresses. To this end, the JHA Return Brief will supersede the original contract documents. While care has been taken to be clear and accurate, should the unlikely event occur where there is conflict between the two documents the JHA Return Brief will take contractual precedence.

It should be further noted that the schematic design drawings which supplement this report are also not exhaustive. The purpose of the drawings is to provide certainty as to the extent and configuration of the electrical services. Due to the Architectural drawings being developed concurrently with the electrical drawings, detailed layouts could not be prepared. Similarly, due to time constraints and continual development it was not intended to reproduce information which was already clear within room data sheets. Consequently, the design development drawings produced offer supplementary information over and above room data sheets only.

4 ELECTRICAL SERVICES

4.1 DESIGN STANDARDS

The Electrical services design will comply with the following standards:

Australian Standards	Electrical Installation – Patient Areas	AS/NZS 3008:2011
	Electrical Installations – Selection of Cables	AS/NZS 3008:2009
	Lightning Protection	AS/NZS 1768
	Electrical Installation	AS/NZS 3000
	Electrical Installations – Classification of the Fire & Mechanical Performance of Wiring Systems Elements	AS/NZS 3013
	Low-voltage switchgear and control gear assemblies - Particular requirements for low-voltage switchgear and control gear assemblies intended to be installed in places where unskilled persons have access for their use - Distribution boards	AS 3439.3
	Interior lighting - Safe movement	AS/NZS 1680.0
	Interior and workplace lighting - Specific applications - Circulation spaces and other general areas	AS/NZS 1680.2.1
	Emergency evacuation lighting for buildings - System design, installation and operation	AS/NZS 2293.1
	Low-voltage switchgear and control gear assemblies - Type-tested and partially type-tested assemblies	AS/NZS 3439.1
	Control of the obtrusive effects of outdoor lighting	AS 4282
Authorities	National Construction Code	*2017*
	Ausgrid	
	NSW Service and Installation Rules	
	NSW Fire Brigade	
Other documents	A_NSW Justice -Cessnock 280_ Specification_ Issued For Concept Design Report	
	NL180226_HE01_A Electrical Services Performance Specification	
	NL180226_HF01_A_Fire Services Performance Specification	
	Ref: 8179180218SCLA_CESSNOCK.docx I051217. Date: 9th April, 2018 - Security Services Specification	
	Facility Assets Correctional Standard - Functional Purpose and Design	
	Facility Assets Correctional Standard (Health Care) - REVISION Mar 2018	
	Mechanical, Hydraulic and Security services documentation	

Room Data Sheets

4.2 GENERAL/ SCOPE OF WORKS

The scope of the electrical services for the proposed new minimum security expansion is broadly summarised as follows:

- Detailed design, documentation and certification
- Staged works so as to maintain a fully functional Correctional Centre
- Services diversions associated with Telstra and NBN lead in cables
- New kiosk substation and associated high voltage cabling works
- Main Switchboard
- Distribution boards
- Bulk power factor correction or provision for Harmonic Filters
- Consumers mains & submains
- Cable management & support
- Metering (Authority & private)
- General power distribution, inclusive of power to other trades
- Emergency backup generator
- UPS support
- General internal lighting
- External lighting inclusive of specific perimeter lighting to complement / supplement external security surveillance and car parks
- Lighting control system (internal & external)
- Emergency & exit lighting
- Body Protected areas
- Lightning protection system
- Training
- Fire rating treatment of all related penetrations
- Smoke seals as required
- Occupation and Maintenance Manuals
- As built Drawings (BIM)
- Certification
- Testing and Commissioning.

4.3 POWER INFRASTRUCTURE

4.3.1 MAXIMUM DEMAND

JHA have undertaken a high level preliminary maximum demand assessment for the new expansion works and have assessed a total demand in the order of 685KVA. This demand assessment will undergo further refinement as the design of all services go through a design development process. On the basis of this preliminary assessment a decision has been made to serve the site with a new 1MVA kiosk substation.

The 1MVA substation was selected so that an allocation of spare capacity of approximately 315MVA can be set aside for the potential future introduction of an additional accommodation building and an industries building (refer to the site plan). Final decisions regarding the nature of the industries fitout will need to be carefully considered with due regard to the available spare capacity from this substation.

Refer to Appendix A – Electrical Services Maximum Demand Calculation.

4.3.2 EXISTING

The Ausgrid Zone Feeder that serves the Prison complex will be augmented with an additional HV interconnector, HV switching changes to transfer loads to different feeders that will all be completed as part of the 330 Bed construction project.

The end result will be that the Zone Feeder for the prison will have capacity available for the 240 Bed complex's electrical demand.

Power to the existing Cessnock 250 Bed Maximum Security facility is provided through HV cables located along the road to the south of the industries buildings. These high voltage cables are currently located within the site boundary of the proposed new 240 bed facility. As part of the 330 bed extension project this existing HV infrastructure will be disconnected and capped off to allow the proposed 240 bed site to be developed.

As stated above the new 240 Bed complex will require a new dedicated L-type 1000kVA Kiosk Substation which shall be fitted with a SAIF 1600Amp LV panel.

The Substation will be installed external to the fence and in close proximity to the new 240 Bed Gate house building which will also house the site main switchboard.

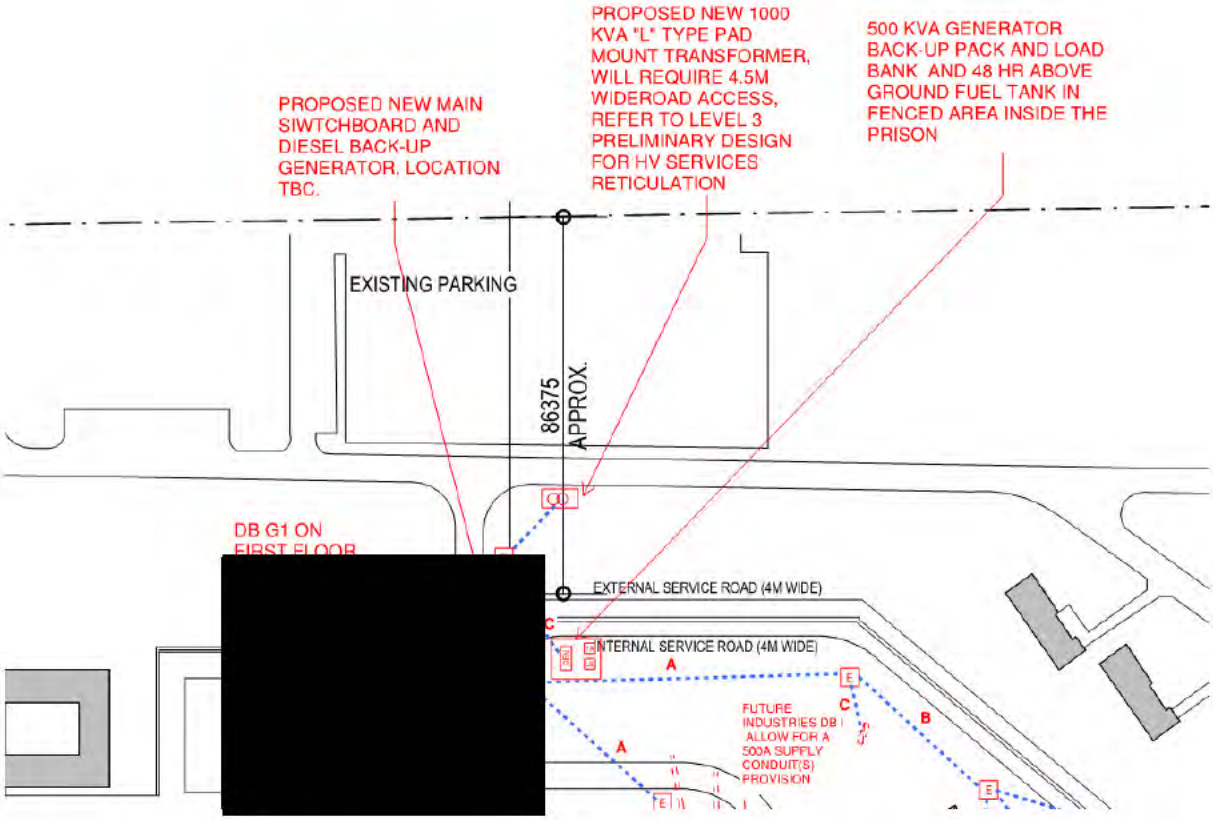
The Ausgrid Electrical Network on the prison site has an underground 11kV cable located adjacent to or within the Tuhega Drive prison entry road that passes the planned 240 Bed Gatehouse building. The construction work needed to link in the new substation will cut this HV cable and then loop in and out of the substation to complete the HV circuit.

4.4 PROPOSED POWER SUPPLY ARRANGEMENT

4.4.1 NEW KIOSK SUBSTATION

As stated above it is proposed that the new 240 bed expansion will be adequately accommodated by the introduction of a new 1MVA kiosk substation connected into the existing high voltage infrastructure in close proximity. It is proposed that this new substation will be located outside the walls of the Correctional Centre to allow the Authority unimpeded access at all times.

The new substation will be installed in close proximity to the new Gatehouse so as to minimise voltage drop impacts. The new site main switchboard will be housed internal to the new gatehouse.



Note, the kiosk substation and the associated high voltage cabling will be the subject of an easement registered in the favour of Ausgrid.

4.4.2 MAIN SWITCHBOARD

It is proposed that the main switchroom for the new centre will be located with the Gate House, servicing the entire site.

The main switchroom will accommodate the main switchboard serving safety services equipment, supply authority meter panels, power factor correction equipment and local distribution boards throughout the centre. The switchboard is reasonably positioned in so much that it is in close proximity to the larger loads of the site (gatehouse, visits & health / reception).

Consumer mains will be reticulated from the new kiosk substation via an underground cables to the Main Switchroom location. Underground consumer mains will not be required to be fire rated and will be sized to accommodate the full rated output of the new kiosk substation. A further spare 150mm conduit will be run with the consumer mains.

The main switchboard will be housed within a dedicated 2 hour fire rated room. The room will be equipped with 2 egress doors spaced well apart as per the requirements of AS/NZS 3000 and the NCC.

The new switchboard shall be rear connected, Form 3B, IP42, freestanding and have a fault levels to suit the substation / generator configurations during a closed transition.

The new switchboard will have a Fire Safety Section (FSS) and a 'Prison Essential Services' section (PES) - for devices that the prison considers essential but the NCC does not). The FSS and PES will be generator backed and will be stepped onto the generator.

Transfer of loads to and from the generator will be by via an Automatic Transfer Switches and motorised circuit breakers to the generator manufacturer's recommendations so as to avoid the potential of overloading. The number of ATS' and the grouping of effected submains are indicatively illustrated on the JHA schematic drawings. The generator will synchronise with the mains for a maximum one second interval before transferring loads back to the mains supply after a blackout and during generator load testing.

As an additional point of redundancy in the event of power failure an external connection point will be provided so that a hire generator can be connected in the event of the permanent unit failing.

Spare capacity will be provided to all sections of the main switchboards.

4.4.3 CONSUMER MAINS / SUBMAINS

The consumer mains will be reticulated underground to the gatehouse main switchboard and as such fire rated cabling will not be required. The consumer mains will be rated to the maximum available current from the respective substation and generator.

Two hour fire rated cabling will be installed to all NCC Fire Safety Services sub-mains only. All generator supported submains will be XPLE unless supporting such NCC essential services. Low smoke zero halogen cables will not be used.

All submains will be reticulated underground or on appropriately sized cable trays.

All submains will be sized to accommodate the calculated maximum demand plus an allocation of spare capacity as dictated by the technical specification.

Voltage drop will be determined on the basis of 7% as per AS3000 requirements.

4.4.4 POWER FACTOR CORRECTION

It is proposed that the new works will be equipped such that the power factor is maintained at 0.98 or better. It is proposed that this will be achieved through either traditional bulk power factor correction units or through the use of

Active Harmonic Filters (AHF). The choice will be left to the installing Contractor with the criteria being that the 0.98 power factor must be achieved. The sizing of such AHF units is difficult to ascertain with accuracy during the design phase of the project as there are many variables which will have an impact. As such it is proposed that spatial provision only will be included initially and that as the building is commissioned that the units will be added to suit the prevailing harmonics and power factor if required.

4.4.5 LIGHTNING AND SURGE PROTECTION SYSTEM

4.4.5.1 Lightning Protection

A lightning protection system will be provided throughout the site to comply with the requirements of AS1768. While it is understood that a number of the external elements and buildings do not require lightning protection under the Standard this is a particular instruction by CNSW.

As a minimum lightning protection will be provided to the following:

1. Building metallic roof, allow to bond each roof metal section to ensure full continuity.
2. Perimeter fences to bond each metal section to ensure full continuity refer also to typical lightning protection section and detail provided within the JHA drawings.
3. All down conductors to be insulated copper cable in conduits. Down conductor locations to be coordinated with the building structure (i.e. to suit column and wall type). Down conductors to be generally concealed within the building fabric. Where this cannot be achieved the down conductor shall be in steel screwed conduit and positioned so as to avoid inmate locations.

4.4.5.2 Surge Protection

Surge protection will be provided at the main switchboard and at each building distribution board. Individual points of protection will also be provided to outgoing external subcircuits and at the base of each light pole location.

4.4.6 BACK-UP DIESEL GENERATOR

The new 240 Bed Centre will be provided with an emergency back-up diesel generator consistent with CNSW briefing. The general philosophy being adopted with the regard to the distribution of emergency power is that services which are considered necessary to ensure staff & inmate safety, plus allow the continued operation of the Centre in a reduced capacity, will be provided with generator support.

It is proposed that a new and dedicated 500 KVA generator, complete with its own weather proof acoustic housing will be implemented. This generator will be positioned in close proximity to the new gate house and inside the perimeter fence. The generator will also be provided with an above ground bulk fuel tank sized so as to ensure a minimum of 48 hours continued operation at full load.

The acoustic housing shall be such that it will achieve a minimum of 70dBA @1 meter.

Load will be transferred onto the generator through automatic transfer switches and / or motorised breakers. Further load control on the larger mechanical services could be facilitated through the BMS.

4.4.7 SERVICES BACK-UP

Northrop Document - NL180226_HE01_A Electrical Services Performance Specification provided details of electrical services which are required to be on diesel generator back-up.

Generally all services required under NCC (essential services such as fire detection, emergency lighting, mechanical fire exhaust systems, fire hydrant services, etc) also critical lighting and power services which are required for the centre to maintain functionality are deemed to be connected to the generator back-up.

The critical services will included but not be limited to the following:

- 100% of all internal and external lighting will be supported off the generator so as to ensure a safe environment and continued functionality.
- Power services to individual areas as per Northrop specification
- Power supplies to communication and security systems equipment including comms rooms and field mounted equipment.
- UPS systems.
- MCR power services

4.4.8 UNINTERRUPTABLE POWER SUPPLY (UPS)

It is proposed that a distributed UPS solution will be adopted for the new expansion. The UPS' have been designed to support all new security and communications infrastructure associated with the expansion in consultation with the security trade. The UPS philosophy can be summarised as follows:

- The gatehouse / visits will be provided with 2 x 30KVA UPS' configured in a 2N arrangement and having a battery autonomy of 20 minutes at full load
- All other buildings (inclusive of reception and the accommodation units) will be provided with a single 12KVA UPS having a battery autonomy of 15 minutes at full load
- All quoted battery autonomy shall be "end of life" (EOL)
- UPS batteries will be in multiple parallel strings to ensure single failure or planned maintenance does not impact on reliability.
- All UPS' will be equipped with external maintenance by pass switches
- UPS sizing has been determined on the basis of detailed loads provided by SCG
- All aspects of the UPS' will comply with the detailed requirements set out in the IPP performance specification for security services.
- The gatehouse UPS' will be housed within a dedicated fire rated UPS room adjacent to the SER. All remaining building UPS' are housed within the respective SER's and are free standing (not rack mounted). Consequently all SER's will be fire rated to satisfy the needs of the NCC.
- The UPS will be monitored by an SNMP card and dedicated alarms will be provided back to the security management system

Typical UPS

4.4.9 DISTRIBUTION BOARDS

All distribution boards will be Form 2 and will be positioned to achieve an efficient reticulation without excessive voltage drop.

Distribution boards will be provided with split chassis and metering compliant with the NCC. Such meters will be capable of being connected to an energy management system.

Boards will be provided with spare pole capacity for all sections as per the requirements of the ESG (25%).

All circuits will be provided with combination over-current and residual current breakers (RCBOs) at the local distribution board with the exception of circuits to body protected areas and those circuits exempted by AS/NZS3000.

All distribution boards shall generally be accessible from circulation areas or plant room areas. Distribution boards within Inmate occupied areas will be avoided.

4.4.10 POWER DISTRIBUTION

The main switchboard will serve all distribution boards located throughout the new expansion site for the distribution of general power, lighting, mechanical services switchboards and other equipment as required.

Each distribution board will be designed to supply light and general power loads as required plus 25% spare capacity. All submains will be sized to have 25% spare capacity.

All mechanical and hydraulic services will be connected through dedicated services power distribution system and will be separately metered in accordance with NCC requirements. Refer to mechanical and hydraulic services section for details.

The distribution boards will be housed within lockable distribution board cupboards or plantrooms as per drawings.

4.4.11 SERVICES WITHIN PRISONER AREAS

'Unsupervised Prisoner Area' (UPA) – cells (observation/holding)

- Light fittings are to be of recessed type and vandal proof.

- GPO's, Switches and Data outlets to be recessed stainless steel type on 3mm face plate with countersunk or concealed security screws and impact resistant.

Unsupervised Prisoner Area' (UPA) – bedrooms

- Light fittings are to be of surface mounted type and vandal proof.

- GPO's, Switches and Data outlets to be recessed 1.6 mm stainless steel type Clipsal secure range or equivalent, with countersunk or concealed security screws and impact resistant.

- No exposed surface mounted conduits.

- Electrical, Fire, Communications and Security cabling to be concealed in ceiling spaces, reticulated on cable trays, catenaries and inside wall cavities. Where exposed to additional mechanical damage, UPVC conduits will be provided for cable protection.

- Fire protection detectors to be fit with secure ant ligature covers.

- Fire protection Speakers to be recessed type and vandal proof.

- Fixtures and fittings are to be anti-pick and anti-ligature below 4.8m.

'Supervised Prisoner Area' (SPA):

- Light fittings can be both surface OR recessed type, and vandal proof.

- GPO's, Switches, data outlets to be UPVC impact resistant, c/w with security screws fixings.

- No exposed surface mounted conduits.

- Electrical, Fire, Communications and Security cabling to be concealed in ceiling spaces, reticulated on cable trays, catenaries and inside wall cavities. Where exposed to additional mechanical damage, UPVC conduits will be provided for cable protection.

'Non-Prisoner Area' (NPA):

- Light fittings can be of standard type.

- GPO's, Switches, data outlets can be of standard type.

- Surface mounted conduits not allowed except non-prisoner secure areas such as plant rooms etc.

- Electrical, Fire, Communications and Security cabling to be concealed in ceiling spaces, reticulated on cable trays, catenaries and inside wall cavities. Where exposed to additional mechanical damage, UPVC conduits will be provided for cable protection.

- Fire protection detectors can be of standard type.

- Fire protection Speakers can be of standard type.

- Fixtures and fittings are NOT required to be anti-pick and anti-ligature.

4.5 LIGHTING

4.5.1 GENERAL PRINCIPLES

Interior lighting throughout all buildings associated with the expansion will be in accordance with the general requirements of AS/NZS 1680 and consistent with a Correctional facility environment (i.e. vandal resistant and fitted with tamper proof screws). All luminaires throughout will implement LED technology to facilitate an energy efficient design outcome and to ensure reduced maintenance. Luminaires will be selected such that they achieve a minimum of 50,000 operating hours at L70.

The details of the design philosophy to be adopted throughout all areas of the project can be seen on the JHA schematic drawings.

Internal illuminance levels throughout shall be in accordance with AS/NZS1680 where applicable.

All lighting shall have a colour temperature of 4000K.

Colour rendering throughout shall generally be no less than Ra 80.

Motion controlled lighting will generally be kept to a minimum and will only be implemented where needed to ensure NCC Section J6 compliance or where a demonstrable benefit exists (i.e. typically the control of 4 lights or more in appropriate rooms) .

It is proposed that 100% of all internal and external lighting will be supported off the generator so as to ensure a safe environment and continued functionality.

4.5.2 LIGHTING LEVELS

In general lighting levels will comply with the requirements of AS1680 and to suit the particular environment as described under NL180226_HE01_A Electrical Services Performance Specification.

4.5.3 EXTERNAL LIGHTING

The external lighting will consist of the following systems:

a. 10m lighting poles located outside the prison perimeter fence which will provide a minimum 10 lux illuminance level along the external road and minimum 5 lux on the top of the fence solid security drum.
b. 7m light poles located internally along the prison perimeter fence which will provide a minimum 10 lux over the VMD /No Go zone.
c. 6m light poles located along footpaths which will achieve a minimum 10 lux along the pathways.
d. 6m light poles within the new carpark which will achieve minimum 5 lux.
e. Wall mounted luminaires on buildings which will achieve minimum 10 lux at the base of the building.

Perimeter security fence lighting (items a and b) above will also achieve a maximum /average ration of no more than 3/1.

4.5.4 CENTRALISED LIGHTING CONTROL

A centralised lighting control will be provided using a CBUS system which will allow for remote control of various lighting systems throughout the site from the new Gate house main control room plus a second designated location TBC by the client during the detailed designs stage.(Assumed at this stage to be Program buildings – post control room)

Two main lighting control panels (MLCP) shall be located at:

a. site control room within the Gatehouse buildings

b. and a second location (as per above assumption).

The panels shall be CBUS compatible and shall allow for ON/OFF switching of various lighting systems as described further bellow.

Site wide lighting control shall only be possible from the two fix main panels (MLCP).

For secure reasons the system shall have no remote or wireless control capabilities. (Subject to Client confirmation.)

Any changes/modifications to the system programing shall only be possible from the two main panels/ central system head end.

In first instance each smart touch panel control should have the following capability:

4.5.4.1 MLCP EXTERNAL LIGHTING CONTROL

External lighting control shall use a combined PE/Timer clock automated control system with override control from the two site MLCP's as per bellow:

- perimeter secure outer fence lighting (On/OFF)
- perimeter secure inner fence lighting (On/OFF)
- buildings external wall lighting (On/OFF)
- carpark lighting (On/OFF)
- override all external lighting (On/OFF)

Any automatic lighting control including PE Cell /Timer/CBUS will be fail safe.(ON)

4.5.4.2 MLCP INTERNAL LIGHTING CONTROL

Remote control for buildings internal lighting services shall consist of:

- Override building internal lighting (On/OFF) switch for Programs and Health buildings.
- Override switch for each accommodation building to allow separate control for ceiling lighting in bedrooms, one (ON/OFF) on switch per building.

The system shall be expandable to allow future building connections.

4.5.4.3 INDIVIDUAL BUILDING LIGHTING CONTROL

Each building except accommodation pods will be provided with local LCP's sized to control each individual lighting zones as per proposed building lighting design layouts to be further developed during the detail design stages. Override local switching facility will be provided for areas such as classrooms, offices, medical rooms, dayrooms, etc. Each building LCP will also be programmed to have 1 override switch to control the entire building internal lighting.

Each building LCP shall be programmed to control only lighting services within the building.

The accommodation pods internal lighting will be controlled locally via motion light switches each area except dayrooms, plantrooms and comms rooms where override light switches will be provided at door entry.

4.6 EMERGENCY AND EXIT LIGHTING

Emergency and exit lighting will be installed throughout all buildings associated with the expansion to achieve strict compliance with AS2293.1 and the NCC.

It is proposed that a new standalone computer monitored emergency and exit lighting system will be introduced for the expansion for future monitoring and maintenance.

Emergency & exit lighting will generally consist of:-

- Recessed spitfire luminaires within corridors and areas where false ceilings exist
- Integrated LED fittings within plantroom areas
- Exit signs shall be of the edge lit type in front of house areas (gatehouse / visits) and conventional style for back of house areas.

4.7 BMS SYSTEM INTERFACE

Provide electrical Systems interface as per attached BMS system interface.

Refer to Appendix B of this report.

4.8 DESIGN DEPARTURES

The proposed ECI design for electrical services has a number of departures from various documents which form part of the client Design documents.

Refer to Appendix C document: Departure Schedule

4.9 DRAWINGS LIST

Electrical			
EL-AA-000	Electrical Services - Cover Sheet	A	EL-AA-000-A.pdf
EL-AA-100	Electrical Services Site Reticulation	B	EL-AA-100-B.pdf
EL-AA-101	Existing Services- External Lighting	B	EL-AA-101-B.pdf
EL-AC-100	Electrical Services Accomodation Ground Floor Power Layout	B	EL-AC-100-B.pdf
EL-AC-101	Electrical Services Accomodation First Floor Power Layout	B	EL-AC-101-B.pdf
EL-AC-130	Electrical Services Accomodation Ground Floor Lighting Layout	B	EL-AC-130-B.pdf
EL-AC-131	Electrical Services Accomodation First Floor Lighting Layout	B	EL-AC-131-B.pdf
EL-GV-100	Electrical Services Gate House Ground Floor Power Layout	B	EL-GV-100-B.pdf
EL-GV-101	Electrical Services Gate House First Floor Power Layout	B	EL-GV-101-B.pdf
EL-GV-130	Electrical Services Gate House Ground Floor Lighting Layout	B	EL-GV-130-B.pdf
EL-GV-131	Electrical Services Gate House First Floor Lighting Layout	B	EL-GV-131-B.pdf

EL-HR-100	Electrical Services Health and Reception Ground Floor Power Layout	B	EL-HR-100-B.pdf
EL-HR-130	Electrical Services Health and Reception Ground Floor Lighting Layout	B	EL-HR-130-B.pdf
EL-PR-100	Electrical Services Programs Ground Floor Power Layout	B	EL-PR-100-B.pdf
EL-PR-130	Electrical Services Programs Ground Floor Lighting Layout	B	EL-PR-130-B.pdf
EL-AA-140	Electrical Services Light Fitting Schedule	B	EL-AA-140-B.pdf
EL-AA-400	Electrical Services Schematics and Detail Sheet 1	B	EL-AA-400-B.pdf
EL-AA-401	Electrical Services Schematics and Detail Sheet 2	A	EL-AA-401-A.pdf
EL-AA-402	Electrical Services Schematics and Detail Sheet 3	B	EL-AA-402-B.pdf
EL-RP1	Electrical Return Services Brief	A	EL-RP1-A.pdf

5 APPENDICES

5.1 A: ELECTRICAL SERVICES MAXIMUM DEMAND

Cessnock CC Max Demand

Revision: 1

BUILDING: EXTERNAL LIGHTING

Date: 30/04/2018

Job number: 180147

ROOM NAME	AREA m²	Lighting (L) (VA/m²)	Power (P) (VA/m²)	AC/Vent (AC) (VA/m²)	Maximum Dermand (VA)	Generator Demand (VA)		UPS (VA)
External lighting					11000		11000	
Water pumps					20000		11000	
Macerator					20000		11000	
TOTAL	**0.00**				**51000.00**		**33000.00**	**0.00**

Cessnock CC Max Demand

Revision: 1

BUILDING: GATEHOUSE [G1]

Date: 30/04/2018

Job number: 180147

ROOM NAME	AREA m²	Lighting (L) (VA/m²)	Power (P) (VA/m²)	AC/Vent (AC) (VA/m²)	Maximum Demand (VA)	Generator Demand (VA)		UPS (VA)
ACC WC	6 00	6	10	30	276	L	36	
ACCESS / BABY CHANGE	5 00	6	10	30	230	L	30	
ACC WC	5 00	6	10	30	230	L	30	
ACCESSIBLE LIFT	4 00	6	0	0	24	L	24	
ARMOURY	20 00	10	20	30	1200	L + P	600	
COMMS	39 00	10	750	750	58890	L + P + AC	58890	29640
EMERGENCY RESPONSE STORE	20 00	6	10	15	620	L	120	
F WC	3 00	6	10	15	93	L	18	
FOYER / WAITING (24 SEATS)	117 00	10	10	30	5850	L	1170	
GUN SAFE	10 00	10	20	30	600	L	100	
HOLDING LOCK	8 00	10	10	50	560	L	80	
HOLDING LOCK	19 00	10	10	50	1330	L	190	
KEY ROOM	32 00	10	20	50	2560	L + P	960	
LOBBY	13 00	10	10	60	1040	L	130	
LOCK	5 00	6	0	15	105	L	30	
M WC	2 00	6	10	15	62	L	12	
MCR	58 00	10	70	60	8120	L + P	4640	4060
METAL DETECTION	11 00	10	50	60	1320	L + P	660	
OFFICER POST	43 00	10	50	60	5160	L + P	2580	2150
PLANT	70 00	6	10	15	2170	L	420	
SALLY PORT	161 00	10	0	0	1610	L	1610	
SEARCH / CHANGE / LOCKER	44 00	10	10	30	2200	L + P	880	
SECURE LOCK	6 00	6	0	0	36	L	36	
SERVICES	66 00	6	10	15	2046	L	396	
STAFF WC	3 00	6	10	15	93	L	18	
STAIR	13 00	6	0	20	338	L	78	
STORE	18 00	6	10	60	1368	L	108	
WAITING / PROCESSING	50 00	10	10	60	4000	L + P	600	
ELECTRICAL WATER HEATING					12000	P	12000	
TOTAL	**851.00**				**114131.00**		**86446.00**	**35850.00**

BUILDING: VISITS [G1]

Date: 30/04/2018

Job number: 180147

ROOM NAME	AREA m²	Lighting (L) (VA/m²)	Power (P) (VA/m²)	AC/Vent (AC) (VA/m²)	Maximum Demand (VA)	Generator Demand (VA)		UPS (VA)
ACCESS / BABY CHANGE	5 00	6	10	30	230	L	30	
CLEANER	3 00	6	10	30	138	L	18	
F WC	2 00	6	10	30	92	L	12	
FAMILY ROOM	11 00	10	10	50	770	L	110	
FAMILY ROOM	11 00	10	10	50	770	L	110	
FAMILY ROOM	11 00	10	10	50	770	L	110	
FAMILY ROOM	11 00	10	10	50	770	L	110	
INDOOR PLAY AREA	27 00	6	10	50	1782	L	162	
INDOOR VISITS (54 TABLES)	321 00	10	10	60	25680	L + P	6420	
LOCK	4 00	6	0	15	84	L	24	
M WC	2 00	6	10	15	62	L	12	
N/C INMATE	4 00	10	10	30	200	L	40	
N/C INMATE	4 00	10	10	30	200	L	40	
N/C INMATE	4 00	10	10	30	200	L	40	
N/C INMATE	4 00	10	10	30	200	L	40	
N/C INMATE	4 00	10	10	30	200	L	40	
N/C INMATE	6 00	10	10	30	300	L	60	
N/C VISITOR	6 00	10	10	30	300	L	60	
N/C VISITOR	4 00	10	10	30	200	L	40	
N/C VISITOR	4 00	10	10	30	200	L	40	
N/C VISITOR	4 00	10	10	30	200	L	40	
N/C VISITOR	4 00	10	10	30	200	L	40	
N/C VISITOR	4 00	10	10	30	200	L	40	
OFFICER POST	35 00	10	50	50	3850	L + P	2100	1750
OUTDOOR PLAY AREA	70 00	6	0	0	420	L	420	
OUTDOOR VISITS (12 TABLES)	124 00	10	0	0	1240	L	1240	
POSSIBLE OUTDOOR HOLD	30 00	10	0	0	300	L	300	
SEARCH / CHANGE / LOCKER	33 00	10	10	30	1650	L + P	660	
SEARCH / CHANGE / LOCKER	18 00	10	10	30	900	L + P	360	
CORRIDOR	22 00	6	10	15	682	L	132	
CORRIDOR	17 00	6	10	15	527	L	102	
CORRIDOR	17 00	6	10	15	527	L	102	
STAFF WC	2 00	6	10	15	62	L	12	
STORE	6 00	6	10	20	216	L	36	
WAITING / PROCESSING	44 00	10	10	50	3080	L + P	880	
LOBBY	23 00	10	10	50	1610	L	230	
ELECTRICAL WATER HEATER					12000	P	12000	
Total	**901.00**				**60812.00**		**26212.00**	**1750.00**

Cessnock CC Max Demand

Revision: 1

BUILDING: ACCOMMODATION [A4]

Date: 30/04/2018

Job number: 180147

ROOM NAME	AREA m²	Lighting (L) (VA/m²)	Power (P) (VA/m²)	AC/Vent (AC) (VA/m²)	Maximum Demand (VA)	Generator Demand (VA)		UPS (VA)
DAYROOM (4-off)	329.3	10	10	40	19758.0	L	6586.0	
DAYROOM PERIMETER (4-off)	234.45	10	0	40	11722.5	L	2344.5	
VERANDAH	48.63	6	0	0	291.8	L	291.8	
BALCONY	48.55	6	0	0	291.3	L	291.3	
PLANT (2-off)	56.96	6	10	10	1481.0	L	341.8	
TOILETS & SHOWERS (4-off)	75.12	6	10	20	2704.3	L	450.7	
KITCHEN (4-off)	60.48	10	200	60	16329.6	L + P	12700.8	
SLEEPOUT (4-off)	42.28	10	0	0	422.8	L	422.8	
DOUBLE BEDROOM (12-off)	114	10	20	40	7980.0	L	1140.0	
ACC. BEDROOM (2-off)	18.4	10	20	40	1288.0	L	184.0	
SINGLE BEDROOM (2-off)	18.38	10	20	40	1286.6	L	183.8	
LAUNDRY (2-off)	18.2	10	100	40	2730.0	L	182.0	
SINGLE BEDROOM (20-off)	175.4	10	20	40	12278.0	L	1754.0	
ACC. WC (2-off)	11.52	6	10	15	357.1	L	69.1	
STORE (2-off)	11.48	6	10	15	355.9	L	68.9	
CLEANER (2-off)	9.34	6	10	15	289.5	-	-	
ELECTRICAL HOT WATER (36KW@50%=18KW)					9000.0			
COMMS ROOM			12000	6000	18000.0		12000.0	12000
TOTAL	**1272.49**				**106566**		**39011.5**	12000

Cessnock CC Max Demand

Revision: 1

BUILDING: EDUCATION / PROGRAMS [E1]

Date: 30/04/2018

Job number: 180147

ROOM NAME	AREA m²	Lighting (L) (VA/m²)	Power (P) (VA/m²)	AC/Vent (AC) (VA/m²)	Maximum Dermand (VA)	Generator Demand (VA)		UPS (VA)
ACC WC	5 00	6	10	15	155	L	30	
AVL	5 00	10	30	60	500	L + P	200	
AVL	5 00	10	30	60	500	L + P	200	
AVL	5 00	10	30	60	500	L + P	200	
CIRCULATION	81 00	6	10	15	2511	L	486	
CLASSROOM	30 00	10	50	60	3600	L	300	
CLASSROOM	31 00	10	50	60	3720	L	310	
CLEANER	4 00	6	10	15	124	L	24	
COMPUTER ROOM	31 00	10	60	60	4030	L	310	
COURTYARD	163 00	6	0	0	978	L	978	
EDB	2 00	6	10	15	62	L	12	
F WC	2 00	6	10	15	62	L	12	
OFFICE	13 00	10	50	60	1560	L + P	780	
INMATES ACC WC	5 00	6	10	15	155	L	30	
INMATES WC	4 00	6	10	15	124	L	24	
INMATES WC	4 00	6	10	15	124	L	24	
INTERVIEW	11 00	10	20	50	880	L + P	330	
INTERVIEW	11 00	10	20	50	880	L + P	330	
INTERVIEW	11 00	10	20	50	880	L + P	330	
INTERVIEW	11 00	10	20	50	880	L + P	330	
INTERVIEW	11 00	10	20	50	880	L + P	330	
LIBRARY	17 00	10	20	50	1360	L	170	
M WC	2 00	6	10	15	62	L	12	
MULTI-PURPOSE ROOM	56 00	10	50	70	7280	L	560	
OFFICER POST	51 00	10	50	60	6120	L + P	3060	
PLANT	13 00	6	10	15	403	L	78	
OFFICE	13 00	10	50	50	1430	L + P	780	
COMMS ROOM			12000	2000	14000	P + AC	14000	12000
OFFICE	13 00	10	50	60	1560	L + P	780	
OFFICE	13 00	10	50	60	1560	L + P	780	
STAFF BREAKOUT	18 00	10	20	60	1620	L	180	
STAFF WC	3 00	6	10	15	93	L	18	
STORE	4 00	6	10	20	144	L	24	
STORE	9 00	6	10	20	324	L	54	
OFFICE	49 00	10	50	60	5880	L + P	2940	
ELECTRICAL WATER HEATING			12000		12000	P	12000	
TOTAL	**706.00**				**76941.00**		**41006.00**	**12000.00**

Cessnock CC Max Demand

Revision: 1

BUILDING: RECEPTION / CLINIC [P1]

Date: 30/04/2018

Job number: 180147

ROOM NAME	AREA m²	Lighting (L) (VA/m²)	Power (P) (VA/m²)	AC/Vent (AC) (VA/m²)	Maximum Dermand (VA)	Generator Demand (VA)		UPS (VA)
AIRLOCK	4 00	6	0	15	84	L	24	
AVL	5 00	10	100	60	850	L + P	5000	
AVL	5 00	10	100	60	850	L + P	5000	
AVL	5 00	10	100	60	850	L + P	5000	
CLEANER	4 00	6	30	30	264	L	24	
CLEANER	5 00	6	30	15	255	L	30	
CONSULT	15 00	10	100	60	2550	L + P	1650	750
CONSULT	15 00	10	100	60	2550	L + P	1650	750
CONSULT	15 00	10	100	60	2550	L + P	1650	750
CONSULT	15 00	10	100	60	2550	L + P	1650	750
CONSULT	15 00	10	100	60	2550	L + P	1650	750
CONSULT	15 00	10	100	60	2550	L + P	1650	750
CORRIDOR	102 00	6	10	60	7752	L	612	
CORRIDOR	45 00	6	10	60	3420	L	270	
CORRIDOR	95 00	6	10	60	7220	L	570	
CORRIDOR	22 00	6	10	60	1672	L	132	
CORRIDOR	18 00	6	10	60	1368	L	108	
CORRIDOR	25 00	6	10	60	1900	L	150	
DAY ROOM	23 00	10	10	70	2070	L + P	460	
DENTAL	20 00	10	250	60	6400	L + P	5200	750
DENTAL UTILITY	10 00	10	50	60	1200	L + P	600	
DIRTY UTILITY	15 00	10	50	60	1800	L + P	900	
DOSE	6 00	10	30	60	600	L + P	240	
EMERGENCY VEHICLE BAY	57 00	10	10	20	2280	L + P	1140	
ENSUITE	6 00	10	20	15	270	L	60	
LOBBY	59 00	10	20	60	5310	L	590	
EQUIPMENT ROOM COMMS			12000	12000	24000	P + AC	24000	12000
F WC	2 00	6	10	15	62	L	12	
HOLD	6 00	10	10	50	420	L + P	120	
HOLD	13 00	10	10	50	910	L + P	260	
HOLD	16 00	10	10	50	1120	L + P	320	
HOLD	16 00	10	10	50	1120	L + P	320	
INMATES ACC WC	6 00	6	10	15	186	L	36	
INMATES WC	3 00	6	10	15	93	L	18	
INTERVIEW	12 00	10	20	50	960	L + P	360	
INTERVIEW	12 00	10	20	50	960	L + P	360	
INTERVIEW	12 00	10	20	50	960	L + P	360	
LAUNDRY	7 00	10	70	60	980	L + P	560	

ROOM NAME	AREA m²							
LEGAL VISITS	12 00	10	20	50	960	L + P	360	
LEGAL VISITS	12 00	10	20	50	960	L + P	360	
LOBBY	22 00	10	10	50	1540	L	220	
M WC	2 00	6	10	15	62	L	12	
MEDICAL RECORDS	23 00	6	10	20	828	L	138	
NEW STOCK STORE	7 00	6	10	20	252	L	42	
NURSE STATION	30 00	10	50	50	3300	L + P	1800	
OFFICE	12 00	10	50	50	1320	L + P	720	
OFFICE	12 00	10	50	50	1320	L + P	720	
OFFICE	12 00	10	50	50	1320	L + P	720	
OFFICE	13 00	10	50	50	1430	L + P	780	
OFFICER POST	31 00	10	50	50	3410	L + P	1860	
OFFICER POST	26 00	10	50	50	2860	L + P	1560	
COURTYARD	23 00	6	0	0	138	L	138	
PATIENT	21 00	10	100	60	3570	L + P	2310	
PHARMACOTHERAPY ROOM	9 00	10	100	60	1530	L + P	990	
PHARMACY	26 00	10	50	60	3120	L + P	1560	
PLANT	11 00	6	10	15	341	L	66	
STORE	54 00	6	10	20	1944	L	324	
SEARCH / CHANGE / LOCKER	24 00	10	10	30	1200	L + P	480	
SECURE YARD	18 00	6	10	0	288	L	108	
SERVICES	12 00	6	20	30	672	L	72	
SHOWER	10 00	6	10	30	460	L	60	
SINGLE CELL	11 00	10	30	60	1100	L + P	440	
SINGLE CELL	11 00	10	30	60	1100	L + P	440	
SINGLE CELL	11 00	10	30	60	1100	L + P	440	
SINGLE CELL	11 00	10	30	60	1100	L + P	440	
STAFF BREAKOUT	31 00	10	20	50	2480	L	310	
STAFF WC	5 00	6	10	15	155	L	30	
TRIAGE	24 00	10	30	50	2160	L + P	960	
URINALYSIS	10 00	10	40	60	1100	L + P	500	
STORE	7 00	6	10	20	252	L	42	
VEHICLE LOCK	92 00	10	10	50	6440	L + P	1840	
WAITING / PROCESSING	10 00	10	10	50	700	L + P	200	
WAITING / PROCESSING	12 00	10	10	50	840	L + P	240	
ELECTRICAL WATER HEATING					12000	P	12000	
TOTAL	**1383.00**				**156838.00**		**96018.00**	**17250.00**

Cessnock CC Max Demand

SUMMARY (Max Demand diversification vs time)

Revision: 1

Date: 4/30/2018

Job number: 180147

TIME	Gatehouse		Visit		Accomodation 1		Accomodation 2		Accomodation 3		Accomodation 4		Accomodation 5		Accomodation 6		Program		Clinic		External		TOTAL	Spare Capacity for Industries
	%	VA	%	VA	%	VA	%	VA	%	VA	%	VA	%	VA	%	VA	%	VA	%	VA	%	VA	VA	VA
TOTAL SITE LOAD																								
6AM-9AM	30%	34239	10%	7881	90%	95910	90%	95910	90%	95910	90%	95910	90%	95910	90%	95910	20%	15388	20%	31368	20%	10200	**674535**	325465
9AM-12PM	75%	85598	75%	59109	50%	53283	50%	53283	50%	53283	50%	53283	50%	53283	50%	53283	90%	69247	90%	141154	20%	10200	**685008**	314992
12PM-6PM	75%	85598	75%	59109	50%	53283	50%	53283	50%	53283	50%	53283	50%	53283	50%	53283	90%	69247	80%	125470	50%	25500	**684624**	315376
6PM-9PM	20%	22826	10%	7881	90%	95910	90%	95910	90%	95910	90%	95910	90%	95910	90%	95910	10%	7694	10%	15684	100%	51000	**680544**	319456
9PM-12AM	20%	22826	10%	7881	50%	53283	50%	53283	50%	53283	50%	53283	50%	53283	50%	53283	10%	7694	50%	78419	100%	51000	**487520**	512480
12AM-6AM	20%	22826	10%	7881	30%	31970	30%	31970	30%	31970	30%	31970	30%	31970	30%	31970	10%	7694	30%	47051	100%	51000	**328272**	671728
TOTAL GENERATOR LOAD																								
6AM-9AM	50%	43223	30%	11464	90%	35110	90%	35110	90%	35110	90%	35110	90%	35110	90%	35110	50%	20503	60%	57611	100%	**33000**	**376462**	623538
9AM-12PM	100%	86446	100%	38212	50%	19506	50%	19506	50%	19506	50%	19506	50%	19506	50%	19506	100%	41006	100%	96018	50%	**16500**	**395216**	604784
12PM-6PM	100%	86446	100%	38212	50%	19506	50%	19506	50%	19506	50%	19506	50%	19506	50%	19506	90%	36905	100%	96018	50%	**16500**	**391116**	608884
6PM-9PM	50%	43223	50%	19106	90%	35110	90%	35110	90%	35110	90%	35110	90%	35110	90%	35110	30%	12302	60%	57611	100%	**33000**	**375903**	624097
9PM-12AM	50%	43223	30%	11464	50%	19506	50%	19506	50%	19506	50%	19506	50%	19506	50%	19506	10%	4101	60%	57611	100%	**33000**	**266432**	733568
12AM-6AM	50%	43223	30%	11464	30%	11703	30%	11703	30%	11703	30%	11703	30%	11703	30%	11703	10%	4101	60%	57611	100%	**33000**	**219619**	780381

5.2 B: DESIGN DEPARTURES SCHEDULE

CESSOCK 240 BEDS EXPANSION

DESIGN DEPARTURE SCHEDULE

Item No.	Item Description	Design Departure Proposal
1.	Services requirements in accommodation buildings. Replace the 3mm stainless steel services outlets in bedrooms/cells (health building) to standard impact resistant power outlets, light switches c/w with anti-push back outlet/switching bracket, fixed with security torx screws and non-pick wall sealant as per bellow. Refer to bellow extract from Facility Assets Correctional Standard Functional Purpose and Design: • Switch plates for light/cell call panel, GPO and TV outlet in cells/bedrooms to be 3mm stainless steel (SS). Corners to be rounded to a radius of 6mm and all edges to be chamfered. Plates to be sealed at wall with a non-pick sealant. 	JIA agreed to proceed with 1.6m stainless steel services outlets within bedrooms, similar to Clipsal secure range stainless steel which will be installed complete with anti-push back outlet/switching bracket, fixed with security torx screws and non-pick wall sealant. Other inmates accessible areas will have impact resistant outlets complete with anti-push back outlet/switching bracket, fixed with security torx screws and non-pick wall sealant.
2.	Secure fence external lighting proposal Northrop specification calls for minimum 6m poles to be installed throughout the site. Current proposal is to maintain the existing outer lighting system (10m poles) and provide inside the site 6m poles around the perimeter secure macem fence and footpaths. Secure VMD/No Go area lighting design parameters are as follows: Outer Perimeter/VMD Zone: Minimum Illuminance – 10 lux Inner Perimeter/VMD Zone: Minimum Illuminance – 10 lux Top of security fence Drum – Minimum Illuminance – 5 lux	Proposed design will include for 10m and 7 m light poles on both sides of the secure fence in order to achieve compliance with design requirements from Security Consultant including lighting uniformity and minimum level on top of secure fence drum located at 5.9m AFFL.
3.	EDB location: Facility Assets Correctional Standard Functional Purpose and Design calls for EDB's to be located in dedicated cupboards. • EDBs are to be readily accessible and situated within cupboards specially designed for the purpose.	Current design proposal is to locate the general lighting and power electrical boards within plantrooms. Applicable to electrical boards in AVL, programs and gatehouse buildings.

		Electrical boards in accommodation and health building which contain essential services will be located in dedicated fire rated cupboards.

5.3 C: LIGHTING SCHEDULE

Cessnock 240 Bed Correctional Centre Expansion

Light Fitting Schedule — Revision B 14.5.18

Picture	Type	Lamp	Description	Supplier
	A1 A2	20W 40W	1200MM,CEILING RECESSED LED LUMINAIRE COMPLETE WITH LOW GLARE LOUVRE (FINISH : WHITE) A1 - DENOTES 2400LM A2 - DENOTES 3800LM E- DENOTES FITTED WITH ADDRESSABLE EMERGENCY BATTERY PACK	PIERLITE - FUTCHA LED
	B1 B2	20W 40W	1200mm, SURFACE MOUNTED LED LUMINAIRE COMPLETE WITH REEDED DIFFUSER (FINISH : WHITE) B1 - DENOTES 2400LM B2 - DENOTES 3800LM	PIERLITE - DBLED
	C1 C2	32W 52W	1200MM,CEILING RECESSED VANDAL RESISTANT LED LUMINAIRE COMPLETE WITH STEEL BODY, POLYCARBONATE LENS, CONCRETE RECESSED BOX AND NIGHT LIGHT. (FINISH : WHITE) C1 - DENOTES 2900LM C2 - DENOTES 4900LM N - DENOTES NIGHT LIGHT WITH SEPARATE CONTROL	MOON LITE - CELL LITE RAW WITH RECESSED CONCRETE FIXING BOX
	D1 D2	32W 52W	1200mm,SURFACE MOUNTED IP66, VANDAL PROOF CLEAR DIFFUSER LED PROOF LUMINIARE. D1 - DENOTES 2900LM D2 - DENOTES 4900LM E- DENOTES FITTED WITH ADDRESSABLE EMERGENCY BATTERY PACK	PIERLITE – VANDALUX
	E0/E1 E2	25W 45W	CEILING SURFACE MOUNTED VANDAL RESISTANT LED LUMINAIRE COMPLETE WITH STEEL BODY, POLYCARBONATE LENS, AND NIGHT LIGHT. (FINISH : WHITE) E1 - DENOTES 2900LM E2 - DENOTES 4900LM N- DENOTES WITH NIGHT LIGHT	AUSTRALUME - FORZA LED
	F1 F2	32W 52W	SURFACE MOUNTED, IP65 LED WEATHER PROOF LUMINIARE WITH PRISMATIC LENS AND POLYCARBONATE BODY E- DENOTES FITTED WITH ADDRESSABLE EMERGENCY BATTERY PACK W- DENOTES WALL MIOUNTED F1 - DENOTES 2900LM F2 - DENOTES 4900LM	PIERLITE - BWP PRO
	1	10W	150MM RECESSED LED DOWN LIGHT WITH WHITE PAINTED OPTICS DALI DIMMABLE(FINISH : WHITE)	ZUMTOBEL - PANOS INFINITY
	2 & 3	27W	240MM,CEILING RECESSED IP65, LED WEATHERPROOF LUMINAIRE WITH STAINLESS STEEL COVER (FINISH : BLACK)	LIGMAN - ROBUST-RO-80481
	G2	31W	1200MMX 300MM,CEILING RECESSED I, LED TROFFER	ZUMTOBEL - MELLOW LIGHT
	W1	27W	WALL MOUNTED IP54 LED LUMINAIRE WITH ALUMINUM BODY AND TOUGHENED GLASSS LENS. WITH T2 LIGHT DISTRIBUTION (FINISH : BLACK)	LIGMAN - AUSTIN-VEKTER LED

	K	35W	RECESSED CONTINUOUS LED EXTRUDED ALUMINIUM LIGHTING SYSTEM.	KLIK SYSTEM 100 REC
	W2	55W	WALL MOUNTED IP54 LED LUMINAIRE WITH ALUMINUM BODY AND TOUGHENED GLASSS LENS. WITH T4 LIGHT DISTRIBUTION (FINISH : BLACK)	LIGMAN - AUSTIN-VEKTER LED
	WL	6W	RECESSED LED READING LIGHT COMPLETE WITH BUILT IN SWITCH	MOON LIGHTING - CELL LITE - ROYALE
	A	80W	LED POST TOP DIMMABLE LUMINAIRE COMPLETE WITH 6 METER POLE (FINISH : SILVER)	LIGMAN POWERMISSION 3
	B	110W	LED POST TOP DIMMABLE LUMINAIRE COMPLETE WITH APPROXIMATELY 9 METER POLE AND TO MATCH EXISTING (FINISH : SILVER)	LIGMAN POWERMISSION 3
	B2	2x110W	TWIN-HEAD LED POST TOP DIMMABLE LUMINAIRE COMPLETE WITH APPROXIMATELY 9 METER POLE TO MATCH EXISTING (FINISH : SILVER) THE OUTREACH ARM SHALL BE PARALLEL WITH THE PART WAY. LUMINAIRE TO BE ORIENTED TO BE PERPENDICULAR TO THE PATHWAY.	LIGMAN POWERMISSION 3
	C	110W	LED POST TOP DIMMABLE LUMINAIRE COMPLETE WITH 6 METER POLE (FINISH : SILVER)	LIGMAN POWERMISSION 3
	D	80W	LED POST TOP DIMMABLE LUMINAIRE COMPLETE WITH 6 METER POLE (FINISH : SILVER)	LIGMAN POWERMISSION 3
	P	80W	LED POST TOP DIMMABLE LUMINAIRE COMPLETE WITH 6 METER POLE (FINISH : SILVER)	LIGMAN POWERMISSION 3
	P2	2x80W	TWIN-HEAD LED POST TOP DIMMABLE LUMINAIRE COMPLETE WITH 6 METER POLE (FINISH : SILVER)	LIGMAN POWERMISSION 3
	EM1		LED NON MAINTAIEND MODE EMERGENCY LUMINIARE	STANILITE - SPITFIRE
	EM2		LED NON MAINTAIEND MODE EMERGENCY LUMINIARE WITH VANDAL RESISTANT COVER	STANILITE - SPITFIRE

	EX1		LED MAINTAINED MODE EXIT LUMINIARE "D" DENOTES DOUBLE SIDED "E" DENOTES RECESSED EDGELIT "V" DENOTES COMPLETE WITH VANDAL RESITANT WIRE GUARD "WP" DENOTES WEATHERPROOF	STANILITE -NEXUS
			DENOTES SINGLE SIDED	STANILITE -NEXUS
			DENOTES DOUBLE SIDED	STANILITE -NEXUS
			360 DEGREE DUAL TECHNOLOGY MOTION SENSOR WITH ADJUSTABLE TIMER 0-30MIN "V" DENOTES VANDAL RESISTANT	
LSP			CBUS LIGHT SWITCH PANEL	
			SWITCH & SWITCHWIRE INSTALLED AT 1100 AFFL "2W" DENOTES TWO WAY "D" DENOTES DIMMER SWITCH "N" DENOTEDS NIGHT LIGHT "WP" DENOTEDS WEATHERPROOF	

5.4 D: AMENDED NORTHROP ELECTRICAL SERVICES PERFORMANCE SPECIFICATION

NORTHROP

Electrical Services Specification
NSW Correctional Facilities Performance Specification

ELECTRICAL SPECIFICATION

PREPARED FOR
Justice Infrastructure & Assets - NSW Department of Justice
Level 2, 50 Phillip Street
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Tel: 02 8061 9315

PREPARED BY
Northrop Consulting Engineers

2-6 Shea Street
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Tel: 02 6285 1822

Ref: NL180226-HE01
Rev: A
Date: 3.04.2018

ELECTRICAL SERVICES SPECIFICATION

Activity Schedule

Date	Revision	Issue	Prepared By	Approved By
13.03.2018	1	For Review and Comment	K.Steele	P.Kelly
3.04.2018	A	Tender	K.Steele	P.Kelly

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1. PREAMBLE

1.1 Introduction

Northrop has been engaged by the NSW Justice Department to formulate several Building Services Specification for five (5) prisons in NSW which are listed later in this specification. While Room Data sheets have been provided no Architectural drawings have been provided at this time. Therefore, the information contained herein is based on all possible scenarios for building services design, inclusive of but not limited to; refurbishment, extensions and new buildings. This specification has been written in conjunction with other Northrop Consulting Engineer documentation for the following building services and should be read in conjunction with these documents:

- Mechanical
- Hydraulic
- Fire

1.2 Coordinated Approach

There has been a coordinated approach between the above mentioned services which has endeavoured to engage several stake holders at various levels within the NSW Department of Corrective Services, documentation available on prisons design and construction and so on. It is worth noting that there is no set policy nor BCA section that specifically identifies construction of a prison. There are however documents provided by the Department relating to room data sheets that provide an insight into the expectation of what building services are required to be installed within a particular space together with examples of some recently documented NSW prison projects.

To this end, Northrop has considered several design scenarios with the thought that we are just one part of developing a successful project outcome. It is the responsibility of the Design and Construct Contractor (D&C) Services contractor to seek out the following, but not limited to, project stakeholders to ensure a cost effective, robust and reliable service is provided:

- NSW Department of Justice
- Architect
- Existing site specific Fire Safety Officers (and/or Orders)
- BCA Certifier
- Fire Safety Engineer
- Building Services Consultants
- Local Fire Brigade
- Local Council
- National Construction Code

1.3 Building Services Performance Specification

This Performance Specification has been prepared to allow the calling of Design and Construction (D&C) tenders for the building services related to new and refurbishment works at various NSW correctional facilities. This specification describes minimum standards for the design, supply, installation, and commissioning of selected elements of building services, which will materially impact on the future occupancy of the buildings.

The information contained within is intended to provide an overview of various systems which may be installed, not all systems described will be included within each project. It is the contractor's responsibility to select system types based on the performance requirements and undertake any life cycle and payback analysis. Note that there are no detailed building services drawings accompanying this specification.

1.4 General

This specification shall be read in conjunction with the general conditions of contract, preliminary clauses, and technical clauses included within this specification.

The work to be carried out comprises the detailed design, manufacture, supply of all necessary fittings, materials and accessories, delivery, co-ordination, construction and installation, testing, commissioning and warranty of the complete electrical works whether individually specified herein or not.

This document is to be read as a performance specification corresponding to the Design and Construct contract for the electrical services. The Contractor shall be responsible for the design of the electrical services to satisfy the requirements of this specification, the requirements of Client briefs, relevant codes and standards, and any other ancillary requirements made known at the time of tender. The Contractor shall prepare design concepts / design drawings for client approval, shop drawings for the electrical services, including coordination with the latest architectural layouts and all other building services' documentation.

The Contractor shall guarantee that the complete electrical services installation will perform all of the functions required.

The electrical services shall be designed and installed in accordance with the current National Construction Code (NCC) and current Australian Standards.

The documents include this specification, associated architectural drawings and other services documentation which combine to identify the full extent of work.

This electrical services specification and any other electrical services documentation shall be read in conjunction with the architectural plans, and in the case of a discrepancy, the latter shall apply.

The Tender Form shall be completed and issued to the client and managing contractor for comment and approval.

The Contractor shall fully inform themselves of the nature of work, carry out mandatory sites visit and take into account any conditions likely to affect the extent or performance of the works specified herein prior to submission of a tender.

The Contractor by tendering shall be deemed to have thoroughly inspected the sites prior to tender and to have taken into account any conditions likely to affect the extent or performance of the works e.g. beam locations, cable routes, penetration locations, existing services, etc.

1.5 Definitions

- ‘AS’ or ‘AS/NZS’ when followed by numbers or letters means an Australian Standard published by Standards Australia (e.g. AS 3000)
- ‘Approved’ means approved in writing by the Superintendent and/or Regulating Authority
- ‘Architect’ shall mean Architect
- ‘Authority’ means any Local, State or Commonwealth statutory body holding jurisdiction over work herein specified under current regulations and statutes
- ‘BCA’ means the Building Code of Australia – Volumes 1 and 2, which forms part of the National Construction Code.
- ‘Client’ shall mean Justice Infrastructure & Assets (JIA) - NSW Department of Justice
- ‘Contractor’ means the person or the persons, firm, company or corporation whose tender has been accepted by the Client and includes their legal representatives, successors and permitted assigns to design, install, test, and commission the electrical services specified herein and on the accompanying drawings
- ‘Day’ means a period of 24 hours
- ‘Equal’ means equivalent in performance, quality and approved
- ‘Fire Resistance Level (FRL)’ means the grading periods in minutes determined in accordance with Specification A2.3 of the BCA Volume 1, for the following criteria -
    - Structural adequacy
    - Integrity; and
    - Insulation, and expressed in that order
- ‘Install’ means accept the delivery of items supplied by others and install them in accordance with the documents
- ‘Electrical Engineer’ means the project engineer nominated by the principal
- ‘Materials’ means all plant, instruments, components, equipment, assemblies and sub-assemblies, parts and other items required for permanent incorporation of the works
- ‘May’ means that there is an option
- ‘NCC’ means the National Construction Code, which comprises the Building Code of Australia - Volumes 1 and 2.
- ‘Provide’ means obtain, manufacture, deliver, install, as applicable, and do everything necessary to complete the work in accordance with this specification
- ‘Required’ means necessary by the contract documents, statutory Authority, law, or as required by site conditions to complete the works
- ‘Shall’ means that the statement is mandatory
- ‘Should’ means that the statement is recommended
- ‘Site’ means the lands and other places on, under, in or through which the works are to be carried out by the Contractor

- ‘Specification’ means this document
- ‘Submit’ means submit to the Electrical Engineer, project manager, or other person(s) as indicated in the general conditions for inspection, information, etc.
- ‘Superintendent’ means the person as nominated by JIA or as nominated in the main building contract
- ‘Supply’ means obtain, manufacture, as applicable, and deliver
- ‘Supply Authority’ is the electricity network operator in the area of the project (Ausgrid, Endeavour Energy, Essential Energy)

1.6 Design Compliance

The Electrical Services shall be installed to comply with all statutory requirements including, but not limited to, Electricity Network Operator Standards, the NSW Service and Installation Rules, the National Construction Code, Australian Communications and Media Authority (ACMA) regulations, other relevant authorities, and relevant Australian Standards. The work shall comply with these listed regulations, whether or not specific reference is made in this Specification.

The work shall comply with these listed regulations, whether or not specific reference is made in this Specification.

A brief summary of key Standards and Codes that generally apply to these works is as follows. Where specific parts are not mentioned, the entire series of the associated Standard shall apply.

Reference	Edition	Title
AS 1074	1989	Steel tubes and tubulars for ordinary service
AS 1102	1997	Graphical symbols for electrotechnical documentation.
AS 1125	2001	Conductors in insulated electric cables and flexible cords.
AS 1284.1	2004	Electricity metering - General purpose induction watt-hour meters.
AS 1627 series		Metal finishing - Preparation and pre-treatment of surfaces.
AS 1627.1	2003	Cleaning using liquid solvents and alkaline solutions.
AS 1627.2	2002	Power tool cleaning.
AS 1627.4	2005	Abrasive blast cleaning.
AS 1627.9	2002	Pictorial surface preparation for painting steel surfaces.
AS 1670	2015	Fire detection.
AS 1734	1997	Aluminium and aluminium alloys - flat sheet, coiled sheet and plate.
AS 1866	1997	Aluminium and aluminium alloys - Extruded rod, bar, solid and hollow shapes.
AS 1882	2002 (R2013)	Earth and bonding clamps.
AS 2293	2005	Emergency evacuation lighting in buildings.
AS 2325	1993 (R2013)	Tungsten filament lamps for general service.
AS 2551	1982 (R2016)	Steel sheet and strip - Cold-rolled, electrolytic zinc-coated.

AS 2700	2011	Colour standards for general purposes.
AS 2946	1991 (R2013)	Suspended ceilings, recessed luminaries and air diffusers - Interface requirements for physical compatibility.
AS 3100	2009	Approval and test specification - Definitions and general requirements for electrical materials and equipment.
AS 3111	2009	Approval and test specification for miniature overcurrent circuit breakers.
AS 3112	2011	Approval and test specification - Plugs and socket-outlets
AS 4680	2006	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles
AS 60044.1	2007	Instrument transformers - Current transformers.
AS 60529	2004	Degrees of protection provided by enclosures (IP Code)
AS 61000.3.100	2011	Electromagnetic compatibility (EMC) - Limits - Steady state voltage limits in public electricity systems
AS/CA S008	2013	Requirements for customer cabling products.
AS/CA S009	2013	Installation requirements for customer cabling (Wiring Rules).
AS/NZS 1367	2016	Coaxial cable and optical fibre systems for the RF distribution of digital television, radio and in-house analog television signals in single and multiple dwelling installations
AS/NZS 1680	2006	Interior and workplace lighting.
AS/NZS 1866	1997	Aluminium and aluminium alloys – Extruded rod, bar, solid and hollow shapes
AS/NZS 2053	2001	Conduits and fittings for electrical installations
AS/NZS 3000	2007	Electrical installations – Wiring rules
AS/NZS 3008.1.1	2009	Electrical installations - Selection of cables - Cables for alternating voltages up to and including 0.6/1 kV - Typical Australian installation conditions
AS/NZS 3080	2013	Information technology - Generic cabling for customer premises
AS/NZS 3084	2003 (R2013)	Telecommunications installations - Telecommunications pathways and spaces for commercial buildings
AS/NZS 3133	2013	Approval and test specification - Air break switches.
AS/NZS 3190	2016	Approval and test specification - Residual current devices (current-operated earth-leakage devices)
AS/NZS 3191	2008	Electric flexible cords.
AS/NZS 3350.1	2002	Safety of household and similar electrical appliances - General requirements
AS/NZS 3350.2.80	1998	Safety of household and similar electrical appliances - Particular requirements - Electric fans
AS/NZS 4117	1999	Surge protective devices for telecommunication applications.
AS/NZS 4782 series		Double-capped fluorescent lamps
AS/NZS 4782.1	2004	Performance specifications, General
AS/NZS 4782.2	2004	Performance specifications, Minimum Energy Performance Standard

AS/NZS 5000 series		Electric cables – Polymeric insulated
AS/NZS 5000.1	2005	Part 1 - For working voltages up to and including 0.6/1 (1.2) kV
AS/NZS 5000.2	2006	Part 2 - For working voltages up to and including 450/750 V
AS/NZS 5000.3	2003	Part 3 - Multicore control cables
AS/NZS 60065	2012	Audio, video and similar electronic apparatus - Safety requirements
AS/NZS 60079.1	2015	Explosive atmospheres - Equipment protection by flameproof enclosures ‘d’
AS/NZS 60155	2000	Glow-starters for fluorescent lamps
AS/NZS 60598 series	2013	Luminaires – General requirements Luminaires – Particular requirements (for all relevant usages)
AS/NZS 60702.1	2005	Mineral insulated cables and their terminations with a rated voltage not exceeding 750V
AS/NZS 60898.1	2004	Electrical accessories - Circuit-breakers for overcurrent protection for household and similar installations - Circuit-breakers for a.c. operation
AS/NZS 60921	2002	Ballasts for tubular fluorescent lamps - Performance requirements
AS/NZS 60922	1998	Auxiliaries for lamps - Ballasts for discharge lamps (excluding tubular fluorescent lamps) - General and safety requirements
AS/NZS 60947.2	2015	Low-voltage switchgear and controlgear - Circuit-breakers
AS/NZS 61048	2002	Auxiliaries for lamps - Capacitors for use in tubular fluorescent and other discharge lamp circuits - General safety requirements
AS/NZS 61347.1	2016	Lamp controlgear - General and safety requirements
AS/NZS 61347.2.3	2016	Lamp controlgear - Particular requirements for a.c. and/or d.c. supplied electronic controlgear for fluorescent lamps
AS/NZS 61347.2.9	2004	Lamp controlgear - Particular requirements for ballasts for discharge lamps (excluding fluorescent lamps)
AS/NZS 61386.1	2015	Conduit systems for cable management - General requirements
AS/NZS 61439 series	2015	Low-voltage switchgear and controlgear
AS/NZS 61558.1	2008	Safety of Power Transformers, Power Supplies, Reactors and Similar Products – General requirements and test
AS/NZS CISPR 14.1	2013	Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus - Emission
AS/NZS CISPR 16.1	2015	Specification for radio disturbance and immunity measuring apparatus and methods
AS/NZS IEC 60947	2015	Low-voltage switchgear and controlgear.
AS/NZS IEC 60947.4.3	2015	Low-voltage switchgear and controlgear - Contactors and motor-starters - AC semiconductor controllers and contactors for non-motor loads
AS/NZS IEC 61935	2012	Specification for the testing of balanced and coaxial information technology cabling

IEC 60998 series	2	Connecting devices for low-voltage circuits for household and similar purposes
IEC 60258	1	Direct acting recording electrical measuring instruments and their accessories
ISO/IEC 11801	2	Information technology – Generic cabling for customer premises
NEMA VE 2	2013	Cable Tray Installation Guidelines
TIA/EIA 568.C0	2012	Generic Telecommunications Cabling for Customer Premises
TIA/EIA 568.C1	2012	Commercial Building Telecommunications Cabling Standard
TIA/EIA 568.C2	2014	Balanced Twisted-Pair Telecommunication Cabling and Components Standard
TIA/EIA 568.C3	2011	Optical Fibre Cabling Components Standard

Facility Assets Correctional Standards

Reference	Edition	Title
D12/095474	2012	Administration
D12/095505	2012	Booking
D12/095486	2012	Food Services
D12/095519	2012	Functional Purpose and Design
D12/095514	2012	Gatehouse
D12/095469	2012	General Storage
D12/494388	2012	Grounds Maintenance
D12/095487	2012	Health Care
D12/095502	2012	Housing - General
D12/095496	2012	Housing - Special
D12/095476	2012	Industries
D12/095484	2012	Laundry
D12/095458	2012	Maintenance Facility
D12/594885	2012	Maintenance
D12/095478	2012	Programs / Services
D12/095480	2012	Recreation
D12/095508	2012	Security
D12/095472	2012	Staff
D12/095482	2012	Visiting
D12/214222	2012	Court Cells
D12/214304	2012	Residential Security
D12/494532	2012	CCTV Systems
D12/493566	2012	Life skills Kitchen

D12/494876	2012	Suppliers and Products
D12/286803	2012	Training Kitchen
D18/07512	2018	DJ Local Area Network Standard
D17/384404	2017	MATV / IPTV Scope for Prison Bed Capacity Program
	2017	Audio-visual Systems Specification
D18/077742	2018	DJ Telecommunications Cabling and Infrastructure Facilities Standard

1.7 Authorities

The Electrical Services installations covered by this Contract shall comply with the regulations and by-laws of all Federal, State, and Local Authorities holding jurisdiction over the works and in particular those listed below:

- The National Construction Code;
- Standards Australia;
- Local Fire Brigades;
- State Department of Fair Trading;
- Work Health & Safety;
- Local City/Shire Council;
- Electricity Network Operators
- Any other authority having jurisdiction over all or part of the installations to ensure that the equipment and installation, when manufactured and installed, shall comply with the relevant rules and regulations.

The Contractor is responsible for lodging all applications, seeking all approvals, and payment of all fees and charges legally demandable for relevant services prior to the commencement of works to meet the project construction programme including:

- Supply Authorities' fees;
- Level 1, Level 2 and Level 3 Service Providers fees;
- Telecommunications carrier fees;
- Any other associated service connection fees.

The Contractor shall submit evidence that:

- Requirements of authorities relating to the work under the contract have been ascertained prior to the commencement of the electrical services installation;
- Fees to authorities, if any, have been paid and all types of approvals obtained;
- Certificates of compliance with regard to the extent of the installation. Such certificates have to be obtained on completion of the installation;
- All fittings, equipment, accessories and the like used in the works shall bear approval marks where and as required by the regulatory authorities;

- Test certificates for all essential and other required service fittings be provided prior to completion.
- Survey and preparation of all documents related to land matters (easements, caveats etc) for execution by the client.
- Payment of all refundable Property Tenure Bonds to Electricity Network Operators.

Where standards and regulations are mentioned in this specification they shall include all amendments and interpretations.

On completion, the whole of the equipment and installation is to be inspected by the appropriate authority's representative.

The Contractor shall obtain and fill in all notices required by the relevant Authorities where necessary and pay all fees in connection therewith and shall submit for approval all necessary drawings and obtain all consents required to permit execution of the works.

The Contractor shall procure all necessary permits and approvals from Authorities and shall advise the Superintendent if obtainment of any permits is likely to delay building construction.

The Contractor shall provide certificates of compliance indicating a satisfactory installation from all relevant Authorities.

1.8 Project Description

The following provides a description of the works involved at each NSW Correctional Facility.

Bathurst Correctional Centre
The Bathurst Correctional Centre is currently a minimum and medium security facility for male offenders housing 495 medium security and 165 minimum security inmates. It is located 200km west of Sydney.

The proposed new 220 bed maximum security male facility is intended to be operated in conjunction with the existing medium security facility.

The works are to be completed to enable acceptance of prisoners in April 2020.

The works are generally summarised as:

- A new 220 bed maximum security compound with Gatehouse, Administration, Staff Amenities, Reception, Accommodation, Industries and Programs, 10 bed Segregation and Clinic buildings all located to the south east of the existing compound.
- The installation of a pedestrian and vehicle lock between the existing medium security compound and the new maximum security compound. This will require an opening in the existing heritage perimeter wall.
- New facilities located outside the secure perimeter for Central Stores and Grounds Maintenance.
- New facilities located within the minimum security compound for Kitchen and Laundry.

Metropolitan Remand and Reception Centre (MRRC)
The Metropolitan Remand and Reception Centre (MRRC) is currently a maximum security facility for male offenders housing 1,086 maximum security inmates. It is located 21km west of Sydney CBD.

The proposed new 440 bed maximum security male facility is intended to be operated in conjunction with the existing facility.

The works are to be completed to enable acceptance of prisoners in June 2020.

The works are generally summarised as:

- A new 440 bed maximum security compound with Accommodation, Recreation, Satellite Clinic and Programs buildings all located in the South East corner of the existing secure facility.
- Refurbishment works to parts of the existing facility. These works will upgrade some existing functionality and services, including security services, within the centre, and provide additional space to utilise the shared Visits, Segregation, Retherm Kitchen, Laundry, Property Stores and Clinic facilities; and
- New facilities located outside the secure perimeter for Staff Parking; and

Dillwynia

The Dillwynia Correctional Centre is currently a minimum/medium security correctional centre for women offenders housing 300 00 at a medium security classification of which 44 a high risk operating beds. Dillwynia is located within the John Morony Correctional Complex at Windsor 56km west of Sydney CBD.

The proposed new 248 bed female maximum security expansion is to be operated in conjunction with the existing medium security facility.

The works are to be completed to enable acceptance of prisoners in April 2020.

The works are generally summarised as:

- A new 248 bed medium security compound with Accommodation, Satellite Clinic, Visits, Reception, Industries, Segregation and Programs; and
- Refurbishment works to parts of the existing facility. These works will upgrade some existing functionality and services, including security services within the centre.

Outer Metropolitan Multi-Purpose Correctional Centre (OMMPCC)

The Outer Metro Multi-Purpose Correctional Centre is currently a multi-purpose correctional centre housing 380 inmates and is located within the John Morony Correctional Complex at Windsor approximately 56km west of the Sydney CBD.

The Outer Metro Multi-Purpose Correctional Centre at John Morony is to provide an upgrade and refurbishment resulting in a total of 150 minimum and 100 medium security beds whilst retaining the existing 70 bed honour house and 80 bed modular accommodation.

The works are to be completed to enable the acceptance of prisoners in 2020.

The Works are generally summarised as:

- The demolition of old and subsequent construction of replacement accommodation blocks with the main correctional centre
- The master planning of a 70-bed minimum security block adjacent to the existing Honour House, 1 x 48 bed minimum security accommodation block plus 1 x 48 medium security accommodation block and a programs building adjacent the 80 modular accommodation.
- Construction of a new visits centre for the Honour House and upgrades to the gatehouse, main visits area and security.

Cessnock 280

The Cessnock Correctional Centre is currently a Medium and Minimum security facility for male and female inmates, the Cessnock Correctional Centre is located within the Cessnock Correctional Complex that is located approximately 150km north west of the Sydney CBD.

The Cessnock Correctional Centre is to be expanded with the addition of a 280-bed minimum security accommodation and supporting infrastructure.

The Works are to be completed to enable the acceptance of prisoners in 2020.

The Works are generally summarised as:

- An extension of the existing Cessnock correctional centre with an additional 280 minimum security beds, and associated infrastructure including a Gatehouse, Health/Reception and Programs building will be constructed to the east and south of the existing centre and are being designed to support the existing centre.
- The Accommodation will be comprised of five accommodation blocks each with forty eight beds
- A new access through the gatehouse to the existing industry buildings will also be included.

The Fire systems may vary from site to site due to site conditions, etc.

It is the intention that the D&C contractor prepares design documentation based on the performance requirements outlined within this specification in conjunction with associated architectural design drawings.

Security, system reliability, ease of maintenance and energy efficiency are a high priority for the project.

2. DESIGN BRIEF

2.1 General

The Design Activities must be carried out with Best Design Practices with emphasis on energy efficiency, ESD principals, adaptability, reliability, durability, safety and allowance for future expansion and reconfiguration.

The engineering services must complement the delivery of the Correctional Services.

2.2 Flexibility and Adaptability of Building Services

Correctional Facilities may be subject to potential for an ongoing program of modification, alteration and upgrades over the life of the facility.

As such, the building services must be designed to be readily adaptable and flexible. Designs must therefore be completed ensuring minimal disruption to the facility, consider security implications and be at a minimum cost.

Correction Facilities include a wide variety of buildings and spaces for a number of different uses. The design must allow for isolation and separation of services, to the degree necessary and appropriate, to allow for part work, maintenance and upgrades. For example, works to an Education Building must not inhibit use of an Accommodation Block.

Services reticulation routes, including service corridors and risers must be directly accessible. No single service shall be required to be shut down to allow work on another service.

Consideration must be given to access for all services, and where possible not require access through or via inmate accessible areas.

Plant and equipment locations shall not be located in such a way as to allow a route for access to building roofs.

2.3 Building Services Plant Space and Reticulation

2.3.1 Plant Space

Engineering Plant and equipment installations must be arranged such that Plant and equipment that requires scheduled maintenance servicing is located outside of inmate occupied areas.

Where riser shafts are used, all riser shafts must be fully accessible for the height of the riser. Plant and equipment requiring access in services cupboards must be limited to a maximum height of 2.2m above floor level. No Plant or equipment will be located such that access to or in riser shafts is impeded.

Plant and equipment must be located to avoid vibration and electromagnetic interference. Plant and equipment accommodation must also take into account the acoustic requirements of adjoining occupied areas.

Where duplicate services are employed, these services must be located in separate riser shafts and follow distinctly separate routes.

Access to equipment in plant rooms must be via normal walk-in access and must not require the use of specialised access equipment or temporary scaffolding. Permanent access platforms and ladders must be provided where safe maintenance access is not possible from floor level.

Plant and equipment access must take into account the access needs for the replacement of all major components. Access and removal routes must be planned.

Correction Facilities are highly secure spaces, and some areas are at high risk of vandalism. When placing expensive services equipment outside, the Contractor must make all necessary provision for security and protection against theft and vandalism.

2.3.2 Services Reticulation

Service routes must be designed such that clearly identified routes are provided for piping and cabling installations from central plant to final usage points.

Zoned ceiling spaces for the reticulation of services with appropriate access must be provided. All services must be segregated to suit the function and type of service.

Cables must be segregated into high voltage, low voltage, communications, fire services and security services.

All services must be fully supported along their length. No service will be supported by an accessible or lightweight ceiling structure.

2.3.3 Redundancy, Capacity and Spatial Provision for Future Expansion

The Contractor must provide sufficient spare space and spare capacity to accommodate for future expansion up to a 20% increase of current nominated inmate capacity.

All services reticulation routes, from those running to central Plant and equipment locations to those routes through corridor ceilings must be provided with a spatial allowance for distribution of future services.

The Contractor must provide the following requirements with regard to spatial provision and engineering services design to accommodate for future expansion:

- the capacity of all incoming and outgoing services to the Site must accommodate the increase in inmate capacity;
- reticulation of installed Site services and infrastructure must make provision for the increase in inmate capacity including distribution of local power and security conduits and connector pillars, distribution of ICT conduits, distribution of water supply and drainage connection points to a location maximum 40m away from the proposed location of the buildings;
- all vertical and horizontal distribution including piping, racks, trays, culverts and service corridors must have allowance for future expansion;
- all switchboards and panels must incorporate spare capacity and spatial allowance for expansion;
- all services risers must be accessible for their full height and must have space for future services;
- all services cupboards for switchboards and panels must have space for future services;
- all central Plant and equipment, including boilers, electrical sub-stations, etc. must have a spare capacity for future growth built into their sizing calculations; and
- the design strategies employed to ensure adequate flexibility and adaptability must include intelligent spatial planning, good access to all services, provision for Plant redundancy and replacement, and the provision of adequate means of isolating systems and parts of systems to carry out future works.

2.4 Safety in Design

The Contractor must comply with the requirements of Work Health and Safety Act 2011 (WHS Act) – in particular section 22 of the Act. The WHS Act is supported by Work Health and Safety Regulation 2011, Codes of Practice and guidance material. The WHS Act has safety duties which apply to anyone who has control of the design or

manufacture of plant, a workplace or a system (including anyone who has the authority to make decisions about design or manufacture).

Safety in Design from an operational and lifecycle maintenance perspective is a requirement of this Contract. The Contractor must design the facility so that – when constructed – it is safe and does not pose risks to the health, safety and welfare of people working or contained there, when using the workplace for a purpose for which it was intended.

The Contractor must complete Safety in Design reviews throughout all of the design phases under this contract. The Safety in Design assessment must consider the principles of "so far as reasonably practicable" and apply a hierarchy of controls, risk reduction and mitigation.

Engage with the Department of Justice and use a structured methodology for identifying risks (phase 1) and for eliminating and managing risks (phase 2).

Use a risk analysis approach, and risk workshops to consider the scope of the Project as a work environment. Identify the range of workers/inmates who will be employed/contained at the site, and their work tasks. Progressively develop the design using the "Preliminary Hazard Analysis" which identifies a range of different types of hazards and risks as part of managing risk. In iterative design reports, identify the design team's response to identified hazards and safety risks, including providing clear and traceable evidence that the design has been refined and changed to eliminate or reduce identified safety hazards. For each design decision that carries a legacy maintenance or repair requirement, consider the design solution for the perspective of a safe working environment.

Document and submit copies of the design team's "Preliminary Hazard Analysis" and the response to identified hazards including evidence that the design has been refined and changed to eliminate or reduce identified hazards.

2.5 Existing Infrastructure

Condition and Adequacy of Existing Systems:

- Each individual sites service connections shall be assessed for suitability and adequacy to facilitate the new works. Allow to complete all necessary investigations, council liaising, fees and charges as part of the due diligence exercise. It is noted that some preliminary investigations have been completed for a number of sites. Where available, the Contractor shall use these initial Authority assessments/investigations as the basis for their design assessment. The Contractor shall request copies of such reports and assessments at the commencement of the project.
- The initial investigations, due diligence and assessment shall commence immediately after engagement.
- If the existing conditions do not conform or meet the needs to facilitate the new works, submit proposals to rectify the deficiencies including related costing, time and other impacts caused by the proposed works.
- Subject to the rectification works on existing systems, achieve the performance in the contract documents in conjunction with the design intent of this specification.

2.6 Working on & Extending from Existing Systems

General: Decommission, isolate, demolish and remove from the site all existing redundant equipment including minor associated components that become redundant as a result of the demolition.

Breaking Down: Disassemble or cut up equipment where necessary to allow removal.

Recovered Materials: Recover all components associated with the listed items. Minimise damage during removal and deliver to the locations documented.

Live Operation: Where works are to be carried out on or extended from existing systems the contractor shall develop a robust methodology to ensure the existing systems remain live at all time where possible. Where this is not possible the Contractor shall coordinate with the Superintendent to ensure the works have minimal impact on the existing facilities. The Contractor shall provide the Superintendent a detailed schedule of agreed shut down times to enable the connections/extensions a minimum of two (2) weeks prior to the commencing.

2.7 Building and Room Requirements Summary

Note that the following Building summaries are typical, and do not necessarily represent the complete list of all rooms which may be included in specific buildings. Refer Appendix A for a list of room data sheets that has been included to provide more detailed information for the specific room types.

Room	Accommodation Block – In Situ	Accommodation Block – In Situ	Programs	Industries (Kitchen &/or Laundry)	Industries (Other) / External Store	Health	Segregation	Visits	Gatehouse	Administration	Reception	Sports / Gym / Recreation
Armoury									■	■		
AVL Suite	■						■					
Bathroom c/w shower	■	■	■	■		■	■	■	■	■	■	■
Bathroom c/w WC only	■	■	■	■		■	■	■	■	■	■	■
Break out space			■			■						
Carrier Room									■			
Cell – Access	■	■					■					
Cell – Single	■	■					■					
Cell – Double	■	■										
Cell – Holding	■	■				■		■				
Cell - Observation						■					■	
Change room												■
Chemical Store				■								
Cleaner	■	■	■	■	■	■	■	■	■	■	■	■
Comms	■	■	■	■	■	■	■	■		■	■	■
Consultation						■						
Contact Visits								■				

Room	Accommodation Block – In Situ	Accommodation Block – In Situ	Programs	Industries (Kitchen &/or Laundry)	Industries (Other) / External Store	Health	Segregation	Visits	Gatehouse	Administration	Reception	Sports / Gym / Recreation
Control Room									■	■		
Cool Room				■								
Court Indoor												■
Day Room	■	■					■					
Dispensary						■	■					
Dormitory	■											
Dress/ Undress								■				
Dry Store				■								
Entry	■	■	■			■		■	■	■	■	■
Freezer				■								
Inmate Clerk				■	■							
Interview Room	■	■	■	■	■	■	■	■	■	■	■	
Kitchen exhaust hoods				■								
Kitchen/Tea	■	■	■		■	■	■	■	■	■	■	
Legal								■				
Locker Room									■	■		
Meals			■	■	■	■		■	■	■	■	
Medicine						■						
Meeting			■			■		■	■	■	■	
Multi-faith			■									
Non-Contact								■				
Office - Large			■	■	■	■		■	■	■	■	
Office - Medium			■	■	■	■		■	■	■	■	
Office - Small			■	■	■	■		■	■	■	■	
Officer Post	■	■	■	■	■	■	■	■	■	■	■	■
Officer Post 2			■									

Room	Accommodation Block – In Situ	Accommodation Block – In Situ	Programs	Industries (Kitchen &/or Laundry)	Industries (Other) / External Store	Health	Segregation	Visits	Gatehouse	Administration	Reception	Sports / Gym / Recreation
Passage-Airlock							■					
Passage-Corridor	■	■					■					
Plant	■	■	■	■	■	■	■	■	■	■	■	■
Print Room									■	■		
Processing											■	
Programs 1			■									
Programs 2			■									
Property Store											■	
Ready Room									■	■		
Retherm Kitchen				■								
Retherm Ovens				■								
Roof Space	■	■	■	■	■	■	■	■	■	■	■	■
Secure Store											■	
Secure Waiting											■	
Server Room									■	■		
Store	■	■	■	■	■	■	■	■	■	■	■	■
Tool store					■							
Training Room				■	■							
Treatment						■						
UPS									■			
Utilities						■						
Visitor Waiting Room								■				
Waiting Room								■	■			
Wash zone				■								
Washing/ Drying				■								
Yard	■	■			■	■	■	■				

3. GENERAL REQUIREMENTS

3.1 Existing Electrical Drawings

Any provided existing electrical services documentation are provided for information only. The Contractor should satisfy themselves via site inspection and investigation of the accuracy of the supplied documentation. The Contractor shall allow for all necessary diversions and minor adjustments to equipment as may be necessary to complete the works.

3.2 Design and Construct Contractor Responsibilities

The services shall be undertaken on a Design and Construct (D&C) basis where it is the Electrical Contractor's responsibility to be completely aware of all project requirements incorporated in the design intent documents. The Contractor is to ensure that all obligations with respect to the brief are met, including design, installation, and the performance requirements of the design intent documentation.

The design intent documentation provides the minimum performance requirements information. It is the Contractor's responsibility to ensure that their design incorporates any client requirements in the complete the design package.

3.2.1 Design and Construct Documentation Obligation

The Electrical Contractor shall be responsible for developing the electrical design documentation to completion, as deemed acceptable by the Principal:

- Documentation to the most current architectural plans.
- Provide confirmation of adequacy of spatial allocations.
- Size and locations of penetrations in walls and floors.
- Coordination with all architectural plans and all structural beams and columns.
- Workshop drawings shall be drawn at a minimum of 1:100 scale.
- Locations of all fixed equipment with permanent connections.
- Coordination with all other services (including, but not limited to, Mechanical, Hydraulic, Fire, Audio-Visual, Food Services, Security, Lifts, IT, etc.) to ensure all requirements by other services have been satisfied.
- Lighting calculations for proposed lighting layouts and proposed luminaires.
- Sizing of all mains, submains and sub-circuits including full calculations.
- Drawings indicating circuiting details of all lighting and power final sub-circuits.
- Single line diagrams of all main switchboards and distribution boards showing circuit breaker ratings, cable sizing, fault current, surge protection, emergency power changeover systems, voltage drop etc.
- Lightning protection systems.
- Workshop drawings of main switchboards, power factor correction equipment and distribution boards.
- Drawings of main switch rooms, services cupboards and communications rooms showing layout and elevations.
- Complete details of schematic diagrams for all relevant services.

- As installed documentation and operations and maintenance manuals.
- Provision of design certificates and installation conformance certification.

3.3 Scope of Works

The electrical services systems shall comprise the design, coordination, workshop documentation, supply, installation, testing, commissioning, quality assurance, certification, and maintenance during defects liability period as indicated in this specification.

The whole of the works shall comply with all the latest relevant Regulations and to all Local Authority requirements. The cost of any materials or equipment required to meet such regulations and requirements shall be included in the tender whether specially shown or described in the documents or not.

All materials and equipment shall be the best quality of their respective kinds, complying with the relevant Australian Standards. All materials and equipment shall be new and shall be delivered to the site with the manufacturer's label intact.

The Contractor shall assume the role and responsibility of all associated aspects in whole as the Design and Construct Contractor. The extent of the works covered in this Specification and the accompanying documentation, but not limited to:

- Upgrade of existing substation(s), or the installation of new substation(s), and HV infrastructure if required to accommodate new works including engagement of Level 3 Accredited Service Provider (ASP) as required to undertake the necessary design, engagement of Level 1 ASP's to undertake installation.
- Upgrade the existing power supply connection from the existing substation service mains and/or consumer mains including liaising with local authorities, engagement of Level 1 and Level 2 ASP's as required to undertake and complete the associated works.
- Payment of all associated fees, charges and completion of all application forms associated with supply authorities.
- Supply and install new consumer mains from the substation including spare conduits and cable trays for future connection.
- Supply and install electrical and communications pits as required including trenching, backfilling, compaction and surface re-instatement.
- Modify and expand existing main switchboard to accommodate new circuit breakers to match existing and supply and install all associated controls to provide a fully functional, compliant system.
- Supply and install of new distribution boards including keys, doors, escutcheons, labelling and all associated equipment.
- Upgrade of existing distribution boards and mechanical services switchboards as required including keys, doors, escutcheons, labelling and all associated equipment.
- Supply and install of new submains to the distribution boards including heavy duty cable ladder trays.
- Upgrade of existing submains to the distribution boards as required, including heavy duty cable ladder trays.
- Join and extend all existing submains, sub circuits and all associated controls/equipment to new switchboards.
- Supply and install new or upgrade of existing submains to all other services panels including all mechanical switchboards, hydraulic panels, lifts etc.

- Upgrade of existing submains to other services panels as documented, including mechanical switchboards, hydraulic panels, lifts etc.
- Supply and install lighting, power and communication services to lifts.
- Supply and install automatic power factor correction units, including circuit breakers in main switchboards.
- Certification of all Essential Electrical Services.
- Modification, expansion, supply and installation of internal/external lighting systems including associated sub circuiting/associated controls including photoelectric cells, timer switches etc.
- Modification, expansion, supply and installation of emergency and exit lighting system complete with test switches and as required by AS 2293.
- Modification, supply and installation of power outlets and permanent electrical connections along with associated sub circuiting.
- Supply and install an uninterruptible power supplies and all associated cabling and equipment to service security systems, IT equipment and critical systems.
- Modification, expansion, supply and installation of backup power generator(s) including all the cabling and control systems including facilities for off line monthly testing.
- Modification, expansion or new of lightning protection systems for all extended or additional buildings.
- Supply and install all fire rated equipment/accessories to fire rate all electrical services penetrations through fire rated walls and structures.
- Modification, expansion, supply and installation of MATV and IPTV System including antenna, amplifiers, equipment, splitters and associated outlets.
- Supply and install all other miscellaneous minor works as described elsewhere in this specification.
- Testing and commissioning of all systems in accordance with submitted Inspection and Testing Plans (ITP).
- Defects liability period and maintenance in line with the head contract, or twelve (12) months, whichever is greater.
- Workshop drawings, as-installed drawings and photos of hidden cabling within roof spaces and other cavities.
- Comprehensive user training to ensure that the Client is fully familiar with operational and maintenance procedures.

The Tenderer shall seek information where possible on ambiguities in this Specification at the time of tender for the scope of works documented. As part of the Contractor's responsibility for this design and construct contract, it is implied that a suitable cost has been provided to satisfy completion and compliancy of the above works. Claims for extra costs based on the lack of knowledge of this Specification or services or works not queried by the Tenderer at the time of tender will not be accepted after submission of the tender.

3.4 Obvious Work

The Contractor shall allow for obvious works as part of the works. Such obvious works may not be documented as part of this contract though it is assumed the Contractor shall make provision for such works.

Examples of obvious works required by the Contractor include, but are not limited to:

- Providing separate circuits to equipment.

- Investigation of electrical infrastructure to determine available capacity and required upgrades (both on site and off site).
- Disconnection and removal of existing services.
- Provision of temporary electrical works to enable new / refurbishment works.
- Liaising with relevant authorities to coordinate incoming services and certification of works.
- Final set out of outlets, switches, lights and the like.
- Mounting supports for all equipment, including wedges, backing timber etc.
- Coordinating connection of consumer mains to substations.
- Providing fire rated cabling systems to all emergency services.
- Marking of cable routes underground on the surface.
- Draining of pits and sealing of conduits.

3.5 Existing Services

The Contractor shall in general decommission, isolate, demolish and remove as required from the site, all existing redundant equipment including minor associated components that shall become redundant as a result of the corresponding new services.

The works above mentioned shall form part of the Contractor's duty of care and above all compliance statement and contract that any services known to be existing and requiring modification, alteration or otherwise removal shall be allowed for in their costs as part of this Specification's tender form.

The Contractor shall be held responsible for any damage caused to existing equipment on site as a result of undertaking any processes or actions associated with completing the Works.

3.6 Work by Others

The Contractor as part of this Specification shall coordinate and cooperate with all associated trades in respect to the project scope of works and works to be undertaken by others. The Contractor shall provide all necessary information as a means to enable other trades as defined below to carry out associated works. Works excluded from this Specification but forming part of the building works and in accordance with Contractor's coordination as required are defined in the following clauses.

3.6.1 Associated Work by Builder

- Co-ordination with all trades involved.
- Rooms, cupboards, risers etc. for electrical and communication including signage and labelling, locks, smoke sealing, etc.
- Provision of core holes and penetrations through beams, walls, floors, ceilings, roofs and cupboards.
- Openings in ceilings for recessed lights, ceiling mounted outlets, electrical equipment, including any supports and trimming required.
- Supports for suspended luminaires.
- Footings for external luminaires.

- Making good of all existing walls, new walls where chased, ceilings, trenches and the like by patching, painting and backfilling with materials to match its original finish to meet the client's requirements.
- Fire-sealing of all penetration associated with the Electrical Services trade.
- Provision of openings in joinery for lighting, outlets etc.
- Structural supports for all required plant.
- Garbage collection, including removal of waste from site.
- Concrete plinths.

3.6.2 Associated Work by Mechanical Contractor

- Supply and installation of mechanical services switchboards and controls.
- Termination of sub-mains for mechanical services (provided by the Electrical Contractor), including confirmation of fault level of switchboards to match the electrical system.
- Exhaust systems including termination.
- Mechanical ventilation and pressurisation systems.
- HVAC systems.
- Smoke handling systems.
- Confirmation of mechanical services loads.
- Supply and installation of BMS system and cabling.

3.6.3 Associated Work by Hydraulic Contractor

- Supply and installation of hydraulic services control panels.
- Confirmation of essential and non-essential hydraulic services.
- Confirmation of positioning for all isolators relating to the hydraulics trade.
- Water heaters, boiling water units, pumps etc. including final wiring connections.
- Tap sensors within bathrooms.
- Urinal sensors within male toilets.

3.6.4 Associated Work by Fire Services Contractor

- Supply and installation of fire services control panels and related hydraulic equipment (e.g. pumps).
- Fire suppression systems including sprinklers.
- Coordination of wet fire control wiring and interface with dry fire system.
- Dry fire services.
- Occupant Warning and evacuation systems.

3.6.5 Associated Work by Lift Services Contractor

- Provide connection terminals at lift services panel for connection of submains cable.

- Coordinate with the electrical contractor regarding cable type, size and quantity of cores to ensure that each lift services panel is suitably arranged for the specified cabling.
- Confirm each lift services panel load rating and final installation location.
- Supply and installation of cables to accommodate the installation of security access control card readers and CCTV cameras. The cables shall terminate in a suitable enclosure external to each lift motor room.
- Cut-outs within each lift car to accommodate the installation of a security access control reader.
- Supply and installation of cabling associated with the Lift Services, except for submains to switchboards and wiring specifically detailed herein.
- Supply and installation of audio and/or audio-visual cabling from terminal strips located at the highest lift landing served by each lift car. Speakers to be supplied from lift panel.
- Supply and installation of emergency telephone recess in lift cars and cabling between each car and the telephone terminal strip in the lift control panel. Electrical Contractor is to provide 2 hour fire rated telephone cabling from communications room to lift control panel.
- Access to lift shafts to fit fire detection equipment.

3.6.6 Associated Work by Communications, Security, CCTV & Access Control Services Contractor

- Provision of communications, IT, call systems, duress, security, CCTV and access control equipment.
- Marking out exact location of power requirements for the Electrical Contractor to provide.

3.6.7 Associated Work by Audio Visual System Contractor

- Provision of all audio-visual system equipment.
- Marking out exact location of power requirements for the Electrical Contractor to provide.

3.7 Familiarisation with Site

The tenderer is required to carry out a detailed site inspection prior to tendering and include and allow for all relevant items in this tender.

Acknowledge in the tender that such an inspection has been carried out, take into account all relevant factors in the tender price.

No claims arising from the neglect of the foregoing on the grounds of ignorance of the amount and kind of work involved and the conditions under which the works will be executed will be considered.

3.8 Site Requirements

The contractor shall maintain all work areas in a tidy state free of debris and rubbish. Contractor shall make allowance for the removal from site of all redundant equipment and cabling.

3.9 Interruption of Supply

It shall be noted that it is illegal to interrupt the power supply to a facility without notification.

Interruption of supply will only be permitted during construction work after prior approval. Contractor shall be responsible for any interruption of supply to nearby properties as a result of the work carried out.

Where power or telecommunications services are affected, temporary supplies will be required to be installed to enable the changeover or upgrade works. This includes, but is not limited to, cabling, backup supply, mobile phones and the like as required to maintain the operations of the facility.

3.10 Notices and Fees

Make all required arrangements with the local Utility Authorities and the like, attend to service of all notices required by such authorities and/or by law. In addition, make payment of all fees, charges and deposits or levies including any charges on supply of controlling equipment for such items as off-peak water heaters, and the like as noted in the scope of works.

Submit applications to the local Utility Authorities to meet the project construction program and ensure the electrical and communications services are pre-provisioned in time to avoid delays. In particular, timely submissions to Electricity Supply Authorities for power services and Telecommunications Authorities for communications services are critical to avoid delays in occupation of the buildings.

3.11 Equipment and Materials

Provide all equipment and materials to execute a complete and safe installation.

All materials shall be new and of good quality and of proven, established design.

Where brand names are specified, it is expected that adherence is made and appropriate inclusions made within the tender submitted. Unless prior approval is sought, no alternatives are permissible.

3.12 GST

GST shall be included as a separable item.

3.13 Cleaning

Prior to practical completion, clean all electrical equipment which has been supplied and/or installed.

3.14 Painting, Sealants and Adhesives

Clean, prime and paint all metal surfaces and other surfaces required for paint application in accordance with the paint manufacturer's instructions.

3.15 Test on Completion

At the completion of the works, carry out all necessary tests in accordance with approved Inspection and Testing Plans to prove operation of the total installation and obtain all certificates of compliance for submission to Council and any other Authority.

Provide three (3) working days' minimum notice of the intended tests to permit tests to be witnessed.

Tests shall include, but not be limited to:

- Insulation Resistance testing
- Earth Resistance testing
- Integrated systems testing (generator, mechanical systems, security etc)
- Polarity and Phase rotation

- Internal/External Lighting and controls
- Emergency and Exit Lighting testing
- Telephone Cabling System testing
- Structured Cabling System testing

3.16 Shop Drawings

Contractor shall submit to scale shop drawings detailing the installation of services and equipment prior to construction, including the relationship to building structure and other services.

Shop drawings shall include, but not be limited to:

- Power installation including schematic, outlet locations and circuiting layouts.
- Internal, external, security and emergency and exit lighting installation including set-out, controls and circuiting layouts.
- Standby power systems (UPS and generator(s)).
- Lightning protection systems.

3.17 As-Installed Drawings/Operations and Maintenance Manuals

Prepare and supply as-installed drawings to an approved standard. As-installed drawings shall be electronically drafted and made available for review in hard-copy and soft-copy formats. Soft copies bundled with the Operations and Maintenance Manual shall be in physical format, such as CD/DVD or USB flash drive.

Copies of design drawings shall always be kept on site and continually updated, so that upon completion of the works, an accurate as installed set of drawings are available. An operation and maintenance manual, including as-installed drawings shall be made available for review within five (5) days of practical completion.

The operation and maintenance manual is to be produced in accordance with AS/NZS 4509.1. The manual shall be issued in a hard bound A4 folder clearly labelled –

NSW Correctional Facilities *"Insert Project"*

As Built Documentation

The manual shall include the following sections clearly separated with dividers for easy reference:

1. Table of contents.
2. Contractor details, including 24 hour service contacts.
3. Detailed scope of works completed including system descriptions.
4. Bill of materials complete with product information, part numbers and quantities.
5. Product Information.
6. Full set of 1:100 scale As Installed drawings, including schematic diagrams, in hard and soft copy (CAD and PDF) formats. These drawings shall clearly indicate all new equipment locations, outlet numbers and cable routes.
7. Detailed equipment shop drawings.
8. Test results.
9. Certification and Warranty details.

3.18 Inspections

Contractor is to give 3 days (minimum) notice for inspections to be completed at the following stages:

- Trench excavation before installing cables.
- Completion of cable roughing-in.
- Testing and commissioning.
- Practical completion.

3.19 Defects Liability and Guarantee

Provide a guarantee and be responsible for maintenance of the works for the full defects liability period, as described in the head contract. Include all works other than replacement of items that normally have a short life, i.e. some lamp types.

List any items not covered by normal maintenance during the defects liability period.

3.20 Work Method Statement

The Contractor shall submit a Work Method Statement for the works associated with Contract prior to any work commencing on site.

A complete risk assessment of the noted scope of work shall be completed from which the Work Method Statement shall be developed.

3.21 Job Safety Analysis

Prior to the commencement of each shift, a Job Safety Analysis form shall be filled out and forwarded for approval. The purpose of the Job Safety Analysis is to identify all potential hazards associated with the scope of work, work environment and to provide corrective actions to minimise such hazards occurring.

Such hazards may include plant or process related type, including, but not limited to:

- Mobile Equipment Movement
- Restricted Areas
- Live Electrical Equipment
- Removal of redundant equipment
- Working at heights
- Slippery floors

The Contractor shall provide and maintain all necessary fencing, guards, hoarding, warning notices, lighting etc. to ensure the safety and convenience of persons in the vicinity of the works, throughout the entire project duration.

As part of the tender submission the tenderer shall submit a preliminary list of potential plant and process related hazards, including corrective actions which relate to completing the above noted scope of works.

3.22 Work Health & Safety

3.22.1 General Requirements

The Contractor is responsible for constructing the work in accordance with the Work Health and Safety (WHS) Act 2011.

WHS Regulations 2011, Relevant Codes of Practice, Australian Standards and other regulatory requirements. The Contractor must inform all stakeholders including Northrop of new hazards identified in the course of preparing the work safety report.

During the preparation of the Performance Specification for Electrical Services, Northrop have identified residual safety risks that we consider to be unusual or non-typical. These residual safety risks are shown in this section. Hazards which are normal workplace hazards, are to be managed by persons in control of the workplace through a WHS system to manage the normal risk associated with construction, use, and maintenance of the Building Services.

The residual safety risks identified in this Section are not an assessment of all hazards, and do not relieve other parties or stakeholders of their responsibility under the WHS Act 2011. WHS Regulations 2011, the Code of Practice for Safety Design of Structures, and Code of Practice for Safe Design, Manufacture, Import, and Supply of Plant.

All designers (WHS Act 2011 Section 22) and a person conducting a business or undertaking are to refer to the WHS Act and Regulations 2011 to understand their legislative obligations and refer to the Code of Practice for Safety Design of Building Services for guidance for effective safety in design in relation to Building Services.

3.22.2 Residual Risk Register

Residual Risk	**Action**
Hazard caused by non-compliant device or equipment.	It is the Electrical Contractor, Builder, Project Manager or Principal Contractor's responsibility to build the works strictly in accordance with the contract documents and not to make any variations to the construction without the specific written approval of the designer.
Existing site hazards	It is the client's responsibility, through consultation and engagement of suitably qualified professionals, to make the designer aware of any information relating hazards and risks where construction work is to be carried out, including but not limited to the location of underground and above ground services, identification of contaminated soils and other materials or the presence of dangerous materials including asbestos.
Wet areas	It is the Builder, Electrical Contractor, Project Manager or Principal Contractor's responsibility to ensure that there are no uncontrolled wet areas throughout the site. If such situations occur, electrical work shall halt immediately and power to affected area isolated.
Trained staff	It is the Builder, Electrical Contractor, Project Manager or Principal Contractor's responsibility to ensure that site workers are suitably qualified, trained and insured for the tasks being undertaken on site.
Adequate space and protection	It is the Builder, Electrical Contractor, Project Manager or Principal Contractor's responsibility to ensure that all site personnel are provided adequate space, ventilation and appropriate personal protective equipment to undertake the works required. All construction equipment is to be

	used in accordance with best industry safe practices and regulations.
Site machinery and electrical equipment	All site machinery and electrical equipment is to be kept in good working order with current safety tagging and servicing where applicable.
Residual current device	The Builder, Electrical Contractor, Project Manager or Principal Contractor must ensure, so far as is reasonably practicable, that any electrical risk associated with the supply of electricity to the electrical equipment through a socket outlet is minimised by the use of an appropriate residual current device. The residual current device must have a tripping current that does not exceed 30 milliamps if electricity is supplied to the equipment through a socket outlet not exceeding 20 amps. The Builder, Electrical Contractor, Project Manager or Principal Contractor must take or reasonable steps to ensure that all residual current devices used at the workplace are tested regularly by a competent person to ensure that the devices are operating effectively.

4. CABLE SUPPORT & DUCT SYSTEMS

4.1 General

The Contractor shall supply, install and certify a complete cable support system in accordance with the relevant standards. The system shall accommodate the purpose cables and be installed in an approved and compliant manner.

Where existing cable support systems exist, the Contractor shall make alterations to existing cable support systems as deemed compliant for re-use. Additions to the existing cable support system shall be of the same finish and manufacturer to maintain uniformity. Where the existing cable support is considered non-compliant, the Contractor shall remove the cable support system and supply, install and certify a new complete cable support system in accordance with the relevant standards. The Contractor shall provide a detailed breakdown of the cable supports deemed non-compliant and seek approval from the Client prior to performing any works on site. The system shall accommodate the purpose cables and be installed in an approved and compliant manner.

All service runs are to be concealed to prevent tampering or vandalism by inmates. If agreement is reached to permit exposure of any services, such an agreement will be contingent upon the safety to all inmates and personnel with detailing and construction to minimise vandalism and self-harm risks.

Concealed service runs that require to be accessed for inspection, maintenance or alterations are to have securely fabricated and lockable access panels or doors. Service access panels or doors are not permitted in bedrooms.

The position of underground pipework, joints and other structural elements that may have implications for security are to be marked by location plaques on adjacent buildings to allow prompt identification. Services access pits are to be lockable.

4.2 Selection

The type of cable containment shall be selected to achieve the design intent and meeting all relevant codes of compliance. Consideration shall be given to the location of the installation.

4.2.1 Internal Cable Containment

The selection of internal cable containment shall depend on the location of the installation:

- Cast in slabs
- Concealed space
- Surface mounted
- Close proximity to equipment
- Chemical exposure
- Fire Rating
- Moisture
- Type of room the containment is serving

4.2.2 External Cable Containment

The selection of external cable containment shall depend on the location of the installation:

- Underground/overhead containment
- Surface mounted
- Highly corrosive areas
- Elemental influence; Flora, fauna, UV, water, etc.
- High impact zones
- Adjacent machinery
- Industrial specifics requiring higher grade protection

4.2.3 General Requirements of Selection of Cable Containment

General requirements of cable containment are defined below and shall be utilized in accordance with relevant codes of compliance and as above defined, but not limited to:

- Cast concrete slabs: Unsheathed cable in heavy duty UPVC conduit.
- Accessible spaces: Thermoplastic insulated and sheathed cables.
- Concealed spaces: Unsheathed cable in UPVC conduit.
- Plastered or rendered surfaces: Cable in UPVC conduit.
- Stud walls without bulk insulation: Thermoplastic insulated and sheathed cables.

Primary cable containment, including sub-main circuit cabling and consolidated services paths shall be served by appropriate means of cable tray/ladder as required to support the purpose cables for the length of the path. Where secondary containment requiring short distance cable support is required, the Contractor shall provide any of the following options as deemed suitable to requirements:

- Reduced size cable tray/ladder
- Independent catenary wire
- Soffit supported fixings
- Conduits
- Cable Duct

For all service cables larger than 10mm², the Contractor shall reticulate the cables on cable ladder/trays.

Clearance between cable supports and other services shall be maintained as part of Australian Standards and specifically:

- Hot Water Pipes – minimum 200mm
- Boilers/Furnaces – minimum 500mm

The cable support system shall be of a single manufacturer respective to the application.

4.3 Standards and Regulations

The following standards and guidelines are applicable to this scope of works:

Reference	Name

AS/NZS 3000:2007	Electrical Installations: Wiring Rules
AS/NZS 4680	Hot-dip galvanized coatings on fabricated ferrous articles
AS/NZS 1866	Aluminium and aluminium alloys – Extruded rod, bar, solid and hollow shapes
AS/CA S009	Installation requirements for customer cabling
AS/NZS 61386.1	Conduit systems for cable management - General requirements
AS/NZS 4296	Information technology - Implementation and operation of customer premises cabling
AS/NZS 3837	Method of test for heat and smoke release rates for materials and products using an oxygen consumption calorimeter
AS 3996	Access covers & grates
IEC 61537	Cable Management – Cable tray systems and cable ladder systems
ISO/IEC 14763.2	Information technology - Implementation and operation of customer premises cabling
NEMA VE-2	Cable Tray Installation Guidelines

4.4 Conduits

The Contractor shall provide conduits in accordance with relevant standards and manufacturer's recommendations. Where possible, conduits shall be concealed in spaces by running in slabs, ceiling spaces, wall cavities, chasing into walls, etc. with the exception of switch rooms where only surface mounted conduit shall be permitted.

The Contractor shall inspect the existing works and provide conduits as required to satisfy compliancy for alterations to existing apparatus. The Contractor shall allow to provide a complete solution and be of a single manufacturer. Where conduits are deemed to be of a non-compliant nature, the Contractor shall allow in their costs to rejuvenate/replace the service. The Contractor shall advise the client of any variations to contract and seek approval prior to commencement of any works on site.

Conduits shall be securely fixed by appropriate galvanised saddles in a neat and symmetrical manner. Frequency of saddles shall be the responsibility of the Contractor and ensure adequate support across the length of the conduit. The conduits shall be:

- No less than the following and separated between lighting and power services
    - Commercial installations; 25mm in diameter
    - Industrial installations; 25mm in diameter
- Run parallel to building members where surface mounted and be provided with one (1) approved expansion joint for each straight section exceeding 6,000mm in length.
- Provided with an additional draw-in box when installed where cables would be required to bend more than twice and complete with draw wires.
- For communications, PVC type, light gauge to ISO/IEC 14763.2, high impact and cold setting, unless noted otherwise.

Rigid PVC conduit shall not be used in any application where the cable support may be exposed to mechanical damage, locations deemed hazardous or on surfaces exposed to view where other means of installation are available.

4.4.1 Heavy Duty Conduits

Heavy Duty (HD) conduits shall be used in applications considered impact probable or underground. HD conduits shall be identified as light orange in colour and noting:

- Fitted with corrosion resistant fittings
- Fitted with bell-mouths at each respective end
- Installed over approved routes
- Maintain for the duration of the conduit, appropriate clearance to all other services and easements
- Ensure installed in accordance with standards in rulings on depth of cover and identification

4.4.2 Galvanised Conduits

Galvanised conduits shall be installed where specified on the electrical drawings or as otherwise required. The solution shall be heavy duty screwed type conduit, noting:

- Cut square and threaded with minimal number of required threads
- Consistent in union and painted over the threads with conductive paint
- Reamed to remove burrs
- Adequately terminated into threaded connection or locknuts with no visible threads after assembly
- Fixed at maximum 1,200mm centres where the service is surface mounted

4.5 Cable Trays and Ladders

The Contractor shall provide proprietary support, fixings and accessories from a single manufacturer cable tray and ladder solution. Fixings shall be provided as required to achieve the loading and deflection requirements mentioned in relevant standards and as per manufacturer's recommendations. The fixings shall be capable of securing the cable support to walls and ceiling as required to maintain uniformity without sagging.

The Contractor shall inspect the existing works and provide cable trays and ladders as required to satisfy compliancy for alterations to existing apparatus. The Contractor shall allow to provide a complete solution and be of a single manufacturer. Where trays and ladders are deemed to be of a non-compliant nature, the Contractor shall allow in their costs to rejuvenate/replace the service. The Contractor shall advise the client of any variations to contract and seek approval prior to commencement of any works on site.

The cable trays and ladders shall be installed to support multiple runs of cable and shall have the following features:

- Materials/Finish:
    - Interior: Zinc-coated steel, or steel with two-pack liquid coating, air-drying enamel or stoving enamel finish.
    - Exterior: Hot dip galvanised steel.
    - Highly corrosive areas: Marine grade stainless steel
- Purpose or manufactured made bends, tees, intersections, etc.
- Shall have minimum 200mm clearance between the bottom of the cable tray/ladder support bracket and the top of the ceiling

- All cable ducts/ladders shall be earthed continuously with equipotential bonding along the length of the support by manufacturer designed fish plates and compression bolts/ washer systems or by other approved means of earthing.
- Minimum steel thickness:
    - Trays < 150 mm wide: 1 mm
    - Trays > 150 mm, < 300 mm wide: 1.2 mm
    - Trays > 300 mm wide: 1.6 mm
- Cable ladders shall be two (2) folded steel or extruded structural grade aluminium side rails with cable support rungs between the rails and 300mm maximum rung spacing.
- Fix supports to the building structure or fabric using direct fixings, hangers or brackets. Supports shall be spaced as required by the manufacturer and not more than 1,500mm for cable trays and 3,000mm for cable ladders.

Cables fixed to the ladders and trays shall be neatly tied. For power services, plastic ties at 1,000mm spacing for vertical services and 2,000mm for horizontal services. Essential services cabling shall be fixed to appropriate cable ladders and tray by stainless steel ties and comply with the relevant standards. Communications cabling shall be fixed by Velcro cable and shall not exceed more than 24 individual cables in each loom. The looms shall be laid across the width of the cable trays and ladders and shall not be stacked for the duration of the loom group.

Spacing for cables on trays and ladders shall be considered in accordance with AS 3008 and de-rating factor shall be avoided.

4.6 Cable Ducts

Cable ducts shall be fabricated of sheet steel or extruded aluminium. Duct and lids shall be galvanised or zicanneal (where painted) sheet steel of suitable thickness in accordance with manufacturer's requirements. Locations where specified, the Contractor shall allow for rigid PVC cable ducts. Cable ducts shall be sized to comply with AS 3000 requirements and allow for 30% spare capacity for future provisions.

Ducts shall be provided complete with all necessary matching bends, tees, risers, end strops and other accessories as required to form the installation requirements.

Lids shall be provided for the length of the duct unless specified otherwise and shall be electrically continuous. Lids and top edges of ducts shall have a minimum 10mm return edge for fastening and stiffening purposes.

The Contractor shall seek appropriate approval for colour and size of cable ducts on site with the Architect prior to commencement of any works on site.

4.7 Penetrations

Penetrations shall be provided under approval for existing structures. No penetrations shall be made through fire walls, floor and structural members without required approval from the relevant party. No penetrations shall be made through damp courses.

Each penetration shall be fitted with a UPVC sleeve through ground floor slabs, ground floor beams and external walls for cables not enclosed in conduit. In addition to the UPVC sleeve, a sleeve shall be provided for each masonry penetration for MIMS cables.

Penetrations shall be no less than 10mm greater than the pipe or sleeve diameter for pipes and sleeves penetrating existing internal walls, ground slabs or ground floor beams.

Seal penetrations around conduits and sleeves with a weak sand cement mix, or similar sealing compound approved by the Builder. Seal the space between cables within sleeves with a pliable waterproof compound.

Fireproof penetrations for cables and bus-ways through fire rated floors and walls in accordance with BCA regulations. The fireproofing shall be provided by means of an approved fire rated material with a certified fire resistance rating in accordance with AS3837.

Fire rated pillows may be used to seal large penetrations where the remainder of gaps/holes can be caulked by refine rate sealant.

4.8 Trenches & Excavation

4.8.1 Underground Services Trenches

The Contractor shall have sufficient available information of the existing underground services and systems prior to works being performed on site. Services shall be identified and any works involved with or affecting the infrastructure shall be part of the known scope of works or as otherwise approved by the Builder. The Contractor shall employ an “underground services locator” where unknown to locate all underground services and record all findings for approval by the Builder. Services damaged during the works shall be reinstated at the Contractor’s expense.

The Contractor shall avoid landscaped areas where possible. In all areas where landscaping, trees, ground cover, retaining walls etc. are disturbed, the Contractor shall reinstate the disturbed area to its original condition to the satisfaction of the Superintendent.

Where excavation near existing trees may occur, a review with the Head Contractor and the Arborist shall be carried out prior to commencement of any excavation works. An agreed distance from the tree to the proposed trenches shall be confirmed and approved by the relevant parties.

Underground boring shall be the preference wherever possible to avoid the breaking/damaging of existing services. The Contractor shall advise the Superintendent of any likely disturbances of existing before commencement of works on site.

Should underground boring not be available, the Contractor shall saw-cut the existing concrete and bituminous surface on each side of the trench path and excavate as required thereafter. The intent is that the saw-cutting shall produce a parallel linear path for the excavation component of works to be performed. The paving shall be stored for later reinstatement and made good to compliant standards. Intent shall be to trench as considered practical in a lineal manner between pits, junction and changes in cable route with vertical sides and uniform grades.

Excavated material shall generally be used for filling or backfilling. Excess material shall be allowed to be removed from site and disposed of.

Trench widths shall be kept to the minimum consistent dimension with the laying and bedding of services and the construction of pits.

If excavation is necessary below the level of adjacent footings, seek approval, and provide necessary support for the footings.

Clear trenches of sharp projections. Cut back roots to at least 600 mm clear of services. Remove other obstructions including stumps and boulders, which interfere with services or bedding. If rock is encountered, give notice.

Keep trenches free of water. Place sand as bedding material, services and backfilling on firm ground free of surface water.

If trench excavation exceeds the correct depth, reinstate to the correct depth and bearing value using compacted bedding material or grade N20 concrete.

Excavated cable routes shall be recorded before commencement of backfilling. Locations of underground services shall be accurately marked using route markers consisting of a marker plate set flush in a concrete base. Markers are required to be placed at the following locations, but not limited to:

- Joints
- Route junctions
- Changes of direction
- Termination points
- Building entry point
- Straight run intervals of not more than 100m

Markers shall show the direction of the cable run using direction arrows on the marker plate and indicate distance to the next marker. Marker plates shall generally be constructed as below:

- Plates: Brass, minimum size 75 x 75 x 1 mm thick.
- Plate fixing: Waterproof adhesive and 4 brass or stainless steel countersunk screws.
- Marker height: Set the marker plate flush with paved surfaces, and 25 mm above other surfaces.
- Marker tape: Where electric bricks or covers are not provided over underground wiring, provide a 150 mm wide yellow or orange marker tape bearing the words "WARNING - electric cable buried below", laid in the trench 150 mm below ground level.

4.8.2 Backfilling

Backfill trenches as soon as possible after approval of laid and bedded service. Place the backfill in layers 150 mm thick and compact to the density which applies to the location of the trenches to minimise settlement, and so that pipes are buttressed by the trench walls.

Backfill material shall be:

- Under roads and paved areas: Coarse sand, controlled low strength material or fine crushed rock.
- In topsoil areas: Coarse sand backfill to a level 150 mm above the top of conduits. Complete the backfilling with topsoil for at least the top 50 mm.
- In reactive clay: Coarse sand backfill to a level 150mm above the top of conduits. In sites classified M, H or E to AS 2870.1, use an impervious material if trenches fall towards footings.
- Elsewhere: Well graded, inorganic, non-perishable material, maximum size 75 mm, plasticity index < 55%. Do not place stones greater than 25 mm within 150 mm of services.
- Compaction of trench to achieve minimum 80%.

4.8.3 Reinstatement

Reinstatement of areas of services trenches:

- In lawn areas: Provide 150 mm of loam and re-turf the lawn over the trench and other disturbed areas; ongoing watering plan shall also be provided

- In paving and roads: Reinstate to match adjacent work, paved surfaces and assets disturbed or removed during excavation of trenching.
- In concrete surfaces: Reinstate concrete surfaces to the original level. If necessary, provide steel reinforcement keyed to the adjacent concrete, laid to prevent the reinstalled concrete from subsiding and cracking.
- In bituminous surfaces: Provide crushed rock base and sub-base to match the pavement. Prime coat the edges of the surfacing with bitumen. Lay and compact hot-mix asphalt so that the edges are flush and the Centre is cambered 10 mm above the pavement. If hot pre-mix is not available, cold pre-mix may be accepted. Minimum asphalt thickness shall be 50mm or the adjacent asphalt thickness, whichever is greater.

4.9 Electrical Pillars

Note: Electrical pillars shall not be installed within secure areas.

Electrical pillars shall be proprietary fiberglass type and be:

- Green in colour; unless requested by the Client
- Installed on concrete plinth, plum and level
- Key lockable (Front and back to separately keyed, contractor to provide three (3) keys minimum for each lock) with additional pad lock on footing bolt.
- Weatherproof.
- Sized to contain the required outlets.
- Stainless steel labelling to be provided

Where larger loads are to be provided via a pillar, a custom built enclosure shall be provided similar to a weatherproof switchboard that is free standing, all specifications of the switchboard shall apply to this pillar. Such circumstance of this nature shall be designed where applicable to the following standard:

- Stainless steel enclosures for all public areas, parks, domain areas, transport, etc.
- IP56/IP66 minimum rating in areas deemed required for protection
- Authority keying system to be provided as required and requested upon by the relevant parties

4.10 Pits

The Contractor shall determine the appropriate size of pits and demonstrate compliance with standard requirements and bending radii limitations of incoming and outgoing cables. Pit selection shall be in accordance with AS 3996 and suit structural requirements as defined in the below table. The Contractor shall allow to appropriately drain all pits to prevent the build-up of water through provision of 100mm holes from the bottom of the cable pits, either to absorption trenches filled with rubble or to the storm water drainage system. The pit selection and installation shall be co-ordinated on site with the Hydraulic/ Civil Contractor as applicable,

- Absorption trenches: Minimum size 300 x 300 x 2000 mm.

All cable pits shall have their lids marked with the word “ELECTRICAL” or “COMMUNICATIONS” as appropriate. Construct walls and bottoms using rendered brickwork or 75 mm thick reinforced concrete. Incorporate a waterproofing agent in the render or concrete.

Cable pits shall be installed in the following situations:

- Wherever there is more than one 90 degree or greater change in direction in any single conduit run which is not occurring at a lighting pole.
- On long straight runs exceeding 60 meters.
- In locations as approved by the Client to offer greater management of reticulation of services

All cable pits shall be installed firmly in the ground with the lid flush with the finished surface, and be away from paths and driveways if possible. All cable pits are to be lockable.

Conduits serving through the pit shall be distributed evenly in the pit and, where available, holes for provisions in the pit as per manufacturer's recommendations shall be utilised to maximise structural integrity. All conduit connections to cable pits shall be made waterproof by approved sealant or other method by the Principal. Pit covers shall be cast iron and concrete filled and suit the expected load requirements of the area in which they are installed.

Provide lockable pit covers to suit heavy traffic loads with a lifting handle for each side of the cover section. Fit flush with the top of the pit.

Testing of covers and grates as defined in the table below shall be in accordance with Section 4 of AS 3996.

Load Class	Wheel Load	Maximum Force	Duty Level	Typical Uses	Cable Pit Suitability	Cable Lid & Access Cover Suitability
A	330kg	10kN	Extra Light	Footways & areas accessible only to pedestrians and pedal cyclists	Plastic Polymer Concrete	Concrete lids Powerlok lids Urbanfill/ Pavermate access covers Casting / steel / concrete access covers
B	2,670kg	80kN	Light	Footways mountable by vehicle or livestock and light tractor paths	Polymer Concrete	Powerlok lids Urbanfill/ Pavermate access covers Casting / steel / concrete access covers
C	5,000kg	150kN	Medium	Malls and pedestrian areas open to slow moving commercial vehicles	Concrete	Casting / steel / concrete access covers
D	8,000kg	210kN	Heavy	Carriageways of roads and areas open to commercial vehicles	Concrete	Casting / steel / concrete access covers
E	13,700kg	400kN	Extra Heavy	General docks and aircraft pavements	Concrete	Casting / steel / concrete access covers
F	20,000kg	600kN	Extra Heavy	Docks and aircraft pavements subject to high wheel loads	Concrete	Casting / steel / concrete access covers
G	30,000kg	900kN	Extra Heavy	Docks and aircraft pavements subject to very high wheel loads	Concrete	Casting / steel / concrete access covers

4.11 Future Provisions

As part of the Contractor's requirements, future provisions shall be made on site to accommodate unforeseen works to the development up to but not limited to:

- Spare Conduits shall be installed at a minimum of 1 metre in length exiting the pits and capped off to avoid egress of soil and other contaminants into the pit.
- Caps shall be provided to the spare conduits at both ends as required to avoid blockage and contamination of the conduit.
- Labels shall be provided inside the pit to nominate what conduits are considered spare.

5. LOW VOLTAGE POWER SYSTEMS

5.1 General

The Contractor shall make modifications, alterations and additions to existing low voltage power systems as deemed compliant for re-use. Additions to the existing low voltage power system shall be of the same finish and manufacturer to maintain uniformity. Where the existing power systems are considered non-compliant, the Contractor shall remove the system and supply, install and certify a new complete low voltage power system in accordance with the relevant standards. The system shall accommodate the power requirements and be installed in an approved and compliant manner. Any variations to this design will not be considered unless a specific instruction has been provided by an authorising party and approved as required.

The following responsibilities shall form as part of the Contractor's obligations under the Contract, but not limited to:

- Confirm ratings of equipment
- Confirm phase requirements of all components of the power system
- Seek advice for exact locations for placement for power outlets
- Confirm connection types required for all equipment
- Coordinate with other trades on site prior to installation of any power systems
- Test and commission all wiring and controls
- Verify operation of all equipment in conjunction with those responsible for the supply and installation of equipment where applicable

5.2 Standards and Regulations

The following standards and guidelines are applicable to this scope of works:

Reference	Name
AS/NZS 3000	Electrical Installations: Wiring Rules
AS/NZS 3100	Approval and Test Specification – General Requirements for Electrical Equipment
AS/NZS 3112	Approval and Test Specification – Plugs and Socket-Outlets
AS/NZS 3123	Approval and Test Specification – Three Phase and Round Pin Sockets
AS/NZS 3013	Electrical Installations – Classification of The Fire and Mechanical Performance of Wiring System Elements
AS/NZS 3008.1.1	Electrical Installations – Selection of Cables – Cables for Alternating Voltages Up To and Including 0.6/1kV – Typical Australian Installation Conditions
AS/NZS 4961	Electric Cables – Polymeric Insulated – For Distribution and Service Applications
AS 60529	Degrees of Protection Provided By Enclosures (IP Code)
AS/NZS 61000	Electromagnetic Capability (EMC)

AS/NZS 3017	Electrical Installations – Verification Guidelines
AS/NZS 3190	Approval and test specification - Residual current devices (current-operated earth-leakage devices)
AS/NZS 1930	Circuit-breakers for Distribution Circuits

5.3 Interpretations

5.3.1 Abbreviations

The following abbreviations are applicable to this specification section:

Abbreviation	Description
RCD	Residual Current Device
SPD	Surge Protection Device

5.4 Submissions

5.4.1 Design Documentation

Workshop drawings and associated documentation shall be provided and completed by the Contractor to encapsulate all client requirements and as documented through the drawings and this Specification.

The completed design documentation provided by the Contractor shall have information for each main, sub-main and final sub circuit for installation on site. Calculations required in conjunction with the mentioned low voltage power systems shall also form part of the Contractor's obligations and shall include, but not be limited to:

- Single line diagrams
- Fault levels at switchboards and substations
- Maximum demand calculations
- Cable and conductor cross sectional area and insulation type
- Voltage drop calculations at design load conditions
- Protection design characteristics
- Discrimination and grading of protection devices
- Prospective short circuit current automatic disconnection times
- Earth fault loop impedance calculations for testing and verification
- Certification of conformance to AS/NZS 3000 for electrical services
- Confirmed cable routes

5.4.2 Operation and Maintenance Manuals

The Contractor shall provide all operational and maintenance documentation necessary to all equipment and low voltage power systems installed.

5.4.3 Samples

The Contractor shall provide samples of all components, equipment and visible accessories installed.

5.4.4 Testing and Commissioning

Test results shall be provided by the Contractor in accordance with relevant standards and methods as outlined above.

5.5 Electrical Supply

The existing electrical power supply shall be augmented to facilitate the new requirements to the site. The augmented service shall be nominally 400 Volts phase to phase, 230 Volts phase to neutral, 3-phase and neutral, 50 Hertz as provided by Supply Authority. All equipment connected shall be rated to withstand those voltages including voltage fluctuations within the thresholds as nominated in the Act.

Electrical power supply shall be via an underground service from the new / existing / upgraded substation to the new / existing / upgraded main switchboard.

It is the Contractor's responsibility to survey, determine, trace and check for the exact locations of cable routes and coordinate with other services and building works with potential to interfere with the pathway, including underground search and ground penetrating radar. The confirmed depth and layouts of the conduits shall comply with relevant standards as above mentioned.

The Contractor shall liaise with the relevant supply authorities and submit a confirmed exact location for connection prior to commencement and installation of any works on site. All new equipment and cables shall be installed in accordance with supply authority requirements.

An additional 100mm diameter HDPVC underground conduit shall be supplied and installed by the Contractor complete with draw wires for future use. The conduit shall be an additional requirement to the documented services on the drawings.

5.5.1 Substation

The Contractor shall liaise with supply authorities in the works associated with the existing substation(s) as required to service the new facilities. Contractor is to note that some facilities are High Voltage (HV) customers and augmentation of the private HV network will be required.

The works associated with alterations to the existing substation(s) shall be fully coordinated with supply authorities and other trades in accordance with relevant standards.

The substation works shall include for all supply authority associated works, Level 1, 2 & 3 Service Provider works and payment of associated fees and charges forming part of this scope of works. Works as such shall include, but not be limited to:

- Transformers
- Switchgear
- High voltage trenching
- High voltage cabling
- Earthing requirements
- Service cabling
- Concrete plinth

- Testing and commissioning

The substation works shall be executed in a timely manner in accordance with the project programme with all associated earth works in the region. The Contractor shall provide all works associated with the installation of equipment in accordance with supply authorities to ensure the program is met.

Short circuit and overload protection shall be provided at the transformer secondary supply through fault current limiting circuit breakers with adjustable overload and short circuit current setting facilities as deemed required at the secondary output.

The circuit breakers shall include full discrimination and cascade protection and grade with the incoming supply protection system and the downstream site protection devices to ensure optimal operational efficiency.

Final testing, commissioning and completion of the substation associated works shall be the responsibility of the Contractor. A fully functional system shall be provided at completion and be a fully coordinated solution in conjunction with the Builder's construction program and in accordance with the above mentioned standards and supply authority requirements.

5.5.2 Surge Protection

Surge protection shall be provided as a minimum in the following, but not limited to:

- At the Main Switchboards; on consumers mains cabling
- At the Main Switchboards; on all outgoing sub-main cables
- At the Distribution Boards; on all circuits for sensitive equipment including, but not limited to:
    - Communications cabinets;
    - Security panels;
    - Fire Indicator Panels (FIP);
    - Head-end equipment, etc.
    - Telecommunications Main, Intermediate and Final Distribution Frames.

Further analysis of provision of surge protection devices are described in this section.

Typical surge protection ratings for AC powered systems shall be considered through the table below.

Category	**SPD Location**	**I_{max} rating**
A	Long final sub circuits and electricity supply outlets	3 – 10kA
B	Major sub mains, short final sub-circuits and load centres	10 – 40kA
C I	Service entrance, other than below.	40kA
C II	Service entrance, building fed by long overhead service lines, or is a large industrial or commercial premises	40 – 100kA
C III	Service entrance, building in a high lightning area, or fitted with a LPS.	100kA

5.5.2.1 Consumer Mains

SPDs should operate at a nominal system voltage (V_{rms}) of 230/400V, 50Hz.

- Protection rating shall be designed in accordance with recommended surge ratings defined in AS 1768.

- The products shall be UL1449-3 standard recognized

The SPD shall have visual indication and voltage free contacts. The alarm shall be raised when there is 50% depletion of the surge material on any line. The surge protection device shall have at 2 replaceable modules for changeover after an alarm condition.

The SPDs shall be 'T' connected off the load side of the main switch. The wiring to the SPD shall be kept as short and direct as possible. Extending the flying leads of a SPD should be avoided where possible. The branch wiring shall be protected by 63A HRC fuses or equivalent circuit breakers if upstream protection is greater than 100A.

5.5.2.2 Sub-Mains

SPDs should operate at a nominal system voltage (V_{rms}) of 230/400V, 50Hz.

- Protection rating shall be designed in accordance with recommended surge ratings defined in AS 1768.
- Neutral to Earth protection shall be by means of a Gas Discharge Tube or MOV with I_{max} greater than 40kA.

The product shall be equivalent to:

- CRITEC TDS150 for single phase applications
- CRITEC TDS350 for three phase applications

The SPD shall have visual indication and voltage free contacts.

50 kA SPDs shall be 'T' connected off the load side of the main switch. The wiring to the SPD shall be kept as short and direct as possible, using at least 6mm2 SDI cable. The branch wiring shall be protected by 32A HRC fuses or equivalent circuit breakers if upstream protection is greater than 80A.

5.5.2.3 Sensitive Equipment

SPDs should operate at a nominal system voltage (V_{rms}) of 230/400V, 50Hz.

Protection rating shall be designed in accordance with recommended surge ratings defined in AS 1768.

- The voltage rise time attenuation shall be 30V/µs on the incidence of surge voltage waveforms defined as 1.2/50us, voltage waveform, under AS 1768, which produce about 6000 V/us rise time. The filter shall provide EMI filtering as well as surge filtering.
- The filter shall employ Triggered Spark Gap technology for front end protection to enable efficient filtering at the secondary stage.
- The Maximum Continuous Operating Voltage, Uc shall be greater than 320 Volts.
- The product shall be ERICO, Critec TSG-SRF, Surge Reduction Filter

The surge reduction shall have alarms and voltage free contacts to indicate failures. A minimum of 5 years warranty is to be provided for each surge diverter.

Testing is to be undertaken to the following standards:

- UL1449 Edition 3
- AS 1768

5.5.3 Consumers Mains and Sub Mains

Note: No Consumers Mains or Sub Mains are to be installed within prisoner areas.

The Contractor shall provide consumers mains, submains, associated services and all necessary fault and overload current protection equipment in accordance with AS/NZS 3000 Section 3, supply authority requirements and service and installation rules. Protected consumers mains shall be provided with necessary short circuit and overload protection where required by the supply authorities.

The design, supply and install of all mains cabling shall be the responsibility of the Contractor. Workshop drawings shall be provided as part of the Contractor's submission encapsulating the size and type of mains cables to be provided in this Contract. No works shall commence on site prior to approval of Workshop Drawings.

For the purpose of tendering, the Contractor shall allow for mains to be sized in accordance with maximum demand calculations.

As a minimum, the Contractor shall meet the following requirements:

- Sub main cabling shall be reticulated on appropriately sized cable ladder tray within buildings as shown on the drawings and where necessary.
- Sub main cabling shall be reticulated in such a manner so as to ensure that derating of the cabling is in accordance with AS/NZS08.
- Consumer mains should be installed clear of buildings where possible. Check proposal with CSNSW to ensure planned route does not interfere with possible future development.
- The reticulation of all such cabling shall be coordinated with all other services in the region. Cabling should not be located in such a position as to restrict vehicular or pedestrian headroom. It should avoid disabled car spaces and wet areas where possible.
- Sub main size and type is to be identified at each end in the form of engraved labelling on the distribution boards.
- Verify all final proposed loads and advise the Superintendent prior to installation of the sub mains.
- All 3 phases shall be evenly balanced for both sub mains and consumer mains.
- All sub mains shall utilise stranded copper conductors.
- All terminators shall be fitted with compression lugs.

5.6 Metering

5.6.1 Supply Authority Meters

Authority meters shall be supplied and installed in accordance with local Supply Authority requirements in conjunction with electricity retailer required items. Allowance shall be made by the Contractor to pay all associated fees, Australian Service Provider and establishment costs to provide a fully compliant solution. Such items including meter panels, links, current transformers, protection devices and associated hardwire to the requirements of the supply authority shall be included in the Contractor's scope of works.

Final location of meter panels are to be confirmed prior to installation.

5.7 Earthing

5.7.1 Earthing System

A protective earthing system shall be provided complete with a Multiple Earth Neutral (MEN) connection in accordance with AS/NZS 3000 Section 5. The installation shall be earthed to supply authority requirements and ACMA requirements as required. Such items requiring earthing shall include but not be limited to:

- Main Switchboards
- Distribution Boards
- General Purpose Outlets
- Permanent/Special Purpose Outlets
- Luminaires
- Components and equipment in accordance with AS/NZS 3000

Earth conductors shall be sized to carry the maximum earth fault current for the respective HV or LV supply for one (1) second as calculated in AS 3008.

The complete Earthing system shall be to supply authority requirements and the location shall be confirmed on site prior to commencement of associated works.

5.7.2 Earth Electrodes

An Earth Electrode shall be provided as part of the overall Earthing design as required in AS/NZS 3000 Clause 5.3.6. Acceptable Earth Electrodes shall conform to requirements as set out in Table 5.2 of AS/NZS 3000 and be installed to satisfy requirements of the relative standards and supply authority requirements.

5.7.2.1 Inspection Pits

Earth electrodes shall be located within approved pit or core hole as required. The enclosure shall have a removable top cover and shall be buried with the cover flush with finished ground level. The enclosure shall be a purpose made concrete inspection pit or a galvanised steel inspection pit embedded in concrete. The earth electrode connection shall be just below the lid of the inspection pit with adequate access for testing purposes.

5.7.2.2 Earthing Joints and Connections

Where connection is made to Earth Electrodes, the contact surfaces shall be cleaned to bright metal, the joint shall be made and afterwards paint the overall connection with “Roval” or similar.

The connections shall be made with approved copper and brass band type clamps, or proprietary made clamp assemblies (A.L.M. or similar). Steel clamping bolts shall be galvanised or stainless steel.

The Earth connection shall have a securely fixed label:

- Minimum 1.2mm annealed copper.
- Approximately 75mm x 32mm.
- Stamped with 4mm letters:
    - “Danger, Main Earth, Do Not Disconnect”
- The word “Danger” shall be complete with red fill and all remaining lettering with green fill.

5.7.3 Earthing Conductors

The main Earthing conductor shall form part of the complete electrical services installation in accordance with above standards and be connected to an Earthing Electrode as defined above. The conductor shall be suitably fixed to the electrode by means of an approved Earthing clamp.

Where functional Earthing conductors are required, the Contractor shall ensure they are provided in accordance with AS/NZS 3000 Clause 5.3.7.

All joints and connections with Earthing and bonding conductors shall me minimalized to optimise operational efficiency. All contact surfaces shall be thoroughly cleaned and coated with anti-corrosive compound suitable for the conductor materials.

5.7.4 Testing and Commissioning

The complete Earthing system shall be tested to relative standards, supply authority requirements and shall not exceed values provided as part of AS/NZS 3000. The system shall be tested without any artificial additives or associated interferences at the Earth Electrodes to achieve the reading, unless otherwise approved by the Engineer.

Test findings and recordings shall be provided at practical completion as part of the operation and maintenance manuals and in the presence of the Engineer.

5.8 Wiring Systems

Provision shall be made to complete the design, supply, install and certify a suitable wiring system in accordance with the provided documentation in conjunction with relevant standards and client requirements. The design shall be complete in all areas but not limited to:

- Underground services
- Above-ground services
- In-building services

The Contractor shall provide as part of this contract, Workshop Drawings detailing all components of the wiring system for installation and shall seek approval from the Client prior to commencement of associated works on site.

5.8.1 Standards

Power cables shall be selected in accordance with AS/NZS 5000.1. Cable standards shall be made applicable in accordance with the power cables are as follows:

- PVC Insulated Cables: AS 3147
- Flexible cords: AS 3191
- MIMS cables: AS 3187
- XLPE cables: AS 3198
- Cable selection: AS 3008
- Fire or mechanical damage to cables: Classifications to AS/NZS 3013

5.8.2 Power Cables

The Contractor shall provide workshop drawings detailing the selection of power cables for the project.

Power and lighting cables shall be equal to the following:

- 1 Core (10mm² and above); XLPE/TPE
- 2 Core/3 Core and Earth (1.5mm² and above); XLPE/TPE
- 4 Core and Earth (1.5mm² and above); EPR/CPE

All sub circuit power cables shall be PVC/PVC insulated except in the case of sub-mains and other mains cabling which shall be XLPE/PVC insulated. The wiring system shall comply with the requirements of AS3013 and AS3000; any associated essential and fire services shall be appropriately fire rated.

The Contractor shall be responsible for final locations of cable routes, co-ordination with other services, building structure and architectural details. Corresponding wiring systems such as communications, security, etc. shall be installed in a similar manner the power and lighting wiring systems.

The systems shall be fully supported throughout their entire length and be supported adjacent to termination point of the cable to relieve undue termination stress. Where cables may pass through their length in any steelwork holes, they shall be bushed, dags removed and cables protected as required against damage. The cables shall not be embedded within plaster concrete or other finishes of the same criteria unless they are fully enclosed within suitable conduit and are removable after installation completion.

The bending radii of cable shall not be less than 6 times cable diameter and in no way shall be smaller than the bending radii recommended by the cable manufacturer.

5.8.3 Cable Types

All cables to be used in this installation shall be of the type described below:

5.8.3.1 PVC/PVC Cables

PVC/PVC cables shall be 0.6/1kV, V-90, PVC insulated, PVC sheathed, stranded copper conductor, single or multicore cables in accordance with AS 3147.

5.8.3.2 XLPE/PVC Cables

XLPE/PVC cables shall be 0.6/1kV, X-90, XLPE insulated, PVC sheathed, stranded copper conductor, single or multicore cables in accordance with AS 3198.

5.8.3.3 Fire Resistant Cables

Fire Resistant/Fire Rated cables shall be 0.6/1kV, special fire resistant insulated, sheathed stranded copper conductor single or multicore cables, type FR to comply with AS 3013, construction to AS 3116 and AS 1670.

Fire rated cables shall be:

- Installed and terminated in accordance with the manufacturers recommendations.
- Have the tails sleeved with phase colour coded sleeving over each conductor.
- Terminated with suitable glands where entering switchboards.
- Cable support system to be 2-hour fire rated.

5.8.3.4 TPI Cables

TPI cables shall be:

- 0.6/1kV, 75° temperature rated unless otherwise indicated, and coloured coded to AS 3000:2007.
- Enclosed within conduits or cable toughing.
- Not drawn into conduit systems until the conduit run is complete and swabbed out.
- Installed on the loop-in system without the use of connectors.
- Jointed only at outlet or switch positions.

5.8.3.5 TPS Cables

TPS cables shall be:

- 0.6/1kV, 75° temperature rated unless otherwise indicated, and coloured coded to AS/NZS 3000.
- Not installed in locations where they cannot easily be withdrawn for rewiring purposes.
- Enclosed within concealed conduit where run in rendered walls or concrete.
- Installed through suitably sized and bushed access holes positioned vertically or horizontally in line where run through stud partitions.
- Secured in position by approved methods where installed in accessible locations.
- Not secured or clipped where installed in inaccessible locations such as cavities and stud partitions.
- Protected by steel conduits where installed in locations which are liable to mechanical damage and where specified herein.
- Installed using the loop-in system without the use of junction boxes being interposed.
- Installed on cable trays or in wiring ducts where six or more cables are installed over common routes.
- Grouped together and fixed to cable trays for single core conductors which from a circuit or sub-main group.
- Installed in trefoil formation for single core TPS conductors sized 120mm2 or larger using purpose made clamps, such that, proximity effects in adjacent ferrous metals are minimised and equal reaction values between phases are achieved.
- Fitted with a cable gland on all circular cables where they penetrate equipment enclosures.
- Fixed directly to the underside of the slab/roof structure where installed in false ceiling spaces by means of approved clips and/or saddles or tied to catenary wires with approved nylon strap fasteners.

5.8.4 Colour Coding

All cables to be used in this installation shall be of the colour coding described below:

Cable Type	**Colour Code**
2 Core Cable	Red and Black
3 Core Cable	A Phase: Red B Phase: White

	C Phase:	Blue
3.5 Core or 4 Core Cable	A Phase: B Phase: C Phase: Neutral:	Red White Blue Black
Control Cables	All Cores White with Black Numbers Max. 100mm spacing	
Earth Cores	Green and Yellow	

5.8.5 Sub-Circuit Wiring Systems

Circuiting configuration shall be the responsibility of the contractor and shall be in strict accordance with AS3000, including the selection of protective devices (e.g. circuit breakers, RCDs etc.).

The maximum number of single general power outlets (GPOs) which shall be installed on any one (1) sub-circuit are:

- Twelve (12) GPOs (or six (6) Double GPOs) rated 10A or less
- One (1) GPO rated 15A or greater

Sub-circuits and protective devices for outlets, isolators or supplies required for specific equipment shall be installed in accordance with manufacturer's specifications and supplied with a dedicated circuit as required. The contractor shall submit an RFI if limited manufacturer's information is available or if clarification is required.

Contractor shall limit quantity of luminaires on any one circuit to twenty-five (25) maximum to prevent unwanted tripping of RCDs.

Final sub-circuits shall originate from the appropriate distribution board. Load balancing shall be executed as evenly as possible over all phases, and provide evidence at completion of installation.

5.8.6 Installation

Installation of wiring systems shall generally be executed in the following manner:

- Sub circuit cables shall not be permitted to be resting or supported on ceilings.
- All cables shall have copper stranded conductors and be adequately fixed and supported with purpose made clips, cleats or saddles and be installed to permit adequate air circulation around each cable.
- Install between equipment without any joints and install on the loop-in, loop-out principle without the use of connectors for sub-circuit wiring.
- Install cables so that they can be readily withdrawn for the purposes of relocation, and/or rewiring and install such that they are not bent through radii less than the minimum bending radii recommended by the manufacturer.
- Where installed together over parallel routes, power cables shall be spaced apart to provide a gap of one cable diameter (minimum) between adjacent circuits or sub-main groups or as shown.
- Fix to permanent structural components of the building where the cables supply exit and emergency lighting. Additionally, these cables shall be positioned above ducts, pipes and other building components that may become dislodged and cause interference to the cables.

- Cables shall be of the size and type as shown and scheduled and be installed over routes which have been fully co-ordinated with other services and be installed on a square grid principle parallel or normal to the Building External walls.
- Cables shall follow the basic routes as indicated on the drawings and be identified at each end by approved labels fixed to cable sheaths or conduit, and identifying the cable size, type and purpose.
- The Contractor shall terminate and connect cables to equipment and/or switchboards.
- Prior to ordering the cables the Contractor shall verify with other relevant Trade Contractor that the cables specified are adequate for the proposed loads.

5.8.6.1 Voltage Drop

Under normal service conditions, the voltage at the terminals of any power consuming electrical equipment shall be not less than the lower limit specified in the relevant electrical equipment Standard.

Where the electrical equipment concerned is not covered by a Standard, the voltage at the terminals shall be such as not to impair the safe functioning of the electrical equipment.

Voltage drop shall be calculated in accordance with the guidelines stated in AS/NZS 3008.1 series.

The cross-sectional area of every current-carrying conductor shall be such that the voltage drop between the point of supply for the low voltage electrical installation and any point in that electrical installation does not exceed 5% of the nominal voltage at the point of supply.

Allowance for a voltage drop of up to 7% shall be considered when a substation is located and dedicated to the premises.

Incoming supplies (consumer's mains) shall not exceed 1.2% voltage drop.

The value of current used for the calculation of voltage drop on a circuit need not exceed the:

- total of the connected load supplied through the circuit; or
- maximum demand of the circuit; or
- Current rating of the circuit protective device.

The drop in voltage in conductors at any point in an extra-low voltage electrical installation shall not exceed 10% of the nominal value when all live conductors are carrying the circuit-operating current. This requirement need not apply where electrical equipment is specially designed for operation with a voltage drop greater than 10%.

5.8.6.2 Lugs

Cable termination lugs shall be copper installed on all conductors except where tunnel terminals are provided on equipment and comprise an approved clamp type cable lug with bolted connection to the conductor or crimp type installed with a ratchet type crimping tool.

Cable Lugs shall be in accordance with the cable manufacturer's recommendations.

5.8.7 Minimum Sizes

The Contractor shall be responsible for appropriately sizing required cable in accordance with AS/NZS 3008 and the final method of installation.

Generally, cables shall be 0.6/1kV PVC or XLPE insulated, PVC sheathed multicore standard copper cables to AS 3147. Minimum insulation temperature rating shall be V-90.

It shall be the Contractor's responsibility to ensure that all sub-circuit wiring is sized to comply with AS/NZS 3000 and AS/NZS 3008.1 with respect to voltage drop and current rating of the circuit.

In general, cables shall be not less than the following:

- Lighting sub-circuits: 2.5mm² at 20A circuits (1.5mm² shall not be allowed unless approved by the Consultant)
- Power sub-circuits: 2.5mm²
- Submains: 6mm²
- Control circuits: 1.5mm².

Where larger sizes are required for current or voltage drop requirement, they shall be provided, i.e. external lighting where cable runs are excessive. Generally, sub-circuits with protection rated at 20A shall utilise the following cabling:

- Length up to 30m: 2.5mm²
- Length up to 40m: 4.0mm²
- Length up to 60m: 6.0mm²

5.8.7.1 Derating

The sizes of conductors nominated by the Contractor in accordance with the previous section shall form the minimum required size applicable to that conductor. It is the Contractor's responsibility to ensure any derating of cables as defined in AS/NZS 3008.1 are sized and installed as required to satisfy standards.

The size, grouping, spacing, enclosure and location of cables shall be installed so that the current rating of the conductors as permitted by AS 3008.1 after the appropriate de-rating factors have been applied is not less than the specified current rating of the circuit breaker or fuse which protects the conductor.

Where conductors are installed, grouped, spaced, or enclosed by the Contractor in such a manner that their de-rated current rating is less than the specified current rating of the protective device, the size of the conductor shall be increased to provide a current rating of the conductor which is not less than the specified current rating of the respective protective circuit breaker or fuse.

5.9 Labelling

All general-purpose outlets, special purpose outlets, isolators, circuit breakers on switchboards etc., shall be identified with engraved labels or "Dymo", or "Brother" printed labels, black lettering on clear or white type.

5.10 Electrical Accessories

The Contractor shall supply and install GPO's and multi-phase sockets outlets as required. The system shall be of a single manufacturer to match existing as deemed achievable. Where multiple manufacturers accessible are evident, the Contractor shall seek advice from the Architect and/or Client for direction.

5.10.1 Socket Outlets

General-purpose outlets (GPO) and switchplates shall have 10 A make/break switch mechanisms. Essential (generator backed), shall be identified by red mechanisms. Critical (UPS backed), shall be identified by blue mechanisms. GPO's installed shall comply with AS3112 for general applications and AS3123 for industrial applications.

All wall plates in general areas shall be equal to Clipsal 2000 range. Such plates shall include but not be limited to:

- Lighting switches
- Power outlets
- MATV outlets

Wall plates within accommodation blocks are to be tamper proof stainless steel.

Where two outlets or a double outlet are nominated, they shall be mounted under a common flush plate. They shall be installed selected from the standard colour range and be the same type as light switches in that area. Sockets outlets shall be made of impact resistance plastic, standard size recessed flush plates fitted to wall boxes and narrow plates fitted to skirting duct lids unless shown otherwise.

Where socket outlets are to be mounted within fire rated walls, the Contractor shall allow recessed fire rated and acoustic rated wall boxes as required to achieve nominated fire rating.

5.10.2 Weatherproof Socket Outlets

Where mounted externally, GPO's & SPO's shall be IP56 minimum weatherproof type and comply with the requirements of AS1930. They shall be horizontally mounted at heights nominated or as advised.

IP56 weatherproof GPO's as a minimum shall be installed for all outdoor, exposed locations and elsewhere where subject to adverse environment or mechanical damage e.g. workshops higher IP rated outlets shall be installed.

5.10.3 Combined RCD Switched Socket Outlets (SSO)

Combined RCD SSO shall be an integral type RCD unit with a double switched socket outlet. The outlet shall be of the same manufacturer as other socket outlets and rated at 10 Amps. Consideration of RCD trip current shall conform to the following:

- General light and power: 30mA Type II to AS/NZS 3190
- Patient treatment areas: 10mA Type I to AS/NZS 3190
  (to be determined in accordance with AS3003)

5.10.4 Residual Current Devices (RCD)

All circuits throughout the complex shall generally be protected by residual current devices set to 30mA detection, unless the load is of typically high leakage (e.g. air conditioning condensers, water heaters, stoves and ovens).

5.10.5 Three Phase Outlets

Three phase outlets shall be rated at a minimum of 20A, 500V A.C.

The outlets shall have:

- Five (5) x round pins mounted with;
- One (1) x earth pin at the 6 o'clock position;
- Neutral pins in the centre of the outlet and;
- The red, white and blue phases in a clockwise sequence when viewed from the front of the outlet.

Outlets equal to Clipsal 56 series outlets shall also be utilised in the plant room areas.

5.10.6 Floor Boxes

Floor boxes shall be:

- Floor recessed unless otherwise noted
- Coordinated with joinery and furniture.
- Fitted with mounting plates for voice, data outlets etc.
- Complete with lid recess for installation of flooring material. Confirm floor finish with architect prior to ordering
- Floor boxes are to be equal to CMS Titan or CMS Apollo recessed in concrete type, with infill panels to match the floor finishes.
- Total numbers of outlets have been nominated on the electrical documentation; allow adequate number of floor boxes to accommodate the total number of outlets.
- All power outlets are to be equal to Quad auto switches types with data outlets to match.

5.10.7 Starter Sockets

Starter Sockets shall be:

- Rating shall be 20Amps single phase
- White or black in colour (Confirm the colour with the architect)
- To be mounted on a fixed surface (Floor or ceiling or wall)
- Starter sockets are to be equal to CMS Electracom SW84011.

5.10.8 Umbilical

Supply and install snap together “Rigid mode” umbilical to reticulate power from floor boxes to work surface. Provide cable segregation as per the standards between the power and communications cabling.

Supply and install all mounting accessories including floor base and workstation mounting.

Umbilical shall be CMS Electracom Axess or equivalent.

5.10.9 Ceiling Fans

All ceiling fans are to be suspended to height confirmed on site by the architect. Fan controllers are to be located adjacent to light switches with individual fan controls. Maximum of two controls per single standard switch plate.

Finish to architect’s approval.

5.11 Positioning of Outlets

The positions of power outlets, isolators, equipment etc. are shown approximately on the drawings for the purpose of tendering.

The Contractor shall allow varying the position of any outlets and services within 2 metres in any direction without variation to the contract. Verify the position of all outlets on site with the Architect and other drawings before the relevant work is implemented.

Refer to the architectural drawings for the exact set-out and installation heights for all fixed equipment, GPOs, communications outlets, etc. Generally, switches and emergency shut-off buttons shall be mounted at approx. 1250mm AFFL.

The Contractor shall provide workshop drawings as required for approval prior to locating services in accordance with the drawings. In general, heights shall be as follows:

- Above bench outlets to be approximately 300mm above bench height
- Under bench outlets to be approximately 100mm below bench height
- High level outlets to be approximately 200mm below ceiling height
- Other outlets to be approximately 300mm above finished floor level

6. POWER GENERATION

6.1 General

The Contractor shall supply and install, or modify existing, diesel generating set(s) with a continuous standby rating capacity to support security systems, lighting, some power, and other equipment as directed by the client. The fuel tank is to have capacity for 6 hours of continuous operation. The generator shall be complete with mains synchronisation control system including all necessary wiring, housings and control equipment. The Contractor shall provide phase rotation metering and a remote starter within the remote generator connection point cubicle.

The Contractor shall be responsible for supply, delivery, installation and commissioning of the system including:

- All generator switchboards and control panels (By Contractor).
- Generator room acoustic treatment to authority regulations, state Environment Protection Agency (EPA), local council and acoustic engineer requirements.
- Intake, exhaust and combustion air systems and associated attenuation to authority regulations, EPA and acoustic engineer requirements.
- Coordination of power requirements for battery charging, fuel pump and phase failure relays.
- Fuel tank, base tank and/or fuel room.
- Fuel pumping system including pipework from inlet to storage location.
- Supervisory control and data acquisition (SCADA) control system.
- Generator control panel.
- Interfaces to Building Management Control System (BMS/BMCS).
- Interfaces to each switchboard requiring standby power.
- Low level interface cabling from automatic transfer switches to generator controller
- Lifting and moving into place, traffic controls and road closures (as required) and crane.

6.2 Standards and Regulations

The following standards and guidelines are applicable to this scope of works:

Reference	**Name**
AS/NZS 4509, Parts 1 and 2	Stand-alone Power Systems
AS/NZS 3010	Electrical Installations – Generating Sets
AS 60034, Parts 1, 5, 7, 8, 9 and 11	Rotating Electrical Machines
AS 4029, Parts 1, 2 and 3	Engine Start Batteries
AS 4044	Battery Chargers
AS 3731, Parts 1 and 2	Control and Alarm Batteries

6.3 Interpretations

6.3.1 Definitions

The following definitions are applicable to this specification section:

Term	Description
Net continuous rated output (or prime rating)	Net continuous electrical output available at alternator terminals, not including the electrical power consumed by the generating set's dependent and essential auxiliaries.
Net short-time rated output (or stand-by rating)	Net electrical output available from the generating set for 1 hour in every 12 hours at net continuous rated output, not including electrical power consumed by the generating set's dependent and essential auxiliaries.
Start response time	Total elapsed time from receipt of start signal to final connection to load.

6.4 Submissions

6.4.1 Operation and Maintenance Manuals

Provide all operational and maintenance documentation necessary to operate and maintain the systems installed in accordance with AS/NZS 4509.1.

6.4.2 Products and Materials

Submit technical data including the following:

- Technical description and specifications of each generating set, including output curves for base load and stand-by conditions, alternator and engine data, automatic voltage regulator, synchronising and load sharing modules and auxiliaries.
- Type test reports as follows:
- Generating sets.
- Alternators: To AS 60034.1, AS 60034.5 and AS 60034.7.
- Net continuous rated output.
- Net short-time rated output.
- Transient and subtransient reactance of the alternators.
- Voltage regulation grade.
- Generating set efficiency at 50%, 75% and 100% load.
- Calculations for performance of acoustic enclosures and silencers.
- Evidence that the engine type has previously passed cold starting tests at the minimum ambient site temperature.

6.4.3 Shop Drawings

Submit shop drawings indicating the following:

- General arrangement of equipment, generating sets, fuel tanks, fuel pipe work/inlets, exhaust silencers, control panels, batteries, cable tray runs.
- Single line schematic showing the interconnection with the building electrical system.
- Operating sequence in test and emergency modes as well as restoration of normal supply.
- Location and size of fuel tanks.
- Physical size of exhaust silencers including clearances from other system, building and structural elements.
- Physical size of generating set base and clearances for maintenance.
- Location and estimated size of control and distribution boards.
- Location of control and starting batteries.
- Acoustic performance criteria (engine, exhaust, air flow), to determine the level of sound proofing required.
- Maximum mass and overall dimensions of each separable assembly.
- Access clearances for operational maintenance and dismantling.
- Electrical single line diagram, and general arrangement for the complete system.
- Control diagrams.
- Alarms and shutdown annunciator text engraving schedule.
- Details of foundations and anti-vibration mountings.

6.5 Requirements

6.5.1 Multiple Generating Sets

For multiple generating sets operating in parallel, provide generating sets of the same make and type.

6.5.2 Mounting

Mount the engine and alternator units on a common structural steel frame to support the generating set assembly and the engine local control board.

6.5.3 Vibration Suppression and Seismic Restraints

Vertical and horizontal restraint: Support the mounting frame on vibration isolating mountings complete with seismic snubbers or captive type vibration isolation mounts.

6.5.4 Coupling

Directly couple the engine and generator shafts with a self-aligning type coupling, capable of transmitting the engine maximum output torque under operating conditions, including starting and overload.

6.5.5 Plinths

Provide reinforced concrete plinths for floor mounted equipment, sized to suit equipment footprints.

6.5.6 Resilient Mounts

Provide at least 6 resilient mounting blocks between the frame and the plinth.

6.5.7 Drip Trays

Provide removable drip trays under those parts of the assembly where fuel or lubricant leakage may occur. Provide overflow outlet pipes taken to a point where a receptacle can be fitted under the pipe outlet.

Capacity shall be at least 1.5 times the oil capacity of the engine sump. Material of manufacture shall be 1.6 mm galvanized steel with brazed joints and rolled edges.

6.6 Components

6.6.1 Alternators

Standards: To AS 60034.1, AS 60034.5, AS 60034.7, AS 60034.8, AS 60034.9 and AS 60034.11.

Voltage waveform shall be sinusoidal, with total wave form deviation not exceeding 10%.

Excitation: Provide self-regulated brushless type exciters.

Overspeed: Withstand a speed of 1.2 times unit rated speed for both alternator and engine.

Alternator underspeed withstand: Normal operation at net continuous rated output at a speed of 0.95 times unit rated speed, without overheating.

Sustained short-circuit withstand: At least 2.5 times full load steady state short-circuit current, for at least 5 s.

Number of poles: 4.

Enclosure classification: IP21, with screened ventilation openings.

Cooling method classification: Class IC 01, to AS 1359.106.

Insulation classification: Thermal class 180 (H), to IEC 60085.

6.6.1.1 Anti-Condensation Heaters (Externally located Generators)

Provide at least 2 anti-condensation heaters within the winding enclosure. Rate heaters to maintain the windings and insulation at least 6°C above ambient temperature when the alternator is at rest and one heater is in service.

Locate a heater at each end of alternator windings in a position which allows heat transfer to the winding insulation by convection, without exceeding maximum allowable insulation temperature. Do not fix heaters to windings. Connect heaters to separate identified terminals within a separate accessories terminal box which is connected to a permanent supply.

Provide a connection diagram for the heaters. Locate within the terminal box.

6.6.1.2 Winding Thermistors

Provide thermistors to alternator stator windings.

Standard: To AS/NZS IEC 60947.8 and AS 60034.11.

Thermistor type shall be positive temperature coefficient.

Thermistor temperatures:

- Engine shutdown: 160°C.
- Winding temperature high pre-alarm: 140°C.

6.6.1.3 Terminal Boxes

Provide metal terminal boxes sized to allow the neat installation and termination of the current transformers, power and control cables and cable lugs with necessary clearances between live parts and the box, and without placing undue strain on termination points.

Provide removable lid and side covers to supply cable terminal box.

Provide star connected windings. Bring both ends of each winding out to separate terminals. Establish a neutral terminal.

Provide neoprene or bonded cork gaskets between terminal boxes and their frames and covers.

Marking: To AS 60034.8.

6.6.2 Engines

Provide a permanent test load either using the building load or a permanent resistive test load.

Provide a separate fan cooled, resistive test load connected to the generating set control panel.

Enclose test load resistors and fan and associated switchgear and controls in 2 segregated enclosures within a common ventilated sheet metal enclosure.

Type: Turbocharged diesel engine.

Provide front and rear main bearings, so that crankshaft alignment is not affected by dismantling of the alternator.

6.6.2.1 Governing

Provide electronic or mechanically controlled governors connected to the alternator.

Governor should allow for the rotational speed to operate continuously at 1500 r/min from no-load to the maximum rated electrical load.

Provide filters to prevent interference with the operation of the governor, overspeed or underspeed cut out devices from harmonics or switching spikes generated by the load.

Provide adjustment settings for the following:

- Speed droop.
- Stability.
- Maximum speed.
- Acceleration rate.
- Load gain.

6.6.2.2 Engine Cooling

Provide a cooling system consisting of radiators, fans and pumps. Connect the cooling air outlet to generator room cooling air outlet.

6.6.2.3 Engine Air Intake

Provide dry type air intake filters of sufficient capacity to permit continuous engine operation for 200 hours before filter servicing becomes necessary. Provide filter manometers.

Ductwork shall be supplied to AS 4254.2.

Provide a fan selected for the installed system air pressure drop. Include power absorbed by the fan under site operating conditions when calculating generator output.

6.6.3 Diesel Fuel System

The Contractor shall be responsible for design, supply, install and commissioning of a complete fuel storage and pipe system, pumps, fill point equipment, etc.

Fuel storage shall be designed as per AS 1940 requirements. Day tank fuel storage within the building shall be limited to 1000 litres unless on or below the lowest level of a building. Capacities above 1000 litres require the fuel storage structure to be bonded and 240/240/240 fire-rated. If the average load factor is expected to be less than 67%, a less-costly standard 1000 litre tank may be considered adequate.

6.6.3.1 Fuel Storage

A new day fuel tank (Base tank) shall be sized to ensure that the generator may operate at 100% capacity without the need for refuelling for a period of no less than 6 hours of continuous operation.

6.6.3.2 Fuel Fill Point

The fuel-fill point shall be located as nominated and no more than 2 metres within the building overhang. An emergency stop and level gauge are to be provided in this recessed unit. High and low-level alarms are to be provided to the BMCS and interfaced to the fuel-fill point.

6.6.3.3 Fuel Connections

Fuel piping and associated auxiliary equipment shall comply with AS 1940.

Provide stop valves on the inlet to, and outlets from, the daily service tank.

6.6.4 Diesel Fuel Leak Detection

The Contractor shall provide a sensor system to monitor all fuel lines within the system. The system shall comprise multiple sense cables connected to a single central digital monitoring unit. The system shall be capable of managing information of all leaks related to the number of sense cables installed. (E.g. 120 sense cables installed will correspond to 120 possible detected and displayed leaks).

Besides leak, the system shall be capable of detecting circuit interruption (cable break) on any of its connected sense cables. In the event of a “cable break”, an audible alarm is triggered, the indicator light changes to red, the dry contact is activated and the display shows “cable break” and its location.

The sense cable shall continuously perform three functions: to detect the presence of liquid at any point along its length, to detect a cut or break at any point along its length and to communicate digitally the nature and location of the fault to the nearest metre.

6.6.4.1 Cable Specification

The sense cable shall consist of a helically-winded central core (data bus), on which PEHD (Polyethylene high-density) conductor wires are spiralled. This shall ensure a prompt detection as well as a short drying time after the risk is eliminated.

The insulation and signal wires shall be of flame-retardant polymer. The jacket of sense wires shall be of conductive polymer on the ground wire.

A microcontroller shall be embedded in the sense cable to ensure digital and independent communication between each sense cable and the digital monitoring unit.

The sense cable shall be Underwriters Laboratories (UL) listed.

6.6.4.2 Digital Monitoring Unit

The digital monitoring unit shall be a microprocessor based complete leak locating system. It shall receive data processed and transmitted by the sense cables as well as raising the alarm.

The digital monitoring unit shall be supplied by 230 VAC, 50/60Hz, single phase. The total power consumption shall not exceed 16 VA. The digital monitoring unit shall be enclosed in a NEMA12 enclosure.

Buttons shall be provided on the front of digital monitoring unit:

- "Test": to check system operations. The monitoring unit shall start a self-test automatically once powered on. The name and total quantity of cables on every output shall be shown on the LCD display on the front of the digital monitoring unit.
- "Esc": to acknowledge and silence the alarm
- "Menu": to configure the digital monitoring unit
- "History": to record alarm history. Event log of (30) events deep shall provide storage on a FIFO basis. When the memory is full, the latest record shall be stored and the earliest record shall then drop out automatically.

6.6.4.3 Communication

Configurable dry contacts shall be available in the system to enable remote monitoring and control. The dry contacts shall indicate normal and alarm condition. Any interruption in power shall be acknowledged by the general dry contact.

The digital monitoring unit shall be compatible with existing operating systems. RS-232, RS-485 serial ports with Modbus/Jbus communication protocol shall be available on the digital monitoring unit, so as to interface with executive and streamline printing.

6.6.4.4 LCD display

A four (4) lines by twenty (20) characters backlit LCD shall be located on the front of the digital monitoring unit. In the event of simultaneous leaks or multiple faults, the display shall show all alarms one after the other. English language shall be the language by default.

6.6.4.5 Indicator light

An indicator light placed at the front of the digital monitoring unit shall indicate both power and alarm status.

6.6.4.6 Jumper Cable Connection and Auxiliary Equipment

Where leak detection is required, a four core jumper cable shall be used to connect sense cables in between zones, floors or rooms.

6.6.4.7 Labels

Warning labels shall be placed on the sense cable approximately every five (5) metres. Hold-down clips shall be used to fix the sense cables every one (1) metre.

6.6.4.8 Floor Plan

Schematic drawings shall represent the layout of the leak detection system installed. It shall indicate the location of sense cables, jumper cables and all auxiliary equipment.

Drawings shall be provided by the contractor installing the leak detection system. The floor plan is essential for good management of the leak detection system since it makes it possible to locate quickly any existing faults, as indicated by the digital monitoring unit.

6.6.5 Exhaust System

Provide exhaust piping from the engine complete with silencers, piping, ductwork, supports and expansion devices.

6.6.5.1 Exhaust Piping

- Material: Type 321 Stainless steel.
- Diameter: Match engine exhaust manifold connection.
- Connections: Provide flanged connections to silencers and pipe interconnections.
- Vibration isolation: Provide a stainless steel flexible connection to the engine.
- Insulation: Lagging to be provided for where the piping may be subjected to physical contact.

6.6.5.2 Weatherproofing

Provide weatherproof flashing, sleeves and acoustic seals where the exhaust system penetrates the roof or external walls.

6.6.5.3 Exhaust Drainage

Grade the exhaust line away from the engine to drainage pockets, or connect to a suitable drainage outlet.

6.6.5.4 Exhaust Pipe Insulation

Insulate the full length of exhausts within buildings.

- Insulation Material: Mineral wool, suitable for temperatures up to 260°C.
- Maximum thermal conductivity: 0.036 W/m.K at 20°C.
- Minimum thickness: 50 mm.

Wrap insulation around exhaust pipes. Hold in place with 12 mm x 0.55 mm zinc-coated steel straps at 600 mm maximum centres.

Sheath insulation as follows:

- Sheathing not exposed to weather: 0.55 mm metallic-coated steel sheet.
- Sheathing exposed to weather: 0.55 mm metallic-coated steel sheet or 0.8 mm minimum aluminium sheet.
- Joints: Lap joints in sheathing at least 30 mm and rivet or screw at 150 mm maximum centres.
- Edges: Neatly cut around nozzles and cone down to flanges.
- Terminations: At terminations, return edges of sheathing to protect edges of insulation.

6.6.6 Controls

Provide automatic and manual modes to start and shut down generating sets in the selected sequence and, if operating in parallel, share the load to optimise their rated kW and kVAr capacities.

6.6.6.1 Manual Sequence Control

Provide controls to manually, start, synchronise and shut-down each generating set. Include emergency stop, synchroscope, meters, selector switches, check synchroniser and status indicating lights.

6.6.6.2 Automatic Start Control

Provide for the following:

- When a start signal is received, generating sets start automatically, come on-line and, if appropriate synchronise before connecting to the load.
- Connection of alternators for sequential control of load sharing/shedding.
- Shutdown of alternate machines.

6.6.6.3 Automatic Engine Shutdown

Provide for generating sets to run to suit the load demand until receipt of the mains restored signal is received. At this point the automatic sequenced engine shutdown signal must be activated after an adjustable time delay of 0 to 30 min.

6.6.6.4 Engine Shutdown

Provide a shutdown control system which disconnects the alternators, and shuts down engines upon the occurrence of fault conditions, so that:

- Engines cannot be restarted before safety devices have been manually reset and system alarm sensors have returned to the normal state.
- The overspeed shutdown acts directly to disconnect the fuel supply independent of the governor.
- The shutdown control system may be reset by the operation of one reset switch, after safety devices have been manually reset.

6.6.6.5 Emergency and Fault Shutdown

Provide for the following conditions to register as audible and visible alarms and to cause each generating set main circuit breaker to open immediately and each generating set to immediately shutdown:

- Emergency stop push-button: Pressed.
- Generating set: Over voltage.
- Generating set protection: Activated.
- Generating set: Over current.
- Engine: Overspeed.
- Engine oil pressure: Low.
- Jacket water temperature: High.

6.6.7 Remote Monitoring

Provide for common alarm to be connected into a remote monitoring system.

Provide an interface to enable a building management control system to monitor system output, monitor system alarms.

6.6.8 Control Panels

Provide control panels, switchgear and controlgear assemblies as documented in the Switchboards section of this specification.

Accommodate equipment operating in parallel and stabilise load sharing between each generating set at all load steps. Include reverse power interlock.

6.6.8.1 Engine Local Control Board

For each generating set, provide the following:

- Key operated local engine start/stop control.
- Controls for auto/off/manual/load test.
- Emergency manual shutdown.
- Analog indicating meters with minimum 1% accuracy: Speed indicator, kW meter, frequency meter, ammeter, voltmeter, kVAr meter, power factor meter, and hours run meter.
- Indicator showing generating set under local control.
- Oil pressure indicator.
- Coolant temperature indicator.
- Undervoltage protection: Adjustable down to 90% rated voltage with time delay 0 to 10 s.
- Under frequency protection with two stages:
    - First stage: Adjustable 47 to 50 Hz with time delay 0 to 10 s.
    - Second stage: Adjustable down to 40 Hz and with instantaneous trip.
- Automatic voltage regulator consisting of the following:
    - Switch to select manual or automatic voltage control.
    - Solid-state type automatic voltage regulator.
- Under and overvoltage sensing.
- Power transducers.
- Over and underspeed sensors.

For overload and fault protection at the alternator output provide a circuit breaker appropriately sized for protection of the alternator.

Alternator voltage control shall be regulated by the following:

- Manual control adjustment.
- Automatic voltage regulator:
- Voltage adjustment.
- Set point adjustment.

6.6.9 Batteries and Chargers

Provide separate batteries and charger systems for the following:

- Engine start.
- Control and alarm functions.

6.6.9.1 Starting Batteries

Locate in proprietary battery holders attached to the generating set, or on purpose-built stands next to the set and constructed of timber or other corrosion resistant material. Isolate batteries from vibration.

Provide a high-impact resistant transparent cover for each battery.

Capacity shall be sufficient to crank the engine for 3 successive attempted starts, repeated at 5 min intervals.

Provide a lockable isolator to prevent accidental starting.

6.6.9.2 Starting Batteries Chargers

Select the charger to suit the batteries supplied.

Connect chargers to the mains power. Make sure power is maintained to the charger under all supply conditions.

Provide the following local audible and visual alarms together with facilities for extending them via a common alarm output to a remote location:

- Mains off.
- Over voltage.
- Over current.
- Low battery voltage.
- Insufficient charge rate.

6.6.9.3 Control and Alarm Batteries

Segregate battery and charger equipment from generator control equipment.

Capacity shall be sufficient to supply full generating set control, monitoring and alarm functions for a period of 48 hours, and then operate circuit breaker and transfer devices for 10 consecutive open-trip-close cycles with mains supply off and at minimum ambient temperature.

6.6.9.4 Chargers - Control and Alarm Batteries

Select the charger to suit the batteries supplied.

Provide the following local audible and visual alarms together with facilities for extending them via a common alarm output to a remote location:

- Mains off.
- Over voltage.
- Over current.
- Low battery voltage.

- Insufficient charge rate.

6.6.10 Starting

Provide starter motors, batteries and chargers, and associated control equipment to automatically start each engine.

Wire starter motors so that starter motor solenoid contacts are on the active side and field windings are at earth potential when the motor is de-energised. Provide an interlock, connected directly to the engine, to prevent the starter motor operating when the engine is running.

Provide a starting lock out system which prevents further starting attempts after 3 successive unsuccessful attempts.

6.6.11 Acoustic Enclosures

Provide weatherproof acoustic enclosures to surround generating sets, including inlet and outlet sound attenuators.

Sound Pressure Level (SPL) shall be less than 85 dB (A) at 12 locations 1 m from the enclosure exterior surface, at 1.5 m above floor or roof levels, measured with the generating set operating at constant maximum rated full load output, with doors closed and service penetrations sealed.

Size enclosures to accommodate diesel engine inlet and outlet attenuators and permit an unobstructed walkway at least 600 mm wide between the generating set and internal face of the enclosure.

Provide doors of same material as the enclosure. Provide door stays to each door.

Provide ventilation to the enclosure so that:

- With generating sets running at full rated output the enclosure temperature rise does not exceed 10°C.
- Hazardous concentrations of toxic or explosive fumes and gases are prevented.

6.7 Marking and Labelling

6.7.1 Rating Plates

If temperature-rise limits are achieved by de-rating an oversized generator, state the de-rated value.

State alternator mass (in kg).

6.7.2 Thermistor Detector Identification and Warning Plates

Provide details of thermistor type classification and reference temperature.

Provide a warning engraved in 4 mm high lettering as follows:

"WARNING – Do not apply more than 2.5 V across the protection thermistor devices."

For anti-condensation heater identification and warning: Locate next to heater terminals. State the number, voltage and power rating of the heaters, and the following separate warning engraved in red letters on a white background:

"WARNING – Anti-condensation heater. Circuit is live when the set is off."

6.7.2.1 Auxiliary Wiring

Provide ferrules to wiring ends identifying each conductor.

6.7.2.2 Engine Direction of Rotation

If driving shafts or associated rotating parts are accessible, clearly and permanently mark the direction of rotation on an adjacent fixed surface.

Provide a label within the supply cable terminal box identifying the relationship between the direction of rotation and the marking of terminals.

6.7.2.3 Charger Enclosure Markings

Provide enclosure with the following:

- Manufacturer's rating plates.
- Markings to AS 4044.
- Plate material: Stainless steel.

6.8 Testing and Commissioning

6.8.1 Permanent Test Load

Provide a permanent, fan cooled, resistive test load connected to the generating set control panel.

Enclose test load resistors and fan and associated switchgear and controls in 2 segregated enclosures within a common ventilated sheet metal enclosure.

Degree of protection:

- Indoor locations: IP42.
- Outdoor locations: IP56.

Rating: At least 50% rated output of combined generating sets.

Resistor bank: 400 V, 3 phase, delta connected, stainless steel finned, sheathed element type. Interconnect resistors with nickel plated copper links supported on stand-off insulators. Arrange resistor banks to suit switched load steps.

Resistor bank switching: Switched in at least 3 equal load steps, from the generating set control panel.

Internal wiring:

- Connection to elements: 150°C silicone rubber insulation.
- General internal wiring: V-90HT insulation.

Circuit breakers: Provide a main circuit breaker to connect the alternator supply and individual circuit breakers for each resistor group.

Protection: Provide a thermal overload relay for fan motor protection. Provide safety interlocks to disconnect the load if ventilation air flow is restricted or resistor temperature limits are exceeded.

Fan run-on: 5 min after load disconnection.

Remote monitoring: Provide outputs for remote monitoring of the following:

- Load step indication.
- Fan run-on.

- Common alarm for fan motor overload, air flow restriction, and safety interlock operation.

6.8.2 Completion

Prior to handover, for each generating set, carry out the following:

- Check tightness of connections and securing devices.
- Verify correctness of operation of protection devices and systems including sensor settings. Simulate actual conditions as far as possible, in order to test responses to faults imposed.
- Before to connecting the generator to mains supply or project loads, verify that the correct electricity supply phase sequence is provided at switchboards and control panels, and that circuit protective devices are correctly sized and adjusted.
- Functional checks to AS 4594.1 Table 7, List C, items C1 to C5 inclusive.
- Cold start with the engine having been at rest for the previous 24 hours, timed from receipt of mains failure signal to acceptance of full rated load in 3 load steps to within the limits of output voltage and frequency.
- Continuous operational trial consisting of:
    - 3 hours at 100% rated power.
    - 1 hour at 110% rated power.
    - 30 min at 75% rated power.
    - 30 min at 50% rated power.
- Record fuel consumption for each step of the continuous trial.
- Sample engine oil from engine sump before and after tests. Perform laboratory analysis and submit a report on each oil sample.
- Continuous operational trial: During the trial, measure the following at maximum intervals of 30 minutes:
    - Generator kW and kVAr output.
    - Generator output voltage.
    - Generator output current.
    - Generator output frequency.
    - Power factor.
    - Oil pressure and water temperature.
    - Electrical power requirements of continuously running electric motor driven ancillaries.
    - Each battery charger current and voltage readings.
    - Noise level.

6.8.2.1 Synchronisation/Load Sharing Tests

For generating sets running in parallel perform tests to verify automatic synchronisation and load sharing including the following:

- Sequence start and shutdown of each generating set.
- Parallel operation of generating sets.

- Synchronising of generating sets.
- Equal load sharing of kW and kVAr over 5 equal load steps.
- Neutral switching sequence and operation, where provided.
- Operation of controls, switchgear and auxiliaries.

6.8.2.2 Temporary Test Loads

Provide test loads including power and control wiring, ancillary equipment and test instruments to achieve the kW, kVAr and necessary load steps.

6.8.2.3 Reports

Submit reports from manufacturers or suppliers verifying the performance of safety and control functions of each system.

6.8.3 Maintenance

Respond to call outs for breakdowns or other faults requiring corrective maintenance. Attend on site within 24 hours of notification. Rectify faults and replace faulty materials and equipment.

7. UNINTERRUPTIBLE POWER SUPPLY

7.1 General

The Contractor shall provide Class A (Unrestricted Sales Distribution) uninterruptible power supply (UPS) units to support the following equipment: servers, duress alarm systems, VoIP and digital telephone systems, security and local area network switches, CCTV system (including HDD recorders) and intercom systems for a period of at least 30 minutes. These should be combined if possible to reduce the number of individual UPSs in an area. The UPSs are to be provided with a Simple Network Management Protocol (SNMP) interface to warn of problems.

Contractor shall be responsible for supply, delivery, installation and commissioning of the system complete with all necessary wiring, housings and control equipment including:

- Internal automatic and manual bypass facility and an external maintenance bypass switch/ Inverter Interlock.
- The standalone UPSs shall be wired to a dedicated load centre located within the Communications rooms/ cupboards.

7.2 Standards and Regulations

The following standards and guidelines are applicable to this scope of works:

Reference	Name
AS 62040.2, AS IEC 62040.3	Uninterruptible Power Systems
AS 60146.2	Self-commutated semiconductor converters
AS/NZS 5603	Stand-alone inverters: performance requirements
AS/NZS 4029, Parts 2 and 3	Stationary Batteries
AS 2676 series	Installation and maintenance of batteries in buildings
AS 3011 series	Electrical installations — secondary batteries installed in buildings

7.3 Requirements

7.3.1 Pre-Completion Tests

Contractor shall carry out the following tests:

- Inrush current: Record the instantaneous peak value of inrush current at switch-on.
- Power factor (PF): Record the line-side power factor with a full load rated output at 0.8 PF lagging.
- Overload capacity tests: Comply with the Overload capacity table; output at 0.8 PF lagging including operation of static switch after the test period has expired.
- Line voltage drop compensation test: Linearly increase the test current from 0 - 100% of rated output, at 0.8 PF lagging.

UPS rated capacity	Overload capacity test current	Duration
< 1200 VA	110% of rated output	10 min

> 1200 VA, < 6 kVA	125% of rated output 150% of rated output	10 min 1 min
> 6 kVA	125% of rated output 150% of rated output	10 min 10 s

7.3.2 Submissions

Submit shop drawings indicating the following:

- The UPS system general arrangement and layout with details of connections, circuit breakers, cable sizes, overall dimensions, weight, location of access doors, cable terminating locations, and necessary clearances.
- Functional block diagram.
- The general arrangement of the remote manual by-pass switch/cabinet, and indication/alarm panel with details of installation requirements.
- Type and rating of equipment items.
- Battery layout and associated details.
- Heat loads, submitted to the Mechanical Services Contractor.

7.4 Components

7.4.1 Batteries

Provide a battery system having an operating life of at least 10 years and suitable for operation of the UPS system in accordance with AS 4029.2 or AS 4029.3.

Batteries shall be sealed lead-acid, recombination type and sufficient to provide the rated output from the UPS for minimum of 10 minutes.

7.4.2 Rectifiers/Chargers

UPS shall be provided with input current limiters to limit input current to 125% of the full rated load current.

Battery chargers shall be automatic constant voltage type with maximum charging current adjustable from 0% to 10% of one-hour rate of the battery.

7.4.3 Inverters

Inverters shall synchronise with the AC input supply within ±0.5 Hz.

Provide controls which ensure that the AC input supply is stable and within tolerances for 30 s before automatic return from free running to synchronised running.

7.5 Operation

7.5.1 By-pass Arrangement

Provide an automatic, no-break, integral static by-pass switch with automatic reset to transfer the load automatically to the by-pass supply when the UPS output characteristics are outside the designated limits.

Provide an external manual by-pass switch adjacent UPS cubicle to manually transfer the load to the mains supply, bypassing the UPS and the static by-pass switch.

7.5.2 Harmonics

UPS shall have an input total harmonic voltage distortion: < 5%.

7.5.3 Current Limiting

Provide inrush current limiting to 125% of the UPS rated load current.

7.5.4 Protection

Upstream circuit protection shall be sufficient to supply the full rated load to the inverter and the battery-charging load.

Circuit breakers, both input and output, within the UPS, shall fully discriminate with upstream and downstream circuit breakers.

Provide component protection to minimise damage and downtime in the event of component failure. Include the following as appropriate:

- Fuses.
- Circuit breakers.
- Overloads.
- Thermal sensors.

Provide protection against output overload and short circuit. Ensure that output short circuits will not damage the UPS.

Provide interlocks to prevent accidental damage to the UPS during maintenance or normal operation.

7.6 Controls

7.6.1 General

Provide facilities for manual control and status monitoring of systems within the UPS. Provide an additional wall-mounted panel which indicates common alarm conditions for the UPS.

7.6.2 Local Control Equipment

Provide the following manual controls in an accessible location near to the UPS cabinet:

- Incoming mains isolation.
- Battery supply isolation, if batteries are not contained within the UPS enclosure.
- Manual bypass, to isolate the UPS and maintain power to connected equipment.

7.6.3 Local Status Monitoring

Provide indicator lights or a display to clearly show the status of local manual controls and protection equipment, including the following:

- Incoming mains, on/off/trip.
- Battery supply, on/off/trip.
- Over temperature shut down, activated.

- System automatic bypass, activated.

7.6.4 Alarms

Provide audible and visual alarms for the following:

- Overload shutdown.
- High temperature warning.
- Over temperature shutdown.
- Battery contactor open.
- Low battery.
- D.C. overvoltage.
- Input power failed.
- Output overvoltage/undervoltage.
- Static switch on manual.
- Load on bypass.
- UPS free running.

7.6.5 Instrumentation

Provide instruments, displays, keypads and selector switches, including for the following:

- Input voltage.
- Input current display.
- D.C. battery charge/discharge display.
- D.C. battery voltmeter.
- Output and input AC voltage.
- Output and bypass AC current.
- Elapsed operating time.

7.7 Testing and Commissioning

7.7.1 Spares

Supply spare parts necessary to maintain the maintenance time specified.

7.7.2 Completion Tests

Test run the UPS system continuously connected to a test load, for at least 48 hours. Record line and load voltage, current frequency and temperature measurements.

Supply reactive test loads including power, control wiring and ancillary equipment to achieve the kW, and kVAr and load steps necessary to demonstrate and verify the designated steady state and transient frequency and voltage responses and waveform deviation tests.

7.7.3 Maintenance

Respond to call outs for breakdowns or other faults requiring corrective maintenance for a period of 12 months. Attend on site within 24 hours of notification. Rectify faults and replace faulty materials and equipment.

7.7.4 Training

At a minimum of two weeks prior to the completion of the project, provide for the Client or Client Representative's staff, an on-site 2-hour training course in the operation and maintenance of the UPS system, including instruction on basic theory, location and rectification of faults (down to replacement of printed circuit cards) and all operating procedures.

8. SWITCHBOARDS

8.1 General

Supply and install new switchboards as required to accommodate new works.

Modify and expand the existing switchboard(s) as required to accommodate new circuit breakers, including provision of additional cubicles matching the existing switchboard ensuring that the new additional cubicle fits in the existing space.

Existing fault ratings shall be considered and calculated to ensure the new additional cubicle matches the existing switchboard's characteristics.

Provide a back generator to carry out the changeover works. All essential systems such as security systems, access control systems, fire systems, CCTV, lighting, refrigerators, cool rooms and similar shall be provided with backup power during the changeover works. The generator hire costs are to be included in the tender. Failure to do so will void any variation claims.

Where required, temporary submains are to be provided to all relevant distribution boards to ensure the facility is kept operational.

The following general requirements apply to all switchboards:

- Switchgear shall be of Schneider Electric or NHP manufacture. Where the Contractor wishes to install switchgear which they consider 'equal' to the above, they may formally do so in writing, and must submit corresponding technical data and specification sheets to the Electrical Engineer to show equivalent performance to the specified product.
- Large switchboards should be constructed in sections for ease of transport, installation and access to the site. Contractor is to confirm access requirements prior to manufacture.
- Switchboards are to be provided with suitable lifting means such as removable lifting eyes for transportation and position and secure supports, such that vertical lifting forces are not transferred to the top of the switchboard, but are wholly transferred to the sides.
- Switchboards are to be designed to facilitate thermographic surveying of all joints and terminations without the need for any circuit isolation.
- Switchboards shall be complete in every respect, factory wired and tested.
- Switchboards shall be of overall dimensions to suit the intended allocated space and accommodate all required switchgear and equipment.
- Switchboards shall be designed to provide easy access to equipment.
- Switchboards shall be segregated between metered and unmetered sections where applicable.
- Install with provision for 25% minimum additional space for future outgoing circuits within each section of the switchboard.
- Compliance with the requirements of the Supply Authority, AS/NZS 3439.1 and AS/NZS IEC 61439.5 shall be demonstrated.
- Install with main busbars and busbar connections to the circuit protection devices, capable of withstanding, without damage, the specified fault level for a period of one (1) second.

- Switchboards shall be manufactured from zinc coated steel, primed, undercoated and finished with enamel or powder-coated to selected colour or with proprietary paint to tested standard.
- External switchboards or switchboards incorporating energy authority equipment shall be key lockable in accordance with Supply Authority requirements. All other switchboards to be lockable type to standard manufacturer keying systems, provide uniform keying systems to all switchboards.
- Provide with main protective devices which are coordinated with protection devices both upstream and downstream.
- Provide with adequate ventilation with brass fine wire protection where required.
- Provide with hinged or lift off doors to comply with AS/NZS 3000 clearances.
- Provide with labelling in accordance with NSW Service and Installation Rules and AS/NZS 3000.

8.2 Standards and Regulations

The following standards and guidelines are applicable to this scope of works:

Reference	Name
AS 2430	Classification of hazardous areas
AS/NZS IEC 61439.5	Low-Voltage Switchgear and Controlgear Assemblies
AS/NZS 3000	Electrical Installations: Wiring Rules
AS 2700	Colour Standards for General Purposes
AS 1595	Cold-rolled, unalloyed, steel sheet and strip
AS 2338	Preferred dimensions of wrought metal products
AS 2067	Substations and high voltage installations exceeding 1kV A.C.
AS/NZS 3111	Approval and test specifications – Miniature overcurrent circuit breakers

8.3 Main Switchboard

In addition to the above requirements, the main switchboard shall be:

- Floor mounted to 75mm RS channel plinth and be free standing.
- Complete with maximum demand indicators and voltmeters.
- Provided with space for the future installation of digital smart sub-meters for out-going sub-main supplies i.e. lighting, power, mechanical etc.
- Provided with surge protection to the consumer mains.
- Complete with busbars designed to allow for future extendibility at either end of the main switchboard.

The following **minimum** specification shall be adhered for the following technical parameters:

Parameter	Specification
Form of separation	Form 3B
IP Rating	IP42

Fault rating	Withstand the maximum calculated fault current for 1 second
Spare Space	125% spare space or 2 three-phase spare spaces (whichever is greatest) for each frame size excluding main switch(es).
Connection	Bottom/Top/Back
Busbar rating	Busbars shall be rated to 125% initial load
Circuit Breakers	Air-circuit breakers to be used when frame size is equal to or above 1600 Amps, three-phase. Moulded case circuit breakers to be used when frame size is below 1600 Amps, three-phase.
Private Meters	Digital Power Analysers/meters shall have at least 0.5% accuracy for revenue and at least 2% for private usage.
Energy Authority Meters	Supply Authority meters to be provided to each tenancy to NSW Services and Installation rules.
Finishes	Internal Colour – White External Colour – Orange X15 to AS2700

8.4 Metering

Provide all metering panels, links, current transformers, protection devices and hardware to the requirements of the local Supply Authority and install within the main switchboard assembly.

The metering arrangement shall be as per client requirements.

8.4.1 NCC Section J

Separate busbars with individual private power meters for lighting, power, mechanical services, vertical transportation and central hot water services shall be provided to comply with NCC section J8. These have been diagrammatically nominated in the single line diagrams.

Where metering systems are provided, connections to BMS system including terminal strips shall be provided in switchboards. Co-ordination with the BMS Contractor shall be carried to ensure the adequate number of terminals and types are provided.

8.5 Construction

8.5.1 General

Switchboards shall be constructed in accordance with the manufacturers' prepared and approved workshop drawings, copies of which are required to be submitted for approval prior to commencement of manufacture. Switchboards shall be designed and constructed to fit within the allocated space.

Switchboard construction shall also comply with the following requirements:

- Machine folded and welded and reinforced for rigidity as required.
- Provide separate compartment with hinged, lockable door, for the mounting of equipment requiring attention for service and maintenance such as motor overloads, resets, contactors, time switches and control switches.
- Cubicles to be sized for easy access to and maintenance of equipment.
- Provide integral 75mm hot dipped galvanised rolled channel section plinth in high corrosive environments (such as close proximity to oceans, chemical exposure, etc.) toed out, with fixing holes.

- Stresses from lifting shall be transferred to the channel plinth via the switchboard structure.
- Provide a degree of protection of IP44 for installation in an internal location and IP66 for installation in an external location. All cable entries and switchboard cutouts shall not void the specified degree of protection.
- Switchboards shall not be installed in hazardous areas as defined in AS 2430.
- The short circuit protection and strength of each switchboard, including busbars and switchgear, shall be suitable to withstand the thermal and dynamic stresses of the specified short circuit capacity or as notified by the Supply Authority.
- Switchboards shall be constructed with the specified Form of Construction as required or as specified in the Electrical Services Drawings, and in accordance with AS/NZS 3439.1.
- Ensure that the switchboards are of vermin proof construction. Protect all bolts, nuts, washers etc., used in the construction of the switchboard against corrosion by means of electroplating. Use zinc plated and passivated hardware within the switchboard and chrome plated hardware where used on the visible face of the switchboard.

8.5.2 Factory Testing

- Switchboards shall be tested in accordance with the applicable parts of AS/NZS 3439.1. All instrumentation and associated controls shall be tested to prove their correct operation.
- Upon completion of the construction of the main switchboard and prior to delivering the board to site, arrange for an inspection to be carried out at the factory premise.
- Commission the main switchboard prior to delivery to site. This shall include calibration of necessary equipment, injection tests for all meters and set points for all adjustable devices etc.
- A copy of all tests performed and associated results shall be recorded and provided within the operations and maintenance manual.

8.5.3 Cable Entries

Provide cable entry facilities within assembly cable zones for incoming and outgoing power and control cabling. Provide sufficient clear space within each enclosure next to cable entries to allow incoming and outgoing cables and wiring to be neatly run and terminated, without unnecessary bunching or sharp bends.

For cable entry and internal distribution, provide cable entries of not less than 100 mm depth by the full width of cubicle space which is unrestricted by equipment or internal wiring.

Provide 150 mm maximum width cover plates butted together and covering the continuous cable entry slot. Provide removable gland plates fitted with gaskets to maintain the degree of protection.

Manufacturing materials shall be generally 1.5 mm thick steel, 5 mm thick composite material or laminated phenolic.

8.5.4 Doors

- Maximum Width: 800mm.
- Height: 2000mm unless where the door is bolted on lift off panels, where the maximum height would be 800mm for safety in design consideration.
- Minimum Door Swing: through 90 degrees.

- Hanging: Hang doors on heavy-duty chromium-plated steel hinges which allow easy removal of the door when in the open position.
- Door Hardware: Provide a chromium plated lever-type handle to each door, operating a latching system with latching bar and guides.
- Locking: Incorporate a cylinder lock in the latching system. All the locks of one installation shall be keyed alike.
- Number of keys required: 4.
- Dust Seals: Provide a resilient strip seal, of famed neoprene or the like, around each door, housed in a suitable channel or housing and fixed with an approved industrial adhesive.
- Seal contact: Indoor locations: Positive contact with a float surface of the enclosure at least as wide as the seal strip.
- Smoke Seals: Provide smoke seals to all switchboards and distribution boards.

8.5.5 Escutcheon Plates

Provide hinged removable escutcheon plates with neat cutouts for circuit breaker handles and the like. Fit chromium plated lifting handles or knobs to each escutcheon plate.

Provide a continuous 12mm wide support frame for the fixing of each escutcheon plate, including additional support where necessary to prevent panel distortion.

Fix each plate to the frame with metal fixings held captive in the plate and spaced uniformly.

Maximum dimensions: 900 mm wide and 1.2 m^2 surface area.

8.5.6 Terminations

- Provide removable 6mm aluminium gland plates for the glanding of all single core double insulated cables of rating 160 Amps or higher.
- Provide brass gland plates for the glanding of all MIMS cabling.
- Secure all steel and aluminium gland plates with zinc plated bolts and nuts.
- Fit all cable lugs and termination hardware to all internal switchboard wiring including switchgear prior to delivery to site.

8.5.7 Finishes

- Manufacturer’s standard semi-glass enamel, 2 coats quality baked enamel, to AS 2700-1996
- Internal Colour: White
- External Colour: Orange X15 to AS2700

8.5.8 Material

Where a switchboard shall be exposed to weather or subject to corrosion due to condensate and/or proximity to corrosive atmosphere (e.g. salt-laden air in coastal locations or polluted air adjacent heavy traffic), use zinc-seal sheet and ensure corrosion protection is maintained throughout the fabrication process.

Generally 2mm thick cold reduced, furniture grade, bright, low carbon steel sheet to AS 1595; front fascia panel to be minimum 2mm thick, removable panels of area not greater than 1m^2 shall be minimum 1.6mm thick.

8.5.9 Compartmentation

Provide compartmentation in accordance with the form of construction. Achieve compartmentation with physical metalwork barriers within the switchboard. Compartmentation shall be provided in the form of non-metallic barriers or other methods only to approval.

Segregate NCC emergency equipment from non-emergency equipment with metal partitions designed to prevent the spread of a fault from non-emergency equipment to emergency equipment.

Provide separate cable zones for switchboard where the loads are in excess of 300 Amps or where the cable surface area is larger than 50mm².

8.5.10 Ventilation

Required to maintain design operating temperatures at full load. Cover ventilation openings with non-combustible and corrosion resistant 1 mm mesh.

8.5.11 Storage

Provide suitable off-site storage until required and protect from elements at all times.

8.5.12 Layout

Position equipment to provide safe and easy access for operation and maintenance. Group devices by function.

Separate shipping sections, subsections, cable and busbar zones, functional unit modules and low voltage equipment compartments using vertical and horizontal steel partitions which suit the layout and form of separation.

Form 1 enclosures: Separate into compartments with partitions at 1.8 m maximum centres.

All normal operations from front of assembly. Provide facilities on at least one end for expansion of the switchboard in that direction.

8.6 Busbars

Connect all submain controls and other equipment by means of busbars. Cabling is unacceptable where the cables are likely to cause stress on the switch gear or protection device.

Material shall be high conductivity hard drawn rolled edge copper of uniform rectangular cross section to AS 2338 and AS 2067.

Select the cross sectional area of active and neutral busbars such that the busbar surface temperature does not exceed the following temperature rise limits:

- Maximum rated current temperature rise limits: 65 ± 1.5°C by type test or calculation to AS 3768 or AS 60890.
- Maximum short-circuit withstand current temperature rise limits: 160°C by calculation to AS 3865.

Cross section shall be rectangular. Remove sharp edges of rectangular busbar by filing the edge or use radiused edges.

Minimise the length of the busbar system where possible. The busbar arrangements shall be designed so that easy access to the entire system is available without the need for interrupting any component associated with the board.

Assemblies shall be type tested, four pole, air insulated with a continuous current rating not less than that specified in the design. Use of systems reliant upon extrapolation of type test data must be approved.

Submit calculations regarding extrapolation of type tested systems.

Provide cross sectional area of neutral busbars not less than that of the associated phase busbars. Neutral to be 100% size of active phase bars.

Phase and neutral busbars of the same distribution group shall be grouped together and shall utilise common penetrations in steelwork to minimise eddy currents. Support busbars securely by approved, type tested, proprietary epoxy resin insulators, moulded insulators mounted in metal frames or purpose made cleats fabricated of approved non-hygroscopic insulating material.

Provide cleats fabricated of high impact strength insulators of a temperature grade consistent with the calculated busbar temperature after sustaining a three-phase fault. Secure to supporting metalwork using not less than four bolts.

Provide connections from busbars to functional units by means of dedicated conductors, short time fault rated to the design fault level of the switchboard, as short as possible and rigid.

For design prospective fault levels greater than 30 kA, busbar joints to be adequate to withstand the fault levels of the switchboard. Single bolt connections may be considered for lesser duties.

All busbar sizes shall be confirmed by submission of test certificates and calculations as applicable. Submit all calculations for approval prior to manufacture such as type test certificated, heat rate of rise, current capacity ratings, etc.

8.6.1 Colour Coding

Provide 25 mm minimum width colour bands permanently applied to busbars at 500 mm maximum intervals with at least one colour band for each busbar section within each compartment.

- Active busbars: Red, white and blue respectively for the A, B and C phases.
- Neutral busbar: Black.
- MEN link: Green-yellow and black.
- Protective earth busbar: Green-yellow.

Do not provide adhesive type colour bands.

8.6.2 Busbar Covers

Provide busbar covers to comply with the requirements of the specified form of construction. To accommodate the use of thermal imaging inspection, provide infrared-transparent viewing windows in covers as required. Provide warning labels on busbar covers.

8.6.3 Fault Withstanding

Bus chassis fault ratings are to be determined by calculations, in the absence of such the following shall apply:

- 250A - 18kA for 0.3 sec.
- 300A - 20kA for 1.0 sec.

8.6.4 Earthing

Provide continuous copper earth bar running the whole length of the assembly, complete with Multiple Earthed Neutral (MEN) link.

Make provision for the connection of the communications earth terminal (CET) at switchboard earth bar to AS/CA S009.

8.7 Switchboard Equipment

8.7.1 General

All switchgear shall be rated for non-interrupted duty and for the fault capacity to match the housing switchboard, unless where fault current limiters have been installed for reducing the fault currents.

Assume the asymmetrical current peak as being 210% of the RMS symmetrical fault equivalent.

Where the fault capacity of the switchgear nominated is inadequate for the proposed duty, provide fault current limiting, HRC fuse protection in accordance with the switchgear manufacturers recommendations. Label HRC fuses used as fault current limiters as such.

8.7.2 Main Isolators and Combination Fuse Switches (CFS)

Provide main switches as required by the standards.

Fault make, load break with fault rating to match the peak fault current of the host switchboard and load rating to be not less than the certified load current rating of the supplied busbar chassis.

Provide manual interlocking to prevent closure concurrent with other control equipment.

Isolator operation shall be manual, independent of operator control.

Indication of contact position shall be independent of operator position.

8.7.2.1 Rating Classification

- Uninterrupted duty
- Enclosed
- Non-ventilated

8.7.2.2 Utilisation Category

- Not less than AC-21 for normal switching duty.
- AC-23 for motor starter duty

8.7.3 Moulded Case Circuit Breakers (MCCB)

MCCBs shall be of the current rating indicated on the single line diagrams and shall trip for conditions of circuit overload, and short circuit and comply with AS 3111 or AS 3439.1

8.7.3.1 Combination RCD

Where shown on single line diagrams or switchboard schedules, or to comply with AS/NZS 3000, circuit breakers shall also trip for residual current conditions. Provide separate indication for RCD trip.

Provide single phase RCBOs in a single pole-width package and 3-phase RCBOs in a maximum of a 4 pole width package.

8.7.3.2 Marking

Current rating and characteristic of circuit breakers shall be readily apparent, indelibly embossed on a visible part of the circuit breaker body when installed in a switchboard.

8.7.3.3 Operating and Mechanisms

Operating mechanisms shall be quick make, quick break, over centre type which are trip free. The contact position shall be positively indicated.

All poles shall open, close and trip simultaneously.

8.7.3.4 Tripping

Tripping characteristics shall incorporate inverse definite minimum time overcurrent and instantaneous functions, and shall be consistent with the circuit breaker mounted in any position.

8.7.3.5 Locking

Provide with capacity for locking in the “OFF” position. Fit a lock dog where indicated on the single line diagrams or switchboard schedule.

8.7.3.6 Remote trip

Provide with capacity for remote tripping. Fit a shunt trip where indicated on the single line diagrams. Extend trip circuit wiring to terminals, clear of power equipment.

8.7.4 Residual Current Devices

RCDs shall incorporate integral overcurrent protection.

8.7.4.1 Space

RCDs shall occupy not more than 2 poles of the chassis for single phase, 4 poles for three phase. DIN rail devices occupy additional 3 poles which total to 6 poles.

8.7.4.2 Trip Characteristics – General

RCDs should nominally trip at 30 mA of residual current.

Provide local indication of type of fault.

8.7.5 Air Circuit Breakers (ACB)

Provide air circuit breakers of current ratings and interrupting capacity shown, suitable for operation on the nominated supply system and in accordance with the single line diagram, rated for uninterrupted duty, enclosed (non-vented enclosure) operation.

8.7.5.1 Withdrawable

To be withdrawable, rack-in mounting, and interlocked so that racked isolation and re-insertion may only be accomplished with the circuit breaker in the “open” or “off” condition.

Racking shall incorporate three positions,

- An isolated position which isolates all main and auxiliary contacts,
- An intermediate position which isolates only the main current-carrying contacts, providing for the testing and commissioning of control and measurement circuits,

- The normal position with the main and auxiliary contacts engaged.

Back-frames installed for future installation of withdrawable circuit breakers shall incorporate safety shutters which prevent access to live contacts when the circuit breaker is withdrawn.

8.7.5.2 Closing

Provide with motor operated, stored energy closing mechanism.

8.7.5.3 Tripping

Provide solenoid operated shunt-trip mechanisms to suit the available auxiliary supply. Where external tripping supplies are utilised, provide positive indication of trip-supply being available. Non-availability of trip supply shall generate an alarm condition.

Where shown on the single line diagram, provide no-volt-trip solenoids, rated for continuous duty, to suit the supply voltage.

Operation shall be trip-free so that further attempts to close onto a fault tripped condition are prevented.

8.7.5.4 Auxiliaries

Provide at least two normally open, two normally closed, and one early-make, late-break auxiliary switches. All auxiliaries to be rated at a minimum of 230V, 10A and with the electrical operators, shall be wired to the auxiliary finger contacts of the withdrawable assembly.

8.7.5.5 Overcurrent Protection

Where shown on the single line diagram, provide relays to perform the following protective functions:

- Instantaneous overcurrent/earth-fault;
- Inverse/definite time overcurrent/earth fault;
- Directional/control overcurrent/earth fault;
- Restricted earth/frame fault; and
- Reverse power.

Protection relays not incorporating draw-out modules with C/T shorting contacts shall be provided with separately mounted test – links.

Induction disc protection relays shall be flush cubicle mounted case type, having single or multiple withdrawable elements, incorporating finger contacts. Auxiliary case mounted finger contacts shall short circuit any current transformer circuits when the element is withdrawn.

8.7.5.6 Tripping Battery and Charger

Where an auxiliary tripping supply is required, provide a fully automatic nickel-cadmium battery and charger suitable for 10 successive tripping operations of 4 Amps, at a duty cycle of 0.5/1.0 seconds, maintaining 80% terminal voltage.

Provide (minimum):

- DC Voltmeter
- DC Ammeter
- Pilot light indication of AC supply available; boost charge

- Alarm indication for remote monitoring of:
    - Charger fault
    - Battery Voltage Low
    - Battery Voltage High
    - Electrolyte Level Low

Provide power supply transformer, solid state rectifiers and filtering devices to generate smoothed DC trickle-charging current at the appropriate voltage to the battery.

Provide surge diverters to protect the battery charger against power supply surges. Circuit protection shall comprise moulded case circuit breakers for the supply and the DC load circuits. Each circuit breaker shunt trip solenoid shall be separately circuited.

8.7.6 Transfer Switches

8.7.6.1 General

Automatic and manual transfer switches shall be 4-pole, 3-pole where neutral is required.

3 pole transfer switches may only be used where in accordance with NSW Service and Installation Rules.

8.7.6.2 Manual Transfer Switches

Consist of a single assembly of fault-make, load-break isolators, mechanically interlocked to prevent the two isolators being closed at the same time. Volt free auxiliary contacts of each isolator shall be wired to terminal blocks for connection to the generator control panel for status monitoring.

8.7.6.3 Automatic Transfer Switches

Consist of a single assembly of two motorised circuit breakers complete with lever interlocking configured to prevent the two circuit breakers being closed at the same time. The circuit breakers shall also be capable of being manually operated.

Each circuit breaker shall be fitted with a shunt trip mechanism, volt free auxiliary contacts of each circuit breaker shall be wired to terminal blocks for connection to the generator control panel for status monitoring.

Transfer from failed normal supply to standby shall occur automatically upon the generator attaining required operating conditions of voltage and frequency.

Transfer from standby supply to normal supply shall be affected automatically when normal supply has stabilised.

8.7.7 Fault Current Limiters

Use only where shown on the single line diagram or to specific approval.

Proprietary 3 pole off-load LV disconnects fitted with DIN type fuses of rating not greater than recommended by the circuit breaker manufacturer for the fault level nominated. Mount disconnects to open in the direction of the operator.

8.7.7.1 Spares

For each switchboard, provide one spare set of 3, mounted in purpose made panel, of each configuration used in that switchboard.

8.7.8 Contactors

Shall be to IEC 60947-5-1 and incorporate the following features:

- Block type, air-break, electromagnetic.
- Rated for uninterrupted duty.
- AS-3 utilisation category, unless otherwise noted on the drawings.
- Provide contactors complete with accessories and auxiliary contacts as shown on the drawings.
- Where no auxiliary contacts are shown, provide at least 2 sets of changeover auxiliary contacts.
- Mount contactors by bolting to switchboard panel or where size permits, clipped to DIN-rail.

8.7.8.1 Changeover or Reversing Contactors

To be mechanically and electrically interlocked.

8.7.8.2 Rating

For the intended switching duty (minimum lighting switching and motor starting duty AC-7a DIN contactors in distribution boards).

Mechanical endurance to be Class 10, rated to 106 on-load operating cycles.

8.7.8.3 Noise

Contactor operating mechanisms shall be essentially noise-free in the energised state. Where contactors are mounted within enclosures or cupboards within or adjacent to normally occupied spaces, provide acoustic isolation to minimise the operating noise from contactors.

8.7.9 Control and Indication

Selector switches, push button switches, indicator lamps of the same type shall be of the same manufacture and series.

Current rating of contacts: 10 Amps minimum, AC 11.

Use IP65 protected devices in damp situations, such as plant rooms.

8.7.9.1 Selector switches

Rotary cam type, with engraved escutcheon plate, and knob or key operated actuators as shown on the drawings. ‘Test’ and other momentary contact positions shall spring return to the ‘off’ or neutral position.

8.7.9.2 Pushbuttons

Flush operator type, oil-tight, complete with knurled chromed brass retaining rings, not less than 22mm diameter, with plastic insert of colour as specified on the drawings. Pushbuttons switches used for emergency stop purposes shall be fitted with a large red mushroom head operator, with keyed reset action. Where shown on the drawings, pushbutton switches shall incorporate an integral indicating lamp.

8.7.9.3 Indicating LED

Flush type, oil-tight, complete with knurled chromed brass retaining rings, not less than 22mm diameter with removable coloured glass lenses, which permits changing LED from the front.

Provide with “push to test” facility.

Incorporate epoxy encapsulated, dual wound 230/12 V transformers, unless shown otherwise.

8.7.9.4 Control Relays

Suitable for continuous operation at the voltages required. Provide at least one spare changeover contact.

Industrial plug-in type, with front connected DIN rail mounting base. DC and AC relays shall not be interchangeable.

Provide gold-flashed contacts for switching of currents less than 1A. Otherwise provide silver-cadmium oxide contacts, of minimum continuous rating 10A, capable of making and breaking for 106 operations, the maximum currents which may occur in the circuits that they control.

8.7.9.5 Phase Failure Relays

Electronic type, suitable for detection of under-voltage (<85%), reverse phase sequence, and phase angle imbalance. Insensitive to frequencies of other than 50 Hz, supply surges, electromagnetic fields and ripple control signals.

8.7.9.6 Time Delay Relays

Pin-compatible with control relays of the same coil characteristics. Timing functions may be electro-magnetic, electro-pneumatic or solid state as appropriate. Label socket bases and time delay relays identically.

8.7.10 HRC Fuses

Shall be ASTA type test certified and incorporate the following features:

- Equal to English Electric “Red Spot”.
- Maximum fusing factor of 1.5 to BS 88.
- Rupturing capacity 80 kA.

8.7.11 Indicator LED

Comply with AS/NZS 3000 and incorporate the following features:

- Grouped LED lamps for higher voltage circuits. 240V rated lamp types are not permitted.

8.7.12 Private Metering

Multifunction digital meters shall be complete with RS232 & RS422 communication capabilities. The meters shall be capable of reading the following as a minimum:

- Phase to phase voltage (RMS and Peak)
- Phase to neutral voltage (RMS and Peak)
- Power factor
- Current (each phase separately)
- Distortion (%)
- Maximum demand
- KVars and KW

The meters shall be capable of recording information and storing it in RAM and shall be capable of downloading the stored information via its communication port to a remote PC.

8.7.13 Time Switches

Incorporate the following features:

- Be daily, seven day and yearly programmable.
- Battery reserve with 100 hour operating capacity.
- Microprocessor controlled.
- Manual over-ride.
- Multi-channel, minimum four (4) or 2 x 2 channel.

8.7.14 Cascading and Discrimination

The switchgear shall be selected to provide discrimination between all upstream and downstream devices.

Obtain from the Supply Authority the protection settings required for all adjustable protection devices to enable correct grading with the network protection.

In general, discrimination shall be arranged so that in the event of a fault, only switchgear immediately upstream of the fault shall operate to clear the fault.

Where switchgear is being used, discrimination shall be achieved between all devices and details of protection settings submitted with shop drawings shall include existing devices.

Allow to modify settings of protective devices on equipment within their capability to improve discrimination if necessary.

8.8 Labelling

Marking shall be in accordance with AS/NZS 3000 and include labels for each switchboard control, circuit designation and rating, fuses fitted to fuse holders, current-limiting fuses, warning notices for operational and maintenance personnel, and the like.

Labels shall be of two-colour laminated plastic or photo-anodised rigid aluminium. Warning notices shall have white letters on red background. Other labels shall have black letters on white background.

Lettering height shall generally be not less than the following:

- Switchboard designation: 25 mm.
- Main switches: 20 mm.
- Feeder control switches: 10 mm.
- Identifying labels: (on outside of cubicle rear covers, etc.): 4 mm.
- Equipment labels within cubicles: 3 mm.
- Warning notices: 10 mm for heading and 5 mm for remainder.

Screw-fix each label adjacent to its relevant item of equipment, but not on the equipment. Labels shall be aligned horizontally and vertically with adjacent labels.

Provide samples of proposed label material, label sizes, lettering sizes and lettering text for approval.

8.8.1 Labels on Assembly Exteriors

Assemblies shall be labelled with essential markings. Manufacturer's name is required. Provide designation labels stating source of electrical supply and identify separate sections of enclosures.

Label controls and fault current limiters, including the following:

- Circuit designation for main switches, main controls and submains controls.
- Details of consumer's mains and submains.
- Incoming busbar or cable rating to first tee-off.
- Fuse link size.

8.8.2 Labels on Assembly Interiors

Provide labels for equipment within assemblies. Locate so that it is clear which equipment is referred to and lettering is not obscured by equipment or wiring.

If circuit breaker manufacturer's markings are obscured by operating handle mechanisms or motor operators, provide additional markings open to view on or next to the circuit breaker.

8.8.3 Danger, Warning and Caution Notices

If polymer membrane coating for busbars is used without further insulation, provide warning notices on the front cover near the main switch or local main switch, and on rear covers, indicating that busbars are not insulated.

In assembly sections containing fault current limiter fuses, provide caution notices fixed next to the fault current limiters stating that replacement fuse links are to match as-installed fuse link ratings, make and characteristics. Provide a separate label stating fault current limiting fuse ratings.

To prevent accidental contact with live parts, provide warning notices for equipment on assemblies not isolated by the main switch or local main switch.

To prevent accidental switching off, provide caution notices for anti-condensation heaters.

For insulation or shrouding requiring removal during normal assembly maintenance, provide danger notices with appropriate wording for replacement of insulation shrouding before re-energising assemblies.

Locate notices so that they can be readily seen, next to or, if impracticable, on busbar chamber covers of functional units, and behind the front cover of functional units. Provide circuit identification labels in the cabling chamber of each functional unit, located next to external terminations.

8.9 Shop Drawings

Manufacturer's shop drawings shall be submitted to the Electrical Engineer for review.

Shop drawings shall, as a minimum, show the following information:

- Manufacturers' name and schedule of all equipment used
- Fault level
- Fully dimensioned general arrangement. This shall include equipment layout (doors and covers removed) plan
- Full details of construction with internal elevations and sections
- Busbar rating, layouts, support details and associated dimensions

- Details of all cables and connections
- Wiring schematics of instrument protection and control circuits
- Single line diagram and associated control drawings
- Label schedule including associated details, sizes and colours
- Prepare and submit for approval shop drawings before commencing manufacture or installation.
- Drawings shall be prepared using AS 1102 drafting standard symbols.
- Drawings shall be provided with a legend of symbols where applicable.
- Shop drawings shall all be on the same size drawing sheets and shall be to the scale of not less than 1:100 and larger where necessary.
- Three (3) copies of the shop drawings shall be submitted. Allow one (1) week for return of shop drawings with approval and/or comments. When requested amend shop drawings and resubmit.

Note that shop drawings are reviewed for general principle of design only of shop drawings by the Engineer in no way relieves the board manufacturer of his responsibility to comply with the requirements of this specification and associated drawings.

8.10 Testing and Commissioning

8.10.1 At Completion

Carry out pre-commissioning and commissioning in accordance with the approved ITP. Log all results and provide record of results in the O&M Manual.

Reparations shall include dismantling and abrading the identified joint(s), applying contact cleaning fluid and renewing associated hardware. Upon completion of reparation, re-inspect the switchboard as above and continue the process until a satisfactory result is achieved.

Immediately prior to the end of the Defects Liability Period, re-inspect the switchboard as above and follow the same procedure.

8.10.2 Schedule Cards

Provide schedule cards of minimum A4 size typed text showing the following as-installed information:

Mount schedule cards in a holder fixed to the inside of the assembly or cupboard door, next to the distribution circuit switches. Protect with hard plastic transparent covers. Cards should be non-yellowing and non-degrading in warm environments.

Typed schedule cards shall be provided for each switchboard within a hard plastic cover fixed to enclosure door. Typed schedule shall show the following (as a minimum):

- Incoming mains origin, size and circuit breaker rating
- Outgoing sub-mains designation, size and rating
- Sub-circuit number, rating, type and area supplied

8.10.3 Thermographic Survey

Arrange for a thermographic survey of all busbars, equipment and cable joints and connections within the main switchboard by an approved independent thermographic survey company prior to practical completion and also prior to the expiry of the defects liability period.

The dates of the survey shall be agreed and shall be conducted when electrical supply and loads are connected.

All results shall be submitted in the form of a detailed report.

All joints or connections requiring correction shall be amended and new thermographs shall be carried out to prove the necessary corrections.

8.10.4 On Site Testing

Switchboards shall be tested after erection for the following:

- Check all electrical terminations to ensure their tightness.
- Operation checks on all switchgear and switches.
- Test on all control circuits to prove correct operation of relays, timers, internal sequence interlocking, closing and tripping circuits etc.

Simulate all external devices as necessary during the proving tests as directed.

8.10.5 Deliverables at Completion

The following accessories shall be provided by the Contractor.

- Insulating rubber mat not less than 1,000mm wide running the full length of the switchboard;
- An authorised sign giving instructions, with illustrations, upon the treatment of persons suffering from electric shock;
- Glass fronted frame in which operating instructions and single line diagram are mounted
- Full size, A1, laminated as-built drawings for the main switchboard and single line diagram shall be mounted on the wall adjacent to the main switchboard, or other suitable location. As-built drawings shall, as a minimum, show the following information:
    - Manufacturers' name and schedule of all equipment used
    - Fault level
    - Fully dimensioned general arrangement. This shall include equipment layout (doors and covers removed) plan
    - Full details of construction with internal elevations and sections
    - Busbar rating, layouts, support details and associated dimensions
    - Details of all cables and connections
    - Wiring schematics of instrument protection and control circuits
    - Single line diagram and associated control drawings
    - Label schedule including associated details, sizes and colours
    - Drawings shall be prepared using AS 1102 drafting standard symbols.
    - Drawings shall be provided with a legend of symbols where applicable.

- As-built drawings shall all be on the same size drawing sheets and shall be to the scale of not less than 1:100 and larger where necessary.

9. POWER FACTOR CORRECTION

9.1 General

The following is relevant if there is no existing Power Factor Correction (PFC) installed for the facility, or insufficient to achieve 0.9 lagging power factor.

Supply, deliver, install and commission a new single, centralised low voltage PFC unit and connect to the electrical system. This unit shall be designed to improve the power factor of the premises to a minimum of 0.9 lagging or better, complete with all wiring and associated control equipment.

The PFC shall have the following:

<200 kVAr in 25 kVAr, or >200kVAr in 50 kVAr steps

The PFC cubicle shall be capable of housing expanded capacity up to 50% of rated capacity without major alteration or additions, other than additional module(s).

All PFC equipment/capacitors shall be designed and installed in such a way as to eliminate any resonances or resonant amplification of voltages and currents.

Current transformer installation into the main switchboard shall be coordinated and the associated wiring installed before the main switchboard is energised.

9.2 Standards and Regulations

The following standards and guidelines are applicable to this scope of works:

Reference	Name
IEC 60831 Parts 1 and 2	Shunt power capacitors of the self-healing type for a.c. systems having a rated voltage up to and including 1000 V
AS/NZS 3000:2007	Electrical Installations: Wiring Rules
AS/NZS 3000:2008 Section 4.15.3.3	Control of capacitor bank discharge
AS/NZS IEC 61439	Low-Voltage Switchgear and Controlgear Assemblies
IEC 61921	Power Capacitors

9.3 Submissions

9.3.1 Operation and Maintenance Manuals

Provide all operational and maintenance documentation necessary to operate and maintain the systems installed in accordance with AS/NZS 4509.1.

9.3.2 Shop Drawings

Submit shop drawings to a scale that best describes the detail, showing the following:

- The system general arrangement and layout with details of connections, circuit breakers, cable sizes, overall dimensions, weight, location of access doors, cable terminating locations and necessary clearances.
- Control schematics. A description of operation with all control schematics.

- Functional block diagram.
- Heat generated by the PFC.
- Type and rating of all equipment items.

9.4 Performance Requirements

The PFC unit shall meet the following design criteria:

Criteria	Requirement
Operating Voltage	400V, 50Hz, 3 phase
Equipment Rating	Capacitors, cables and contactors are capable of operating at: • 10% overvoltage for 8 hours over 24 hours • 20% overvoltage for 5 minutes daily • 30% overvoltage for 1 minute due to harmonics
Capacitors	Insulation voltage: 3 kV Rated impulse withstand voltage: 8 kV Design life: 15 years
Contactors	Specially designed for 3 phase capacitor switching Complies with: • IEC 60947-4-1, according to AC-6b utilization category • IEC 60070 and 60831 • UL, CSA and CCC certified
Maximum Power Dissipation	• 8 – 9 W/kVAr for capacitor bank (incl. detuned reactor) • < 0.5 W/kVAr for power capacitor (incl. discharge resistor)
Operating Temperature	The unit shall be able to operate within the following temperature conditions, as per IEC 60439-1: • Average temperature: +35°C, over 24 hours • Minimum temperature: -5°C • Maximum temparature: +40°C
Mechanical Ventilation	Thermostatically controlled forced-ventilation to maintain a temperature <50°C within the cubicle

9.4.1 Electrical

The equipment shall be sized to provide the most suitable reactive power compensation with an optimised electrical steps configuration made up with a combination of 12.5 kVAr, 25 kVAr or 50 kVAr steps. The smallest physical steps shall be about 10% of the PFC unit rating. Size of any individual step shall not exceed 100kVAr.

Paralleling of capacitors shall not be done at the capacitor terminals. Each physical step shall be fitted with a 7% 190Hz detuned reactor. Each physical step shall be fitted with a means of isolation and protection using a HRC fuse, isolator or MCCB.

The equipment shall be electrically isolated at one single point within the cubicle. The equipment shall be isolated upon generator supply through the provision of terminals for volt-free signal. An adequately sized neutral cable needs to be provided to the PFC unit. A copper earth bar will be provided for connection effectively earthing all modules and enclosures.

9.4.2 Mechanical

The PFC unit shall be of a modular design using functional trays for easy replacement and expansion. The unit shall comprise of a stand-alone floor standing enclosure. Provision shall be made to allow the supply cable to enter from the top or bottom to connect to the supply conductors (or busbars) within the cubicle.

Cubicles must be able to be bolted to each other side by side for future expansion. The gland plates shall be in aluminium and be removable by means of unbolting.

The following general mechanical requirements are applicable to the PFC unit housing.

- Enclosure frame: 1.25 mm thick steel.
- Enclosure cover panels: Sheet steel, thickness; side and rear panel 0.8mm, door 1.25 mm
- Overall Dimensions (single tier): 2100 mm X 650 mm 600 mm (H X W X D) up to 250 kVAr
- Degree of protection: IP31 internal, IP56 external.
- 12 microns thick anti-corrosion epoxy electrophoresis treatment
- 40 microns thick thermosetting, polyester-resin-modified epoxy coating of orange RAL 2000 colour, satin finish.

9.4.3 Capacitors

The power capacitor shall be fully compliant to IEC 60831, Parts 1 & 2, in 12.5, 25 and 50 kVAr rating. Its power loss shall be < 0.2 W/kVAr at the dielectric and < 0.5 W/kVAr for the complete capacitor unit including the discharge resistor, with a residual voltage < 50 V after 60 seconds.

The discharge resistor shall be factory fitted and non-removable without mechanically disassembling the unit and electrical connections. The capacitor shall be equipped with a HRC cartridge fuse for high current fault protection, non-reversible internal pressure sensitive disconnector and must be self-healing.

The capacitor shall be in an extruded aluminium can casing with a metalized polypropylene film with Zn/Al alloy and a non-PCB, dry sticky resin impregnation. It shall be mountable, indoor, upright and horizontally.

The capacitor voltage shall be 525 V AC continuous. The capacitors shall be capable of withstanding the following overvoltage levels:

- 1.10 x Rated Voltage: 8 hours daily
- 1.15 x Rated Voltage: 30 minutes daily
- 1.20 x Rated Voltage: 5 minutes daily
- 1.30 x Rated Voltage: 1 minute daily

The capacitor overcurrent withstand capability shall be up to 1.8 x rated current. The capacitor tolerance shall be -5%, +10%. The capacitor shall be able to withstand a peak inrush current of 250 x rated current and capable of

handling up to 7,000 switching operations per year. The capacitor mean life expectancy shall be up to 130,000 hours and capable of operating at ambient temperature between -25°C and +55°C.

9.4.4 Contactor

The Contactor shall be specifically designed for switching 3-phase, single or multiple-step capacitor banks. The contactor shall comply with IEC 60947-4-1 according to AC-6b utilisation category for 400V, 50/60Hz.

The Contactor shall be equipped with a block of early make poles and damping resistors (fitted externally) limiting the value of the current on closing to 60 x I_n max. The contactor shall not be operable for manual switching and the damping resistor shall not be removable.

The Contactor shall have a maximum operating rate of at least 100 operating cycles per hour and an electrical durability of 300,000 switching operations at nominal load at 400V.

9.4.5 Alarms

An audible and visual alarm system shall be provided to indicate PFC unit failures. This shall be located on the power factor correction unit and be capable of interfacing with other systems (e.g. fire indicator panel, security panel etc.) as required. Alarm system shall indicate the following types of failures:

- Failure to achieve target power factor
- Mains failure
- Over temperature
- PFC unit not functioning

9.4.6 Power Factor Controller

The power factor controller (PF controller) shall carry out the automatic switching of each capacitor step until the target power factor is achieved. It shall be panel or DIN-rail mountable, rated IP41 front panel with a backlit display. The controller shall offer automatic detection of C/k setting, list at least 5 last alarms, provide step counters on the front display and accept a secondary CT setting of 1 or 5A. The controller shall have a nominal power consumption <15VA.

The PF controller shall have a reaction time > 15ms for power outage detection and provide a reconnection delay setting between 10 to 900s. It shall have a target cos-ϕ ranging from 0.85-inductive to 0.9-capacitive. The PF controller shall provide a thermostat for temperature control. It shall also have a temperature limit to safely shut down the PFC unit for internal temperature rise above permissible levels.

PF controller shall be capable of accepting 12 capacitor steps, provide a master-slave arrangement for parallel connection in a multi-PFC units application and be suitable for use in a power generation application. The controller shall be able to automatically detect the CT polarity.

The PF controller shall accept the following stepping sequences:

- Linear (stack program) – all capacitor steps are equal following a LIFO principle – 1.1.1.1
- 2+ Linear (normal program) – step ratio 1.2.4.4
- Circular program – all capacitor steps are equal following a FIFO principle – 1.1.1.1
- 1+ Circular program – step ratio 1.2.2.2
- Optimal program – step ratio:
    - 1.1.1.1.1

- 1.1.2.2.2
- 1.1.2.3.3
- 1.1.2.4.4
- 1.2.2.2.2
- 1.2.3.3.3
- 1.2.3.4.4
- 1.2.3.6.6
- 1.2.4.4.4
- 1.2.4.8.8

Additionally, it shall display the following electrical parameters:

- Frequency
- Input Voltage
- Capacitor steps
- Temperature
- THD voltage and current
- Measured cos-ϕ, kVAr, kW, kVA, kA
- Number of steps and connection times

The controller shall have on-board MODBUS communications capabilities allowing integration in an energy management system or equivalent. The MODBUS control module shall accept a daisy-chain like connection through RS485 or RS-232, 2 or 4-wire. It shall also provide the following information:

- Number of connections by step
- Voltage harmonics measured for 3rd to 21st order
- Cos-ϕ sign for the direction of power flow

9.4.7 Harmonics

The PFC unit shall be equipped with detuned reactors to protect the capacitors against harmonic currents. The detuned reactors shall be connected in series with the capacitor bank for each step and sized appropriately to avoid any resonance.

The detuned reactor shall be of tuning order of 3.8 (190 Hz) with impedance not less than 7% of the associated capacitive reactance. It shall also comply with the following requirements:

- Compliant with IEC 60289
- 3-phase, dry, magnetic circuit, impregnated
- Thermal protection against overtemperature
- Insulation level: 1.1kV
- Insulation Class H

- Suitable for 400 – 415V, 50Hz network
- Inductance tolerance per phase: ±5%
- Operating temperature 35°C average over 24 hours, 40°C max.

9.4.8 Cooling

The cubicle will have forced cooling by thermostatically controlled ventilating fans 240 V with filter. Ventilation hood present on the roof.

Air flow-rate per fan: ≥ 300 m^3/hr

Air natural and air forced grill vents to minimize hot spots.

9.5 Testing and Commissioning

All final testing and commissioning, including measurement of harmonics, shall be carried out by the PFC equipment manufacturer.

9.6 Warranties

Provide 24 month warranty with six monthly service.

10. LIGHTING

10.1 General

The Contractor shall source, supply, deliver to site, store, assemble where required, install, test, clean and commission luminaires and control systems for the project.

The Contractor shall be responsible to procure all light fittings to meet the construction programme. At the commencement of the project the Contractor shall confirm all lead times with the supplier prior to procurement, and notify the design team of the lead times. Products that are identified to have a long lead time shall be procured early in the construction phase to ensure that the construction program is not jeopardised by late deliveries.

Generally, the following requirements apply to all lighting installations:

- Luminaires shall be of the type specified.
- Luminaires shall suit the application and satisfy installation requirements of ceiling type, available ceiling space, ambient temperature, required IP rating, required IK rating, additional support requirements etc.
- Luminaires shall be mounted regularly and uniformly in straight lines with respect to positioning of other lights and the ceiling architecture including consideration of ceiling types and heights. If unsure of a final location, confirmation is to be sought before any work commences.
- Have new lamps, suitable control gear mounting plates, chassis, diffusers, suspension kits and reflectors thoroughly cleaned just prior to handing over of the installation.
- Ensure that there are no light leaks and there are no loose internal or external cables that may cast a shadow on the light fitting.

It is the Contractor's responsibility to provide suitable storage space for the luminaires in secured, dry and well ventilated storage space. Any damage to the light fittings after delivery shall be rectified by the contractor. If necessary, all damaged stock shall be replaced with new.

The Contractor shall be responsible to guarantee the manufacturers' listed lamp life for every type of lamp installed in the project. The lamps' operational lamp life shall commence with 100 hours of initial operation (burning in).

If the Contractor chooses to use the newly installed luminaires as temporary lighting or lighting for construction purposes, lamps used as such must be replaced before practical completion in order to guarantee the manufacturers' listed lamp life.

Note: Manufacturer's names and catalogue numbers quoted in schedules may have changed since issue of documentation. Confirmation is to be sought before ordering if the written description does not match the product code.

10.2 Standards and Regulations

The following standards and guidelines are applicable to this scope of works:

Reference	Name
AS/NZS 60598.2.19	Air-handling luminaires
AS/NZS CISPR 15	EMC compliance and Radio Interference Limits

AS 4282	Control of the obtrusive effects of outdoor lighting
AS/NZS 4783.2	Energy efficiency for ballasts and lamps
AS/NZS 60598.2.1	Fixed general purpose luminaires
AS/NZS 60598.2.5	Floodlights
AS/NZS 61000.3.2	Harmonic limits
AS/NZS 1680 series	Interior lighting (All parts)
AS/NZS 1158 series	Lighting for roads and public spaces (All parts)
AS/NZS 3827 series	Lighting system performance (All parts)
AS/NZS 60598.1	Luminaires, general requirements and tests
AS/NZS 60598.2.25	Luminaires for use in clinical areas of hospitals and health care buildings
AS/NZS 60598.2.2	Recessed luminaires

10.2.1 Minimum Energy Performance Standards (MEPS)

To AS/NZS 4782.2 and AS/NZS 4783.2 and AS 4934.2.

The minimum energy performance standard (MEPS) level for a particular ballast-lamp combination is the maximum permitted corrected total input power of a ballast-lamp circuit specified in AS/NZS 4783.2. Clause 6.4 specifies a minimum energy performance standard (MEPS) for combinations of ballasts and type FD lamps.

10.3 Interpretations

10.3.1 Abbreviations

The following abbreviations are applicable to this specification section:

Abbreviation	**Description**
CCT	Correlated colour temperature.
CFL	Compact fluorescent lamps.
CRI	Colour rendering index.
DALI	Digital addressable lighting interface.
EEI	Energy efficiency index.
ELV	Extra low voltage.
EMC	Electromagnetic compatibility.
HID	High intensity discharge.
LED	Light-emitting diode.
PIR	Passive infra-red.
RCD	Residual current device.
UPS	Uninterruptable power supply.

10.3.2 Definitions

The following definitions are applicable to this specification section:

Term	Description
Control System	A lighting control system comprising a combination of some or all of the following: • Manual switches • Automatic sensing and control components. • Timers. • Manual overrides. • Programmable lighting control systems
Proprietary Luminaires	Luminaires available as a catalogue item.
Custom-built Luminaires	Luminaires designed, manufactured, wired and tested to order.
Desk Height	Means nominally 750mm AFFL *Note: Confirm with architect.*
LON	Arc Dimming Level (%) of the luminaires in a room/area upon activation by a switch or motion sensor to achieve the illuminance outlined by Section 10.5 of this specification. (LON=Lights On Level).
LMIN	Minimum permissible Arc Dimming Level (%) of the luminaires in a room/area.
LMAX	Maximum permissible Arc Dimming Level (%) of the luminaires in a room/area.
Override Sequence	A list of control scenarios to be executed after a specified delay, normally when a room is unoccupied.
Input Profile (IP0x)	A set of DALI commands, override sequences and scenes active during a particular predefined time of day.

10.4 Design Requirements

The design of lighting systems is a specialist task and shall be undertaken by the Design and Construct Contractor. The system shall be designed to achieve the recommended illumination levels outlined in Section 10.5, AS/NZS 1680, AS/NZS 1158, the Development Application requirements and all other Client or conditional requirements associated with this project.

The overall design produced by the Contractor shall comply with the design brief, this Specification, all relevant Australian Standards, and the current edition of the NCC. Furthermore, the Contractor shall liaise with the Architect and all other trades in producing a design that is fully coordinated with all other building systems and services.

Guidance is provided by the following standards:

- The AS/NZS 1158 series (Parts 0, 1.1, 1.3, 3.1 and 4) for public lighting of roadways, pathways and circulation spaces.
- The AS/NZS 1680 series (Parts 0, 1, 2.1, 2.2, 2.3, 2.4, 2.5 and 3) for interior lighting. AS/NZS 1680.0 is cited in the NCC as this applies to interior lighting for safe movement.

- AS/NZS 3827 (Parts 1 and 2) provides guidance on lighting system performance and the methods to be used to establish compliance.
- AS/NZS 4282 - Control of the obtrusive effect of outdoor lighting.
- Section J6 of the NCC for energy efficiency measures.

The Contractor shall complete and submit to the Electrical Engineer a lighting calculation, detailing, at minimum: lux levels including visual lux plots, lighting power density and upwards waste light ratio (for external lighting). The Contractor shall liaise with the Architect to determine surface/finish reflectance values used to prepare the calculations.

10.4.1 Internal Lighting Performance Brief

Internal lighting shall be selected as appropriate for use to suit the individual areas requirements. Ie. General areas, accommodation blocks. Refer to table in Appendix A for details.

The design of lighting shall incorporate the following;

- Take advantage of daylight where and when possible.
- Lighting layouts are to allow flexibility for multi-use and adaptability for changing area function.
- Ensure the accessibility of light fittings for maintenance.
- Provide general lightings levels complying with the Australian Standards as a minimum, with task lighting for special function higher lighting levels where necessary.
- Light fittings in stairwells are to be wall mounted for easy maintenance.
- Timer switches or automatic sensors shall be used for energy saving, except where VMD cameras are in operation.
- Vandal proof where appropriate.

10.4.2 External Lighting Performance Brief

External lighting shall be selected as appropriate for use to suit the individual areas requirements. Ie. Perimeter fencing, general areas, carparking. Refer to table in Appendix A for details.

The design of lighting shall incorporate the following;

- Ensure the accessibility of light fittings for maintenance.
- External light fittings to be vandal proof design.
- Selection of fittings and light placement to consider light spillage into cells.
- Timer switches or automatic sensors shall be used for energy saving, except where VMD cameras are in operation.
- Perimeter security lighting is to illuminate the base of the wall to 10 lux with minimal variation.
- Carpark luminaire mounting heights are to be 5-6 metres with maximum spacing of 4 times the mounting height.
- Light poles are to be base plate mounted to allow easy relocation or replacement.
- Locate light poles to avoid impact from vehicles.

- All exterior areas shall be designed to comply with varying classifications of AS/NZS 1158.3.1 Pedestrian Area (Category P) Lighting.
- The main entrance shall be illuminated to AS/NZS 1158.3.1 Category P7. This provides a brightly lit, welcoming environment to create a feeling of safety and accessibility, whilst enhancing the prestige of the building.
- All interconnecting elements such as walkways and stairways shall be lit to Category P9 as a requirement of AS/NZS 1158.3.1.
- All other perimeter lighting shall be provided to achieve the minimum safety levels of lighting.
- All exterior luminaires shall be selected to achieve IP65 external grade classification or higher.

10.5 Internal Lighting Levels

The lighting arrangement shall be designed and installed to meet the following light levels:

Space	**Lux Level**
Car Park Entrance, Daytime, First 15 m	800 lx
Car Park Entrance, Daytime, Next 4 m	160 lx
Car Park Entrance, Night-time	160 lx
Car Park Bays & Circulation	40 lx
Foyer/Lobby	160 lx
Amenities	80 lx *Note: Toilets can be 40 lx*
Kitchen	240 lx
Storage	80 lx *Note: Dead Storage can be 40 lx*
Office Workplane	320 lx *Note: Beware of Green Star*
Plant Rooms (excluding Electrical Switchrooms)	80 lx
Fire Control Room	400 lx
Electrical Switchrooms	160 lx
Communications Room	400 lx
Circulation Spaces	160 lx
Fire Stairs	80 lx

10.6 Submissions

In accordance with the General Requirements of the Specification, the Contractor shall submit operational and maintenance documentation necessary to operate and maintain the equipment and systems installed. Specific to the lighting installation, the Contractor shall also submit the following:

10.6.1 Technical Data

For all light fitting installations, submit technical data for:

- Lamps

- Control gear
- Accessories
- Mounting details
- Paints
- Warranties and level of cover

For all LED type light fittings, the following additional technical data requirements apply, and shall be submitted in conjunction with the above:

- Light Output (lumen output of the fitting - not just the LED light source but the fitting as a whole)
- Luminous Efficacy (measured in Lumens/watt)
- CCT
- CRI
- Polar Curve
- Life
- Thermal management
- Binning
- Power Factor

10.6.2 Calculations

As part of the Design & Construct contract requirements, the Contractor shall submit a complete set of lighting calculation drawings as detailed in Section 10.4 of this Specification.

10.6.3 Shop Drawings

Submit workshop drawings, at minimum, for the following items and installations. The Contractor shall also submit any shop drawings for further items and installations that are deemed necessary to the project.

- Nominated type of light fittings
- Mounting height and location of all light fittings
- Custom made luminaires
- Custom made light/artworks
- Light poles and finishes
- Light brackets
- Suspension rods or hangers
- Footing cage details
- Lighting column mounting bases

10.6.4 Samples

The Contractor shall submit samples for all specified luminaires and accessories except any custom made luminaires and/or specialist or artistic lighting works.

10.7 Custom Made Luminaires

Select, design and provide luminaire housing, reflectors, accessories, lamps and control equipment which allow the lamp(s) to achieve the performance given in the lamp manufacturer's published data sheets. The luminaire shall achieve MEPS in accordance with Clause 10.2.1 of this Specification.

10.7.1 Specific Submissions

10.7.1.1 Design Drawings and Briefing Documents

Contractor shall examine the design drawings and familiarise with the design intent. The sketches for the custom made luminaires do not indicate the exact dimensions, manufacturing process, mounting details and assembly details of the custom made luminaires.

It is the specialist lighting manufacturer's responsibility to design the luminaire fit for purpose, suitable for the installation whilst maintaining the design intent.

The manufacturer shall examine the interior designer's sketches, rendering, images of the space to be lit, the architectural drawings, elevations, sections, building details etc. prior to commencement of the design work.

Contractor shall contact the designer if any of the briefing information on the tender document requires clarification.

10.7.1.2 Shop Drawings

Submit shop drawings of custom-built luminaires showing dimensions of equipment, mounting details, location of accessories, details of materials and wiring. Provide colour images and 3D renders.

10.7.1.3 Prototyping and Development

Provide a prototype of each custom made luminaire for review and approval before manufacturing. Give sufficient notice so that inspection may be made of the custom-built luminaires in the workshop.

10.7.1.4 Technical Data

Submit photometric data if requested for each type of custom-built luminaire, to standard AS 1680.3.

Provide a test certificate for each custom-built luminaire type.

10.7.2 Construction

Provide materials, body shape and methods of manufacture so that luminaires neither warp nor sag when installed. Ceiling trim provision for recessed mounting in suspended ceilings shall be designed to AS 2946. Moulded plastic bodies for exterior use shall be UV stabilised.

10.8 Installation and Wiring

All internal cabling shall be high temperature rated. Connections to building wiring must be in accordance with AS/NZS 3000. Cable entry points shall be protected to prevent any damage to the cable.

10.8.1 Supports

Install luminaires on proprietary supports by means of structurally sound timber support to support the light fitting weight including 50% spare load capacity in all battens, trims, noggings, roses and packing material.

10.8.2 Suspended Luminaires

Install suspended luminaires to the heights as nominated in the drawings. Verify the suspension height with the Client before installation. Cabling to the light fitting must be concealed, exposed cables will not be acceptable.

All suspended luminaires must be securely fixed using the one of the following methods and as specified on the lighting legend:

- **Rods:** Steel pipe suspension rods fitted with gimbal joints to support the weight of the light fitting, with 50% spare load capacity.
- **Chains:** Electroplated welded link chain to support the weight of the light fitting, with 50% spare load capacity. (Where electrical supply cables are fixed to the suspension chain and exposed the supply cables shall be double insulated and protected with external decorative cover and securely fixed to the suspension chain by means of suitable cable ties as per the manufacturer's recommendations. Minimum 300mm spacing shall be applied between fixing points unless the manufacturer advises otherwise.
- **Levelling wire:** Stainless steel, appropriately sized to support the weight of the light fitting.

Adjust the suspension system length so that the lighting system is level and even. A horizontal tolerance of ± 3 mm between luminaires within the one space will be permitted.

10.8.3 Surface Mounted Luminaires

Fit packing pieces to level luminaires and prevent distortion of luminaire bodies. Provide packing strips to align end to end luminaires.

Provide 2 fixings at each end of fluorescent luminaires. A single fixing at each end in conjunction with 1.6 mm backing plates may be used for narrow luminaires.

Surface mounted luminaires shall:

- Where wider than 150mm, be fixed with two anchor type fixings at each end of the luminaire.
- Be fixed to suspended ceilings by masonry screws, appropriately sized to carry the weight into timber battens or rafters.
- Be fixed to the primary ceiling by appropriately sized masonry screws.
- Fixing to suspension rails using "Caddy" clips may be accepted only subject to approval.

10.8.4 Recessed Luminaires

Provide recessed luminaires with an external ≥ 1.5 m length of 0.75 mm^2 3-core V75 (minimum) PVC/PVC flexible cord, connected to a 10 Amp 3-pin moulded plug connected to the building wiring and fixed to the building structure, and not to catenaries or ceiling suspension. Plug adapters are not acceptable for this purpose.

Recessed downlights having larger than 200mm diameter trims must have three fixing brackets to avoid dislodgment of the downlights from the ceiling panel or ceiling tile.

10.9 Ballasts

10.9.1 General

All luminaires in the installation which utilise electronic ballasts shall conform to the minimum performance standards as outlined below.

10.9.2 Electronic Fluorescent Lamp Ballasts

Provide electronic fluorescent lamp ballasts for fluorescent lamp lighting systems selected for compatibility with the lamp and control method. Provide separate ballasts for each lamp or integral dual ballasts as an alternative for dual lamp fittings. Ballasts should utilise soft-start technology to reduce power draw on energisation.

Ballasts must meet the minimum specified EEI of “A2” when tested in accordance with AS 4783.1. Ballasts must be marked with their EEI rating. The ballast model must meet the performance requirements set out in AS/NZS 61347.2.3 and AS/NZS ISO 60929.

Power factor of the ballasts shall be 0.9 lagging or better with total harmonic distortion (THD) not greater than 15%.

10.9.3 Electronic Fluorescent Dimming Ballasts

In addition to the above requirements, electronic fluorescent dimming ballasts shall be capable of the following:

Use a high frequency (>25kHz) electronic ballast providing flicker free dimming of T8 (26mm) triphosphor lamps, TC-L, TC-DEL and TC-TEL compact fluorescent lamps and T5 (16mm) tubular fluorescent lamps.

Provide a dimming range of 100% down to at least 10% with the lamp capable of striking at any level.

Power factor of the ballast is to be better than 0.9 lagging at any level of dimming.

Provide digital control with minimum of 200 steps from maximum to minimum levels using a control module capable of controlling up to 100 ballasts.

Ballast failure rate is to be no more than 10% of sample at 100,000 hours at operating temperatures up to 600°C.

10.9.4 HID Ballasts

Provide ballasts for lighting systems selected for compatibility with the lamp and control method.

High-pressure mercury vapour, low-pressure sodium vapour, high-pressure sodium vapour and metal halide type ballasts shall conform to AS/NZS 61347 and AS/NZS 60923.

The ballast specified for metal halide type luminaires shall be:

- ≤ 150 W: Reactors or electronic controlgear.
- > 150 W indoor: To the lamp manufacturer’s recommendation.
- > 150 W outdoor: To the lamp manufacturer’s recommendation.

If documented, provide igniters which cut out when lamp ignites and after pre-determined time period if lamp fails to ignite. If required, provide instant restrike igniters for instant restart of suitable HID lamps to the manufacturer’s requirements.

10.10 Lamps

10.10.1 Colour Temperature

All lamps shall be of the colour temperature specified in the design drawings, with a tolerance of one MacAdam Ellipse. If the specified colour temperature is not available for any reason the contractor shall submit an RFI to determine an appropriate alternative. Under no circumstances will substitution of lamps with a different colour temperature be permitted.

10.10.2 Colour Rendering

Unless stated otherwise, all compact HID, halogen, fluorescent and LED lamps shall have a Colour Rendering Index (CRI) of greater than 80.

10.10.3 Luminous Efficacy

The luminous efficacy for all lamps shall be greater than 75 lm/W at 25°C.

10.11 Controls

10.11.1 Lighting Switches

Lighting switches shall be rated at 15 A, 250 V, with mechanisms in accordance with AS 3133.

Lighting switches in all areas denoted adaptable, accessible, or accessed by seniors or persons with reduced mobility, shall be horizontally aligned with door handles and other controls not less than 900 mm and not more than 1100 mm above the plane of the finished floor, and not less than 500 mm from internal corners.

Internally installed light switches in general areas shall be a standard recessed flush plate type, unless architrave type specified, with removable clip style cover plate and indicator and be equal to Clipsal C2000 Series, of colour selected by Architect, unless noted otherwise. Lighting switches shall be mounted generally at 1100 mm above the plane of the finished floor, unless noted otherwise.

Wall plates within accommodation blocks are to be tamper proof stainless steel.

External/weatherproof light switches shall be IP56 wall mounted type, rated at 15 A, 250 V, with mechanisms in accordance with AS 3133 and be equal to Clipsal 56 Series, unless noted otherwise.

10.11.2 Multi-Gang Light Switch Panels

Multi-gang switch panels shall be of a brushed stainless steel finish, minimum 1.6mm thick and be fully engraved with black infill lettering to the Client's approval. Lighting switch panels shall be mounted generally at 1100 mm above the plane of the finished floor, unless noted otherwise.

All multi-gang switch panels shall be fixed to approximately sized, flush mounted, metal wall boxes.

10.11.3 Motion Sensors

Occupancy sensors shall be;

- Infra-red sensing type.
- Ceiling recessed where possible.
- Capable of providing coverage to the usable floor area of the room in which they are installed.
- Installed in series with lighting to be controlled.

- 180° or 360° sensing spectrum, as nominated on drawings.
- Complete with time settings from 5-30mins (minimum).
- Installed with additional channel to be interfaced with mechanical exhaust fan where required.
- Where switching of loads exceeds 10 A, relays or contactors shall be used.

10.11.4 Photoelectric Cells

Photoelectric Cells (PE Cells) shall be supplied, installed and programmed to the Client's requirements. Contractor is to locate PE Cells to minimise shadowing from existing and future obstructions including structures and vegetation.

PE Cells shall be:

- Complete with timer functionality to automatically switch off lights at a set time interval, in 2 hour blocks, from initial activation (i.e. sunset).
- Programmable to vary activation based on light intensity threshold, from 20 lux to 500 lux.
- IP66 rated.

10.11.5 Time Switches

Digital Time Switches shall be supplied, installed and programmed to the Client's requirements. Contractor to confirm all time switch settings with Client on site prior to handover. Time Switches shall be DIN-rail type, installed in the local switchboard/Clipsal 56 Series type, internally or externally mounted in a location agreed with the client.

Time Switches shall be:

- Programmable:
    - To allow events to occur on a specific day of the week, weekdays, weekends or all days of the week.
    - For a period ranging from 1 minute to 24 hours.
- Complete with 150 hour battery backup to preserve time switch settings in the event of power loss.
- Complete with a "Daylight Savings Time" mode switch button.

10.11.6 Time Delay Switches

Time delay switches equal to Clipsal 31/2031VETR3 shall be installed where documented. Contractor to confirm all time switch settings with Client on site prior to handover.

Time delay switches shall be programmable to allow the following:

- Time setting selectable from 10 seconds to 15 hours.
- High timing accuracy (0.5%)
- Configurable modes of operation (contactor open during timing or contactor closed during timing)

10.12 Power Factor Correction

All luminaires shall achieve a power factor of not less than 0.9 lagging after two hours of continuous operation, in accordance with AS/NZS 61048 and AS/NZS 61049. Should any luminaire not meet this requirement, capacitors shall be provided to correct the power factor to at least 0.9 lagging.

10.13 Testing and Commissioning

Prior to handover, verify the operation of all luminaires. All faulty lamps shall be replaced at no additional cost. All lamps shall be observed to have the correct colour temperature as designed – non-compliant lamps shall be replaced at no additional cost.

All luminaires should be in the correct position and oriented correctly with the correct spacing (as specified in the drawings, and in accordance with the Architect's intent). Adjustable luminaires shall be aimed and focused in accordance with the Architect's intent.

Clean all luminaires internally and externally. Clean diffusers and reflectors.

Remove finger print marks. Check for light leaks.

Rectify all sagging luminaires and readjust any luminaires out of alignment. No glare and spill light should be observed.

Ensure that no cables are resting on luminaires above the ceiling. Remove any items that obstruct air circulation around recessed fittings.

Replace lamps which have been in service for a period greater than 50% of the lamp life as published by the lamp manufacturer.

10.14 Warranty

10.14.1 Lamps

All lamps shall be warranted to the manufacturers' rated lamps life.

All lamps shall have a 50% mean time to failure (MTTF), as follows:

- Fluorescent T5: 20,000 hours
- Fluorescent T8:13,000 hours
- Compact Fluorescent: 13,000 hours
- HID: 10,000 hours
- LED: 40,000 hours

Where the design drawings make reference to 'Long Life T5' or 'Long Life T8' lamps, these shall have a MTTF of 45,000 hours and 75,000 hours respectively.

10.14.2 Control Gear

The Contractor shall offer high quality control products. Warranty for lighting components, management systems, LED modules and systems shall equal or exceed standard legal guarantees.

The Contractor shall offer a 5-year guarantee on all devices with a rated life of at least 50,000 hours of operation.

A warranty of minimum 3 years shall be offered on devices with a rated life of less than 50,000 hours of operation. Batteries are excluded from this guarantee.

The warranty requirement applies to all electronic control gear supplied by the light fitting manufacturer using Tridonic or similarly reputable control gear products, such as electronic ballasts for fluorescent lamps, electronic ballasts for HID lamps, electronic transformers, ignitors, emergency units, converters for LED light sources, control units as well as LED light sources.

10.14.3 Basic Warranty

A basic warranty period of 5 years shall apply to products with a physical rated life equal to or greater than 50,000 hours of operation. To ensure that the product warranty matches the warranty offered by the luminaire manufacturer, the warranty shall be extended by a further 6 months from the date of manufacture indicated on the product, up to a maximum of 66 months from the date of manufacture.

10.14.4 Limited Warranty

A limited warranty period of 3 years shall apply to products with a physical rated life less than 50,000 hours of operation. To ensure that the product warranty matches the warranty offered by the luminaire manufacturer, the warranty shall be extended by a further 6 months from the date of manufacture indicated on the product, up to a maximum of 42 months from the date of manufacture.

10.14.5 Housing and Internal Wiring

Warranties for housings, enclosures, diffusers, reflectors and other lighting components, light sources and light management systems, LED-modules and wiring and cable terminations shall equal or exceed standard legal warranties.

Luminaire housing, reflectors, diffusers, internal components and internal wiring shall have minimum 5 year warranties from date of installation.

11. EMERGENCY & EXIT LIGHTING

11.1 General

Supply and install a complete emergency evacuation lighting system incorporating emergency luminaires; emergency luminaires as part of complete lighting fixtures; and illuminated exit signs in accordance with the requirements of AS 2293.3.

The Contractor shall incorporate monitoring and testing of the emergency luminaires and exit signs into the facility's greater emergency lighting monitoring system such that a separate system is not required.

Emergency luminaires and illuminated exit signs shall:

- Be classified by an approved Authority in accordance with AS 2293, with the classification being clearly marked on the luminaire label.
- Be numerically identified with a permanent approved engraved label with numbers corresponding with the log book identification and as-installed drawings.
- Be circuited in accordance with the intent of AS 2293, enabling push button timer control testing to be performed without interruption to general lighting.
- Be monitored and tested in accordance with the AS2293.
- Form part of the centrally monitored emergency lighting system.
- Be provided with an automatic testing facility.

The following inclusions shall be included as part of the Lighting System Sub-Contractor's works:

- Supply, cabling of, installing, commissioning documentation of key system components including barcode scanner, system controller and single point units.
- Hand-over test of all single point units in accordance with AS 2293.
- As installed drawings showing cable routes between system controller and all associated components.

11.2 Standards and Regulations

The following standards and guidelines are applicable to this scope of works:

Reference	Name
AS/NZS 2293.1	Emergency escape lighting and exit signs: System design, installation and operation
AS/NZS 2293.2	Emergency escape lighting and exit signs: Inspection and maintenance
AS/NZS 2293.3	Emergency escape lighting and exit signs: Emergency escape luminaires and exit signs
AS/NZS 60598.1	Luminaires, general requirements and tests
AS/NZS 60598.2.2	Recessed luminaires

11.3 Submissions

In accordance with the General Requirements, the Contractor shall submit operational and maintenance documentation necessary, to AS 2293.1, Section 8, to operate and maintain the equipment and systems installed. Specific to the lighting installation, the Contractor shall also submit the following:

11.3.1 Technical Data

For each type of luminaire and exit sign, submit technical data for:

- Maximum luminaire spacing for a given mounting height.
- Luminaire classification to AS 2293.3.

Technical datasheets shall also comprise:

- Construction details.
- Overall dimensions.
- Wiring arrangement.
- Type test data.

11.3.2 Samples

The Contractor shall submit samples of all emergency luminaires and exit signs.

11.4 Installation

Emergency luminaires and illuminated exit signs shall be installed in accordance with AS/NZS 2293.1.

Power supply to each component shall be an unswitched active supply to each luminaire and exit sign, originating from the test switch control panel. Recessed emergency luminaires shall be provided with 4 core PVC/PVC flexible cable, fitted with a polarised 4 pin plug top. Control gear shall be mounted, or suspended, clear of ceiling structure.

Flexible cables shall be of sufficient length to enable the luminaire to be connected into a matching plug socket incorporated within the building wiring.

11.4.1 Distribution Board Works

Provide a common test switch on the local distribution board which disconnects main supply to the luminaires and tests for discharge performance and automatically reverts to normal operating mode after testing.

Provide a timed test switch at each distribution board to energise emergency lights and exit signs and then to automatically reset controls after a maximum of 2 hours.

All distribution boards shall be labelled in accordance with AS/NZS 2293.1 to visually indicate circuit breakers which supply emergency luminaires. Labelling shall be performed with a pre-fabricated or computer printed self-adhesive label, hand-drawn labels will not be acceptable.

11.5 Selection

Emergency luminaires and exit signs shall be selected based on the location of installation. Where not explicitly nominated, the type of emergency luminaire shall be as follows:

- Internal, Plasterboard/T-Bar Ceiling up to 3 metres AFFL: Ceiling recessed type.
- Internal, Slab/Beam/No Ceiling up to 3 metres AFFL: Surface mounted type.
- Internal, Ceiling greater than 3 metres AFFL: Large format type.
- External: Surface mounted, IK08 (or higher) vandal resistant, IP65 weatherproof type.

11.6 Luminaires

Emergency luminaires and exit signs shall comply with all sections of AS/NZS 2293 and be located at changes in corridor direction and in all areas in accordance with NCC Part E4. Duration of operation shall not be less than two (2) hours.

Provide protection of the inverter system against damage in the event of failure, removal or replacement of the lamp, while in normal operation.

Provide a momentary action test switch, accessible from below the ceiling, on each luminaire to temporarily disconnect the mains supply and connect the battery to the lamp.

11.6.1 Single Point Emergency Luminaires

Each standalone emergency lighting unit shall be of the self-contained single point type complete with LED light source, batteries, dual rate battery charger, inverter, test switch and light emitting diode to indicate that the charger is operating.

11.6.2 Emergency Luminaires as Part of Other Luminaires

Where emergency lighting units are contained within standard LED or fluorescent luminaires, the batteries and associated control equipment shall be housed in a separate metal enclosure attached to the luminaire and located so that the batteries are not affected by the high temperatures generated within the luminaire during normal operation.

11.6.3 Emergency Exit Signs

Emergency exit luminaires shall be of the ‘Running Man’ pictorial type complete with arrows as required and classified by an approved authority in accordance with AS/NZS 2293.1, with the classification being clearly identified on the luminaire label.

Emergency exit luminaires shall be complete with a wide range of mounting brackets, integral power socket/junction box, be securely fixed in place, and be of the LED light source.

11.7 Monitoring System

Provide a real time emergency lighting monitoring system to efficiently manage and maintain the emergency lighting system.

The system shall be capable of the following:

- Manage the installation and allow removal of components.
- Provide cost effective test and monitoring of the system.
- Displaying graphics on screen.
- Assign units to groups so that units can be tested together in a logical manner.
- Interfacing with the building management system.
- Manage maintenance activities such that when any unit fails a test or exhibits a fault, the unit will be automatically added to a register to be replaced in the next maintenance cycle. Units shall be automatically removed from the register once they have be replaced and re-tested.
- Ensure that tests are performed properly.
- Prepare reports where testing and maintenance functions can be documented.

- Log test results and print as required.
- Self-monitoring so that in the event of damage to the system, a log will be registered. Faults shall be reported instantly and location identified.

11.8 Emergency Status

The Emergency Monitor software shall indicate the status of the emergency luminaires. The control system shall display when the fitting is in emergency stand-by mode, when a test is pending or running, and the date and result of the last test.

In the event of a failed test the Emergency Monitor software shall indicate the reason for the failure.

The result of a test and its validity shall remain unchanged until a new test is performed.

If a test cannot be started or is interrupted due to an emergency situation (mains failure), the test shall be automatically delayed until the battery is recharged.

11.9 Reporting

Results of discharge tests at practical completion shall be recorded and stored in the logbook. The logbook shall be retained on site.

The system shall be capable of displaying the lamp hours of a luminaire in normal operation and in emergency operation.

11.10 Batteries

Battery type shall be lead-acid, low self-discharge nickel-metal hydride or nickel-cadmium batteries capable of operating each lamp at its rated output continuously for at least two (2) hours during commissioning tests and 1.5 hours during subsequent tests.

Battery life shall be at least 3 years from date of commissioning when operating under normal conditions at an ambient temperature of between 10^{o}C and 40°C and subject to charging and discharging at 6 monthly intervals. Indelibly mark each battery with its date of manufacture.

Batteries shall be suitably located away from heat sources i.e. transformer, ballast and lamps in order to achieve optimum battery life. Batteries shall be securely fastened using purpose made clamps, incorporated into the battery pack or luminaire body. Battery connection shall be by quick connect tabs and receptacle connectors, and shall be positioned in such a way as to facilitate removal without the need to remove other components, and with the luminaire mounted in position.

All emergency and exit luminaires shall have automatic regulated constant current dual rate charging circuitry for extended battery life. Charging circuits shall automatically switch for high rate to trickle charging after 16 hours. Provide a red LED indicator, readily visible when the luminaire is in its operating location, which indicates that the battery is being charged. Indicator should show the current charging mode: flashing to indicate boost charging, and steady-on to indicate trickle charging.

11.11 Testing and Commissioning

11.11.1 Automatic Testing and Maintenance

All emergency and exit lighting shall be able to perform an automatic battery discharge test at six (6) monthly intervals in accordance with AS/NZS 2293.

In order to maintain the integrity of the emergency lighting system, duration testing shall be conducted in sections so that adjacent emergency luminaires are not tested together. The luminaires shall be placed on full discharge for two (2) hours. Any units failing shall be flagged in the system to be replaced and re-tested.

Tests may be initiated manually from the computer, scheduled by the Line Controllers, triggered by a switch at the switchboard or started automatically by the luminaire using the built-in DALI auto test function. Any units failing shall be replaced and re-tested.

11.11.2 Test Procedure

Carry out tests, including out-of-hours tests, to demonstrate the emergency and evacuation system's performance. Include the following:

- Test components for correct function and operation.
- Demonstrate illumination performance on site, to at least the level stated in the manufacturer's recommendations for performance for that device.
- Test operation of battery discharge test and control test switch functions, including discharge and restoration.
- Demonstrate system functions under mains fail condition.
- Demonstrate operation of the battery and charger including a full discharge/recharge over the designated time.

Provide certification at completion i.e. "Essential Services - Emergency and Exit Lighting - Design and Installation" in accordance with AS/NZS 2293.2. All results shall be recorded for entry into the Log book.

11.11.3 Commissioning

Before commissioning, make sure mains supply has been continuously connected for at least 24 hours. The Contractor shall be responsible to fully test the operation of the system and to demonstrate its operation in the presence of the Superintendent.

All emergency luminaires, exit signs and associated equipment shall be labelled in accordance with AS/NZS 2293.

11.11.4 Continual Testing

Provide two (2) visits at six (6) monthly intervals during the defects liability period to test the emergency lighting in accordance with AS/NZS 2293. At each visit, the Log book must be updated with the complete test results.

12. TELEVISION DISTRIBUTION

12.1 General

12.1.1 Master Antenna Television System (Free-to-air)

Modification / expansion / supply and install a complete digital master antenna television (MATV) system to serve the new facilities. The system shall be complete with antenna, head-end equipment, amplifiers, mast, earthing system, support hardware and Belling-Lee socket outlets. The system shall be suitable for the reception and distribution of HD digital television, video, radio and sound signals.

The system shall be installed by a qualified MATV system sub-contractor demonstrating a minimum of 10 years' experience installing similar systems.

12.1.2 IP Television System

Supply and install provisions for the future installation of a complete IP Television system to serve the premises.

Provisions shall consist of a 4 pair 100-ohm Category 6A unscreened cable with screened pair type twisted pair cable to all locations that is to have an MATV outlet.

12.2 Standards and Regulations

The following standards and guidelines are applicable to this scope of works:

Reference	Name
AS 1367	Coaxial cable and optical fibre systems for the RF distribution of analog and digital television and sound signals in single and multiple dwelling installations
AS 1417	Receiving antennas for radio and television in the VHF and UHF broadcast bands—Design, manufacture and performance of outdoor terrestrial television antennas
D17/384404	MATV / IPTV Scope for Prison Bed Capacity Program
AS/NZS 3000	Wiring Rules

12.3 Submissions

12.3.1 Operations and Maintenance Manuals

Submit all operational and maintenance documentation necessary to operate and maintain the systems installed. Documentation shall be provided to AS/NZS 1367 Appendix D.

12.3.2 Shop Drawings

Prior to commencing the works, submit shop drawings, showing the following:

- Schematic diagram, proposed location of all components and interconnecting cabling.
- Antennae types and their method of mounting.

12.3.3 Technical Data

Prior to commencing the works, submit technical data, showing the following:

- Design frequencies.
- Free-to-air reception quality report, citing methods used for determination. Address all signals that the system is to receive.
- Calculations of signal levels at outlets and at the input and output of amplifiers, splitters and taps.

12.4 Performance Requirements

12.4.1 Bandwidth

The MATV system shall be capable of receiving all Australian VHF/UHF digital terrestrial television channels, transmitting a high-quality, artefact-free signal to each outlet served. Specifically, broadcast television signals from 5 MHz to 860 MHz shall be targeted.

12.4.2 System Performance

The signal received at any point within the MATV system shall be above the minimum threshold for acceptable digital television reception as specified below. No visual artefacts or pauses in transmission shall be observed in the system, independent of weather conditions.

The nominal impedance of all cables, connectors, passive and active components shall be 75Ω.

At any time, all points within the MATV system shall be operating above the Quasi Error Free (QEF) minimum performance levels. To achieve QEF, the system shall provide the following signal performance levels:

- The minimum carrier level of any digital channel at any active head-end equipment or amplifier shall be no less than 50dBµV.
- The minimum carrier level of any digital channel at any service outlet shall be between 70dBµV and 80dBµV.
- The carrier level of any 2 channels at any service outlet shall not differ by more than 5dB.
- Any spurious or unwanted interference shall be at least 46dB below the lowest digital carrier level.
- The carrier level of any one channel across any two service outlets shall not differ by more than 6dB.
- Isolation of more than 40dB between any two service outlets (derated @ -1.5dB per octave to 860MHz).
- The cross modulation of any signal shall be less than -52dB at any service outlet.
- The maximum signal level at any point within the MATV system shall not exceed 120dBµV.
- Bit error ratio (BER) for all digital channels at any point within the MATV system shall be better than 2E-06 (i.e. at most, 2 errors may be present for every 1,000,000 bits of data transmitted prior to error correction).
- Modulation error ratio (MER) for all digital channels at any point within the MATV system shall be better than 20dB.

All active components shall automatically reset to their pre-programmed operation upon the return of power after a power failure.

12.5 Antenna

The Contractor shall supply and install the antenna on the roof at a high location after reception testing. The exact final positioning shall be confirmed on site in consultation with the Client and Architect and with respect to the DA conditions prior to installation.

The antenna shall be installed in accordance with the manufacturer recommendations and be able to withstand wind velocities of up to 120 km/h. The antenna mount shall not extend more than 3 metres above the highest point of the building unless otherwise approved by the Engineer and Local Authorities having jurisdiction in this matter.

The antenna shall provide separate high gain VHF and UHF sections to provide distortion free signals at no less than 60dB or 0dBmV of digital signal per channel at the amplifier input. Antenna mast and support equipment is to be hot dip galvanised to minimise corrosion.

The antenna shall be bonded to the electrical earthing system. Where a lightning protection system is installed, the antenna shall be bonded to the main bonding element of the system to avoid damage caused by lightning strikes. Galvanic separators shall be installed to provide lightning protection on each antenna down lead cable.

12.6 Active Equipment

Provide head end equipment to suit signal sources, distribution systems and documented performance. Signal amplifiers shall be of wide band type as appropriate and provide an adequate signal level from the head-end.

All active components shall automatically reset to their pre-programmed operation upon the return of power after a power failure.

All equipment shall be installed on a painted steel gear panel, timber or wood backing will not be acceptable.

12.6.1 Head-End

Supply and install a digital processor head-end, located in the communications room (to be confirmed during detailed design). Launch amplifier shall have high output and low noise characteristics and comprise an adjustable output level and adjustable gain. Provide adequate ventilation for continuous rated operation.

12.6.2 Distribution Amplifiers

Supply and install multiple single-channel amplifiers with all necessary duplexing and passive equipment incorporating adjustable gain and automatic gain control.

The amplifier equipment shall be installed within a cubicle located as determined on site. Amplifier characteristics shall be adequate to provide the specified system's levels with the off-air levels, whilst being free from discernible cross modulation inter-carrier interference, at the amplifier output.

The Sub-contractor shall provide a standard 10 Amp outlet for each amplifier.

12.7 Passive Equipment

Directional couplers' inputs, outputs and taps shall be female F-type connectors. All unconnected taps and outputs shall be complete with a terminating resistor. The operating frequency of directional couplers shall be 5-860 MHz and an isolation level (TAP-TAP) of 36dB minimum.

All splitters, tee units, directional couplers and other passive equipment shall be adequately screened to avoid induction or radiation and shall be fitted with F-type connectors.

Passive equipment shall not be resistive and shall be capable of distribution of the specified bandwidth. Passive equipment shall be located in accessible locations for maintenance purposes on non-combustible, non-conductive panels. Leads shall be permanently fixed to the panel.

Component open ends shall be terminated using a 75Ω matching impedance.

Where components are exposed to the weather or potential mechanical damage, they shall be enclosed in a weatherproof metal enclosure to the satisfaction of the Client.

12.8 Cabling

All RF signal cable shall be quad-shield coaxial type with nominal impedance of 75Ω.

All cables shall be supported on cable ladders or trays, segregated from all power cables, securely fixed and be continuous, free from joints. Cables shall be free of kinks, damage or other distortions. All wiring is to be concealed. Cables shall be installed with a minimum bending radius of 10 times the cable diameter.

Cables shall be of closed cell foamed polyethylene dielectric with copper clad steel centre conductor, quad shield tape-braid-tape-braid shielding and UV resistant black PVC jacket construction.

The sweep performance of cables shall be 5 - 1000MHz.

RG-6 cables shall have 60% inner and 40% outer braid coverage with attenuation of 20dB per 100m @ 860MHz or better.

RG-11 cables shall have 53% inner and 32% outer braid coverage with attenuation of 13dB per 100m @ 860MHz or better.

Cable subject to excessive bending or stress shall be replaced at the Sub-contractor's expense.

All coaxial cable connections shall be with crimped F-type connectors.

All splitter inputs and outputs shall be female F-type connectors with an operating frequency of 5-860MHz and isolation (OUT-OUT) of 20dB, minimum.

12.8.1 Trunk Cabling

RG-6 quad-screened type coaxial cabling shall be used between the antenna and head end equipment. RG-11 quad-shield type coaxial cabling or optical fibre shall be used from the headend to each floor. RG-6 quad-screened coaxial cable shall be used between directional couplers.

Fibre cabling shall be Single Mode type fibre using SC/APC connectors.

12.8.2 Horizontal Cables

RG-6 quad-screened type cabling shall be used for final connection to outlets where the length is less than 50m; otherwise RG-11 quad-screened type cabling shall be used.

12.8.3 Patch Leads

Following commissioning of the system, provide 1500 mm fly leads to all outlets.

12.9 Outlets

Outlets shall each comprise an approved 75Ω coaxial female Belling-Lee socket mounted on a high impact PVC wall plate. Wall plates shall generally be equal Clipsal 2000 series.

Wall plates within accommodation blocks are to be tamper proof stainless steel depending.

12.10 Performance Testing and Guarantee

On completion, the Contractor shall test the system and make final adjustments to ensure system operation is within the specified limits.

Sub-contractor shall arrange for equipment to be tested to demonstrate satisfactory performance.

Contractor shall provide a written report of digital signal levels, bit error ratio (BER) and modulation error ratio (MER) achieved at each outlet and a performance guarantee on the completed installation for the duration of the defects liability period.

13. LIGHTNING PROTECTION

13.1 General

The Contractor shall design, supply, and install a lightning protection system to protect the new facilities.

The lightning protection system shall be a conventional lightning protection system, designed to comply with AS/NZS 1768.

Where a lightning protection system is installed, surge protection with an I_{max} rating of 100 kA must be installed in the main switchboard.

13.2 Standards and Regulations

The following standards and guidelines are applicable to this scope of works:

Reference	Name
AS/NZS 1768	Lightning Protection
AS/NZS 3000	Electrical Installations: Wiring Rules
UL 96	Standard for Lightning Protection Components
UL 96A	Standard for Installation Requirements for Lightning Protection Systems
IEC 62305	Lightning Protection Standard

13.3 Interpretations

13.3.1 Definitions

The following definitions are applicable to this specification section:

Term	Description
Bonding conductor	Provides electrical connection between the lightning protection system and other metalwork and between various metal parts of a structure or between earthing systems.
Connecting strap	A short conductor for the connection of structures to the lightning protection system.
Earthing boss (terminal lug)	A metal boss specially designed and welded to process plant, storage tanks, or steelwork to which earthing conductors are attached by means of removable studs or nuts and bolts.
Strip	Rectangular cross-section bar/strip.

13.4 Design Requirements

The Contractor shall conduct a risk assessment using the procedure defined in AS/NZS 1768 Section 2, to determine the level of protection required for the structure.

13.4.1 Lightning Protection Level

The Contractor shall design a lightning protection solution to the nominated lightning protection level (I, II, III or IV). Specify protection levels based on lightning protection system efficiencies calculated using AS/NZS 1768 as follows:

- Protection Level I: 98%.
- Protection Level II: 95%.
- Protection Level III: 90%.
- Protection Level IV: 80%.

13.5 Submissions

13.5.1 Records

Provide records in accordance with AS/NZS 1768, Clause 8.4.

13.5.2 Shop Drawings

Submit layout drawings of the lightning protection system showing the following information:

- Details of the locations and types of joints, air and earth terminations.
- Down conductors, materials and the provisions for minimising galvanic action.
- Arrangement of components in earthing pits.
- Provision for building movement and building penetrations.
- Details of bonding to conductive building structural elements, where the structure is used as part of the lightning protection system.
- Details of bonding to other high level and in-ground services entering, or in the vicinity of, the building.
- Catalogue data with complete description of material components.

13.5.3 Submissions

Submit results of completion tests in accordance with AS/NZS 1768, Clause 8.3.

13.6 Components

13.6.1 Air Terminals

Provide air terminals, mounting bases and accessories coordinated with building structure and roof top plant equipment.

Air terminal dimensions shall generally be between 12.7mm and 16mm in diameter; between 600 mm and 920 mm in height. Dimensions may be modified to suit the project requirements.

Where installed in sections of the roof that are metal, air terminals shall be manufactured out of aluminium. Where installed in sections of the roof that are concrete, air terminals shall be manufactured out of copper. Copper terminals shall be tinned to avoid discolouration due to weathering.

Provide mounting bases and assemblies to support the air terminals under the wind load and natural harmonic resonance conditions expected at the site.

13.6.2 Down Conductors

Provide down conductors to AS/NZS 1768 to suit the down conductor system documented.

Position in accordance with AS/NZS 1768 clause 4.3.3.

13.6.2.1 Structural Reinforcement Encased In Concrete

For building structures with reinforcement steel encased in concrete about the perimeter use the reinforcement steel as lightning protection down conductors. Ensure the steel is electrically continuous from top to bottom and that the overall resistance is less than 0.2 ohms.

The Contractor shall liaise with the structural works contractor to ensure that electrical continuity is provided at all column locations. Continuity shall be enforced by welding reinforcement bars as necessary.

The Contractor shall test the electrical continuity before each new column section is poured.

Provide bond plate assembly between the air terminal network and the steel reinforcement.

Provide grounding plate assembly connected to reinforcement steel via a cable tail at the base of the building to act as a test point. The same arrangement can be used at the top of the building to provide a break out point for connection to the air terminal network and test point for checking continuity of the down conductors.

Install or enclose the earth test link to protect the connection and prevent injury to persons.

Provide a sufficient number of test points around the perimeter of the building to allow satisfactory testing of the down conductor continuity and resistance.

If metals of different types are connected together, or in close proximity, prevent electrolytic action.

Measure the ground resistance of the reinforcement steel in foundation piles to be used as earthing electrodes, before the installation of slab steel that interconnects the columns. If not providing an overall earth resistance of 10 ohms or less, provide additional earth electrodes or an earthing mat. Use the grounding plate assembly as a connection point when adding earthing electrodes. Connect ground plates to the reinforcement steel by welding the steel rod provided with the assembly or using reinforcement bar clamps.

13.6.2.2 Independent Down Conductors

Provide strip or smooth weaved cable conductors and support accessories to AS/NZS 1768 Table 4.6.

If strip conductor is used, conductor size shall be (cross section) 25mm x 3mm minimum. If smooth weaved cable conductor is used, cable size shall be 35mm^2 if copper, 50mm^2 if aluminium.

The lightning protection earthing system shall be bonded to the MEN earthing rod and buried metallic service pipes entering the building.

For joining of aluminium conductors, clean contact surfaces and provide corrosion-inhibiting compound to inhibit oxidation.

Avoid direct contact between aluminium conductors and concrete, mortar and the ground to avoid corrosive effects on the conductors.

Screw fix conductors to the building structure with propriety metal saddles, compatible with the strip down conductor material. Allow for thermal expansion of the down conductors. Provide support of down conductors in both the vertical and horizontal configuration.

If cable conductors are necessary, use copper cable supported and joined with propriety cable support brackets, saddles, clamps and fittings, installed and fixed to the manufacturer's recommendations.

For protection of down conductors system exposed to mechanical damage, cover with a moulding or tubing of non-conductive material.

13.6.3 Equipotential Bonding Conductors

Provide 35 mm^2 (copper) or 50mm^2 (aluminium) cable bonding conductors and support accessories to bond roof mounted structures and external services to the lightning protection system. If the environmental conditions will adversely affect annealed copper, use tinned copper, aluminium or stainless steel. Provide fixing and support as required to properly secure.

External steel structures include:

- Ladders and handrails.
- Aerial supports.
- Roofing structures.
- Cladding.
- Air conditioning plant.
- Piping systems.
- Any metallic object that may come in contact with the lighting including the MATV antennas, satellite dishes and any communications transmitters/receivers.

Provide grounding plate welded to reinforcement steel via a cable tail at the base of the building to act as a bonding point for the lightning protection system.

13.6.3.1 Bonding Roof Mounted Structures

Provide earthing bosses and connecting straps as required for the connection of external structures to the lightning protection system.

Provide welded earthing boss with stud washer and nut arrangements, for bonding structures to the lightning protection system.

For both the earthing boss and the connecting strap, use materials which are compatible with one another to prevent corrosion and to make a sound electrical connection.

Provide copper, flexible or rigid connection straps or cables to allow connection from the earthing boss provided on structures to the general lightning protection system.

13.6.4 Thermal Expansion

Provide expansion joints in horizontal air terminations between fixing points.

Install saddles to allow for thermal expansion of down conductors and support down conductors in both the vertical and horizontal configuration.

Saddle spacing shall be conformant to AS/NZS 1768. Provide suitable support to the conductor with spacings no greater than 1.0 m on horizontal runs and not exceeding 1.5 m on vertical runs.

13.6.5 Earthing Electrodes

Provide a dedicated earthing system using driven copper bonded steel earthing electrodes and accessories located directly below each down conductor. Earthing electrodes terminating a series of down conductors about the perimeter of the building may be interconnected.

Provide copper bonded steel earthing electrodes located at the perimeter base of the building directly below the down conductor. Terminate down conductors using cable and strap accessories.

Earthing system resistance shall be 10 Ω or less to AS/NZS 1768. If earthing electrodes cannot be driven into the ground, install the electrodes in predrilled holes backfilled with a conductive, non-corrosive, carbon based ground enhancement material (GEM) conformant to IEC 62561-7.

Earth rods shall be solid copper rods, minimum 12mm in diameter and 1000mm long. Locate driven earth electrodes with suitable PVC pits.

13.6.6 Electrode Pits

Install driven earth electrodes in dedicated pits. For pits installed in concrete paths or for reinforced steel concrete paths, bond any reinforcement steel to the earth electrodes.

Mark pit covers with the words: “LIGHTNING PROTECTION EARTH” with embedded engraved bronze plate, moulded into the finished concrete surface.

All pit entries from below are to be sealed to protect against vermin ingress.

13.7 Testing and Commissioning

At the completion of the Lightning Protection earthing installation, the Contractor shall complete all required tests as to AS/NZS 1768, Section 8.3.

At installation completion, an independent inspection shall be carried out by Underwriters Laboratories (UL) to certify compliance with AS/NZS 1768.

Following the initial installation, a 12 month defects liability period or the required determined period as per the main contract shall be provided as a warranty.

APPENDIX A – ELECTRICAL ROOM SUMMARY

Room Name	Lighting			Power			
	Lighting Levels	Controls	Comments	Outlets (DGPO generally)	Generator Backup	UPS Backup	Comments
Archive Room	160 lux	Local switching		3	No	No	
Armoury	240 lux	Local switching	Task lighting over bench	3	Power and Lighting	No	All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Armoury	240 lux	Local switching	Task lighting over bench	3	Power and Lighting	No	All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Baby Change	200 lux	Local switching		1	Lighting only	No	All switches to have Red mechanism(s) to indicate Generator backup
Bathroom	100 lux	Local switching		2	Lighting only	No	All switches to have Red mechanism(s) to indicate Generator backup
Battery Room	200 lux	Local switching		4	Power and Lighting	Yes	All switches and power outlets to have Red mechanism(s) to indicate Generator backup - Provision for 3 Phase outlet 20A
Bedroom - Dual - Min. Sec.	200 lux	Local switching	Vandalproof with night light. Vandalproof reading light for each inmate.	2	Lighting only	No	All switches to have Red mechanism(s) to indicate Generator backup

Room Name	Lighting			Power			
	Lighting Levels	Controls	Comments	Outlets (DGPO generally)	Generator Backup	UPS Backup	Comments
Bedroom - Single Min. Sec.	200 lux	Local switching	Vandalproof with night light. Vandalproof reading light for each inmate.	1	Lighting only	No	All switches to have Red mechanism(s) to indicate Generator backup
Booking - Legal Visits	200 lux	Local switching	-	-	Lighting only	No	All switches to have Red mechanism(s) to indicate Generator backup
Breast Feeding	200 lux	Local switching	-	2	No	No	
Business Unit - Industries	400 lux	Local switching	-	3	Power and Lighting	No	250A DB and 30 spare poles per workshop 3x DGPO around workshop initially running from DB
Cell - Access	200 lux	Switched from officer post	Vandalproof with night light. Vandalproof reading light for each inmate.	1	Lighting only	No	All switches and outlets to have 3mm thick SS panel - All switches to have Red mechanism(s) to indicate Generator backup.
Cell - Detox/Form 7	200 lux	Switched from officer post	Vandalproof with night light. Vandalproof reading light for each inmate.	1	Lighting only	No	Outlet located within secure TV enclosure. All switches to have Red mechanism(s) to indicate generator backup

Room Name	Lighting			Power			
	Lighting Levels	Controls	Comments	Outlets (DGPO generally)	Generator Backup	UPS Backup	Comments
Cell - Detox/Form 7	200 lux	Switched from officer post	Vandalproof with night light. Vandalproof reading light for each inmate.	1	Lighting only	No	Outlet located within secure TV enclosure. All switches to have Red mechanism(s) to indicate generator backup
Cell - Dry	200 lux	Switched from officer post	Vandalproof with night light. Vandalproof reading light for each inmate.	1	Lighting only	No	Outlet located within secure TV enclosure. All switches to have Red mechanism(s) to indicate generator backup
Cell - Dual - Corner	200 lux	Switched from officer post	Vandalproof with night light. Vandalproof reading light for each inmate.	2	Lighting only	No	All switches and outlets to have 3mm thick SS panel - All switches to have Red mechanism(s) to indicate Generator backup.
Cell - Dual	200 lux	Switched from officer post	Vandalproof with night light. Vandalproof reading light for each inmate.	2	Lighting only	No	All switches and outlets to have 3mm thick SS panel - All switches to have Red mechanism(s) to indicate Generator backup.
Cell - Holding - Access	200 lux	Switched from officer post	Vandalproof		Lighting only	No	All switches to have Red mechanism(s) to indicate Generator backup

Room Name	Lighting			Power			
	Lighting Levels	Controls	Comments	Outlets (DGPO generally)	Generator Backup	UPS Backup	Comments
Cell - Holding - Transit	200 lux	Switched from officer post	Vandalproof	1	Lighting only	No	Outlet located within secure TV enclosure. All switches to have Red mechanism(s) to indicate generator backup
Cell - Holding - With Shower	200 lux	Switched from officer post	Vandalproof	1	Lighting only	No	Outlet located within secure TV enclosure. All switches to have Red mechanism(s) to indicate generator backup
Cell - Holding	200 lux	Switched from officer post	Vandalproof	1	Lighting only	No	Outlet located within secure TV enclosure. All switches to have Red mechanism(s) to indicate generator backup
Cell - Management	200 lux	Switched from officer post	Vandalproof with night light. Vandalproof reading light for each inmate.	2 (Single) / 4 (Double)	Lighting only	No	DGPO per desk, DGPO per TV. All switches to have Red mechanism(s) to indicate Generator backup
Cell - Protection - Dual	200 lux	Switched from officer post	Vandalproof with night light. Vandalproof reading light for each inmate.	1	Lighting only	No	All switches and outlets to have 3mm thick SS panel - All switches to have Red mechanism(s) to indicate Generator backup.

Room Name	Lighting			Power			
	Lighting Levels	Controls	Comments	Outlets (DGPO generally)	Generator Backup	UPS Backup	Comments
Cell - Protection - Single	200 lux	Switched from officer post	Vandalproof with night light. Vandalproof reading light for each inmate.	1	Lighting only	No	All switches and outlets to have 3mm thick SS panel - All switches to have Red mechanism(s) to indicate Generator backup.
Cell - Safe	200 lux	Switched from officer post	Vandalproof with night light.	1	Lighting only	No	Outlet in Cell Entry lock. All switches to have Red mechanism(s) to indicate Generator backup
Cell - Segregation	200 lux	Switched from officer post	Vandalproof with night light. Vandalproof reading light for each inmate.	1 (Single) / 2 (Double)	Lighting only	No	All switches and outlets to have 3mm thick SS panel - All switches to have Red mechanism(s) to indicate Generator backup.
Cell - Single	200 lux	Switched from officer post	Vandalproof with night light. Vandalproof reading light for each inmate.	1	Lighting only	No	All switches and outlets to have 3mm thick SS panel - All switches to have Red mechanism(s) to indicate Generator backup.
Change/Search Cubicle	200 lux	Switched from processing post		-	Lighting only	No	All switches to have Red mechanism(s) to indicate Generator backup

Room Name	Lighting			Power			
	Lighting Levels	Controls	Comments	Outlets (DGPO generally)	Generator Backup	UPS Backup	Comments
Change/Search Cubicle	200 lux	Switched from processing post		-	Lighting only	No	All switches to have Red mechanism(s) to indicate Generator backup
Circulation - Inmate Accom.		Timer control with override	Vandalproof	-	No	No	Wiring to be protected by steel conduits
Circulation - Internal Corridor	100 lux	Motion sensor		1	No	No	
Circulation - Movement Control		Timer control with override	Vandalproof	-	No	No	Wiring to be protected by steel conduits
Circulation - Visits Corridor	200 lux	Switched from officer post		2	No	No	
Clean Utility	300 lux	Local switching		2	Power for Refridgerators	No	Refridgerator(s) to be Generator backed. Outlets to have Red mechanism(S).
Clean Linen Store	200 lux	Local switching		-	No	No	
Cleaner	150 lux	Local switching		2	No	No	

Room Name	Lighting			Power			
	Lighting Levels	Controls	Comments	Outlets (DGPO generally)	Generator Backup	UPS Backup	Comments
Communications Cupboard	400 lux	Local switching		1		Yes	To be designed based on equipment selections - Provision DGPO initially. UPS to service communications equipment.
Conference Room	400 lux	Dimmable		17	Lighting only	No	Allow for some outlets in ceiling fo AV services and outlets located in centrally located floorbox. All switches to have Red mechanism(s) to indicate Generator backup
Control Room	200 lux	Local switching (minimum 2)		4	Lighting and Power	No	All switches and power outlets to have Red mechanism(s) to indicate Generator backup. Additional GPOs to be determined by security contractor

Room Name	Lighting			Power			
	Lighting Levels	Controls	Comments	Outlets (DGPO generally)	Generator Backup	UPS Backup	Comments
Cool Room - Bulk Food	200 lux	Switch outside room		2	Lighting and Power	No	3 Phase 20A supply provision to be provided for coolroom. DGPOs to be located above coolroom door. All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Cool Room - Dispatch	200 lux	Switch outside room		2	Lighting and Power	No	3 Phase 20A supply provision to be provided for coolroom. DGPOs to be located above coolroom door. All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Cool Room - Fruit & Veg	200 lux	Switch outside room		2	Lighting and Power	No	3 Phase 20A supply provision to be provided for coolroom. DGPOs to be located above coolroom door. All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Cool Room - Meat Goods	200 lux	Switch outside room		2	Lighting and Power	No	3 Phase 20A supply provision to be provided for coolroom. DGPOs to be located above coolroom door. All switches and power outlets to have Red mechanism(s) to indicate Generator backup

Room Name	Lighting			Power			
	Lighting Levels	Controls	Comments	Outlets (DGPO generally)	Generator Backup	UPS Backup	Comments
Cool Room - Milk & Dairy	200 lux	Switch outside room		2	Lighting and Power	No	3 Phase 20A supply provision to be provided for coolroom. DGPOs to be located above coolroom door. All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Cool Room - Preparation	200 lux	Switch outside room		2	Lighting and Power	No	3 Phase 20A supply provision to be provided for coolroom. DGPOs to be located above coolroom door. All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Courtyard	100 lux	Local switching	Weatherproof switch and luminaire	-	No	No	
Crate/Trolley Wash & Store	100 lux	Local switching	Weatherproof switch and luminaire	1*	No	No	*15A Weatherproof outlet
Dayroom - Protection	200 lux	Switched from officer post		4	Lighting and Power	No	All switches and power outlets to have Red mechanism(s) to indicate Generator backup

Room Name	Lighting			Power			
	Lighting Levels	Controls	Comments	Outlets (DGPO generally)	Generator Backup	UPS Backup	Comments
Dayroom - Segregation	200 lux	Switched from officer post		4	Lighting and Power	No	All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Dayroom - (Max. Security)	200 lux	Switched from officer post		6	Lighting and Power	No	All switches and outlets to have 3mm thick SS panel - All switches to have Red mechanism(s) to indicate Generator backup.
Dental Suite	320 lux	Local switching		6*	Lighting and Power	No	*Provisional - To be determined during detailed design. All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Dining - Living - Kitchen (Min. Security)	200 lux	Local switching		9*	No	No	*Living 1, Dining 4, 25A for Hob, 15A for BWU, Kitchen 4
Dirty In	200 lux	Motion sensor		3*	No	No	*1x DGPO; 3 phase outlet for roller door and scales
Dirty Utility (Sterile Room)	300 lux	Motion sensor		2	No	No	
Dispatch Clean	200 lux	Motion sensor		2*	No	No	*1x DGPO; 3 phase outlet for roller door
Dispensary (Awaiting Review)	200 lux	Local switching		2	Lighting and Power	No	All switches and power outlets to have Red mechansim(s) to indicate Generator backup. Backup required for vaccine and medication fridges

Room Name	Lighting			Power			
	Lighting Levels	Controls	Comments	Outlets (DGPO generally)	Generator Backup	UPS Backup	Comments
Dog Food Preparation	200 lux	Local switching		5*	No	No	*4x DGPO, 1x DGPO waterproof
Dog Kennel	200 lux	Local switching		-	No	No	
Dog Run	-	-		-	No	No	
Dog Wash	200 lux	Local switching		1	No	No	Weatherproof
Drug Dispensing Room	200 lux and 1 40W security fitting mounted at window head on inmate side	Switch for external light		3	No	No	
Entry - Visitors to Visits Building	200 lux	Local switching		1	Lighting and Power	No	Cleaner outlet. All switches and power outlets to have Red mechanism(s) to indicate Genrator backup
Entry - Waiting - Clinic	200 lux	Local switching		-	Lighting and Power	No	All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Entry Corridor	200 lux	Motion sensor		1	No	No	
Entry Lock - Visits Area	200 lux	Switched from processing post		1	No	No	Cleaner outlet

Room Name	Lighting			Power			
	Lighting Levels	Controls	Comments	Outlets (DGPO generally)	Generator Backup	UPS Backup	Comments
Equipment Room	200 lux	Local switching		2*	Lighting and Power	No	*Provisional - To be determined during detailed design. All switches and power outlets to have Red mechanism(s) to indicate Generator backup. Power provision for 2 A/C units
Female Inmate Search/Shower	200 lux	Control system at Officer's Post		1	Lighting	No	Weatherproof. All switches to have Red mechanism(s) to indicate Generator backup
Female SHR/WC	200 lux	Local switching		1	No	No	Weatherproof
Foyer - Administration	240 lux	Local switching	Additional feature lighting required	2	Lighting	No	Cleaner outlets. All switches to have Red mechanism(s) to indicate Generator backup
Foyer - Business Unit	200 lux	Local switching		3	No	No	
Foyer - Inmate Visitors	240 lux	Local switching	Additional feature lighting required	2	Lighting and Power	No	Cleaner outlets. All switches and power outlets to have Red mechanism(s) to indicate Generator backup

Room Name	Lighting			Power			
	Lighting Levels	Controls	Comments	Outlets (DGPO generally)	Generator Backup	UPS Backup	Comments
Foyer - Staff & Official Visitors	240 lux	Local switching	Additional feature lighting required	1	Lighting and Power	No	Cleaner outlets. All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Freezer Room	200 lux	Switch outside room		3*	Lighting and Power	No	*2x 15A outlet above door, 3 phase 15A outlet from Mechanical DB. All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Garbage Area	200 lux	Motion sensor		1	No	No	Weatherproof
General Manager's Assistant Office	400 lux	Local switching		6x DGPOs	Lighting and Power	No	All switches and power outlets to have Red mechanism(s) to indicate Generator backup
General Manager's Office	400 lux	Local switching	2 switching groups	10*	Lighting and Power	No	*3 Outlets at desk, 2 outlets for tea making, 1x outlet in ensuite, 1x outlet near meeting table, 3x outlets at wall unit. Permanent connection for BWU. All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Gym	200 lux	Motion sensors		9*	No	No	DGPO at TV location
IDS - Aboriginal Resource Room	200 lux	Local switching		3	No	No	*2x DGPO, 2x 15A GPO for BWU, 1x GPO for fridge

Room Name	Lighting			Power			
	Lighting Levels	Controls	Comments	Outlets (DGPO generally)	Generator Backup	UPS Backup	Comments
IDS - Arts & Crafts	300 lux	Local switching		5	No	No	
IDS - Chapel Space	200 lux	Local switching		3	No	No	
IDS - Classroom - Group Room	300 lux	Local switching		6	No	No	
IDS - Computer Classroom	300 lux	Dimmable		14	No	No	
IDS - Gymnasium	200 lux	Local switching		-	No	No	
IDS - Library	200 lux	Local switching		6	No	No	
IDS - Multipurpose	200 lux	Local switching		8	No	No	5x DGPO, 1x DGPO for TV, 1x DGPO ceiling mounted
Inmate Property Store	200 lux	Local switching		4*	No	No	*Minimum
Inmate Valuables Store	200 lux	Local switching		1	No	No	
Interview - Justice Health	300 lux	Local switching		2	Lighting only	No	All switches to have Red mechanism(s) to indicate Generator backup
Interview - Police Charge Room	200 lux	Local switching		3	No	No	

Room Name	Lighting			Power			
	Lighting Levels	Controls	Comments	Outlets (DGPO generally)	Generator Backup	UPS Backup	Comments
Interview - Visits	300 lux	Local switching		1	No	No	
Interview Room	300 lux	Local switching		2	No	No	
IT Room - Store	160 lux	Local switching		2	No	No	
Key Issue/Return	200 lux	Local switching		13	Lighting and Power	No	All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Key Room	200 lux	Local switching	Task lighting over bench	4	Lighting and Power	No	All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Kiosk/Kitchenette	200 lux	Local switching		4	No	No	1 outlet for BWU
Kitchen	200 lux	Local switching		6	No	No	1 outlet for BWU
Laundry - Booking	200 lux	Local switching		3	No	No	
Laundry/Cleaner Max. Sec. Acc.	200 lux	Local switching		3	No	No	
Laundry/Cleaner Min. Sec. Acc.	200 lux	Local switching		2	No	No	
Laundry	200 lux	Local switching		7*	No	No	*Outlets for WM, dryer, ironer, ozone dispenser and 3x for general use

Room Name	Lighting			Power			
	Lighting Levels	Controls	Comments	Outlets (DGPO generally)	Generator Backup	UPS Backup	Comments
Lunch Room - Kit & Ldry - Inmates	200 lux	Local switching		5	No	No	1 outlet for BWU
Lunch Room - W'Shops - Inmates	300 lux	Local switching		7	No	No	1 outlet for BWU
Male SHR/WC	200 lux	Local switching		1	No	No	Weatherproof
Multi-Use Room	200 lux	Control system at Officer's Post		10	Lighting only	No	2x DGPO for kiosk, 1 GPO 2100 AFFL for TV, 3x DGPO for general, 3x DGPO for bench, 1 GPO for BWU. All switches to have Red mechanism(s) to indicate Generator backup
Nap Room	100 lux	Local switching		1	No	No	
Office - Area Manager	400 lux	Local switching		3	Lighting only	No	All switches to have Red mechanism(s) to indicate Generator backup
Office - Bail Payment & Deposits	400 lux	Local switching		3	Lighting only	No	All switches to have Red mechanism(s) to indicate Generator backup. Outlets under bench
Office - Business Unit	300 lux	Local switching		9*	Power and Lighting	No	*6x DGPO, 1 GPO for refridgerator, 1x DGPO for Kitchen bench, 1x outlet for BWU. All switches and power outlets to have Red mechanism(s) to indicate Generator backup

Room Name	Lighting			Power			
	Lighting Levels	Controls	Comments	Outlets (DGPO generally)	Generator Backup	UPS Backup	Comments
Office - Chapel	200 lux general, 400 lux for task lighting	Local switching		3	Lighting only	No	All switches to have Red mechanism(s) to indicate Generator backup
Office - Clerical - Business Unit	300 lux	Local switching		2	Lighting only	No	All switches to have Red mechanism(s) to indicate Generator backup
Office - Clerical - MGR. of Industries	300 lux	Local switching		2	Lighting only	No	All switches to have Red mechanism(s) to indicate Generator backup
Office - Consulting (Awaiting Update)	200 lux	Local switching		1	Power and Lighting	No	All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Office - Dual	300 lux	Local switching		6	Lighting only	No	All switches to have Red mechanism(s) to indicate Generator backup
Office - General	400 lux	Local switching		15	Power and Lighting	No	All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Office - Gym	300 lux	Local switching		6*	Lighting only	No	*4x DGPO, 1x GPO for BWU, 1x GPO for refridgerator. All switches to have Red mechanism(s) to indicate Generator backup

Room Name	Lighting			Power			
	Lighting Levels	Controls	Comments	Outlets (DGPO generally)	Generator Backup	UPS Backup	Comments
Office - Kitchen & Laundry	300 lux	Local switching		7*	Lighting only	No	*4x DGPO, 1x GPO for BWU, 1x GPO for refridgerator, 1x DGPO above bench. All switches to have Red mechanism(s) to indicate Generator backup
Office - Large	200 lux general, 400 lux for task lighting	Local switching		3	Lighting only	No	All switches to have Red mechanism(s) to indicate Generator backup
Office - Librarian	200 lux general, 400 lux for task lighting	Local switching		3	Lighting only	No	All switches to have Red mechanism(s) to indicate Generator backup
Office - Manager of Industries	300 lux	Local switching		3	Lighting only	No	All switches to have Red mechanism(s) to indicate Generator backup
Office - Night Senior & Officer Post	200 lux general, 400 lux for task lighting	Local switching		16*	Lighting only	No	*Tea preparation: 1x GPO for refridgerator, 2x DGPO, 1 GPO for BWU. Office: 11x DGPO under bench, 1x GPO for cleaning. All switches to have Red mechanism(s) to indicate Generator backup
Office - Nurses Station	200 lux general, 400 lux for task lighting	Local switching		6*	Lighting only	No	*6x DGPO for 30m2, 8x for 40m2, 9x for 50m2. All switches to have Red mechanism(s) to indicate Generator backup

Room Name	Lighting			Power			
	Lighting Levels	Controls	Comments	Outlets (DGPO generally)	Generator Backup	UPS Backup	Comments
Office - Records	200 lux general, 400 lux for task lighting	Local switching		1	Lighting only	No	All switches to have Red mechanism(s) to indicate Generator backup
Office - Store	200 lux	Lighting switch panel		9	Lighting only	No	All switches to have Red mechanism(s) to indicate Generator backup
Office - Warrants	200 lux general, 400 lux for task lighting	Local switching		7	Lighting only	No	All switches to have Red mechanism(s) to indicate Generator backup
Office - Welfare	200 lux general, 400 lux for task lighting	Local switching		2	Lighting only	No	All switches to have Red mechanism(s) to indicate Generator backup
Office	200 lux general, 400 lux for task lighting	Local switching		3	Lighting only	No	All switches to have Red mechanism(s) to indicate Generator backup
Officer Post - Booking	200 lux	Local switching		8*	Power and Lighting	No	*Direct connection to XRAY unit. All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Officer Post - Gatehouse Staff Entry	400 lux	Local switching		13*	Power and Lighting	No	*Tea Prep: 3x DGPO. Post 10x DGPO. All switches and power outlets to have Red mechanism(s) to indicate Generator backup

Room Name	Lighting			Power			
	Lighting Levels	Controls	Comments	Outlets (DGPO generally)	Generator Backup	UPS Backup	Comments
Officer Post - Gatehouse Visitor Entry	400 lux	Local switching		13	Power and Lighting	No	All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Officer Post - Movement Control	200 lux	Local switching		10*	Power and Lighting	No	*Tea Prep: 4x DGPO. Post: 6x DGPO. All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Officer Post - Open	200 lux	Local switching		2	No	No	
Officer Post - Visitor Entry	200 lux	Local switching		9*	Power and Lighting	No	*Tea Prep: 3x DGPO. Post: 6x DGPO. All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Officer Post	200 lux	Local switching		4	Power and Lighting	No	All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Officer Post - Retreat	200 lux	Local switching		4	Power and Lighting	No	*Tea Prep: 3x DGPO. Post: 1x DGPO. All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Plant Room - Services	100 lux	Local switching		-	No	No	*To be determined during detailed design
Procedure Treatment (Awaiting Update)	300 lux general, 400 lux for task lighting	Local switching		5	Lighting only	No	All switches to have Red mechanism(s) to indicate Generator backup

Room Name	Lighting			Power			
	Lighting Levels	Controls	Comments	Outlets (DGPO generally)	Generator Backup	UPS Backup	Comments
Processing - Entry Lock (XRAY) Staff and Visitor Areas	400 lux	Local switching		1*	Lighting only	No	*Direct connections required fro Secuirty Screening Equipment. All switches to have Red mechanism(s) to indicate Generator backup
Processing Area - Booking	200 lux	Local switching		1*	Power and Lighting	No	All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Reception - Administration	240 lux	Local switching	Feature lighting to be be provided	6	Yes	No	5x DGPO under bench, 1 GPO behind counter
Reheating/Retherm Area	200 lux	Motion sensor		1*	Yes	No	*20A 3 phase outlets per oven
Sandwich Plating	300 lux	Local switching		7*	No	No	*5x Pendant outlets
Search - Business Unit	300 lux	Switched from processing post		1x DGPO, direct connection to metal detector	Lighting only	No	*Direct connection to metal detector
Search Cubible - Booking	300 lux	Switched from processing post		-	Lighting only	No	

Room Name	Lighting			Power			
	Lighting Levels	Controls	Comments	Outlets (DGPO generally)	Generator Backup	UPS Backup	Comments
Secure Lock	200 lux	Local switching		1	No	No	Weatherproof
Services - Elect. Distribution Board	-	-		1	No	No	
Services - Fire Hose Reel	-	-		-	No	No	
Sick Ward - Clinic (2 Bed)	160 lux	Override switch outside cell	Vandalproof with night light. Vandalproof reading light for each inmate.	3	Power and Lighting	No	GPO for TV required. All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Sick Ward Ensuite	160 lux	Local switching	Vandalproof	-	No	No	
Sitting Area	100 lux	Local switching		7*	No	No	*Tea prep: 1 GPO for fridge, 1 GPO for microwave, 1 GPO above bench, 1 GPO for BWU Room: 3x DGPOs
Staff Facilities - Staff Room	200 lux	Local switching		7*	No	No	*5x DGPO, 1 GPO for BWU, 1 DGPO for TV 2000 AFFL
Staff Facilities - Tea Making	200 lux	Local switching		4*	No	No	*2x DGPO, 1 GPO for fridge, 1 GPO for BWU
Staff Locker Room	200 lux	Local switching		2	No	No	2x DGPO for cleaner

Room Name	Lighting			Power			
	Lighting Levels	Controls	Comments	Outlets (DGPO generally)	Generator Backup	UPS Backup	Comments
Staff Room	200 lux	2x Motion sensors w/ local switching		6	No	No	5x DGPO, 1 DGPO 2100 AFFL for TV
Store - Accom. - Max. Sec.	100 lux	Local switching		1	Lighting Only	No	All switches to have Red mechanism(s) to indicate Generator backup
Store - Chapel	100 lux	Local switching		1	No	No	
Store - Chemical	200 lux	Local switching		4	No	No	
Store - Command	160 lux	Local switching		4	Lighting Only	No	All switches to have Red mechanism(s) to indicate Generator backup
Store - Dry Goods	200 lux	Local switching		-	No	No	
Store - External - Max. Sec.	100 lux	Local switching		-	No	No	
Store - General Use	100 lux	Local switching		1	No	No	
Store - Gym	100 lux	Local switching		1	No	No	
Store - Medical Records	300 lux	Local switching		3	No	No	
Store - Pharmacy	200 lux	Local switching		2	No	No	
Store - Pottery	100 lux	Local switching		1	No	No	

Room Name	Lighting			Power			
	Lighting Levels	Controls	Comments	Outlets (DGPO generally)	Generator Backup	UPS Backup	Comments
Store - Resource	100 lux	Local switching		1	No	No	
Store - Tools	200 lux	Local switching		1	No	No	
Toilet - Inmate	100 lux	Local switching		1	No	No	
Toilet - Officer	100 lux	Local switching		1	No	No	
Toilet - Staff	100 lux	Local switching		1	No	No	
Toilet - Visitor	100 lux	Local switching		1	No	No	
Toilet - Access	100 lux	Local switching		1	No	No	
Toilet - Inmates - Industries	100 lux	Local switching		1	No	No	
Toilet/Lockers - Inmate - Food Services & Laundry	100 lux	Local switching		1	No	No	
Toilets - Female Visitors	200 lux	Control system at Processing Post		1	No	No	
Toilets - Male Visitors	200 lux	Control system at Processing Post		1	No	No	

Room Name	Lighting			Power			
	Lighting Levels	Controls	Comments	Outlets (DGPO generally)	Generator Backup	UPS Backup	Comments
Toilet/Shower - Access - Inmate	100 lux	Local switching		1	No	No	
Toilet/Shower - Access - Staff	100 lux	Local switching		1	No	No	
Training/Command	400 lux	Dimmable		13	Power and Lighting	No	4x GPO located in floor box. All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Urinalysis	200 lux	Control system at Officer Post		4	Lighting only	No	All switches to have Red mechanism(s) to indicate Generator backup
Utility Room	240 lux	Motion sensor		4	No	No	
Vehicle Lock	240 lux	Local switching		2*	Power and Lighting	Np	*Direct connection to Roller door and XRAY Scanner. All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Vehicle Wash Bay	200 lux	Local switching		1	No	No	Weatherproof

Room Name	Lighting			Power			
	Lighting Levels	Controls	Comments	Outlets (DGPO generally)	Generator Backup	UPS Backup	Comments
Video Conferencing, Court Studio	200 lux	Switching at Officer Post		2	Power and Lighting	No	Specialist electrical fitout by National Technical Services and equipment by Electroboard. Refer to TRIM file 12/15245 for full requirements. All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Video Conferencing, Professional Studio	200 lux	Switching at Officer Post		2	Power and Lighting	No	All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Video Equipment	200 lux	Switching at Officer Post		6	Power and Lighting	No	All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Video Reception	200 lux	Lighting switch panel		13	Power and Lighting	No	All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Visiting - Contact Visiting Area	200 lux	Local switching		7	Power and Lighting	No	1x DGPO, 5x DGPO for vending machines and cleaning, 1x GPO fro BWU. All switches and power outlets to have Red mechanism(s) to indicate Generator backup

Room Name	Lighting			Power			
	Lighting Levels	Controls	Comments	Outlets (DGPO generally)	Generator Backup	UPS Backup	Comments
Visiting - Dress	200 lux	Controlled from Post		-	Lighting only	No	All switches to have Red mechanism(s) to indicate Generator backup
Visiting - Monitor Room	200 lux	Controlled from Post		6	Power and Lighting	No	All switches and power outlets to have Red mechanism(s) to indicate Generator backup
Visiting - Non Contact	200 lux	Controlled from Post		1	Lighting only	No	All switches to have Red mechanism(s) to indicate Generator backup
Visiting - Secure Visit	200 lux	Controlled from Post		1	Lighting only	No	All switches to have Red mechanism(s) to indicate Generator backup
Visiting - Undress	200 lux	Controlled from Post		-	Lighting only	No	All switches to have Red mechanism(s) to indicate Generator backup
Visitor Waiting - Gatehouse	200 lux	Controlled from Post		-	Lighting only	No	All switches to have Red mechanism(s) to indicate Generator backup
Waiting Area - Health	160 lux	Local switching`	2x security fitting at dispensary window	-	No	No	
XRAY Operator - Health Care (Awaiting Update)	300 lux	Dimmable		8	Power and Lighting	No	All switches and power outlets to have Red mechanism(s) to indicate Generator backup

Tender Schedule

Tender form for the Electrical Services for:

Correctional Facilities Performance Specification

"INSERT PARTICULAR CORRECTIONAL FACILITY HERE"

We, the undersigned, hereby tender for the supply, delivery, installation, commissioning and testing of the Electrical Services for NSW Correctional Facilities Building Services Performance Specification in accordance with Northrop Consulting Engineers' specification no. NL180226-HE01 revision A, dated 3.04.2018, and accompanying drawings.

We unconditionally guarantee the performance of the installation and completion of the works in accordance with this specification, accompanying drawings and statutory regulations.

Itemised Lump Sum Tender Price: .....
(Dollars, in words)

$ ..... (including GST)

Tenderer Name: .....

Tenderer Address: .....

.....

Signed: ..... Date: .....

This tender shall be valid for sixty (60) days following this date.

Electrical Services Items Schedule

The amounts included in the Lump Sum Tender Price, including overhead costs and profit margins, are as follows:

1.	Consumer mains cabling	$
2.	Main switchboard, metering & power factor correction	$
3.	Sub-mains cabling	$
4.	Distribution boards	$
5.	Essential & Critical power systems including controls and protection	$
6.	General power installation, including sub-circuits and protection	$
7.	Internal lighting installation, including all sub-circuits and controls	$
8.	External lighting installation, including all sub-circuits and controls	$
9.	Emergency and Exit Lighting, including all wiring	$
10.	Master Antenna Television (MATV) system	$
11.	Conduits, pits and cable tray	$
12.	Testing and Commissioning	$
13.	As installed drawings and Operations & Maintenance manuals	$
14.	Other works (detailed below)	$
	Sub Total	$
	GST	$
	Total Fixed Lump Sum	$

Tenderer Name: .....

Signed: ..... Date: .....

Electrical Services Unit Rates Schedule

The following rates shall be used to assess variations and include all allowances for overheads, profit, attendance, and mark-up, union requirements, superannuation payments and the like.

Labour	Normal Time	Time & Half	Double Time
Foreman	$ /hr	$ /hr	$ /hr
Qualified Tradesman	$ /hr	$ /hr	$ /hr
Apprentice	$ /hr	$ /hr	$ /hr
Labourer	$ /hr	$ /hr	$ /hr

Material

Mark-up to be applied on cost to purchase materials: ..... %

Tenderer Name: .....

Signed: ..... Date: .....

RETURN BRIEF

CESSNOCK CORRECTIONAL CENTRE

240 BED MINIMUM SECURITY EXPANSION

FIRE SERVICES

JHA

CONSULTING ENGINEERS

DOCUMENT CONTROL SHEET

Project Number	180147
Project Name	Cessnock Correctional Centre, 240 bed Minimum Security Expansion
Description	Return Brief
Key Contact	Con Serban

Prepared By

Company	JHA
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Authorised	Barry Martin

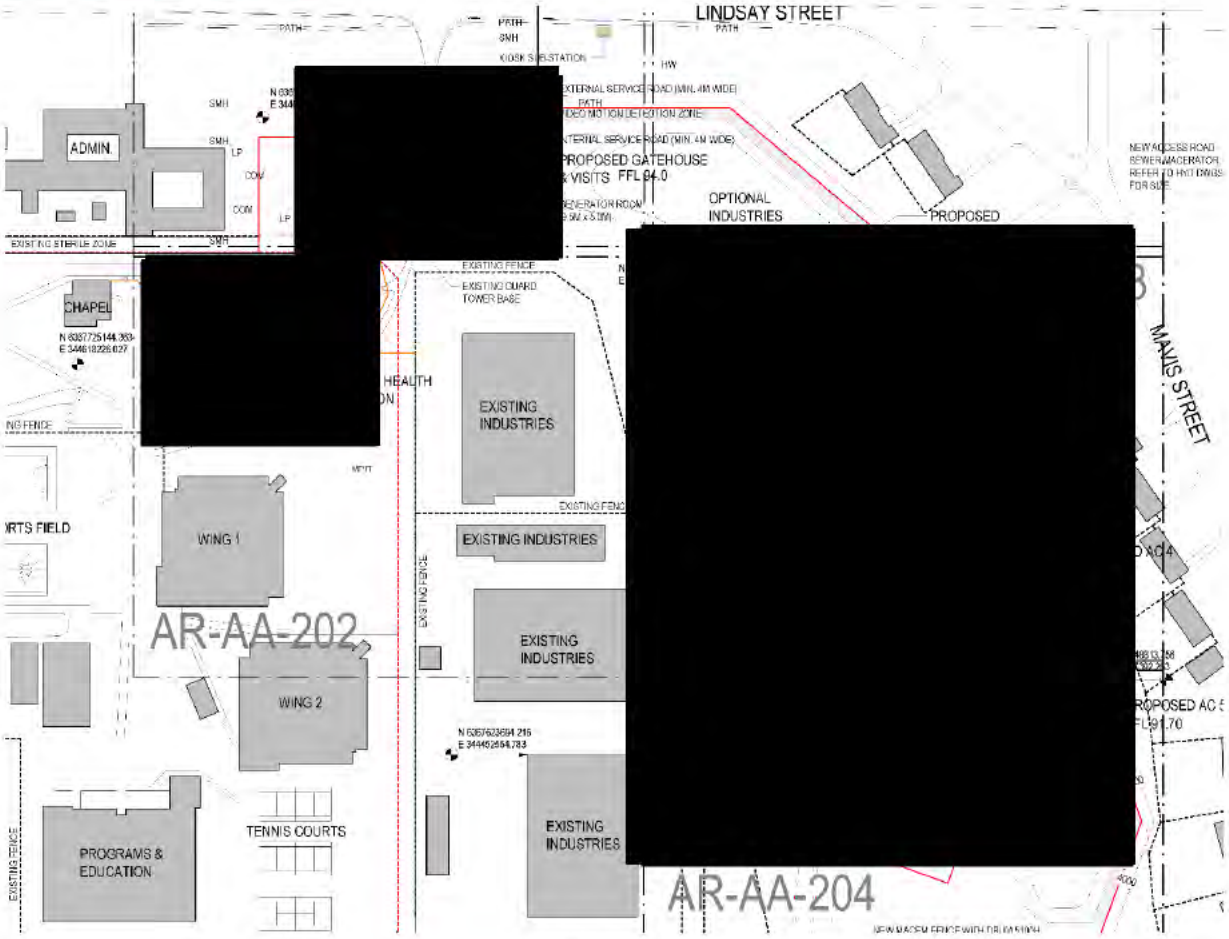
Revision History

Issued To	Revision and Date	
Lend Lease – Gary Lyle	REV	B
	DATE	25/05/2018
	REV	
	DATE	
	REV	
	DATE	

CONTENTS

1 PROJECT DESCRIPTION

1.1 PROJECT SCOPE



Site plan

It is proposed that a 240 bed minimum security expansion be constructed on a site directly bounding the existing industries zone, which currently serves as part of the existing Cessnock Correctional Centre. These new expansion works will incorporate a new gatehouse, entry and linking zone and common facilities to serve and form a larger minimum security centre of approximately 760 beds.

The works proposed are identified on the above site plan and are further described as follows:

- A new purpose-designed Gatehouse (with new MCR and Security Server) constructed outside the perimeter of the currently operating prison which incorporates a new minimum security visits centre capable of serving the whole 760 bed minimum security centre;
- A new Inmate Reception & Health (Clinic) building to be constructed within the existing site in place of the existing visits building serving the whole 760 bed minimum security centre;
- A new + upgraded secure perimeter configured to suit the proposed new 280 bed minimum security expansion, the new Gatehouse location, new Reception / Clinic building location and the integration with the existing remand centre and industries precinct to form a single centre;
- Construction of 240 additional beds, consisting of five (5) minimum security residential accommodation units each consisting of 48 beds with future capacity for construction of a 6th unit;
- A New Programs building with movement control Officer Post to service the bed expansion zone;
- New recreational spaces, central field, fitness stations, landscape elements and courtesy fencing;

- New internal service road(s) configured to provide emergency and maintenance vehicle access for the combined centre site;
- New and upgraded internal pedestrian links to provide access and inmate movement control across the new centre configuration;
- A new visitors car park providing access to the new gatehouse;
- Demolition of the existing minimum security Visits building and surrounding external spaces

The CSNSW Functional Design Brief requested additional architectural master planning consideration be given to;

- Future expansion provision for 1 additional 48 bed accommodation building in the new minimum precinct;
- Industry Unit(s) future expansion

2 INTRODUCTION/ ROLES & RESPONSIBILITIES

JHA have been engaged by Lend Lease to progress the concept design to a schematic design level to assist design resolution during the Early Contractor Involvement (ECI) phase of the project. JHA's specific role over the duration of the project can be summarised as follows:

ECI Phase: JHA and the services Contractors will jointly undertake the schematic design of fire services to a level suitable for the Contractors to reasonably price on a design & construct basis, plus allow the Principal to understand the scope of services offered. JHA will further serve as an advisor and representative to the overall Lend Lease team on all technical items.

Delivery Phase (Post ECI): JHA's specific role during the delivery phase is to provide technical advice to the Contractors (and the general Lend Lease team) on all fire services throughout the proposed new works. JHA's further role is to review all fire services design, documentation and installation to ensure that they are fully compliant with Lend Lease's contractual obligations and that they are consistent with a Correctional Centre of this nature and scale.

The Contractors have been engaged by Lend Lease and is responsible for the design, documentation, certification, installation, commissioning and warranty of the fire services throughout the proposed new works.

JHA and the Contractors will be working collaboratively, along with the broader Lend Lease team, to ensure that a fully compliant Correctional Centre is delivered.

3 PURPOSE OF DOCUMENT

This return brief is a document which captures the design decisions that have been made during the ECI phase of the project. This return document should be read in conjunction with the developed JHA drawings and performance specifications.

This brief does not intend to repeat in detail the contents of the contract documents, rather, the brief looks to offer the following:

- A summary of decisions and departures reached during the ECI phase as the design evolves into schematic design
- Give a summarised overview of the contact requirements
- Clarify/ expand on briefing requirements as developed with the CNSW
- Clearly identify departures to the contract documents (additions and deletions) and the rationale as to why
- Clearly identify issues which require further resolution with the CNSW

It is important to note that the purpose of this report is to 'de-risk' the fire services scope and provide certainty for all parties as the project progresses. To this end, the JHA Return Brief will supersede the original contract documents. While care has been taken to be clear and accurate, should the unlikely event occur where there is conflict between the two documents the JHA Return Brief will take contractual precedence.

It should be further noted that the schematic design drawings which supplement this report are also not exhaustive. The purpose of the drawings is to provide certainty as to the extent and configuration of the fire services. Due to the Architectural drawings being developed concurrently with the fire services drawings, detailed layouts could not be prepared. Similarly, due to time constraints and continual development it was not intended to reproduce information which was already clear within room data sheets. Consequently, the design development drawings produced offer supplementary information over and above room data sheets only.

4 FIRE SERVICES

The Fire Services design and installation will conform to the latest requirements of:

- Fire services to comply with the National construction code 2016.
- Fire services to comply with all current statutory requirements and guidelines including Council, Fire and Emergency Services Authority and Department of Environmental Protection.
- Fire engineering report

Fire Services to comply with current Australian Standards where applicable and particularly the following (unless alternative solutions are provided as a departure to the deemed to satisfy provisions of the BCA.

System	National Construction Code (NCC) Clause Reference	Applicable Australian Standards
Smoke Detection Systems	E2.2a ,clause4	AS 1670.1-2015
OWS	E2.2a sections 4 & 6	1670.1-2015
Portable Fire extinguisher	E1.6	AS2444-2001

4.1 GENERAL

- An automatic fire detection and alarm system will be provided to satisfy the requirement outlined in the BCA report and AS1670.1-2015. An AS1670.1 point type fire detection will be installed throughout all buildings except in bed rooms of accommodation areas and in the holding cells of health and reception buildings.
- A multi aspirated smoke detection (MASD) system will be provided in accordance with AS1670.1-2015 in bed rooms of accommodation area and holding cells of health and reception buildings. The MASD system will connect to the local fire panel in a manner compliant with AS1670.1 The MASD will be able to report the blockage of any single sampling point. The MASD will be able to identify which individual holding cell has caused the alarm. For bedrooms, a maximum of five bedrooms in one area will be responsible for any one alarm to ensure prompt response.
- Smoke detection for smoke hazard management shall be provided for mechanical shutdown and operation of the fire fans where mechanical shutdown or fire fan operation is nominated in the mechanical and fire services drawings.
- Heat detectors will be provided at spacing and locations in accordance with AS 1670.1-2015 in the plant rooms, bathrooms and in and around kitchen areas to avoid generating spurious signal. Where a kitchen or kitchenette is part of an area with large, uninterrupted ceiling the closest detectors to the kitchenette will be thermal but with at least one smoke detector on the ceiling Heat detectors will also be provided in covered yard areas and areas where vehicle exhaust may be present..
- Each new building will be equipped with an addressable FIP. The site's main FIP (also addressable) will be located on the ground floor of the new gate house and will be linked to the Fire Brigade by ASE As nominated in the FER, sub FIP's will be located in the programs, accommodation and health& reception buildings. Each subFIP will be networked to the main FIP by a certified optical fibre networking system consisting of fibre laid point-to-point underground in 63mm conduit over two geographically separated paths.
- Mimic panels will be located on the first floor of the new gate house (within the control room) and within the nursing staff area of the health & reception building. Mimic panels will be wired to and powered from the local SFIP.
- The existing FIP in the existing gate house will serve as a sub FIP and will be connected linked to the main FIP in at the new gate house such that all signals from the existing FIP are relayed to the new panel

- Fibre-optic network cable will be used to interconnect all FIP's throughout the development
- Fire Indicator Panels are to be of microprocessor type, capable of operating a distributed and multi loop network of analogue addressable smoke, heat and MASD detectors as well as other ancillary devices. The FIP shall be interfaced with other services such as mechanical services, lift services and security systems. The smoke hazard management system will interface with essential services equipment as required. The FIP shall also include occupant warning system in accordance with AS1670.1-2015 and NCC requirements.
- An OWS will be provided in each building as required by AS1670.1. Primarily, all areas except holding cells and bed rooms will have a speaker network of flush (or recessed) speakers. Surface mounted or horn type speakers will be provided only where embedment in the ceiling is not possible and not in areas accessible to inmates. All speakers will be connected to a tone generator located within the building's FIP.
  Speakers will not be provided to bedrooms, holding cells or any other location where the occupant cannot leave of their own accord.
- Provide manual call points at each FIP and mimic panel and in each lockable hose reel cupboard
- Portable Fire Extinguishers – Portable fire extinguishers will be provided throughout the new and refurbished building to meet the requirements of the Fire Engineering Report, relevant Australian Standards (including AS 2444 -2001) and the NCC. Portable fire extinguishers and fire blankets will be positioned and selected to suit the individual space. Portable extinguishers will be located within locked cupboard according to FER requirements.

4.2 SMOKE DETECTOR

Generally addressable photo optical smoke detectors shall be provided throughout all areas requiring protection.

In areas where spurious alarms may be present thermal detectors shall be used in lieu of photo optical smoke detectors

Tamper -proof perforated guards over the point type smoke detectors will be installed to prevent tampering. The guards will be designed to meet Justice's anti-ligature requirements and to ensure that the operation of the combined guard and detector meets applicable point detector standards.

4.3 HEAT DETECTORS

Generally thermal detectors shall be intelligent addressable devices rated at 58 degree Celsius and have rate of raise element.

Tamper -proof perforated guards over the point type thermal detectors will be installed to prevent tampering. The guards will be designed to meet Justice's anti-ligature requirements and to ensure that the operation of the combined guard and detector meets applicable point detector standards. .

4.4 MULTIPLE ASPIRATING DETECTION SYSTEM

A Multi Aspirated Smoke Detection (MASD) system shall be provided in the bed rooms of accommodation buildings and in holding cells of health and reception building.

The MASD system will comprise of a ASD detectors, pipework, sampling point and caps throughout the bed rooms and holding cells and shall be linked via high level interface, through the corresponding SFIP to the main FIP, which in turn shall be interfaced with the BMS. All parts of the MASD and its connections will be battery backed to comply with AS1670.1.

In air aspirating system, the air is sampled from points in the room provides a much broader range of sensitivity to a single point detector and includes multiple levels of alarm so early investigation and action can occur. The sensitive end of the scale can detect combustion many hours before it is visible to the human eye. In some cases, this can lead to shutting down or diverting the duties of the faulty item before it affects multiple items in the room.

Caps over the aspirating smoke detectors will be installed to prevent tampering. The caps must be certified to not affect system operation by the MASD supplier. MASD exhaust air shall be returned to the same space as the intake air where

possible to avoid air pressure issues. Filters will be in accessible locations. Cleaning of sampling tubes should not require access to cells.

4.5 MAIN FIP

The Main Fire Indicator Panel (MFIP) is to be located internally at the main entrance of new gate house. All monitoring alarms and indications shall be replicated on the Mimic Panels located in areas nominated above.

The existing FIP in the existing gate house will serve as a sub FIP and will be connected linked to the main FIP in at the new gate house such that all signals from the existing FIP are relayed to the new panel

A minimum of 50% spare capacity for loops and detectors shall be provided at the MFIP. A minimum of 50% spare capacity will be provided in the zone amplifiers.

The MFIP shall be interfaced with mechanical, electrical, security, BMS and external monitoring systems as required.

A fire fan control panel will be provided within the FIP to allow manual operation of the Fire Fans by Fire & Rescue NSW in fire condition.

Manufacture of FIP will be fusion.

4.6 SUB FIP

Sub Fire Indicator Panels (SFIP) shall be provided in accommodation, program and, health &reception building

For the Health and reception building, all monitoring alarms / indication shall be replicated on the Mimic Panel located in the nursing area.

The SFIP's will directly monitor and control MASD system for accommodation areas and the health & reception building.

A minimum of 50% spare capacity shall be provided at the MFIP and in the zone amplifiers.

A fire fan control panel will be provided within the FIP to allow manual operation of the Fire Fans by Fire & Rescue NSW in fire condition

Manufacture of FIP will be fusion.

4.7 OCCUPANT WARNING SYSTEM

The local alarm system shall be directly controlled and monitored by the MFIP /SFIP and shall be in the form of an Occupant Warning System (OWS). The OWS shall be designed and installed to suit the buildings layout and will sound through all internal building areas.

Occupant warning via alert tones and emergency tones after a specified time lapse shall be achieved via warning speakers installed throughout the buildings. Areas with ceilings shall be installed with ceiling recessed speakers.

Areas without ceilings shall be installed with surface mounted speakers or horn type speakers.

It will be possible to make announcements over the OWS independently in each building from both a handset at the local FIP, a handset at the control room mimic panel and a handset at the main FIP. The latter will be the highest priority handset.

4.8 PORTABLE FIRE EXTINGUISHERS

Portable fire extinguishers will be provided throughout the Facility to meet the requirement of relevant Australian Standards including AS 2444 and National Construction Code.

Portable fire extinguishers and fire blankets will be positioned and selected to suit the individual risk. Portable extinguisher will be located within locked cupboard according to FER requirement. For portable fire extinguishers the following design criteria shall apply:

Risk	Equipment Type and Rating	Preferred Location
Plant Rooms	4.5 kg Dry Chemical Powder (4A 60B:(E)) or Carbon Dioxide 5 kg (5B(E))	Adjacent to and internal side of entry door between 2m and 5m maximum.
Throughout	4.5kg and 9 Dry Chemical Powder (4A 60B:(E))	Within 2m of each Fire Hose Reel.

4.9 INTERFACES WITH OTHER SYSTEMS

Operation of the building services in fire mode requires interfaces from the fire detection system with other services. Interfaces will be provided between the fire detection system and the following building services:

Mechanical ventilation used for smoke hazard management

General air conditioning systems

Building management systems (provide a high level interface from each FIP to the BMS)

Security and access control devices

Automatic door operators

It will be possible to reset all systems affected by an alarm from the FIP.

The following Fire Trips and cabling to mechanical systems will be the responsibility of the fire contractor

- Accommodation Building
    - Provision of wiring between FIP/FFCP and location adjacent to MCC-A-1 (non-essential) requiring fire tripping to AS 1668.1. Final connection onto MCC by the mechanical contractor.
    - Provision of On/Auto/Off manual switches in FIP/FFCP for the fans required to operate in fire mode as per AS 1668.1.2015. Final connection onto the fans by the mechanical contractor.
        - Smoke exhaust fans: SEF-1, SEF-2, SEF-3 & SEF-4
        - Make up air dampers: MVCD-1, MVCD-2, MVCD-3, MVCD-3
        - Zone control dampers: MVCD-1.1 & MVCD-1.2, MVCD-2.1 & MVCD-2.2, MVCD-3.1 & MVCD-3.2, MVCD-4.1 & MVCD-4.2
    - Provision of four fire trip signal for fire shutter for each building.

- Health/Reception Building
    - Provision of wiring between FIP/FFCP and location adjacent to MCC-H-1 &MCC-H2 (non-essential) requiring fire tripping to AS 1668.1. Final connection onto MCC by the mechanical contractor.
    - Provision of On/Auto/Off manual switches in FIP/FFCP for the fans required to operate in fire mode as per AS 1668.1.2015. Final connection onto the fans by the mechanical contractor.
    - Smoke exhaust fan: SEF-1
    - Make up fan: SAF-1

- Gatehouse Building
    - Provision of wiring between FIP/FFCP and location adjacent to MCC-G-1 (non-essential) requiring fire tripping to AS 1668.1. Final connection onto MCC by the mechanical contractor.

- Program Building

    - Provision of wiring between FIP/FFCP and location adjacent to MCC-P-1 (non-essential) requiring fire tripping to AS 1668.1. Final connection onto MCC by the mechanical contractor.

4.9.1 PRECEDENCE

Project specific requirements in this document will over-ride general requirements in the specification.

5 APPENDICES

5.1 A: DESIGN DEPARTURE

CESSNOCK CORRECTIONAL CENTRE – DEPARTURES/NON-COMPLIANCE REGISTER

Item No	Reference	Non-Compliance	Reason for Non-Compliance	Comment
F01	FACS design section 2.9.9	tamper-proof guards over smoke and thermal detectors are not to be installed	Guards not provided over the detectors. Guards can have impact on the fire system functionality and will most probably affect the system performance and they are not certified.	
F02	AS 1670.1-2015	Occupant warning not provided on cells	Prison guards will be on site at all times and will be the ones responsible for the safety of the prisoners. Prisoners will not have the freedom to evacuate themselves in the event of an alarm and will be notified of a fire in the building by correctional officers conducting a managed evacuation (if required). Based on this, provision of occupant warning in the cells is not required	

5.2 B: AMENDE NORTHROP FIRE SERVICES PERFORMACE SPECIFICATION

Amended Northrop Fire Services Performance Specification-JHA-25.05.2018

NORTHROP

Fire Services Specification

NSW Correctional Facilities Performance Specification

SPECIFICATION

PREPARED FOR
Justice Infrastructure and Assets – NSW Department of Justice
Level 2
50 Phillip Street
Sydney NSW 2000

Tel: 02 8061 9315

PREPARED BY
Northrop Consulting Engineers

2-6 Shea Street
Phillip ACT 2606

Tel: 02 6285 1822

Ref: NL180226-HH02
Rev: A
Date: 04.04.2018

FIRE SERVICES SPECIFICATION

Activity Schedule

Date	Revision	Issue	Prepared By	Approved By
01.03.2018	1	For Review & Comment	D.Reid	A.Cordina
29.03.2018	2	Preliminary	D.Reid	A.Cordina
04.04.2018	A	Tender	D.Reid	A.Cordina

Note added by JHA:

This specification is quite general and includes requirements for many systems that are not needed for this project. The associated Fire Return Brief outlines project specific requirements. Each installed device/system nominated in the brief must comply with the general requirements of this specification. Where there are contradictions the brief will take precedence over this specification. Otherwise , requirements of both the specification and brief must be met.
Hydrants and hose reels are dealt with by hydraulic services and are not mentioned in the return brief. Nevertheless, hydrant and hose reel requirements in the specification must still be complied with.

Northrop Consulting Engineers Pty Ltd

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TABLE OF CONTENTS

1. PREAMBLE

1.1 Introduction

Northrop has been engaged by the NSW Justice Department to formulate several Building Services Specification for the following five (5) prisons in NSW which have been listed later in this specification. While Room Data sheets have been provided no Architectural drawings have been provided at this time. Therefore, the information contained herein is based on all possible scenarios for building services design, inclusive of but not limited to; refurbishment, extensions and new buildings. This specification has been written in conjunction with other Northrop Consulting Engineer documentation for the following building services:

- Electrical
- Hydraulic
- Mechanical

1.2 Coordinated Approach

There has been a coordinated approach between the above mentioned services which has endeavoured to engage several stake holders at several levels within the NSW Department of Corrective Services, documentation available on prisons construction and so on. It is worth noting that there is no specific design guideline that identifies design and construction of building services in a prison. There are however documents provided by the Department relating to room data sheets that provide an insight into the expectation of what building services are required to be installed within a particular space together with examples of some recently documented NSW prison projects.

To this end, Northrop has considered several design scenarios with the thought that we are just one part of developing a successful project outcome. It is the responsibility of the D&C Services contractor to seek out the following, but not limited to project stakeholders to ensure a cost effective, robust and reliable service is provided:

- NSW Department of Justice
- Architect
- Existing site specific Fire Safety Officers (and/or Orders)
- BCA Certifier
- Fire Safety Engineer
- Building Services Consultants
- Local Fire Brigade
- Local Council

1.3 Building Services Performance Specification

This Performance Specification has been prepared to allow the calling of Design and Construction (D&C) tenders for the building services related to new and refurbishment works at various NSW correctional facilities. This specification describes minimum standards for the design, supply, installation, and commissioning of selected elements of building services, which will materially impact on the future occupancy of the buildings.

The information contained within is intended to provide an overview of various systems which will be installed within the correctional centre. It is the contractor's responsibility to select system types based on the performance requirements and undertake any life cycle and payback analysis. Note that there are no detailed building services drawings accompanying this specification.

1.4 General

This part of the specification shall be read in conjunction with the general conditions of contract, preliminary clauses, and technical clauses included in the main specification that follows.

The Fire services works shall comprise of the design, coordination, workshop documentation, supply, construction, installation, testing, commissioning, quality assurance, certification, and maintenance during defects liability period of the complete Fire services works whether specified herein or not.

This document is to be read as a performance brief for the Fire services. Where ambiguous, inconsistent or contradictory information is present in the documentation, it is the contractor's responsibility to highlight those and seek clarification during the tendering process. Where assumptions are made or where alternatives exist, the more onerous shall apply.

The Contractor shall be responsible for completion of the design of the Fire services to satisfy the requirements of this specification, Client Briefs, relevant codes and standards, and any other ancillary requirements made known at the time of tender. The Contractor shall prepare design concepts, detailed design drawings and shop drawings for the final Fire services required, including coordination with the latest architectural layouts and all other building services' documentation.

The Contractor shall guarantee that the complete Fire services installation will perform all functions required.

The Fire services shall be designed and installed in accordance with the current National Construction Code (NCC) and current Australian Standards. Where alternative solutions are required they shall be addressed within the contractors design certification and shall be fully agreed with the relevant authorities prior to the design proceeding.

The documents include this performance specification, Corrective Services NSW Standards, Room Data Sheets, Security Brief, other services trade drawings, and associated architectural drawings which combined identify the full extent of work.

The Contractor shall fully inform themselves of the nature of work, carry out a mandatory site visit and to take into account any conditions likely to affect the extent or performance of the works specified herein prior to submission of tender.

The Contractor by tendering shall be deemed to have thoroughly inspected the site prior to tender and to have taken into account any conditions likely to affect the extent or performance of the works e.g. beam locations, cable routes, penetration locations, existing services, etc.

1.5 Definitions

- 'AS' or 'AS/NZS' when followed by numbers or letters means an Australian Standard published by Standards Australia (e.g. AS 1668)
- 'Approved' means approved in writing by the Superintendent and/or Regulating Authority
- 'Architect' shall mean Architect
- 'Authority' means any Local, State or Commonwealth statutory body holding jurisdiction over work herein specified under current regulations and statutes
- 'BCA' means the Building Code of Australia – Volumes 1 and 2, which forms part of the National Construction Code.
- 'Client' shall mean Justice Infrastructure and Assets (JIA) - NSW Department of Justice
- 'CSNSW' shall mean Corrective Services NSW
- 'Contractor' means the person or the persons, firm, company or corporation whose tender has been accepted and includes their legal representatives, successors and permitted assigns to design, install, test, and commission the fire services specified herein and on the accompanying drawings
- 'Day' means a period of 24 hours
- 'Equal' means equivalent in performance, quality and approved
- 'Fire Resistance Level (FRL)' means the grading periods in minutes determined in accordance with Specification A2.3 of the BCA Volume 1, for the following criteria -
    - Structural adequacy
    - Integrity; and
    - Insulation, and expressed in that order
- 'General Access Area' means areas that are generally accessed by Prisoners.
- 'High Needs Area' means individual segregation cells or cell blocks.
- 'Install' means accept the delivery of items supplied by others and install them in accordance with the documents.
- 'Fire Engineer' nominated by the Principal
- 'Materials' means all plant, instruments, components, equipment, assemblies and sub-assemblies, parts and other items required for permanent incorporation of the works
- 'May' means that there is an option
- 'NCC' means the National Construction Code, which comprises the Building Code of Australia - Volumes 1 and 2.
- 'Inmate' means a person sentenced or awaiting sentence by the Court to a term of imprisonment to be detained in a prison

- 'Provide' means obtain, manufacture, deliver, install, as applicable, and do everything necessary to complete the work in accordance with this specification
- 'Required' means necessary by the contract documents, statutory Authority, law, or as required by site conditions to complete the works
- 'Shall' means that the statement is mandatory
- 'Should' means that the statement is recommended
- 'Site' means the lands and other places on, under, in or through which the works are to be carried out by the Contractor
- 'Specification' means this document
- 'Submit' means submit to the Fire engineer, project manager, or other person(s) as indicated in the general conditions for inspection, information, etc.
- 'Superintendent' means the person as nominated by JIA or as nominated in the main building contract
- 'Supply' means obtain, manufacture, as applicable, and deliver

1.6 Design Compliance

The work shall comply with these listed regulations, whether or not specific reference is made in this Specification.

A brief summary of key Standards and Codes that generally apply to these works is as follows. Where specific parts are not mentioned, the entire series of the associated Standard shall apply.

Reference	Title
NCC	National Construction Code of Australia
AS 1074	Steel Tubes and Tubulars for Ordinary Service
AS 1345	Identification of the Contents of Pipes, Conduits and Ducts
AS 1432	Copper tubes for Plumbing, Gasfitting and Drainage Applications
AS 1530	Methods for Fire Tests on Building Materials, Components and Structures
AS 1668	The use of Ventilation and Air-conditioning in Buildings
AS 1682	Fire Dampers
AS 1670	Fire detection, warning, control and intercom systems
AS 1851	Maintenance of Fire Protection Systems and Equipment
AS 2118	Automatic Fire Sprinkler Systems
AS 2304	Water Storage Tanks for Fire Protection Systems
AS 2419	Fire Hydrant Installations
AS 2444	Portable Fire Extinguishers and Fire Blankets
AS 2865	Confined Spaces
AS 2941	Fixed Fire Protection Installations - Pumpset Systems
AS 3000	Electrical Installations – Wiring Rules

NA

NA

NA

NA

Not Applicable for this project

AS 3013	Electrical installations - Classification of the fire and mechanical performance of wiring system elements
AS/NZS 3500.1	Plumbing and Drainage - Water Services NA
AS 3772	Pre-engineered fire protection systems for cooking equipment NA
AS 4118.1	Fire Sprinkler Systems - Components NA
AS 4118.2.1	Fire Sprinkler Systems - Piping NA
AS 4129	Fittings for Polyethylene (PE) Pipes for Pressure Applications
AS 4130	Polyethylene (PE) Pipes for Pressure Applications
AS 4214	Gaseous Fire-extinguishing Systems NA
AS 4426	Thermal insulation of pipework, ductwork and equipment selection, installation and finish
AS 4428	Fire detection, warning, control and intercom systems - Control and indicating equipment
AS 7240	Fire detection and alarm systems
AS/CA S009	Installation requirements for customer cabling (Wiring Rules).
AS ISO 14520	Gaseous Fire-extinguishing Systems NA
HB 233	Fire Protection Systems Testing - Water Conservation Handbook NA

Facility Assets Correctional Standards

Reference	Edition	Title
D12/095474	2012	Administration
D12/095505	2012	Booking
D12/095486	2012	Food Services
D12/095519	2012	Functional Purpose and Design
D12/095514	2012	Gatehouse
D12/095469	2012	General Storage
D12/494388	2012	Grounds Maintenance
D12/095487	2012	Health Care
D12/095502	2012	Housing - General
D12/095496	2012	Housing - Special
D12/095476	2012	Industries
D12/095484	2012	Laundry
D12/095458	2012	Maintenance Facility
D12/594885	2012	Maintenance
D12/095478	2012	Programs / Services
D12/095480	2012	Recreation

D12/095508	2012	Security
D12/095472	2012	Staff
D12/095482	2012	Visiting
D12/214222	2012	Court Cells
D12/214304	2012	Residential Security
D12/494532	2012	CCTV Systems
D12/493566	2012	Lifeskills Kitchen
D12/494876	2012	Suppliers and Products
D12/286803	2012	Training Kitchen
D18/07512	2018	DJ Local Area Network Standard
D17/384404	2017	MATV / IPTV Scope for Prison Bed Capacity Program
	2017	Audio-visual Systems Specification
D18/077742	2018	DJ Telecommunications Cabling and Infrastructure Facilities Standard

1.7 Authorities

The complete installation and all works being carried out shall comply with the requirements and regulations of all Statutory Authorities and Codes relevant to the works, including:

- The National Construction Code (Building Code of Australia);
- Standards Australia;
- The Local Fire Brigade;
- Work Health & Safety;
- Local City/Shire Council;
- Any other authority having jurisdiction over all or part of the installations to ensure that the equipment and installation, when manufactured and installed, shall comply with the relevant rules and regulations.

Observe all requirements and regulations of the Lifts and Scaffolds Act.

The Contractor is responsible for lodging all applications, seeking all approvals, and payment of all fees and charges legally demandable for relevant services prior to the commencement of works to meet the project construction programme.

Where standards and regulations are mentioned in this specification they shall include all amendments and interpretations. On completion, the whole of the equipment and installation is to be inspected by the appropriate authority's representative.

The Contractor shall obtain and fill in all notices required by the relevant Authorities where necessary and pay all fees in connection therewith and shall submit for approval all necessary drawings and obtain all consents required to permit execution of the works.

The Contractor shall procure all necessary permits and approvals from Authorities and shall advise the Superintendent if obtainment of any permits is likely to delay building construction. The Contractor shall provide certificate of compliance indicating a satisfactory installation from all relevant Authorities.

1.8 Project Description

The following provides a description of the works involved at each NSW Correctional Facility.

Bathurst Correctional Centre

The Bathurst Correctional Centre is currently a minimum and medium security facility for male offenders housing 495 medium security and 165 minimum security inmates. It is located 200km west of Sydney.

The proposed new 220 bed maximum security male facility is intended to be operated in conjunction with the existing medium security facility.

The works are to be completed to enable acceptance of prisoners in April 2020.

The works are generally summarised as:

- A new 220 bed maximum security compound with Gatehouse, Administration, Staff Amenities, Reception, Accommodation, Industries and Programs, 10 bed Segregation and Clinic buildings all located to the south east of the existing compound.
- The installation of a pedestrian and vehicle lock between the existing medium security compound and the new maximum security compound. This will require an opening in the existing heritage perimeter wall.
- New facilities located outside the secure perimeter for Central Stores and Grounds Maintenance.
- New facilities located within the minimum security compound for Kitchen and Laundry.

Metropolitan Remand and Reception Centre (MRRC)

The Metropolitan Remand and Reception Centre (MRRC) is currently a maximum security facility for male offenders housing 1,086 maximum security inmates and 21km west of Sydney CBD.

Not Applicable

The proposed new 440 bed maximum security male facility is intended to be operated in conjunction with the existing facility.

The works are to be completed to enable acceptance of prisoners in June 2020.

The works are generally summarised as:

- A new 440 bed maximum security compound with Accommodation, Recreation, Satellite Clinic and Programs buildings all located in the South East corner of the existing secure facility.
- Refurbishment works to parts of the existing facility. These works will upgrade some existing functionality and services, including security services, within the centre, and provide additional space to utilise the shared Visits, Segregation, Retherm Kitchen, Laundry, Property Stores and Clinic facilities; and
- New facilities located outside the secure perimeter for Staff Parking; and

Dillwynia

The Dillwynia Correctional Centre is currently a minimum/medium security correctional centre for women offenders housing 300 00 at a medium security classification of which 44 a high risk operating beds. Dillwynia is located within the John Morony Correctional Complex at Windsor 56km west of Sydney CBD.

The proposed new 248 bed female maximum security expansion is to be operated in conjunction with the existing medium security facility.

The works are to be completed to enable acceptance of prisoners in April 2020.

The works are generally summarised as:

- A new 248 bed medium security compound with Accommodation, Satellite Clinic, Visits, Reception, Industries, Segregation and Programs; and
- Refurbishment works to parts of the existing facility. These works will upgrade some existing functionality and services, including security services within the centre.

Outer Metropolitan Multi-Purpose Correctional Centre (OMMPCC)

The Outer Metro Multi - Purpose Correctional Centre is currently a multi-purpose correctional centre housing 380 inmates and is located within the John Morony Correctional Complex at Windsor approximately 56km west of the Sydney CBD.

The Outer Metro Multi-Purpose Correctional Centre at John Morony is to provide an upgrade and refurbishment resulting in a total of 150 minimum and 100 medium security beds whilst retaining the existing 70 bed honour house and 80 bed modular accommodation.

Not Applicable

The works are to be completed to enable the acceptance of prisoners in 2020.

The Works are generally summarised as:

- The demolition of old and subsequent construction of replacement accommodation blocks with the main correctional centre
- The master planning of a 70-bed minimum security block adjacent to the existing Honour House, 1 x 48 bed minimum security accommodation block plus 1 x 48 medium security accommodation block and a programs building adjacent the 80 modular accommodation.
- Construction of a new visits centre for the Honour House and upgrades to the gatehouse, main visits area and security.

Cessnock 280

The Cessnock Correctional Centre is currently a Medium and Minimum security facility for male and female inmates, the Cessnock Correctional Centre is located within the Cessnock Correctional Complex that is located approximately 150km north west of the Sydney CBD.

The Cessnock Correctional Centre is to be expanded with the addition of a 280-bed minimum security accommodation and supporting infrastructure.

The Works are to be completed to enable the acceptance of prisoners in 2020.

The Works are generally summarised as:

- An extension of the existing Cessnock correctional centre with an additional 280 minimum security beds, and associated infrastructure including a Gatehouse, Health/Reception and Programs building will be constructed to the east and south of the existing centre and are being designed to support the existing centre.
- The Accommodation will be comprised of five accommodation blocks each with forty eight beds
- A new access through the gatehouse to the existing industry buildings will also be included.

The Fire systems may vary from site to site due to site conditions, etc.

It is the intention that the D&C contractor prepares design documentation based on the performance requirements outlined within this specification in conjunction with associated architectural design drawings.

Security, system reliability, ease of maintenance and energy efficiency are a high priority for the project.

2. DESIGN BRIEF

2.1 General

The Design activities must be carried out with Best Design Practices with emphasis on energy efficiency, ESD principals, adaptability, reliability, durability, safety and allowance for future expansion and reconfiguration.

The engineering services must complement the delivery of the Correction Services requirements.

2.2 Flexibility and Adaptability of Building Services

Correctional Facilities may be subject to potential for an ongoing program of modification, alteration and upgrades over the life of the facility.

As such, the building services must be design to be readily adaptable and flexible. Designs must therefore be completed ensuring minimal disruption to the facility, consider security implications and be at a minimum cost.

Correction Facilities include a wide variety of buildings and spaces for a number of different uses. The design must allow for isolation and separation of services, to the degree necessary and appropriate, to allow for part work, maintenance and upgrades. For example, works to an Education Building must not inhibit use of an Accommodation Block.

Services reticulation routes, including service corridors and risers must be directly accessible. No single service shall be required to be shut down to allow work on another service.

Consideration must be given to access for all services, and where possible not require access through or via inmate accessible areas.

Plant and equipment locations shall not be located in such a way as to allow a route for access to building roofs.

2.3 Building Services Plant Space and Reticulation

2.3.1 Plant Space

Engineering Plant and equipment installations must be arranged such that Plant and equipment that requires scheduled maintenance servicing is located outside of inmate occupied areas.

Where riser shafts are used, all riser shafts must be fully accessible for the height of the riser. Plant and equipment requiring access in services cupboards must be limited to a maximum height of 2.2m above floor level. No Plant or equipment will be located such that access to or in riser shafts is impeded.

Plant and equipment must be located to avoid vibration and electromagnetic interference. Plant and equipment accommodation must also take into account the acoustic requirements of adjoining occupied areas.

Where duplicate services are employed, these services must be located in separate riser shafts and follow distinctly separate routes.

Access to equipment in plant rooms must be via normal walk-in access and must not require the use of specialised access equipment or temporary scaffolding. Permanent access platforms and ladders must be provided where safe maintenance access is not possible from floor level.

Plant and equipment access must take into account the access needs for the replacement of all major components. Access and removal routes must be planned.

Fresh air intakes (including openable windows) must be arranged to minimise the risk of air recirculation under prevailing wind conditions, or cross contamination from nearby exhaust vents and flues.

Correction Facilities are highly secure spaces, and some areas are at high risk of vandalism.. When placing expensive services equipment outside, the Contractor must make all necessary provision for security and protection against theft and vandalism.

2.3.2 Services Reticulation

Service routes must be designed such that clearly identified routes are provided for piping and cabling installations from central plant to final usage points.

Zoned ceiling spaces for the reticulation of services with appropriate access must be provided. All services must be segregated to suit the function and type of service.

Cables must be segregated into high voltage, low voltage, communications, fire services and security services.

All services must be fully supported along their length. No service will be supported by an accessible or lightweight ceiling structure.

2.3.3 Redundancy, Capacity and Spatial Provision for Future Expansion

The Contractor must provide sufficient spare space and spare capacity to accommodate for future expansion up to a 50% increase of current nominated inmate capacity.

All services reticulation routes, from those running to central Plant and equipment locations to those routes through corridor ceilings must be provided with a spatial allowance for distribution of future services.

The Contractor must provide the following requirements with regard to spatial provision and engineering services design to accommodate for future expansion:

- the capacity of all incoming and outgoing services to the Site must accommodate the increase in inmate capacity;
- reticulation of installed Site services and infrastructure must make provision for the increase in inmate capacity including distribution of local power and security conduits and connector pillars, distribution of ICT conduits, distribution of water supply and drainage connection points to a location maximum 40m away from the proposed location of the buildings;
- all vertical and horizontal distribution including piping, racks, trays, culverts and service corridors must have allowance for future expansion;
- all switchboards and panels must incorporate spare capacity and spatial allowance for expansion;
- all services risers must be accessible for their full height and must have space for future services;
- all services cupboards for switchboards and panels must have space for future services;
- all central Plant and equipment, including boilers, electrical sub-stations, etc. must have a spare capacity for future growth built into their sizing calculations; and
- the design strategies employed to ensure adequate flexibility and adaptability must include intelligent spatial planning, good access to all services, provision for Plant redundancy and replacement, and the provision of adequate means of isolating systems and parts of systems to carry out future works.

2.4 Safety in Design

The Contractor must comply with the requirements of Work Health and Safety Act 2011 (WHS Act) – in particular section 22 of the Act. The WHS Act is supported by Work Health and Safety Regulation 2011, Codes of Practice and guidance material. The WHS Act has safety duties which apply to anyone who has control of the design or manufacture of plant, a workplace or a system (including anyone who has the authority to make decisions about design or manufacture).

Safety in Design from an operational and lifecycle maintenance perspective is a requirement of this Contract. The Contractor must design the facility so that – when constructed – it is safe and does not pose risks to the health, safety and welfare of people working or contained there, when using the workplace for a purpose for which it was intended.

The Contractor must complete Safety in Design reviews throughout all of the design phases under this contract. The Safety in Design assessment must consider the principles of "so far as reasonably practicable" and apply a hierarchy of controls, risk reduction and mitigation.

Engage with the Department of Justice and use a structured methodology for identifying risks (phase 1) and for eliminating and managing risks (phase 2).

Use a risk analysis approach, and risk workshops to consider the scope of the Project as a work environment. Identify the range of workers/inmates who will be employed/contained at the site, and their work tasks. Progressively develop the design using the "Preliminary Hazard Analysis" which identifies a range of different types of hazards and risks as part of managing risk. In iterative design reports, identify the design team's response to identified hazards and safety risks, including providing clear and traceable evidence that the design has been refined and changed to eliminate or reduce identified safety hazards. For each design decision that carries a legacy maintenance or repair requirement, consider the design solution for the perspective of a safe working environment.

Document and submit copies of the design team's "Preliminary Hazard Analysis" and the response to identified hazards including evidence that the design has been refined and changed to eliminate or reduce identified hazards.

2.5 Existing Infrastructure

Condition and Adequacy of Existing Systems:

- Each individual sites service connections (water, power, detection, etc.) shall be assessed for suitability and adequacy to facilitate the new works. Allow to complete all necessary investigations, council liaising, fees and charges as part of the due diligence exercise. It is noted that some preliminary investigations have been completed for a number of sites. Where available, the Contractor shall use these initial Authority assessments/investigations as the basis for their design assessment. The Contractor shall request copies of such reports and assessments at the commencement of the project.
- The initial investigations, due diligence and assessment shall commence immediately after engagement.
- If the existing conditions do not conform or meet the needs to facilitate the new works, submit proposals to rectify the deficiencies including related costing, time and other impacts caused by the proposed works.
- Subject to the rectification works on existing systems, achieve the performance in the contract documents in conjunction with the design intent of this specification.

2.6 Working on & Extending from Existing Systems

General: Decommission, isolate, demolish and remove from the site all existing redundant equipment including minor associated components that become redundant as a result of the demolition.

Breaking Down: Disassemble or cut up equipment where necessary to allow removal.

Recovered Materials: Recover all components associated with the listed items. Minimise damage during removal and deliver to the locations documented.

Live Operation: Where works are to be carried out on or extended from existing systems the contractor shall develop a robust methodology to ensure the existing systems remain live at all time where possible. Where this is not possible the Contractor shall coordinate with the Superintendent to ensure the works have minimal impact on the existing facilities. The Contractor shall provide the Superintendent a detailed schedule of agreed shut down times to enable the connections/extensions a minimum of two (2) weeks prior to the commencing.

2.7 Design Life Cycle

System or Item of Equipment or Element	Minimum Design Service Life
Fire Detection System	15 years
Occupant Warning System	15 years
MASD Systems	15 years
Fire Extinguishers	15 years
Fire Suppression	20 years
Fire Sprinkler System	30 years
Fire Booster Pumps	
Kitchen Hood Suppression	15 years

Not Applicable

2.8 Design Constraints

The mechanical services design must consider the following design, construction and ongoing maintenance constraints.

- Ensure that there are no possible ligature points in inmate areas.
- Be anti-tamper proof
- Fire services plant and equipment should be located in dedicated plant areas and/or cupboards that cannot be accessed from inmate areas.

Refer to room data sheet

2.9 Building and Room Requirements Summary

Note that the following Building summaries are typical, and do not necessarily represent the complete list of all rooms which may be included in specific buildings. Refer Appendix A for a list of room data sheets that has been included to provide more detailed information for the specific room types.

Room	Accommodation Block – In Situ	Accommodation Block – In Situ	Programs	Industries (Kitchen &/or Laundry)	Industries (Other) / External Store	Health	Segregation	Visits	Gatehouse	Administration	Reception	Sports / Gym / Recreation
Armoury									■	■		
AVL Suite	■						■					
Bathroom c/w shower	■	■	■	■		■	■	■	■	■	■	■
Bathroom c/w WC only	■	■	■	■		■	■	■	■	■	■	■
Break out space			■			■						
Carrier Room									■			
Cell – Access	■	■					■					
Cell – Single	■	■					■					
Cell – Double	■	■										
Cell – Holding	■	■				■		■				
Cell - Observation						■					■	
Change room												■
Chemical Store				■								
Cleaner	■	■	■	■	■	■	■	■	■	■	■	■
Comms	■	■	■	■	■	■	■	■		■	■	■
Consultation						■						
Contact Visits								■				
Control Room									■	■		
Cool Room				■								
Court Indoor												■
Day Room	■	■					■					
Dispensary						■	■					
Dormitory	■											

Room	Accommodation Block – In Situ	Accommodation Block – In Situ	Programs	Industries (Kitchen &/or Laundry)	Industries (Other) / External Store	Health	Segregation	Visits	Gatehouse	Administration	Reception	Sports / Gym / Recreation
Dress/ Undress								■				
Dry Store				■								
Entry	■	■	■			■		■	■	■	■	■
Freezer				■								
Inmate Clerk				■	■							
Interview Room	■	■	■	■	■	■	■	■	■	■	■	
Kitchen exhaust hoods				■								
Kitchen/Tea	■	■	■		■	■	■	■	■	■	■	
Legal								■				
Locker Room									■	■		
Meals			■	■	■	■		■	■	■	■	
Medicine						■						
Meeting			■			■		■	■	■	■	
Multi-faith			■									
Non-Contact								■				
Office - Large			■	■	■	■		■	■	■	■	
Office - Medium			■	■	■	■		■	■	■	■	
Office - Small			■	■	■	■		■	■	■	■	
Officer Post	■	■	■	■	■	■	■	■	■	■	■	■
Officer Post 2			■									
Passage-Airlock							■					
Passage-Corridor	■	■					■					
Plant	■	■	■	■	■	■	■	■	■	■	■	■
Print Room									■	■		
Processing											■	
Programs 1			■									

Room	Accommodation Block – In Situ	Accommodation Block – In Situ	Programs	Industries (Kitchen &/or Laundry)	Industries (Other) / External Store	Health	Segregation	Visits	Gatehouse	Administration	Reception	Sports / Gym / Recreation
Programs 2			■									
Property Store											■	
Ready Room									■	■		
Retherm Kitchen				■								
Retherm Ovens				■								
Roof Space	■	■	■	■	■	■	■	■	■	■	■	■
Secure Store											■	
Secure Waiting											■	
Server Room									■	■		
Store	■	■	■	■	■	■	■	■	■	■	■	■
Tool store					■							
Training Room				■	■							
Treatment						■						
UPS									■			
Utilities						■						
Visitor Waiting Room								■				
Waiting Room								■	■			
Wash zone				■								
Washing/ Drying				■								
Yard	■	■			■	■	■	■				

2.10 Fire Services Overview

The following provides a brief overview of the works involved for the various NSW Correctional Facilities based on a design & construct methodology:

- Fire Detection Systems.
- Networked of Main Fire Indicator Panel (MFIP) connected to building Sub Fire Indicator Panels (SFIP)
- Building Occupant Warning Systems
- Fire Extinguishers and blankets.
- ~~Fire Suppressions systems – Hydramist or Kitchen Hood Suppression~~
- Fire Sprinkler Syste[m] (Not Applicable) [y] Alternate Solution)
- ~~Fire Booster Pumps &/or Tanks – If required~~

2.11 Building Fire Services Design Summary

General: The new facility require the installation of fire alarm system compliant with Specification E2.2a of the BCA and any additional requirement for smoke hazard management as identified within the approved Fire ~~engineering report~~ 1670.1-2015

2.11.1 Fire Detection

Overview: Each building will be equipped with smoke detection and occupant warning system complaint to AS 1670.1. Area for inmates' accommodation (cells) and similar sensitive areas will be equipped with a Multi-aspirating Smoke Detection (MASD). The use of a VESDA system or equal approved will facilitate the intent of the site specific Fire engineering Report in consultation with the Fire Safety Engineers requirements.

point type fire detection will be installed throughout all buildings except in bed rooms of accommodation areas and in the holding cells of health and reception buildings.

~~The occupant warning system will consist of emergency warning speakers and where applicable, additional visual~~ warning strobe lights. The warning devices will be distributed throughout the premises to provide occupants a fire warning signal.

Refer to below page for additional information regarding MASD

Refer to below page for FIP description

MASD

Multi-Aspirating smoke detectors units (~~MADA~~) will be networked between them and communicate with the local Sub FIP to the Main FIP. A high level interface network will link all the MASD units complete with power supply and battery back-up. The MASD will display alarm at the main FIP and local indication in each building. Each building will be equipped with external strobe light to facilitate the location of the building in alarm.

Break glass alarms (BGA) are to be installed within each lockable hose reel cupboard within the building to compliment the FIP BGA. ~~Dry Fire system will be represented by a colour graphics system inclusive of building, MASD, ancillaries as required by the NSW Corrective Services~~.

The fire detection and alarm system (dry fire) is to be connected to third party fire monitoring with the nominated services provider Code Red or equal approved.

Refer: Product group specific applicable sections of this specification contained herein.

Refer to below page for additional information regarding MASD

FIP:

Each new building will be equipped with an addressable FIP.
The site's main FIP (also addressable) will be located on the ground floor of the new gate house and will be linked to the Fire Brigade by ASE As nominated in the FER, sub FIP's will be located in the programs, accommodation and health& reception buildings. Each subFIP will be networked to the main FIP by a certified optical fibre networking system consisting of fibre laid point-to-point underground in 63mm conduit over two geographically separated paths
Mimic panels will be located on the first floor of the new gate house (within the control room) and within the nursing staff area of the health & reception building. Mimic panels will be wired to and powered from the local SFIP.
The existing FIP in the existing gate house will serve as a sub FIP and will be connected linked to the main FIP in at the new gate house such that all signals from the existing FIP are relayed to the new panel
F bre-optic network cable will be used to interconnect all FIP's throughout the development
Fire Indicator Panels are to be of microprocessor type, capable of operating a distributed and multi loop network of analogue addressable smoke, heat and MASD detectors as well as other ancillary devices. The FIP shall be interfaced with other services such as mechanical services, lift services and security systems. The smoke hazard management system will interface with essential services equipment as required. The FIP shall also include occupant warning system in accordance with AS1670.1-2015 and NCC requirements

Mimic panel
Mimic panels will be located on the first floor of the new gate house (within the control room) and within the nursing staff area of the health & reception building. Mimic panels will be wired to and powered from the local SFIP.

MADS

A multi aspirated smoke detection (MASD) system will be provided in accordance with AS1670.1-2015 in bed rooms of accommodation area and holding cells of health and reception buildings. The MASD system will connect to the local fire panel in a manner compliant with AS1670.1. The MASD will be able to report the blockage of any single sampling point. The MASD will be able to identify which individual holding cell has caused the alarm. For bedrooms, a maximum of five bedrooms in one area will be responsible for any one alarm to ensure prompt response.

Caps over the aspirating smoke detectors will be installed to prevent tampering. The caps must be certified to not affect system operation by the MASD supplier. MASD exhaust air shall be returned to the same space as the intake air where poss ble to avoid air pressure issues. Filters will be in access ble locations. Cleaning of sampling tubes should not require access to cells.

OWS

An OWS will be provided in each building as required by AS1670.1. Primarily, all areas except holding cells and bed rooms will have a speaker network of flush (or recessed) speakers. Surface mounted or horn type speakers will be provided only where embedment in the ceiling is not possible and not in areas accessible to inmates. All speakers will be connected to a tone generator located within the building's FIP.
Speakers will not be provided to bedrooms, holding cells or any other location where the occupant cannot leave of their own accord.

1670.1-2015

2.11.2 Occupant Warning System (OWS)

Overview: OWS shall be provided in each building as required by AS1670.1. Primarily, all areas will have a speaker network of surface mount, flush (or recessed) or horn type speakers connected to a tone generator located within the building FIP. The first ~~speak~~ SPEAKER shall be connected to the FIP with fire rated cable in accordance with the applicable Australian Standards requirements. Each speaker circuit shall be terminated with an End of Line (EOL) device to allow fault identification at the FIP. This devices location must be shown on the "As Installed" drawings upon project completion.

Where high noise areas are likely to occur a strobe is to be fitted. Sound pressure levels are to comply with the requirements of AS1670.1.3.22 with specific attention but not limited to the following:

- Generally a minimum of 65dB(A) throughout all buildings
- Where required to arouse sleeping occupants a minimum of 75dB(A) is required at the bedhead with all doors closed.

Refer: Product group specific applicable sections of this specification contained herein.

2.11.3 Fire Extinguishers and blankets

Overview: Portable fire extinguishers will be provided in accordance with BCA provision and type of hazard. The portable extinguisher will be located in proximity of Fire hose reels and other hazardous location to cover for class A and E type of fire.

Refer: Fire Extinguishers and Blankets section of this specification for details.

~~2.11.4~~ Hydrants & Hose Reels

Overview: Hydrants and hose reels do not form part of this specification. The Hydraulic contractor will be responsible for the design and installation of these systems. However, should the hydrant system require pumps and tanks this shall fall to the Fire services contractor.

The fire services contractor is to determine the co Not Applicable fire water storage tanks in consultation with the relevant project stake holders. The fire services contractor is responsible for the design, construction, installation, commissioning and ongoing maintenance.

Where pumps are required, the contractor shall install design, construct, install, commission and complete maintenance for the adequate number, type and correctly sized fire booster pumps complete with all hardware as specified herein.

Refer: Product group specific applicable sections of this specification contained herein.

2.11.5 Other Systems

Other systems such as Hydramist, Kitchen Hood Suppression systems and sprinkler systems will likely form part of a wider asset protection s Not Applicable tractor is to seek out the relevant project stakeholders and meet the client's expectations and/or Fire Safety Engineers requirements.

3. GENERAL REQUIREMENTS

3.1 Description of Works

This Performance Specification has been prepared to allow the calling of Design and Construction (D&C) tenders for the Fire Services related to new works and refurbishment works at the nominated NSW correctional facilities.

3.2 Design & Construct

3.2.1 Design and Construct Documentation Obligation

Scope of Works: The extent of the fires work covered in this Specification consist of the Design and Construct of the following systems and services. Note that w ay be mandated as part of a site/building alternate solution, the installation of sprinklers i NSW Corrective services due to vandalism and nuisance issues and alternative systems are to be installed to protect the facility;

Not Applicable

- Fire Detection and Alarm System
- Occupant Warning System
- Fire Extinguishers and Fire Blankets.
- Water-mist Fire Suppression Service;
- Kitchen H sion Service;
- Fire Sprinkler Service;

Not Applicable

Requirement: The Contractor shall be responsible for developing the fire design and construct documentation to completion, as deemed acceptable by the Principal:

- Update of all documentation to the most current architectural layouts;
- Final confirmation of adequacy of spatial allocations;
- Size and locations of penetrations in walls and floors;
- Final coordination with all architectural layouts and all structural beams and columns;
- Workshop drawings drawn in 1:100 scale;
- Final coordination with all other services including, but not limited to, Mechanical, Electrical, Hydraulic, Audio-Visual, Food Services, Security, Landscaping, and Vertical Transport;
- Final sizing of all pipework and associated fire services plant including detailed design calculations.

Authority Regulations: The whole of the works shall comply with all the latest relevant Regulations and to all Local Authority requirements. The cost of any materials or equipment required to meet such regulations and requirements shall be included in the tender whether specially shown or described in the documents or not.

Materials: All materials and equipment shall be the best quality of their respective kinds, complying with the relevant Australian Standards. All materials and equipment shall be new and shall be delivered to the site with the manufacturer's label intact.

3.2.2 Design and Construct Contractor Responsibilities

Design by Contractor: The services shall be undertaken on a Design and Construct basis where it is the Contractor's responsibility to be completely aware of all project requirements incorporated in the design intent documents. The Contractor is to ensure that all obligations with respect to the brief are met, including design and installation, and the performance requirements of the design intent documentation. The contractor shall use only appropriately qualified persons and conform to all statutory requirements.

Design Development: The works include development of the design beyond that documented, as required. The fire services contractor will need to, on a design and construct basis, indicate the spatial allowances, design concepts, fire risers, and main fire pip[illegible]n in principle. It is the Contractors responsibility to further advance the design intent documentation in order to complete the final design package in coordination with all other contract documentation of other trade and disciplines.

Not Applicable

Design for Durability: Develop the design so the systems achieve the documented performance, reliability, service life, energy efficiency and safety requirements, and are easily maintainable.

Access for Maintenance: Develop the design so the systems conform to Access for Maintenance.

Conflict with the Documents: If it is believed that a conflict exists between statutory requirements and the documents, notify the contract administrator immediately and provide a recommendation to resolve the conflict.

3.2.3 Contractor Documentation Submissions

Requirement: The Contractor shall be responsible for developing the fire design and construct documentation to completion, as deemed acceptable by the Principal:

- Contractor submission schedules;
- Workshop drawing submission schedule;
- Coordinated workshop drawings;
- Coordinated structural penetration drawings;
- Material and equipment schedules;
- Detailed fire calculations for each fire services system;
- Testing and commissioning procedures;
- Testing and commissioning records;
- As-built drawings;
- Operation and maintenance manuals;
- Design certification;
- Installation certification.

3.3 Compliance

Requirement: The Fire Services shall be installed to comply with all current statutory requirements including, but not limited to, Building Code of Australia, Local Legislative requirements, Local NSW Council, Local NSW Water Authority, NSW Fire Brigade, NSW Department of Justice and relevant Australian Standards. The work shall comply with these listed regulations, whether or not specific reference is made in this Specification.

3.3.1 Contractual Relationships

General: Responsibilities and duties of the principal, contractor and contract administrator are not altered by requirements in the documents referenced in this specification.

3.3.2 Current Editions

General: Use referenced documents which are the editions, with amendments, current 3 months before the closing date for tenders, except where other editions or amendments are required by statutory authorities.

Relevance: If doubt exists as to the appropriate standard, the decision shall be made by the Superintendent after consultation with the Fire Services Engineer prior to the commencement of any work on or off site. No consideration of claim for redundant work shall be given if the Superintendent and Fire Services Engineer have not been notified.

3.3.3 Standards and Codes

The work shall comply with these listed regulations, whether or not specific reference is made in this Specification. A brief summary of key Standards and Codes that generally apply to these works is as provided in Section2. Where specific parts are not mentioned, the entire series of the associated Standard shall apply.

3.4 Contract Documents

3.4.1 Accompanying Drawings

General: There are no accompanying drawings with this specification.

3.4.2 Services Diagrammatic Schematic Drawings

General: Where provided layouts of service lines, plant and equipment shown on the drawings are diagrammatic only, except where figured dimensions are provided or calculable.

3.4.3 Before Commencing Work

General: Prior to commencing any works on site the following but not limited to should be obtained,

- Obtain project specific architectural drawings
- Obtain measurements and other necessary information;
- Coordinate the design and installation in conjunction with all trades.

Note 1: The Contractor shall ensure that the latest revision of the contract documentation are being referenced at all times.

Note 2: No warranty is given as to the completeness or accuracy of drawings and/or manuals of existing services. The Contractor shall allow for all necessary diversions and minor adjustments to pipework and equipment as may be necessary to complete the works.

3.4.4 Drawings and Manuals for Existing Services

General: The fire services contractor should obtain any and all existing services drawings prior to works commencing one site.

Warranty: No warranty is given as to the completeness or accuracy of drawings and/or manuals of existing services.

3.5 Interface of Dry & W Not Applicable ces

3.5.1 Wet Fire/Dry Fire

Interface	Wet Fire	Dry Fire
Flow Switches	Provide flow switches complete with anti-tamper screws (on cover) for dual SPDT enclosed switch for connection to dry fire system.	Provide interface device to connect to the flow switch.
Pressure Switches	Provide pressure switch Not Applicable anti-tamper screws (on cover) for enclosed switch for connection to dry fire system.	Provide interface device to connect to the pressure switch.
Anti-tamper Devices	Provide anti tamper device complete with anti-tamper screws (on cover) for enclosed switch for connection to dry fire system.	Provide interface device to connect to the anti-tamper device.
Remote Test Drains	Provide remote test drain pipework and equipment complete with lockable ball valve.	Provide solenoid and interface devices to connect to the pipework provided.
Jacking Pump Starts	Provide jacking pump Not Applicable in.	Provide interface device to connect to the anti-tamper device.
Fire Booster Pumps	Provided fire services booster pumps complete with control systems as documented herein.	Provide interface device to connect to the anti-tamper device.

3.6 Work by Other Trades

3.6.1 Builder/Fire

Interface	Builder	Fire
Fire Brigade Booster Assembly	Provide concrete plinth for booster assembly.	Provide Fire Brigade Booster Assembly complete with enclosure, signage & block plans.
Fire Services Pumpset Enclosure	Provide enclosure complete with concrete plinth for fire [illegible] and graded floors Not Applicable	Provide fire booster pump assembly.
Fire Sprinkler Alarm Valve Enclosure	Provide enclosure for Fire Sprinkler Alarm Valve and associated equipment	Provide Fire Sprinkler Alarm Valve/s and all associated equipment
Fire Services Test Drains	Provided bunding wall for drainage system.	Coordinate final position of bunding wall for annual flow testing.
Ceiling Tiles	Supply and install all ceiling tiles (& ceilings) required.	Removal and replacement of ceiling tiles for commissioning of ceiling mounted equipment.
Openings through the building structure for the passage of pipework, cabling and the like.	Provide clear openings through the building structure.	Submit details of openings required. Fire stopping of penetrations through fire rated floors, walls and the like by pipework, conduit, etc.
Access panels for the inspection, adjustment, access and maintenance of equipment	Provide access openings and panels in walls, masonry shafts and ceilings.	Provide a marked up drawing of required access panels required prior to commencement on site.
General lighting, temporary power and water for construction purposes.	Provide access lighting, temporary power and water for construction purposes.	Provide task lighting.
Water, gas and electricity for commissioning and test running of the plant and equipment.	Provide water, gas and electricity for commissioning and test running of the plant and equipment.	Submit commissioning plans and schedules.
Roof or External Wall penetrations	Provide adequate material for installation of hardware.	Install deck-tights, over flashing and under flashing of ducts, pipes and the like penetrating external walls and roof.
Tanks	Hardstands required to support tank structures. Not Applicable	Provide all fire water storage tanks required to supply the fire services based on the requirements of the system.

3.6.2 Hydraulic/Fire

Interface	Hydraulic	Fire
Water Supply	Provide water to service the Fire Services System. Provided termination point for Fire Services within the property boundary and/or at the Fire Booster Assembly.	Inform hydraulic contractor of fire sprinkler system water supply requirements.
Fire Brigade Booster	Provide Fire Brigade Booster Assembly complete with table E flanges for connection to sprinkler system (as required) & monitoring devices on isolation valves.	Connect to table E flanges provided on the booster assembly. Provide dry fire interface for booster assembly anti-tamper monitoring
Fire Services Pumpset	Coordinate with the fire services contractor to confirm design intent of combined hydrant/sprinkler system (as required). Provision of a flanged wa Not Applicable fire booster pump room t valve nominally 300 mm above the finished floor.	Provide fire booster pump complete with suitable duty for sprinklers & hydrants where combined systems are installed.
Fire Services Main Test Drains	Provide drain points for high flow test drains as advised by the Fire Services contractor.	Coordinate final position of remote test drains with the Hydraulics contractor.
Fire Services Remote Test Drains	Provide drain points for remote test drains as advised by the Fire Services contractor.	Coordinate final position of remote test drains with the Hydraulics contractor.
Fire Hose Reels	Provision for all components of the fire hose reel system.	No works required.
Fire Services Water Tanks	Automatic infill system for tanks.	Provided fire services water tanks.

3.6.3 Electrical/Fire

Interface	Electrical	Fire
Power Supply in Sprinkler Valve Room/Enclosure	Single phase 240V power supply complete with captive socket suitable for three (3) pin plug). Not Applicable	Provide technical data for connection power supply for jacking pump/s.
Power Supply at Main Fire Indicator Panel (FIP)	Single phase 240V power supply and connection to FIP.	Fire Services Contractor to provide information for connection of submains.
Power Supply at Sub Fire Indicator Panel (SFIP)	Single phase 240V power supply and connection to SFIP.	Provide technical data for connection of power supply for SFIP. Mimic panels will be wired to and powered from the local SFIP.
Power Supply Multi Aspirating Smoke Detectors (MASD)	Single phase 240V power supply and connection to MASD.	Provide technical data for connection of power supply for MASD.
Fire Booster Pumps	Single phase 240V power supply and connection to Fire Pump Controller/s. Three Phase 415V power supply and connection to Elec Not Applicable Pump as required.	Provide technical data for connection of power supply for Fire Pump Controller/s. Provide technical data for connection of power supply for Fire Booster Pump/s.
Lighting and power	Provision of lighting and general power outlets in the fire control enclosures.	Provide design input to Electrical Contractor for requirements of lighting and power for Fire Services.

3.6.4 Mechanical/ Fire

Interface	Mechanical	Fire
General Fire Alarm	Provide control wiring, terminal strip, relays and interlocks associated to receive 24V dry contact from FIP.	Wire from the Fire Indicator Panel and connect to terminal strip in mechanical services switchboard in each location as required.
Fire Indicator Panel (FIP)	Provide the Fire Services Contractor with the information required for the FIP to interface with the mechanical services switchboard/s.	Provide FIP complete with interface logic & field based hardware to interface with mechanical services switchboard.
Fire Fan Control Panel	Provide the Fire Services Contractor with the information required for the FIP to interface with the mechanical services switchboard/s.	Provide FFCP complete with interface logic & field based hardware to interface with mechanical services switchboard.
Air handling plant fire mode operation	Provide control wiring, terminal strip, relays and interlocks associated with the	Wire from the Fire Indicator Panel/fire fan control panel and connect to

Interface	Mechanical	Fire
	air handling plant fire mode operation in the mechanical services switchboard.	terminal strip in mechanical services switchboard.
Air handling plant equipment	Provide information to the Fire Services contractor pertaining to mechanical duct work locations for fire detection hardware to be installed.	Provide all fire detection hardware required to interface with the mechanical air handling system to ensure correct operation during fire mode.
Fire smoke dampers	Provide control wiring, terminal strip, relays and interlocks associated with fire/smoke dampers in air ducts, plenums and penetrations.	Wire from the Fire Indicator Panel and connect to terminal strip in mechanical services damper control panel in each location as required.
Smoke Control (&/or Ventilation)	Provide control wiring, terminal strip, relays and interlocks associated with the smoke control (&/or ventilation) plant fire mode operation in the mechanical switchboard. Provide fan status signals within the Fire Fan Control Panel (FFCP). Provide wiring , connections & interfaces between smoke control system and operable louvre and fire shutters and exhausts	Wire from the Fire Indicator Panel/fire fan control panel and connect to terminal strip in mechanical services switchboard. Provide the following signals: • Exhaust Fan Run • Exhaust Fan Stop • Supply Fans Run • Supply Fans Stop Wire from FIP/FFCP and connect to mechanical services switch board . provide the fire trip signal for fire shutter and louver Pick-up the fan status signals from the terminal strip in the mechanical switchboard.
Smoke detectors in air handling units ductwork and plenums	Provide access panels for access to smoke detectors etc. Provide openings and penetrations for the passage of wiring, conduit, smoke detectors, etc. Provision of collars and sealing of penetrations.	Provision of a complete smoke detection system to serve the air conditioning systems and the ventilation systems in accordance with AS 1670.1, including supply air and return air smoke detectors, required exit smoke detectors and provision of an integrated Fire Indicator Panel and Fire Fan Control Panel (FFCP). and exhausts
Sprinklers in air handling units ductwork and plenums, etc	Provide access panels for access to sprinkler heads. Provide openings for the passage of fire services pipework, sprinklers, etc. Provision of collars and sealing of penetrations. Not Applicable	Provision of a sprinkler and piping complete with duct box connected to sprinkler system network piping.
Full Fire Function Matrix (FFFM)	Coordinate with the Fire Services contractor all equipment required to operate in fire mode. Review FFFM for sign off during commissioning.	Complete FFFM.

Interface	Mechanical	Fire
Tactical Fire Plan	Provide the information required for the tactical fire plan.	Prepare the tactical fire plan for the building.
Commissioning (Full Function Fire Test)	Provide all personnel and equipment necessary for commissioning of all mechanical systems fire mode operations.	Arrange for integrated testing of the fire system.

3.6.5 BMCS/Fire

Interface	BMCS	Fire
High Level Interface (HLI) Monitoring and Control of Fire Systems	For systems with BMCS confirm with Fire Services Contractor type of interface required. For High Level Interface (HLI), provide the Fire Services contractor with type of comms required.	Provide high level interface device and wiring to BMCS interface point via MODBUS or Bacnet interface
Low Level Interface (LLI)	Where LLI is only required, provide the Fire Services contractor with type of input to accepted 0V clean contact	Provide 0V clean contact from the Fire Indicator Panel to the BMCS front end hardware.
Commissioning	Commission complete Fire Services system in conjunction with the Fire Services contractor.	Commission complete Fire Services system in conjunction with the BMCS subcontractor. Record and advise BMCS subcontractor of all set points determined during commissioning for MASD, fire services interfaces, etc.

3.6.6 Security/Fire

Interface	Mechanical	Fire
Security Access Control System	Provide control wiring, terminal strip and relays or programming associated with the security system to operate during fire mode operation.	Provide GFA from the Fire Indicator Panel to the main security control panel.
Air handling plant equipment	Provide information to the Fire Services contractor pertaining to mechanical duct work locations for fire detection hardware to be installed.	Provide all fire detection hardware required to interface with the mechanical air handling system to ensure correct operation during fire mode.

3.6.7 Lift/Fire

Interface	Lift	Fire
Lift Fire Mode Operation	Control wiring, terminal strip, relays and interlocks associated with grounding of lifts in fire mode.	Fire Services Contractor to wire from interface devices to lift control equipment.
Commissioning	Provide all personnel and equipment necessary for commissioning of all mechanical systems fire mode operations.	Arrange for integrated testing of the fire system.

3.6.8 Communications/Fire

Interface	Communications	Fire
Alarm Signaling Equipment (ASE) Hardware	No work required	Fire Services Contractor to ASE hardware complete with provision for 12 months monitoring with NSW Justice Department service provider. Pay all associated connection fees during DLP.
Alarm Signaling Equipment (ASE) Wiring	Termination of cables at the PABX.	Fire Services Contractor to connect the FIP to the PABX location.
Phone Line	Provide phone line for connection of ASE to communications (telephone) line as required to services the third party fire monitoring provider.	Arrange for integrated testing of the fire system connection to the third party fire monitoring provider. Pay associated annual phone line fee during DLP.

3.7 Responsibilities

General: This part of the specification shall be read in conjunction with the general conditions of contract, preliminary clauses, and technical clauses included in the main specification.

Design Intent: The design intent of this project is for the Design & Construct of Fire Services for the products groups nominated in herein.

Requirement: The fire services works shall comprise of but not limited to the coordination, workshop documentation, supply, installation, testing, commissioning, quality assurance, certification, and maintenance during defects liability period of the complete fire services works whether specified herein or not.

Contract: This document is to be read as a Design & Construct performance specification corresponding to the Design and Construct contract for the fire services. The Contractor shall be responsible for completion of the design of the fire services to satisfy the requirements of this specification, the requirements of the Client, and any other ancillary requirements made known at the time of tender. The Contractor shall prepare shop drawings for the final fire services required, including coordination with the latest architectural layouts and all other building services' documentation.

3.8 Precedence

Order of Precedence:

- The requirements of other work sections of the specification override conflicting requirements of this work section;
- The requirements of the work sections override conflicting requirements of their referenced documents. The requirements of the referenced documents are minimum requirements.
- Where the BCA, FER, Australian Standards and this specification conflict the more onerous shall apply.

3.9 Interpretation

3.9.1 Abbreviations

General: For the purposes of this specification the following abbreviations apply:

- *AS:* Australian Standard.
- *ASE:* Alarm Signalling Equipment
- *BCA:* National Construction Code Series Volume One: Building Code of Australia Class 2 to 9 Buildings and Volume Two: Building Code of Australia Class 1 and Class 10 Buildings.
- *Cu:* Copper.
- *D&C:* Design & Construct
- *FER:* Fire Engineering Report
- *FIP:* Fire Indicator Panel
- *GMS:* Galvanised Medium Steel.
- *IP:* Ingress protection.
- *MASD:* Multi-Aspirating Smoke Detector
- *NATA:* National Association of Testing Authorities.
- *NCC:* National Construction Code.
- *NZS:* New Zealand Standard.
- *OWS:* Occupant Warning System
- *PCA:* National Construction Code Series Volume Three: Plumbing Code of Australia.
- *PE:* Polyethylene.
- *SDS:* Safety data sheets.
- *VOC:* Volatile Organic Compound.
- *WHS:* Work Health and Safety.

3.9.2 Definitions

General: For the purposes of this specification, the following definitions apply:

- *Access for Maintenance:* Includes access for maintenance, inspection, measurement, operation, adjustment, repair, replacement and other maintenance related tasks.
- *Accessible, Readily:* Readily accessible, easily accessible, easy access and similar terms mean capable of being reached quickly and without climbing over or removing obstructions, mounting upon a chair, or using a movable ladder, and in any case not more than 1500 mm above the ground, floor or platform.
- *Approved:* Approved in writing by the Superintendent and/or Regulating Authority.
- *Architect:* Architect nominated for the project by the client.
- *AS:* When followed by numbers or letters means an Australian Standard published by Standards Australia (e.g. AS 2118).
- *Attendance:* Attendance, provide attendance and similar expressions mean give assistance for examination and testing.
- *Baseline Data:* Data derived from the approved design and commissioning, which serve as a basis for subsequent comparison with the data derived from inspection, test and survey.
- *BCA:* Building Code of Australia
- *Client:* Justice Infrastructure - NSW Department of Justice.
- *Control & Indicating Equipment (CIE):* Equipment for receiving, processing, controlling, indicating and initiating the onward transmission of information as used in fire alarm system
- *Consumable:* Materials or components intended to be replaced within the service life of the associated plant or equipment.
- *Contract Administrator:* Has the same meaning as architect or superintendent and is the person appointed by the owner or principal under the contract.
- *Contractor:* Has the same meaning as builder and is the person or organisation bound to carry out and complete the work under the contract.
- *Day:* A period of 24 hours.
- *Default:* Specified value, product or installation method which is to be provided unless otherwise documented.
- *Design Life:* The period of time for which it is assumed, in the design, that an asset will be able to perform its intended purpose with only anticipated maintenance but no major repair or replacement being necessary.
- *Documented:* Documented, as documented and similar terms mean contained in the contract documents.
- *Economic Life:* The period of time from the acquisition of an asset to the time when the asset, while still physically capable of fulfilling its function and with only anticipated maintenance, ceases to be the lowest cost alternative for satisfying that function.
- *Electricity Distributor:* Any person or organisation that provides electricity from an electricity distribution system to one or more electrical installations. Includes distributor, supply authority, network operator, local network service provider, electricity retailer or electricity entity, as may be appropriate in the relevant jurisdiction.
- *Equal:* Equivalent in performance, quality, and approved.

- *Emergency Warning & Intercom System:* Refer to SSISEP.
- *Fire Engineering Report:* The report completed by the Fire Safety Engineer that identifies any alternate solution required to meet the BCA Deemed to Satisfy (DtS) provisions.
- *Fire Detection Control & Indicating Equipment (FDCIE):* Refer to CIE
- *Fire Indicator Panel (FIP):* Refer to CIE
- *Fire Services Engineer:* Northrop Consulting Engineers Pty Ltd.
- *Fire Safety Engineer:* An independent consultant engaged to provide the Fire Engineering Report (FER)
- *Fire Resistance Level (FRL):* The grading periods in minutes determined in accordance with the BCA Volume 1, for the following criteria:
    - Structural adequacy;
    - Integrity; and
    - Insulation, and expressed in that order.
- *Full Function Fire Matrix (FFFM):* Matrix of fire services interfaces and operational requirements of the fire safety system.
- *Full Function Fire Test (FFFT):* System interface test of Fire Services in accordance with the FFFM.
- *General Access Area:* Areas that are generally accessed by inmates.
- *Geotechnical Site Investigation:* The process of evaluating the geotechnical characteristics of the site in the context of existing or proposed construction.
- *Give Notice:* Give notice, submit, advise, inform and similar expressions mean give notice (submit, advise, inform) in writing to the contract administrator.
- *Hot-dip Galvanized:* Zinc coated to AS/NZS 4680 after fabrication with coating thickness and mass to AS/NZS 4680.
- *High Level Interface:* Systems transfer information in a digital format using an open system interface.
- *High Needs Area:* Individual segregation cells or cell blocks.
- *Ingress Protection:* IP, IP code, IP rating and similar expression have the same meaning as IP Code in AS 60529.
- *Inmate:* A person sentenced or awaiting sentence by the court to a term of imprisonment to be detained in a prison.
- *Local (Government) Authority:* A body established for the purposes of local government by or under a law applying in a state or territory.
- *Low Level Interface:* Systems transfer information in a 0V clean contact interface.
- *Manufacturer's Recommendations:* Recommendations, instructions, requirements, specifications (and similar expressions) provided in written or other form by the manufacturer and/or supplier relating to the suitability, use, installation, storage and/or handling of a product.
- *Materials:* All plant, instruments, components, equipment, assemblies and sub-assemblies, parts and other items required for permanent incorporation of the works.

- *May:* Means that there is an option.
- *Metallic-coated:* Steel coated with zinc or aluminium-zinc alloy.
- *Multi Aspirating Smoke Detector (MASD):* Equipment to sample air for the purposes of smoke detection.
- *NCC:* The National Construction Code, which comprises the Building Code of Australia - Volumes 1 and 2, and the Plumbing Code of Australia - Volume 3.
- *Obtain:* Obtain, seek and similar expressions mean obtain (seek) in writing from the contract administrator.
- *Occupant Warning System (OWS):* A life safety system with a speaker network installed throughout the building to be activated when the FDCIE is in alarm mode.
- *Periodic Maintenance:* Planned routine maintenance of plant and equipment (proactive), including fire safety measures and statutory requirements.
- *Pipe:* Includes pipe and tube
- *Piping or Pipe* Not Applicable ly of pipes, with or without valves or other fittings, connected together for the conveyance of liquids and gases.
- *Practical Completion or Defects Free Completion:* The requirements for these stages of completion are defined in the relevant building contract for the project.
- *Principal:* Principal has the same meaning as owner, client and proprietor and is the party to whom the contractor is legally bound to construct the works.
- *Professional Engineer:* As defined by the BCA.
- *Proprietary:* Identifiable by naming the manufacturer, supplier, installer, trade name, brand name, catalogue or reference number.
- *Prototype:* A full size mock-up of components, systems or elements to demonstrate or test construction methods, junctions and finishes, and to define the level of quality.
- *Provide:* Provide and similar expressions mean supply and install and include development of the design beyond that documented.
- *Record Drawings:* Record drawings has the same meaning as as-installed drawings, as-built drawings and work-as-executed drawings.
- *Referenced Documents:* Standards and other documents whose requirements are included in this specification by reference.
- *Registered Testing Authority:* An organisation registered by the National Association of Testing Authorities (NATA) to test in the relevant field; or
    - An organisation outside of Australia registered by an authority recognised by NATA through a mutual recognition agreement; or
    - An organisation recognised as being a Registered Testing Authority under legislation at the time the test was undertaken.
- *Repairs:* Unplanned/corrective maintenance (reactive).
- *Replace/replacement:* Exchange of components on a regular cycle on a like for like basis, e.g. repainting, replacement of valves etc.

- *Required:* Required by the contract documents, the local council or statutory authorities.
- *If Required:* A conditional specification term for work which may be shown in the documents or is a legislative requirement.
- *Sample:* A physical example that illustrates workmanship, materials or equipment, and establishes standards by which the work will be judged. It includes samples, prototypes and sample panels.
- *Shall:* Means that the statement is mandatory.
- *Should:* Means that the statement is recommended.
- *Site:* The lands and other places on, under, in or through which the works are to be carried out by the Contractor.
- *Sound System & Intercom System for Emergency Purposes (SSISEP):* A master control panel interfaced to the buildings FDCIE complete with; warden intercom points; manual call points; a master warden control point; and warning speakers distributed throughout the building.
- *Specification:* This document.
- *Statutory Authority:* A public sector entity created by legislation, that is, a specific law of the Commonwealth, State or Territory.
- *Sterile Access Area:* An area in which Inmates do not access under normal circumstances
- *Supply:* Supply, furnish and similar expressions mean supply only.
- *Superintendent:* The person as nominated by the Project Manager or as nominated in the main building contract.
- *Tactical Fire Plan:* A building and/or site plans fixed within the main control room which shows the location of fire safety equipment. They are in the form of colour coded schematic drawings.
- *Tests – Completion:* Tests carried out on completed installations or systems and fully resolved before the date for practical completion, to demonstrate that the installation or system, including components, controls and equipment, operates correctly, safely and efficiently, and meets performance and other requirements. The superintendent may direct that completion tests be carried out after the date for practical completion.
- *Tests – Pre-completion*: Tests carried out before completion tests, including: Production: Tests carried out on a purchased item, before delivery to the site.
    - *Progressive:* Tests carried out during installation to demonstrate performance in conformance with this specification.
    - *Site:* Tests carried out on site.
    - *Type:* Tests carried out on an item identical with a production item, before delivery to the site.
- *Tolerance:* The permitted difference between the upper limit and the lower limit of dimension, value or quantity.
- *Verification:* Provision of evidence or proof that a performance requirement has been met or a default exists.
- *Waterproof:* The property of a material that does not allow moisture to penetrate through it
- *Water Resistant:* The property of a system or material that restricts moisture movement and will not degrade under conditions of moisture.

3.10 Expectations of the Tenderer

General: This Specification is based on the understanding that the tenderer possesses the trade expertise necessary to complete the works. The Contractor is deemed to have thoroughly reviewed all relevant drawings and specification and identified, at the time of submitting the tender, the following:

- Clauses within the Specification or information on the drawings, which require interpretation;
- Issues that required design input or clarification from the Fire Services Engineer. These will include the clarification of any issues raised by the tenderer's suppliers or it's sub-contractors in respect of the equipment proposed or the proposed method of operation of any of the proposed equipment;
- Omissions from either the specification or the drawings;
- Inconsistencies or discrepancies in the scale or definition of drawings;
- Specification or drawing items, which may be in conflict. Seek direction from the Fire Services Engineer as to the item to take precedence;
- Deviations or alternatives proposed by the Contractor. In identifying the proposed deviations, the Contractor shall factor into its cost estimate the fees that may be claimed by the Fire Services Engineer for the analysis of any proposed alternative. The Contractor shall provide a comprehensive report on any alternative in support of the proposal.

3.11 Submissions

3.11.1 Requirement

General: Submit the following, as documented:

- Authority Approvals: Notes of meetings with authorities whose requirements apply to the work and evidence that notices, fees and permits have been sought and paid, that authority connections are complete and that statutory approvals by the authorities whose requirements apply to the work have been received.
- Building Penetrations: Details of the methods to maintain the required structural, fire and other properties to Building Penetrations;
- Certification: Certification of conformance to documented requirements, including certification that the plant and equipment submitted meets all requirements of the contract documents and that each installation is operating correctly;
- Design Documentation: Design data and certification of proposed work, if required and as documented;
- Execution Details: Execution programs, schedules and details of proposed methods and equipment. For building services include the following:
    - Embedded Services: Proposed method for embedding services in concrete walls or floors or chasing into concrete or masonry walls;
    - Fixing of Services: Typical details of locations, types and methods of fixing services to the building structure;
    - Inaccessible Services: If services will be enclosed and not accessible after completion, submit proposals for location of service runs and fittings.
- Marking and Labelling: Samples and schedules of proposed marking and labels to Marking and Labelling;

- Operation and Maintenance Manuals: For the whole of the work to Operation and Maintenance Manuals;
- Products: Products and materials data, including manufacturer's technical specifications and drawing, evidence of conformance to product certification schemes, performance and rating tables and installation and maintenance recommendations;
- Prototypes: Prototypes of components, systems or elements;
- Records: As-built documents, photographs, system diagrams, schedules and logbooks to Record Drawings;
- Samples: Representative of proposed products and materials and including proposals to incorporate samples into the works, if any to Samples;
- Shop drawings: To Shop Drawings;
- Substitutions: To Substitutions;
- Tests:
    - Inspection and testing plan consistent with the construction program including details of test stages and procedures;
    - Certificates for type tests;
    - Fire hazard properties: Evidence of conformance of proposed proprietary products to documented requirements for fire hazard properties;
    - Test reports for testing performed under the contract to Tests.
- Warranties: To Warranties.

Contractor Review: Before submissions, review each submission item and check for coordination with other work of the contract and conformance to contract documents.

3.11.2 Certification

Requirement: Submit certification that the plant and equipment submitted meets the requirements and capacities of the contract documents except for departures that are identified in the submission.

3.11.3 Electrical Loading

Loading: Submit for all equipment before completion of the main switchboard shop drawings.

Loading and Connection: Submit the information for items not supplied from the services switchboards.

Starting Characteristics: Submit details for motors with reduced current starting. Make sure starting characteristics are within the characteristics of the respective submain protection devices.

Switchboards: Submit the following information for each building services switchboard:

- Board location and designation.

For each submain connected to the board, submit the following for each item connected to it:

- Submain designation;
- Item designation and name;
- Power rating in kW;
- Number of phases;

- Full load amps per phase;
- Power factor;
- Total amps on each phase for respective sub main.

3.11.4 Maintenance Program

General: Submit details of maintenance procedures and program, relating to installed plant and equipment, 6 weeks before the date for practical completion. Indicate dates of service visits. State contact telephone numbers of service operators and describe arrangements for emergency calls.

3.11.5 Products and Materials

Equipment: Documented pump heads are based on provisional equipment selections and estimated pressure drops. Before ordering equipment, calculate the respective system pressure losses based on the equipment offered and layouts shown on the shop drawings and submit the proposed selections.

Data: Submit technical data for all items of plant and equipment, including the following:

- Assumptions;
- Calculations;
- Model name, designation and number;
- Capacity of all system elements;
- Country of origin and manufacture;
- Materials used in the construction;
- Size, including required clearances for installation;
- Certification of conformance to the applicable code or standard;
- Technical data schedules corresponding to the equipment schedules in the contract documents. If there is a discrepancy between the two, substantiate the change;
- Manufacturers' technical literature;
- Type test reports.

3.11.6 Submission Times

Default Timing: Make submissions at least 5 working days before ordering products or starting installation of the respective portion of the works.

Submission Response Times: Allow in the construction program for at least the following times:

- Shop Drawings: Two (2) working days.
- Samples and Prototypes: Two (2) working days.
- Manufacturers' or Suppliers' Recommendations: Two (2) working days.
- Product Data: Two (2) working days.
- Product/Design Substitution or Modification: Two (2) working days.

Proposed Products Schedules: If major products are not specified as proprietary items, submit a schedule of those proposed for use within 3 weeks of site possession.

3.11.7 Identification

Requirement: Identify the project, contractor, subcontractor or supplier, manufacturer, applicable product, model number and options, as appropriate and include relevant contract document references. Include service connection requirements and product certification.

Non-conformance: Identify proposals that do not conform to project requirements, and characteristics which may be detrimental to successful performance of the completed work.

3.11.8 Errors

Errors: If a submission contains errors, make a new or amended submission as appropriate, indicating changes made since the previous submission.

3.12 Fire Services Engineer Inspections

3.12.1 General

Requirement: The installation of fire services and related items is subject to periodic inspections from the Fire Services Engineer on behalf of the client. The intent of these inspections is to:

- Provide the client with an overview of the quality and progression of the fire installation;
- Ensure an acceptable standard of workmanship is maintained;
- Compliance is met with Australian Standards and the local Authority's requirements;
- Ensure the installation of services is congruent to the fire documentation and suitable for its intended purpose.

Inspection Report: The results of the inspections will be documented in a report which is issued to the client and will outline any inconsistencies with the contract documentation and/or applicable regulatory requirements.

Response to Report: Upon receipt of the report it is the responsibility of the fire Contractor to:

- Acknowledge receipt of the report within 7 days;
- Remediate each item within the report as indicated;
- Provide photographic evidence and certification proving the rectification work has occurred in a manner deemed satisfactory by the Fire Services Engineer.

3.12.2 Notice

Concealment: If notice of inspection is required for parts of the works that are to be concealed, advise when the inspection can be made before concealment.

Tests: Give notice of the time and place of documented tests.

Minimum Notice: 48 hours.

3.12.3 Light Levels

Requirement: To AS/NZS 1680.2.4.

3.12.4 Attendance

General: Provide attendance for the entirety of inspections and tests.

3.13 Installation

3.13.1 Accessories

General: Provide the accessories and fittings necessary for the proper functioning of the systems, including taps, valves, outlets, pressure and temperature control devices, strainers, gauges and pumps.

Isolating Valves: In addition to valves required to meet sta nts, provide valves to allow safe isolation of parts of the system, with minimum inconvenien occupants, in event of leaks or maintenance.

Not Applicable

3.13.2 Connections to Network Utility Operator Mains

General: Excavate to locate and expose the connection points and connect to the network utility operator mains. On completion, backfill and compact the excavation and reinstate surfaces and elements which have been disturbed such as roads, pavements, kerbs, footpaths and nature strips.

General: If the network utility operator elects to perform or supply part of the works, make the necessary arrangements. Install equipment supplied, but not installed, by the authorities.

3.14 Products

Use equipment listed in the SSL Register of Accredited Products

3.14.1 Manufacturers' or Suppliers' Recommendations

General: Provide and select, if no selection is given, transport, deliver, store, handle, protect, finish, adjust and prepare for use the manufactured items in conformance with the recommendations of the manufacturer or supplier.

Proprietary Items/Systems/Assemblies: Assemble, install or fix to substrate in conformance with the recommendations of the manufacturer or supplier.

Project Modifications: Advise of activities that supplement, or are contrary to the recommendations of the manufacturers or supplier.

3.14.2 Sealed Containers

General: If materials or products are supplied by the manufacturer in closed or sealed containers or packages, bring the materials or products to point of use in the original containers or packages.

3.14.3 Prohibited Materials

General: Do not provide the following:

- Materials, exceeding the limits of those listed, in the Safe Work Australia Hazardous Substances Information System (HSIS);
- Materials that use chlorofluorocarbon (CFC) or hydro chlorofluorocarbon (HCFC) in the manufacturing process.

3.14.4 Substitutions

Identified Proprietary Items: Identification of a proprietary item does not necessarily imply exclusive preference for the identified item, but indicates the necessary properties of the item.

Alternatives: If alternatives to the documented products, methods or systems are proposed, submit sufficient information to permit evaluation of the proposed alternatives, including the following:

- Evidence that the performance is equal to or greater than that specified;
- Evidence of conformity to a cited standard;
- Samples;
- Essential technical information, in English;
- Reasons for the proposed substitutions;
- Statement of the extent of revisions to the contract documents;
- Statement of the extent of revisions to the construction program;
- Statement of cost implications including costs outside the contract;
- Statement of consequent alterations to other parts of the works.

Availability: If the documented products or systems are unavailable within the time constraints of the construction program, submit evidence.

Criteria: If the substitution is for any reason other than unavailability, submit evidence that the substitution:

- Is of net enhanced value to the principal;
- Is consistent with the contract documents and is as effective as the identified item, detail or method.

3.15 Materials and Components

3.15.1 Consistency

General: For each material or product use the same manufacturer or source and provide consistent type, size, quality and appearance.

3.15.2 Corrosion Resistance

General: Conform to the following atmospheric corrosivity category as defined in AS 4312 and the AS/NZS 2312 series.

3.15.3 Galvanizing

Severe Conditions: Galvanize mild steel components (including fasteners) to AS 1214 or AS/NZS 4680 as appropriate, if:

- Exposed to weather;
- Embedded in masonry;
- Exposed to or in air spaces behind the external leaf of masonry walls;
- In contact with chemically treated timber, other than copper chrome arsenate (CCA).

3.16 Samples

Incorporation of Samples: Only incorporate samples in the works which have been endorsed for inclusion. Do not incorporate other samples.

Retention of Samples: Keep endorsed samples in good condition on site, until the date of practical completion.

Unincorporated Samples: Remove on completion.

3.17 Shop Drawings

Standard: To AS 1100.101, AS 1100.201, AS 1100.301, AS 1100.401 and AS/NZS 1100.501 as applicable.

Requirement: Submit detail drawings at minimum 1:100 scale, showing the following:

- Pipework and equipment layout and sections showing the work to be installed on the level that the services are installed. Do not submit glass floor drawings;
- Riser layouts and sections;
- Piping and other schematic drawings including numbering of each valve to correspond to valve tags notation;
- Inclusions: Include the following on the drawings:
    - Access openings, cover plates, valve boxes, and access pits;
    - Details of control panels including control and power diagrams;
    - Location, type, grade and finish of piping, fittings, valves, and pipe supports;
    - Provision of a temporary fire hydrant service in the construction period;
    - Provision of road barriers and lighting;
    - Provision of trafficable cover plates in the public domain;
    - Site and floor set out points;
    - Tank stands and supporting structures.

Documentation: Include dimensioned drawings showing details of the fabrication and installation of structural elements, building components, services and equipment, including relationship to building structure and other services, cable type and size, and marking details.

Diagrammatic Layouts: Coordinate work shown diagrammatically in the contract documents, and prepare dimensioned set-out drawings.

Record Drawings: Amend all documented shop drawings to include changes made during the progress of the work and up to the end of the defects liability period.

Services Coordination: Coordinate with other building and service elements. Show adjusted positions on the shop drawings.

Space Requirements: Check space and access for maintenance requirements of equipment and services indicated diagrammatically in the contract documents.

Submission Medium: .pdf, .dwg, and .rvt.

Drawing Size: A3 minimum.

3.18 Off-site Disposal

Removal of Material: Dispose of building waste material off site to the requirements of the relevant authorities.

3.19 Fixing

3.19.1 General

Suitability: If equipment is not suitable for fixing to non-structural building elements, fix directly to structure and trim around penetrations in non-structural elements.

3.19.2 Fasteners

General: Use proprietary fasteners capable of transmitting the loads imposed, and sufficient for the rigidity of the assembly.

Anti-tamper: All fasteners shall be anti-tamper type and approved for use by the client.

3.20 Services Installation

3.20.1 General

Fixing: If non-structural building elements are not suitable for fixing services to, fix directly to structure and trim around holes or penetrations in non-structural elements.

Installation: Install equipment and services plumb, fix securely and organise reticulated services neatly. Allow for movement in both structure and services.

Concealment: Unless otherwise documented, conceal all cables, ducts, trays and pipes except where installed in plant spaces, ceiling spaces and riser cupboards. If possible, do not locate on external walls.

Lifting: Provide heavy items of equipment with permanent fixtures for lifting as recommended by the manufacturer.

Suspended Ground Floors: Keep all parts of services under suspended ground floors at least 150 mm clear of the ground surface. Make sure services do not impede access.

Arrangement: Arrange services so that services running together are parallel with each other and with adjacent building elements.

3.20.2 Dissimilar Metals

General: Join dissimilar metals with fittings of electrolytically compatible material.

3.20.3 Temporary Capping

Pipe Ends: During construction protect open ends of pipe with metal or plastic covers or caps.

3.20.4 Piping

General: Install piping in straight lines at uniform grades without sags. Arrange to prevent air locks. Provide sufficient unions, flanges and isolating valves to allow removal of piping and fittings for maintenance or replacement of plant.

Not Applicable

Spacing: Provide at least 25 mm clear betwe[illegible]veen pipes and building elements, additional to insulation.

Changes of Direction: Provide long radius elbows or bends and sets where practicable, and swept branch connections. Provide elbows or short radius bends where pipes are led up or along walls and then through to fixtures. Do not provide mitred fittings.

Vibration: Arrange and support piping so that it remains free from vibration whilst permitting necessary movements. Minimise the number of joints.

Embedded Pipes: Do not embed pipes tha ressure in concrete or surfacing material.

Not Applicable

Valve Groupings: If possible, locate valves in groups.

Pressure Testing Precautions: Isolate items not rated for the test pressure. Restrain pipes and equipment to prevent movement during pressure testing.

3.20.5 Differential Movement

General: If the geotechnical site investigation report predicts differential movements between buildings and the ground in which pipes or conduits are buried, provide control joints in the pipes or conduits, as follows:

- Arrangement: Arrange pipes and conduits to minimise the number of control joints;
- Magnitude: Accommodate the predicted movements.

3.21 Building Penetrations

3.21.1 Penetrations

Requirement: Maintain the required structural, fire and other properties when penetrating or fixing to the following:

- Structural building elements including external walls, fire walls, fire doors and access panels, other tested and rated assemblies or elements, floor slabs and beams;
- Membrane elements including damp-proof courses, waterproofing membranes and roof coverings. If penetrating membranes, provide a waterproof seal between the membrane and the penetrating component.

3.21.2 Sealing

Fire-resisting Building Elements: Seal penetrations with a system conforming to AS 4072.1.

Non Fire-resisting Building Elements: Seal penetrations around conduits and sleeves. Seal around cables within sleeves. If the building element is acoustically rated, maintain the rating.

3.21.3 Sleeves

General: If piping or conduit penetrates building elements, provide metal or PVC-U sleeves formed from pipe sections as follows:

- Movement: Arrange to permit normal pipe or conduit movement;
- Diameter (for non-fire resisting building elements): Sufficient to provide an annular space around the pipe or pipe insulation of at least 12 mm;
- Prime paint ferrous surfaces;
- Terminations:
    - If cover plates are fitted: Flush with the finished building surface;
    - In fire-resisting and acoustic rated building elements: 50 mm beyond finished building surface;
    - In floors draining to floor wastes: 50 mm above finished floor;
    - Elsewhere: 5 mm beyond finished building surface;

- Termite management: To AS 3660.1.

- Thickness:
  - Metal: 1 mm or greater;
  - PVC-U: 3 mm or greater.

Sleeves for Cables: For penetrations of cables not enclosed in conduit through ground floor slabs, beams and external walls provide sleeves formed from PVC-U pipe sections.

3.22 Fire-stopping

3.22.1 Standards

Service Penetration Fire-stopping Systems: To BCA C3.15.

Control Joint Fire-stopping Systems: To AS 4072.1.

3.22.2 Submissions

3.22.2.1 Execution Details

General: Give notice, if substrates or penetrants or both are not suitable for fire-stopping.

3.22.2.2 Operation and Maintenance Manuals

General: For fire-stopping systems which are intended to be modified in service, submit a user manual.

3.22.2.3 Products and Materials

General: If fire-stopping is documented without reference to brand, submit the following:

- Evidence that systems conform to documented requirements;
- Copies of relevant manufacturers' instructions;
- Safety data sheets (SDS).

Type Tests: Submit type test certificates for each combination of fire-stopping system, application, type of service, substrate, penetration orientation, and drawings of tested details. Include for:

- Service penetration fire-stopping systems: Fire-resistance tested to AS 1530.4;
- Fire-stop mortars: Resistance to explosive spalling to AS 1774.36;
- Control joint fire-stopping systems: Fire-resistance tested to AS 1530.4.

3.22.2.4 Samples

Sample Panels: Supply a sample panel of each fire-stopping assembly, on representative substrates. If built into the works, identify by marking it as a control sample.

Size: 500 mm run for junction seals and 500 x 500 mm area for penetration seals.

3.22.2.5 Subcontractors

General: Submit names and contact details of proposed suppliers and installers.

3.22.3 Inspection

Notice: Give notice so that inspection may be made of the following:

- Service penetrations completed and ready for fire-stopping;
- Finished fire-stopping, before being concealed.

3.22.4 Materials

3.22.4.1 General

Shelf Life: Use materials that have not exceeded their shelf life.

Toxic Materials: Free of asbestos and lead and free of, nor requiring the use of, toxic solvents.

Toxicity in Fire: Non-toxic.

3.22.4.2 Fire-Stop Mortars

Type: Re-enterable cement-based compound, mixed with water. Non-shrinking, moisture resistant. Insoluble in water, after setting.

3.22.4.3 Formulated Compound of Incombustible Fibres

Material: Formulated compound mixed with mineral fibres, non-shrinking, moisture resistant. Insoluble in water after setting.

3.22.4.4 Fibre Stuffing

Material: Mineral fibre stuffing insulation, dry and free of other contaminants.

Standard: AS/NZS 4859.1 Section 8.

3.22.4.5 Fire-Stop Sealants

Material: Elastomeric sealant. Soft, permanently flexible, non-sag, non-shrinking, moisture resistant. Capable of providing a smoke-tight, gas-tight and waterproof seal when properly installed. Insoluble in water after setting.

3.22.4.6 Fire-Stop Foams

Material: Single component compound of reactive foam ingredients, non-shrinking, moisture resistant. Insoluble in water after setting.

3.22.4.7 Fire-Stop Putty

Material: Single component, mouldable, permanently flexible, non-shrinking, moisture resistant, intumescent compound which conforms to the following:

- Expands on exposure to surface heat gain to form a high-volume thermally insulating char that closes gaps and voids;
- Resists the turbulence of a severe fire;
- Can be placed by hand to form an immediate fire seal;
- Insoluble in water after setting.

3.22.4.8 Product Certification

Conformance: Address the following:

- Statutory and performance requirements;
- Adequacy of application/installation.

Appointment: In the joint names of the contractor and the principal.

3.22.5 Installation

3.22.5.1 General

Extent: Fire-stop and smoke-stop interruptions to fire-resistance rated assemblies, materials and components, including penetrations through fire-resisting elements, breaks within fire-resisting elements (e.g. expansion joints), and junctions between fire-resisting elements.

Sequence: Fire-stop after services have been installed through penetrations and properly spaced and supported, after sleeving where appropriate, and after removal of temporary lines, but before restricting access to the penetrations, including before dry lining.

Ventilation: Supply ventilation for non-aqueous solvent-cured materials.

Density: Apply fire-stopping material to a uniform density.

Fire-stopping Exposed to View: Finish surfaces to a uniform and level condition.

Protection: Protect adjacent surfaces from damage arising through installation of fire-stopping. Protect completed fire-stopping from damage arising from other work.

Loose or Damaged Fire-stopping Material: Remove and replace.

Penetrations by Pipes: Allow for thermal movement of the pipes.

Preventing Displacement: Reinforce or support fire-stopping materials with non-combustible materials when:

- The unsupported span of the fire-stopping materials is greater than 100 mm;
- The fire-stopping materials are non-rigid (unless shown to be satisfactory by test).

Large Openings: Provide fire-stopping capable of supporting the same loads as the surrounding element or provide similar structural support around the opening.

3.22.5.2 Preparation

Cleaning: Clean substrates of dirt, dust, grease, oil, loose material, and other matter which may affect the bond of fire-stop material.

Primer: Clean and dry substrates for primers and sealants.

Restraint: Install backing and/or damming materials to arrest liquid material leakage. Remove temporary dams after material has cured.

3.22.6 Systems

3.22.6.1 Fire-Stop Mortars

Ambient Conditions: Do not install below 5°C.

3.22.6.2 Fibre Stuffing

Installation: Compress to 40% of its uncompressed volume.

3.22.6.3 Fire-stop Sealants

Ambient Conditions: Do not store above 32°C. Do not install outside the temperature range recommended by the sealant manufacturer. Do not install when humidity exceeds that recommended by the sealant manufacturer for safe installation.

3.22.6.4 Fire-stop Foams

Ambient Conditions: Do not store above 32°C. Do not install below 15°C or above 32°C. Do not apply when temperature of substrate and air is below 15°C. Maintain this minimum temperature before, during and for 3 days after installation.

Installation: Test substrates for adhesion and prime if necessary. Place in layers for homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.

3.22.6.5 Fire-stop Putty

Ambient Conditions: Do not install below 5°C. Do not allow the material to freeze.

3.22.6.6 Fire-stop Collars

Material: Mechanical device with incombustible intumescent fillers covered with sheet steel jacket. Airtight and watertight.

3.22.6.7 Fire-stop Pillows

Material: Formed self-contained compressible flexible mineral fibre in cloth bags, rated to permit frequent changes in service.

Ambient Conditions: Do not install in conditions outside the manufacturer's recommendations.

Installation Accessories: Provide clips, collars, fasteners, temporary stops and dams, and other devices required to position, support and contain fire-stopping and accessories.

3.22.6.8 Labelling

General: Label each fire-stopping installation with a permanently fixed tag or sticker containing the following information:

- Manufacturer's name;
- Name and address of installer;
- Date of installation.

3.22.7 Completion

Cleaning

Requirement: Remove spilled and excess fire-stopping materials without damaging other work.

3.23 Concrete Plinths

General: Coordinate with the builder to provide all concrete plinths as documented and under all equipment located on concrete floor slabs as follows:

- Height: 150 mm or greater, as documented;
- Concrete: Grade N20;
- Finish: Steel float flush with the surround;
- Reinforcement: Single layer of F62 fabric;

Requirement: Fire Services contractor to provide galvanized steel surround at least 75 mm high and 1.6 mm thick. Fix to the floor with masonry anchors. Fill with concrete.

3.24 Support and Structure

Requirement: Provide incidental supports and structures to suit the services.

3.25 Plant and Equipment

Location: Locate so that failure of plant and equipment (including leaks) does not create a hazard for the building occupants and causes a minimum or no damage to the building, its finishes and contents including water sensitive equipment or finishes.

3.26 Access for Maintenance

3.26.1 Clearances

Minimum Clearances for Access: Conform to the following:

- ≥ 2100 mm clear vertically above horizontal floors, ground and platforms;
- ≥ 1000 mm clear between equipment and building features including walls, but in no case less than 600 mm horizontally between equipment;
- If tools are required to operate, adjust or remove equipment, provide sufficient space so that the tools can be used in their normal manner and without requiring the user to employ undue or awkward force;
- If equipment components are hinged or removable, allow the space recommended by the manufacturer;
- Within plant items: Conform to the preceding requirements, and in no case less than the clearances recommended In BS 8313.

3.26.2 Elevated Services Other Than in Occupied Areas

Access Classifications:

- Access Class A: Readily accessible. Provide clear and immediate access to and around plant items. If plant or equipment is located more than 1500 mm above the ground, floor or platform, provide a platform with handrails accessible by a stair, all to AS 1657.
- Access Class B: If the plant item requiring access is located more than 1500 mm above the ground, floor or platform, provide a platform with handrails accessible by a non-vertical ladder, all to AS 1657.
- Access Class C: Locate plant so that temporary means of access conforming to Work health and Safety regulations can be provided.

Temporary Means of Access: Make sure there is adequate provision in place which is safe and effective.

Areas in Which Access is Restricted to Authorised Maintenance Personnel: Provide access as follows:

- Instruments, Gauges and Indicators (Including Warning And Indicating Lights) Requiring Inspection At Any Frequency: Readily accessible;
- Access Required Monthly or More Frequently: Access Class A;
- Access Required Between Monthly and Six Monthly: Access Class A or B;
- Access Required Less Frequently Than Six Monthly: Access Class A, B or C.

Other Areas: Provide access as follows:

- Locate to minimise inconvenience and disruption to building occupants or damage to the building structure or finishes;
- In suspended ceilings, locate items of equipment that require inspection and/or maintenance above tiled parts. If not possible, provide access panels where located above set plaster or other inaccessible ceilings. Arrange services and plant locations to reduce the number of access panels. Coordinate with other trades to use common access panels where feasible;
- Do not locate equipment requiring access above partitions;
- Instruments, gauges and other items requiring inspection at any frequency: Readily accessible.

3.26.3 Facilities for Equipment Removal and Replacement

Requirement: Provide facilities to permit removal from the building and replacement of plant and equipment, including space large enough to accommodate it and any required lifting and/or transportation equipment. Arrange plant so that large and/or heavy items can be moved with the minimum of changes of direction.

Removal of Components: Allow sufficient space for removal and replacement of equipment components. Provide access panels or doors large enough to permit the safe removal and replacement of components within air handling units.

3.26.4 Facilities for Access

Equipment behind Hinged Doors: Provide doors opening at least 150°.

Equipment behind Removable Panels: Provide panels with quick release fasteners or captive metal thread screws.

Removable Panels: Provide handles to permit easy and safe removal and replacement.

Insulated Plant and Services: If insulation must be removed to access plant and services provide access for maintenance, arranged so it can be repeatedly removed and replaced without damage.

3.26.5 Piping

Requirement: Conform to the following:

- Provide access and clearance at fittings which require maintenance, inspection or servicing, including control valves and joints intended to permit pipe removal;
- Arrange piping so that it does not inter Not Applicable val or servicing of associated equipment or valves or block access or ventilation openings;
- Preferably run piping, conduits, cable trays and ducts at high level and drop vertically to equipment.

3.26.6 Electrical and Controls

Electrical Equipment: Provide clearances and access space to AS/NZS 3000.

Switchboards and Electrical Control Equipment: Locate near the main entrance to plant space. Arrange plant so that, to the greatest extent possible, switchboards are visible from the plant being operated.

Control Panels: Locate near and visible from the plant controlled.

3.27 Vibration Suppression

3.27.1 General

Requirement: Minimise the transmission of vibration from rotating or reciprocating equipment to other building elements.

3.27.2 Standard

Rotating and Reciprocating Machinery Noise and Vibration: Vibration severity in Zone A to AS 2625.1 and AS 2625.4.

3.27.3 Speeds

General: If no maximum speed is prescribed do not exceed 1500 r/min for direct driven equipment.

3.27.4 Connections

General: Provide flexible connections to rotating machinery and assemblies containing rotating machinery. Isolate pipes by incorporating sufficient flexibility into the pipework or by use of proprietary flexible pipe connections installed so that no stress is placed on pipes due to end reaction.

3.27.5 Inertia Bases

General: If necessary to achieve the required level of vibration isolation, provide inertia bases having appropriate mass and conforming as follows:

- Construction: Steel or steel-framed reinforced concrete. Position foundation bolts for equipment before pouring concrete;
- Supports: Support on vibration isolation mountings using height saving support brackets.

3.27.6 Vibration Isolation Mountings

General: Except for external equipment that is not connected to the structure of any building, support rotating or reciprocating equipment on mountings as follows:

- For Static Deflections < 15 mm: Single or double deflection neoprene in-shear mountings incorporating steel top and base plates and a tapped hole for bolting to equipment;
- For Static Deflections ≥ 15 mm: Spring mountings.

Selection: Provide mountings selected to achieve 95% isolation efficiency at the normal operating speeds of the equipment.

Installation: Set and adjust vibration isolation mounting supports to give clearance for free movement of the supports.

Spring Mountings: Provide freestanding laterally stable springs as follows:

- Clearances: ≥ 12 mm between springs and other members such as bolts and housing;
- High Frequency Isolation: 5 mm neoprene acoustic isolation pads between baseplate and support;
- Levelling: Provide bolts and lock nuts;
- Minimum Travel to Solid: ≥ 150% of the designated minimum static deflection;
- Ratio of Mean Coil Diameter To Compressed Length At The Designated Minimum Static Deflection: ≥ 0.8:1;
- Snubbing: Snub the springs to prevent bounce at start-up;
- Vertical Resilient Limit Stops: To prevent spring extension when unloaded, to serve as blocking during erection and which remain out of contact during normal operation.

3.28 Seismic Restraint of Non-structural Components

Requirement: All pipework shall be provided with seismic restraints complying with AS1170.4 providing stabilisation both transversely and longitudinally. Hanger rods shall also be provided with rod stiffeners to prevent buckling during seismic events.

Earthquake Design Category: 4

Spacing Generally: Component hanger spacing will typically be less than the required seismic spacing.

Ductile Material Spacing: The maximum allowable brace spacing for piping constructed of ductile materials (e.g. steel, copper, aluminium) are:

- 12m for transverse bracing (piping larger than 65mm dia.);
- 24m for longitudinal bracing (piping larger than 65mm dia.);
- 9m for transverse bracing (piping smaller than 65mm dia.);
- 18m for longitudinal bracing (piping smaller than 65mm dia.).

Non-ductile Material Spacing: The maximum allowable brace spacing limits for piping non-ductile materials (e.g. cast iron, plastic) are:

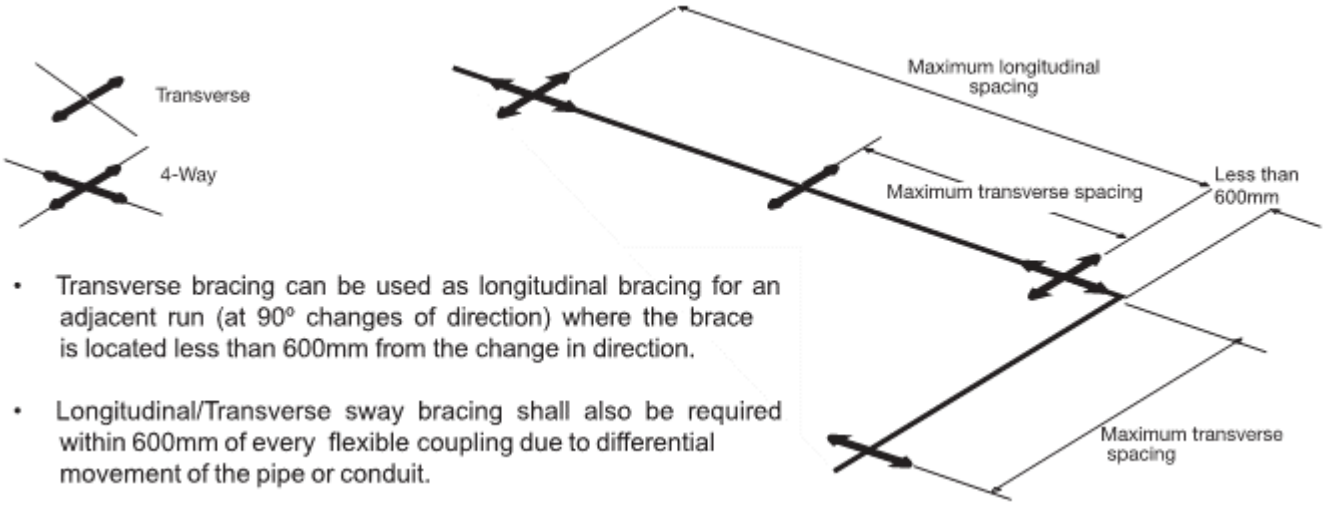
- 6m for transverse bracing;
- 12m for longitudinal bracing.

Installation:

- All seismic restraint systems shall be installed in strict accordance with the manufacturer's seismic restraint guidelines manual and all certified submittal data;
- Transverse restraint for one pipe section may also act as a longitudinal restraint for a pipe section of the same size connected perpendicular to it if the restraint is installed within 600mm of the elbow or tee or combined stresses are within allowable limits at longer distances;
- Hold down clamps must be used to attach pipe to all trapeze members before applying restraints;
- Branch lines may not be used to restrain main lines;
- Provide reinforced clevis bolts when required;
- Piping crossing building seismic or expansion joints, passing from building to building, or supported from different portions of the building shall be installed to allow differential support displacements without damaging

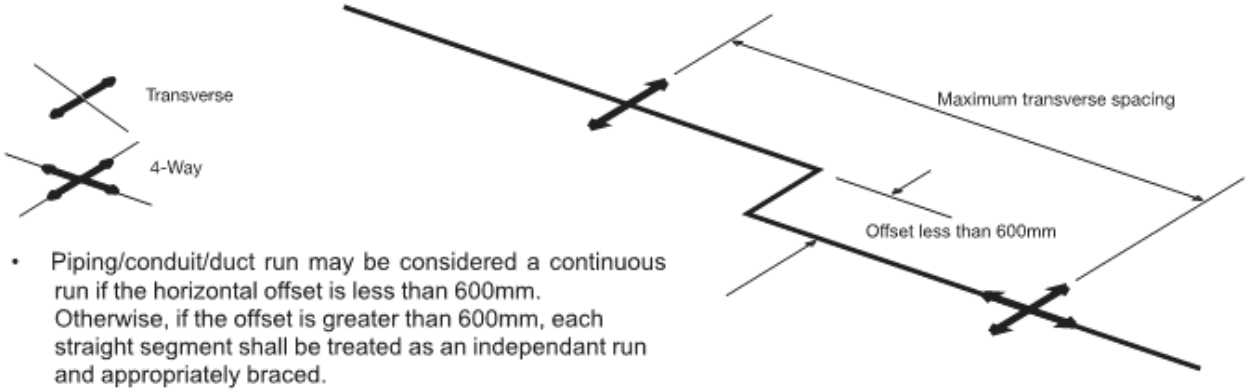
the pipe, equipment connections, or support connections. Pipe offsets, loops, anchors, and guides shall be installed as required to provide specified motion capability and limit motion of adjacent piping;

- Do not brace a system to two independent structures such as ceiling and wall;
- Provide appropriately sized openings in walls, floors, and ceilings for anticipated seismic movement. Provide fire seal systems in fire-rated walls.



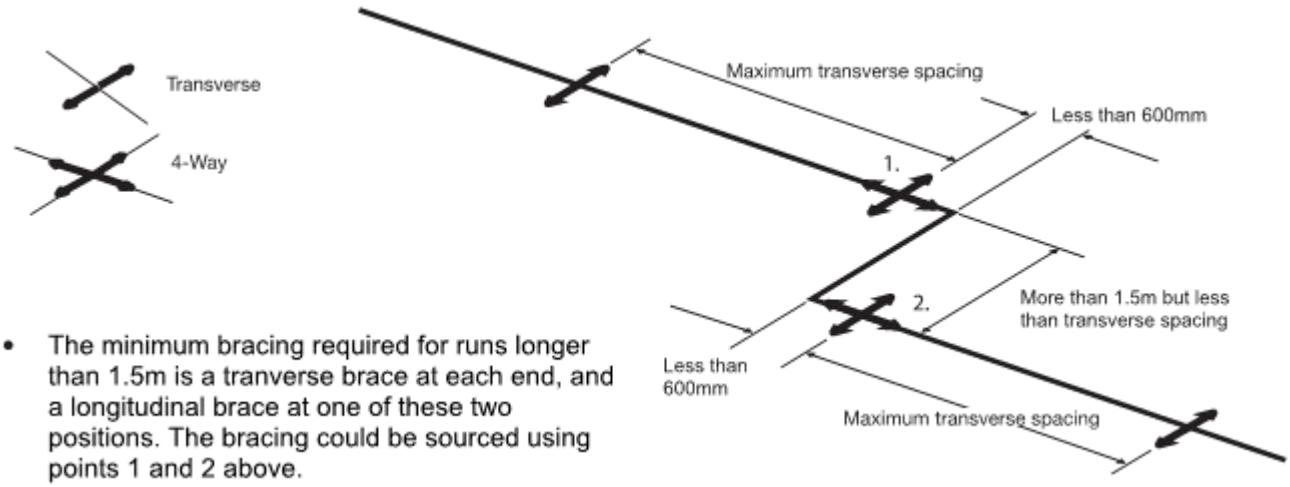
- Transverse bracing can be used as longitudinal bracing for an adjacent run (at 90° changes of direction) where the brace is located less than 600mm from the change in direction.
- Longitudinal/Transverse sway bracing shall also be required within 600mm of every flexible coupling due to differential movement of the pipe or conduit.

Change in Direction Bracing



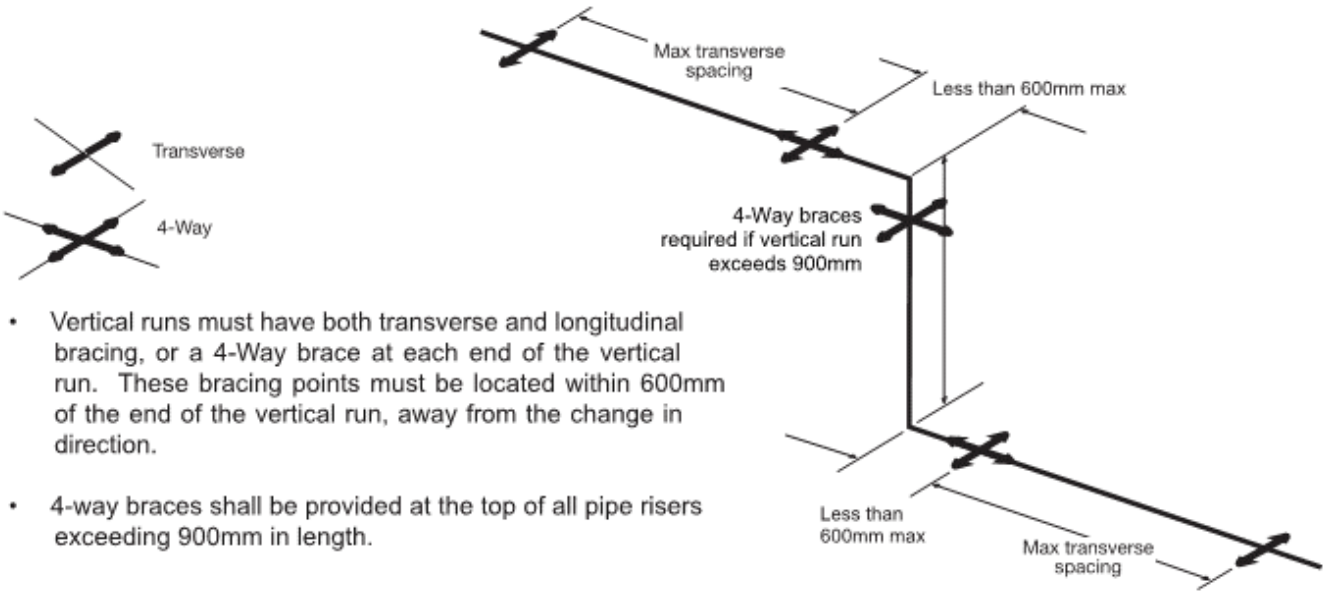
- Piping/conduit/duct run may be considered a continuous run if the horizontal offset is less than 600mm. Otherwise, if the offset is greater than 600mm, each straight segment shall be treated as an independant run and appropriately braced.

<600mm Offset Bracing



- The minimum bracing required for runs longer than 1.5m is a tranverse brace at each end, and a longitudinal brace at one of these two positions. The bracing could be sourced using points 1 and 2 above.

>1.5m Offset Bracing



- Vertical runs must have both transverse and longitudinal bracing, or a 4-Way brace at each end of the vertical run. These bracing points must be located within 600mm of the end of the vertical run, away from the change in direction.
- 4-way braces shall be provided at the top of all pipe risers exceeding 900mm in length.

Vertical Transition Bracing

3.29 Finishes to Services

3.29.1 General

Requirement: If exposed to view (including in plant rooms), paint new services and equipment.

Exceptions: Do not paint chromium or nickel plating, anodised aluminium, GRP, stainless steel, non-metallic flexible materials and normally lubricated machined surfaces. Surfaces with finishes applied off-site need not be re-painted on-site provided the corrosion resistance of the finish is not less than that of the respective finish documented.

Standard: Conform to the recommendations of AS/NZS 2311 or AS/NZS 2312.1 as applicable.

3.29.2 Powder Coating

Standard: Conform to the following:

- Aluminium for Architectural Applications: To AS 3715;
- Other Metals: To AS 4506.

3.29.3 Painting Systems

New Unpainted Interior Surfaces: To AS/NZS 2311.

New Unpainted Exterior Surfaces: To AS/NZS 2311.

3.29.4 Paint Application

Coats: Apply the first coat immediately after substrate preparation and before contamination of the substrate can occur. Make sure each coat of paint or clear finish is uniform in colour, gloss, thickness and texture and free of runs, sags, blisters or other discontinuities.

Combinations: Do not combine paints from different manufacturers in a paint system.

Protection: Remove fixtures before starting to paint and re-fix in position undamaged when painting is complete.

3.29.5 Underground Metal Piping

Corrosion Protection: Provide corrosion protection for the following:

- Underground ferrous piping;
- Underground non-ferrous metal piping in corrosive environments.

Protection Methods: Select from the following:

- Cathodic Protection: Sacrificial anodes or impressed current. Incorporate a facility for periodic testing. Conform to the recommendations of AS 2832.1;
- Continuous wrapping using proprietary petroleum taping material;
- Impermeable flexible plastic coating;
- Sealed polyethylene sleeve.

3.29.6 Low VOC Emitting Paints

Paint Types: To the recommendations of AS/NZS 2311.

3.30 Marking and Labelling

3.30.1 General

Requirement: Mark and label services and equipment for identification purposes as follows:

- Locations Exposed to Weather: Provide durable materials;
- Pipes, Conduits and Ducts: To AS 1345 throughout its length, including in concealed spaces.

Consistency: Label and mark equipment using a consistent scheme across all services elements of the project.

Identification Colour:

Service	Colour
Fire Services	Signal Red (R13)

3.30.2 Label Samples and Schedules

Submission Timing: Before marking or labelling.

Schedule: For each item or type of item include the following:

- A description of the item or type of item for identification;
- The proposed text for marking or labelling;
- The proposed location of the marking and labelling.

3.30.3 Operable Devices

Requirement: Mark to identify the following:

- Controls;
- Indicators, gauges, meters;

- Isolating switches.

3.30.4 Equipment Concealed In Ceilings

Location: Provide a label on the ceiling, indicating the location of each concealed item requiring access for routine inspection, maintenance and/or operation. In tiled ceilings, locate the label on the ceiling grid closest to the item access point. In flush ceilings, locate adjacent to closest access panel.

3.30.5 Pressure Vessels

General: Mount manufacturer's certificates in glazed frames on a wall next to the vessel.

3.30.6 Valves and Pumps

General: Label to associate pumps with their starters and valves. Screw fix labels to body or attach label to valve handwheels with a key ring.

3.30.7 Labels and Notices

Materials: Select from the following:

- Cast metal;
- For indoor applications only, engraved two-colour laminated plastic;
- Proprietary pre-printed self-adhesive flexible plastic labels with machine printed black lettering;
- Stainless steel or brass minimum 1 mm thick with black filled engraved lettering.

Emergency Functions: To AS 1319.

Colours: Generally to AS 1345 as appropriate, otherwise black lettering on white background except as follows:

- Danger, Warning Labels: White lettering on red background;
- Main Switch And Caution Labels: Red lettering on white background.

Edges: If labels exceed 1.5 mm thickness, radius or bevel the edges.

Labelling Text and Marking: To correspond to terminology and identifying number of the respective item as shown on the record drawings and documents and in operating and maintenance manuals.

Lettering Heights:

- Danger, Warning and Caution Notices: Minimum 10 mm for main heading, minimum 5 mm for remainder.
- Equipment Labels within Cabinets: Minimum 3.5 mm.
- Equipment Nameplates: Minimum 40 mm.
- Identifying Labels On Outside Of Cabinets: Minimum 5 mm.
- Isolating Switches: Minimum 5 mm.
- Valves: Minimum 20 mm.
- Self-Adhesive Flexible Plastic Labels:
    - Labels less than 2000 mm above floor: 3 mm on 6 mm wide tape.
    - Labels minimum 2000 mm above floor: 8 mm on 12 mm wide tape.

- Other locations: Minimum 3 mm.

Label Locations: Locate labels so that they are easily seen and are either attached to, below or next to the item being marked.

Fixing: Fix labels securely using screws, rivets, proprietary self-adhesive labels or double-sided adhesive tape and as follows:

- If labels are mounted in extruded aluminium sections, use rivets or countersunk screws to fix the extrusions;
- Use aluminium or monel rivets for aluminium labels.

Vapour Barriers: Do not penetrate vapour barriers.

3.30.8 Below Ground Pipe Marker Tape

Requirement: During the process of backfilling lay a plastic warning tape 150 mm above all underground pipes. This tape shall extend for the full length of pipes. Warning tapes shall be 200 mm in width of approved durable plastic material with colour to comply with AS 1345 printed with the words **DANGER – BURIED [SERVICE] PIPE BELOW** repeated continuously. Warning tape shall contain a trace wire which shall be secured and terminate above surface each end.

3.31 Software

Requirement: Provide the software required for the operation and management of fire services systems and equipment.

3.32 Warranties

Requirement: If a warranty is documented, name the principal as warrantee. Register with manufacturers as necessary. Retain copies delivered with components and equipment.

Warranty Period: Start warranty periods at acceptance of installation.

Approval of Installer: If installation is not by manufacturer, and product warranty is conditional on the manufacturer's approval of the installer, submit the manufacturer's written approval of the installing firm.

3.33 Record Drawings

3.33.1 General

Requirement: Show the following:

- Installed locations of building elements, services, plant and equipment;
- Off-the-grid dimensions and depth if applicable;
- Any provisions for the future.

3.33.2 Recording, Format, and Submission

Progress Recording: Keep one set of drawings on site at all times, expressly for the purpose of marking changes made during the progress of the works.

Drawing Layout: Use the same borders and title block as the contract drawings.

Quantity and Format: Conform to Submissions.

Endorsement: Sign and date all record drawings.

Accuracy: If errors in, or omissions from, the record drawings are found, amend the drawings and re-issue in the quantity and format documented for Submissions.

Date for Submission: Not later than two (2) weeks after the date for practical completion.

3.33.3 Services Record Drawings

General: To General and Recording, Format, and Submission and the following:

- Fire Service Mains: Show the pressure available at the initial connection point and the pressure available at the most disadvantaged location on each major section of the works;

Diagrams: Provide diagrammatic drawings of each system including the following:

- Controls;
- Piping including all valves and valve identification tags;
- Principal items of equipment;
- Single line wiring diagrams;
- Acoustic and thermal insulation;
- Access provisions and space allowances;
- Fixings;
- Fixtures;
- Switchgear and control gear assembly circuit schedules including electrical service characteristics, controls and communications;
- Charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

Subsurface Services: Record information on underground or submerged services to the documented quality level, conforming to AS 5488.

3.34 Operation and Maintenance Manuals

3.34.1 General

Authors and Compilers: Personnel experienced in the maintenance and operation of equipment and systems installed, and with editorial ability.

Referenced Documents: If referenced documents or technical work sections require that manuals be submitted, include corresponding material in the operation and maintenance manuals.

Subdivision: By installation or system, depending on project size.

3.34.2 Contents

Requirement: Include the following:

- Table of Contents: For each volume. Title to match cover;
- Directory: Names, addresses, and telephone and facsimile numbers of principal consultant, sub-consultants, contractor, subcontractors and names of responsible parties;

- Record Drawings: Complete set of record drawings, full size;
- Drawings and Technical Data: As necessary for the efficient operation and maintenance of the installation. Include:
    - Switchgear and control gear assembly circuit schedules including electrical service characteristics, controls and communications;
    - Charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- Installation Description: General description of the installation;
- Systems Descriptions and Performance: Technical description of the systems installed and mode of operation, presented in a clear and concise format readily understandable by the principal's staff. Identify function, normal operating characteristics, and limiting conditions;
- Systems Performance: Technical description of the mode of operation of the systems installed;
- Baseline Data: To AS 1851 and AS/NZS 1668.1;
- Documentation: To AS 1851 including the schedule of essential functionality and performance requirements;
- Digital photographic records of underground services;
- Equipment Descriptions:
    - Name, address, email address and telephone and facsimile numbers of the manufacturer and supplier of items of equipment installed, together with catalogue list numbers;
    - Schedules (system by system) of equipment, stating locations, duties, performance figures and dates of manufacture. Provide a unique code number cross-referenced to the record and diagrammatic drawings and schedules, including spare parts schedule, for each item of equipment installed;
    - Manufacturers' technical literature for equipment installed, assembled specifically for the project, excluding irrelevant matter. Mark each product data sheet to clearly identify specific products and component parts used in the installation, and data applicable to the installation;
    - Supplements to product data to illustrate relations of component parts. Include typed text as necessary.
- Certificates:
    - Certificates from authorities;
    - Copies of manufacturers' warranties;
    - Product certification;
    - Test certificates for each service installation and all equipment;
    - Test report;
    - Test, balancing and commissioning reports;
    - Control system testing and commissioning results.
- 7 day record of all trends at commissioning;
- Operation Procedures:
    - Manufacturers' technical literature as appropriate;

- Safe starting up, running-in, operating and shutting down procedures for systems installed. Include logical step-by-step sequence of instructions for each procedure;
- Control sequences and flow diagrams for systems installed;
- Legend for colour-codes services;
- Schedules of fixed and variable equipment settings established during commissioning and maintenance;
- Procedures for seasonal changeovers;
- If the installation includes cooling towers, a water efficiency management plan.

- Maintenance Procedures:
  - Detailed recommendations for periodic maintenance and procedures, including schedule of maintenance work including frequency and manufacturers' recommended tests;
  - Manufacturer's technical literature as appropriate. Register with manufacturer as necessary. Retain copies delivered with equipment;
  - Safe trouble-shooting, disassembly, repair and reassembly, cleaning, alignment and adjustment, balancing and checking procedures. Provide logical step-by-step sequence of instructions for each procedure;
  - Schedule of spares recommended to be held on site, being those items subject to wear or deterioration and which may involve the principal in extended deliveries when replacements are required. Include complete nomenclature and model numbers, and local sources of supply;
  - Schedule of normal consumable items, local sources of supply ,and expected replacement intervals up to a running time of 40, 000 hours. Include lubrication schedules for equipment;
  - Schedules for recording recommissioning data so that changes in the system over time can be identified;
  - Instructions for use of tools and testing equipment;
  - Emergency procedures, including telephone numbers for emergency services, and procedures for fault finding;
  - Safety data sheets (SDS);
  - Instructions and schedules conforming to AS 1851, AS/NZS 3666.2, AS/NZS 3666.3 and AS/NZS 3666.4.
- Maintenance Records:
  - Prototype service records conforming to AS 1851 prepared to include project specific details;
  - Prototype periodic maintenance records and report to AS/NZS 3666.2, AS/NZS 3666.3 and AS/NZS 3666.4 as appropriate, prepared to include project specific details;
  - For Hard Copies: In binders which match the manuals, loose leaf log book pages designed for recording completion activities including operational and maintenance procedures, materials used, test results, comments for future maintenance actions and notes covering the condition of the installation. Include completed log book pages recording the operational and maintenance activities performed up to the time of practical completion;
  - Number of Pages: The greater of 100 pages or enough pages for the maintenance period and a further 12 months.

3.34.3 Format – Electronic Copies

Scope: Provide the same material as documented for hardcopy in electronic format.

Printing: Except for drawings required in the Record Drawings clause provide material that can be legibly printed on A4 size paper.

3.34.4 Format – Hard Copy

General: A4 size loose leaf, in commercial quality, 4 ring binders with hard covers, each indexed, divided and titled. Include the following features:

- Cover: Identify each binder with typed or printed title **OPERATION AND MAINTENANCE MANUAL**, to spine. Identify title of project, volume number, volume subject matter, and date of issue;
- Dividers: Durable divider for each separate element, with typed description of system and major equipment components. Clearly print short titles under laminated plastic tabs;
- Drawings: Fold drawings to A4 size with title visible, insert in plastic sleeves (one per drawing) and accommodate them in the binders;
- Pagination: Number pages;
- Ring Size: 50 mm maximum, with compressor bars;
- Text: Manufacturers' printed data, including associated diagrams, or typewritten, single-sided on bond paper, in clear concise English.

Number of Copies: Three (3).

3.34.5 Date for Submission

Draft Submission: The earlier of the following:

- Two (2) weeks before the date for practical completion;
- Commencement of training on services equipment.

Final Submission: Within two (2) weeks after practical completion.

3.35 Tools and Spare Parts

3.35.1 Spare Parts

General: Provide spare parts listed in the appropriate work sections.

Replacement: Replace spare parts used during the maintenance period.

3.35.2 Tools and Spare Parts Schedule

Submission Timing: At least eight (8) weeks before the date for practical completion.

Requirement: Prepare a schedule of tools, portable instruments and spare parts necessary for maintenance of the installation. For each item state the recommended quantity and the manufacturer's current price. Include the following in the prices:

- Checking receipt, marking and numbering in conformance with the spare parts schedule;
- Packaging and delivery to site;

- Painting, greasing and packing to prevent deterioration during storage;
- Referencing equipment schedules in the operation and maintenance manuals;
- Suitable means of identifying, storing and securing the tools and instruments. Include instructions for use.

Replacement: Replace spare parts used during the maintenance period.

3.36 Testing

3.36.1 Attendance

General: Provide attendance on tests.

3.36.2 Testing Authorities

General: Except for site tests, have tests carried out by a registered testing authority.

Test Instruments: Use instruments calibrated by a registered testing authority.

3.36.3 Test Reports

General: Indicate observations and results of tests and conformance or non-conformance with requirements.

3.36.4 Notice

Inspection: Give sufficient notice for inspection to be made of the commissioning and completion testing of the installation.

3.36.5 Controls

General: Calibrate, set and adjust control instruments, control systems and safety controls.

3.36.6 Circuit Protection

General: Confirm that circuit protective devices are sized and adjusted to protect installed circuits.

3.36.7 Completion Tests

General: Test the works under the contract to demonstrate conformance with the documented performance requirements of the installation.

Functional Checks: Carry out functional and operational checks on energised equipment and circuits and make final adjustments for the correct operation of safety devices and control functions.

Type Test Reports: Required, as evidence of conformance of proprietary equipment.

Sound Pressure Level Measurements: Conform to the following:

- Correction for Background Noise: To AS/NZS 2107;
- External: To AS 1055.1;
- Internal: To AS/NZS 2107;
- Measurement Positions: If a test position is designated only by reference to a room or space, do not take measurements less than 1 m from the floor, ground or walls;
- Sound Pressure Level Analysis: Measure the sound pressure level and the background sound pressure level over the full range of octave band centre frequencies from 31.5 Hz to 8 kHz at the designated positions;

- Sound Pressure Levels: Measure the A-weighted sound pressure levels and the A-weighted background sound pressure levels at the designated positions.

3.36.8 Certification

General: On satisfactory completion of the installation and before the date of practical completion, certify that each installation is operating correctly.

3.37 Training

3.37.1 General

Duration: Instruction to be available for the whole of the commissioning and running-in periods.

Format: Conduct training at agreed times, at system or equipment location. Also provide seminar instruction to cover all major components.

Operation and Maintenance Manuals: Use items and procedures listed in the final draft operation and maintenance manuals as the basis for instruction. Review contents in detail with the principal's staff.

Certification: Provide written certification of attendance and participation in training for each attendee. Provide register of certificates issued.

3.37.2 Demonstrators

General: Use only qualified manufacturer's representatives who are knowledgeable about the installations.

3.37.3 Maintenance

General: Explain and demonstrate to the principal's staff the purpose, function and maintenance of the installations.

3.37.4 Operation

General: Explain and demonstrate to the principal's staff the purpose, function and operation of the installations.

3.37.5 Seasonal Operation

General: For equipment requiring seasonal operation, demonstrate during the appropriate season and within 6 months.

3.38 Final Cleaning

General: Before the date for practical completion, clean throughout, including all exterior and interior surfaces except those totally and permanently concealed from view.

Labels: Remove all labels not required for maintenance.

3.39 Periodic Maintenance of Services

3.39.1 General

Requirement: During the maintenance period, carry out periodic inspections and maintenance work as recommended by manufacturers of supplied equipment, and promptly rectify faults.

Emergencies: Attend emergency calls promptly.

Annual Maintenance: Carry out recommended annual maintenance procedures before the end of the maintenance period.

Maintenance Period: The greater of the defects liability period and the period documented in the Maintenance requirements schedule.

3.39.2 Maintenance Program

General: Submit details of maintenance procedures and program, relating to installed plant and equipment, 6 weeks before the date for practical completion. Indicate dates of service visits. State contact telephone numbers of service operators and describe arrangements for emergency calls.

3.39.3 Maintenance Records

General: Record in binders provided with the Operation and maintenance manuals.

Referenced Documents: If referenced documents or technical work sections require that log books or records be submitted, include this material in the maintenance records.

Certificates: Include test and approval certificates.

Service Visits: Record comments on the functioning of the systems, work carried out, items requiring corrective action, adjustments made and name of service operator. On completion of the visit, obtain the signature of the principal's designated representative on the record of the work undertaken.

3.39.4 Site Control

General: Report to the principal’s designated representative on arriving at and before leaving the site.

3.40 Post-Construction Mandatory Inspections and Maintenance

Requirement: For the duration of the defects liability period, provide inspections and maintenance of safety measures required by the following:

- AS 1851;
- Other statutory requirements applicable to the work.

Records: Provide mandatory records.

Certification: Certify that mandatory inspections and maintenance have been carried out and that the respective items conform to statutory requirements.

Annual Inspection: Perform an annual inspection and maintenance immediately before the end of the defects liability period.

4. SERVICE TRENCHING

4.1 Design

Steel Shoring and Trench Lining Systems: To AS 4744.1.

Hydraulic Shoring and Trench Lining Equipment: To AS 5047.

4.2 Standards

Earthworks: To AS 3798.

4.3 Interpretation

4.3.1 Definitions

General: For the purposes of this worksection the definitions given in AS 1348, AS 3798 and the following apply:

- *Description and Classification of Soils:* To AS 1726.
- *Site Classification:* To BCA 3.2.4.
- *Bad Ground:* Ground unsuitable for the purposes of the works, including fill liable to subsidence, ground containing cavities, faults or fissures, ground contaminated by harmful substances and ground which is or becomes soft, wet or unstable.
- *Discrepancy:* A difference between contract information about the site and conditions encountered on the site, including but not limited to discrepancies concerning the following:
    - The nature or quantity of the material to be excavated or placed;
    - Existing site levels;
    - Services or other obstructions beneath the site surface.
- *Rock:* Monolithic material with volume greater than 0.5 m3 which cannot be removed until broken up by rippers or percussion tools.
- *Site Topsoil:* Soil excavated from the site which contains organic matter, supports plant life, conforms generally to the fine to medium texture classification to AS 4419 (loam, silt, clay loam) and is free from:
    - Stones more than 25 mm diameter;
    - Clay lumps more than 75 mm diameter;
    - Weeds and tree roots;
    - Sticks and rubbish;
    - Material toxic to plants.
- *Zone Of Influence:* A foundation zone bounded by planes extending downward and outward from the bottom edge of a footing, slab or pavement and defining the extent of foundation material having influence on the stability or support of the footings, slab or pavement.

4.4 Tolerances

Finish: Finish the surface to the required level, grade and shape within the following tolerances:

- Under building slabs and load bearing elements: + 0, - 25 mm;
- Pavement subgrades: + 0, - 40 mm;
- Batters: No steeper than the slope shown on the drawings. Make sure flatter slopes do not impact on boundaries or required clearances to buildings, pavements or landscaping;
- Other ground surfaces: ± 50 mm, provided the area remains free draining and matches adjacent construction where required. Provide smoothness as normally produced by a scraper blade.

4.5 Submissions

Extent: Submit a plan of trench works noting the location and type of service.

Design Calculations: Submit calculations by a professional engineer to show that proposed excavations and temporary supports, including where applicable supports for adjacent structures, will be stable and safe.

Notice: Advise on proposed duration of open excavation.

Construction: Submit details of proposed equipment and method of excavation.

Stability: If shuttering and/or bracing of the sides of a trench is required for safety and stability, provide proposals.

Geotechnical Data: Provide a geotechnical report supporting the procedures proposed for trenching and/or boring.

Hazards: Identify WHS hazards that may be encountered with deep trenches including toxic gases and liquids.

Boring: Submit proposals for the following:

- Limits on length;
- Existence of other services and method of protection;
- Pressure grouting to voids;
- The effect of pressure grouting on other services, ground heave and proposals for minimising such effects;
- Access to properties outside the site;
- Council permits;
- Service interruptions including a plan for minimising unintended interruptions.

Temporary Shoring: Submit a proposal for any temporary shoring or underpinning required including the progressive removal.

Proof Rolling: Submit method and equipment for proof rolling.

Certified Records of Measurement: Submit a certified copy of the agreed records of measurement.

Imported Fill: Submit certification or test results by a GTA registered laboratory which establish the compliance of imported fill with the contract including the source.

Compaction: Submit certification and/or test results in conformance with the specified level of responsibility to AS 3798.

Disposal Location: Submit the locations and evidence of compliance with the relevant authorities for the disposal of material required to be removed from the site.

4.6 Inspection

Notice: Give notice so that inspection may be made at the following stages:

- Service trenches excavated before laying the service;
- Services laid in trenches and ready for backfilling.

4.7 Fill Materials

Suitable Material: To AS 3798 including inorganic, non-perishable material suitably graded and capable of compaction to the documented density.

Unsuitable Materials: Do not use unsuitable material for fill in conformance with AS 3798.

Sulphur Content: Do not provide filling with sulphur content exceeding 0.5% within 500 mm of cement bound elements (for example concrete structures or masonry) unless such elements are protected by impermeable membranes or equivalent means.

Re-Use of Excavated Material: Only re-use suitable material in conformance with AS 3798.

Stockpiles: Segregate the earth and rock material and stockpile, for re-use in backfilling operations.

Locations: Do not stockpile excavated material against tree trunks, buildings, fences or obstruct the free flow of water along gutters where stockpiling is permitted along the line of the trench excavation.

Disposal: If stockpiling is not permitted under the contract, dispose of excavated material off-site to AS 3798.

4.8 Borrow or Imported Fill

Borrow or Imported Material: Only when no suitable excavated material is available.

Suitable material: To AS 3798 clause 4.4.

Borrow Pits:

- Location: More than 3 m from any fence line, boundary, edge of excavation or embankment;
- Strip and stockpile topsoil;
- Provide erosion protection during winning operations of material and make sure drainage is maintained;
- On completion of winning operations grade abrupt changes of slope, re-spread topsoil and apply and maintain hydroseeded grassing.

4.9 Existing Services

4.9.1 Location

Requirement: Before commencing service trenching, locate and mark existing underground services in the areas which will be affected by the service trenching operations.

Utility Services: Contact DIAL BEFORE YOU DIG to identify location of underground utility services pipes and cables.

4.9.2 Excavation

General: Do not excavate by machine within 1 m of existing underground services.

4.10 Existing Surfaces

4.10.1 Concrete and Asphalt Pavements

Method: Saw cut trench set out lines for the full depths of the bound pavement layers except where the set out line is located along expansion joints.

Removal of Concrete and Asphalt: Break out concrete or asphalt pavement material between the trench set out lines, remove and dispose of off-site.

4.10.2 Segmental Paving Units

Removal: Take up segmental paving units both full and cut by hand, between the trench set out lines, and neatly stack on wooden pallets.

Concrete Edging: Break out, remove and dispose of off-site.

Concrete Subbase: If present, saw cut along the trench set-out lines.

4.10.3 Grass

Removal Method: Neatly cut grass turf between trench set-out lines into 300 mm squares.

Grass Suitable for Re-Use: Take up and store the turf and water during the storage period, otherwise remove and dispose of it off-site.

4.10.4 Small Plants, Shrubs and Trees

Small Plants Required For Re-Planting: Take up and store. Wrap the rootball in a hessian or plastic bag with drain holes and water during the storage period.

Unsuitable Vegetation: Remove and dispose of off-site.

4.11 Excavating

4.11.1 Excavation

General: Excavate for underground services in conformance with the following:

- To required lines and levels, with uniform grades;
- Straight between access chambers, inspection points and junctions;
- With stable sides;
- Width tolerance: ± 50 mm, unless constrained by adjacent structures.

4.11.2 Trench Widths

General: Keep trench widths to the minimum, consistent with the laying and bedding of the relevant service and construction of access chambers and pits.

4.11.3 Trench Depths

General: As required by the relevant service and its bedding method.

Adjacent to Existing Footings: If excavation is required within the zone of influence of an existing footing, use methods including (temporary) shoring or underpinning that maintain the support of the footing and make sure that the structure and finishes supported by the footing are not damaged.

4.11.4 Obstructions

General: Clear trenches of sharp projections. Cut back roots encountered in trenches to at least 600 mm clear of services. Remove other obstructions including stumps and boulders which may interfere with services or bedding.

Tree Protection: To AS 4970.

4.11.5 Dewatering

General: Keep trenches free of water. Place bedding material, services and backfilling on firm ground, free of surface water.

Pumping: Provide pump-out from adjacent sumps or install well points.

Adjacent Subsidence: Provide recharge points to isolate the dewatering zone.

4.11.6 Excess Excavation

General: If trench excavation exceeds the correct depth, reinstate to the correct depth and bearing value using compacted bedding material or sand stabilised with 1 part of cement to 20 parts of sand by volume.

4.11.7 Stockpiles

Excavated Material for Backfill: If required, segregate the earth and rock material and stockpile, for re-use in backfilling operations.

Locations: Do not stockpile excavated material against tree trunks, buildings, fences or obstruct the free flow of water along gutters where stockpiling is permitted along the line of the trench excavation.

Disposal: If stockpiling is not permitted, dispose of excavated material off-site.

4.11.8 Unsuitable Material

Disposal: Remove unsuitable material from the bottom of the trench or at foundation level and dispose of off-site.

4.11.9 Boring

Subcontractor: If under road boring is required instead of trenches, engage a suitably qualified subcontractor to do the work.

4.12 Adjacent Structures

4.12.1 Temporary Supports

General: Provide supports to adjacent structures where necessary, sufficient to prevent damage arising from the works.

Lateral Supports: Provide lateral support using shoring.

Vertical Supports: Provide vertical support where necessary using piling or underpinning or both.

4.12.2 Permanent Supports

General: If permanent supports for adjacent structures are necessary and are not described, give notice and obtain instructions.

4.12.3 Encroachments

General: If encroachments from adjacent structures are encountered and are not shown on the drawings, give notice and obtain instructions.

4.13 Trench Backfill

4.13.1 General

Timing: Backfill service trenches as soon as possible after laying and bedding the service, if possible on the same working day.

Marking Services: Underground marking tape to AS/NZS 2648.1.

4.13.2 Placing Fill

4.13.2.1 General

Layers: Place fill in near-horizontal layers of uniform thickness, deposited systematically across the fill area.

Extent: Place and compact fill to the designated dimensions, levels, grades, and cross sections so that the surface is always self-draining.

Edges: At junctions of fill and existing surfaces, do not feather the edges.

Mix: Place fill in a uniform mixture.

Previous Fill: Before placing subsequent fill layers, make sure that previously accepted layers still conform to requirements, including moisture content.

Protection: Protect the works from damage due to compaction operations. Where necessary, limit the size of compaction equipment or compact by hand. Commence compacting each layer at the structure and proceed away from it.

Protective Covering: Do not disturb or damage the protective covering of membranes during backfilling.

4.13.2.2 Placing at Structures

General: Place and compact fill in layers simultaneously on both sides of structures, culverts and pipelines to avoid differential loading. Carefully place first layers of fill over the top of structures.

Concrete: Do not place fill against concrete retaining walls until the concrete has been in place for 28 days unless the structure is supported by struts.

4.13.3 Bedding, Haunch, Side and Overlay Zones

Installation and Material: To the particular utility authority or utility service requirements. Secure pipes against floatation.

Overlay Zone Thickness: Maximum 300 mm immediately over the utility service.

Topsoil Areas: Complete the backfilling with at least 100 mm of topsoil.

Material In Reactive Clay Areas: In sites classified M, M-D, H1, H1-D, H2, H2-D, E or E-D to AS 2870, re-use excavated site material at a moisture content within ± 1% of that of the adjoining in situ clay.

4.13.4 Selected Material Zone

Extent: The section of trench within the zone, if applicable.

Backfill Material: Selected material free from stones larger than 100 mm maximum dimension and the fraction passing a 19 mm Australian Standard sieve to have a 4 day soaked CBR value, in conformance with AS 1289.6.1.2, and not less than that of the adjacent selected material zone.

4.13.5 Trees

Backfill at Trees: Backfill minimum 300 mm thick, around tree roots with a topsoil mixture. Place and compact in layers of 150 mm minimum depth to a dry density equal to that of the surrounding soil.

Do Not Place Backfill: Above the original ground surface around tree trunks or over the root zone.

Watering: Thoroughly water immediately after backfilling the tree root zone.

4.14 Compaction Requirements for Backfill

4.14.1 General

Control Moisture within Backfill: Adjust the moisture content of fill during compaction within the range of 85 to 115% of the optimum moisture content determined by AS 1289.5.1.1 or AS 1289.5.2.1, as appropriate, to achieve the required density.

Layers: Compact all material in layers not exceeding 150 mm compacted thickness. Compact each layer to the required relative compaction before starting the next layer.

Precautions: If compacting adjacent to utility services, use compaction methods which do not cause damage or misalignment.

4.14.2 Density

Excavated and Stripped Ground Surface: After excavation and/or stripping, compact these surfaces to a minimum depth of 150 mm.

Maximum Rock and Lump Size In Layer after Compaction: To AS 3798.

Fill Batter Faces: Either compact separately, or overfill and cut back. Form roughened surfaces to the faces.

Minimum Relative Compaction: To AS 3798.

4.14.3 Density Tests

Testing Authority: Carry out density tests of pipe bedding and backfilling by a registered testing authority.

Test Methods: Conform to the following:

- Compaction control tests: To AS 1289.5.4.1 or AS 1289.5.7.1;
- Field dry density: AS 1289.5.3.2 or AS 1289.5.3.5;
- Standard maximum dry density: AS 1289.5.1.1;
- Dry density ratio: AS 1289.5.4.1;
- Density index: AS 1289.5.6.1.

4.14.4 Compaction Control Tests

Compaction Control Tests: To AS 1289.5.4.1 or AS 1289.5.7.1.

4.14.5 Compaction Control Test Frequency

Standard: To AS 3798.

Confined Operations: 1 test per 2 layers per 50 m2.

4.15 Completion

Site Restoration: Where variation of existing ground surfaces is not required as part of the works, restore surfaces to the condition existing at the commencement of the contract.

5. MATERIALS

5.1 General

Requirement: All materials, fittings, accessories and ancillaries are to be new (unless the re-use of existing materials is specified) and of first class design and manufacture, complying with the appropriate and current Australian Standard specification and shall comply with Local Authority requirements.

Samples: Provide for the approval of the Superintendent prior to commencing installation, samples of all accessories, fittings and apparatus proposed to be used in the work, and only such items as are approved may be installed. Failure to comply with this provision may result in the unconditional rejection of such items when installed on site. Any rejected materials, fittings, accessories or apparatus shall be removed from the site within 24 hours of such rejection.

Workmanship: The whole of the work shall be carried out by skilled, qualified tradesmen, supervised by the Contractor, and/or his authorised representative. Workmanship shall be of the highest standard and each section of the work shall be properly and neatly executed to the best current trade practice.

5.2 Supply of Materials

Requirement: Supply and fix all materials required to complete the works. All costs associated with replacement of rejected materials shall be borne by the Contractor. All materials shall conform to the latest Australian Standard Specification, Code or Interim Code. If no Australian Standard exists they shall conform to the latest British Standard or the requirements of the American Society for Testing and Materials in that order.

WaterMark Certification: Submit evidence that proposed components are listed in the WaterMark Product Database.

Australian Products: Preference should be given to Australian made products wherever possible, providing their use will not result in a lowering of the project quality.

5.3 Rejection of Unsatisfactory Materials

Requirement: In the event of materials being of a mixed description and quality, the Superintendent shall have power to order to have those portions of the materials, which in their opinion are unsuitable for the works, picked out, marked and stacked where directed, and all defective or unsuitable materials removed from the site.

5.4 Alternative Materials and Equipment

Requirement: Where any material and equipment is specified as being similar or equal to a particular manufacture, the particular brand or product specified is to be allowed for. Should a tenderer desire to use alternative materials or equipment, they shall submit with their tender a description of such material or equipment and advise of the tender price variation that would result from its use. Unless a variation of the work as specified is agreed to before signing of the contract, or is ordered by the Superintendent in accordance with the general condition of contract, the brand or product specified shall be used in the works.

5.5 Dissimilar Materials

Requirement: The Contractor shall be responsible for separating dissimilar metals from direct contact with each other. All necessary gaskets, dielectric couplings, etc., required shall be supplied and installed by the Contractor. All metal screws, clamps, etc. shall be of the same metal and finish as the materials supported.

Pipe Supports: Where clips, brackets and pipe supports are of dissimilar metal to the actual piping used, completely insulate the piping at all fixing points with at least 10 mm thick insulation or 8mm thick vibration resistant rubber wrapped around the pipe prior to fixing in position.

5.6 Copper Piping

5.6.1 Pipes

Standard: To AS 1432 Type A and Type B or as documented, hard drawn.

5.6.2 Jointing

General: Select from the following except where a specific jointing method is documented:

- Brass flanges with brass nuts and bolts (no size limitation);
- Screwed brass unions: ≤ DN 50;
- Compression joints: ≤ DN 50;
- Proprietary grooved joints (no size limitation).

5.6.3 Fittings

Capillary Fittings Including Adaptor Capillary Fittings with Threaded Ends or Compression-Type Connector Ends: To AS 3688, of copper or dezincification-resistant copper alloy.

Compression Fittings Including Adaptor Compression Fittings with Connector-Ends for Screwed or Capillary Joints: To AS 3688, flared type, of copper or dezincification-resistant copper alloy.

Unions: Bronze, proprietary manufacture, with ground or accurately machined face joints.

Flanges: Brazing metal to AS 2129. Expand pipes into flanges and braze.

Bends and Tees: Provide sweep tees and long radius type bends.

Centreline Radius of Bend or Tee Branch: ≥ 1.5 times the pipe diameter.

5.6.4 Permanent Joints

General: Provide brazed slip joints. Provide either capillary fittings, or expand one pipe over the other leaving a minimum clearance and an effective overlap.

5.6.5 Slip Joint Overlap Table

Nominal Pipe Size (DN)	Overlap (mm)
≥ 15, < 20	12
≥ 20, < 32	15
≥ 32, < 50	25
≥ 50, < 80	30
≥ 80, < 125	35
≥ 125, < 200	40

5.7 Black Steel Piping

Fittings: Wall thickness to match that of the pipe.

Screwed Fittings: Heavy pattern, low carbon steel suitable for making screwed joints to AS ISO 7.1.

Welded Pipe Construction: Provide butt-weld flanges.

Pipe Bends: To AS 4041.

Elbows:

- < DN 50: Screwed type;
- ≥ DN 50: Either welded or segmented roll-grooved type.

Tees:

- < DN 50: Screwed type;
- ≥ DN 50: Either welded or roll-grooved type.

Mechanical Roll-grooved Fittings: Provide only in accessible locations, in sprinkler-protected areas.

Flanges: To AS 2129.

Bolts for Flanges:

- Carbon steel to AS 2129;
- Zinc-plated in non-corrosive environments; otherwise a protective finish with equivalent corrosion resistance to, and compatible with, the flange.

Thread Sealing: Seal the threads of screwed connections with degreased PTFE tape or hemp with a thread sealing compound.

5.8 Galvanized Steel Piping

5.8.1 Galvanized Pipes

Galvanized Standard: To AS 1074 Medium Grade or as documented.

5.8.2 Jointing

General: Pipe and fittings shall be hot dipped galvanised; nuts and bolts shall be stainless steel.

Jointing: Select from the following except where a specific jointing method is documented:

- Screwed and socketed up to 50 mm size;
- Galvanized screwed flanges;
- Proprietary grooved joints.

Grooved Joints: Shall be selected from the Victaulic Registered Trade Mark system of fittings and couplings. Couplings shall be constructed of two galvanised ductile iron housings with pressure responsive gasket, Victaulic Style 177 and 75 flexible coupling and Style 107H and 07 rigid couplings with Registered Trade Mark manufacture system of fittings.

Flanges: Table E for AS 2129 completed with an approved rubber type gasket inserted for jointing purposes.

5.8.3 Fittings

Welded Pipe: Butt weld fittings (e.g. bends and tees).

Bends and Tees: Provide sweep tees and long radius type bends.

- Centreline Radius of Bend or Tee Branch: ≥ 1.5 times the pipe diameter.

Steel for Fabricated Pipe Fittings: Same grade and wall thickness as the pipe.

Non-vertical Lines: Eccentric reducing fittings installed to avoid gas binding, liquid retention or both.

5.9 Valves and Fittings

5.9.1 General

Requirement: All valves shall be either Active Fire Listed or WaterMark certified by a JAS-ANZ accredited Conformity Assessment Body in accordance with the NCC.

5.9.2 Components

Valve Size: Equal to the nominal pipe size, unless a smaller size is specified.

Insulated Valves: Extended shafts or bodies to butterfly and ball valves to allow full thickness of insulation without restricting movement of hand-wheel or lever.

Connections:

- Valves ≤ DN 50: Screwed to AS ISO 7.1;
- Valves > DN 50: Flanged to AS 2129.

Handwheels and Handles: Removable, with the direction of closing marked permanently on handwheels.

Copper Alloy Valves: Dezincification resistant and stamped accordingly.

5.9.3 Installation

Valves: If practicable, install with the stem horizontal.

Non-Return Valves: Provide at least 6 pipe diameters of straight pipe on the upstream side.

5.9.4 Valve Identification

General: Tag all valves for identification purposes. Provide a circular brass disc attached to the valve by a stainless steel wire drawn through the holes in the disc on each valve provided with operating handwheel or lever stamp the valve identification mark on the disc in characters 10 mm high.

Valves Without Operating Handwheels: Mark by aluminium or brass strap 20 mm wide by 90 mm long stamped in the same manner as the valve identification discs. Attach by wire to the body of the valves.

5.9.5 Selection

Working Pressure Rating: Minimum 1.4 MPa and to suit the system pressure range.

Working Temperature Rating: To suit the system operating temperature range.

5.9.6 Gate Valves

Description: Straight-through flow, solid wedge type, inside screw design, medium pattern.

Standards:

- Bronze Valves: To AS 1628;
- Flanged Cast Iron Valves: To AS/NZS 2638.1.

Construction:

- Body:
    - ≤ DN 80: Bronze;
    - > DN 80: Cast iron.
- Seats: Integral seats for bronze valves, replaceable bronze seats for cast iron valves.

5.9.7 Globe Valves

Description: Inside screw design.

Construction:

- Body:
    - ≤ DN 50: Bronze;
    - > DN 50: Steel;
    - Stem and gland: Forged brass.

Bronze Screwed Globe Valves ≤ DN 50: Zetco Figure 2010 or equal approved.

Bronze Screwed Globe Valves > DN 50: Zetco Figure 2020 or equal approved.

5.9.8 Ball Valves

Description: Full bore pattern with handle parallel to the direction of flow when the valve is fully open.

Construction:

- Body: Bronze;
- Ball: Hard chromed brass;
- Gland Seal: Adjustable;
- Seat: PTFE.

DZR Brass Press-fit Ball Valves ≤ DN 50: Zetco Figure 6100 or equal approved.

DZR Brass Press-fit Ball Valves Where Publicly Accessible ≤ DN 50: Zetco Figure 6107 or equal approved.

DZR Brass Screwed Ball Valves ≤ DN 50: Zetco Isis Figure 1001 or equal approved.

DZR Brass Screwed Ball Valves Where Publicly Accessible ≤ DN 50: Zetco Isis Figure 1007 or equal approved.

Above Ground Bronze Flanged Ball Valves > DN 50: Zetco Figure 2605 or equal approved.

Above Ground Bronze Flanged Ball Valves Where Publicly Accessible > DN 50: Zetco Figure 2607 or equal approved.

Below Ground Bronze Screwed Ball Valves ≤ DN 50: Zetco Figure 2506 or equal approved.

Below Ground Bronze Flanged Ball Valves DN 65 - DN 100: Zetco Figure 2606 or equal approved.

Below Ground Bronze Flanged Ball Valves > DN 100: Zetco Figure 2606 or equal approved.

5.9.9 Butterfly Valves

Description: Tapped lug type.

Operation:

- ≤ DN 150: Positive locating operating bar, parallel to the disk with notched plate;
- > DN 150: Geared or motorised operator;
- All Sizes Used for Throttling and Balancing: Geared operators.

Construction:

- Body: Cast aluminium or cast iron;
- Shaft: Stainless steel;
- Disc: Bronze generally, stainless steel for condenser water systems.
- Disc Fixing Method: Select from the following:
    - One-piece disc and shaft;
    - Disc keyed and screwed to shaft.
- Seat: Bonded EPDM selected for compatibility with the fluid and water treatment chemicals.

Grooved Gear Operated Butterfly Valves: Victaulic VIC-300 or equal approved.

Anti-tamper Switch: Amtron Class A or equal approved.

5.9.10 Non-Return Valves

Flanged Valves for Water: To AS 4794.

Disc Type:

- Body: Stainless steel or bronze;
- Disc and spring: Stainless steel.

Swing Type: To AS 1628.

- Body: Bronze;
- Plates: Bronze or stainless steel.

Dual Flap Type:

- Body: Cast iron;
- Pin and spring: Stainless steel;
- Seat: Integral nitrile rubber;
- Plates: Bronze or stainless steel.

DZR Brass Screwed Spring Check Type ≤ DN 50: Zetco Figure 1907 or equal approved.

Bronze Screwed Swing Type ≤ DN 50: Zetco Figure 1805 or equal approved.

Bronze Flanged Swing Type DN 65 - DN 100: Zetco Figure 1808 or equal approved.

Grooved Swing Check >DN 65: Victaulic Series 717 or equal approved.

5.9.11 Double Check Detector Assembly (DCDA)

Standard: To AS 2845.1.

Construction:

- Valve Body: Epoxy coated ductile iron;
- Springs: Stainless steel;
- Seats: Bronze;
- Seat Discs: EPDM;
- Flanges: Table 'E';
- Fasteners: Stainless steel.

Support: Provide minimum two galvanized steel cradle supports under the DCDA and gate valves.

Bypass Line: The DCDA shall have a bypass line of a minimum DN 20 with a water meter complying with AS 3565.1.

Isolation Valves: Provide 50mm wide 003 keyed padlocks with 6 mm galvanized steel chain to lock all valves fully open.

Concrete Plinth: Provide 100 mm thick concrete plinth below the DCDA for entire length. Concrete slab shall be 25 mm above surrounding ground.

Pipe Jointing: Join polyethylene pipe to above ground copper pipe with poly electrofusion stub flanges, with stainless steel backing flanges and bolt with stainless steel bolts and nuts to 200 mm bronze brazing flanges each side of DCDA assembly. Provide cement mortar blocks formed around poly to copper/stainless flanged joints.

5.9.12 Strainers

Selection: 15 kPa maximum pressure drop.

Construction:

- Body: Bronze or cast iron as documented;
- Screen: Stainless steel.

Strainers > DN 65 Diameter: Fit a 25mm ball valve for blowdown.

DZR Brass Screwed Strainers ≤ DN 50: Zetco Figure 1504 or equal approved.

Bronze Flanged Strainers DN 65 - DN 100: Zetco Figure 1525 or equal approved.

5.10 Pressure Gauges

5.10.1.1 General

Standard: Bourdon tube type to AS 1349.

Scale Range: Full scale between 130% and 200% of maximum working pressure.

Construction:

- Case: Glass filled nylon. Minimum diameter 100 mm;
- Lens: UV stabilised polycarbonate;
- Dial: UV stabilised polycarbonate;
- Indicating Pointer: Adjustable;
- Configuration: Direct mounting, bottom entry;
- Bourdon Tube Material: Stainless steel for hot water systems. Phosphor bronze for other services.

5.10.1.2 Installation

General: Mount gauges vertically and in locations free from vibration. Provide gauge line connection cocks. If necessary, eliminate needle fluctuations caused by pressure fluctuations, by either of the following:

- An orifice or restrictor;
- A capillary tube pressure pulse damper.

Pressure Gauge Connections: For gauges not permanently connected, seal outlets of isolating valves with flared seal cap nuts.

5.11 External Fire Hydrant Valves

General: External fire hydrants shall comprise of NSW Fire Brigade approved dual 65 mm storz hydrant valves complete with caps and chains, dual head fire hydrant valve riser, tamper resistant dual head hydrant covers, dual head hydrant support posts, and two (2) galvanised protection bollards (where required).

Concrete Anchor: Install each external hydrant on a 100 mm GMS riser complete with a 450 mm x 450 mm x 450 mm concrete base finished 25mm above ground level.

Identification: Paint a white band 100 mm wide on the riser with the letters FH in signal red in 80mm high text.

Siting: Locate hydrants at least 10m away from building unless protected by 90/90/90 fire rated construction to the requirements as specified in AS 2419.1.

Installation: Position valve centre line minimum 750 mm above finished ground level and allow to direct outlets sloping not more than 35 degrees below the horizontal. Valves shall be complete with a storz coupling fittings, brass caps and chains. Valve handwheel shall be 100 mm clear of any obstruction. Two hydrant valves shall be provided on each hydrant riser.

5.12 Internal Fire Hydrant Landing Valves

General: Internal fire hydrants shall comprise of NSW Fire Brigade approved 65 mm storz hydrant valves located within all fire equipment cabinets, fire isolated stair risers or fire hydrant cabinet locations as generally indicated on the accompanying drawings and complete with caps and chain.

Installation: Position valve centre line minimum 750 mm above finished ground level and allow to direct outlets sloping not more than 35 degrees below the horizontal. Valves shall be complete with a storz coupling fittings, brass caps and chains. Valve handwheel shall be 100 mm clear of any obstruction.

5.13 Fire Hydrant Couplings

General: All hydrant couplings shall be that approved by the site Fire Officer and/or the local fire brigade.

Couplings: All couplings must be fitted with delivery washers except hard suction couplings, which must be fitted with a suction washer. All storz couplings shall be fitted with a blank cap.

Thread Connection: 65mm connectors shall be fitted using standard FRNSW thread of 64 mm x 4.88 mm pitch (2V2 x 51/5 TPI). A low strength thread sealant is recommended for use between the connector and pipe thread creating a semi-permanent connection so that a damaged connector may be expediently removed and replaced.

General: Storz couplings where required shall be forged aluminium alloy manufactured to DIN 14303 and fitted to all hydrant system inlets and outlets including boosters, feed hydrants, attack hydrants and hard suction outlets.

Requirement: The fire services contractor shall inform the project supervisor of the hardware required and the cost of variation into the contract as required by the local authorities.

Local Authorities: Site Fire Officer in consultation with the local NSW Fire Brigade. In conjunction, the NSW Corrective Services Fire Safety Risk manager.

5.14 Block Plan

General: Provide a block plan consisting of minimum A3 size laminated, weather proof and framed, showing a diagram of the complete fire service systems located in the brigade booster cabinet, enclosure, recess, fire control room, and pump room in a conspicuous location.

Requirement: The block plan shall comply with AS 2419.1 and NSW Fire Brigade requirements as stated in the general section.

Installation: Provide and install two hot dip galvanized steel supports all as detailed on drawing and secure into position with bulk concrete. Provide two (2) 50 mm equal stainless steel angle section for each block plan concreted into ground and secure plan with stainless steel bolts and anti-tamper nuts.

5.15 Installation

5.15.1 General

Requirement: Install piping in straight lines at uniform grades with no sags. Arrange to prevent air locks. Provide sufficient unions, flanges and isolating valves to allow removal of piping and fittings for maintenance or replacement of plant.

Layout: Follow the line of walls, ceilings, etc., and include all necessary offsets and arrange to avoid interference with the building or other services.

Arrangement: Arrange and support piping so that it remains free from vibrations whilst permitting necessary movements. Minimise the number of joints.

Spacing: Provide at least 50 mm clear between pipes, flanges, unions and couplings and between these and building elements, additional to insulation.

Dissimilar Metals: Join dissimilar metals with fittings of electrolytically compatible material and as follows:

- Flanges: Provide insulating flange kit;
- Proprietary Grooved Piping Systems: Provide proprietary thermoplastic lined dielectric isolating fitting.

5.15.2 Connections

Requirement: Arrange connections to plant to permit dismantling of the plant without disturbing other pipes and to permit removal of the plant without cutting or removal of the piping, or cutting or damaging building elements. Provide union on at least one side of each screwed valve and screwed pipeline component requiring removal for inspection or maintenance. Make all connections to plant by one of the following methods:

- Flare compression joints (up to 20 mm copper and only where there is no vibration);
- Screwed brass unions (up to 50 mm size and for pressures up to 800 kPa);
- Bolted flanges (no size limitation);
- Proprietary grooved joints (no size limitation).

5.15.3 Separation of Components

Requirement: Install pipeline components to manufacturer's recommendations and the following:

- Pump Discharge to Check Valve: ≥ 5 diameters of straight pipe. The flexible connection (if used) and reducer (if used) may be included in calculating this length;
- Before Pump Suction: ≥ 5 diameters of straight pipe. The flexible connection (if used) and reducer (if used) may be included in calculating this length.

5.16 Concrete

Type: Concrete shall be mixed in an approved central plant and transported to the site in a pre-mixed condition by means of specially constructed conveyances. Transit mixers will be accepted, provided that they comply in all respects with the requirements of this specification and AS 1379 and its use is approved or machine mixed to AS1480.

Strength: All concrete used in conjunction with this work shall have a minimum strength of 20 mPa at twenty eight days when tested in accordance with AS 1012.8.

5.17 Anchorages

Requirement: Install anchorages in the form of lateral or longitudinal anchor blocks, of not less than 20 MPa concrete, to restrain lateral movement in pipelines at bends and changes of direction on pipework above 100 mm diameter. Bear anchor blocks against the body of the fitting only, clear of joints, and against firm undisturbed ground or compacted filling.

Rubber Ring Joints: Where rubber ring jointed pipes and where the gradient is greater than 1 in 20 (5%), concrete stops shall be provided 150 mm thick and built around the pipe extending from the bottom of the trench up to a height of 300 mm above pipe and recessed 75 mm into each side of the trench.

Submissions: Submit to the Superintendent all details of the inground pipe systems including proposed positions of concrete thrust blocks for approval before installation of pipework commences.

5.18 Cleaning

General: Remove scale, rust, burrs and grease and make sure that surfaces are clean and dry.

Protection: During construction, prevent the entry of foreign matter into the piping system by temporarily sealing the open ends of pipes and valves with purpose-made covers of pressed steel or rigid plastic.

5.19 Pipe Supports

5.19.1 Support Systems

General: Provide hangers, brackets, saddles, clips, and support system components, incorporating provisions for adjustment of spacing, alignment, grading, and load distribution. Support pipework from associated equipment or building structure. Support valves, strainers and major line fittings so that no load is placed on adjacent pipes or transmitted to them during operation and maintenance.

Support Type: Proprietary metallic-coated steel channel section with clamps and hangers sized to match external diameter of pipe being supported.

Vertical Pipes: Provide anchors and guides to maintain long pipes in position, and supports to balance the mass of the pipe and its contents.

Saddles: Saddle type supports may only be used for pipes no more than DN 25.

Pipe Supports: Clamp piping supports directly to pipes.

Dissimilar Metals: If pipe and support materials are dissimilar, provide industrial grade electrically non-conductive material securely bonded to the pipe to separate them. Provide fixings of electrolytically compatible material.

Uninsulated Pipes: Clamp piping supports directly to pipes, subject to electrical isolation of dissimilar metals.

Insulated Pipes:

- Spacers: Provide spacers at least as thick as the insulation between piping supports and pipes. Extend either side of the support by at least 20 mm;
- Spacer Material: Rigid insulation material of sufficient strength to support the piping and suitable for the temperature application;
- Vapour Barriers: For cold pipes, apply aluminium foil tape over the circumference of the spacer to form a vapour barrier. Fit to spacer before installation of the bracket on the pipe;
- Metal Sheathing: Provide a 0.55 mm thick metallic-coated steel band between the aluminium foil tape and the support for the full width of the spacer.

5.19.2 Support Spacing

Fire Sprinkler Pipes: To AS 2118.9. Provide additional brackets, clips or hangers to prevent pipe movement caused by water pressure effects.

<<COMBINED_FIRE_SPRINKLER_AND_HYDRANT_SERVICE>>Fire Hydrant Pipes: To AS/NZS 3500.1. Provide additional brackets, clips or hangers to prevent pipe movement caused by water pressure effects.

Other Pipes: To AS/NZS 3500.1.

5.19.3 Hanger Size Table

Outside Diameter of Pipe or Sheathing (mm)	Minimum Hanger Diameter (mm): Light Series	Minimum Hanger Diameter (mm): Heavy Series
< 20	6	6
≥ 20, < 35	10	10
≥ 35, < 65	12	12

≥ 65, < 120	12	16
≥ 120, < 220	16	16
≥ 220, < 275	16	20
≥ 275, < 325	20	24
≥ 325, < 410	24	30

5.20 Flexibility

5.20.1 General

Requirement: Pipe anchors, offsets or expansion devices and pipe guides to accommodate expansion and contraction, and to minimise the transmission vibration and noise to building structures.

Anchors and Guides: Locate anchors and guides at equal distances on each side of expansion devices. Weld or securely clamp anchors to bare pipe. If limitations in the strength of structures prevent the use of expansion devices and anchors, arrange piping to move in lateral and linear directions (e.g. at bends) while not deviating from gradients.

5.20.2 Flexible Connections

General: Minimise the transmission of vibration and noise through the piping. Isolate vibrating sources as follows:

- Connections to Major Plant Items: Reinforced rubber type, spherical shape with flanged ends;
- Elsewhere: Flexible reinforced nylon hose.

5.21 Joints

5.21.1 General

Requirement: Minimise the number of joints. If practicable, provide welded or brazed joints or a proprietary pipe coupling system.

5.21.2 Demountable Joints

Requirement: Locate as follows:

- At connections to pumps;
- At maintenance locations.

Pipes ≥ DN 65: Flanges or proprietary grooved joint.

5.21.3 Flanged Joints

Metal Flanges: Full face flanges with undistorted machined joint faces, to AS 2129.

Minimum Flange Thickness: 12 mm.

Bolting: To AS 2129 and AS 2528.

Material:

- Corrosive Environments: Material with equivalent corrosion resistance to, and compatible with, the flanges;

- Non-corrosive Environments: Zinc-plated steel.

Flange Jointing Material: Preformed proprietary type at least 0.8 mm thick.

Installation: Install flanges square with the run of pipe and aligned parallel to each other. Do not correct misalignment by bolting.

5.21.4 Screwed Joints

General: To AS ISO 7.1. Do not provide long screws or barrel nipples. Seal threads of screwed connections with degreased PTFE tape or a thread sealing compound.

5.21.5 Grooved Piping Systems

5.21.5.1 Compatibility of Components

Grooved Mechanical Jointing Systems: Provide piping grooved on machines supplied by Victaulic.

Grooved End Product Manufacturer: Certified to ISO 9001.

Piping: For Victaulic jointing systems, provide pipe supplied by an authorised Victaulic distributor.

Grooving: Provide rolled groove pipe.

Grooving Tools: Use tools supplied by the same manufacturer as the grooved components.

Site Rolled Grooves: To be made only by Victaulic trained personnel, stamped, and recorded to Victaulic approved quality control system.

5.21.5.2 Components

Gaskets: Provide gaskets in the Victaulic couplings of style and material selected for the operating temperature and pressure range of the system and for long term compatibility with the pipe contents including chemical water treatment.

Victaulic Advanced Groove System: Provide only on piping ≥ DN 350.

Finish: Painted or galvanized.

5.22 Underground Metal Piping

5.22.1 Proximity to Other Services

General: Separate underground piping from electrical cables and gas pipes, by at least 300 mm.

5.22.2 Installation

Pipe Underlay: Bed piping on a continuous underlay of bedding material, at least 75 mm thick after compaction. Grade the underlay evenly to the gradient of the piping.

Bedding Material: Sand free from material retained on a 13.2 mm sieve.

Chases: If necessary, form chases to prevent projections such as sockets and flanges from bearing on the trench bottom or underlay.

Other Services: Separate underground piping from electrical cables and other services by ≥ 300 mm.

5.22.3 Pipe Surrounds

General: Place the material in the pipe surround in layers less than 200 mm loose thickness and compact without damaging or displacing the piping.

Protection: Lay continuously concrete tiles more than 25 mm thick, or PVC tape at least 3 mm thick, in the overlay, 50 to 75 mm clear of the piping, for the length of the piping.

Warning Tape: During backfilling lay plastic warning tape 300 mm above buried piping, for the full length of the piping.

- Type: Minimum 100 mm width.

Valves: Install in underground control boxes.

5.22.4 Corrosion Protection

Protection: Either encase piping in continuous PVC-U watertight pipe or provide continuous wrapping over all pipe and fittings using proprietary petroleum taping material installed in accordance with manufacturer's recommendations.

5.23 Wiring & Hardware

5.23.1 General

Comply with the General Requirements section.

5.23.2 Standards

To AS/NZS 3000 and AS/CA S009

5.23.3 Authorities

Documents evidencing approval of regulatory authorities, to be provided before practical completion or other specified dates, including but not limited to NSW Building Control Electrical Inspection Certificate.

5.23.4 Cables

General: Use multi-stranded copper cable generally, except for MIMS. Cabling shall be non-PVC to meet Green Star requirements. All conductors shall be copper, insulated and sheathed. The outer sheathing colour shall be red.

Minimum size:

- 1.0 mm² for AS 1670 system.
- 0.75 mm² for warning systems.

5.23.5 Installation

1670.1-2015

Standard: Fire or mechanical damage: Classifications to AS/NZS 3013.

Installation Methods: Comply with the requirements of Section 3.24 and Appendix B of AS 1670.1. Install the cables to comply with AS/NZS 3000 and AS/CA S009. Each wiring method shall comply with the requirements of the relevant clauses within this specification. Segregate the fire detection and alarm circuits from circuits in excess of extra low voltage (not exceeding 32V AC or 115V DC) and all other services required to have segregation. Install all wiring for the fire lines from the FIP to the main telephone building distributor to comply with AS 1670.1.

1670.1-2015

Install cables in the following manner:

- Fix and support with purpose made clips, cleats or saddles. Fire rated cables shall be fixed and supported by suitable fire rated steel fixings.
- Install to permit adequate air circulation around each cable.
- Install between equipment without any joints.
- Installed on the loop-in, loop-out principle without the use of connectors.
- Install so that they can readily be withdrawn for the purposes of relocation and/or rewiring.
- Install the cables on a square grid form parallel to walls, etc

Do not bend through radii less than the minimum bending radii recommended by the manufacturer.

Install free of joints.

Fix to permanent structural components of the building. Additionally, cables shall be positioned above ducts, pipes and other building components which may become dislodged and cause interference to the cables.

Space from power and other wiring systems in accordance with AS/CA S009 and AS/NZS 3000.

5.23.6 Handling Cables

General: Handle cables so as to avoid damage to insulation and serving or sheathing. Report damage to cable insulation, serving or sheathing.

Straight-Through Joints: Joints shall comply with the requirements of AS/CA S009. Unless unavoidable due to length or difficult installation conditions, run cables without intermediate straight-through joints. Joints in conductors are not permitted except in runs excess of 100mm.

Cable Joints: Locate in accessible positions in junction boxes as directed. Refer to Section 3.24.6 of AS 1670.1 for the specific requirements.

Tagging: Identify multicore cables and trefoil groups at each end (and at crowded intermediate points) using stamped non-ferrous tags or other approved labels clipped around each cable or trefoil group.

Marking: Identify the origin of all wiring using legible indelible marking.

Flexible Conduit: Provide for equipment and plant subjected to vibration. If necessary, provide for adjustment or ease of maintenance. Provide the minimum possible length.

Associated Fittings: Ensure the same type and material as the conduit. Wall boxes on UPVC conduits: For special size wall boxes not available in UPVC, use prefabricated earthed metal boxes. Provide inspection-type fittings only in accessible locations and where exposed to view

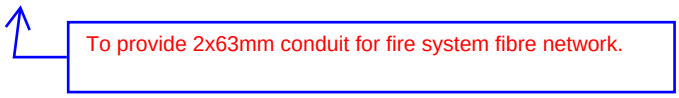
5.23.7 Wiring Enclosures and Cable Supports

General: Conduits shall be semi rigid ((non-metalic) PVC) or rigid (galvanised mild steel) wiring enclosures supplied and installed with the following, but not limited to the minimal features as follows:

Minimum Sizes:

Metallic and non-metallic conduits: 20 mm.

Galvanised water pipe: Medium or heavy, to AS 1074.



Rigid Conduits: Provide straight long runs, smooth and free from rags, burrs and sharp edges. Set conduits to minimise the number of fittings.

Set Out: Where exposed to view, install conduits in parallel runs with right angle changes of direction complete with inspection fittings located in accessible positions.

5.23.8 Draw Cords

General: Provide draw cords in conduits not in use. Leave 1 m of cord coiled at each end of the run.

Material: Polypropylene cord, or insulated stranded earth wire, 2.5 mm^2 minimum size.

Draw-In Boxes: Provide draw-in boxes at intervals not exceeding 30 m in straight runs, and at changes of level or direction. Where draw in boxes are underground, provide covers complete with gaskets to seal against moisture.

5.23.9 Concealed Conduits

Routes: Conduits concealed in wall chases, embedded in floor slabs or installed in inaccessible locations: Run directly between points of termination, minimising the number of sets. Do not use inspection fittings.

Conduits in Concrete Slabs: Do not run in concrete toppings. Do not run within pre-tensioning cable zones; cross pre-tensioning cable zones at right angles. Route to avoid crossovers and minimise the number of conduits in any location.

Parallel Spacing: Space conduits at least 50 mm apart.

Minimum cover: Conduit diameter or 20 mm.

Conduit size: 25 mm maximum diameter.

Fixing: Fix directly to top of the bottom layer of reinforcing where the conduits pass above a single layer of reinforcing.

Prohibited Floor Slabs: Do not run conduits in the floor slabs of boiler rooms, plant rooms and tank rooms.

Hollow-Block Floors: Locate conduits in the core-filled sections of precast hollow-block type floors.

Columns: Do not place more than four 25 mm (maximum) diameter conduits centrally in each column. It is the contractor's responsibility to obtain approval from the project Structural Engineer.

Bends: Enter columns via bends with minimum radius of 150 mm.

Chasing: Do not chase columns. Contractor to obtain approval from the project manager & the structural engineer prior to any chasing being performed.

5.23.10 Non-Metallic Conduits and Fittings

Standard: Non-metallic conduits and fittings: AS/NZS 2053 Parts 2, 3, 4, 5 or 6. These shall be non-PVC.

Conduits in Roof Spaces: Locate below roof insulation and sarking. In accessible roof spaces, provide mechanical protection for light-duty conduits.

Conduit in Slabs : High compression corrugated conduit, restrain at regular intervals to achieve a nominally straight run

6. CABLE SUPPORT & DUCT SYSTEMS

6.1 General

The Contractor shall design, supply, install and certify a complete cable support system in accordance with relevant standards. The system shall be designed to accommodate the purpose cables and be installed in an approved and compliant manner. The Contractor shall provide as part of their design, workshop drawings detailing a design intent for the major cable support and duct systems for approval prior to performing any work on site. The Contractor shall assume the responsibility of the design of the system and no variations will be accepted after submitted drawings have been approved for installation.

6.2 Selection

The type of cable containment shall be selected to achieve the design intent and meeting all relevant codes of compliance. Consideration shall be given to the location of the installation.

6.2.1 Internal Cable Containment

The selection of internal cable containment shall depend on the location of the installation:

- Cast in slabs
- Concealed space
- Surface mounted
- Close proximity to equipment
- Chemical exposure
- Fire Rating
- Moisture
- Type of room the containment is serving

6.2.2 External Cable Containment

The selection of external cable containment shall depend on the location of the installation:

- Underground/overhead containment
- Surface mounted
- Highly corrosive areas
- Elemental influence; Flora, fauna, UV, water, etc.
- High impact zones
- Adjacent machinery
- Industrial specifics requiring higher grade protection

6.2.3 General Requirements of Selection of Cable Containment

General requirements of cable containment are defined below and shall be utilized in accordance with relevant codes of compliance and as above defined, but not limited to:

- Cast concrete slabs: Unsheathed cable in heavy duty UPVC conduit.
- Accessible spaces: Thermoplastic insulated and sheathed cables.
- Concealed spaces: Unsheathed cable in UPVC conduit.
- Plastered or rendered surfaces: Cable in UPVC conduit.
- Stud walls without bulk insulation: Thermoplastic insulated and sheathed cables.

Primary cable containment, including sub-main circuit cabling and consolidated services paths shall be served by appropriate means of cable tray/ladder as required to support the purpose cables for the length of the path. Where secondary containment requiring short distance cable support is required, the Contractor shall provide any of the following options as deemed suitable to requirements:

- Reduced size cable tray/ladder
- Independent catenary wire
- Soffit supported fixings
- Conduits
- Cable Duct

For all service cables larger than 10mm², the Contractor shall reticulate the cables on cable ladder/trays.

Clearance between cable supports and other services shall be maintained as part of Australian Standards and specifically:

- Hot Water Pipes – minimum 200mm
- Boilers/Furnaces – minimum 500mm

The cable support system shall be of a single manufacturer respective to the application.

6.3 Standards and Regulations

The following but not limited to, Australian Standards and guidelines are applicable to this scope of works:

Reference	Name
AS/NZS 3000	Electrical Installations: Wiring Rules
AS/NZS 3013	Electrical Installations - Classification of the fire and mechanical performance of wiring system elements
AS/NZS 4680	Hot-dip galvanized coatings on fabricated ferrous articles
AS/NZS 1866	Aluminium and aluminium alloys – Extruded rod, bar, solid and hollow shapes
AS/CA S009	Installation requirements for customer cabling
AS/NZS 61386.1	Conduit systems for cable management - General requirements
AS/NZS 4296	Information technology - Implementation and operation of customer premises cabling
AS/NZS 3837	Method of test for heat and smoke release rates for materials and products using an oxygen consumption calorimeter

AS 3996	Access covers & grates
IEC 61537	Cable Management – Cable tray systems and cable ladder systems
ISO/IEC 14763.2	Information technology - Implementation and operation of customer premises cabling
NEMA VE-2	Cable Tray Installation Guidelines

Note, unless otherwise referenced in the BCA edition certified for this project, the most current edition of the above mentioned standards is to apply. Should this specification conflict with the BCA, standard or authority having jurisdiction, the most onerous shall apply.

6.4 Cabling Systems

Fire Services cabling shall be separate & distinct from other services and shall be installed in accordance with, but not limited to AS3000, AS/CA S009, AS3013 and manufacturer's recommendations. Where possible, cabling shall be concealed in spaces by running in slabs, ceiling spaces, wall cavities, chasing into walls, etc.

All cabling shall be new. Refer to each relevant section of this specification for specific details of cabling requirements pertaining to fire services.

6.5 Catenary Cables

Catenary cables shall be used where cables are not mounted on cable trays, ladders, ducts and so on. Insulated and sheathed cables be fixed directly to the underside of the slab/roof structure where installed in false ceiling spaces by means of approved clips and/or saddles & tied to catenary wires with approved nylon strap fasteners.

Catenary cables shall be stainless steel with a minimal cross sectional area of 0.4mm^2. They shall be in straight runs and provide adequate segregation between ELV & LV circuits to comply with the requirements of AS/CA S009. Coordinate catenary cable runs in a grid arrangement with other building services. Each end of the catenary cable shall be securely fixed to an appropriate structural member to support the load. Contractor to obtain approval of cable support paths and cabling runs from the project superintendent prior to installation.

6.6 Conduits

The Contractor shall provide conduits in accordance with relevant standards and manufacturer's recommendations. Where possible, conduits shall be concealed in spaces by running in slabs, ceiling spaces, wall cavities, chasing into walls, etc. with the exception of switch rooms where only surface mounted conduit shall be permitted.

<<EXIST_BLDG>>The Contractor shall inspect the existing works and provide conduits as required to satisfy compliancy for alterations to existing apparatus. The Contractor shall allow to provide a complete solution and be of a single manufacturer. Where conduits are deemed to be of a non-compliant nature, the Contractor shall allow in their costs to rejuvenate/replace the service. The Contractor shall advise the client of any variations to contract and seek approval prior to commencement of any works on site.

Conduits shall be securely fixed by appropriate galvanised saddles in a neat and symmetrical manner. Frequency of saddles shall be the responsibility of the Contractor and ensure adequate support across the length of the conduit. The conduits shall be:

- No less than the following and separated between lighting and power services
    - Residential installations; 20mm in diameter
    - Commercial installations; 25mm in diameter

- Industrial installations; 25mm in diameter

- Run parallel to building members where surface mounted and be provided with one (1) approved expansion joint for each straight section exceeding 6,000mm in length.
- Provided with an additional draw-in box when installed where cables would be required to bend more than twice and complete with draw wires.
- For communications, PVC type, light gauge to ISO/IEC 14763.2, high impact and cold setting, unless noted otherwise.

Rigid PVC conduit shall not be used in any application where the cable support may be exposed to mechanical damage, locations deemed hazardous or on surfaces exposed to view where other means of installation are available.

6.6.1 Heavy Duty Conduits

Heavy Duty (HD) conduits shall be used in applications considered impact probable or underground. HD conduits shall be identified as light orange in colour and noting:

- Fitted with corrosion resistant fittings
- Fitted with bell-mouths at each respective end
- Installed over approved routes
- Maintain for the duration of the conduit, appropriate clearance to all other services and easements
- Ensure installed in accordance with standards in rulings on depth of cover and identification

6.6.2 Galvanised Conduits

Galvanised conduits shall be installed where specified on the electrical drawings or as otherwise required. The solution shall be heavy duty screwed type conduit, noting:

- Cut square and threaded with minimal number of required threads
- Consistent in union and painted over the threads with conductive paint
- Reamed to remove burrs
- Adequately terminated into threaded connection or locknuts with no visible threads after assembly
- Fixed at maximum 1,200mm centres where the service is surface mounted

6.7 Cable Trays and Ladders

The Contractor shall provide proprietary support, fixings and accessories from a single manufacturer cable tray and ladder solution. Fixings shall be provided as required to achieve the loading and deflection requirements mentioned in relevant standards and as per manufacturer's recommendations. The fixings shall be capable of securing the cable support to walls and ceiling as required to maintain uniformity without sagging.

<<NEW_BLDG>><<DANDC_TRUE>>The Contractor shall provide as part of their design, suitably sized cable tray and ladders with minimum 50% spare capacity for future provisions. Workshop drawings shall be provided by the Contractor prior to any works commencing on site and be approved by the appropriate party for construction. No variations shall arise from the Contractor failing to allow for a suitable solution other than that arising from a client driven request.

<<NEW_BLDG>><<DANDC_FALSE>>Where the route designed imposes limitations for the reticulation of cables, a suitable alternative path shall be proposed by the Contractor and approved by the appropriate party for construction as part of the required workshop drawings.

<<EXIST_BLDG>>The Contractor shall inspect the existing works and provide cable trays and ladders as required to satisfy compliancy for alterations to existing apparatus. The Contractor shall allow to provide a complete solution and be of a single manufacturer. Where trays and ladders are deemed to be of a non-compliant nature, the Contractor shall allow in their costs to rejuvenate/replace the service. The Contractor shall advise the client of any variations to contract and seek approval prior to commencement of any works on site.

The cable trays and ladders shall be installed to support multiple runs of cable and shall have the following features:

- Materials/Finish:
    - Interior: Zinc-coated steel, or steel with two-pack liquid coating, air-drying enamel or stoving enamel finish.
    - Exterior: Hot dip galvanised steel.
    - Highly corrosive areas: Marine grade stainless steel
- Purpose or manufactured made bends, tees, intersections, etc.
- Shall have minimum 200mm clearance between the bottom of the cable tray/ladder support bracket and the top of the ceiling
- All cable ducts/ladders shall be earthed continuously with equipotential bonding along the length of the support by manufacturer designed fish plates and compression bolts/ washer systems or by other approved means of earthing.
- Minimum steel thickness:
    - Trays < 150 mm wide: 1 mm
    - Trays > 150 mm, < 300 mm wide: 1.2 mm
    - Trays > 300 mm wide: 1.6 mm
- Cable ladders shall be two (2) folded steel or extruded structural grade aluminium side rails with cable support rungs between the rails and 300mm maximum rung spacing.
- Fix supports to the building structure or fabric using direct fixings, hangers or brackets. Supports shall be spaced as required by the manufacturer and not more than 1,500mm for cable trays and 3,000mm for cable ladders.

Cables fixed to the ladders and trays shall be neatly tied. For power services, plastic ties at 1,000mm spacing for vertical services and 2,000mm for horizontal services. Essential services cabling shall be fixed to appropriate cable ladders and tray by stainless steel ties and comply with the relevant standards. Communications cabling shall be fixed by Velcro cable and shall not exceed more than 24 individual cables in each loom. The looms shall be laid across the width of the cable trays and ladders and shall not be stacked for the duration of the loom group.

Spacing for cables on trays and ladders shall be considered in accordance with AS 3008 and de-rating factor shall be avoided.

6.8 Cable Ducts

Cable ducts shall be fabricated of sheet steel or extruded aluminium. Duct and lids shall be galvanised or zicanneal (where painted) sheet steel of suitable thickness in accordance with manufacturer's requirements. Locations where specified, the Contractor shall allow for rigid PVC cable ducts. Cable ducts shall be sized to comply with AS 3000 requirements and allow for 30% spare capacity for future provisions.

Ducts shall be provided complete with all necessary matching bends, tees, risers, end strops and other accessories as required to form the installation requirements.

Lids shall be provided for the length of the duct unless specified otherwise and shall be electrically continuous. Lids and top edges of ducts shall have a minimum 10mm return edge for fastening and stiffening purposes.

The Contractor shall seek appropriate approval for colour and size of cable ducts on site with the Architect prior to commencement of any works on site.

6.9 Penetrations

<<EXIST_BLDG>>Penetrations shall be provided under approval for existing structures. No penetrations shall be made through fire walls, floor and structural members without required approval from the relevant party. No penetrations shall be made through damp courses.

<<NEW_BLDG>>Penetrations shall be provided in accordance with the structural drawings and as otherwise approved by the Builder. No penetrations shall be made through fire walls, floor and structural members without required approval from the relevant party. No penetrations shall be made through damp courses.

Where the contractor is responsible for the provision of penetrations through fire rated building elements the contractor shall ensure to fire rate all penetrations in accordance with but not limited to the BCA Clause 3.15, AS4072.1, AS1530.4 & AS3837.

Each penetration shall be fitted with a UPVC sleeve through ground floor slabs, ground floor beams and external walls for cables not enclosed in conduit. In addition to the UPVC sleeve, a sleeve shall be provided for each masonry penetration for MIMS cables.

Penetrations shall be no less than 10mm greater than the pipe or sleeve diameter for pipes and sleeves penetrating existing internal walls, ground slabs or ground floor beams.

Seal penetrations around conduits and sleeves with a weak sand cement mix, or similar sealing compound approved by the Builder. Seal the space between cables within sleeves with a pliable waterproof compound.

Fireproof penetrations for cables and bus-ways through fire rated floors and walls in accordance with BCA regulations. The fireproofing shall be provided by means of an approved fire rated material with a certified fire resistance rating in accordance with AS3837.

Fire rated pillows may be used to seal large penetrations where the remainder of gaps/holes can be caulked by refine rate sealant.

6.10 Trenches & Excavation

6.10.1 Underground Services Trenches

The Contractor shall have sufficient available information of the existing underground services and systems prior to works being performed on site. Services shall be identified and any works involved with or affecting the infrastructure shall be part of the known scope of works or as otherwise approved by the Builder. The Contractor shall employ an "underground services locator" where unknown to locate all underground services and record all

findings for approval by the Builder. Services damaged during the works shall be reinstated at the Contractor's expense.

The Contractor shall avoid landscaped areas where possible. In all areas where landscaping, trees, ground cover, retaining walls etc. are disturbed, the Contractor shall reinstate the disturbed area to its original condition to the satisfaction of the Superintendent.

Where excavation near existing trees may occur, a review with the Head Contractor and the Arborist shall be carried out prior to commencement of any excavation works. An agreed distance from the tree to the proposed trenches shall be confirmed and approved by the relevant parties.

Underground boring shall be the preference wherever possible to avoid the breaking/damaging of existing services. The Contractor shall advise the Superintendent of any likely disturbances of existing before commencement of works on site.

Should underground boring not be available, the Contractor shall saw-cut the existing concrete and bituminous surface on each side of the trench path and excavate as required thereafter. The intent is that the saw-cutting shall produce a parallel linear path for the excavation component of works to be performed. The paving shall be stored for later reinstatement and made good to compliant standards. Intent shall be to trench as considered practical in a lineal manner between pits, junction and changes in cable route with vertical sides and uniform grades.

Excavated material shall generally be used for filling or backfilling. Excess material shall be allowed to be removed from site and disposed of.

Trench widths shall be kept to the minimum consistent dimension with the laying and bedding of services and the construction of pits.

If excavation is necessary below the level of adjacent footings, seek approval, and provide necessary support for the footings.

Clear trenches of sharp projections. Cut back roots to at least 600 mm clear of services. Remove other obstructions including stumps and boulders, which interfere with services or bedding. If rock is encountered, give notice.

Keep trenches free of water. Place sand as bedding material, services and backfilling on firm ground free of surface water.

If trench excavation exceeds the correct depth, reinstate to the correct depth and bearing value using compacted bedding material or grade N20 concrete.

Excavated cable routes shall be recorded before commencement of backfilling. Locations of underground services shall be accurately marked using route markers consisting of a marker plate set flush in a concrete base. Markers are required to be placed at the following locations, but not limited to:

- Joints
- Route junctions
- Changes of direction
- Termination points
- Building entry point
- Straight run intervals of not more than 100m

Markers shall show the direction of the cable run using direction arrows on the marker plate and indicate distance to the next marker. Marker plates shall generally be constructed as below:

- Plates: Brass, minimum size 75 x 75 x 1 mm thick.
- Plate fixing: Waterproof adhesive and 4 brass or stainless steel countersunk screws.
- Marker height: Set the marker plate flush with paved surfaces, and 25 mm above other surfaces.
- Marker tape: Where electric bricks or covers are not provided over underground wiring, provide a 150 mm wide yellow or orange marker tape bearing the words "WARNING - electric cable buried below", laid in the trench 150 mm below ground level.

6.10.2 Backfilling

Backfill trenches as soon as possible after approval of laid and bedded service. Place the backfill in layers 150 mm thick and compact to the density which applies to the location of the trenches to minimise settlement, and so that pipes are buttressed by the trench walls.

Backfill material shall be:

- Under roads and paved areas: Coarse sand, controlled low strength material or fine crushed rock.
- In topsoil areas: Coarse sand backfill to a level 150 mm above the top of conduits. Complete the backfilling with topsoil for at least the top 50 mm.
- In reactive clay: Coarse sand backfill to a level 150mm above the top of conduits. In sites classified M, H or E to AS 2870.1, use an impervious material if trenches fall towards footings.
- Elsewhere: Well graded, inorganic, non-perishable material, maximum size 75 mm, plasticity index < 55%. Do not place stones greater than 25 mm within 150 mm of services.
- Compaction of trench to achieve minimum 80%.

6.10.3 Reinstatement

Reinstatement of areas of services trenches:

- In lawn areas: Provide 150 mm of loam and re-turf the lawn over the trench and other disturbed areas; ongoing watering plan shall also be provided
- In paving and roads: Reinstate to match adjacent work, paved surfaces and assets disturbed or removed during excavation of trenching.
- In concrete surfaces: Reinstate concrete surfaces to the original level. If necessary, provide steel reinforcement keyed to the adjacent concrete, laid to prevent the reinstalled concrete from subsiding and cracking.
- In bituminous surfaces: Provide crushed rock base and sub-base to match the pavement. Prime coat the edges of the surfacing with bitumen. Lay and compact hot-mix asphalt so that the edges are flush and the Centre is cambered 10 mm above the pavement. If hot pre-mix is not available, cold pre-mix may be accepted. Minimum asphalt thickness shall be 50mm or the adjacent asphalt thickness, whichever is greater.

6.11 Electrical Pillars

Electrical pillars shall be proprietary fiberglass type and be:

- Green in colour; unless requested by the Client

- Installed on concrete plinth, plum and level
- Key lockable (Front and back to separately keyed, contractor to provide three (3) keys minimum for each lock) with additional pad lock on footing bolt.
- Weatherproof.
- Sized to contain the required outlets.
- Stainless steel labelling to be provided

Where larger loads are to be provided via a pillar, a custom built enclosure shall be provided similar to a weatherproof switchboard that is free standing, all specifications of the switchboard shall apply to this pillar. Such circumstance of this nature shall be designed where applicable to the following standard:

- Stainless steel enclosures for all public areas, parks, domain areas, transport, etc.
- IP56/IP66 minimum rating in areas deemed required for protection
- Authority keying system to be provided as required and requested upon by the relevant parties

6.12 Pits

The Contractor shall determine the appropriate size of pits and demonstrate compliance with standard requirements and bending radii limitations of incoming and outgoing cables. Pit selection shall be in accordance with AS 3996 and suit structural requirements as defined in the below table. The Contractor shall allow to appropriately drain all pits to prevent the build-up of water through provision of 100mm holes from the bottom of the cable pits, either to absorption trenches filled with rubble or to the storm water drainage system. The pit selection and installation shall be co-ordinated on site with the Hydraulic/ Civil Contractor as applicable,

- Absorption trenches: Minimum size 300 x 300 x 2000 mm.

All cable pits shall have their lids marked with the word “FIRE”. Construct walls and bottoms using rendered brickwork or 75 mm thick reinforced concrete. Incorporate a waterproofing agent in the render or concrete.

Cable pits shall be installed in the following situations:

- Where indicated on fire services drawings.
- Wherever there is more than one 90 degree or greater change in direction in any single conduit run which is not occurring at a lighting pole.
- On long straight runs exceeding 60 meters.
- In locations as approved by the Client to offer greater management of reticulation of services

All cable pits shall be installed firmly in the ground with the lid flush with the finished surface, and be away from paths and driveways if possible.

Conduits serving through the pit shall be distributed evenly in the pit and, where available, holes for provisions in the pit as per manufacturer’s recommendations shall be utilised to maximise structural integrity. All conduit connections to cable pits shall be made waterproof by approved sealant or other method by the Principal. Pit covers shall be cast iron and concrete filled and suit the expected load requirements of the area in which they are installed.

Provide lockable pit covers to suit heavy traffic loads with a lifting handle for each side of the cover section. Fit flush with the top of the pit.

Testing of covers and grates as defined in the table below shall be in accordance with Section 4 of AS 3996.

Load Class	Wheel Load	Maximum Force	Duty Level	Typical Uses	Cable Pit Suitability	Cable Lid & Access Cover Suitability
A	330kg	10kN	Extra Light	Footways & areas accessible only to pedestrians and pedal cyclists	Plastic Polymer Concrete	Concrete lids Non-locking/ Powerlok lids Urbanfill/ Pavermate access covers Casting / steel / concrete access covers
B	2,670kg	80kN	Light	Footways mountable by vehicle or livestock and light tractor paths	Polymer Concrete	Non-locking/ Powerlok lids Urbanfill/ Pavermate access covers Casting / steel / concrete access covers
C	5,000kg	150kN	Medium	Malls and pedestrian areas open to slow moving commercial vehicles	Concrete	Casting / steel / concrete access covers
D	8,000kg	210kN	Heavy	Carriageways of roads and areas open to commercial vehicles	Concrete	Casting / steel / concrete access covers
E	13,700kg	400kN	Extra Heavy	General docks and aircraft pavements	Concrete	Casting / steel / concrete access covers
F	20,000kg	600kN	Extra Heavy	Docks and aircraft pavements subject to high wheel loads	Concrete	Casting / steel / concrete access covers
G	30,000kg	900kN	Extra Heavy	Docks and aircraft pavements subject to very high wheel loads	Concrete	Casting / steel / concrete access covers

6.13 Future Provisions

As part of the Contractor's requirements, future provisions shall be made on site to accommodate unforeseen works to the development up to but not limited to:

- Spare Conduits shall be installed at a minimum of 1 metre in length exiting the pits and capped off to avoid egress of soil and other contaminants into the pit.
- Caps shall be provided to the spare conduits at both ends as required to avoid blockage and contamination of the conduit.
- Labels shall be provided inside the pit to nominate what conduits are considered spare.

7. AUTOMATIC FIRE DETECTION & ALARM SYSTEM

7.1 General

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General: The automatic fire detection section is a Design & Construct performance brief and provides design guidelines for the installation. The contractor shall design and construct a fully addressable automatic fire detection system complying with the current National Construction Code, AS 1670 and all requirements for the performance of AS 1668 Ventilation & Air-conditioning Systems.

Only qualified contractors with experience in fire detection system installation shall install the system and are required to be recognised as *'Competent Fire Safety Practitioners'* in accordance with NSW Government Co-regulatory Accreditation Framework. The entire installation shall be in accordance with the requirements of the relevant regulations, Local Council, NSW Fire Brigade and Occupational Health and Safety requirements.

Design Intent: The works specified in this section describe the design intent for the automatic fire detection & alarm system based on a Design & Construct methodology.

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Requirement: The works specified in this section comprises the complete design, supply, installation, testing, and commissioning of the fire detection and alarm system in accordance with but not limited to AS1670.1.

Scope of Works: The scope of work includes, but is not limited to, the following:

&Mimic Panel

- Supply and installation of Main FIP complete with occupant warning tone generator and associated hardware at site entrance in a location agreed with the relevant project stake holders.
- Supply and installation of a networked Sub FIP (SFIP) complete with occupant warning tone generator and associated hardware connected to the main FIP located in the central building Officers Station in a location agreed with the relevant project stake holders.

New Gate house

- Provide a block plan for approval prior to installation at all FIP locations & SFIP locations complete with zone/loop and detector address information.
    - Mount block plan in an approved frame for location next to or within the FIP or on FIP panel software/touch screen system.
- Supply and install addressable detection and devices in accordance with AS1670.1 requirements. The following list is provided as a guide for suitable detection locations and situations in a D&C methodology:

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    - Select the appropriate type of detector to be installed in locations to avoid any spurious fire alarms.
    - Install detectors so they can be easily inspected and tested in situ, and readily withdrawn from service.
    - Provide access for maintenance of detectors in concealed spaces shall be provided. Where personnel entry to the concealed space is required the access dimensions shall be not less than 450 mm × 350 mm. Where access panels can not be utilised due to security requirements and so on, FAMCO retractable type systems, or equal approved are to be provided for each detector.
    - Where a concealed space contains electrical lighting or power equipment that is fully within the concealed space, and is connected to an electrical supply in excess of extra low voltage, a detector shall be mounted on the ceiling of the concealed space within 1.5 m measured horizontally from the equipment. An exception to this is when light fittings are not rated above 100 W and power equipment with moving parts is not rated above 100 W and other power equipment is not rated above 500 W.
    - Any cupboard that has a capacity exceeding 3 m³ shall be protected with detectors. Cupboards divided by partitions or shelves into separate areas of less than 3 m³ capacity do not require detectors.

Also concealed smoke detectors shall be provided where concealed space exceeds 800 mm.

- Cupboards containing electrical or electronic equipment having voltages greater than extra low voltage shall be protected internally if in excess of 1 m³.
- Protection shall be provided under intermediate horizontal surfaces such as ducts, loading platforms, and storage racks in excess of 3.5 m in width and whose under surface is in excess of 800 mm above the floor.
- Where the distance from the underside of the intermediate surface to the ceiling is less than 800 mm, the underside of the intermediate surface may be considered as the ceiling and does not require detectors above the intermediate surface.
- If the side of the duct or structure is in excess of 800 mm from the wall or other ducts or structures, detectors shall be provided at the highest accessible point on the ceiling.
- Where a concealed space is formed above or below the intermediate surface, such as ducts above false ceilings, Clause 3.26 shall apply.
- Where detectors are installed in areas to which fire service access is restricted, each area shall be a separate alarm zone, or have a suitably labelled remote indicator installed outside the entry to the area. Examples of restricted access may include the following locked areas: shops (in arcades, malls and plazas), vaults, strong rooms, lift motor rooms, lift shafts, cool rooms, freezers, cupboards and electrical switch rooms.
- Photoelectric smoke detectors or photoelectric smoke alarms shall be installed within the stairwells at each floor level having access to the stairwell.
- Any enclosure that is manufactured to be transportable, not used for the transport of goods, and utilized for storage or offices, located within the protected building and with an internal volume greater than 10 m³, shall be protected as if part of building.
- Vertical risers, lift shafts, and similar openings between storeys, that exceed 0.1 m² in area shall be protected within the riser at the top as follows:
  - (a) Where vertical shafts penetrate any storey and are not fire-isolated from other areas, a detector shall be located on the ceiling of each storey not more than 1.5 m horizontally distant from where the vertical shaft that penetrates the storey above.
  - (b) Any ceiling that contains openings exceeding 9 m² and permitting free travel of fire between storeys shall have detectors located within 1.5 m of the edge of the opening, and spaced not more than 7.2 m apart around the perimeter of the opening. Such detectors may be regarded as part of the general protection for the area below the opening. If the opening is less than 0.5 m from a wall, no detectors are required between the wall and the opening.

Supply and install ASD system and according to1670.1-2015. system design shall be according to 5.2.2 of 1670.1-2015 and Installation requirement shall be based on clause 5.2.3.

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- Supply and installation of a suitable speaker network in location to ensure minimal SPL are achieved throughout the site in accordance with AS1670 requirements. The following list is provided as a guide for suitable speaker type, layout and situations in a D&C methodology:
  - All new speakers to match existing (as required in finish) and comply with AS1670 and AS7240.24
  - SPLs of 10dba above ambient level and between 65dba and 105dba area achieved in all occupied areas.
  - SPLs of 75dba above the bedhead in location required to arouse sleeping occupants
  - Required speech intelligibility levels throughout all occupied areas achieve a minimum CIS score of 0.7.

- Supply and installation of third party fire monitoring complete with Alarm Signalling Equipment (ASE) and cabling compliant with AS1670.3 & NSW Justice Department monitoring contracts. Refer to the work by others schedule for details.
- The Contractor shall set out the locations of all equipment supplied and installed and perform all cutting and chasing required for the installation.

7.2 Standards and Regulations

The following standards and guidelines are applicable to this scope of works:

Reference	Name
BCA Part E2	Smoke Hazard Management
AS 1670.1	Fire Detection
AS 1668.1	The use of Ventilation and Air-conditioning in Buildings
AS 3000	Wiring Rules

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7.3 Submissions

7.3.1 Pre-Installation Design

- Copies as nominated in general section for all designs shall be submitted to the Engineer for review.
- All references to manufacturer's model numbers and other pertinent information herein is intended to establish minimum standards of performance, function and quality.
- Equivalent compatible CSIRO JAS-ANZ or ActivFire listed equipment from any manufacturers may be supplied as long as the minimum standards and features of this specification are met.
- For equipment other than that specified, the contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, quality and standards of the specified equipment.

7.3.2 Shop Drawings

- Shall contain sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
- Shall include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, cabinets, complete wiring point-to-point diagrams, and conduit layouts.
- Shall show annunciator layout, circuit and equipment configurations, and terminations.

7.3.3 Manuals

- Shall be submitted simultaneously with the shop drawings, complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets.
- Wiring diagrams shall indicate internal wiring for each device and the interconnections between the items of equipment.
- Shall provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system.

7.3.4 Certifications

Together with the shop drawing submissions, submit a certification from the major equipment manufacturer indicating that the proposed supervisor of the installation and the proposed performer of contract maintenance is an authorised representative or suitably qualified and experienced. Include names and addresses in the certification.

7.3.5 Warranty

All work performed and all material and equipment furnished under this contract shall be free from defects for a period of at least one (1) year from the date of acceptance (the defects liability period). The full cost of maintenance, labour and materials required to correct any defect during the defects liability period shall be included in the tender submission.

7.3.6 Approvals

All equipment shall have a certificate of compliance as applicable and be listed by CSIRO JAS-ANZ or ActivFire.

Equipment shall be approved by Federal, State and Local Building Codes as adopted by the Authority having Jurisdiction.

All detectors shall be listed in the CSIRO JAS-ANZ or ActivFire database. Copies of Certificates shall be provided by the Contractor with the tender submission for the works specified herein.

7.3.7 Authority Approvals

Documents evidencing approval of regulatory authorities, to be provided before practical completion, include the following:

- A Telstra Certificate approving the fire indicator panel for connection to Telstra lines needs to be provided.
- Certificate of Fire Brigade approval of the installation shall also be provided. Only CSIRO JAS-ANZ or ActivFire approved and listed equipment shall be used for all fire alarm, A/C Controls and evacuation systems on this project.

7.3.8 Testing

The system shall be commissioned upon completion and necessary certification issued.

Carry out all tests as necessary and, without charge, make good as necessary to obtain approvals. Provide necessary certification for submission to Council, i.e. Essential Services - Design and Installation of Automatic Smoke Detection system in accordance with AS1670.

7.4 Installation Requirements

The Contractor shall set out the locations of all equipment supplied and installed and perform all cutting and chasing required for the installation. All field equipment shall be supervised for faults. Additionally, the contractor shall comply with the following:

7.4.1 Cabling Systems

This part is to be read in conjunction with the Cable Support and Duct Systems section of this specification. Should this section conflict with the other sections of this specification, the more onerous shall apply. Fire Services cabling shall be separate & distinct from other services and shall be installed in accordance with, but not limited to AS3000, AS/CA S009, AS3013 and manufacturer's recommendations. Where possible, cabling shall be concealed in spaces by running in slabs, ceiling spaces, wall cavities, chasing into walls, etc.

All fire alarm system cabling shall be new.

Externally energized circuits except for the FIP power shall not form part or be contained within the FDAS &/or FIP, meaning that no other services such as but not limited to, Mechanical, Electrical, Security (etc.) shall be powered by the FIP.

7.4.1.1 Sizing & Marking

The number, size and type of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 0.75mm^2 for initiating device circuits (conventional circuits) and Signalling Line Circuits (addressable loops), and 1.5mm^2 for networked elements of the FDAS. In all cases voltage drop shall be as recommended by the manufacturer, considered and cabling sized to maintain acceptable voltage levels at equipment terminals.

Marking for detection circuits shall be red with ELV Fire marked in white at 2m intervals. Marking for OWS circuits shall be red cable with white stripe marked LV FIRE in white at 2m intervals. All other cables used in the FDAS are to be marked with a red 25mm wide mark spaced at 2m intervals.

Cabling used for Signalling Line Circuits (addressable loops) shall be twisted and unshielded and support a maximum wiring distance of 3,800 metres. The design of the system shall permit the use of conventional zone circuits and annunciator device circuits in the same conduit with the Signalling Line Circuits (addressable loop) circuit. All field wiring shall be electrically supervised for open circuit and earth fault.

The Fire Indicator Panel shall support t-tapping and open loop (Style 4) of the Signalling Line Circuits (addressable loops) without registering a fault. Systems that do not allow or have restrictions in, for example, the amount of t-taps, length of t-taps, open loop, etc., are not acceptable.

7.4.1.2 Protection

Cable shall have a fire resistance, water and mechanical rating suitable for the installation as required and applicable in but not limited to AS1670.1, AS1670.3, AS1670.4, AS1668.1, ~~AS2118.1, AS2118.4, AS 2220.2~~ etc. All cable shall be listed and/or approved by a recognized testing agency for use in this application. Provide all certification in accordance with the BCA.

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7.4.1.3 Segregation

Cable segregation is critical with special attention between HV, LV & ELV to be in accordance with but not limited to the requirements of AS/CA S009. Cable must be separated from any open conductors of mains power, and shall not be placed in any conduit, junction box or ducting containing these conductors, per AS3000, AS1670.1 and ~~AS2220~~. As a guide LV & ELV are to be separated by at least 50mm and any fire services must be separated by 500mm to HV cables unless contained in conduit. Contractor to obtain approval from local authority having jurisdiction, local legislations and project superintendent prior to any installation.

7.4.2 Transmission Path Protection

All field devices shall be monitored. The following field based hardware shall be non-fire rated cable of WSX1 in accordance with AS3013;

- Detection
- VWD, VAD, AAD
- Ancillary devices

The following field based hardware shall be fire rated cable of WS5XW in accordance with AS3013, installed as a loop in separate risers as required;

- Power (loop not required)

- Fire Fan Controls (FFC) to MSSB
- Networked parts of the CIE
- Supply air smoke detectors and any smoke detectors installed to initiate zone pressurisation
- ~~EWIS panel connections~~ OWS
- Fire Suppression interface

7.4.2.1 Fire rated Cable

All cable types as required to be installed by Australian Standards AS/NZS 1670.1, 1670.4, 1668.1 and 4214 or as may be required by specific project requirements, must be tested, approved and certified to fully comply with the requirements of AS/NZS 3013 and AS/ACIF SOO8. Only cables which have been independently tested by a Third Party, NATA registered laboratory and which are currently Activfire listed by the CSIRO are acceptable on this project.

As evidence of testing and approval, an independent “Test Certificates” issued by a Third Party, NATA registered laboratory, must be provided for each cable type providing details of the Fire, Water, Impact and Cutting test ratings achieved to determine the cables WS rating classification.

The WS classification cable rating used on the various essential and emergency circuits must be in accordance with the applicable Australian Standards installation requirements. All cables (screened or unscreened) must have a minimum 2 hours fire rating to WS5X as specified in AS/NZS 3013

When speaker feeds are used for low-voltage telecommunication transmission paths, the outer sheath of the cable shall be red with a white stripe with contrasting marking **‘LV Fire’** at intervals not exceeding 2m to AS1670.1-2015

Conductors on all cables shall be 7 strands of Annealed Copper to AS/NZS1125. Insulation and Sheath materials shall be suitable for a continuous conductor operating temperature of 110 deg C with Low Smoke, Zero Halogen and Flame Retardant characteristics. The materials shall be X-HF-110 for Insulation and HFS-100-TP for Sheath.

Cable outer sheath must be easy to strip without any binding to the inner insulation cores. The cable outside diameter shall also be a maximum of 10.3mm to enable two cables to be installed in a single conduit.

Stainless Steel cable ties shall be used for fixing cable to cable tray every 1.0 metre when mounted horizontal and every 0.6 metres when mounted vertically.

Only Stainless Steel cable ties which are ActivFire approved for use with active Fire approved Fire Rated cables shall be used in this scope of works

7.4.2.2 Non-Fire Rated Cable

Where required for wiring to the various fire and EWIS ancillaries, these cables shall be insulated with PVC V-90 material and having an outer sheath of Easytear PVC V-90 material to provide ease of stripping during installation.

As per AS1670.1-2015 Clause 3.26 Transmission paths shall be protected against mechanical damage to a minimum of WSX1 in accordance with AS/NZS 3013. Cables which do not have a certificate of conformity to WSX1 are not acceptable in this scope of works.

Only cables which have been independently tested by a Third Party, NATA registered laboratory and which are currently Activfire listed by the CSIRO are acceptable on this project. For extra-low voltage transmission paths, the outer sheath of a cable shall be coloured red with contrasting marking ‘ELV Fire’ at intervals not exceeding 2m as per AS1670.1-2015. For low-voltage telecommunication transmission paths, the outer sheath of the cable

shall be red with a white stripe with contrasting marking 'LV Fire' at intervals not exceeding 2m as per AS1670.1-2015. Conductors on all cables shall be 7 strands of Annealed Copper to AS/NZS1125. Cables must be tested and approved to fully comply with the requirements of AS/ACIF SOO8.

Cables used in projects which require PVC Best practice must be independently certified to the Green Building Council of Australia PVC Best Practice Guidelines and issued with a validated certificate of compliance.

7.4.2.3 Non-Fire Rated Cable - NON PVC - Halogen Free TPS

Where required specifically for the project as identified in the scope of works herein, for wiring to the various fire and EWIS ancillaries, these cables shall be insulated and sheathed with NON PVC - Halogen Free materials with low smoke, low toxicity materials providing an operating temperature of 90°c.

Outer sheath must be clearly marked as "fire alarm cable" and be red in colour. Conductors must be insulated in red and white. Conductors shall be 7 strands of Annealed Copper to AS/NZS1125. Cables must be tested and approved to fully comply with the requirements of AS/ACIF SOO8. FireSense TPSHF-1.50-2C or equal approved shall be used

7.4.3 Conduit

Unless otherwise noted, refer to the Cable Support and Duct Systems section of this specification. Should this section conflict with the cabling section of this specification, the more onerous shall apply. Conduit shall be in accordance with but not limited to AS 3000, AS/CA S009 and NCC requirements.

Wiring for 24 volt DC control, alarm annunciation, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signalling line circuits provided adequate protection is applied to meet compliance with the relevant Australian Standards. However, advice should be sought from the equipment manufacturer to ascertain the correct cable types and methods to permit simultaneous operation of all circuits without interference or loss of signals.

Conduit shall not enter the Fire Indicator Panel or any other remotely mounted control panel equipment or back boxes, except where conduit entry is specified by the FIP manufacturer.

Conduit shall be 20mm minimum.

7.4.4 Terminal Boxes, Junction Boxes and Cabinets

All boxes and cabinets shall be approved and suitable for their use and purpose. All junction boxes shall be accessible, shown on as installed plans and marked in 25mm lettering "FIRE". Cabling shall be clapped either side of the junction box to prevent stress on terminations.

7.4.5 Conventional Detection Circuits

Conventional detection circuits shall be arranged such that where manual call points are installed with detectors on the same circuit, operation of the manual call point shall not extinguish the LED's on detectors or reset detectors in alarm.

7.4.6 Primary Power Supply

The Fire Indicator Panel shall be connected to a separate dedicated mains power branch circuit; maximum circuit breaker capacity shall not exceed 20 amperes (confirm with equipment manufacturer prior to installation), with local or switchboard mounted surge protection. This circuit shall be labelled at the main power distribution panel as FIRE INDICATOR PANEL. Fire Indicator Panel primary power wiring shall be 2.5mm. The control panel cabinet shall be properly earthed in accordance with AS 3000.

- An addressable circuit serving more than 10 consecutive storeys or more than a 20 000 m² floor area shall have two separate cable paths, each protected to not less than WSX2 in accordance with AS/NZS 3013.

- An addressable circuit shall serve not more than 1000 devices of any type, and shall be limited to one site.

7.5 Fire Indicator Panel

This specification includes the supply, installation, commissioning testing and certification of the microprocessor controlled, fire alarm equipment required to form a complete, operative, integrated system. It shall include, but not be limited to, alarm initiating devices, alarm annunciation devices, Fire Indicator Panels (FIPs), auxiliary control devices, building occupancy warning systems, and wiring as shown on the drawings and specified herein.

The fire alarm system shall comply with requirements of AS 1670.1, AS4428.1, AS 4428.7, AS 1668.1, ~~AS 2220, AS2118~~, AS 3000, the Building Code of Australia and the requirements of any authority having jurisdiction (AHJ), except where modified and supplemented by this specification.

The fire alarm system shall be manufactured by an ISO 9001 certified company and meet the requirements of AS / NZS ISO 9001: 1994.

The FIP and peripheral devices shall be manufactured by a single Australian manufacturer (or division thereof).

The system and its components shall be tested and approved by CSIRO under the appropriate Australian Standards and/or listed in the JAS-ANZ or ActivFire Protection Equipment Listing Scheme (JAS-ANZ or ActivFire CSIRO Listed) for fire alarm applications.

Whilst other accreditations are acceptable under the Building Code of Australia, JAS-ANZ and/or ActivFire CSIRO Listing is the industry benchmark and the minimum accreditation acceptable for this project. The system shall be installed such that compliance with the JAS-ANZ and/or ActivFire CSIRO listing is not compromised.

The installing company shall employ Australian Communications & Media Authority (ACMA) registered technicians and licensed electricians where required on site to ensure the system's integrity.

7.5.1 System Performance

A new microprocessor controlled addressable fire detection system shall be installed in accordance with the project specifications and drawings.

7.5.2 Basic Performance

Alarm, fault and supervisory signals from all addressable reporting devices shall be encoded on Signalling Line Circuits (SLCs) (addressable loops) in accordance with AS 1670.1.

Conventional zone circuits shall be provided via 8 zones input modules, which can be mounted either in the FIP or distributed remotely around the installation on a distributed data ring circuit.

Alternative methods for conventional zone circuits shall be wired as part of an addressable monitoring device connected by the SLC (addressable loop).

Where alarm annunciation audio/visual circuits are wired as part of an addressable device connected by the SLC Circuit, circuit supervision shall be maintained in accordance with Clause 8.7 of AS 1670.1

On Style 6 (closed loop circuit) or Style 7 (closed loop with redundant path circuit) configurations, a single earth fault or open circuit on the Signalling Line Circuit shall not cause system malfunction, loss of operating power or the inability to report an alarm.

Alarm signals arriving at the FIP shall not be lost following a primary AC power failure.

Building occupancy warning system power and speaker circuits shall be arranged such that they are installed in full supervision compliance with Clause 8.7 of AS 1670.1.

Building occupancy warning audio amplifiers and tone generating equipment shall be electrically supervised for normal and abnormal conditions.

7.5.3 Basic System Functional Operation

When a fire alarm condition is detected and reported by one of the system initiating devices, the FIP display shall operate in full compliance with the Fire Fighters Interface requirements of AS 4428 &/or AS7240.

All system output programs assigned via customised system configuration programming to be activated by the particular point in alarm shall be executed, and the associated system outputs (annunciation devices, building occupancy warning systems and/or relays) shall be activated.

The FIP shall be equipped with a backlit quarter VGA display capable of displaying simultaneously the details of at least eight active alarms on the one display. The display shall also indicate in a continuous summary display the number of active alarms, faults, isolates and non-alarms (supervisory). If there are none present, the display shall show “0” against each category.

Printing and history recording equipment shall log the information associated with each new Fire Indicator Panel event, along with time and date of the occurrence and the panel (node) in which the event occurred. The history log shall be stored in non-volatile flash memory such that if the power and batteries are disconnected from the system, the history log is not lost. The history log shall have a minimum capacity of 4,000. All alarms, acknowledgements, resets, isolates, de-isolates, faults, cleared faults, supervisory alarms (non alarms), password access level gained, change to the configuration software and power up must be logged against a time and date stamp. The history log shall be backed up by a “shadow” history log which cannot be erased.

Where required by the codes and standards, approved alarm signalling equipment (ASE) shall notify an approved and licensed monitoring company of the appropriate alarm event.

7.5.4 Software and Software Modifications

For the purpose of definition:

Application software shall mean the software tool supplied by the FIP manufacturer. Application software is used by any suitably skilled person to create the configuration software for a particular installed system.

Configuration software shall mean the software that configures the FIP to function to the specific project requirements. Configuration software is specific to the hardware configuration of any particular system and configures this hardware to operate in accordance with the specific input and output requirements of the particular installed system. Configuration software is created by a person using the application software tool described above.

Manufacturer’s firmware shall mean the embedded operating program of the FIP which is proprietary to the FIP manufacturer. The manufacturer’s firmware enables the FIP to operate in accordance with its approvals. The manufacturer’s firmware interacts with the information in the logic scripts of the configuration software to ensure the functional integrity of the FIP for a particular installation.

7.5.5 Software General

The configuration software shall be able to be created, edited and uploaded / downloaded by the application software. The application software shall be readily available to any person suitably trained by the manufacturer of the equipment. Access to the application software to create, edit or upload / download the configuration software shall not be restricted to employees of the manufacturer or the manufacturer’s agents or distributors. Where such restrictions apply, the FIP and system will not be acceptable.

There shall be no restriction on the copying of the configuration software for the purpose of back-up protection or for modification. There shall be no restrictions on copying the application software for the purpose of back-up.

There shall be no restriction placed on the use of the application software. Any system which will not allow the above specified programming flexibility will not be acceptable.

The contractor shall provide the services of a factory trained and authorised technician to perform all configuration software modifications, upgrades or changes.

The contractor shall provide all hardware, application software and documentation necessary to modify the fire alarm system on site. Modification includes but is not limited to addition and deletion of devices, circuits, zones and changes to system logic scripts and custom label changes for devices or zones.

The system structure and software shall place no limit on the type or extent of software modifications that can be carried out on-site.

The system structure shall allow on site programming without the need for a personal computer.

All software shall be included in the system supplied to this specification and shall be updated, free of charge, to include any applicable changes made to the manufacturer's firmware during the defects liability period.

The contractor shall provide the following:

- A copy of the system configuration software. The copy shall contain all programs, tables, variables, constant and any other part of the program that may need to be altered to allow modification or extension of the supplied system at any time. This shall be supplied within one month of the completion of commissioning, and shall include all changes made during commissioning. An additional updated copy shall be supplied within two weeks of completion of the defects liability period as the final "as installed" version. The copy shall be provided on professional multi-speed high density compact disc.
- A copy of the application software. The copy shall be provided on professional multi-speed high density compact disc. The application software shall be all that is required to allow modification of any part of the system configuration program and allow upload/download of the configuration program.
- Two copies of the application software programming instruction manuals describing the steps needed to modify the configuration software. This shall include, but not necessarily be limited to:
    - An overview of the application software, describing the broad function, with particular emphasis on those aspects relating to the configuration of the software to a particular installation. Specific information on which parts of the program need to be modified for likely configuration changes, e.g. adding additional detector circuits, adding a data link to another monitoring system, etc.
    - An overview of the modification process, followed by specific instructions for each step to be followed in the process, including the order in which steps are to be performed.
    - Details of possible error conditions that may rise during the modification process and the recovery procedure for each.
    - Detailed examples for a minimum of two, different, likely changes one of which shall be the addition of a new detector circuit.

7.6 Sub Fire Indicator Panel (SFIP) & Mimic Panels

FIP and SFIP shall be addressable .

7.6.1 System Capacity and General Operation.

Distributed systems using sub indicator panels shall comply with the following:

- The sub fire indicator panel (SFIP) shall be connected to the FIP as at least a separate alarm zone and be monitored for alarm, fault, isolate and power supply failure. The fault, isolate and power supply failure shall either be indicated separately or combined and indicated as a zone fault at the FIP.

Site mimic panel shall be connected to Main FIP. Health and reception mimic panel shall be connected to health and reception SFIP.

- SIPs shall only be connected directly to the FIP and not via any other SIP or distributed part of CIE unless the failure of an intermediate part does not prevent the transmission of an alarm to the FIP. Such failure shall indicate as a fault at the FIP.
- The FIP indications of SFIP events shall clear when they are reset or restored at the SIP.
- Multiple SFIPs mounted adjacent to each other and not individually identified at the FIP, shall be considered as a single SFIP.
- SFIPs with a total of more than 250 devices shall be connected to the FIP using two separate signal paths. These signal paths shall be individually and suitably protected (see Clause 2.6.4). Duplicated paths are not required to be separated where run underground or protected to WSX3 in accordance with AS/NZS 3013.
- Where multiple signal paths are used, a fault condition on one of the paths from the SIPs shall not prevent the transmission of an alarm on the other path.
- Any signal path fault between the FIP and SFIPs shall indicate as a fault at the FIP, and where the SFIPs have more than 250 devices shall also indicate at the SIPs.
- A short circuit in the signal path or signal paths between the FIP and SFIPs shall indicate as either a fault or an SFIP alarm at the FIP.
- An SFIP shall be powered from the building in which it is located and shall be capable of stand-alone operation. Audio Amplifiers for building occupancy warning systems.

7.7 Occupant Warning System (OWS)

General: Typically the OWS will consist of the following but not limited to:

- Tone Generator
- Loud speakers compliant with AS7240.24 configured as surface mount or flush mount dependent on the ceiling type and/or horn speakers
- Strobes

Note that multiple or cascading zoning are not permitted unless the building occupancy warning system is an AS 2220 compliant and approved Sound System and Intercom System for Emergency Purposes (SSISEP) and is installed in accordance with AS 1670.4. This type of system (SSISEP) would only be used in special cases and should not form part of a typical fire services design.

Standard: AS1670.1.3.22.

AS7240.24

AS3500.

AS/CA S009

AS3013

The local alarm system shall be directly controlled and monitored by the MFIP /SFIP and shall be in the form of an Occupant Warning System (OWS). The OWS shall be designed and installed to suit the buildings layout and will sound through all internal building areas. Occupant warning via alert tones and emergency tones after a specified time lapse shall be achieved via warning speakers installed throughout the buildings. Areas with ceilings shall be installed with ceiling recessed speakers.
Areas without ceilings shall be installed with surface mounted speakers or horn type speakers.
It will be possible to make announcements over the OWS independently in each building from both a handset at the local FIP, a handset at the control room mimic panel and a handset at the main FIP. The latter will be the highest priority handset.

Sound Levels: Typically, sound pressure levels (SPL) are to be 65dB(A) in all areas except as follows:

- Plant Rooms – 10dB(A) above ambient
- Unsupervised sleeping areas - 75dB(A) at the bedhead
- Accommodation areas - 75dB(A) at the bedhead with doors closed

7.7.1 Configuration

The audio amplifiers will provide audio power @ 100 Volts RMS for distribution to the speaker circuits. Amplifiers shall be available in at least 10, 30, and 50 watt configurations. The amplifier shall include speaker circuit supervision.

Multiple audio amplifiers may be mounted in the Fire Indicator Panel (FIP) using additional cabinets if necessary. Where multiple amplifiers are installed as a basic building occupancy warning system (OWS) as defined under Clause 3.22 of AS1670.1, all amplifiers shall operate simultaneously as one zone in building occupancy warning mode.

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A built-in microphone shall be provided to allow public address announcements through speaker circuits and shall have priority over the alarm tones. All terminal blocks for the connection of field wiring shall be suitably labelled to allow for ease of field wire installation in a cabinet or at a remote location.

7.7.2 Controls & Indicators

The audio amplifiers shall include an integral power supply, and shall provide the following controls and indicators:

- Power available LED
- 'Alert' action LED
- 'Evac' action LED
- Output open circuit LED
- Output short circuit LED
- Local/remote microphone input
- Local/remote microphone gain adjust
- Master amplifier gain adjust

Adjustment of the correct audio level for the amplifier shall not require any special tools or test equipment.

7.8 System Components – Addressable Devices

7.8.1 Addressable Devices - General

Addressable devices shall use simple to install and maintain decade decimal address switches. Devices shall be capable of being set to an address in a range of 001 to 159.

Addressable detectors and modules, which use a binary-coded address setting method, such as a DIP-switch, or require special hand held programming devices, or set an automatic address at the panel are not an acceptable substitute.

Sensors shall be intelligent (analogue) and addressable, and shall connect with two wires to the Fire Indicator Panel Signalling Line Circuits (addressable loops).

Addressable smoke and thermal sensors shall provide dual alarm and power/polling LED's. Both LED's shall flash green under normal conditions, indicating that the sensor is operational and in regular communication with the control panel, and both LED's shall be placed into steady red illumination by the control panel, indicating that an alarm condition has been detected. An output connection shall also be provided in the base to connect an external remote alarm LED.

The Fire Indicator Panel shall permit detector sensitivity adjustment through field programming of the system. The Fire Indicator Panel shall have the facility to automatically adjust the sensitivity on a time-of-day/date basis.

Using software in the FIP, sensors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The sensors shall be listed by UL and CSIRO as meeting the calibrated sensitivity test requirements of the appropriate standards.

The sensors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Bases available shall include a sounder base with a built-in (local) sounder rated at 85 DBA minimum, a relay base and an isolator base designed for Style 7 (redundant path) applications.

The sensors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.

Sensors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).

Sensors will operate in an analogue fashion, where the sensor simply measures its designed environment variable and transmits an analogue value to the FIP based on real-time measured values. The FIP software, not the sensor, shall make the alarm/normal decision, thereby allowing the sensitivity of each sensor to be set in the FIP program and allowing the system operator to view the current analogue value of each sensor.

Addressable devices shall store an internal identifying code that the control panel shall use to identify the type of device.

A magnetic test point shall be provided to test sensors. Sensors shall report an indication of an analogue value more than 100% of the alarm threshold when under magnetic test.

Addressable modules shall mount in a square 100 mm square, 54 mm deep electrical box. An optional surface mount Lexan enclosure shall be available.

A range of loop powered addressable sounders, strobes and sounder/strobe combinations shall be available as bases or for wall mounting. Up to 99 strobes, 60 sounders or 45 sounder/strobe combinations may be installed on each loop.

7.8.2 Addressable Manual Fire Alarm Call points

Addressable manual fire alarm call points shall, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.

All operated stations shall have a positive, visual indication of operation and utilize a key type reset.

Manual fire alarm call points shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters in accordance with Australian Standards.

A manual call point shall be installed in a clearly visible and readily accessible location inside the main entrance area of the building. It may be located on any CIE within this area.

The operation of a manual call point shall not extinguish a previously lit detector indicator. Where manual call points are subject to outdoor weathering, they shall comply with the weathering test of as appropriate.

Manual Call points to be Red (when connected to FIP)/White (when connected to SSIP) and Green (when controlling access such as locked doors doors) to suite the installation.

Specification shall be as follows:

Maximum Voltage	30VDC
Switch Rating	2A
LED Rating	Max. 30mA
Temperature Range	10°C to 55°C
Humidity Range	0% to 95% non-condensing
IP Rating	IP67
EOL Value	47K ohms

7.8.3 Intelligent Photoelectric Smoke Sensors

The sensors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analogue level of smoke density in real time.

The sensors shall have nine sensitivity levels and nine pre-alarm sensitivity levels selectable in software and be sensitive to a minimum obscuration of 1.6 % per metre.

7.8.4 Intelligent Laser Photo Smoke Detector

The intelligent laser photo smoke detector shall be a point type detector that incorporates a laser diode and an integral lens that focuses the light beam to a very small volume near a receiving photo sensor. The photo sensor shall be activated by the scattering of smoke particles.

The laser detector shall have conductive plastic so that dust accumulation is reduced significantly.

The intelligent laser photo detector shall have nine sensitivity levels and be sensitive to a minimum obscuration of 0.~~09 percent per metre~~ 0.08

The laser detector shall not require expensive conduit, special fittings or PVC pipe.

The intelligent laser photo detector shall support standard, relay, isolator and sounder detector bases.

The laser photo detector shall not require specialised cleaning processes. Replacement, refurbishment or specialized cleaning of the detector head shall not be required.

The laser photo detector shall include two bicolour LED's which flash green in normal operation and illuminate steady red in alarm.

7.8.5 Intelligent Ionization Smoke Detector

The detectors shall use the dual-chamber ionization principal to measure products of combustion and shall, on command from the control panel, send data to the panel representing the analogue level of products of combustion.

7.8.6 Intelligent Multi Criteria Acclimatising Detector

The intelligent multi criteria detector shall be an addressable device that is designed to monitor a minimum of photoelectric and thermal technologies in a single sensing device. The design shall include the ability to adapt to its environment by utilizing a built-in microprocessor to determine its environment and choose the appropriate sensing settings. The detector design shall allow a wide sensitivity window, no less than 3 to 12% per metre obscuration. This detector shall utilize advanced electronics that react to slow smouldering fires and thermal properties all within a single sensing device.

The microprocessor design shall be capable of selecting the appropriate sensitivity levels based on the environment type it is in (office, manufacturing, kitchen, car park etc.). They shall have the ability to automatically change the sensitivity setting as the environment changes e.g. as walls are moved or as the occupancy use changes. Multi criteria sensors that have to be manually changed in software to a profile or setting to suit a changed environment are not considered an acceptable alternative.

The intelligent multi criteria detection device shall include the ability to combine the signal of the thermal sensor with the signal of the photoelectric signal in an effort to react hastily in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a false alarm condition by examining the characteristics of the thermal and smoke sensing chambers and comparing them to a database of actual fire and deceptive phenomena.

7.8.7 Intelligent Thermal Detectors

Thermal detectors shall be intelligent addressable devices rated at 58 degrees Celsius and have a rate-of-rise element rated at 9.4 degrees C per minute. It shall connect via two wires to the Fire Indicator Panel signalling line circuit.

There are two main forms of heat-sensitive detector. One is the point-type of detector, which is affected by the hot gas layer immediately adjacent to it. The other is the line-type of detector, which is sensitive to the effect produced by heated gases along any portion of the detector line.

The two main types of heat-sensitive element in each form as follows:

Rate-of-rise temperature elements, which are designed to operate when their temperature rises abnormally quickly.

Fixed-temperature (static) elements, which are designed to operate when they reach a preselected temperature.

It must be appreciated that a rate-of-rise detector will normally respond to the presence of fire conditions faster than a fixed-temperature type because of its ability to sense rapid increases in temperature. Accordingly, the use of rate-of-rise detectors is preferred for general protection of areas. Thermal detectors shall be of the Type A variety with normal temperature duty, incorporating both fixed temperature and rate-of-rise temperature.

Type A (white dot)—normal temperature duty, incorporating both a fixed-temperature actuation within the range of 58°C to 88°C and rate-of-rise actuation. Recommended for use in the majority of moderate temperature applications below 45°C where rapid temperature increases are not normally experienced.

Type B (blue dot)—normal temperature duty, incorporating a fixed-temperature actuation within the range of 58°C to 88°C only. Recommended where rapid temperature increases are normally encountered and the maximum temperature does not normally exceed 45°C.

Type C (green dot)—high temperature duty incorporating both a fixed-temperature actuation within the range of 88°C to 132°C and rate-of-rise actuation. Recommended for use in high temperature applications below 75°C where rapid temperature increases are not normally experienced.

Type D (red dot)—high temperature duty, incorporating a fixed-temperature actuation within the range of 88°C to 132°C only. Recommended where rapid temperature increases are normally experienced and the maximum temperature does not normally exceed 75°C.

Type E (yellow dot)—special purpose fixed temperature. Intended to provide protection in areas that cannot be satisfactorily protected by Types A to D owing to some factor associated with the environment, such as extremely high ambient temperatures, severe corrosion, and the like.

Attention of designers is drawn to the size to which a fire must develop before detection. Heat detectors mounted on higher ceilings require a larger fire size before the fire is detected (see Table A1 AS1670.1).

7.8.8 Intelligent Duct Smoke Detector

The duct smoke detector housing shall include an intelligent photoelectric detector and a form C alarm relay.

When sufficient smoke is sensed, an alarm signal is initiated at the FIP, and appropriate action taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system.

7.8.9 Hostile-Area Smoke Detector

The detector shall be designed to provide early warning smoke detection in environments where traditional smoke detectors are not practical.

The detector shall have a filter system to remove particles down to 25 microns.

This filter system shall remove unwanted airborne particles and water mist. This shall allow the detector to operate in environments where traditional smoke detectors would have nuisance alarms.

The filter system shall consist of 2 filters one of which is field replaceable.

The filter system shall have an intake fan to draw air and smoke through the filters into the sensing chamber.

The filter system shall be supervised so that if the filter is clogged or the fan fails the control panel reports trouble.

The filter system shall be powered from 24 VDC separate from the SLC communications.

The detector shall utilize a photoelectric sensing chamber.

7.8.10 Addressable Dry Contact Monitor Module

Addressable monitor modules shall be provided to connect one supervised zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the Fire Indicator Panel SLCs (addressable loops).

An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

For difficult to reach areas, the monitor module shall be available in a miniature package and shall be no larger than 70 mm x 32 mm x 13 mm. This version need not include an LED.

7.8.11 Two Wire Detector Monitor Module

Addressable monitor modules shall be provided to connect one supervised zone of conventional 2-wire detectors or alarm initiating devices (any N.O. dry contact device).

An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel, the LED shall illuminate steadily to indicate the conventional zone is in alarm.

7.8.12 Addressable Control Module

Addressable control modules shall be provided to supervise and control the operation of one conventional alarm annunciation device of compatible, 24 VDC powered, polarised audio/visual building occupancy warning devices.

The control module alarm annunciation circuit may be wired for up to 1 amp of inductive audio/visual signal, or 2 amps of resistive audio/visual signal operation.

Audio/visual power shall be provided by a separate power circuit from the main Fire Indicator Panel or from a supervised CSIRO listed remote power supply.

The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC.

7.8.13 Addressable Sounders and Strobes

A range of loop powered addressable sounders, strobes and sounder/strobe combinations shall be available as bases or for wall mounting.

Up to 99 strobes, 60 sounders or 45 sounder/strobe combinations may be installed on each loop.

7.8.14 Addressable Relay Module

Addressable Relay Modules shall be available for HVAC control and other building functions. The relay shall be form C and rated for a minimum of 2.0 amps resistive or 1.0 amp inductive. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to ensure that 100% of all auxiliary relay may be energized at the same time on the same pair of wires.

7.8.15 Isolator Module

Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC (addressable loop circuit) and branch from the circuit. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop segment or branch. At least one isolator module shall be provided for each floor or protected zone of the building.

If a wire-to-wire short occurs, the isolator module shall automatically open-circuit (disconnect) the SLC. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section.

The isolator module shall not require address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.

The isolator module shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

7.8.16 Batteries

The battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 30 minutes of alarm upon a normal AC power failure for systems that are connected to a certified monitoring station. Where the system is not connected to a certified monitoring station, the standby capacity shall be increased to comply with the requirements of the relevant Australian Standard.

The batteries shall be of the completely maintenance free type. Batteries containing liquids that require level checks for refilling, spills, and leakage shall not be acceptable.

If necessary to meet standby requirements, external battery and charger systems may be used.

7.8.17 Detectors Concealed Above Ceilings

Remote indicators are not required where the detector location is indicated at the FIP or the concealed space is accessible and:

- has a height exceeding 2 m and is trafficable by personnel; or
- Is beneath removable flooring (such as computer flooring).

Where a detector is mounted under removable flooring such as in a computer room and the detector location is not indicated at the FIP, a label shall be affixed to the ceiling or ceiling grid immediately above the detector indicating the location of the detector below.

7.8.18 Audible Speakers and Horns

Occupant warning shall be provided to alert all building occupants to a fire alarm situation.

The warning system shall be one of the following:

Electronic sounders or amplified sound systems producing the evacuation signal (with or without verbal message). The evacuation signal shall operate simultaneously throughout the building.

At all places where warning signals are conveyed to building occupants, the A-weighted sound pressure level during the 'on' phases of the audible emergency evacuation signal, measured with the time-weighting characteristic F (fast) (see AS 1259.1), shall comply with the following:

- The requirements of ISO 8201.
- Exceed by a minimum of 10 dB the ambient sound pressure level averaged over a period of 60 s, not be less than 65 dB (A) and not more than 105 dB (A). These values shall be determined in accordance with AS 2659.1.

Recessed speakers are to be:

Rated Power	6W @ 100V
Transformer Power Taps	6W, 3W, 1.5W, 0.75W, 0.375W
Default Power Tap	0.75W
Sensitivity	90 dB (1 Watt @ 1 Metre)
Maximum SPL	102 dB
Frequency Response	110 Hz - 13 kHz
Dimensions	186mm Ø x 80mm
Colour	Signal White RAL 9003
Cut Out	165mm Ø
Surface Mounting	Provide surface mounted proprietary bases for surface mounting

Surface Mounted Horns are to be:

Rated Power	15W @ 100V
Transformer Power Taps	1.9W, 3.75W, 7.5W 15.0W
Default Power Tap	0.65W
Sensitivity	105 dB (1 Watt @ 1 Metre)
Frequency Response	400 Hz - 6 kHz

Operating Temperature	-20° - 70°C
Weatherproof Rating	IP66
Colour	Signal White RAL 9003

7.8.19 Visual Indicators

The system shall operate one red strobe light complying with AS 1603.11 to indicate a fire alarm.

The strobe shall be located on the outside of the building, be visible from the main approach to the building and shall be as near as practicable to the designated building entry point.

The word 'FIRE' shall be marked on or adjacent to the strobe in lettering not less than 25 mm in height on a contrasting background. The label shall be upright and clearly legible when the strobe is installed.

The strobe shall be connected to a supervised output on the CIE.

Dual Strobes to be:

Operating Voltage	18 - 30 V DC
Flash Rate	1.2 Hz
Flash Energy	3.12 joules/sec
Maximum Current Draw	245 mA
Lens Colours	Red & Amber

7.8.20 Fire Trip

Contractor to allow for cabling, connectors and programming from the FIP to the following at a minimum:

- Mechanical services switchboard(s)
- Hydraulic services control panel(s)
- Smoke door magnetic holder(s)
- Fire shutter(s)
- Access control system

Please refer to below page for more detail

7.8.21 Fire Brigade

Contractor shall supply and install a dedicated phone line to the FIP for direct contact to the fire brigade.

Connect the main FIP to an approved Automatic Fire Alarm Service Provider; provide the necessary wet and dry transponders. Provide all equipment; liaise with Client's preferred communications carrier to provide this facility to comply with their requirements.

Provide 24 months monitoring of the system. The electrical contractor shall ascertain 3 competitive quotes which are to be submitted to client for approval of which service provider is to be engaged.

7.9 AS 1668 Smoke Control

On/Auto/Off switches and status indicators (LEDS) shall be provided for monitoring and manual control of each fan, damper, HVAC control unit, stairwell pressurization fan, and smoke exhaust fan where they form part of the smoke hazard management system for this installation.

Fire Trip:(Fire contractor respons bility)

Accommodation Building

1) Provision of wiring between FIP/FFCP and location adjacent to MCC-A-1 (non-essential) requiring fire tripping to AS 1668.1. Final connection onto MCC by the mechanical contractor.
2)Provision of On/Auto/Off manual switches in FIP/FFCP for the fans required to operate in fire mode as per AS 1668.1.2015. Final connection onto the fans by the mechanical contractor.
Smoke exhaust fans: SEF-1, SEF-2, SEF-3 & SEF-4
Make up air dampers: MVCD-1, MVCD-2, MVCD-3, MVCD-3
Zone control dampers: MVCD-1.1 & MVCD-1.2, MVCD-2.1 & MVCD-2.2, MVCD-3.1 & MVCD-3.2, MVCD-4.1 & MVCD-4.2
3.) provision of four fire trip signal for fire shutter for each building.

Health/Reception Building

1)Provision of wiring between FIP/FFCP and location adjacent to MCC-H-1 &MCC-H2 (non-essential) requiring fire tripping to AS 1668.1. Final connection onto MCC by the mechanical contractor.
2)Provision of On/Auto/Off manual switches in FIP/FFCP for the fans required to operate in fire mode as per AS 1668.1.2015. Final connection onto the fans by the mechanical contractor.
Smoke exhaust fan: SEF-1
Make up fan: SAF-1

Gatehouse Building

1)Provision of wiring between FIP/FFCP and location adjacent to MCC-G-1 (non-essential) requiring fire tripping to AS 1668.1. Final connection onto MCC by the mechanical contractor.

Program Building

2)Provision of wiring between FIP/FFCP and location adjacent to MCC-P-1 (non-essential) requiring fire tripping to AS 1668.1. Final connection onto MCC by the mechanical contractor.

- The units supplied shall fully comply with, AS 4428.1, AS 4428.7 as well as the requirements of AS 1668.1 and AS1670.7.
- The control system shall be field programmable such that any input on the system either as a switch position or input from the field can be programmed to operate any output or group of outputs.
- This programming flexibility shall apply whether those outputs are LED's or relay operations at the panel or in the field or at another FIP when installed on a common peer to peer network.
- Multiple control points in multiple FIPs across a common network shall be possible. The system shall have sufficient capacity for future use and system expansion in both software and hardware expansion.
- The fault indicator shall indicate a fault in the control and/or monitor points associated with that switch be it a fan motor or damper control. In addition, each group of eight switches shall have two additional LEDS and one additional momentary switch which will allow at least the following programmable functions:
- An Amber LED to indicate an OFF-NORMAL switch position (system in manual control i.e. any switch in other than auto position)
- A Green LED to indicate when the fire panel is in latched fire mode
- A momentary switch which acts as a lamp test when the panel is not in fire mode and acts as a latched fire mode reset switch after all alarms have been reset.

Each switch shall have the capability to monitor and control at least two addressable inputs and two addressable outputs. In all modes, the ON and OFF indicators shall continuously follow the device status not the switch position. Positive feedback shall be employed to verify correct operation of the device being controlled. Systems that indicate on/off/auto by physical switch position only are not acceptable.

All HVAC switches (i.e., limit switches, vane switches, etc.) shall be supplied and installed by the HVAC contractor.

- It shall be possible to meet the requirements mentioned above utilising wall mounted custom graphic panels for fire fan override control and monitoring.
- The fire alarm and detection system shall provide general fire trips, zone trips (fire affected floor) and fire fan override outputs to terminals installed at the mechanical services switchboards by the mechanical services contractor for that purpose. The trips and override interface from the fire detection system to the mechanical services control system shall be by way of voltage free contacts which shall switch mechanical services control voltage at no more than 24VDC or AC.

All logic and sequencing of dampers and motors for smoke hazard management shall be the responsibility of the mechanical services contractor. The sequencing and control shall be initiated by zone trips (Fire affected floor trips) and general fire trips from the fire alarm and detection system. If manual override outputs are received from the fire alarm and detection system at any time, the mechanical contractor shall ensure that appropriate sequencing of dampers occurs to allow the fans to operate without damage to ductwork, structure or construction.

7.10 Multi-Aspirating Smoke Detection (MASD)

General: This section provides the functional requirements for the aspirating or very early smoke detection system. These systems will generally be used in the High Needs areas.

Standard: To AS 1670.1, AS 1670.6, AS 7240.20, AS 3000 & AS 1603.8

Approvals: Must be of a type submitted to, tested, approved, and/or listed by: ActivFire Register of CSIRO or JAZ-ANZ approvals.

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according to AS1670.1-2015

Required: Design, supply, install, test and commission aspirating detection in areas where future maintenance will not be possible or too hazardous and/or High Needs areas. The Detector shall be self-contained unit with the display module, programmer and the detector. The system shall consist of highly sensitive laser-based smoke detectors with aspirators connected to networks of sampling pipes.

Design Requirements: The systems shall consist of a highly sensitive Laser-based smoke detector, aspirator, and filter. The systems shall allow programming of the following but not limited to:

At least three (3) smoke threshold alarm levels.

Time delays.

Faults including airflow, detector, power, filter and network as well as an indication of the urgency of the fault.

Seven (7) or more configurable relay outputs for remote indication of alarm and fault conditions.

Provide an air sampling pipe network to transport air to the detection system. Provide the design calculations for the pipe network from a computer-based design modelling tool.

Performance Requirements: The MASD shall be capable of the following:

- Shall be tested and approved to cover up to 2,000m^2
- Shall be approved to provide very early smoke detection and provide four output levels corresponding to Alert, Action, Fire 1 and Fire 2. These levels shall be programmable and able to be set at sensitivities ranging from 0.005 – 20% obsc/m.
- Shall report any fault on the unit by using configurable fault output relays or via VSM.
- Shall be self-monitoring for filter contamination.
- Shall incorporate a flow sensor in each pipe and provide staged airflow faults.

Technology: Both light scattering and particle counting shall be utilised in this device as follows:

- The laser detection chamber shall be of the mass light scattering type and capable of detecting a wide range of smoke particle types of varying size. A particle counting method shall be employed for the purposes of:
    - Preventing large particles from affecting the true smoke reading; and
    - Monitoring contamination of the filter (dust and dirt etc.) to automatically notify when maintenance is required.
    - The particle counting circuitry shall not be used for the purpose of smoke density measurement.
- The laser detection chamber shall incorporate a separate secondary clean air feed from the filter; providing clean air barriers across critical detector optics to eliminate internal detector contamination

7.10.1 MASD Set Up

Where the Contractor proposes to install Multi Aspirating Smoke Detection (MASD), they must be VESDA or equal approved type, comprising a system capable of identifying specific cells or areas as appropriate, have independent power supplies complete with battery back up. The systems are to be set up with the following alert/alarm activations:

Sensitivity:

- Detector sensitivity settings (threshold) should be calculated based on the required hole sensitivity as defined within AS7240-20 Class A, B or C. This calculation should take into effect the total number of sampling holes/

cells on a particular detector and/or pipe. The calculations should be performed using approved design software.

- The Fire 1 trigger pint will be the agreed class of sensitivity for the risk area; eg: Normal cells may trigger F1 at the Class C level as defined within AS7240-20
- In High Needs areas the F1 trigger point may be as required within Class B.
- Due to the critical nature of these threshold settings, detectors installed will need to maintain the set sensitivity level throughout the life of the unit. Drift compensation will not be permitted.

Transport time:

- While each class of sensitivity has a maximum allowable transport time as noted below, actual performance may be required to exceed this
- Class A-60 Seconds
- Class B-90 Seconds
- Class C-120 Seconds.

For example, a system achieving Class C sensitivity may be required but transport time should not exceed 90 seconds.

7.10.2 Commissioning

General: The MASD system is to be done on an area by area basis with the above mentioned sensitivity and times utilised as an initial setup. Once on line, the commissioning is to be completed in consultation with NSW Corrective Services Fire Engineer – Wayne Wilkins.

Contact Details: Contact project super-intendent for contact details for Wayne Wilkins – NSW Corrective Service Fire Engineer.

7.10.3 Detector Assembly

General: The detector, filter, aspirator and relay outputs shall be housed in a mounting box and shall be arranged in such a way that air is drawn from the fire risk and a sample passed through the dual stage filter and detector by the aspirator.

The detector shall be Laser-based type and shall have an obscuration sensitivity range of 0.005 – 20% obs/m. The detector shall have four independent field programmable smoke alarm thresholds across its sensitivity range with adjustable time delays for each threshold between 0-60 seconds.

The assembly must contain relays for alarm and fault conditions. The relays shall be software programmable to the required functions. The assembly shall have built-in event and smoke logging. It shall store smoke levels, alarm conditions, operator actions and faults. The date and time of each even shall be recorded. Each detector (zone) shall be capable of storing up to 18,000 events.

Faults: The detector shall also incorporate facilities to transmit the following faults:

- Detector fault
- Airflow fault
- Filter fault
- System fault

- Zone fault
- Network fault
- Power fault

7.10.4 Filter

General: The filter must be a two-stage disposable filter cartridge. The first stage shall be capable of filtering particles in excess of 20 microns from the air sample. The second stage shall be ultra- fine, removing more than 99% of contaminant particles of 0.3 microns or larger, to provide a clean air barrier around the detector's optics to prevent contamination and increase service life.

7.10.5 Aspirator

General: The aspirator shall be a purpose-designed rotary vane air pump. It shall be capable of allowing for multiple sampling pipe runs up to 200m in total, (4 pipe runs per detector) with a transport time of less than 90 seconds or as appropriate codes dictate.

7.10.6 Display

General: Where displays are to be utilised they are to comply with the following:

- The detector display module shall be located within the detector.
- Each display shall provide the following features at a minimum:
- A 20 segment bar graph display.
- Three independent high intensity alarm indicators, Alert, Action, Fire 1, corresponding to the three alarm thresholds of the detector.
- Alarm threshold indicators for Alert, Action and Fire 1.
- Detector fault and airflow fault indicators.
- Faults originating in the particular VLP zone (Zone Fault) shall be distinguished from those produced by the overall smoke detection system and from those resulting from network wiring errors (Network Fault).
- LED indicators shall be provided for each fault category.
- Minor and urgent fault LED indicators.
- A remotely mounted Display may be optionally equipped with 7 or 12 configurable relays for signalling alarm and fault conditions.
- Four buttons supporting the following features:
    - Mode/Test: Scrolls through the information on the display's digital display: Sensitivity (Fire 1 Threshold setting), current smoke level and VLP Zone number. When pressed and held initiates a lamp test on the individual display module.
    - Silence: Silences all devices on the system.
    - Reset: Unlatches all latched alarm conditions on the assigned VLP zone.
    - Isolate: Isolates the individual VLP zone (inhibits Alarm and Fault relays and initiates Isolate relay).

7.10.7 Programmers

General: Where programmers are to be utilised they are to comply with the following:

- The programmer module shall be located within the detector assembly.
- Each programmer shall support the following features at a minimum:
- Programming of any device on the VESDAnet system.
- Viewing of the status of any device in the system.
- Adjustment of the alarm thresholds of a nominated detector.
- Setting of day/night, weekend and holiday sensitivity threshold settings.
- Initiation of AutoLearn™, to automatically configure the detector's alarm threshold settings to suit the
- current environment.
- Multi-level password control.
- Programmable latching or non-latching relay operation.
- Programmable energised or de-energised relays.
- Programmable high and low flow settings for airflow supervision.
- Programmable aspirator speed control.
- Programmable maintenance intervals.
- Facilities for referencing with time dilution compensation

7.10.8 Application

Detection Alarm Levels: The laser based aspirating detection system shall have four (4) independently programmable alarm thresholds. The four alarm levels may be used as follows:

- Alarm Level 1 (Alert): Activate a visual and audible alarm in the fire risk area.
- Alarm Level 2 (Action): Activate the electrical/electronic equipment shutdown relay and activate visual and audible alarms in the Security Office or other appropriate location.
- Alarm Level 3 (Fire 1): Activate an alarm condition in the Fire Alarm Control Panel to call the Fire Brigade and activate all warning systems.

Programme the alarm level functions to suit the client's and fire brigade requirements.

Initial Detection Alarm Settings: Initial settings for the alarm levels shall be determined by the requirements of the fire zone. However, the setting for Fire 1 (Alarm Level 3) shall always appear as 100% on the bar graph scale. Default settings of the unit shall not be less than those required by point type detectors.

Initial (Factory Default) Alarm Delay Thresholds: Initial (factory default) settings for the alarm delay threshold shall be:

- Alarm Level 1 (Alert): 10 seconds.
- Alarm Level 2 (Action): 10 seconds.
- Alarm Level 3 (Fire 1): 10 seconds.

- Fault Alarm: 5 seconds.

Fault Alarms: The detector fault relay shall be connected to the appropriate alarm zone on the fire alarm control panel in such a way that a detector fault would register a fault condition on the FIP. The minor fault and isolate relays shall also be connected to the appropriate control system.

Power Supply and Batteries: The system shall be powered from a regulated supply of nominally 24V DC. The battery charger and battery shall comply with the requirements of section 3.16.4 of AS 1670.1.

7.10.9 Sampling Pipe Design

Sampling Pipe: The sampling pipe shall be smooth bore with an internal diameter between 15-25mm. Normally, pipe with an outside diameter of 25mm and internal diameter of 21mm should be used. The pipe material should be suitable for the environment in which it is installed, or should be the material as required by the specifying body. All joints in the sampling pipe must be air tight and made by using solvent cement, except at entry to the detector. The pipe shall be identified as 'Aspirating Smoke Detector Pipe' along its entire length at regular intervals not exceeding the manufacturer's recommendation or that of fire brigade. All pipes should be supported at not less than 1.5m centres, or that of the local codes or standards. The far end of each trunk or branch pipe shall be fitted with an end cap and drilled with a hole appropriately sized to achieve the performance as specified and as calculated by the system design.

Sampling Holes: Provide appropriately sized sampling holes in the pipe. Each sampling point shall be identified in accordance with AS1670.1. Consideration shall be given to the manufacturer's recommendations in relation to the number of sampling points and the location of the sampling points.

7.10.10 Installation

Detection System: Install the system in accordance with the manufacturer's System Design Manual.

Capillary Sampling Network: The minimum internal diameter of the capillary tube shall be 5mm; the maximum length of the capillary tube shall be 2m unless advised otherwise by the manufacturer. The capillary tube shall terminate at a sampling point specifically designed and approved by the manufacturer. The performance characteristics of the sampling points shall be taken into account during the system design.

Air Sampling Pipe Network Calculations: Air sampling pipe network calculations shall be provided by a sampling pipe aspiration modelling program such as ASPIRE. Pipe work calculations shall be supplied with the proposed pipe layout design to indicate the following performance criteria.

- Transport Time: The manufacturers recommended transport time (time taken for the smoke to enter the pipe and reach the detector) for the least favourable sampling point is 60 seconds or less.
- Balance %: The sample point balance for the pipe shall not be less than 70% as indicated by ASPIRE. That is, the volume of air drawn from the last sampling point shall not be less than 70% of the average volume of air through the other holes.
- Share %: The sample hole share for the pipe shall not be less that 70% as indicated by ASPIRE. That is, the sum volume of air drawn through the sampling holes must always be greater than 70% of the total volume of air entering the pipe (i.e. the end vent must not exceed 30% of the total flow).

Commissioning Tests: Test and commission the installation in the presence of the manufacturer's representative, project manager and the fire brigade officer. Provide all necessary instrumentation, equipment, materials and labour as required. Record all tests and system calibrations and retain a copy of these results.

System Checks: Visually check all pipes to ensure that all joints, fittings, bends, sampling points, etc., comply with the specification. Check the system to ensure the following features are operational and programmed in accordance with the specification:

- Alarm threshold levels.
- Pipes in use.
- Detector address.
- Display address
- Time and date.
- Time delays.
- Air flow fault thresholds.
- Display buttons operable (Mode, Silence, Reset, Isolate).
- Referencing.
- Units set to S.I

Check to ensure that all ancillary warning devices operate as specified.

Check interconnection with fire alarm control panel to ensure correct operation.

Tests: Introduce smoke into the detector assembly to provide a basic functional test as follows:

- Introduce smoke to the least favourable sampling point in each sampling pipe. Transport time is not to exceed the recommendations of AS1670.1.
- Where more than two bar graph divisions illuminate under normal conditions (no smoke test), review event log for two (2) weeks from date of commissioning and make appropriate adjustments to the alarm and delay thresholds.
- Activate the appropriate fire alarm zones and advise all concerned that the system is fully operational. Fill out the log book and commissioning report accordingly

7.11 Surge Protection Devices

General: Provide all mode metal oxide varistor based series connected SPD to protect final equipment in racks and cabinets.

Standard: To AS 4262.1 and AS 4262.2.

Surge Rating: Imax ≥ 20 kA per phase.

Residual Voltage: Up < 600V.

Visual indicator: Provide visual indication of SPD status.

Enclosure and installation: House SPD in a metal enclosure and protected with a suitable rated circuit breaker equal to or less than the load current rating of the SPD.

The FIP and any Sub FIPs (SFIP) shall incorporate surge protection. The SPDs shall be CRITEC brand or equal approved, manufactured by ERICO. Surge protection shall be provided as follows;

- On the mains power supply, located within the FIP on the input side of the 230 V AC power supply to the FIP. All Sub FIP's shall incorporate surge protection located within the Sub FIP on the input side of the 230 V AC power supply to the FIP;
- The copper cabling of the PSTN for the Fire Brigade alarm connections;

- Transmission paths between the FIP and nodes of the system and;
- Any sensor/detector loops with a cable length greater than 25 metres.

7.12 Third Party Fire Monitoring

General: Fire Alarm Monitoring will be provided for each Main FIP ~~and each sprinkler system connected to the~~ main FIP.

Standards: AS1670.3, AS 7240.21 & AS 4428.6

Required: Connect the installation to a third party fire monitoring service provider. Connect using telecommunications fixed wire carrier lines. Provide dual paths as required. The ASE should have at least two communication links, primary and secondary and indicate status of same.

The ASE should monitor Alarm, Fault and Isolate and be able to provide for multiple separate alarms such as pump run, tamper, and secondary alarms for Fire Services where required and incorporate a system whereby when a key is inserted or a isolate /test device is used the key/device is identifiable to the issued party using same.

Certification: Certificate issued by CSIRO Active Fire Certification system or JAZ-ANZ approvals system, including any varied ASE intended such as a dual radio device.

7.13 Post Contract Works

7.13.1 Post Contract Maintenance

Complete maintenance and repair service for the fire alarm and detection system shall be available from personnel trained by the manufacturer of the major equipment for a period of five (5) years after expiration of the defects liability period.

As part of the tender submission, include a quote for a maintenance contract to provide all maintenance, tests, and repairs described below. Include also a quote for unscheduled maintenance/repairs, including hourly rates for technicians trained on this equipment, and response travel costs for each year of the maintenance period. Submissions that do not identify all post contract maintenance costs will not be accepted. Rates and costs shall be valid for the period of five (5) years after expiration of the defects liability period.

Maintenance and testing shall be in full compliance with the requirements of the Australian Standards relevant at the time of testing and maintenance. For example the AS 1851 suite of Australian Standards, the Building Code of Australia and the Authority Having Jurisdiction (AHJ). A preventive maintenance schedule shall be provided by the contractor describing the procedures for preventative maintenance.

The schedule shall include:

- Systematic examination, adjustment and cleaning of all detectors, manual fire alarm stations, control panels, power supplies, relays, water flow switches and all accessories of the fire alarm system.
- Each circuit in the fire alarm system shall be tested in a compliant regime.
- Each detector shall be tested in accordance with the requirements of AS 1851.8.

7.13.2 Post Contract Additions

The contractor shall have the ability to provide parts and labour to expand the system specified, if so requested, for a period of three (3) years from the date of acceptance.

As part of the tender submission, include a quotation for all parts and material, and all installation and test labour as needed to increase the number of intelligent or addressable devices by twenty five percent (25%). This quotation shall include intelligent smoke detectors, intelligent heat detectors, addressable manual stations, addressable monitor modules and addressable modules equal in number to one tenth of the number required to meet this specification (list actual quantity of each type).

The quotation shall include installation, test labour, and labour to reprogram the system for this 25% expansion. If additional FIP hardware is required, include the material and labour necessary to install this hardware.

Tender submissions that do not include this estimate of post contract expansion cost will not be accepted.

7.13.3 On-going Maintenance

Smoke Detection: To AS 1851 and manufacturer's requirements. Contractor to provide schedule of maintenance in accordance with the above mentioned standards in the project O&M Manual.

Multi-aspirating Smoke Detection: To AS 1851 and manufacturer's requirements. Contractor to provide schedule of maintenance in accordance with the above mentioned standards in the project O&M Manual.

OWS: To AS 1851 and manufacturer's requirements. Contractor to provide schedule of maintenance in accordance with the above mentioned standards in the project O&M Manual.

Field Based Hardware: To AS 1851 and manufacturer's requirements. Contractor to provide schedule of maintenance in accordance with the above mentioned standards in the project O&M Manual.

Requirement: Provide 12 months warranty for all materials and equipment installed under this contract, including replacement of faulty components at no cost for the full extent of the defects liability period.

Log Book: Provide a log book in the FIP in accordance with AS 1851 of sufficient pages to include all entries for the defects liability period.

Maintenance: Provide regular testing and preventative maintenance in accordance with the schedules provided in the reference documents and ensures that all maintenance visits and tests conducted are correctly recorded in the log book.

8. COLOUR GRAPHIC SYSTEMS

8.1 General

The Contractor shall design, supply, install and certify a complete Colour Graphic system in accordance with relevant standards. The system shall be designed to accommodate the purpose and be installed in an approved and compliant manner. The Contractor shall provide as part of their design, workshop drawings detailing a design intent for the colour graphic system for approval prior to performing any work on site. The Contractor shall assume the responsibility of the design of the system and no variations will be accepted after submitted drawings have been approved for installation.

The Colour Graphics package shall be compatible with the dry fire systems. The contractor shall install FireWorks™ or approved equal. The system utilised shall be a powerful software and hardware package that work in concert with Fire Detection and Alarm system and/or the Life Safety and Property Protection systems. The colour Graphics platform shall be capable of integrating with third-party systems with solutions to provide the user with clear, concise, and coordinated information.

The contractor shall provide an intuitive user interface, taking all information and presenting it in an easy-to-understand format by dividing major system functions into easy-to-manage viewports. The system is to be event driven. The user should have the ability to deal with system events and eliminate any confusion experienced when systems present all information at once.

The colour graphics system is to automatically prioritize the events for the user in an Event Viewport. The highest priority event is displayed first, and the lowest priority event is displayed last. It is to allow the user to quickly determine which events warrant the most immediate attention. Each of the other supporting viewports are to provide specific information and/or control options that relate data to the event highlighted in the Event Viewport. Related information may include event action information (specific tasks the user may need to perform in response to the event), or information about the area where the event has taken place (any hazardous materials present in the area, etc.). Images, CCTV, video, audio messages and graphical maps may also be presented to aid in the understanding of an event and how it should be managed.

8.2 Application

The Colour Graphic system is to gather, consolidate, disseminate, display and control systems and points throughout a facility and/or site. Each operator shall have the ability to configure the system to have anywhere from 2 to 6 viewports. Viewport options are Map, Image, Event List, Event Action, Browser and CCTV.

8.3 View Ports

8.3.1 Event Activation Viewport

The Event Action Viewport displays any custom instructional text associated with the event. This text could include information about hazardous materials present at the location, or instructions for implementing the facility's emergency action plan. Common control switches for Alarm Silence, Panel Silence, Drill and Reset are also available in the Event Action viewport. Also accessible from this viewport are the Event Acknowledge button, the Computer Silence button, and the Event Log tab:

The Screen is used to provide instructions on how to respond to the selected event, and also to acknowledge that these instructions have been carried out Acknowledgment of events is accomplished from the Event Action Viewport. The CG system is to support the use of custom audio messaging through the use of .wav fles. These audio messages are used to reinforce the action a user should take for a given situation. Audio messaging and the PC buzzer may be silenced by the user without affecting the connected life safety networks or panels. This feature shall allow the PC to be silenced without having to acknowledge events. The user only acknowledges each event when all response procedures have been carried out. Once acknowledged, the event moves from the Event List new messages tab to the Acknowledged Events tab. By selecting the Log Entry Tab on the Event Action Viewport, the user can record the steps taken in response to the selected event. Event logs are attached to the history file for the event and are available for review when needed.

8.3.2 Event Log

The Selectable as a tab in the Event Action Viewport, this area allows the user to record actions taken in response to the selected event:

8.3.3 Image Viewport

Any event, any device, or any combination of devices and events can retrieve instant graphical information that is relevant to the occurrence and can be understood at a glance. The viewport shall display still images of the active device with a brief description of its function. It can show what a gate valve looks like, or which model of smoke detector is in alarm, or what kind of detector is active.

8.3.4 Map Viewport

This viewport shall provide a graphical display of the event's physical location. This viewport is customized to the layout of the facility. A site map may be displayed showing one or multiple buildings. This gives the user an overview of the event's location in the context of its surroundings and the entire facility.

This configuration shall display an event and begin flashing at the appropriate TSA (touch-sensitive area) or alarm area in red. TSAs for supervisory events display with a gold or yellow boarder (feld selectable). Security events can display in orange. Trouble or monitor events in yellow. Restorations in green. This shall provide a clear indication of the event area of the alarm. The operator may then touch the flashing area to advance to the next screen providing a more detailed view of the area of incident. The operator may also choose to go directly to the device in alarm.

From within the Map Viewport the operator shall enable or disable devices, retrieve device sensitivity, &/or modify specific extended message text for any device.

8.4 Engineering

The Graphic Workstation Functions shall display the address of the alarm or off-normal point with type and description and time of the event in a prioritized color-coded event list. Highlighting an event in the event list shall automatically cause the other viewports (described below) to display information relating to the highlighted event. The system LCD shall display colour graphical representation of the area in which the alarm or off normal device is located. It shall be possible for the operator to manually zoom down to any portion of a vector-based graphic without aliasing, arti-facting, or pixilation of the image. The operator must be able to Log comments for each event to history with time and date. The history must be accessible for future review.

It must be possible to operate common control functions from the Workstation including acknowledging, silencing, and resetting of fire alarm functions while maintaining UL listings. It must be possible to manually activate, deactivate, enable, and disable individual fire alarm points. The workstation shall be capable of generating status, maintenance and sensitivity reports for all fire alarm components. The workstation must be capable upon receipt of a fire alarm to activate an audio WAV file over the workstation speakers alerting the operator to an alarm, and providing audible instructions.

It shall be possible via a compatible remote PC connection through an accessible connection to a VPN, LAN, or WAN to obtain status, diagnostics, and reports from the workstations. The graphics work station shall act as a server to simultaneously communicate the status of all systems connected to the graphics work station to up to fifteen (15) concurrent remote PCs running graphics client software over the owner's data network or VPN. Clint software shall actively poll the graphic work station server to determine event status. All event changes shall be automatically announced on the client PC. No operator interaction shall be required to retrieve or display incoming events. Web browser technology shall not be considered as equal. All workstation to client communications shall be encrypted for privacy. It shall be possible to capture at the remote PC events that take place on the workstation. It shall be possible from the remote PC to run workstation and panel reports.

The workstation shall be capable of communicating through one or multiple digital alarm receivers to display events from any panel that supports Contact ID or 4/2 industry standard protocols. The workstation shall provide the ability to schedule the automatic running of reports. Reports shall be capable of being scheduled daily, weekly or monthly. Scheduled reports shall be automatically stored electronically for easy retrieval. The Workstation shall provide for simple control via a computer mouse, touchscreen and keyboard commands

9. AUTOMATIC FIRE SPRINKLER SYSTEM

9.1 General

General: The automatic fire detection specification is a Design & Construct performance brief and provides design guidelines for the installation. The contractor shall design and construct an automatic sprinkler system complying with the current National Construction Code, AS 2118 and all requirements for the performance of AS 1668 Ventilation & Air-conditioning Systems utilised in this project.

Only qualified contractors with experience in fire detection system installation shall install the system and are required to be recognised as *'Competent Fire Safety Practitioners'* in accordance with NSW Government Co-regulatory Accreditation Framework. The entire installation shall be in accordance with the requirements of the relevant regulations, Local Council, NSW Fire Brigade and Occupational Health and Safety requirements.

Preference: Note that it is the preference of the NSW Department of Justice to not have any sprinkler systems installed unless required by the BCA for a DtS solution. However where this is the case or as prescribed by the site specific FER this section is to apply for the area to be sprinkler protected.

Design Intent: The works specified in this section describe the design intent for the automatic fire sprinkler system based on a Design & Construct methodology.

Requirement: The works specified in this section comprises the complete design, supply, installation, testing, and commissioning of the fire sprinkler service in accordance with but not limited to AS2118.

Scope of Works: The scope of work includes, but is not limited to, the following:

- Developing the fire sprinkler service design and construct documentation to completion, as deemed acceptable by the principal to provide a co[Not applicable]lly functional system within the regulations and by-laws of all Federal, State, and Local Autho[Not applicable]urisdiction over the works;
- Make connection to the capped Table E flange provision provided by the Hydraulic Contractor;
- Provide a fire sprinkler service pressure booster pumpset to AS 2419.1, AS 2941, NSW Fire Brigade, and Local NSW Water Authority requirements;
- Provide a fire sprinkler service storage tank to AS2304, AS2118.1 (AS2118.4 where required), AS2419.1, NSW Fire Brigade, and Local NSW Water Authority requirements;
- Provide sprinkler control valve assemblies complete with flow test pipework, flow switches, transponders, pressure gauges and solenoid flow switch test valves and strainer upstream of each solenoid valve and connection of all monitored equipment to the FIP;
- Provide all necessary pipes, junctions, bends, supports, pumpsets, and sundry equipment as required for the installation;
- Coordinate with the builder and other services contractors prior to any setting out and pipe installation taking place. Pipeline positions shall be determined on site in conjunction with all other disciplines to ensure adequate coordination of all services and elements;
- Test, commission, and certify the complete fire sprinkler service installation to meet Authority and Australian Standard requirements, and ensure operational serviceability.

9.2 Standards

General: BCA E1.5, NSW Fire Brigade, Local NSW Water Authority, and AS 2118.1 requirements.

Maintenance of Fire Protection Equipment: To AS 1851.

Wall Wetting Sprinklers (Drenchers): To AS 2118.2.

Deluge System: To AS 2118.3.

Accommodation Buildings 4 Storeys or Less in Height: To AS 2118.4.

Combined Sprinkler and Hydrant Systems: To AS 2118.6.

Minor Modifications: To AS2118.8.

Piping Support and Installation: To AS2118.9.

Approval Documentation: To AS2118.10.

Pumpsets: To AS2941.

9.3 Design Criteria

9.3.1 Performance Requirements

- Maximum Pipe Velocity: 10 m/sec
- Maximum Pipe Velocity at Valves: 6 m/sec
- Minimum Sprinkler Discharge Pressure (Light Hazard System): 70 kPa
- Minimum Sprinkler Discharge Pressure (Ordinary Hazard System): 35 kPa
- Minimum Sprinkler Discharge Pressure (High Hazard [illegible] Pa

Not applicable

- The fire sprinkler service must be designed, constructed, and installed in such a manner as to:
    - Provide water to fire-fighting equipment at a flow rate and pressure that is adequate for the correct functioning of the equipment;
    - Not provide a ligature point
    - Avoid the likelihood of leakage or failure including uncontrolled discharges;
    - Allow adequate access for maintenance of mechanical components and operational controls;
    - Avoid the likelihood of contamination of drinking water;
    - Allow the system and backflow prevention devices to be isolated for testing and maintenance.

General: The sprinkler system shall be capable of providing the design density of discharge over the assumed areas of operations in accordance with AS 2118.1. The table below is indicative only and appendix A in AS2118.1 should be referred to for design purposes.

Calculations: Hydraulic calculations prepared for the fire sprinkler service shall allow for most hydraulic favourable and unfavourable areas of operation so as to provide suitable selection of the booster pumpset/s. In the case of two booster pumpsets being required, each pumpset shall be capable of providing the required pressure and flow requirements independently.

Occupancy Classification:

Area	Occupancy Classification
Accommodation	Residential
Sterile	Light Hazard (LH)
General	Ordinary Hazard 1 (OH1)
High Needs	Ordinary Hazard 2 (OH2)

This table is indicative only in order to offer design parity over several projects.

9.4 Submissions

9.4.1 Certification

General: Submit installer's completion certificates, before practical completion.

9.4.2 Products

Product Listing: Submit documentation to verify product listing in the JAS-ANZ or ActivFire Register of Fire Protection Equipment Register of Fire Protection Equipment for the respective item.

Pipe Fittings: Submit proposals for the provision of mechanical roll-grooved fittings.

Retard Devices: Submit proposals for use and type.

9.4.3 Samples

General: Submit samples of accessories not d Not Applicable prietary items, including the following:

- Sprinkler heads;
- Valves and flow switches.

9.5 Inspection

Notice: Give notice so that inspection may be made of the following:

- Enclosed work ready to be covered or concealed.
- System ready for testing.

9.6 Products

9.6.1 Authorised Products

Requirement: Provide equipment listed in the JAS-ANZ or ActivFire Register of Fire Protection Equipment.

9.6.2 Piping

Piping Material: As documented.

9.7 Pumpset

Standard: To AS 2941 and AS 2419.1.

Requirement: Conform to the Hydraulic Pumps section.

9.8 Fire Brigade Booster Assembly (by Hydraulics)

Standard: To AS 2419.3.

General: To be installed and coordinate with the Hydraulic Contractor.

Type: Provide a proprietary booster assembly with a cast bronze body, DN 65 inlets suitable for quick connect couplings, back pressure valves, pressure gauge, drain valve, and main stop valve.

Number of Booster Valves: As required.

Signage and Block Plan: To AS 2419.1.

9.9 Fire Sprinkler Block Plan

General: Provide a block plan consisting of minimum A3 size laminated, weather proof and framed, showing a diagram of the fire sprinkler service systems located in the sprinkler room, enclosure/recess, fire control room, and pump room in a conspicuous location.

Requirement: The block plan shall comply with AS 2419.1 and NSW Fire Brigade requirements as stated in the general section.

Installation: Provide and install two hot dip galvanized steel supports all as detailed on drawing and secure into position with bulk concrete. Provide two (2) 50 mm equal stainless steel angle section for each block plan concreted into ground and secure plan with stainless steel bolts and anti-tamper nuts.

9.10 Sprinkler Control Valve Assembly

Not Applicable

General: The control valve assembly for each ins ude the items detailed herein and all other equipment necessary for the satisfactory operation, control and testing of the system. All valves shall be secured in their normal operating positions by means of padlocked leather straps and conform to the following:

- A sprinkler isolation valve which shall isolate the water supply to the whole system shall be of the rising spindle type, padlocked in the open position;
- An alarm check valve which shall be normally closed and which shall be arranged to open whenever the water pressure in the system falls below that of the water supply. The valve shall incorporate means of admitting water to the system whenever a sprinkler head operates;
- An alarm test valve which shall be of not less than 15 mm nominal bore and which shall be arranged so that it may be used for testing the operation of the alarm check valve and alarm system without the operation of any sprinkler head. Drain pipe, running to waste shall be provided;
- Pressure gauges shall be arranged to indicate the water pressure on either side of the alarm check valve seat and the water pressure of each water supply main. The gauges shall be provided with ‘shut-off’ valves;
- The main clack of the check valve shall be arranged to ensure that the system pressure does not fall with falling water supply;
- Alarm valve pressure differential shall be carefully considered with expected maximum static head above the valve in relation to maximum pressure below the valve being the influencing factors;
- Provide a pop-up indicator on each Control Valve Set to indicate operating of system.

9.11 Sprinkler Heads

Type: Silica bulb.

Manufacturer: Tyco or equal approved.

Orifice Diameter: 10 mm (LH), 15 mm (OH).

Temperature Rating: 68°C.

Where Located Under Glazed Areas: Shall be 93°C temperature rated.

Where Located within Lift Shafts, Service Shafts, and Enclosed Chutes: Shall be 141°C temperature rated.

Where Located within Unventilated Concealed Spaces: Shall be between 79°C and 100°C temperature rated.

9.12 Flexible Sprinkler Hose

Requirement: To FM Global Approval and Underwriters Laboratories Standard for Safety UL 1474 and SSL Specification FAS 112 requirements and test procedures.

Flexible Sprinkler Hoses: Shall have a minimum internal diameter of 27 mm. The hose tube shall be Grade 304 stainless steel with an outside 0.3 mm thick Grade 304 stainless steel braided sleeve.

Type: Shall be equal to assemblies supplied by Victaulic or equal approved.

9.13 Water Motor Alarm

General: Provide a water motor alarm consisting of a turbine driven gong incorporating a revolving striking hammer, rotator nozzle, gong and gong cover. The gong shall drain to waste. Provide waste drain pipe.

Size: The alarm gong shall be a minimum of 200 mm Not Applicable cated in the position indicated on the accompanying drawings.

Gong Turbine: The gong turbine shall have a bronze rotor and sleeve bearings. Provision shall be made for lubricating the rotor bearings.

9.14 Flow Switches

General: Flow switches shall be provided for each fire zone distribution pipe.

Type: Single pole, magnetic switch type, suitable for the pressure range, with test cocks.

Zones: If sprinkler systems are divided into zones, provide flow switches to indicate the zone in which the sprinklers have operated. Connect test cocks to the drainage system with galvanized pipe.

Time Delay: Each flow switch shall incorporate a time delay mechanism adjustable from 0-30 seconds to enable water flow fluctuation to be accepted within the total system without producing a false alarm transmission. Permanent provision for regular testing by means of a manually operated test cock shall also be provided complete with necessary discharge pipework to drain for each flow switch. Flow switches shall be wired to the existing Fire Alarm Panel.

Testing: Permanent provision for regular testing shall be provided by an electrically operated solenoid valve controlled and powered from the FIP. Each flow switch shall be arranged to provide an alarm in the event of failure i.e. open malfunction or test position.

9.15 Air Bleed Valves

General: Provide brass air bleed valves, suitable for connection to 12 mm hose fittings, at the high points of the sprinkler system.

9.16 Pressure Gauges

General: Shall be oil filled with a minimum dial dimension of 100mm, with normal pressure reading at 50% scale. Each pressure gauge shall be fitted with stop cocks to facilitate maintenance of the gauge.

9.17 Pressure Switches

General: Pressure switches shall be of the totally enclosed, hermetically sealed waterproof type with mercury to mercury contact suitable for operation on the system pressure applicable and 24 volts DC power supply, actuated by bourdon tube elements. Pressure switches shall be rated to at least 1 A.

Manual Reset: Each pressure switch shall incorporate a manual reset function to enable any alarm to be locked in until reset by authorised personnel when returning system to normal status.

9.18 Bell Testing

General: Provide a proprietary bell testing system to simulate the flow of one sprinkler head using a pump or similar means.

9.19 Zone Flow Indicator Testing

General: Provide each zone flow indicator with a proprietary, pump based test facility to simulate zone water flow.

Requirement: Confirm with the project superintendent whether this hardware is to be included in each site specific project.

9.20 Drain Valves

Not Applicable

General: Connect the sprinkler system and auxiliary drain valves to the nearest convenient points of the drainage system.

9.21 Locking

General: Padlock drain and air bleed valves in the closed position.

9.22 Orifice Plates

General: Minimise the number of orifice plates.

9.23 System Monitoring

General: Provide and install valve system monitoring devices in accordance with AS 2118.1.

Anti-tampering: All isolation valves shall be protected from tampering by installation of a supervisory alarm device located to contact when the stop valve is in the fully open position.

Installation: The device shall be installed in a neat and concealed manner arranged to operate against the valve turn sheet or sliding pointer indication arm. An alarm shall be transmitted should the valve be operated, or the device or wires tampered with.

Power Supply: Provide a 24 volt auxiliary relay with normally open contacts connected to the FIP.

9.24 Piping Joints

Permanent Joints: Welded.

Demountable Joints: Provide demountable joints as follows:

- If permanent joints are impracticable;
- If necessary, for maintenance or testing of piping or fittings;
- To attach valves to piping.

Demountable Joint Types: Flanged where possible, and in any case for pipe DN 65; otherwise mechanical roll-grooved, screwed, or compression.

Tappings: Provide pipe tappings by welding sockets to the pipe.

Flushing Connections: Provide flushing connections at the extremities of distribution pipes.

9.25 Welding

Standard: To AS 4041.

Site Welding: Minimise site welding. Do not site weld pipes under DN 50.

9.26 Corrosion Protection

9.26.1 General

Requirement: Provide protection to the corrosion-susceptible parts of the sprinkler system.

9.26.2 Galvanizing

General: Galvanize steel pipe supports, fabricated components, bolts, nuts, washers and clips installed in damp conditions, in the ground, or exposed to weather.

Not Applicable

9.26.3 Painting

General: Do not paint surfaces which must be unpainted for the correct operation of the sprinkler system, such as bearing and sliding surfaces, adjustable screw threads and discharge heads.

9.27 Spares Cabinet

9.27.1 General

Requirement: Provide a spares cabinet of size sufficient to contain the stock of spare sprinklers and spanners, with a lockable hinged door. Store each item separately on clips or in drawer compartments.

9.27.2 Construction

General: Form from machine-folded sheet metal with returns on free edges.

9.28 Marking

9.28.1 Main Sprinkler Isolation Valve Location Plate

General: Supply and install location plate to the main sprinkler isolation valve. The plate shall bear the words SPRINKLER SUPPLY STOP VALVE in 50 mm high letters.

9.28.2 Notice Plate

General: Provide a notice plate containing condensed emergency instructions, legibly printed or engraved on durable material resistant to defacement, at least 3 mm thick or mounted on board at least 3 mm thick, permanently fixed in a convenient position at the control valves.

9.28.3 Orifice Plates

General: Mark flanges next to an orifice plate to show the plate size and other details necessary to ensure correct matching.

9.28.4 Spares Cabinet

General: Mark the spares cabinet SPARE SPRINKLERS in letters at least 30 mm high.

9.29 Pre-completion Tests

Flush: Before testing, flush the sprinkler system with clean water.

Hydrostatic Test: Test the sprinkler system to the designated hydraulic test pressure. If necessary, to complete the inspection of the sprinkler system under test, maintain the test pressure beyond the designated period.

Air Pressure Test: Test dry pipe systems using compressed air, with pipe ends sealed and valves in the distribution system open. Maintain the test pressure for at least 30 min and ensure there are no leaks.

9.30 Completion Tests

Not Applicable

9.30.1 Installer's Completion Certificates

General: Required before practical completion.

9.30.2 Water Quality Tests

Function: To demonstrate that the sprinkler system water is clean and free from foreign matter, including sand, sediments and other impurities.

Discharge Test: Inspect water discharged from at least one of the flushing valves, for foreign matter.

Sprinkler Head Test: Remove at least 10% of the sprinkler heads, at designated locations, and inspect them for foreign matter lodged across the orifices of the heads.

Test Failure: If foreign matter is observed in quantities likely to impair the functioning of the sprinkler system then:

- Drain the system;
- Open and clean the alarm valve and strainer;
- Recharge the system.

9.30.3 Water Supply Proving Tests

General: Demonstrate that the water supply satisfies the pressure and flow requirements.

9.30.4 Pump Capacity Tests

General: Demonstrate that pressure pumps have the designated capacity.

9.30.5 Recording Equipment

Flow and Pressure Recording Equipment: Calibrated by a registered testing authority.

Calibration: Provide satisfactory evidence that test instruments have been checked and passed for accuracy within one month before testing.

9.30.6 Baseline Data

Requirement: Provide baseline data to AS 1851.

9.31 Selections

9.31.1 Pipe Material Schedule

Property	A	B	C
Pipe Material	Polyethylene	Black steel	
Grade or Class	AS 4130 PN20	AS 1074 Medium	
Jointing Method	Electrofusion	Roll grooved couplings or screwed	

Note: All pipework shall be of the sizes shown on the accompanying drawings. Wherever possible, pipes shall be run parallel with the building slabs, walls etc. and all branch take-offs shall be at right angles.

9.31.2 Sprinkler Head Schedule

Not Applicable

Location	Type	ature Rating	Supply Pipe Type
Below ceiling (tiled)	15 mm semi-recessed standard/fast response	68°C	Stainless steel - flexible
Below ceiling (plasterboard)	15 mm flush standard/fast response	68°C	Stainless steel - flexible
Plant rooms	15 mm exposed standard/fast response upright/pendant	68°C	Steel – rigid
Concealed spaces	10 mm exposed standard/fast response upright/pendant	68°C	Stainless steel – flexible
Kitchen exhaust duct	15 mm standard response pendant	182°C	Steel – rigid
Lift shaft	15 mm standard response pendant	141°C	Steel – rigid
Garbage/linen chute	10 mm exposed standard response upright/pendant	68°C	Steel – rigid

9.31.3 Pumpset Schedule

General: The following pump schedules are provided as an indicative item to inform the D&C Fire Services contractor of the acceptable requirements for Fire Booster Pumps. Please refer to the Fire Service Pumpset section of this specification for details.

9.31.3.1 Electric Pumpsets

Property	A	B	C
Manufacturer	Prime Pumps	Prime Pumps	Prime Pumps
Model	40/26	50/26	65/26
Drive	Electric	Electric	Electric
Type	End Suction Centrifugal	End Suction Centrifugal	End Suction Centrifugal
Flow (L/sec)	10	20	30
Duty Head at Flow Rate (kPa)	850	850	850
Impeller Material	Zinc Free Bronze	Zinc Free Bronze	Zinc Free Bronze
Casing Material	Ductile Cast Iron	Ductile Cast Iron	Ductile Cast Iron
Minimum Motor (kW)	22	37	55
Speed (rpm)	2,950	2,950	2,950
Power Supply	400V, 22kW, 38A	400V, 37kW, 72A	400V, 55kW, 92A
Jacking Pump Model	AVM3-19	AVM3-19	AVM3-19
Jacking Pump Drive	Electric	Electric	Electric
Jacking Pump Flow (L/sec)	0.66	Not Applicable	0.66
Jacking Pump Pressure (kPa)	981		981
Jacking Pump Power Supply	230V, 1.5kW, 8.9A	230V, 1.5kW, 8.9A	230V, 1.5kW, 8.9A

9.31.3.2 Diesel Pumpsets

Property	A	B	C
Manufacturer	Prime Pumps	Prime Pumps	Prime Pumps
Model	40/26	50/26	65/26
Drive	Diesel	Diesel	Diesel
Type	End Suction Centrifugal	End Suction Centrifugal	End Suction Centrifugal
Flow (L/sec)	10	20	30
Duty Head at Flow Rate (kPa)	850	850	850
Impeller Material	Zinc Free Bronze	Zinc Free Bronze	Zinc Free Bronze
Casing Material	Ductile Cast Iron	Ductile Cast Iron	Ductile Cast Iron
Minimum Motor (kW)	24	35	60
Speed (rpm)	2,900	2,900	2,900
Engine Cooling System	Heat Exchanger	Heat Exchanger	Heat Exchanger
Power Supply	230V, 1.5kW, 15A	230V, 1.5kW, 15A	230V, 1.5kW, 15A
Jacking Pump Model	AVM3-19	AVM3-19	AVM3-19
Jacking Pump Drive	Electric	Electric	Electric
Jacking Pump Flow (L/sec)	0.66	0.66	0.66

Jacking Pump Pressure (kPa)	981	981	981
Jacking Pump Power Supply	230V, 1.5kW, 8.9A	230V, 1.5kW, 8.9A	230V, 1.5kW, 8.9A

9.32 Maintenance

Sprinkler System: To AS 1851 and manufacturer's requirements. Contractor to provide schedule of maintenance in accordance with the above mentioned standards in the project O&M Manual.

Requirement: Provide 12 months warranty for all materials and equipment installed under this contract, including replacement of faulty components at no cost for the full extent of the defects liability period.

Log Book: Provide a log book in the SFIP in accordance with AS 1851 of sufficient pages to include all entries for the defects liability period.

Maintenance: Provide regular testing and preventative maintenance in accordance with the schedules provided in the reference documents and ensures that all maintenance visits and tests conducted are correctly recorded in the log book.

Not Applicable

10. FIRE SERVICE PUMPS

10.1 Submissions

General: The works specified in this section comprises the complete design, supply, installation, testing, and commissioning of the fire service pumpsets.

Design Intent: The works specified in this section describe the design intent for the automatic fire sprinkler system based on a Design & Construct methodology.

Type Test Records: Submit type test curves for each size and type of pump marked with the duty point.

Standard: To AS 2941, AS2118.1, AS2419 & AS1851.

Scope of Works: The scope of work includes, but is not limited to, the following:

- Design fire service pumpsets to meet system demand and comply with relevant Australian standards
- Supply and installation of fire service pumpsets;
- Test, commission and maintenance of pumsets

10.2 Components

10.2.1 Control Panels

General: Provide control panels to suit the controls. Mount switches, and indicating lights on the door. Mount motor starters, relays and switchgear and termi[illegible] DIN rail inside the cabinet. Run cables in trunking or looms.

Not Applicable

Labelling: Label all components. Number both ends of each cable and number terminal strips to match the circuit diagram. Provide a laminated circuit diagram inside the cabinet.

Metalwork: Vandal proof cabinet constructed from metallic zinc coated steel with powder coat finish. Provide a hinged and lockable door with 2 keys. Keys shall be compatible with the master key type utilised for mechanical equipment items.

Degree of Protection: IP54 or higher.

10.2.2 Controls – Dual Pump Installations

General: Provide controls to alternate the pumps after each cycle of operation, start the idle pump if the other fails, and activate an audible alarm and a flashing warning light to indicate a failure.

Alarm Bells: Mount on an external wall. Provide alarm mute.

Meters: Provide an hours-run meter to each motor.

Selector: Provide an auto-off-on selector for each pump.

Warning Lights: Provide separate lights to indicate power available, run for each pump, fault for each pump and other faults.

10.2.3 Marking

General: Provide a robust label on each pump or pump set showing design flow rate, head, temperature of pumped medium, casing, impeller, and shaft materials.

10.2.4 Motors

Dimensions and Performance: To IEC 60072-3.

Installation: To AS 60034.7.

Motors Minimum 0.75 kW: Three phase, flange mounted.

Overload Protection: Provide each motor with overload protection.

Performance:

- Efficiency: Motors documented as high efficiency to AS/NZS 1359.5, all other motors to AS/NZS 1359.5.
- Power Factor at Full Rated Output: Minimum 0.72 for single phase motors, minimum 0.83 for three phase motors.

Selection: Provide motors selected for the maximum number of starts per hour of the installed system and to provide efficient, non-overloading pumping sets.

Power Rating: At least the maximum power required by the pump when projecting the system resistance curve to the maximum impeller size for the pump casing size.

Degree of Protection: IP54 or higher.

Shaft: If the impeller is mounted directly on the motor shaft use grade 416 stainless steel for the shaft.

10.2.5 Pressure Vessels

Standard: To AS 2971.

Not Applicable

Type: Diaphragm pressure tanks of fabricated steel construction, epoxy coated on metal surfaces in contact with water. Pre-charge the tanks with air.

10.3 Pumps – End Suction Centrifugal

Standard: To ISO 2858 or DIN EN 733.

Type: Close coupled pump accepting standard flange-mounted motors.

Casing Pressure Rating: The greater of 1.6 MPa, and 1.5 times the total of the pump shut-off head plus the static and system pressures.

Casing Material:

- Cast iron to AS 1830 (ISO 185/JL/250), minimum;
- Bronze, grade 836B.

Balancing: Statically and dynamically balance completed rotating assemblies.

Impellers: One piece shrouded type with machined sealing collars constructed from stainless steel or grade 836B bronze.

Shaft: Solid grade 416 stainless steel, machined all over, free of stress concentrations.

Shaft Sleeves: Provide a sleeve extending the full length of the seal housing.

Shaft Seals: Provide mechanical seals compatible with carbon elements rotating against a ceramic stationary face.

10.4 Pumps – Fire Service

10.4.1 General

Requirement: The booster pump shall be supplied and installed so as to maintain a minimum running pressure in accordance with AS 2419.1.

Type: The pumpset shall comprise centrifugal back pull out mechanical seal water pumps with cast iron body, bronze impellor and stainless steel shaft, in accordance with AS 2941.

Jacking Pump: A jacking pump with a cast iron body, bronze impellor and stainless steel shaft direct coupled to a weatherproofed 3 phase TEFC electric motor shall be provided to maintain static system pressure.

Ancillaries: All inter-component piping, valves, controls and wiring are to be provided by pump manufacturer with the assembled package and include; dial pressure gauges, pressure switch, flow switch and control panel all necessary Hydraulic control equipment including relays, fuses, starters, switches and wiring for functioning of system, all to SAA Code.

10.4.2 Electric Motor

Type: Shall be 400 V, 3 phase, squirrel cage TEFC.

Power Supply: Electrical connections shall be such as will ensure that power is available to the motor when switches for the distribution of other power throughout the premises are open. Any switches in the power circuit to the motor shall be locked 'ON' and clearly labelled **FIRE HYDRANT BOOSTER PUMP - NOT TO BE SWITCHED OFF**.

Not Applicable

Electrical Wiring: All wiring to the electrical motor, including wiring related to the remote control starting system and within the building shall be:

- Enclosed in a duct with a fire resistance rating of 2 hours;
- PVC or elastomer insulated and armoured;
- PVC or elastomer insulated and enclosed in screwed steel conduit;
- Mineral-insulated, copper-sheathed.

10.4.3 Diesel Engine

Type: Shall be air-cooled, four cylinder, electrically started type complete with batteries, starter motor, generator, voltage regulator, exhaust and fuel systems, oil bath, air cleaners, gauges, spare parts and tools.

Controls: The diesel motor shall be mechanically governed, have direct fuel injection and be continuously rated for twenty-four (24) hours operation to deliver not less than the horsepower required from the duty, at the loaded governed speed.

10.4.4 Fuel Storage

Requirement: The fuel storage tank shall be mounted over the engine and shall be of sufficient capacity to run the engine for a minimum of six (6) hours. Sufficient fuel shall be kept on hand to run the engine for at least twenty-four (24) hours. The fuel system shall include a 200 mesh filter, contents gauge and all necessary pipework. The pipework shall be arranged to deliver fuel to the engine fuel pump by gravity without any possibility of air locking.

10.4.5 Exhaust Piping

Requirement: Exhaust gases shall be piped from the motor manifold to discharge to atmosphere in an approved location. Exhaust piping shall be heavy gauge galvanised steel tubing of a diameter recommended by the motor manufacturer comply with minimal requirements of the standard.

Insulation: All exhaust piping shall be insulated with a 25 mm thick semi-rigid mineral wool insulation secured with two (2) aluminium clips per section. Piping up to a height of 2000 mm shall be sheathed over a 26 gauge zinc anneal, secured by pop rivets. Provide a suitable stainless steel silencer of the straight through type in the exhaust piping within the pump room.

Exhaust Silencer: The exhaust silencer shall limit the SPL to less than 85dBa.

10.4.6 Pumpsets

Requirement: The pumpsets shall be proven to meet the design duty and to comply with the correct starting procedure, i.e.

- The jacking pumpset shall automatically maintain the system pressure;
- The diesel/electric driven pump shall operate upon a pressure drop below 200 kPa;
- The jacking pumpset shall operate upon a pressure drop below 50 kPa.

Manufacturer Testing: During the guarantee period, the manufacturer reserves the right to carry out, at weekly intervals, test runs of the pumping equipment in accordance with standard approved procedures:

- Starting equipment for the pumpset;
- DOL starting equipment for the jacking pumpset;
- Manual test buttons;
- An alarm gong to indicate booster pump operation with mute switch for the gong;
- Pumpset run lights for all pumpsets.

Not Applicable

10.5 Installation

10.5.1 Standards

Fire Sprinkler Service Pumps: Install to AS 2118 and AS 2941.

Fire Hydrant Service Pumps: Install to AS 2419.1 and AS 2941.

10.5.2 Connections

General: Arrange pumps, piping and valves so that individual pumps can be removed with minimal drain down and disturbance to the connected piping. Support pipes independently of pumps.

Connections: Install vibration isolating couplings in the connecting pipes at the pumps. Provide couplings selected for a working pressure at least twice the system design pressure.

10.5.3 Vibration Mounts

General: Provide corrosion-resistant anti-vibration mounts under each pump. Alternatively, if the pumps are installed on a baseplate the mounts may be installed under the baseplate.

10.5.4 Pressure Tappings

General: Provide a pressure tapping on the inlet and discharge of each pump.

10.5.5 Fixing

General: Fix all pumps and pump sets to the supporting structure. Use expanding shield anchors for concrete.

10.6 Testing & Commissioning

10.6.1 Commissioning

General: Commission to the manufacturers' recommendations.

10.6.2 Testing

General: Provide the following tests for each pump and pumpset before the date for practical completion:

- Pump Operation: Test for correct pump rotation and operation;
- Automatic Changeover: Test changeover sequence under all operational combinations;
- Level Controls: Operate pumps, measure levels and adjust if necessary;
- Safety Controls: Simulate fault for each safety control;
- Alarms: Simulate alarm condition. Verify correct alarm raised;
- Motors: Measure motor current and adjust m Not Applicable uit;
- Completion Test: Provide a full operational test to verify compliance.

10.7 Maintenance

Fire Booster Pumps: To AS 1851 and manufacturer's requirements. Contractor to provide schedule of maintenance in accordance with the above mentioned standards in the project O&M Manual.

Requirement: Provide 12 months warranty for all materials and equipment installed under this contract, including replacement of faulty components at no cost for the full extent of the defects liability period.

Log Book: Provide a log book in the control panel in accordance with AS 1851 of sufficient pages to include all entries for the defects liability period.

Maintenance: Provide regular testing and preventative maintenance in accordance with the schedules provided in the reference documents and ensures that all maintenance visits and tests conducted are correctly recorded in the log book.

11. HYDRAMIST FIRE SUPPRESSION

11.1 General

Description: The Hydramist system shall be deployed to protect cell occupants from the effects of fire in the high needs area of the prison/s, The Hydramist system provides a fast and continuous suppression of the fire heat release rate within the cell using high pressure class 1 water mist spray.

A key feature of this system design is that the anti-ligature nozzle shall remain intact in the event of access being gained to the nozzle by the inmate and will not permit a ligature to be attached to the nozzle in any way.

The installation of the high-pressure water mist firefighting system shall be carried out in accordance with the foll following but not limited to NOMS Ministry of Justice United Kingdom TD.M.SPEC.045; American standard NFPA 750, AS4587 and OEM Requirements

System Capacity: The Hydramist system shall be deployed to protect cell occupants from the effects of fire in the high needs area of the prison/s, The Hydramist system provides a fast and continuous suppression of the fire heat release rate within the cell using high pressure class 1 water mist spray.

The capacity of the high-pressure water mist firefighting system is dependent on the fire load, the space to be protected and the respective protection objectives considering NFPA750 and independently performed and successfully completed full scale fire tests. Th Not Applicable em must be adjusted to the local requirements of the operator as per AS4587.

Requirement: The works specified in this section comprises the supply, installation, testing, and commissioning of the Hydramist fire suppression service. The complete installation must be designed and installed by a contractor trained and accredited by the system manufacturer and who can demonstrate previous recent experience in the installation of systems of equivalent nature.

The contractor must have a high level of experience in the design and installation of high pressure water mist systems. Provide relevant experience references with tender response.

- The following high need areas shall to be protected by the Hydramist System:
- All Single Cell configurations (Maximum of 4 at any one time, two up, two down)
- All Double Cell configurations (Maximum of 4 at any one time, two up, two down)
- All Double/single Cell configurations (Maximum of 4 at any one time, two up, two down)

The extent of protection and the effective area is determined based any one (1) Anti Ligature Hydramist nozzle (open head) operating at any one time.

Extinguishant Activation: A high pressure HYDRAMIST water mist fire fighting system shall be designed to provide optimal fire suppression and droplet distribution within each occupant cell, Class 1 water mist spray shall be produced using a positive displacement 100 MPS 150 bar plunger pump assembly and high pressure Stainless Steel OPEN HEAD Anti Ligature Deluge nozzles with a minimum operating pressure of 100 bar but not more than 140 bar.

Water Mist Suppression Agent: The water mist spray flux density shall consist of 99 dV class 1 fine water mist spray droplets of less than 200 µm. The reaction surface area of the class 1 water droplets, which is very large in relation to the quantity of water, shall remove high energy from the fire and the internal Cell temperature level shall be reduced to increase the tenability level for cell occupant(s).

System Operation: Each Open Head Anti Ligature Hydramist nozzle shall flow a minimum of 17 L/M @100 bar and cover a maximum volume of 36m3, there shall be no more than one nozzle installed within each cell arrangement.

A pressurised ring main of 18 bar shall be installed to each 15 mm 24 Volt DC Wet section valve which will be located in a service duct outside each cell on each level, the ring main pressure shall be automatically maintained via an automatic Jockey Pump Assembly located on the 100 MPS 150 Bar Pump Skid arrangement.

The section of 316L stainless steel tube between each section valve and Open Head Nozzle assembly shall remain dry until the section valve has been activated.

Each wet section valve shall be automatically activated via an aspirating detection system installed within each cell environment, the system logic for activation shall be determined by the installing contractor in conjunction with the authority having jurisdiction.

Upon detection of a fire a maximum of four (4) wet section valves shall open at any one time in a two cell up and two cell down arrangement.

A "single fluid system" is to be used in which pure water is atomised without any additives or the mixing of gases to achieve a fine class 1 water mist spray.

Product Listing: JAS-ANZ or ActivFire listed and VdS equal approved system. Hydramist system without an approved listing shall not be accepted.

Design Responsibility: It is the responsibility of the contractor to determine their own design, which must comply with the following standards in in accordanc[illegible]g hierarchy of design:

Not Applicable

- AS 4587
- NFPA750
- BS8489
- Should these standards conflict the refer to the manufacturers recommended solution

Scope of Work: The scope of work includes, but is not limited to, the following:

- Provide a Hydramist Fire Suppression System or equal approved system consisting of a positive displacement pump assembly and a fixed pipe reticulation to nozzles suitably positioned to apply the extinguishing agent to the risk area;
- The Hydramist system shall consist of but not limited to:
    - Dedicated 750 Litre Integral Potable Water Tank- (Break Tank)
    - Automatic water supply device with tank refilling provided by Others.
    - 415 Volt Three Phase System Control Pump Panel, with soft start capability.
    - Netbiter Argos Remote Management Access Communication Module.
    - Skid Mounted High pressure water mist pump unit.
    - Skid Mounted Jockey Pump for Mains Water pressure maintenance.
    - 316L Stainless Steel Main and distribution lines.
    - 316 Stainless Steel High-Pressure Open Head Anti Ligature water mist nozzles.
    - High Pressure 316 Stainless Steel 24 Volt Wet Control Valves, with test facility

- Carry out system design calculations in accordance with AS 4587. Flow calculations shall use approved flow design software. Provide for approval by the Project Manager a completed design. The design details shall include:
    - The total flooding quantity for the volume of the risk area;
    - Flow calculations together with an isometric view of the distribution system showing length and diameter of each pipe segment and node reference numbers;
    - Discharge time;
    - Type and flow rate of each nozzle including equivalent orifice areas;
    - Enclosure pressurisation and venting areas.
- Where the connection between the pump assembly and the protected area require underground installation this may be achieved using Schedule 40 seamless 316L ASTM-A-312 Stainless steel pipe and 3000 lb stainless steel screwed fittings.
- Install Hydramist hardware, storage cylinders and support structure outside the risk at the location agreed to with end user. Manually operated mechanical means of operation shall be provided at the cylinder bank(s). This shall operate all interfaces as described for automatic detection operation;
- Final connection between the pump high pressure outlet and the system reticulation can be achieved using a minimum 200 bar rated flexible hose connection, this will reduce vibration between the pump and the system reticulation;
- There shall be no more than one nozzle installed within each cell arrangement. Each Open Head Anti Ligature Hydramist nozzle shall flow a minimum of 17 L/M @100 bar and cover a maximum volume of 36m3.
- Provide a pressurised ring main of 18 ba Not Applicable to each 15 mm 24 Volt DC Wet section valve which will be located in a service duct ou each level, the ring main pressure shall be automatically maintained via an automatic Jockey Pump Assembly located on the 100 MPS 150 Bar Pump Skid arrangement
- Supply and install sections of 316L stainless steel tube between each section valve and Open Head Nozzle assembly shall remain dry until the section valve has been activated.
- The pump shall be provided with its own drive motor. Multiple drives, for example one motor for two pumps as well as gears or belt drives shall not be permitted.
- Pump start currents shall be kept as low as possible, the pump shall start without building-up pressure. The solenoid valve required for this shall be installed via a pressure hose. For safety reasons the pump shall be equipped with a safety valve.
- Test equipment and an overflow valve are to be provided as part of the test runs which must be performed regularly as per Original Equipment Manufacturers (OEM) requirements.
- Filters shall be installed in the automatic water feeding line, in the suction line, in front of the pump and in each individual high pressure water mist nozzle.
- The pump test run function must be possible without feeding water into the pipe network. Additionally, the system must be equipped with an overflow valve which shall be independent of the safety valves
- In the case of a breakdown of the tank filling level measurement device, a forced inlet must be ensured.
- All ball valves on the high pressure side within the system must be lockable and must meet the specific requirements of the client.

- Offers containing only general technical information and/or deviations from the stated minimum requirements will be excluded from the tender bid evaluation.
- Test and commission the Hydramist fire suppression system as required by AS 4587 and the Manufacturers System Installation and Maintenance manual.

11.2 Standards

General: To AS 4587, NFPA 750.

Electrical Wiring: To AS/NZS 3000.

11.3 Wiring

Standard: To AS 1670, AS 2220, AS/NZS 3000 and AS 3013.

Circuits: Run through accessible ceilings, electrical riser ducts or other concealed spaces wherever possible. Where exposed to view in corridors and public spaces the wiring shall be enclosed in rectangular ducting except for plant rooms which can be run in conduit. Install as far as possible in corners between walls and ceilings.

Fixing: Fixings shall be made internally and at sufficient frequency to prevent any sagging. Support cables independently of ceilings and other services. Do not use explosive powered fastenings.

Not Applicable

11.4 Pipework

Requirement: Pipework and fittings shall be sized and provided as required by the approved design. High pressure stainless steel 316L annealed seamless metric and or imperial tube shall be used for all system reticulation.

Fixings: Pipework fixings shall consist of cantilever brackets and heavy duty saddles. Water sprinkler fixings such as pear bands and light duty supports are not acceptable.

Pipe clamps, including accessories such as threaded rods, anchors etc., must be suitable for fire fighting systems and designed for fire protection approval as per the relevant design standard AS4587 and or NFPA750, all pipe clamps must be stainless steel or rubber lined if zinc coated so as to avoid galvanic reaction between stainless steel and zinc coated materials.

Pipe Connections: Single and or Twin Ferrule compression fittings shall be used on all pipe joints. Threaded pipe fittings with sealants such as hemp or Teflon are not permitted.

Pressure Reduction: Pressure reducing devices/units shall not be permitted to be installed on the manifold.

11.5 Extinguishing Agent

Requirement: Provide **a** high pressure HYDRAMIST water mist fire fighting system shall be designed to provide optimal fire suppression and droplet distribution within each occupant cell, Class 1 water mist spray shall be produced using a positive displacement 100 MPS 150 bar plunger pump assembly and high pressure Stainless Steel OPEN HEAD Anti Ligature Deluge nozzles with a minimum operating pressure of 100 bar but not more than 140 bar.

The water mist spray flux density shall consist of 99 dV class 1 fine water mist spray droplets of less than 200 µm. The reaction surface area of the class 1 water droplets, which is very large in relation to the quantity of water, shall remove high energy from the fire and the internal Cell temperature level shall be reduced to increase the tenability level for cell occupant(s).

Quantity: The quantity of agent to be stored shall be calculated in accordance with AS 4587 and the equipment supplier's recommendations.

11.6 Pump Assembly

Requirement: 100 Litre/150 Bar Triplex high-pressure plunger pump type 100 MPS with directly flange-mounted electric motor complete with Strainer, 100 µm and Start-up solenoid valve 230 V AC, housing Stainless Steel.

Technical Data for High Pressure Pump: The following data is provided for information purposes. Contractor to confirm with manufacturer the requirements for each separate installation.

- Flow rate: Q = 1 x 100 L/min
- Pressure: p = 150 bar
- Motor power: P = 1 x 30kW, 3 Horse power
- Voltage: V = 1 ~ 415,00 V AC, 50 Hz
- Full load Current: 47 A
- Direct Online Current: 358 A
- Max Inrush Soft Start: 203 A
- Jockey Pump: 0.55kW motor

Not Applicable

Technical Data for Pressure Manifold fo e following data is provided for information purposes. Contractor to confirm with manufacturer the requirements for each separate installation.

- Check valve
- Pressure gauge 0 to 250 bar
- Pressure sensor
- Overflow valve
- Test valve
- System ball valve
- Including all hoses and connecting elements
- The quantity of water released at the overflow valve must be discharged into the on-site drain/floor drain/sanitary drainage, overflow capacity will be approximately 32 L/M.

11.7 Integrated Break Tank Assembly

Requirement: Integrated Break Tank Assembly in accordance with the manufactures requirements.

Technical Data for Integrated Tank Assembly: The following data is provided for information purposes. Contractor to confirm with manufacturer the requirements for each separate installation.

- Effective Discharge Capacity 750 Litres.(7.5 minutes)
- Automatic Infill pressure requirements 1-6 bar
- Infill port size 65mm

- Automatic Infill Solenoid Valve 230 Volt AC.
- Automatic water level sensor.

11.8 Control & Indicating Equipment

Requirement: Provide a cabinet consisting of the following in accordance with the manufacturer's requirements:

Technical Data for Control & Indicating Equipment: The following data is provided for information purposes. Contractor to confirm with manufacturer the requirements for each separate installation.

- Housing and door powder-coated,
- IP 54 protection rating,
- Power supply: 1 ~ 415 V AC/PEN/50 Hz/47 A, 4 core
- 1 potential-free changeover contact 230 V AC/10 A for general fault
- 1 potential-free changeover contact 230 V AC/10 A for pump running message of high pressure water mist pump
- Netbiter Argos Remote Pump Management Communication Module (See 1.3.1)

Display Control Elements: The following data is provided for information purposes. Contractor to confirm with manufacturer the requirements for each separate installation.

Not Applicable

- Indicator lamp running message for high pres[illegible]ump
- Indicator lamps running message jockey pump.
- Fault lamp for pump
- Fault lamp jockey pump
- Fault lamp tank level
- Fault lamp pressure sensor
- Fault lamp power supply 415 V AC/24 V DC
- Lamp test pushbutton
- Reset pushbutton
- Horn off pushbutton
- Emergency start pushbutton for high pressure water mist pump
- High pressure water mist pump stop pushbutton
- Key switch for each high pressure water mist pump
- Key switch accumulator.
- Key switch jockey pump.
- Ampere meter for each high-pressure water mist pump
- Voltmeter with changeover switch.

- Horn, 95 dB +/- 5 %/0,1 m for collective fault

11.9 Netbiter Argos Remote Management Communication Module

Requirement: Provide Netbier Argos Remote Management Communication module as required by Hydramist or equal approved.

Technical Data for Communications Module: The following data is provided for information purposes. Contractor to confirm with manufacturer the requirements for each separate installation.

- Remote off site access to pump control panel status.
- Full on line pump panel interrogation and programming facility.
- Off-site programming debugging, panel upgrades.
- Online monitoring of system status output performance, alarms and fault reports via dashboard interface.

11.10 Nozzles

Requirement: Provide the Hydramist or equal approved high-pressure water mist nozzle. The maximum flow rate for each high pressure water mist nozzle shall [illegible] 00 bar. The nozzles shall be anti-ligature type Open Head Deluge nozzles approved by the U[illegible]nistry of Justice. The droplet spectrum of the nozzles shall correspond to Class 1 per NFPA 750 and AS4587, i.e. the size of the droplets shall be between 20 and 200 µm.

Not Applicable

Technical Data for High-pressure Water Mist Nozzle: The following data is provided for information purposes. Contractor to confirm with manufacturer the requirements for each separate installation.

- Stainless Steel Anti Ligature Nozzle body.
- Droplet size according to Class 1 NFPA 750 with droplet distribution from 20 to 200 µm
- Spray Flux Density 17 L/M @ 100 Bar
- K factor: 1.7
- Maximum Protected area: 36 m3
- Operating pressure: 100 bar
- Material: Stainless steel

11.11 F292 Wet Zone Valve

Requirement: Provide F292 Wet Zone Valve as required by Hydramist or equal approved.

Technical Data for F292 Wet Zone Valve: The following data is provided for information purposes. Contractor to confirm with manufacturer the requirements for each separate installation.

- 316 Stainless Steel with and test facility
- Maximum Working Pressure 120 Bar.
- Zone Operated Flow Switch
- Operation Alarm Signal Output.
- Closing Section Manually

- Zone Pressure Gauge.
- Check valve to allow system drainage of main pipes without draining section pipes.

11.12 Fire Rated Penetrations

Requirement: Seal penetrations for fire suppression services through fire rated barriers to ensure fire rated integrity of barriers is maintained.

11.13 Testing and Commissioning

General: Tests shall be carried out in accordance with the Hydramist Installation and Maintenance Manual and AS 4587.

Tests: Shall demonstrate that the entire control systems function as intended. All circuits shall be tested:

- Automatic discharge;
- Manual discharge;
- Equipment shutdown;
- Alarm devices;
- Storage container pressure.
- Supervision of each circuit;
- Each detection device to AS 1851;
- Safety isolate/inhibit controls;
- Automatic and manual discharge controls;
- Response time for the sampling system;
- Accuracy of suppression system and building FIP indicators;
- Setting of time delays and alarm thresholds;
- Tests nominated in AS 4587. Provide a static and integrity test;
- Correct operation of safety isolate/inhibit controls for suppression, and correct operation of automatic and manual discharge controls;

Not Applicable

Pipework: All system tubing shall be hydrostatically tested to 1.5 times the system running pressure for a two-hour period with no loss of pressure recorded during that time

Flow Test: Flow test shall be performed on the most remote nozzle location using a Hydramist test lance with a liquid filled gauge, the test shall validate that 100 bar minimum flow pressure requirement at the most remote location.

Tests by Trained Personnel: In addition to the testing nominated in the system manual documents, the following tests shall be carried out by trained personnel on completion of the installation:

- Response time for the MASD system;
- Accuracy of suppression system and GFIP indicators;

- Setting of time delays and alarm thresholds;
- Any additional tests as nominated in AS 4587.

Trial Period: Conduct a fourteen (14) day trial period with the building in full operation, during which no fault or instability occurs.

Chart Recorder: Allow for a chart recorder to be connected to the MASD system during the trial period to permit final adjustment of alarm threshold levels to suit background pollution levels.

Test Report: Following satisfactory completion of all tests provide a signed and dated test report recording the results of all tests.

Certification: Provide an installers statement and certification that all system alterations have been carried out in accordance with AS 4587 and other relevant standards.

Training: As a condition of final acceptance, the contractor shall provide operational training to the appropriate end user personnel. The training sessions shall include emergency response procedures, abort functions, system control panel operation, trouble procedures and safety requirements.

On Completion: Upon acceptance by the project manager, the complete system shall be conditioned and the system placed in operation.

Not Applicable

11.14 Maintenance

Hydramist Suppression System: To AS 1851 and manufacturer's requirements. Contractor to provide schedule of maintenance in accordance with the above mentioned standards in the project O&M Manual.

Requirement: Provide 12 months warranty for all materials and equipment installed under this contract, including replacement of faulty components at no cost for the full extent of the defects liability period.

Log Book: Provide a log book in the control panel in accordance with AS 1851 of sufficient pages to include all entries for the defects liability period.

Maintenance: Provide regular testing and preventative maintenance in accordance with the schedules provided in the reference documents and ensures that all maintenance visits and tests conducted are correctly recorded in the log book.

12. KITCHEN HOOD FIRE SUPPRESSION

12.1 General

Requirement: Provide an Ansul R102 automatic and manual wet chemical fire suppression system installation in accordance with Australian Standard AS 3772 and the Building Code of Australia consisting of a cylinder bank(s) and a fixed pipe reticulation to nozzles suitably positioned to apply the R102 extinguishing agent to the risk area.

Extinguishant Activation: The regulated release mechanism shall be a spring-loaded, mechanical/pneumatic type capable of providing the expellant gas supply to one or two agent tanks depending on the capacity of the gas cartridge used.

It shall contain a factory installed regulator deadset at 100 psi (6.9 bar) with an internal relief of approximately 145 psi (10.0 bar). It shall have the following actuation capabilities: automatic actuation by a fusible link detection system and remote manual actuation by a mechanical pull station.

The regulated release mechanism shall contain a release assembly, regulator, expellant gas hose, and agent storage tank housed in a stainless steel enclosure with cover. The enclosure shall contain knock-outs for 1/2 in. conduit. The cover shall contain an opening for a Not Applicable cator.

It shall be compatible with mechanical gas shut-off devices; or, when equipped with a field or factory-installed switch, it shall be compatible with electric gas line or appliance shut-off devices.

Product Listing: System shall be JAS-ANZ or ActivFire listed equal approved Ansul Automan system. The system shall be installed and serviced by personnel trained by the manufacturer.

System Operation: The system shall be an automatic fire suppression system using a wet chemical agent for grease related fires. The system shall be capable of suppressing fires in the following areas associated with cooking equipment: Ventilating equipment including hoods, ducts, plenums, and filters; fryers; griddles and range tops; upright, natural charcoal, or chain-type broilers; electric, lava rock, mesquite or gas-radiant char-broilers. The system shall be the pre-engineered type having minimum and maximum guidelines established by the manufacturer and listed by Underwriters Laboratories, Inc. (UL)

Design Responsibility: It is the responsibility of the installation contractor to determine their own design, which must comply with AS 3772 & the manufacturers requirements..

Scope of Work: The scope of work includes, but is not limited to, the following:

- Carry out system design calculations in accordance with Manufacturer requirements and in accordance with AS3772. Where these documents conflict the more onerous shall apply. Flow calculations shall use approved flow design software. Provide for approval by the Project Manager a completed design. The design details shall include:
    - The total flooding quantity for the volume of the risk area and storage cylinder sizes;
    - Flow calculations together with an isometric view of the distribution system showing length and diameter of each pipe segment and node reference numbers;
    - Discharge time;
    - Type and flow rate of each nozzle including equivalent orifice areas.
- Install R102 storage cylinder/s and support structure outside the risk at the location agreed to with the end client. Manually operated mechanical means of operation shall be provided at the cylinder bank(s). This shall operate all interfaces as described for automatic detection operation.

- Install distribution pipe network and nozzles in accordance with the approved flow calculation and in compliance with AS 3772 and the manufacturers requirements.
- Test and commission the gaseous fire suppression system as required by AS ISO 14520 and the SAPPHIRE System Installation and Maintenance manual.

12.2 Design Standards

General: To AS 3772

Electrical Wiring: To AS/NZS 3000.

12.3 Wiring

Standard: To AS 1670, AS 2220, AS/NZS 3000 and AS 3013.

Circuits: Run through accessible ceilings, electrical riser ducts or other concealed spaces wherever possible. Where exposed to view in corridors and public spaces the wiring shall be enclosed in rectangular ducting except for plant rooms which can be run in conduit. Install as far as possible in corners between walls and ceilings.

Fixing: Fixings shall be made internally and at sufficient frequency to prevent any sagging. Support cables independently of ceilings and other services. Do not use explosive powered fastenings.

12.4 Detectors

General: The detectors shall be the fusible link[Not Applicable] separate at a specific temperature.

Requirement: The contractor is responsible for selecting the specific temperature-rated alloy type fusible links. The devices shall be selected to ensure they separate when the temperature exceeds the rating of the link, allowing the regulated release to actuate.

12.5 Discharge Nozzles

General: Each discharge nozzle shall be tested and listed with the R-102 system for a specific application.

Requirement: It is the contractors responsibility to select nozzle tips suitable to the application (or equipment they protect. The nozzle tips shall be stamped with the flow number designation (1/2, 1, 2, and 3). Each nozzle shall have a metal or rubber blow-off cap to keep the nozzle tip orifice free of cooking grease build-up.

Thrust Forces: Ensure all pipework is adequately supported and provide additional supports at junctions, nozzles and changes of direction to absorb thrust forces generated during agent discharge.

12.6 Pipework

Requirement: Pipework and fittings shall be sized and provided as required by the approved design. As a minimum all distribution pipework shall be stainless steel pipe conforming to ASTM A120, A53, or A106.

Fixings: Pipework fixings shall consist of cantilever brackets and saddles. Water sprinkler fixings such as pear bands and light duty supports are acceptable.

Thrust Forces: Ensure all pipework is adequately supported and provide additional supports at junctions, nozzles and changes of direction to absorb thrust forces generated during agent discharge.

12.7 Wet Chemical Extinguishing Agent

Requirement: The extinguishing agent is a mixture of organic salts designed for rapid flame knockdown and foam securement of grease related fires. It is available in plastic containers with instructions for wet chemical handling and usage.

Quantity: The quantity of agent to be stored shall be calculated in accordance with AS 3772 and the equipment supplier's recommendations.

12.8 Agent tank

Requirement: The agent tank is to be installed in a stainless steel enclosure or wall bracket. The tank is constructed of stainless steel.

The tank includes an adaptor/tube assembly. The adaptor assembly includes a chrome-plated steel adaptor with a 1/4 in. NPT female gas inlet, a 3/8 in. NPT female agent outlet, and a stainless steel agent pick-up tube. The adaptor also contains a bursting disc seal which helps to prevent the siphoning of agent up the pipe during extreme temperature variations.

Sizing: It is the contractor's responsibility to select tanks size appropriately to the risk/s. Tanks are available in two sizes: 1.5 gallon (5.7 L) and 3.0 gallon (11.4 L). The tanks have a working pressure of 110 psi (7.6 bar), a test pressure of 330 psi (22.8 bar), and a minimum burst pressure of 660 psi (45.5 bar).

Fixing: Brackets capable of securely holding the cylinders mounted upright shall be installed.

12.9 Regulated Release Mechanis

Not Applicable

General: The regulated release mechanism is a spring-loaded, mechanical/pneumatic type capable of providing the expellant gas supply to one, two, or three agent tanks depending on the capacity of the gas cartridge used. It contains a factory installed regulator deadset at 110 psi (7.6 bar) with an external relief of approximately 180 psi (12.4 bar). It has automatic actuation capabilities by a fusible link detection system and remote manual actuation by a mechanical pull station.

Requirement: The contractor is responsible for the supply and installation of the regulated release mechanism in accordance with AS 3772 and the manufacturers recommendation.

12.10 Pull Station Assembly

Requirement: The remote manual pull station is made out of a molded red composite material. The red color makes the pull station more readily identifiable as the manual means for fire suppression system operation. The pull station is compatible with the ANSUL Flexible Conduit and with 1/2 in. EMT conduit.

12.11 Cartridges

Requirement: The cartridge shall be a sealed steel pressure vessel containing either carbon dioxide or nitrogen gas. The cartridge seal shall be designed to be punctured by the releasing device supplying the required pressure to expel wet chemical agent from the storage tank.

12.12 Testing and Commissioning

General: Tests shall be carried out in accordance with the Ansul Automan Installation and Maintenance Manual and AS 4772.

Tests: Shall demonstrate that the entire control systems function as intended. All circuits shall be tested:

- Automatic discharge;
- Manual discharge;
- Equipment shutdown;
- Alarm devices;
- Storage container pressure.
- Each detection device to AS 1851;
- Safety isolate/inhibit controls;
- Automatic and manual discharge controls;
- Accuracy of suppression system and building FIP indicators;
- Tests nominated in AS 3772;
- Correct operation of safety isolate/inhibit controls for wet chemical suppression, and correct operation of automatic and manual discharge controls;

Not Applicable

Pipework: The piping shall be pneumatically tested in a closed circuit for a period of ten minutes at 300 kPa. At the end of the ten minutes, the pressure drop shall not exceed 20% of the test pressure. When pressurizing the piping, pressure shall be gradually increased in 100 kPa increments.

Flow Test: A flow test using nitrogen shall be performed on the piping network to verify that flow is continuous and the piping and nozzles are unobstructed.

Tests by Trained Personnel: In addition to the testing nominated in the system manual documents, the following tests shall be carried out by trained personnel on completion of the installation:

- Accuracy of suppression system and SFIP indicators;
- Any additional tests as nominated in AS 3772.

Test Report: Following satisfactory completion of all tests provide a signed and dated test report recording the results of all tests.

Certification: Provide an installers statement and certification that all system alterations have been carried out in accordance with AS 3772, equipment manufacturers requirements and other relevant standards.

Training: As a condition of final acceptance, the contractor shall provide operational training to the appropriate end user personnel. The training sessions shall include emergency response procedures, abort functions, system control panel operation, trouble procedures and safety requirements.

On Completion: Upon acceptance by the project manager, the complete system shall be conditioned and the system placed in operation.

12.13 Maintenance

Kitchen Hood Suppression System: To AS 1851 and manufacturer's requirements. Contractor to provide schedule of maintenance in accordance with the above mentioned standards in the project O&M Manual.

Requirement: Provide 12 months warranty for all materials and equipment installed under this contract, including replacement of faulty components at no cost for the full extent of the defects liability period.

Log Book: Provide a log book in the SIP in accordance with AS 1851 of sufficient pages to include all entries for the defects liability period.

Maintenance: Provide regular testing and preventative maintenance in accordance with the schedules provided in the reference documents and ensures that all maintenance visits and tests conducted are correctly recorded in the log book.

Not Applicable

13. FIRE EXTINGUISHERS & FIRE BLANKETS

13.1 General

Requirement: Provide portable fire extinguishers and fire blankets to NCC and NSW Fire Brigade requirements. Extinguishers and blankets are to be installed in accordance with AS 2444.

Scope of Works:

- Mount fire extinguishers in position on an approved mounting bracket not more than 1200 mm above floor and the bottom not less than 100 mm from floor;
- Provide a corresponding identification plate above each extinguisher;
- Mount the extinguisher in exact positions as directed on site or by the Certified Extinguisher Installer;
- Where an extinguisher is available with two or more product weights for the same rating the larger product weight extinguisher shall be used.

Portable fire extinguisher to be according to AS 2444-2001requirement.
Portable extinguisher to be located within a locked cupboard.

13.2 Authorised Products

General: Provide equipment listed in the JAS-ANZ or ActivFire Register of Fire Protection Equipment.

13.3 Fire Extinguishers

General: Provide portable fire extinguishers and location signs as follows:

- General Requirements: AS/NZS 1841.1;
- Water: AS/NZS 1841.2;
- Wet Chemical: AS/NZS 1841.3;
- Foam: AS/NZS 1841.4;
- Powder: AS/NZS 1841.5;
- Carbon Dioxide: AS/NZS 1841.6;
- Non-rechargeable: To AS/NZS 1841.8;

Selection and Location: To AS 2444

Certification: Required.

Certification Provider: An organisation accredited by the Joint Accreditation System of Australia and New Zealand (JAS-ANZ).

13.4 Fire Blankets

General: To AS/NZS 3504.

Certification: Required.

Certification Provider: An organisation accredited by the Joint Accreditation System of Australia and New Zealand (JAS-ANZ).

Selection and Location: To AS 2444.

13.5 Maintenance

Fire Extinguishers: To AS 1851.

Fire Blankets: To AS 1851.

13.6 Selections

Refer to the drawings for location and number

13.6.1 Fire Extinguisher Schedule

Property	Kitchen	Officer Post	Plant	Comms/UPS Plant
Location	AS2444	AS2444	AS2444	AS2444
Number	1	1	1	1
Unit Type	Wet Chemical	DCP	DCP	CO^2
Classification and Rating	F	6A:40B:E	6A:40B:E	E
Nozzle Type	To Manufacturer's Recommendations	To Manufacturer's Recommendations	To Manufacturer's Recommendations	To Manufacturer's Recommendations
Maximum Force to Operate Lever (N)	100N	100N	100N	100N
Maximum Force to Frangible Seal (N)	100N	100N	100N	100N
Cabinet: Type	Steel	Steel	N/A	N/A
Cabinet: Security	003 Key	003 Key	003 Key	003 Key
Waterproof Cover	N/A	N/A	N/A	N/A

13.6.2 Fire Blanket Schedule

Location	Number	Size
Kitchen	1	1.5m x 1.5m
Officer Station	1	1.5m x 1.5m

Refer to the drawings for location and number

14. MAINTENANCE

14.1 General

Requirement: Maintain the fire systems for the documented maintenance period so that the performance, reliability, service life, energy efficiency and safety of the system is equal to or better than that at the beginning of the maintenance period, in parallel with and including:

- Periodic and statutory maintenance, cleaning and replacement of consumables;
- Emergency repairs;
- Condition reporting.

Maintenance Period: 12 months.

14.2 Standards

General: BCA E1.5, NSW Fire Brigade, Local NSW Council Authority, and NSW State Government requirements.

Maintenance of Fire Protection Equipment: To AS 1851.

14.3 Submissions

14.3.1 Certification

Annual Certification: Inspect and submit certification for all items required to be inspected annually under statutory requirements.

14.3.2 Records

Maintenance Records: Conform to the General Requirements section.

Periodic Maintenance and Performance Report: At the frequency documented in accordance with AS1851, submit reports summarising the maintenance performed and the performance of the hydraulic installation in the preceding period. Set out the report in a form that permits comparison with previous reports. Include the following as minimum requirements:

- Dates and number of site labour hours for periodic maintenance. Exclude travelling time;
- Dates, number of site labour hours and nature of work for emergency repairs. Exclude travelling time;
- Dates and number of site labour hours for defects liability rectification if within the defects liability period. Exclude travelling time;
- List of any motors for which the motor current varied by more than 10% from the current measured during commissioning;
- For each separately metered item, the water or gas use for each month of the reporting period.

14.4 Inspection

Requirement: Give notice so that an inspection may be held simultaneously with the final programmed maintenance visit.

14.5 Product Selection

Proprietary Items: Select products, as consumables or replacement items, of the same make, model and type as those being replaced.

Substitutions: Where the existing product is no longer available, provide products with at least the same performance and construction characteristics.

14.6 Emergency Repairs

14.6.1 General

Requirement: Respond to call outs for breakdowns or other faults requiring emergency repairs. Rectify faults and replace faulty materials and equipment.

Remedial Work: Carry out any remedial work, including temporary work, necessary to restore each system to safe and satisfactory operation. Verify each system is operating correctly before leaving the site. Do not leave the plant in an unsafe condition.

Temporary Work: Promptly replace temporary work with permanent rectification.

14.6.2 Contact Details

Emergency Contract: Provide contact details including after hours and emergency mobile and/or pager details, to permit notification of emergency conditions.

14.6.3 Response Time

Period: Attend site for emergency service within the documented response time.

Response Period: Starts at the time of notification to the contactor's nominated contact point.

14.7 Periodic Maintenance

14.7.1 General

Routine Visits: Make routine service visits at the frequency documented in accordance with AS1851 and Manufacturers recommended schedules. Service items of equipment in conformance with the maintenance schedules in the operation and maintenance manuals.

Notification of Defects: When defects in the installation are identified, give notice.

Requirement: Provide maintenance work including, but not limited to, the following:

- Carry out the manufacturers' recommended maintenance;
- Attend to reported defects and complaints;
- Check for and repair corrosion;
- Check for and rectify any unsafe conditions;
- Replace faulty or damaged parts and consumable components;
- Check anti-vibration supports, brackets and clamps, holding down bolts and flexible connections, for deterioration and for freedom of movement of assembly;

Identification of Pipes, Conduits and Ducts Maintenance: To AS 1345;

Safety Signs Maintenance: To AS 1319.

14.7.2 Cleaning

Requirement: At the end of the maintenance period:

- Remove waste and clean all parts of the installation;
- Remove temporary protective coatings, packaging and labels;
- Clean screens and strainer baskets.

14.7.3 Piped Systems

Tasks: Perform the following:

- Check equipment items and record values for operation, calibration, performance compliance, temperature, and energy consumption;
- Rectify all water leaks regardless of size. Clean and repair any water damage;
- Provide service tags recording inspections and tests.

14.7.4 Fire Booster Pumps

Pumps and Pump Seals: Check and rectify if defective.

Safety and Other Controls: Check for correct operation and adjust if necessary.

14.7.5 Water Conservation

Requirement: Conform to SAA HB 233.

14.7.6 Automatic Controls

Requirement: Perform the following but not limited to:

- Make routine service visits at the frequency documented in accordance with AS1851 and Manufacturers recommended schedules
- Check operation and safety controls for variable speed drives. Check and record output frequency. Adjust if incorrect. Rectify defects;
- Record readings of thermometers, gauges, meters, current draw of motors and heaters, sample readings, control set points and controlled space conditions;
- Check sensor calibration. Recalibrate if incorrect;
- Check electrical and control systems, including safety limits for temperature, pressure and humidity. Adjust if incorrect. Rectify defects;
- Provide service tags recording inspections and tests.

14.7.7 Electrical Systems

Requirement: Perform the following but not limited to:

- Make routine service visits at the frequency documented in accordance with AS1851 and Manufacturers recommended schedules

- Check for hot joints, burnt insulation, burn contacts and repair;
- Check electrical connections for tightness. Tighten loose connections;
- Check operation of all electrical components. Rectify defects;
- Check indicating lights and replace defective lamps;
- Check and record motor currents;
- Check overload settings. Adjust if necessary;
- Check and report any changes to controls and wiring;
- Provide service tags recording inspections and tests.

Standards:

- Fire Protection Equipment: To AS 1851
- Electrical Equipment Generally: To AS/NZS 3760;
- Switchboards: To AS 2467;
- Repair and Overhaul of Rotating Electrical Equipment: To AS 4307.1.

14.8 Completion

14.8.1 End of Maintenance Period Service

Requirement: Within a month of the end of the maintenance period, undertake all work scheduled to be carried out on an annual basis.

14.8.2 Maintenance Records

Service Records: Record maintenance undertaken in the schedules in the operation and maintenance manuals.

Maintenance Reports: Prepare maintenance reports as documented.

14.8.3 Restitution after Maintenance Tasks

Requirement: Restore removed, damaged, contaminated or soiled services and building elements when the maintenance task is complete.

Standard: Equal to the condition of the original installation.

15. APPENDIX A – FIRE SERVICES ROOM SUMMARY

General: The following tables provide the indicative fire services within each room type of particular building types. These have been derived from documents provide by NSW Corrective Services past project and are provided as a design guideline for the projects reference herein. These are to be cross referenced with the Architectural drawings for each of the building types listed previously in this specification (refer to Section 2).

Should a building type not be contained in the following tables the contractor is to inform the superintendent immediately and seek clarification from the consultant.

Definitions: The following terms are utilised in the following tables:

- Main Fire Indicator Panel (MFIP)
- Sub Fire Indicator Panel (SFIP)
- Fire Mimic Panel (MIMIC)
- Multi Aspirating Smoke Detection (MASD)
- Point Type Smoke Detection (PTSD)
- Point type Thermal Detection (PTTD)
- Smoke Duct Detector (SDD)
- Thermal Duct Detector (TDD)
- General Fire Alarm (GFA)
- Occupant Warning System (OWS)
- Strobe (STR)
- Flush or Surface Mount Type Speaker (SM)
- Horn Speaker (HS)
- Dry Chemical Powder Extinguisher (DCP)
- Carbon Dioxide Extinguisher (CO^2)
- Wet Chemical Extinguisher (WC)
- Fire Blanket (FB)
- Kitchen Hood Suppression (KHS)
- Hydramist Suppression System (HSS)

Overview: Typically, each of the following buildings will consist of but not limited to the following fire services:

- Fire detection system complete with sub FIP. Main FIP located at Gate House/Control Room
- Occupant Warning System
- External Strobe at main entry to the building
- Fire Extinguishers/Blankets

Refer to below page for room data sheet

15.1.1 Room Data Sheets

Room Name	Description	Detection	OWS	Suppression	Extinguisher	Other
Armoury		MASD	65dB(A) SM			
AVL Suite		PTSD	65dB(A) SM			
Bathroom c/w shower		PTTD				
Bathroom c/w WC only		PTSD				
Break out space		PTSD	65dB(A) SM			
Carrier Room	Communications	PTSD	65dB(A) SM			
Cell – Access	1xAccessible inmate	MASD	75dB(A)	HSS		HSS in High needs only
Cell – Single	1x Inmate	MASD[1]	+75dB(A)2	HSS		HSS in High needs only
Cell – Double	2x Inmate	MASD[2]	+75dB(A)[2]			
Cell – Holding	Non Over night	MASD	+75dB(A)			
Cell - Observation	1x Inmate overnight	MASD[2]	+75dB(A)[2]			
Change room		TDD	65dB(A) SM			
Chemical Store		PTSD	65dB(A) SM			
Cleaner		PTTD				
Comms		PTSD	65dB(A) SM		5kg CO2	GFA

[1] MASD sampling point typically in cell exhaust air duct. Coordinate location with mechanical contractor. Obtain approval from project superintendent.
[2] No speaker within the cell. SPL to be minimum 75dB(A) within the cell to wake sleeping occupant with cell door closed via speakers adjacent to cell (passageway, airlock or corridor).

Consultation		PTSD	65dB(A) SM			
Room Name	**Description**	**Detection**	**OWS**	**Suppression**	**Extinguisher**	**Other**
Contact Visits	100-200 People	PTSD	65dB(A) SM			
Control Room	Security Screens	PTSD	65dB(A) SM			SFIP OWS
Coolroom		PTTD				
Court Indoor	Sports Area	PTSD	65dB(A) HS		9kg DCP	
Day Room		PTSD	65dB(A) SM			
Dispensary	Issue/Store Drugs	PTSD	65dB(A) SM			
Dress/ Undress	Change clothes and Search	PTSD	65dB(A) SM			
Dry Store		PTSD	65dB(A) SM			
Entry		PTSD	65dB(A) SM		9kg DCP	STR (external)
External Covered Work Area		PTTD	65dB(A) HS			
Freezer		PTTD				
Inmate Clerk		PTSD	65dB(A) SM			
Interview Rm		PTSD	65dB(A) SM			
Kitchen exhaust hoods		TDD		KHS		
Kitchen/Tea		PTSD	65dB(A) SM		1kg DCP FB	

Room Name	Description	Detection	OWS	Suppression	Extinguisher	Other
Large Internal Work Area		PTTD	65dB(A) HS			
Legal		PTSD	65dB(A) SM			
Locker Room	Staff Change	PTSD	65dB(A) SM			
Meals	Includes Kitchen/Tea	PTSD	65dB(A) SM			
Meals		PTSD	65dB(A) SM			
Medicine	Store & sort drugs	PTSD	65dB(A) SM			
Meeting	1-20 Occupant	PTSD	65dB(A) SM			
Meeting	5-20 Occupant	PTSD	65dB(A) SM			
Multi-faith	40 Occupants	PTSD	65dB(A) SM			
Non-Contact		PTSD	65dB(A) SM			
Office large	6-20 Occupant	PTSD	65dB(A) SM		9kg DCP	
Office medium	2-5 Occupant	PTSD	65dB(A) SM			
Office small	1x Occupant	PTSD	65dB(A) SM			
Officer Post		PTSD	65dB(A) SM		9kg DCP FB	SFIP OWS
Officer Post 2		PTSD	65dB(A) SM		9kg DCP FB	MIMIC
Outdoor Covered	Sports Area	PTTD	65dB(A) HS		9kg DCP	

Room Name	Description	Detection	OWS	Suppression	Extinguisher	Other
Passage – Airlock		PTSD	+85dB(A) SM		9kg DCP	
Passage – Corridor		PTSD	+85dB(A) SM		9kg DCP	
Plant Room		PTSD[3]	65dB(A) HS & STR		5kg CO2 9kg DCP	GFA Damper FFC
Print Room		PTSD	65dB(A) SM			
Processing		PTSD	65dB(A) SM			
Programs 1	Classroom - 20 Occupants	PTSD	65dB(A) SM			
Programs 2	Computer Room - 20 Occupants	PTSD	65dB(A) SM			
Property Store		PTSD	65dB(A) SM			
Ready Room		PTSD	65dB(A) SM			
Retherm – Kitchen		PTTD	65dB(A) SM		7LT WC	KHS
Retherm – Ovens	4-10 Ovens	PTTD[4]	65dB(A) SM			
Roof Space		MASD				
Secure Store		PTSD	65dB(A) SM			
Secure Waiting		PTSD	65dB(A) SM			

[3] Substitute PTSD with PTTD where plant room area/s are exposed to outside air conditions.
[4] Where PTTD is used in retherm area it shall be Type D Fixed Temp set to 88^{O}C at commissioning. Allow for adjustment to suit site specific conditions after commissioning.

Room Name	Description	Detection	OWS	Suppression	Extinguisher	Other
Server Room	Security System	MASD	65dB(A) SM		5kg CO^2	GFA
Store		PTSD	65dB(A) SM			
Tool store		PTSD	65dB(A) SM			
Training Room	30 Occupants	PTSD	65dB(A) SM			
Treatment		PTSD	65dB(A) SM			
UPS		PTSD	65dB(A) SM		5kg CO2	
Utilities	Cleaning Medical Eq.	PTSD	65dB(A) SM			
Visitor Waiting Room		PTSD	65dB(A) SM		9kg DCP	MIMIC[5] GFA for door
Waiting Room		PTSD	65dB(A) SM		9kg DCP	GFA to door
Wash zone		PTSD	65dB(A) SM			
Washing/ Drying	5-15 Machines	PTTD	65dB(A) SM			
Yard		PTTD	65dB(A) HS			

[5] Mimic panel required provided this is the main building entry point in accordance with AS1670.1.2.2

Room data sheet

Room	Descrip	Detection	OWS	Suppression	Extinguisher	Other
Accommodation						
2 Bed (Double)		MASD	Note 1			
1 Bed (Single)		MASD	Note 1			
Cell Access		MASD	Note 1			
Living /Dining		PTSD	65dB(A)		Dry Powder Fire Blanket	
Acc Bath		HD	STR,SM			
Bath Room		HD	SM/RM			
Sleep Out		HD				
Comms		PTSD	65dB(A) SM		Dry Powder/ CO2	GFA SFIP
Laundry		PTSD	SM			
Hydraulic Plant		HD	HR &STR		Dry Powder (4.5)	GFA Smoke detector in duct
Cleaner		PTSD	65dB(A			
Gate house						
Country Yard		HD	HR			
Indoor Visits		PTSD	65dB(A) RM		Dry Powder(9 kg)	
Store		PTSD	65dB(A) RM			
Family Room		PTSD	65dB(A) RM			
Indoor play area		PTSD	65dB(A) RM			
Office post		PTSD	65dB(A) RM		Dry Powder (4.5)	SFIP
Waiting /Process		PTSD	65dB(A) RM			
Waiting Lobby		PTSD	65dB(A) RM			
Search/change		PTSD	65dB(A) RM			
Search corridor		PTSD	65dB(A)			
NC Inmate		PTSD	65dB(A)			
NC Visitor		PTSD	65dB(A)			
Secure Corridor		PTSD	65dB(A)			
Cleaner		PTSD	65dB(A)			
Lock		PTSD	65dB(A)			
Access /Change		PTSD	SM/RM&STR			
Services		HD	HR&STR		Dry Powder (4.5)	

Holding Lock		PTSD	65dB(A)			
Key Room		PTSD	65dB(A)			
Processing		PTSD	65dB(A)		Dry Powder (4.5)	
Foyer /waiting		PTSD	65dB(A)		Dry Powder (9kg)	
Air Lock		PTSD	65dB(A)			MFIP
Gun Safe		PTSD	65dB(A)			
Lock		PTSD	65dB(A)			
Wc		PTSD	RM			
Officer Post		PTSD	65dB(A)		Dry Powder (4.5) FB	
Arc/change/ locker		PTSD	65dB(A)			
Metal Detection		PTSD	65dB(A)			
Sally port		HD	HR&STR		Dry Powder (9kg)	
Emergency Response		PTSD	65dB(A)			
Armoury		PTSD	65dB(A)			
Plant		HD	HR &STR		Dry Powder (4.5)	
UPS		HD	65dB(A)			
Security Equip		PTSD	65dB(A)			
MCR		PTSD	65dB(A)		Dry Powder (4.5) FB	MIMIC Panel And Graphic System
Mech Plant		PTSD	HR &STR		Dry Powder (4.5)	
Secure Lock		PTSD	65dB(A)			
ACC WC		PTSD	RM			
Cleaner		PTSD	65dB(A)			
Health /Reception						
Plant		HD	HR& STR			
WC		PTSD	RM			
Lobby		PTSD	65dB(A)			
Legal		PTSD	65dB(A)			
Corridor		PTSD	65dB(A)			
AVL		PTSD	65dB(A)			

Interview		PTSD	65dB(A)			
Laundry		PTSD	65dB(A)			
Valuable Store		PTSD	65dB(A)			
Stock Store		PTSD	65dB(A)			
Hold		PTSD	65dB(A)			
Property Store		PTSD	65dB(A)			
Office Post		PTSD	65dB(A)		Dry Powder (4.5) FB	SFIP
Search		PTSD	65dB(A)			
UR		HD	65dB(A)			
O2 store		HD	65dB(A)			
Comms		PTSD	65dB(A)			
Yard		HD				
Trace		PTSD	65dB(A)			
Dayrcom		PTSD	65dB(A)			
Lock		PTSD	65dB(A)		Dry Powder (4.5)	
Consult		PTSD	65dB(A)			
Corridor		PTSD	65dB(A)			
Equipment		PTSD	65dB(A)			
Sterile		PTSD	65dB(A)			
Dental		PTSD	65dB(A)			
Dental Work		PTSD	65dB(A)			
Waiting		PTSD			Dry Powder (4.5)	MIMIC
WC & Shower		HD	RM			
Waiting		PTSD	65dB(A)		Dry Powder (4.5)	
Nursing		PTSD	65dB(A)			
Medical Record		PTSD	65dB(A)			
Corridor		PTSD	65dB(A)			
Dose		PTSD	65dB(A)			
Pharmacotherapy		PTSD	65dB(A) (Note1)			
Administration		PTSD	65dB(A)			
Hold		PTSD	65dB(A)			

Staff		PTSD	65dB(A)		Dry Powder (4.5)	
Pwd WC			RM			
Staff Entry		PTSD	65dB(A)		Dry Powder (4.5)	
Office		PTSD	65dB(A)			
SHR		HD				
Ward		PTSD	65dB(A)			
Plant			HR &STR			MASD detector located in plant room
Cells		MASD	Note 1			Sampling point in cells
Programs Building						
Office post		PTSD	65dB(A)		Dry Powder (4.5) FB	SFIP
Func Manager Office		PTSD	65dB(A)			
Staff			(Note1)			
Interview		PTSD	65dB(A)			
Plant		HD	HR &STR			
Staff Breakout		HD	65dB(A)			
Work station		PTSD	65dB(A)		Dry Powder (4.5)	
Senior Office		PTSD	65dB(A)			
Mech		HD	HR &STR		Dry Powder (4.5)	
AVL		PTSD	65dB(A)			
Classroom		PTSD	65dB(A)			
Library		PTSD	65dB(A)			
Multi-Purpose room		HD	65dB(A)		Dry Powder (4.5) FB	
Walk way					2 xWeather proof Dry Powder (9)	

Note:

1. No speaker within cells. SPL to be 75 dB(A) within cells to wake sleeping occupant with the cell door closed via speakers adjacent to cell (corridor or passage way)

2. Substitute PTSD with PTTD where plant room area/s are exposed to outside air conditions

3. Where PTTD is used in retherm area it shall be Type D Fixed Temp set to 88 OC at commissioning. Allow for adjustment to suit site specific conditions after commissioning.

TENDER FORM 1

Tender form for the Fire Services for:

Correctional Facilities Performance Specification

(INSERT CORRECTIONAL FACILITY NAME HERE)

We, the undersigned, hereby tender for the supply, delivery, installation, commissioning and testing of the Fire Services for Correctional Facilities Performance Specification in accordance with Northrop Consulting Engineers' specification no. NL180226-HF01 revision A, dated 04.04.2018.

We unconditionally guarantee the performance of the installation and completion of the works in accordance with this specification, accompanying drawings and statutory regulations.

Itemised Lump Sum Tender Price: .....
(Dollars, in words)

$ ..... (including GST)

Tenderer Name: .....

Tenderer Address: .....

.....

Signed: ..... Date: .....

This tender shall be valid for sixty (60) days following this date.

TENDER FORM 2

The amounts included in the Lump Sum Tender Price, including overhead costs and profit margins, are as follows:

Lump Sum Tender Prices

a)	Provision of Site Establishment	$_____
b)	Design of Fire Services	$_____
c)	Provision of Fire Detection & Alarm System	$_____
d)	Provision of MASD including Network	$_____
e)	Provision of Colour Graphics	$_____
f)	Provision of Fire Extinguishers & Blankets	$_____
g)	Provision of Fire Sprinkler System	$_____
h)	Provision of Fire Booster Pumps	$_____
i)	Provision of Fire Water Storage Tanks	$_____
j)	Provision of Hydramist System	$_____
k)	Provision of Kitchen Hood Suppression Systems	$_____
l)	Associated building works	$_____
m)	Provision for Commissioning	$_____
n)	12 months tuning and final (Paid progressively)	$_____
o)	Maintenance and Warranty (Paid progressively)	$_____
p)	Provision of operating & maintenance manual	$_____
q)	Provision of 'as installed' drawings	$_____
r)	Cranage, hoisting and the like	$_____
s)	Others (please list)	$_____
	GST	$_____
	Total Tender Price	$_____

Total Tender Price (in words)___

_____

Tenderer Name:.....

Signed: ..... Date: .....

TENDER FORM 3

Manufacturers Proposed

Item of Equipment	Manufacturer, Supplier or Subcontractor	Range or type	Model No.
Fire Indicator Panel			
Detection Field Devices			
Multi-aspirating Smoke Detectors			
Colour Graphics			
Speakers			
Non Fire Rated Cable			
Fire Rated (FR) Cable			
Non FR Non PVC TPS			
High Level interface			
Water Mist System			
Pipework			
Sprinkler Hardware			
Sprinklers			
Valves			
Fire Booster Pumps			
Fire Water Storage Tanks			
Kitchen Hood Suppression			

Tenderer Name:.....

Signed: ..... Date: .....

RETURN BRIEF

CESSNOCK CORRECTIONAL CENTRE

240 BED MINIMUM SECURITY EXPANSION

HYDRAULIC SERVICES

JHA

CONSULTING ENGINEERS

DOCUMENT CONTROL SHEET

Project Number	180147
Project Name	Cessnock Correctional Centre, 240 bed Minimum Security Expansion
Description	Return Brief
Key Contact	Scott Thompson

Prepared By

Company	JHA
Address	Level 23, 101 Miller Street, North Sydney NSW 2060
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Checked	Jeff Potkins
Authorised	Scott Thompson

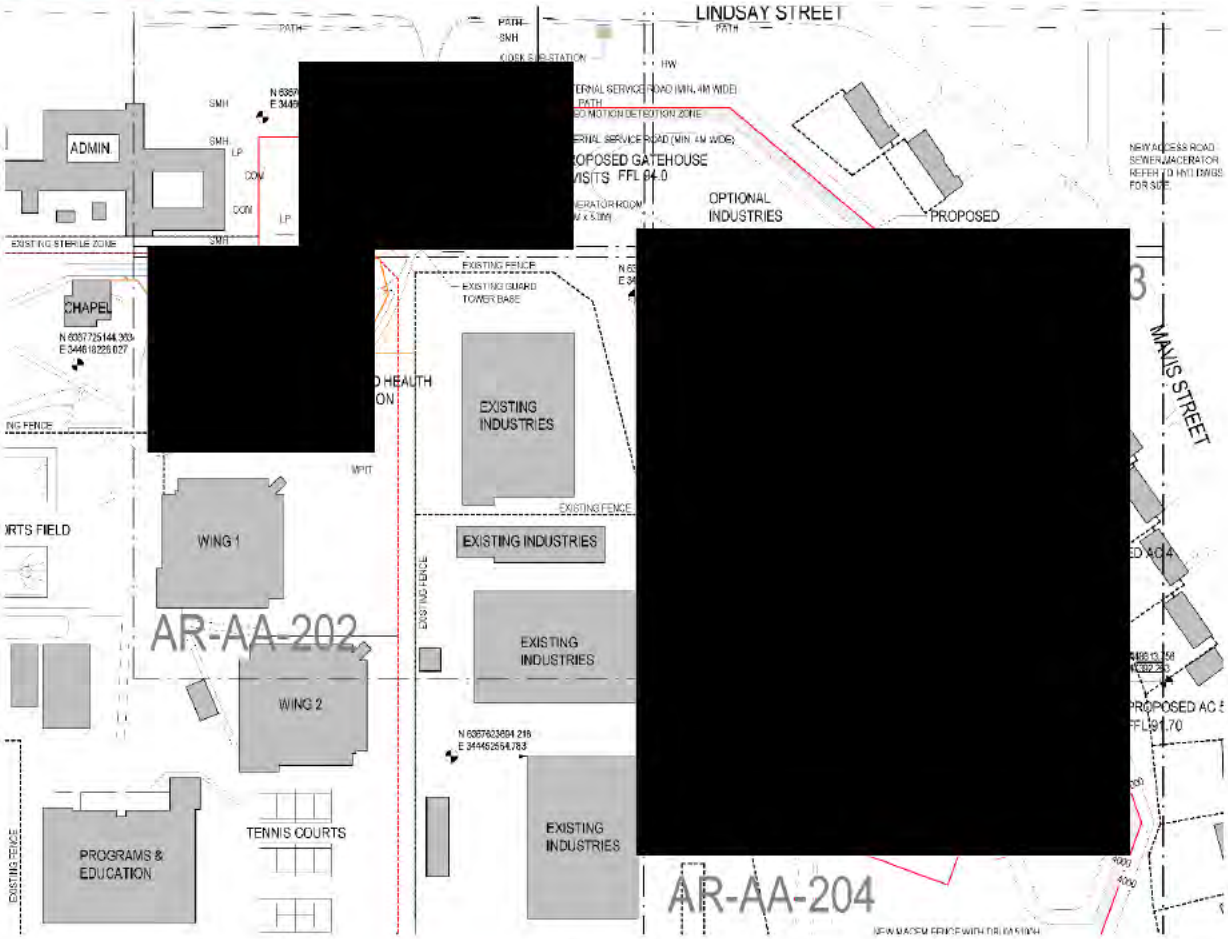
Revision History

Issued To	Revision and Date	
Lend Lease – Gary Lyle	REV	01
	DATE	25/05/2018
	REV	
	DATE	
	REV	
	DATE	

CONTENTS

1 PROJECT DESCRIPTION

1.1 PROJECT SCOPE



Site plan

It is proposed that a 240 bed minimum security expansion be constructed on a site directly bounding the existing industries zone, which currently serves as part of the existing Cessnock Correctional Centre. These new expansion works will incorporate a new gatehouse, entry and linking zone and common facilities to serve and form a larger minimum security centre of approximately 760 beds.

The works proposed are identified on the above site plan and are further described as follows:

- A new purpose-designed Gatehouse (with new MCR and Security Server) constructed outside the perimeter of the currently operating prison which incorporates a new minimum security visits centre capable of serving the whole 760 bed minimum security centre;
- A new Inmate Reception & Health (Clinic) building to be constructed within the existing site in place of the existing visits building serving the whole 760 bed minimum security centre;
- A new + upgraded secure perimeter configured to suit the proposed new 280 bed minimum security expansion, the new Gatehouse location, new Reception / Clinic building location and the integration with the existing remand centre and industries precinct to form a single centre;
- Construction of 240 additional beds, consisting of five (5) minimum security residential accommodation units each consisting of 48 beds with future capacity for construction of a 6th unit;
- A New Programs building with movement control Officer Post to service the bed expansion zone;

- New recreational spaces, central field, fitness stations, landscape elements and courtesy fencing;
- New internal service road(s) configured to provide emergency and maintenance vehicle access for the combined centre site;
- New and upgraded internal pedestrian links to provide access and inmate movement control across the new centre configuration;
- A new visitors car park providing access to the new gatehouse;
- Demolition of the existing minimum security Visits building and surrounding external spaces

The CSNSW Functional Design Brief requested additional architectural master planning consideration be given to;

- Future expansion provision for 1 additional 48 bed accommodation building in the new minimum precinct;
- Industry Unit(s) future expansion

2 INTRODUCTION/ ROLES & RESPONSIBILITIES

JHA have been engaged by Lend Lease to progress the concept design to a schematic design level to assist design resolution during the Early Contractor Involvement (ECI) phase of the project. JHA's specific role over the duration of the project can be summarised as follows:

ECI Phase: JHA and the services Contractors will jointly undertake the schematic design of electrical services to a level suitable for the Contractors to reasonably price on a design & construct basis, plus allow the Principal to understand the scope of services offered. JHA will further serve as an advisor and representative to the overall Lend Lease team on all technical items.

Delivery Phase (Post ECI): JHA's specific role during the delivery phase is to provide technical advice to the Contractors (and the general Lend Lease team) on all electrical services throughout the proposed new works. JHA's further role is to review all electrical design, documentation and installation to ensure that they are fully compliant with Lend Lease's contractual obligations and that they are consistent with a Correctional Centre of this nature and scale.

The Contractors have been engaged by Lend Lease and is responsible for the design, documentation, certification, installation, commissioning and warranty of the electrical services throughout the proposed new works.

JHA and the Contractors will be working collaboratively, along with the broader Lend Lease team, to ensure that a fully compliant Correctional Centre is delivered.

3 PURPOSE OF DOCUMENT

This return brief is a document which captures the design decisions that have been made during the ECI phase of the project. This return document should be read in conjunction with the developed JHA drawings and performance specifications.

This brief does not intend to repeat in detail the contents of the contract documents, rather, the brief looks to offer the following:

- A summary of decisions and departures reached during the ECI phase as the design evolves into schematic design
- Give a summarised overview of the contact requirements
- Clarify/ expand on briefing requirements as developed with the CNSW
- Clearly identify departures to the contract documents (additions and deletions) and the rationale as to why
- Clearly identify issues which require further resolution with the CNSW

It is important to note that the purpose of this report is to 'de-risk' the electrical scope and provide certainty for all parties as the project progresses. To this end, the JHA Return Brief will supersede the original contract documents. While care has been taken to be clear and accurate, should the unlikely event occur where there is conflict between the two documents the JHA Return Brief will take contractual precedence.

It should be further noted that the schematic design drawings which supplement this report are also not exhaustive. The purpose of the drawings is to provide certainty as to the extent and configuration of the electrical services. Due to the Architectural drawings being developed concurrently with the electrical drawings, detailed layouts could not be prepared. Similarly, due to time constraints and continual development it was not intended to reproduce information which was already clear within room data sheets. Consequently, the design development drawings produced offer supplementary information over and above room data sheets only.

4 HYDRAULIC SERVICES

4.1 DESIGN STANDARDS

The hydraulic services design will comply with the following standards:

Australian Standards	Fire Hydrant Installations	AS 2419:2005
	Installation of Fire Hose Reels	AS 2441:2005
	Plumbing and Drainage Part 1 – Water Services	AS/NZS 3500.1:2015
	Plumbing and Drainage Part 2 – Sanitary Plumbing and Drainage	AS/NZS 3500.2:2015
	Plumbing and Drainage Part 4 – Heated Water Services	AS/NZS 3500.4:2015
	Gas Installations	AS 5601:2004
Authorities	National Construction Code	2016
	Hunter Water Corporation	
	NSW Office of Department of Fair Trading	
	NSW Fire Brigade	
Other documents	A_NSW Justice -Cessnock 280_ Specification_ Issued For Concept Design Report	
	NL180226_HY01_A Hydraulic Services Performance Specification	
	Facility Assets Correctional Standard - Functional Purpose and Design	
	Facility Assets Correctional Standard (Health Care) - REVISION Mar 2018	
	*The contractor shall note that for any discrepancies between the above documents the document with the most information in terms of equipment details, no of services, controls etc will take precedence.	

4.2 GENERAL/SCOPE OF WORKS

The scope of the hydraulic services for the proposed new minimum security expansion is broadly summarised as follows:

- Detailed design, documentation and certification
- Staged works so as to maintain a fully functional Correctional Centre
- Services diversions
- Sanitary plumbing and sewer drainage
- Potable cold water
- Potable hot water
- Natural gas
- Fire hose reel
- Fire hydrant
- Occupation and Maintenance Manuals
- As built Drawings (BIM)
- Certification
- Testing and Commissioning.

4.3 SANITARY PLUMBING AND SEWER DRAINAGE

4.3.1 EXISTING SYSTEM

It was advised that Hunter Water had confirmed the existing downstream sewer network had insufficient capacity to receive the predicted maximum wastewater discharge from any future extensions of the Cessnock Correctional Centre. During the first stage of the facilities expansion, the authority sewer main was upgraded along with the construction of an onsite sewer storage tank to limit the rate of wastewater discharge 42L/s. This sewer management strategy was designed to facilitate the maximum inflow of the entire site inclusive of the expansions.

A new DN.225 sewer pipe is currently being constructed as part of the 440 bed upgrade works and will be extended down the site, parallel to the southern boundary of the complex. A capped DN.225 nominated connection point for the 240 bed expansion is to be provided at SMH141. This then extends in DN.300 to the connection location. JHA have undertaken a preliminary fixture unit loading calculation and have assessed the connection size to be adequate for the predicted wastewater flows.

4.3.2 PROPOSED SYSTEM

The new sewer drainage service will be extended from each building picking up various fixtures to a dedicated sewer manhole for direct rodding access. The site drainage will be reticulated through the site in a dedicated service zone conveyed to a sewer macerator just upstream of the connection point.

The sewer macerator is to be comprised of a dual in-line duty standby arrangement with a trash screen on the inlet. The macerator is to be selected to cater for the peak wet weather flow prior to discharging into the site sewer network.

All drainage to WCs accessible to inmates (ie. Accommodation amenities or holding cells) have been sized to a minimum of DN.150 as per particular instruction from CNSW. Direct rodding to all inmate accessible toilets is required.

Two DN.150 provisions have been provided for the future industries and accommodation buildings (refer to site plan).

There will be a number of diversions required to the existing sanitary drainage services. The existing DN.150 sewer drainage service servicing the existing administration building and tower 2 will require to be diverted away from the building footprint of the new gatehouse/visits. Refer to the existing Site Services drawing for information. Investigations will be required to determine locations of all services on site required for diversion.

4.4 POTABLE COLD WATER SERVICE

4.4.1 EXISTING SYSTEM

A small diameter potable water connection to the authority water main is located at the NE corner of the site in Kerlew Street. The existing Cessnock Correctional Centre reticulated network is supplied via onsite storage tanks as the infrastructure was insufficient to cater for the required flow and pressure.

As part of the 440 bed upgrade works, a new DN.200 water main was extended to serve the facilities extension from an authority water main in Oaky Creek Road. This is metered at the newly installed Hunter Correctional Centre and extended to the new correction developments. A 150mm provision to supply the new 240 bed facility was provided as part of this package. This connection supplying future extensions was advised to be capable of supplying 30L/s. JHA have confirmed with Hunter Water Authority (Dean Cecil) that the installed system is capable to supply the new developments.

The two potable water connections to the authority infrastructure to supply Cessnock Correctional Centre are fed from separate reticulation mains supplied from different reservoirs. At no instance should the two services be interlinked as this can compromise the wider Hunter Water network and potentially rupture the existing facilities reticulating pipework due to increased pressure.

4.4.2 PROPOSED SYSTEM

JHA have undertaken a peak potable cold water demand assessment for the new expansion works and have assessed a total demand in the order of 50L/s. As the water provision provided from the new DN 200 potable water main is inadequate to cater for the demand of the development and a 2 day storage is required, the mains supply will be utilised to top up two 75kL potable cold water storage tanks, which will cater for 2 days storage as instructed by CNSW/JI over and above the CNSW standard which stipulates 3 hour peak storage required.

The tank water supply will be fed throughout the new expansion by passing through a series of duty standby backwash filters and boosted via a triplex variable speed pump set located in a dedicated pump house. A reticulating DN.150 ring main around the perimeter of the accommodation buildings is to extend and feed all buildings of the 240 bed expansion. Various stop valves are to be located along the ring man at the take offs to isolate sections for maintenance without the need to shut down the entire system.

Potable cold water service entering each building is to be isolated via a path valve located prior to entering the plant room to a private water meter connected to the BMS sending a pulse reading.

An Enware Smartflow water management system is to be installed for all shared inmate amenities in the accommodation building and supply to holding cells for a solenoid shut off. A Smartflow hub is to be allocated to each group of amenities located in the adjacent wall of plant room totalling to 4 hubs for each accommodation building. Showers are to be limited to 6 minute durations with a dedicated lockout period after use. All connected via BMS with a high level interface. The water management system is to be in adherence to the Northrop and NBRS specifications.

4.5 POTABLE HOT WATER SERVICE

It has been advised the existing facilities utilise electricity for cooking and heating functions. The design shall implement the strategy of installing new electric hot water storage systems for all new buildings. Each centralised plant is provided to cater for the proposed building's peak demand. Each plant utilises a flow and return pipework service fitted with dual circulating pumps to ensure minimal waiting time at outlets. All control panels shall be connected to the BMS system.

Thermostatic mixing valves providing control valves for the hot and cold water shall be strategically located outside of high risk areas and within plant rooms where possible for ease of maintenance. All fixtures accessible by inmates that require temperature controlled water shall be supplied with tempered water at no more than 43.5°C to accessible ablution areas and 50°C to all others.

4.6 NATURAL GAS SERVICE

As part of the first stage extension works, a provision for a DN.125 natural gas line is to be provided for the 240 bed expansion. The current strategy is to leave the capped supply and make no connection to this supply. A new DN.100 gas pipe is to be installed from the connection location and extended through the site and terminated with a capped provision adjacent to the future industries building. No other buildings of the 240 bed extension require natural gas supply so this provision provides an anticipated allowance of approximately 4500MJ/hr at 5kPa. Final decisions regarding the nature of the industries fitout will need to be carefully considered with due regard to the available capacity of the natural gas service. An application to Jemena will need to be made to confirm connection requirements to this supply. The pressure and metering of the proposed NG supply is yet to be confirmed and is not installed on site to date.

4.7 FIRE HYDRANT AND HOSE REEL SERVICE

	Gatehouse & Visitors	Health & Reception	Programs	Accommodation B1-5
Classification	5 & 9b	5	5 & 9b	3
Floor Area	$1000m^2>A>500m^2$	$1000m^2>A>500m^2$	$1000m^2>A>500m^2$	$1000m^2>A>500m^2$
No. FH to flow simultaneously	1	1	1	1

4.7.1 EXISTING HYDRANT SYSTEM

The existing original site wide hydrant system was designed in accordance with Ordinate 70 and maintained as per AS1851-2012. This reticulates to multiple ring mains feeding various external hydrants (refer to site plan). The system is supplied from 2 x 385kL storage tanks located at the North Eastern boundary adjacent to the cold water storage tank. It is anticipated the existing system will be capable of providing adequate performance requirements for the new extension as per AS2419:2005 and NCC clause E1.3. The existing diesel and electric hydrant pumps are rated at 15L/s as identified on site with dual headed hydrants located around the site.

As part of the 330 bed Cessnock Correctional expansion works, the existing hydrant system was extended throughout that site being the most hydraulically disadvantaged area of the existing and new (future) 240 bed site.

4.7.2 PROPOSED HYDRANT SYSTEM

The proposed health/reception and gatehouse/visits building is to be protected via external hydrants strategically located minimum 10m from the building tapping into the existing fire hydrant ring main in the close vicinity. Internal hydrants will be required if final compartmentation and coverage from external is not achievable.

The programs, accommodation and future industries building will also be protect by external hydrants which will be supplied by a supplementary ring main extended from the existing DN.150 service running along the northern side of the existing industries buildings. Stop valves will be located at each tee and branch for locally isolate sections of the ring main for maintenance without the need to shut down the entire system.

All new external hydrants will require protective covers to be installed.

The existing fire hydrant system reticulation indicates a section of pipework will need to be diverted from the building footprint of the new gatehoue/visits and health/reception buildings.

4.7.3 PROPOSED FIRE HOSE REEL SYSTEM

The accommodation building is a Class 3 as per the NCC and is exempt from requiring FHR coverage. CNSW and JI have provided instruction to provide FHR coverage to all accommodation buildings. All hose reels to be provided in accordance with AS2441:2005. All fire hose reels to be located in a locked cupboard.

5 APPENDICES

5.1 A: DESIGN DEPARTURES SCHEDULE

CESSNOCK CORRECTIONAL CENTRE – DEPARTURES/NON-COMPLIANCE REGISTER

Item No	Northrop Performance Specification Reference	Non-Compliance	Reason for Non-Compliance	Comment
H01	Supply of 3 Hr Peak Water Storage to be available	2 Days storage	Request from JIA	
H02	Potable Water Piping to be Copper up to 100mm and CICL 100mm and larger as per CNSW Standard	PE Piping below ground to be used	Cost reduction to install materials used in other Corrections Projects in cessnock.Noted for use in the Northrop Specification.	
H03	Sanitary drainage to be VCP as per CNSW Standard	PVC-U piping and fittings	Used in all Corrections Projects. Noted for use in the Northrop Specification.	

5.2 AMENDED NORTHROP HYDRAUILC SERVICES PERFORMANCE SPECIFICATION

Hydraulic Services Specification

NSW Correctional Facilities Performance Specification

SPECIFICATION

PREPARED FOR

Justice Infrastructure - NSW Department of Justice

Level 2, 50 Phillip Street Sydney NSW 2000

Tel: 02 8061 9315

PREPARED BY

Northrop Consulting Engineers

2-6 Shea Street

Phillip ACT 2606

Tel: 02 6285 1822

Ref: NL180226-HH01-HH01

Rev: A

Date: 04.04.2018

HYDRAULIC SERVICES SPECIFICATION

Activity Schedule

Date	Revision	Issue	Prepared By	Approved By
13.03.2018	1	For Review & Comment	A.Cordina	A.Cordina
29.03.2018	2	For Review & Comment	A.Cordina	A.Cordina
04.04.2018	A	Tender	A.Cordina	A.Cordina

Northrop Consulting Engineers Pty Ltd

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2-6 Shea Street, Phillip ACT 2606

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1. PREAMBLE

1.1 Introduction

Northrop has been engaged by the NSW Justice Department to formulate several Building Services Specification for the following five (5) prisons in NSW which have been listed later in this specification. While Room Data sheets have been provided no Architectural drawings have been provided at this time. Therefore, the information contained herein is based on all possible scenarios for building services design, inclusive of but not limited to; refurbishment, extensions and new buildings. This specification has been written in conjunction with other Northrop Consulting Engineer documentation for the following building services:

- Electrical
- Mechanical
- Fire

1.2 Coordinated Approach

There has been a coordinated approach between the above mentioned services which has endeavoured to engage several stake holders at several levels within the NSW Department of Corrective Services, documentation available on prisons construction and so on. It is worth noting that there is no specific design guideline that identifies design and construction of building services in a prison. There are however documents provided by the Department relating to room data sheets that provide an insight into the expectation of what building services are required to be installed within a particular space together with examples of some recently documented NSW prison projects.

To this end, Northrop has considered several design scenarios with the thought that we are just one part of developing a successful project outcome. It is the responsibility of the D&C Services contractor to seek out the following, but not limited to project stakeholders to ensure a cost effective, robust and reliable service is provided:

- NSW Department of Justice
- Architect
- Existing site specific Fire Safety Officers (and/or Orders)
- BCA Certifier
- Fire Safety Engineer
- Building Services Consultants
- Local Fire Brigade
- Local Council

1.3 Building Services Performance Specification

This Performance Specification has been prepared to allow the calling of Design and Construction (D&C) tenders for the building services related to new and refurbishment works at various NSW correctional facilities. This specification describes minimum standards for the design, supply, installation, and commissioning of selected elements of building services, which will materially impact on the future occupancy of the buildings.

The information contained within is intended to provide an overview of various systems which will be installed within the correctional centre. It is the contractor's responsibility to select system types based on the performance requirements and undertake any life cycle and payback analysis. Note that there are no detailed building services drawings accompanying this specification.

1.4 General

This part of the specification shall be read in conjunction with the general conditions of contract, preliminary clauses, and technical clauses included in the main specification that follows.

The Hydraulic services works shall comprise of the design, coordination, workshop documentation, supply, construction, installation, testing, commissioning, quality assurance, certification, and maintenance during defects liability period of the complete Hydraulic services works whether specified herein or not.

This document is to be read as a performance brief for the Hydraulic services. Where ambiguous, inconsistent or contradictory information is present in the documentation, it is the contractor's responsibility to highlight those and seek clarification during the tendering process. Where assumptions are made or where alternatives exist, the more expensive option shall be priced for.

The Contractor shall be responsible for completion of the design of the Hydraulic services to satisfy the requirements of this specification, Client Briefs, relevant codes and standards, and any other ancillary requirements made known at the time of tender. The Contractor shall prepare design concepts, detailed design drawings and shop drawings for the final Hydraulic services required, including coordination with the latest architectural layouts and all other building services' documentation.

The Contractor shall guarantee that the complete Hydraulic services installation will perform all functions required.

The Hydraulic services shall be designed and installed in accordance with the current National Construction Code (NCC) and current Australian Standards. Where alternative solutions are required they shall be addressed within the contractors design certification and shall be fully agreed with the relevant authorities prior to the design proceeding.

The documents include this performance specification, Corrective Services NSW Standards, Room Data Sheets, Security Brief, other services trade drawings, and associated architectural drawings which combined identify the full extent of work.

The Contractor shall fully inform themselves of the nature of work, carry out a mandatory site visit and to take into account any conditions likely to affect the extent or performance of the works specified herein prior to submission of tender.

The Contractor by tendering shall be deemed to have thoroughly inspected the site prior to tender and to have taken into account any conditions likely to affect the extent or performance of the works e.g. beam locations, cable routes, penetration locations, existing services, etc.

1.5 Definitions

- 'AS' or 'AS/NZS' when followed by numbers or letters means an Australian Standard published by Standards Australia (e.g. AS 1668)
- 'Approved' means approved in writing by the Superintendent and/or Regulating Authority
- 'Architect' shall mean Architect
- 'Authority' means any Local, State or Commonwealth statutory body holding jurisdiction over work herein specified under current regulations and statutes
- 'BCA' means the Building Code of Australia – Volumes 1 and 2, which forms part of the National Construction Code.
- 'Client' shall mean Justice Infrastructure and Assets (JIA) - NSW Department of Justice
- 'CSNSW' shall mean Corrective Services NSW
- 'Contractor' means the person or the persons, firm, company or corporation whose tender has been accepted by the Client and includes their legal representatives, successors and permitted assigns to design, install, test, and commission the Hydraulic services specified herein and on the accompanying drawings
- 'Day' means a period of 24 hours
- 'Equal' means equivalent in performance, quality and approved
- 'Fire Resistance Level (FRL)' means the grading periods in minutes determined in accordance with Specification A2.3 of the BCA Volume 1, for the following criteria -
    - Structural adequacy
    - Integrity; and
    - Insulation, and expressed in that order
- 'General Access Area' means areas that are generally accessed by Prisoners.
- 'High Needs Area' means individual segregation cells or cell blocks.
- 'Install' means accept the delivery of items supplied by others and install them in accordance with the documents.
- 'Hydraulic Engineer' nominated by the Principal
- 'Materials' means all plant, instruments, components, equipment, assemblies and sub-assemblies, parts and other items required for permanent incorporation of the works
- 'May' means that there is an option
- 'NCC' means the National Construction Code, which comprises the Building Code of Australia - Volumes 1 and 2.
- 'Inmate' means a person sentenced or awaiting sentence by the Court to a term of imprisonment to be detained in a prison

- 'Provide' means obtain, manufacture, deliver, install, as applicable, and do everything necessary to complete the work in accordance with this specification
- 'Required' means necessary by the contract documents, statutory Authority, law, or as required by site conditions to complete the works
- 'Shall' means that the statement is mandatory
- 'Should' means that the statement is recommended
- 'Site' means the lands and other places on, under, in or through which the works are to be carried out by the Contractor
- 'Specification' means this document
- 'Submit' means submit to the Hydraulic engineer, project manager, or other person(s) as indicated in the general conditions for inspection, information, etc.
- 'Superintendent' means the person as nominated by JIA or as nominated in the main building contract
- 'Supply' means obtain, manufacture, as applicable, and deliver

1.6 Design Compliance

The work shall comply with these listed regulations, whether or not specific reference is made in this Specification.

A brief summary of key Standards and Codes that generally apply to these works is as follows. Where specific parts are not mentioned, the entire series of the associated Standard shall apply.

Reference	Title
NCC	National Construction Code of Australia
AS 1074	Steel Tubes and Tubulars for Ordinary Service
AS/NZS 1254	PVC-U Pipes and Fittings for Stormwater and Surface Water Applications
AS/NZS 1260	PVC-U Pipes and Fittings for Drain, Waste and Vent Application
AS 1345	Identification of the Contents of Pipes, Conduits and Ducts
AS 1432	Copper tubes for Plumbing, Gasfitting and Drainage Applications
AS/NZS 1477	PVC Pipes and Fittings for Pressure Applications
AS 1851	Maintenance of Fire Protection Systems and Equipment
AS 2032	Installation of PVC Pipe Systems
AS 2033	Installation of Polyethylene Pipe Systems
AS 2419.1	Fire Hydrant Installations
AS 2419.2	Fire Hydrant Installations - Fire Hydrant Valves
AS 2419.3	Fire Hydrant Installations - Fire Brigade Booster Connections
AS 2441	Installation of Fire Hose Reels
AS/NZS 2845.1	Backflow Prevention Devices - Materials, Design and Performance Requirements
AS/NZS 2845.2	Backflow Prevention Devices - Registered Air Gaps and Registered Break Tanks

AS/NZS 2845.3	Backflow Prevention Devices - Field Testing and Maintenance of Testable Devices
AS 2865	Confined Spaces
AS 2941	Fixed Fire Protection Installations - Pumpset Systems
AS/NZS 3500.1	Plumbing and Drainage - Water Services
AS/NZS 3500.2	Plumbing and Drainage - Sanitary Plumbing and Drainage
AS/NZS 3500.3	Plumbing and Drainage - Stormwater Drainage
AS/NZS 3500.4	Plumbing and Drainage - Heated Water Services
AS 4032.1	Thermostatic Mixing Valves - Materials, Design and Performance Requirements
AS 4032.2	Tempering Valves and End-of-line Temperature Actuated Devices
AS 4129	Fittings for Polyethylene (PE) Pipes for Pressure Applications
AS 4130	Polyethylene (PE) Pipes for Pressure Applications
AS 5601	Gas Installations
HB 230	Rainwater Tank Design and Installation Handbook
HB 233	Fire Protection Systems Testing - Water Conservation Handbook
HB 263	Heated Water Systems

Facility Assets Correctional Standards

Reference	Edition	Title
D12/095474	2012	Administration
D12/095505	2012	Booking
D12/095486	2012	Food Services
D12/095519	2012	Functional Purpose and Design
D12/095514	2012	Gatehouse
D12/095469	2012	General Storage
D12/494388	2012	Grounds Maintenance
D12/095487	2012	Health Care
D12/095502	2012	Housing - General
D12/095496	2012	Housing - Special
D12/095476	2012	Industries
D12/095484	2012	Laundry
D12/095458	2012	Maintenance Facility
D12/594885	2012	Maintenance
D12/095478	2012	Programs / Services
D12/095480	2012	Recreation
D12/095508	2012	Security

D12/095472	2012	Staff
D12/095482	2012	Visiting
D12/214222	2012	Court Cells
D12/214304	2012	Residential Security
D12/494532	2012	CCTV Systems
D12/493566	2012	Lifeskills Kitchen
D12/494876	2012	Suppliers and Products
D12/286803	2012	Training Kitchen
D18/07512	2018	DJ Local Area Network Standard
D17/384404	2017	MATV / IPTV Scope for Prison Bed Capacity Program
	2017	Audio-visual Systems Specification
D18/077742	2018	DJ Telecommunications Cabling and Infrastructure Facilities Standard

1.7 Authorities

The complete installation and all works being carried out shall comply with the requirements and regulations of all Statutory Authorities and Codes relevant to the works, including:

- The National Construction Code (Building Code of Australia);
- Standards Australia;
- The Local Fire Brigade;
- Work Health & Safety;
- Local City/Shire Council;
- Any other authority having jurisdiction over all or part of the installations to ensure that the equipment and installation, when manufactured and installed, shall comply with the relevant rules and regulations.

CESSNOCK

HUNTER WATER

Observe all requirements and regulations of the Lifts and Scaffolds Act.

The Contractor is responsible for lodging all applications, seeking all approvals, and payment of all fees and charges legally demandable for relevant services prior to the commencement of works to meet the project construction programme.

Where standards and regulations are mentioned in this specification they shall include all amendments and interpretations.On completion, the whole of the equipment and installation is to be inspected by the appropriate authority's representative.

The Contractor shall obtain and fill in all notices required by the relevant Authorities where necessary and pay all fees in connection therewith and shall submit for approval all necessary drawings and obtain all consents required to permit execution of the works.

The Contractor shall procure all necessary permits and approvals from Authorities and shall advise the Superintendent if obtainment of any permits is likely to delay building construction.

The Contractor shall provide certificate of compliance indicating a satisfactory installation from all relevant Authorities.

1.8 Project Description

The following provides a description of the works involved at each NSW Correctional Facility.

Bathurst Correctional Centre

The Bathurst Correctional Centre is currently a minimum and medium security facility for male offenders housing 495 medium security and 165 minimum security inmates. It is located 200km west of Sydney.

The proposed new 220 bed maximum security male facility is intended to be operated in conjunction with the existing medium security facility.

The works are to be completed to enable acceptance of prisoners in April 2020.

The works are generally summarised as:

- A new 220 bed maximum security compound with Gatehouse, Administration, Staff Amenities, Reception, Accommodation, Industries and Programs, 10 bed Segregation and Clinic buildings all located to the south east of the existing compound.
- The installation of a pedestrian and vehicle lock between the existing medium security compound and the new maximum security compound. This will require an opening in the existing heritage perimeter wall.
- New facilities located outside the secure perimeter for Central Stores and Grounds Maintenance.
- New facilities located within the minimum security compound for Kitchen and Laundry.

Metropolitan Remand and Reception Centre (MRRC)

The Metropolitan Remand and Reception Centre (MRRC) is currently a maximum security facility for male offenders housing 1,086 maximum security inmates. It is located 21km west of Sydney CBD.

The proposed new 440 bed maximum security male facility is intended to be operated in conjunction with the existing facility.

The works are to be completed to enable acceptance of prisoners in June 2020.

The works are generally summarised as:

- A new 440 bed maximum security compound with Accommodation, Recreation, Satellite Clinic and Programs buildings all located in the South East corner of the existing secure facility.
- Refurbishment works to parts of the existing facility. These works will upgrade some existing functionality and services, including security services, within the centre, and provide additional space to utilise the shared Visits, Segregation, Retherm Kitchen, Laundry, Property Stores and Clinic facilities; and
- New facilities located outside the secure perimeter for Staff Parking; and

Dillwynia

The Dillwynia Correctional Centre is currently a minimum/medium security correctional centre for women offenders housing 300 00 at a medium security classification of which 44 a high risk operating beds. Dillwynia is located within the John Morony Correctional Complex at Windsor 56km west of Sydney CBD.

The proposed new 248 bed female maximum security expansion is to be operated in conjunction with the existing medium security facility.

The works are to be completed to enable acceptance of prisoners in April 2020.

The works are generally summarised as:

- A new 248 bed medium security compound with Accommodation, Satellite Clinic, Visits, Reception, Industries, Segregation and Programs; and
- Refurbishment works to parts of the existing facility. These works will upgrade some existing functionality and services, including security services within the centre.

Outer Metropolitan Multi-Purpose Correctional Centre (OMMPCC)

The Outer Metro Multi-Purpose Correctional Centre is currently a multi-purpose correctional centre housing 380 inmates and is located within the John Morony Correctional Complex at Windsor approximately 56km west of the Sydney CBD.

The Outer Metro Multi-Purpose Correctional Centre at John Morony is to provide an upgrade and refurbishment resulting in a total of 150 minimum and 100 medium security beds whilst retaining the existing 70 bed honour house and 80 bed modular accommodation.

The works are to be completed to enable the acceptance of prisoners in 2020.

The Works are generally summarised as:

- The demolition of old and subsequent construction of replacement accommodation blocks with the main correctional centre
- The master planning of a 70-bed minimum security block adjacent to the existing Honour House, 1 x 48 bed minimum security accommodation block plus 1 x 48 medium security accommodation block and a programs building adjacent the 80 modular accommodation.
- Construction of a new visits centre for the Honour House and upgrades to the gatehouse, main visits area and security

Cessnock 280

The Cessnock Correctional Centre is currently a Medium and Minimum security facility for male and female inmates, the Cessnock Correctional Centre is located within the Cessnock Correctional Complex that is located approximately 150km north west of the Sydney CBD.

The Cessnock Correctional Centre is to be expanded with the addition of a 280-bed minimum security accommodation and supporting infrastructure.

The Works are to be completed to enable the acceptance of prisoners in 2020.

The Works are generally summarised as:

- An extension of the existing Cessnock correctional centre with an additional 280 minimum security beds, and associated infrastructure including a Gatehouse, Health/Reception and Programs building will be constructed to the east and south of the existing centre and are being designed to support the existing centre.
- The Accommodation will be comprised of five accommodation blocks each with forty eight beds
- A new access through the gatehouse to the existing industry buildings will also be included.

The Fire systems may vary from site to site due to site conditions, etc.

It is the intention that the D&C contractor prepares design documentation based on the performance requirements outlined within this specification in conjunction with associated architectural design drawings.

Security, system reliability, ease of maintenance and energy efficiency are a high priority for the project.

2. DESIGN BRIEF

2.1 General

The Design Activies must be carried out with Best Design Practices with emphasis on energy efficiency, ESD principals, adaptability, reliability, durability, safety and allowance for future expansion and reconfiguration.

The engineering services must complement the delivery of the Correction Services.

2.2 Flexibility and Adaptability of Building Services

Correctional Facilities may be subject to potential for an ongoing program of modification, alteration and upgrades over the life of the facility.

As such, the building services must be design to be readily adaptable and flexible. Designs must therefore be completed ensuring minimal disruption to the facility, consider security implications and be at a minimum cost.

Correction Facilities include a wide variety of buildings and spaces for a number of different uses. The design must allow for isolation and separation of services, to the degree necessary and appropriate, to allow for part work, maintenance and upgrades. For example, works to an Education Building must not inhibit use of an Accommodation Block.

Services reticulation routes, including service corridors and risers must be directly accessible. No single service shall be required to be shut down to allow work on another service.

Consideration must be given to access for all services, and where possible not require access through or via inmate accessible areas.

Plant and equipment locations shall not be located in such a way as to allow a route for access to building roofs.

2.3 Building Services Plant Space and Reticulation

2.3.1 Plant Space

Engineering Plant and equipment installations must be arranged such that Plant and equipment that requires scheduled maintenance servicing is located outside of inmate occupied areas.

Where riser shafts are used, all riser shafts must be fully accessible for the height of the riser. Plant and equipment requiring access in services cupboards must be limited to a maximum height of 2.2m above floor level. No Plant or equipment will be located such that access to or in riser shafts is impeded.

Plant and equipment must be located to avoid vibration and electromagnetic interference. Plant and equipment accommodation must also take into account the acoustic requirements of adjoining occupied areas.

Where duplicate services are employed, these services must be located in separate riser shafts and follow distinctly separate routes.

Access to equipment in plant rooms must be via normal walk-in access and must not require the use of specialised access equipment or temporary scaffolding. Permanent access platforms and ladders must be provided where safe maintenance access is not possible from floor level.

Plant and equipment access must take into account the access needs for the replacement of all major components. Access and removal routes must be planned.

Fresh air intakes (including openable windows) must be arranged to minimise the risk of air recirculation under prevailing wind conditions, or cross contamination from nearby exhaust vents and flues.

Correction Facilities are highly secure spaces, and some areas are at high risk of vandalism.. When placing expensive services equipment outside, the Contractor must make all necessary provision for security and protection against theft and vandalism.

2.3.2 Services Reticulation

Service routes must be designed such that clearly identified routes are provided for piping and cabling installations from central plant to final usage points.

Zoned ceiling spaces for the reticulation of services with appropriate access must be provided. All services must be segregated to suit the function and type of service.

Cables must be segregated into high voltage, low voltage, communications, fire services and security services.

All services must be fully supported along their length. No service will be supported by an accessible or lightweight ceiling structure.

2.3.3 Redundancy, Capacity and Spatial Provision for Future Expansion

All services reticulation routes, from those running to central Plant and equipment locations to those routes through corridor ceilings must be provided with a spatial allowance for distribution of future services.

The Contractor must provide the following requirements with regard to spatial provision and engineering services design to accommodate for future expansion:

- the capacity of all incoming and outgoing services to the Site must accommodate the increase in inmate capacity;
- reticulation of installed Site services and infrastructure must make provision for the increase in inmate capacity including distribution of local power and security conduits and connector pillars, distribution of ICT conduits, distribution of water supply and drainage connection points to a location maximum 40m away from the proposed location of the buildings;
- all vertical and horizontal distribution including piping, racks, trays, culverts and service corridors must have allowance for future expansion;
- all switchboards and panels must incorporate spare capacity and spatial allowance for expansion;
- all services risers must be accessible for their full height and must have space for future services;
- all services cupboards for switchboards and panels must have space for future services;
- all central Plant and equipment, including boilers, electrical sub-stations, etc. must have a spare capacity for future growth built into their sizing calculations; and
- the design strategies employed to ensure adequate flexibility and adaptability must include intelligent spatial planning, good access to all services, provision for Plant redundancy and replacement, and the provision of adequate means of isolating systems and parts of systems to carry out future works.

2.4 Safety in Design

The Contractor must comply with the requirements of Work Health and Safety Act 2011 (WHS Act) – in particular section 22 of the Act. The WHS Act is supported by Work Health and Safety Regulation 2011, Codes of Practice and guidance material. The WHS Act has safety duties which apply to anyone who has control of the design or manufacture of plant, a workplace or a system (including anyone who has the authority to make decisions about design or manufacture).

Safety in Design from an operational and lifecycle maintenance perspective is a requirement of this Contract. The Contractor must design the facility so that – when constructed – it is safe and does not pose risks to the health, safety and welfare of people working or contained there, when using the workplace for a purpose for which it was intended.

The Contractor must complete Safety in Design reviews throughout all of the design phases under this contract. The Safety in Design assessment must consider the principles of “so far as reasonably practicable” and apply a hierarchy of controls, risk reduction and mitigation.

Engage with the Department of Justice and use a structured methodology for identifying risks (phase 1) and for eliminating and managing risks (phase 2).

Use a risk analysis approach, and risk workshops to consider the scope of the Project as a work environment. Identify the range of workers/inmates who will be employed/contained at the site, and their work tasks. Progressively develop the design using the “Preliminary Hazard Analysis” which identifies a range of different types of hazards and risks as part of managing risk. In iterative design reports, identify the design team’s response to identified hazards and safety risks, including providing clear and traceable evidence that the design has been refined and changed to eliminate or reduce identified safety hazards. For each design decision that carries a legacy maintenance or repair requirement, consider the design solution for the perspective of a safe working environment.

Document and submit copies of the design team’s “Preliminary Hazard Analysis” and the response to identified hazards including evidence that the design has been refined and changed to eliminate or reduce identified hazards.

2.5 Design Compliance

Standard: A summary of key Standards and Codes is as follows, where specific parts are not mentioned, the entire series of the associated Standard shall apply:

Standard	Description
NCC	National Construction Code of Australia
AS 1074	Steel Tubes and Tubulars for Ordinary Service
AS/NZS 1254	PVC-U Pipes and Fittings for Stormwater and Surface Water Applications
AS/NZS 1260	PVC-U Pipes and Fittings for Drain, Waste and Vent Application
AS 1345	Identification of the Contents of Pipes, Conduits and Ducts
AS 1432	Copper tubes for Plumbing, Gasfitting and Drainage Applications
AS/NZS 1477	PVC Pipes and Fittings for Pressure Applications
AS 1851	Maintenance of Fire Protection Systems and Equipment
AS 2032	Installation of PVC Pipe Systems
AS 2033	Installation of Polyethylene Pipe Systems
AS 2419.1	Fire Hydrant Installations
AS 2419.2	Fire Hydrant Installations - Fire Hydrant Valves
AS 2419.3	Fire Hydrant Installations - Fire Brigade Booster Connections
AS 2441	Installation of Fire Hose Reels
AS 2444	Portable Fire Extinguishers and Fire Blankets
AS/NZS 2845.1	Backflow Prevention Devices - Materials, Design and Performance Requirements
AS/NZS 2845.2	Backflow Prevention Devices - Registered Air Gaps and Registered Break Tanks
AS/NZS 2845.3	Backflow Prevention Devices - Field Testing and Maintenance of Testable Devices
AS 2865	Confined Spaces
AS 2941	Fixed Fire Protection Installations - Pumpset Systems
AS/NZS 3500.1	Plumbing and Drainage - Water Services
AS/NZS 3500.2	Plumbing and Drainage - Sanitary Plumbing and Drainage
AS/NZS 3500.3	Plumbing and Drainage - Stormwater Drainage
AS/NZS 3500.4	Plumbing and Drainage - Heated Water Services
AS 4032.1	Thermostatic Mixing Valves - Materials, Design and Performance Requirements
AS 4032.2	Tempering Valves and End-of-line Temperature Actuated Devices
AS 4130 & AS 4129	Polyethylene (PE) Pipes & Fittings for Pressure Applications
AS 5601	Gas Installations
HB 230	Rainwater Tank Design and Installation Handbook
HB 263	Heated Water Systems

Facility Assets Correctional Standards

Reference	Edition	Title
D12/095474	2012	Administration
D12/095505	2012	Booking
D12/095486	2012	Food Services
D12/095519	2012	Functional Purpose and Design
D12/095514	2012	Gatehouse
D12/095469	2012	General Storage
D12/494388	2012	Grounds Maintenance
D12/095487	2012	Health Care
D12/095502	2012	Housing - General
D12/095496	2012	Housing - Special
D12/095476	2012	Industries
D12/095484	2012	Laundry
D12/095458	2012	Maintenance Facility
D12/594885	2012	Maintenance
D12/095478	2012	Programs / Services
D12/095480	2012	Recreation
D12/095508	2012	Security
D12/095472	2012	Staff
D12/095482	2012	Visiting
D12/214222	2012	Court Cells
D12/214304	2012	Residential Security
D12/494532	2012	CCTV Systems
D12/493566	2012	Lifeskills Kitchen
D12/494876	2012	Suppliers and Products
D12/286803	2012	Training Kitchen
D18/07512	2018	DJ Local Area Network Standard
D17/384404	2017	MATV / IPTV Scope for Prison Bed Capacity Program
	2017	Audio-visual Systems Specification
D18/077742	2018	DJ Telecommunications Cabling and Infrastructure Facilities Standard

Relevance: If doubt exists as to the appropriate standard, the decision shall be made by the Superintendent after consultation with the Hydraulic Engineer prior to the commencement of any work on or off site. No consideration of claim for redundant work shall be given if the Superintendent and Hydraulic Engineer have not been notified.

2.6 Existing Infrastructure

Condition and Adequacy of Existing Systems:

- Each individual sites service ties/connections (water, sewer, storm water and gas) shall be assessed for suitability and adequacy to facilitate the new works. Allow to complete all necessary investigations, council liaising, fees and charges as part of the due diligence exercise. It is noted that some preliminary investigations have been completed for a number of sites. Where available, the Contractor shall use these initial Authority assessments/investigations as the basis for their design assessment. The Contractor shall request copies of such reports and assessments at the commencement of the project.
- The initial investigations, due diligence and assessment shall commence immediately after engagement.
- If the existing conditions do not conform or meet the needs to facilitate the new works, submit proposals to rectify the deficiencies including related costing, time and other impacts caused by the proposed works.
- Subject to the rectification works on existing systems, achieve the performance in the contract documents in conjunction with the design intent of this specification.

2.7 Working on & Extending from Existing Systems

General: Decommission, isolate, demolish and remove from the site all existing redundant equipment including minor associated components that become redundant as a result of the demolition.

Breaking Down: Disassemble or cut up equipment where necessary to allow removal.

Recovered Materials: Recover all components associated with the listed items. Minimise damage during removal and deliver to the locations documented.

Live Operation: Where works are to be carried out on or extended from existing systems the contractor shall develop a robust methodology to ensure the existing systems remain live at all time where possible. Where this is not possible the Contractor shall coordinate with the Superintendent to ensure the works have minimal impact on the existing facilities. The Contractor shall provide the Superintendent a detailed schedule of agreed shut down times to enable the connections/extensions a minimum of two (2) weeks prior to the commencing.

2.8 Building and Room Requirements Summary

Note that the following Building summaries are typical, and do not necessarily represent the complete list of all rooms which may be included in specific buildings. Refer Appendix A for a list of room data sheets that has been included to provide more detailed information for the specific room types.

Room	Accommodation Block – In Situ	Accommodation Block – In Situ	Programs	Industries (Kitchen &/or Laundry)	Industries (Other) / External Store	Health	Segregation	Visits	Gatehouse	Administration	Reception	Sports / Gym / Recreation
Armoury									■	■		
AVL Suite	■						■					
Bathroom c/w shower	■	■	■	■		■	■	■	■	■	■	■
Bathroom c/w WC only	■	■	■	■		■	■	■	■	■	■	■
Break out space			■			■						
Carrier Room									■			
Cell – Access	■	■					■					
Cell – Single	■	■					■					
Cell – Double	■	■										
Cell – Holding	■	■				■		■				
Cell - Observation						■					■	
Change room												■
Chemical Store				■								
Cleaner	■	■	■	■	■	■	■	■	■	■	■	■
Comms	■	■	■	■	■	■	■	■		■	■	■
Consultation						■						
Contact Visits								■				
Control Room									■	■		
Cool Room				■								
Court Indoor												■
Day Room	■	■					■					
Dispensary						■	■					
Dormitory	■											

Room	Accommodation Block – In Situ	Accommodation Block – In Situ	Programs	Industries (Kitchen &/or Laundry)	Industries (Other) / External Store	Health	Segregation	Visits	Gatehouse	Administration	Reception	Sports / Gym / Recreation
Dress/ Undress								■				
Dry Store				■								
Entry	■	■	■			■		■	■	■	■	■
Freezer				■								
Inmate Clerk				■	■							
Interview Room	■	■	■	■	■	■	■	■	■	■	■	
Kitchen exhaust hoods				■								
Kitchen/Tea	■	■	■		■	■	■	■	■	■	■	
Legal								■				
Locker Room									■	■		
Meals			■	■	■	■		■	■	■	■	
Medicine						■						
Meeting			■			■		■	■	■	■	
Multi-faith			■									
Non-Contact								■				
Office - Large			■	■	■	■		■	■	■	■	
Office - Medium			■	■	■	■		■	■	■	■	
Office - Small			■	■	■	■		■	■	■	■	
Officer Post	■	■	■	■	■	■	■	■	■	■	■	■
Officer Post 2			■									
Passage-Airlock							■					
Passage-Corridor	■	■					■					
Plant	■	■	■	■	■	■	■	■	■	■	■	■
Print Room									■	■		
Processing											■	
Programs 1			■									

Room	Accommodation Block – In Situ	Accommodation Block – In Situ	Programs	Industries (Kitchen &/or Laundry)	Industries (Other) / External Store	Health	Segregation	Visits	Gatehouse	Administration	Reception	Sports / Gym / Recreation
Programs 2			■									
Property Store											■	
Ready Room									■	■		
Retherm Kitchen				■								
Retherm Ovens				■								
Roof Space	■	■	■	■	■	■	■	■	■	■	■	■
Secure Store											■	
Secure Waiting											■	
Server Room									■	■		
Store	■	■	■	■	■	■	■	■	■	■	■	■
Tool store					■							
Training Room				■	■							
Treatment						■						
UPS									■			
Utilities						■						
Visitor Waiting Room								■				
Waiting Room								■	■			
Wash zone				■								
Washing/ Drying				■								
Yard	■	■			■	■	■	■				

3. GENERAL REQUIREMENTS

3.1 Responsibilities

General: This part of the specification shall be read in conjunction with the general conditions of contract, preliminary clauses, and technical clauses included in the main specification.

Requirement: The hydraulic services works shall comprise of the coordination, workshop documentation, supply, installation, testing, commissioning, quality assurance, certification, and maintenance during defects liability period of the complete hydraulic services works whether specified herein or not.

General: This document is to be read as a performance specification on which the success Tenderer shall use as a guide to complete the full Design and Construct contract for the hydraulic services. The Contractor shall be responsible for completion of the design of the hydraulic services to satisfy the requirements of this specification, the requirements of the Client, and any other ancillary requirements made known at the time of tender. The Contractor shall prepare shop drawings for the final hydraulic services required, including coordination with the latest architectural layouts and all other building services' documentation.

3.2 Precedence

Order of Precedence:

- The requirements of other work sections of the specification override conflicting requirements of this work section;
- The requirements of the work sections override conflicting requirements of their referenced documents. The requirements of the referenced documents are minimum requirements.

3.3 Referenced Documents

3.3.1 General

Requirement: The Hydraulic Services shall be installed to comply with all current statutory requirements including, but not limited to, Local Plumbing Authority, Local Water Authority, Local Gas Authority, NSW Fire & Rescue, and relevant Australian Standards. The work shall comply with these listed regulations, whether or not specific reference is made in this Specification.

3.3.2 Contractual Relationships

General: Responsibilities and duties of the principal, contractor and contract administrator are not altered by requirements in the documents referenced in this specification.

3.3.3 Current Editions

General: Use referenced documents which are the editions, with amendments, current 3 months before the closing date for tenders, except where other editions or amendments are required by statutory authorities.

3.4 Interpretation

3.4.1 Abbreviations

General: For the purposes of this specification the following abbreviations apply:

- *AS:* Australian Standard.
- *BCA:* National Construction Code Series Volume One: Building Code of Australia Class 2 to 9 Buildings and Volume Two: Building Code of Australia Class 1 and Class 10 Buildings.
- *CFC:* Chlorofluorocarbon.
- *Cu:* Copper.
- *GMS:* Galvanised Medium Steel.
- *GRP:* Glass Reinforced Plastic.
- *HCFC:* Hydro chlorofluorocarbons.
- *HDPE:* High Density Polyethylene.
- *IP:* Ingress protection.
- *NATA:* National Association of Testing Authorities.
- *NCC:* National Construction Code.
- *NZS:* New Zealand Standard.
- *LDPE:* Low-density polyethylene.
- *PCA:* National Construction Code Series Volume Three: Plumbing Code of Australia.
- *PE:* Polyethylene.
- *PVC:* Polyvinyl Chloride.
- *PVC-U:* Un-plasticised Polyvinyl Chloride. Also known as UPVC.
- *SDS:* Safety data sheets.
- *VOC:* Volatile Organic Compound.
- *WHS:* Work Health and Safety.

3.4.2 Definitions

General: For the purposes of this specification, the following definitions apply:

- *Access for Maintenance:* Includes access for maintenance, inspection, measurement, operation, adjustment, repair, replacement, and other maintenance related tasks.
- *Accessible, Readily:* Readily accessible, easily accessible, easy access and similar terms mean capable of being reached quickly and without climbing over or removing obstructions, mounting upon a chair, or using a movable ladder, and in any case not more than 1500 mm above the ground, floor or platform.

- *Ambient Water:* Potable water at a temperature provided by the cold water piping system, without further heating or cooling.
- *Approved:* Approved in writing by the Superintendent and/or Regulating Authority.
- *Architect:* Architect.
- *AS:* When followed by numbers or letters means an Australian Standard published by Standards Australia (e.g. AS 2419).
- *Attendance:* Attendance, provide attendance and similar expressions mean give assistance for examination and testing.
- *Bad Ground:* Ground unsuitable for the purposes of the works, including fill liable to subsidence, ground containing cavities, faults or fissures, ground contaminated by harmful substances and ground which is or becomes soft, wet or unstable.
- *Boiling Water:* Potable water at a temperature at or close to 100 °C.
- *Chilled Water:* Potable water at a temperature between 6 °C and 15 °C.
- *Client:* Justice Infrastructure - NSW Department of Justice.
- *Consumable:* Materials or components intended to be replaced within the service life of the associated plant or equipment.
- *Contract Administrator:* Has the same meaning as architect or superintendent and is the person appointed by the owner or principal under the contract.
- *Contractor:* Has the same meaning as builder and is the person or organisation bound to carry out and complete the work under the contract.
- *Day:* A period of 24 hours.
- *Default:* Specified value, product or installation method which is to be provided unless otherwise documented.
- *Description and Classification of Soils:* To AS 1726.
- *Design Life:* The period for which it is assumed, in the design, that an asset will be able to perform its intended purpose with only anticipated maintenance but no major repair or replacement being necessary.
- *Documented:* Documented, as documented and similar terms mean contained in the contract documents.
- *Economic Life:* The period from the acquisition of an asset to the time when the asset, while still physically capable of fulfilling its function and with only anticipated maintenance, ceases to be the lowest cost alternative for satisfying that function.
- *Electricity Distributor:* Any person or organisation that provides electricity from an electricity distribution system to one or more electrical installations. Includes distributor, supply authority, network operator, local network service provider, electricity retailer or electricity entity, as may be appropriate in the relevant jurisdiction.
- *Embedment Material:* Includes bedding, haunch support and overlay material;
- *Emitter:* A device used to control the rate at which water is applied to a specific area.
- *Equal:* Equivalent in performance, quality, and approved.
- *FBS-1 (fibre-bio-soluble) Mineral Wool:* Insulation composed of bio-soluble glass or rock fibres.

- *Fire Resistance Level (FRL):* The grading periods in minutes determined in accordance with the BCA Volume 1, for the following criteria:
    - Structural adequacy;
    - Integrity; and
    - Insulation, and expressed in that order.
- *General Access Area:* Areas that are generally accessed by Inmates
- *Geotechnical Site Investigation:* The process of evaluating the geotechnical characteristics of the site in the context of existing or proposed construction.
- *Give Notice:* Give notice, submit, advise, inform and similar expressions mean give notice (submit, advise, inform) in writing to the contract administrator.
- *Heated Water:* Water that has been intentionally heated. It includes hot water and warm water.
- *High Level Interface:* Systems transfer information in a digital format using an open system interface.
- *High Needs Areas:* Individual segregation cells or cell blocks
- *Hot-dip Galvanized:* Zinc coated to AS/NZS 4680 after fabrication with coating thickness and mass to AS/NZS 4680.
- *Hydraulic Engineer:* Northrop Consulting Engineers Pty Ltd.
- *Ingress Protection:* IP, IP code, IP rating and similar expression have the same meaning as IP Code in AS 60529.
- *Local (Government) Authority:* A body established for the purposes of local government by or under a law applying in a state or territory.
- *Manufacturer's Recommendations:* Recommendations, instructions, requirements, specifications (and similar expressions) provided in written or other form by the manufacturer and/or supplier relating to the suitability, use, installation, storage and/or handling of a product.
- *Materials:* All plant, instruments, components, equipment, assemblies and sub-assemblies, parts and other items required for permanent incorporation of the works.
- *Material R-value:* The thermal resistance (m2.K/W) of a component calculated in conformance with AS/NZS 4859.1. Material R-Value does not include air space or surface resistances;
- *May:* Means that there is an option.
- *Metallic-coated:* Steel coated with zinc or aluminium-zinc alloy as follows:
- *NCC:* The National Construction Code, which comprises the Building Code of Australia - Volumes 1 and 2, and the Plumbing Code of Australia - Volume 3.
- *Obtain:* Obtain, seek and similar expressions mean obtain (seek) in writing from the contract administrator.
- *Periodic Maintenance:* Planned routine maintenance of plant and equipment (proactive), including fire safety measures and statutory requirements.
- *Pipe:* Includes pipe and tube.

- *Piping or Pipework:* An assembly of pipes, with or without valves or other fittings, connected for the conveyance of liquids and gases.
- *Pipe Surround:* Includes pipe overlay, pipe side support, side zone and haunch zone.
- *Practical Completion or Defects Free Completion:* The requirements for these stages of completion are defined in the relevant building contract for the project.
- *Principal:* Principal has the same meaning as owner, client and proprietor and is the party to whom the contractor is legally bound to construct the works.
- *Inmate:* A person sentenced or awaiting sentencing by the Court to a term of imprisonment to be detained in a prison.
- *Professional Engineer:* As defined by the BCA.
- *Proprietary:* Identifiable by naming the manufacturer, supplier, installer, trade name, brand name, catalogue or reference number.
- *Prototype:* A full size mock-up of components, systems or elements to demonstrate or test construction methods, junctions and finishes, and to define the level of quality.
- *Provide:* Provide and similar expressions mean supply and install and include development of the design beyond that documented.
- *Record Drawings:* Record drawings has the same meaning as as-installed drawings, as-built drawings and work-as-executed drawings.
- *Referenced Documents:* Standards and other documents whose requirements are included in this specification by reference.
- *Registered Testing Authority:* An organisation registered by the National Association of Testing Authorities (NATA) to test in the relevant field; or
    - An organisation outside of Australia registered by an authority recognised by NATA through a mutual recognition agreement; or
    - An organisation recognised as being a Registered Testing Authority under legislation at the time the test was undertaken.
- *Repairs:* Unplanned/corrective maintenance (reactive).
- *Replace/replacement:* Exchange of components on a regular cycle on a like for like basis, e.g. repainting, replacement of valves etc.
- *Required:* Required by the contract documents, the local council or statutory authorities.
- *If Required:* A conditional specification term for work which may be shown in the documents or is a legislative requirement.
- *Rock:* Monolithic material with volume greater than 0.5 m3 which cannot be removed until broken up by rippers or percussion tools.
- *Sample:* A physical example that illustrates workmanship, materials or equipment, and establishes standards by which the work will be judged. It includes samples, prototypes and sample panels.
- *Shall:* Means that the statement is mandatory.
- *Should:* Means that the statement is recommended.

- *Site:* The lands and other places on, under, in or through which the works are to be carried out by the Contractor.
- *Site Classification:* To BCA 3.2.4.
- *Site Topsoil:* Soil excavated from the site which contains organic matter, supports plant life, conforms generally to the fine to medium texture classification to AS 4419 (loam, silt, clay loam) and is free from:
    - Stones more than 25 mm diameter;
    - Clay lumps more than 75 mm diameter;
    - Weeds and tree roots;
    - Sticks and rubbish;
    - Material toxic to plants.
- *Specification:* This document.
- *Statutory Authority:* A public sector entity created by legislation, that is, a specific law of the Commonwealth, State or Territory.
- *Sterile Area:* An area in which Inmates do not access under normal circumstances.
- *Supply:* Supply, furnish and similar expressions mean supply only.
- *Superintendent:* The person as nominated by the Project Manager or as nominated in the main building contract.
- *Tests – Completion:* Tests carried out on completed installations or systems and fully resolved before the date for practical completion, to demonstrate that the installation or system, including components, controls and equipment, operates correctly, safely and efficiently, and meets performance and other requirements. The superintendent may direct that completion tests be carried out after the date for practical completion.
- *Tests – Pre-completion*: Tests carried out before completion tests, including: Production: Tests carried out on a purchased item, before delivery to the site.
    - *Progressive:* Tests carried out during installation to demonstrate performance in conformance with this specification.
    - *Site:* Tests carried out on site.
    - *Type:* Tests carried out on an item identical with a production item, before delivery to the site.
- *Tolerance:* The permitted difference between the upper limit and the lower limit of dimension, value or quantity.
- *Verification:* Provision of evidence or proof that a performance requirement has been met or a default exists.
- *Waterproof:* The property of a material that does not allow moisture to penetrate through it
- *Water Resistant:* The property of a system or material that restricts moisture movement and will not degrade under conditions of moisture.
- *Zone of Influence:* A foundation zone bounded by planes extending downward and outward from the bottom edge of a footing, slab or pavement and defining the extent of foundation material having influence on the stability or support of the footings, slab or pavement.

3.5 Contract Documents

3.5.1 Services Diagrammatic Layouts

General: Layouts of service lines, plant and equipment shown on the drawings are diagrammatic only, except where figured dimensions are provided or calculable.

Before Commencing Work:

- Obtain measurements and other necessary information;
- Coordinate the design and installation in conjunction with all trades.

3.5.2 Levels

General: Spot levels take precedence over contour lines and ground profile lines.

3.5.3 Drawings and Manuals for Existing Services

Warranty: No warranty is given as to the completeness or accuracy of drawings and/or manuals of existing services.

3.6 Scope of Works

3.6.1 Design and Construct Contractor Responsibilities

Design by Contractor: The services shall be undertaken on a Design and Construct basis where it is the Contractor's responsibility to be completely aware of all project requirements incorporated in the design intent documents. The Contractor is to ensure that all obligations with respect to the brief are met, including design and installation, and the performance requirements of the design intent documentation. The contractor shall use only appropriately qualified persons and conform to all statutory requirements.

Design Development: The works include development of the design beyond that documented, as required. The accompanying design and construct hydraulic service indicate the spatial allowances, design concepts, hydraulic risers, and main hydraulic pipework reticulation in principle. The accompanying documentation is not reflective nor designed to the level of required of 'For Construction' documentation. It is the Contractors responsibility to further advance the design intent documentation to complete the final design package in coordination with all other contract documentation of other trade and disciplines.

Design for Durability: Develop the design so the systems achieve the documented performance, reliability, service life, energy efficiency and safety requirements, and are easily maintainable.

Access for Maintenance: Develop the design so the systems conform to Access for Maintenance.

Conflict with the Documents: If it is believed that a conflict exists between statutory requirements and the documents, notify the contract administrator immediately and provide a recommendation to resolve the conflict.

3.6.2 Contractor Documentation Submissions

Requirement: The Contractor shall be responsible for developing the hydraulic design documentation to completion, as deemed acceptable by the Principal:

- Contractor submission schedules;
- Workshop drawing submission schedule;
- Coordinated workshop drawings;

- Coordinated structural penetration drawings;
- Material and equipment schedules;
- Detailed hydraulic calculations for each hydraulic services system;
- Sanitary fixture, fitting, and tapware schedule;
- Testing and commissioning procedures;
- Testing and commissioning records;
- As-built drawings;
- Operation and maintenance manuals;
- Design certification;
- Installation certification.

3.6.3 Design and Construct Documentation Obligation

Requirement: The Contractor shall be responsible for developing the hydraulic design documentation to completion, as deemed acceptable by the Principal:

- Update of all documentation to the most current architectural layouts;
- Final confirmation of adequacy of spatial allocations;
- Size and locations of penetrations in walls and floors;
- Final coordination with all architectural layouts and all structural beams and columns;
- Workshop drawings drawn in 1:100 scale;
- Final coordination with all other services including, but not limited to, Mechanical, Electrical, Fire, Audio-Visual, Food Services, Security, Landscaping, and Vertical Transport;
- Finalisation of utility service connections including, but not limited to, stormwater, sewer, water, gas, and fire protection services;
- Final sizing of all pipework and associated hydraulic services plant including detailed design calculations.

Authority Regulations: The whole of the works shall comply with all the latest relevant Regulations and to all Local Authority requirements. The cost of any materials or equipment required to meet such regulations and requirements shall be included in the tender whether specially shown or described in the documents or not.

Materials: All materials and equipment shall be the best quality of their respective kinds, complying with the relevant Australian Standards. All materials and equipment shall be new and shall be delivered to the site with the manufacturer's label intact.

Scope of Works: The extent of the hydraulics work covered in this Specification and as shown on the accompanying drawings consist of the following systems and services;

- Sanitary Plumbing and Drainage;
- Trade Waste Drainage;
- Stormwater Drainage;

- Siphonic Roof Drainage;
- Cold Water Service;
- Hot Water Service;
- Rainwater Re-use Water Service;
- Landscape Irrigation;
- Fuel Gas Service;
- Fire Hydrant Service;
- Fire Hose Reel Service.

3.6.4 Work by Others

3.6.4.1 Building Trade

- Review of the hydraulic services documentation to establish the requirements of the Building Contractor;
- Access panels and inspection panel to hydraulic services equipment in walls and ceilings;
- Cutting holes in finished surfaces, timber, cupboards, false ceilings, vanity units and shelves;
- Provision of all shower bases and hobs;
- Overflow provisions from roof, terrace, and balcony areas;
- All concrete sumps that form part of the concrete floor slabs of the building or are constructed on top of concrete floor slabs of the building;
- All concrete sumps and grated drains that form part of the structural floor slab on suspended floors of the building;
- Forming up and construction of concrete hobs around pipe slot floor penetrations in pumpset enclosure floors;
- Concealment of exposed downpipes, sanitary stacks, vent pipes, etc.;
- Construction of spoon drains, channel drains, or dish drains complete with falls to the outlets provided by the Hydraulic Contractor;
- Saw cutting and reinstatement of concrete surfaces;
- Concrete plinth to cold water service booster pumpset;
- Floor slabs and grading in cold water service booster pumpset enclosure;
- Concrete plinth to the fire brigade booster installation;
- Concrete plinth to the fire hydrant service booster pumpset;
- Floor slabs and grading in fire hydrant service booster pumpset enclosure.

3.6.4.2 Electrical Trade

- Review of the hydraulic services documentation to establish the requirements of the Electrical Contractor;
- Essential power supply to stormwater drainage service submersible pumpset;

- Power supply to sanitary drainage service submersible pumpset;
- Power supply to trade waste drainage service oil/water separator;
- Power supply to cold water service booster pumpset;
- Power supply to hot water service water heating plant;
- Power supply to hot water service water circulator pumpset;
- Power supply to hot water service boiling, chilled and filtered water dispensers;
- Power supply to rainwater re-use water service submersible pumpset;
- Electrical supply to gas automatic safety shutdown valve from the emergency essential supply;
- Electrical supply to gas leak detector from the emergency essential supply. Supply and install alarm bell and flashing light for leak detector;
- Power supply to gas and hot water meter MDL's including associated communication wiring and telephone point adjacent master MDL;
- Essential power supply to fire hydrant service booster pumpset (including wiring from pump panels to FIP and remote pump start switch located within the fire brigade booster enclosure);
- Emergency lighting to fire brigade booster enclosure;
- Emergency lighting to fire hydrant booster pumpset enclosure;
- Temporary power supply during construction.

3.6.4.3 Mechanical Trade

- Review of the hydraulic services documentation to establish the requirements of the Mechanical Contractor;
- Provision of water and/or gas demand information for all mechanical plant to enable correct sizing of hydraulic services provisions;
- Provision of drainage location information for all mechanical plant to enable coordination of hydraulic services drainage provisions;
- Provision of drainage location information for all mechanical plant to enable coordination of hydraulic services drainage provisions (condensate drainage to tundishes, trapped tundishes, floor wastes, etc.);
- Mechanical ventilation of grease arrestor enclosures;
- Provision of cold water demand information for all mechanical plant to enable correct sizing of hydraulic services provisions;
- Extension and connection of water services from isolation valve provision provided by Hydraulic Engineer to mechanical plant and equipment;
- Mechanical ventilation of cold water service booster pumpset enclosure;
- Mechanical ventilation of hot water service water heating plant enclosure;
- Provision of fuel gas demand information for all mechanical plant to enable correct sizing of hydraulic services provisions;

- Extension and connection of fuel gas services from isolation valve provision provided by Hydraulic Contractor, including gas train to mechanical plant and equipment;
- Mechanical ventilation and interlock with gas service to AS 5601 for enclosures where gas meters and/or regulators are installed;
- Mechanical ventilation of fire hydrant service booster pumpset enclosure.

3.6.4.4 Fire Sprinkler Trade

- sReview of the hydraulic services documentation to establish the requirements of the Fire Sprinkler Contractor;
- Extension and connection of fire sprinkler service from capped Table E flange provision provided by Hydraulic Contractor;
- 24 volt wiring from the FIP to the fire hydrant service booster pumpset;
- 24 volt wiring from the FIP to the gas safety shutdown valve.

3.7 Expectations of the Tenderer

General: This Specification is based on the understanding that the tenderer possesses the trade expertise necessary to complete the works. The Contractor is deemed to have thoroughly reviewed all relevant drawings and specification and identified, at the time of submitting the tender, the following:

- Clauses within the Specification or information on the drawings, which require interpretation;
- Issues that required design input or clarification from the Hydraulic Engineer. These will include the clarification of any issues raised by the tenderer's suppliers or it's sub-contractors in respect of the equipment proposed or the proposed method of operation of any of the proposed equipment;
- Omissions from either the specification or the drawings;
- Inconsistencies or discrepancies in the scale or definition of drawings;
- Specification or drawing items, which may be in conflict. Seek direction from the Hydraulic Engineer as to the item to take precedence;
- Deviations or alternatives proposed by the Contractor. In identifying the proposed deviations, the Contractor shall factor into its cost estimate the fees that may be claimed by the Hydraulic Engineer for the analysis of any proposed alternative. The Contractor shall provide a comprehensive report on any alternative in support of the proposal.

3.8 Submissions

3.8.1 Requirement

General: Submit the following, as documented:

- Authority Approvals: Notes of meetings with authorities whose requirements apply to the work and evidence that notices, fees and permits have been sought and paid, that authority connections are complete and that statutory approvals by the authorities whose requirements apply to the work have been received.
- Building Penetrations: Details of the methods to maintain the required structural, fire and other properties to Building Penetrations;

- Certification: Certification of conformance to documented requirements, including certification that the plant and equipment submitted meets all requirements of the contract documents and that each installation is operating correctly;
- Design Documentation: Design data and certification of proposed work, if required and as documented;
- Execution Details: Execution programs, schedules and details of proposed methods and equipment. For building services include the following:
    - Embedded Services: Proposed method for embedding services in concrete walls or floors or chasing into concrete or masonry walls;
    - Fixing of Services: Typical details of locations, types and methods of fixing services to the building structure;
    - Inaccessible Services: If services will be enclosed and not accessible after completion, submit proposals for location of service runs and fittings.
- Marking and Labelling: Samples and schedules of proposed marking and labels to Marking and Labelling;
- Operation and Maintenance Manuals: For the whole of the work to Operation and Maintenance Manuals;
- Products: Products and materials data, including manufacturer's technical specifications and drawing, evidence of conformance to product certification schemes, performance and rating tables and installation and maintenance recommendations;
- Prototypes: Prototypes of components, systems or elements;
- Records: As-built documents, photographs, system diagrams, schedules and logbooks to Record Drawings;
- Samples: Representative of proposed products and materials and including proposals to incorporate samples into the works, if any to Samples;
- Shop drawings: To Shop Drawings;
- Substitutions: To Substitutions;
- Tests:
    - Inspection and testing plan consistent with the construction program including details of test stages and procedures;
    - Certificates for type tests;
    - Fire hazard properties: Evidence of conformance of proposed proprietary products to documented requirements for fire hazard properties;
    - Test reports for testing performed under the contract to Tests.
- Warranties: To Warranties.

Contractor Review: Before submissions, review each submission item and check for coordination with other work of the contract and conformance to contract documents.

3.8.2 Certification

Requirement: Submit certification that the plant and equipment submitted meets the requirements and capacities of the contract documents except for departures that are identified in the submission.

3.8.3 Electrical Loading

Loading: Submit for all equipment before completion of the main switchboard shop drawings.

Loading and Connection: Submit the information for items not supplied from the services switchboards.

Starting Characteristics: Submit details for motors with reduced current starting. Make sure starting characteristics are within the characteristics of the respective submain protection devices.

Switchboards: Submit the following information for each building services switchboard:

- Board location and designation.

For each submain connected to the board, submit the following for each item connected to it:

- Submain designation;
- Item designation and name;
- Power rating in kW;
- Number of phases;
- Full load amps per phase;
- Power factor;
- Total amps on each phase for respective sub main.

3.8.4 Maintenance Program

General: Submit details of maintenance procedures and program, relating to installed plant and equipment, 6 weeks before the date for practical completion. Indicate dates of service visits. State contact telephone numbers of service operators and describe arrangements for emergency calls.

3.8.5 Products and Materials

Equipment: Documented pump heads are based on provisional equipment selections and estimated pressure drops. Before ordering equipment, calculate the respective system pressure losses based on the equipment offered and layouts shown on the shop drawings and submit the proposed selections.

Data: Submit technical data for all items of plant and equipment, including the following:

- Assumptions;
- Calculations;
- Model name, designation and number;
- Capacity of all system elements;
- Country of origin and manufacture;
- Materials used in the construction;
- Size, including required clearances for installation;
- Certification of conformance to the applicable code or standard;
- Technical data schedules corresponding to the equipment schedules in the contract documents. If there is a discrepancy between the two, substantiate the change;

- Manufacturers' technical literature;
- Type test reports.

3.8.6 Submission Times

Default Timing: Make submissions at least 5 working days before ordering products or starting installation of the respective portion of the works.

Submission Response Times: Allow in the construction program for at least the following times:

- Shop Drawings: Two (2) working days.
- Samples and Prototypes: Two (2) working days.
- Manufacturers' or Suppliers' Recommendations: Two (2) working days.
- Product Data: Two (2) working days.
- Product/Design Substitution or Modification: Two (2) working days.

Proposed Products Schedules: If major products are not specified as proprietary items, submit a schedule of those proposed for use within 3 weeks of site possession.

3.8.7 Identification

Requirement: Identify the project, contractor, subcontractor or supplier, manufacturer, applicable product, model number and options, as appropriate and include relevant contract document references. Include service connection requirements and product certification.

Non-conformance: Identify proposals that do not conform to project requirements, and characteristics which may be detrimental to successful performance of the completed work.

3.8.8 Errors

Errors: If a submission contains errors, make a new or amended submission as appropriate, indicating changes made since the previous submission.

3.9 Hydraulic Engineer Inspections

3.9.1 General

Requirement: The installation of hydraulic services and related items is subject to periodic inspections from the Hydraulic Engineer on behalf of the client. The intent of these inspections is to:

- Provide the client with an overview of the quality and progression of the hydraulic installation;
- Ensure an acceptable standard of workmanship is maintained;
- Compliance is met with Australian Standards and the Local Plumbing Authority's requirements;
- Ensure the installation of services is congruent to the hydraulic documentation and suitable for its intended purpose.

Inspection Report: The results of the inspections will be documented in a report which is issued to the client and will outline any inconsistencies with the contract documentation and/or applicable regulatory requirements.

Response to Report: Upon receipt of the report it is the responsibility of the hydraulic Contractor to:

- Acknowledge receipt of the report within 7 days;
- Remediate each item within the report as indicated;
- Provide photographic evidence and certification proving the rectification work has occurred in a manner deemed satisfactory by the Hydraulic Engineer.

3.9.2 Notice

Concealment: If notice of inspection is required for parts of the works that are to be concealed, advise when the inspection can be made before concealment.

Tests: Give notice of the time and place of documented tests.

Minimum Notice: 48 hours.

3.9.3 Light Levels

Requirement: To AS/NZS 1680.2.4.

3.9.4 Attendance

General: Provide attendance for the entirety of inspections and tests.

3.10 Installation

3.10.1 Accessories

General: Provide the accessories and fittings necessary for the proper functioning of the systems, including taps, valves, outlets, pressure and temperature control devices, strainers, gauges and pumps.

Isolating Valves: In addition to valves required to meet statutory requirements, provide valves to allow safe isolation of parts of the system, with minimum inconvenience to the building occupants, in event of leaks or maintenance.

3.10.2 Connections to Network Utility Operator Mains

General: Excavate to locate and expose the connection points and connect to the network utility operator mains. On completion, backfill and compact the excavation and reinstate surfaces and elements which have been disturbed such as roads, pavements, kerbs, footpaths and nature strips.

General: If the network utility operator elects to perform or supply part of the works, make the necessary arrangements. Install equipment supplied, but not installed, by the authorities.

3.11 Support of Plant and Equipment

3.11.1 Support of Roof Mounted Plant and Equipment

Due to the nature of the facilities hydraulic equipment shall not be roof mounted unless directed by the client

3.11.2 Support of Ground Level Plant and Equipment

Ground Level:

- If the ground slope is 15° or over, or the area of the plant and equipment is extensive, obtain the advice of a professional engineer for the documentation of a suitable slab or platform;

- In all other cases, provide proprietary plastic or concrete supports installed with falls that achieve a raised, impervious and water shedding bearing surface.

Protection & Security: All hydraulic plant equipment shall be located in a secure manner within a locked cupboard, duct or plantroom.

3.12 Products

3.12.1 Manufacturers' or Suppliers' Recommendations

General: Provide and select, if no selection is given, transport, deliver, store, handle, protect, finish, adjust and prepare for use the manufactured items in conformance with the recommendations of the manufacturer or supplier.

Proprietary Items/Systems/Assemblies: Assemble, install or fix to substrate in conformance with the recommendations of the manufacturer or supplier.

Project Modifications: Advise of activities that supplement, or are contrary to the recommendations of the manufacturers or supplier.

3.12.2 Sealed Containers

General: If materials or products are supplied by the manufacturer in closed or sealed containers or packages, bring the materials or products to point of use in the original containers or packages.

3.12.3 Prohibited Materials

General: Do not provide the following:

- Materials, exceeding the limits of those listed, in the Safe Work Australia Hazardous Substances Information System (HSIS);
- Materials that use chlorofluorocarbon (CFC) or hydro chlorofluorocarbon (HCFC) in the manufacturing process.

3.12.4 Substitutions

Identified Proprietary Items: Identification of a proprietary item does not necessarily imply exclusive preference for the identified item, but indicates the necessary properties of the item.

Alternatives: If alternatives to the documented products, methods or systems are proposed, submit sufficient information to permit evaluation of the proposed alternatives, including the following:

- Evidence that the performance is equal to or greater than that specified;
- Evidence of conformity to a cited standard;
- Samples;
- Essential technical information, in English;
- Reasons for the proposed substitutions;
- Statement of the extent of revisions to the contract documents;
- Statement of the extent of revisions to the construction program;
- Statement of cost implications including costs outside the contract;

- Statement of consequent alterations to other parts of the works.

Availability: If the documented products or systems are unavailable within the time constraints of the construction program, submit evidence.

Criteria: If the substitution is for any reason other than unavailability, submit evidence that the substitution:

- Is of net enhanced value to the principal;
- Is consistent with the contract documents and is as effective as the identified item, detail or method.

3.13 Materials and Components

3.13.1 Consistency

General: For each material or product use the same manufacturer or source and provide consistent type, size, quality and appearance.

3.13.2 Corrosion Resistance

General: Conform to the following atmospheric corrosivity category as defined in AS 4312 and the AS/NZS 2312 series.

3.13.3 Galvanizing

Severe Conditions: Galvanize mild steel components (including fasteners) to AS 1214 or AS/NZS 4680 as appropriate, if:

- Exposed to weather;
- Embedded in masonry;
- Exposed to or in air spaces behind the external leaf of masonry walls;
- In contact with chemically treated timber, other than copper chrome arsenate (CCA).

3.14 Samples

Incorporation of Samples: Only incorporate samples in the works which have been endorsed for inclusion. Do not incorporate other samples.

Retention of Samples: Keep endorsed samples in good condition on site, until the date of practical completion.

Unincorporated Samples: Remove on completion.

3.15 Shop Drawings

Standard: To AS 1100.101, AS 1100.201, AS 1100.301, AS 1100.401 and AS/NZS 1100.501 as applicable.

Requirement: Submit detail drawings at minimum 1:100 scale, showing the following:

- Pipework and equipment layout and sections showing the work to be installed on the level that the services are installed. Do not submit glass floor drawings;
- Long sections of below ground drainage;
- Riser layouts and sections;
- Piping and other schematic drawings including numbering of each valve to correspond to valve tags notation;

- Inclusions: Include the following on the drawings:
    - Access openings, cover plates, valve boxes and access pits;
    - Details of control panels including control and power diagrams;
    - Insulation of piping, fittings and tanks;
    - Location, capacity, type and other relevant details of water heaters, including supports and safe trays;
    - Location, type, grade and finish of piping, fittings, valves, meters and pipe supports;
    - Provision of a temporary fire hydrant service in the construction period;
    - Provision of blue metal back fill to seepage drain system;
    - Provision of trafficable cover plates in the public domain;
    - Relevant survey levels;
    - Site and floor set out points;
    - Tank stands and supporting structures.

Documentation: Include dimensioned drawings showing details of the fabrication and installation of structural elements, building components, services and equipment, including relationship to building structure and other services, cable type and size, and marking details.

Diagrammatic Layouts: Coordinate work shown diagrammatically in the contract documents, and prepare dimensioned set-out drawings.

Record Drawings: Amend all documented shop drawings to include changes made during the progress of the work and up to the end of the defects liability period.

Services Coordination: Coordinate with other building and service elements. Show adjusted positions on the shop drawings.

Space Requirements: Check space and access for maintenance requirements of equipment and services indicated diagrammatically in the contract documents.

Submission Medium: .pdf, .dwg, and .rvt.

Drawing Size: A3 minimum.

3.16 Off-site Disposal

Removal of Material: Dispose of building waste material off site to the requirements of the relevant authorities.

3.17 Wall Chasing

3.17.1 Holes and Chases

General: If holes and chases are required in masonry walls, make sure structural integrity of the wall is maintained. Do not chase walls nominated as fire-resistance or acoustic rated.

Parallel Chases or Recesses on Opposite Faces of a Wall: Not closer than 600 mm to each other.

Chasing in Blockwork: Only in core-filled hollow blocks or in solid blocks which are not designated as structural.

3.17.2 Concrete Blockwork Chasing Table

Block Thickness (mm)	Maximum Depth of Chase (mm)
190	35
140	25
90	20

3.18 Fixing

3.18.1 General

Suitability: If equipment is not suitable for fixing to non-structural building elements, fix directly to structure and trim around penetrations in non-structural elements.

3.18.2 Fasteners

General: Use proprietary fasteners capable of transmitting the loads imposed, and sufficient for the rigidity of the assembly.

All fasteners in used in General Areas and High Needs Areas shall be of the security type. Product samples to be supplied to the Client for approval prior to procurement and installation.

3.19 Services Installation

3.19.1 General

Fixing: If non-structural building elements are not suitable for fixing services to, fix directly to structure and trim around holes or penetrations in non-structural elements.

Installation: Install equipment and services plumb, fix securely and organise reticulated services neatly. Allow for movement in both structure and services.

Concealment: Unless otherwise documented, conceal all cables, ducts, trays and pipes except where installed in plant spaces, ceiling spaces and riser cupboards. If possible, do not locate on external walls.

Lifting: Provide heavy items of equipment with permanent fixtures for lifting as recommended by the manufacturer.

Suspended Ground Floors: Keep all parts of services under suspended ground floors at least 150 mm clear of the ground surface. Make sure services do not impede access.

Arrangement: Arrange services so that services running together are parallel with each other and with adjacent building elements.

3.19.2 Dissimilar Metals

General: Join dissimilar metals with fittings of electrolytically compatible material.

3.19.3 Temporary Capping

Pipe Ends: During construction protect open ends of pipe with metal or plastic covers or caps.

3.19.4 Piping

General: Install piping in straight lines at uniform grades without sags. Arrange to prevent air locks. Provide sufficient unions, flanges and isolating valves to allow removal of piping and fittings for maintenance or replacement of plant.

Spacing: Provide at least 25 mm clear between pipes and between pipes and building elements, additional to insulation.

Changes of Direction: Provide long radius elbows or bends and sets where practicable, and swept branch connections. Provide elbows or short radius bends where pipes are led up or along walls and then through to fixtures. Do not provide mitred fittings.

Vibration: Arrange and support piping so that it remains free from vibration whilst permitting necessary movements. Minimise the number of joints.

Embedded Pipes: Do not embed pipes that operate under pressure in concrete or surfacing material.

Valve Groupings: If possible, locate valves in groups.

Pressure Testing Precautions: Isolate items not rated for the test pressure. Restrain pipes and equipment to prevent movement during pressure testing.

3.19.5 Differential Movement

General: If the geotechnical site investigation report predicts differential movements between buildings and the ground in which pipes or conduits are buried, provide control joints in the pipes or conduits, as follows:

- Arrangement: Arrange pipes and conduits to minimise the number of control joints;
- Magnitude: Accommodate the predicted movements.

3.20 Building Penetrations

3.20.1 Penetrations

Requirement: Maintain the required structural, fire and other properties when penetrating or fixing to the following:

- Structural building elements including external walls, fire walls, fire doors and access panels, other tested and rated assemblies or elements, floor slabs and beams;
- Membrane elements including damp-proof courses, waterproofing membranes and roof coverings. If penetrating membranes, provide a waterproof seal between the membrane and the penetrating component.
- All penetrations through walls shall be designed to ensure they meet the security requirements. This specifically applies to cell and bedroom walls. Apertures and the like shall be sized, aligned and detailed such that;
    - They provide as neat a fit as practically possible around the penetrating element;
    - The surrounding wall/element is reinforced to prevent the aperture being enlarged to form a breach;
    - Secure sealing can be installed between the walls/element and the penetrating element;
    - The number of access points for servicing fixtures is minimised and they are located where they can be routinely surveilled to reduce the risk of tampering and facilitate the adoption of secure maintenance procedures.

3.20.2 Sealing

Fire-resisting Building Elements: Seal penetrations with a system conforming to AS 4072.1.

Non Fire-resisting Building Elements: Seal penetrations around conduits and sleeves. Seal around cables within sleeves. If the building element is acoustically rated, maintain the rating.

3.20.3 Sleeves

General: If piping or conduit penetrates building elements, provide metal or PVC-U sleeves formed from pipe sections as follows:

- Movement: Arrange to permit normal pipe or conduit movement;
- Diameter (for non-fire resisting building elements): Sufficient to provide an annular space around the pipe or pipe insulation of at least 12 mm;
- Prime paint ferrous surfaces;
- Terminations:
    - If cover plates are fitted: Flush with the finished building surface;
    - In fire-resisting and acoustic rated building elements: 50 mm beyond finished building surface;
    - In floors draining to floor wastes: 50 mm above finished floor;
    - Elsewhere: 5 mm beyond finished building surface;
    - Termite management: To AS 3660.1.
- Thickness:
    - Metal: 1 mm or greater;
    - PVC-U: 3 mm or greater.

Sleeves for Cables: For penetrations of cables not enclosed in conduit through ground floor slabs, beams and external walls provide sleeves formed from PVC-U pipe sections.

3.21 Fire-stopping

3.21.1 Standards

Service Penetration Fire-stopping Systems: To BCA C3.15.

Control Joint Fire-stopping Systems: To AS 4072.1.

3.21.2 Submissions

3.21.2.1 Execution Details

General: Give notice, if substrates or penetrants or both are not suitable for fire-stopping.

3.21.2.2 Operation and Maintenance Manuals

General: For fire-stopping systems which are intended to be modified in service, submit a user manual.

3.21.2.3 Products and Materials

General: If fire-stopping is documented without reference to brand, submit the following:

- Evidence that systems conform to documented requirements;
- Copies of relevant manufacturers' instructions;
- Safety data sheets (SDS).

Type Tests: Submit type test certificates for each combination of fire-stopping system, application, type of service, substrate, penetration orientation, and drawings of tested details. Include for:

- Service penetration fire-stopping systems: Fire-resistance tested to AS 1530.4;
- Fire-stop mortars: Resistance to explosive spalling to AS 1774.36;
- Control joint fire-stopping systems: Fire-resistance tested to AS 1530.4.

3.21.2.4 Samples

Sample Panels: Supply a sample panel of each fire-stopping assembly, on representative substrates. If built into the works, identify by marking it as a control sample.

Size: 500 mm run for junction seals and 500 x 500 mm area for penetration seals.

3.21.2.5 Subcontractors

General: Submit names and contact details of proposed suppliers and installers.

3.21.3 Inspection

Notice: Give notice so that inspection may be made of the following:

- Service penetrations completed and ready for fire-stopping;
- Finished fire-stopping, before being concealed.

3.21.4 Materials

3.21.4.1 General

Shelf Life: Use materials that have not exceeded their shelf life.

Toxic Materials: Free of asbestos and lead and free of, nor requiring the use of, toxic solvents.

Toxicity in Fire: Non-toxic.

3.21.4.2 Fire-Stop Mortars

Type: Re-enterable cement-based compound, mixed with water. Non-shrinking, moisture resistant. Insoluble in water, after setting.

3.21.4.3 Formulated Compound of Incombustible Fibres

Material: Formulated compound mixed with mineral fibres, non-shrinking, moisture resistant. Insoluble in water after setting.

3.21.4.4 Fibre Stuffing

Material: Mineral fibre stuffing insulation, dry and free of other contaminants.

Standard: AS/NZS 4859.1 Section 8.

3.21.4.5 Fire-Stop Sealants

Material: Elastomeric sealant. Soft, permanently flexible, non-sag, non-shrinking, moisture resistant. Capable of providing a smoke-tight, gas-tight and waterproof seal when properly installed. Insoluble in water after setting.

3.21.4.6 Fire-Stop Foams

Material: Single component compound of reactive foam ingredients, non-shrinking, moisture resistant. Insoluble in water after setting.

3.21.4.7 Fire-Stop Putty

Material: Single component, mouldable, permanently flexible, non-shrinking, moisture resistant, intumescent compound which conforms to the following:

- Expands on exposure to surface heat gain to form a high-volume thermally insulating char that closes gaps and voids;
- Resists the turbulence of a severe fire;
- Can be placed by hand to form an immediate fire seal;
- Insoluble in water after setting.

3.21.4.8 Product Certification

Conformance: Address the following:

- Statutory and performance requirements;
- Adequacy of application/installation.

Appointment: In the joint names of the contractor and the principal.

3.21.5 Installation

3.21.5.1 General

Extent: Fire-stop and smoke-stop interruptions to fire-resistance rated assemblies, materials and components, including penetrations through fire-resisting elements, breaks within fire-resisting elements (e.g. expansion joints), and junctions between fire-resisting elements.

Sequence: Fire-stop after services have been installed through penetrations and properly spaced and supported, after sleeving where appropriate, and after removal of temporary lines, but before restricting access to the penetrations, including before dry lining.

Ventilation: Supply ventilation for non-aqueous solvent-cured materials.

Density: Apply fire-stopping material to a uniform density.

Fire-stopping Exposed to View: Finish surfaces to a uniform and level condition.

Protection: Protect adjacent surfaces from damage arising through installation of fire-stopping. Protect completed fire-stopping from damage arising from other work.

Loose or Damaged Fire-stopping Material: Remove and replace.

Penetrations by Pipes: Allow for thermal movement of the pipes.

Preventing Displacement: Reinforce or support fire-stopping materials with non-combustible materials when:

- The unsupported span of the fire-stopping materials is greater than 100 mm;
- The fire-stopping materials are non-rigid (unless shown to be satisfactory by test).

Large Openings: Provide fire-stopping capable of supporting the same loads as the surrounding element or provide similar structural support around the opening.

3.21.5.2 Preparation

Cleaning: Clean substrates of dirt, dust, grease, oil, loose material, and other matter which may affect the bond of fire-stop material.

Primer: Clean and dry substrates for primers and sealants.

Restraint: Install backing and/or damming materials to arrest liquid material leakage. Remove temporary dams after material has cured.

3.21.6 Systems

3.21.6.1 Fire-Stop Mortars

Ambient Conditions: Do not install below 5°C.

3.21.6.2 Fibre Stuffing

Installation: Compress to 40% of its uncompressed volume.

3.21.6.3 Fire-stop Sealants

Ambient Conditions: Do not store above 32°C. Do not install outside the temperature range recommended by the sealant manufacturer. Do not install when humidity exceeds that recommended by the sealant manufacturer for safe installation.

3.21.6.4 Fire-stop Foams

Ambient Conditions: Do not store above 32°C. Do not install below 15°C or above 32°C. Do not apply when temperature of substrate and air is below 15°C. Maintain this minimum temperature before, during and for 3 days after installation.

Installation: Test substrates for adhesion and prime if necessary. Place in layers for homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.

3.21.6.5 Fire-stop Putty

Ambient Conditions: Do not install below 5°C. Do not allow the material to freeze.

3.21.6.6 Fire-stop Collars

Material: Mechanical device with incombustible intumescent fillers covered with sheet steel jacket. Airtight and watertight.

3.21.6.7 Fire-stop Pillows

Material: Formed self-contained compressible flexible mineral fibre in cloth bags, rated to permit frequent changes in service.

Ambient Conditions: Do not install in conditions outside the manufacturer's recommendations.

Installation Accessories: Provide clips, collars, fasteners, temporary stops and dams, and other devices required to position, support and contain fire-stopping and accessories.

3.21.6.8 Labelling

General: Label each fire-stopping installation with a permanently fixed tag or sticker containing the following information:

- Manufacturer's name;
- Name and address of installer;
- Date of installation.

3.21.7 Completion

Cleaning

Requirement: Remove spilled and excess fire-stopping materials without damaging other work.

3.22 Concrete Plinths

General: Provide concrete plinths under all equipment located on concrete floor slabs as follows:

- Height: 150 mm or greater
- Concrete: Grade N20;
- Finish: Steel float flush with the surround;
- Reinforcement: Single layer of F62 fabric;
- Surround: Provide galvanized steel surround at least 75 mm high and 1.6 mm thick. Fix to the floor with masonry anchors. Fill with concrete.

3.23 Support and Structure

Requirement: Provide incidental supports and structures to suit the services.

3.24 Plant and Equipment

Location: Locate so that failure of plant and equipment (including leaks) does not create a hazard for the building occupants and causes a minimum or no damage to the building, its finishes and contents including water sensitive equipment or finishes.

Safe Tray and an Overflow Pipe: Provide to each tank, hot water heater and storage vessel.

3.25 Access for Maintenance

3.25.1 Clearances

Minimum Clearances for Access: Conform to the following:

- ≥ 2100 mm clear vertically above horizontal floors, ground and platforms;
- Preferably ≥ 750 mm clear, but in no case less than 600 mm horizontally between equipment or between equipment and building features including walls;

- If tools are required to operate, adjust or remove equipment, provide sufficient space so that the tools can be used in their normal manner and without requiring the user to employ undue or awkward force;
- If equipment components are hinged or removable, allow the space recommended by the manufacturer;
- Within Plant Items: Conform to the preceding requirements, and in no case less than the clearances recommended In BS 8313.

3.25.2 Elevated Services Other Than in Occupied Areas

Access Classifications:

- Access Class A: Readily accessible. Provide clear and immediate access to and around plant items. If plant or equipment is located more than 1500 mm above the ground, floor or platform, provide a platform with handrails accessible by a stair, all to AS 1657.
- Access Class B: If the plant item requiring access is located more than 1500 mm above the ground, floor or platform, provide a platform with handrails accessible by a non-vertical ladder, all to AS 1657.
- Access Class C: Locate plant so that temporary means of access conforming to Work health and Safety regulations can be provided.

Temporary Means of Access: Make sure there is adequate provision in place which is safe and effective.

Areas in Which Access is Restricted to Authorised Maintenance Personnel: Provide access as follows:

- Instruments, Gauges and Indicators (Including Warning and Indicating Lights) Requiring Inspection at Any Frequency: Readily accessible;
- Access Required Monthly or More Frequently: Access Class A;
- Access Required Between Monthly and Six Monthly: Access Class A or B;
- Access Required Less Frequently Than Six Monthly: Access Class A, B or C.

Other Areas: Provide access as follows:

- Locate to minimise inconvenience and disruption to building occupants or damage to the building structure or finishes;
- In suspended ceilings, locate items of equipment that require inspection and/or maintenance above tiled parts. If not possible, provide access panels where located above set plaster or other inaccessible ceilings. Arrange services and plant locations to reduce the number of access panels. Coordinate with other trades to use common access panels where feasible;
- Do not locate equipment requiring access above partitions;
- Instruments, gauges and other items requiring inspection at any frequency: Readily accessible.

3.25.3 Facilities for Equipment Removal and Replacement

Requirement: Provide facilities to permit removal from the building and replacement of plant and equipment, including space large enough to accommodate it and any required lifting and/or transportation equipment. Arrange plant so that large and/or heavy items can be moved with the minimum of changes of direction.

Removal of Components: Allow sufficient space for removal and replacement of equipment components including air filters, tubes of shell and tube heat exchangers, removable heat exchanger bundles, coils and fan

shafts. Provide access panels or doors large enough to permit the safe removal and replacement of components within air handling units.

3.25.4 Facilities for Access

Equipment behind Hinged Doors: Provide doors opening at least 150° complete with anti-ligature stainless steel hinges.

Removable Panels: Provide panels with metal thread security screws. Provide handle free anti-ligature stainless steel access panels in non-sterile areas. Access panels or doors should be avoided in bedrooms.

Product sample to be supplied to the Client for approval prior to procurement and installation.

Insulated Plant and Services: If insulation must be removed to access plant and services provide access for maintenance, arranged so it can be repeatedly removed and replaced without damage.

3.25.5 Piping

Requirement: Conform to the following:

- Provide access and clearance at fittings which require maintenance, inspection or servicing, including control valves and joints intended to permit pipe removal;
- Arrange piping so that it does not interfere with the removal or servicing of associated equipment or valves or block access or ventilation openings;
- Preferably run piping, conduits, cable trays and ducts at high level and drop vertically to equipment.

3.25.6 Electrical and Controls

Electrical Equipment: Provide clearances and access space to AS/NZS 3000.

Switchboards and Electrical Control Equipment: Locate near the main entrance to plant space. Arrange plant so that, to the greatest extent possible, switchboards are visible from the plant being operated.

Control Panels: Locate near and visible from the plant controlled.

3.26 Vibration Suppression

3.26.1 General

Requirement: Minimise the transmission of vibration from rotating or reciprocating equipment to other building elements.

3.26.2 Standard

Rotating and Reciprocating Machinery Noise and Vibration: Vibration severity in Zone A to AS 2625.1 and AS 2625.4.

3.26.3 Speeds

General: If no maximum speed is prescribed do not exceed 1500 r/min for direct driven equipment.

3.26.4 Connections

General: Provide flexible connections to rotating machinery and assemblies containing rotating machinery. Isolate pipes by incorporating sufficient flexibility into the pipework or by use of proprietary flexible pipe connections installed so that no stress is placed on pipes due to end reaction.

3.26.5 Inertia Bases

General: If necessary to achieve the required level of vibration isolation, provide inertia bases having appropriate mass and conforming as follows:

- Construction: Steel or steel-framed reinforced concrete. Position foundation bolts for equipment before pouring concrete;
- Supports: Support on vibration isolation mountings using height saving support brackets.

3.26.6 Vibration Isolation Mountings

General: Except for external equipment that is not connected to the structure of any building, support rotating or reciprocating equipment on mountings as follows:

- For Static Deflections < 15 mm: Single or double deflection neoprene in-shear mountings incorporating steel top and base plates and a tapped hole for bolting to equipment;
- For Static Deflections ≥ 15 mm: Spring mountings.

Selection: Provide mountings selected to achieve 95% isolation efficiency at the normal operating speeds of the equipment.

Installation: Set and adjust vibration isolation mounting supports to give clearance for free movement of the supports.

Spring Mountings: Provide freestanding laterally stable springs as follows:

- Clearances: ≥ 12 mm between springs and other members such as bolts and housing;
- High Frequency Isolation: 5 mm neoprene acoustic isolation pads between baseplate and support;
- Levelling: Provide bolts and lock nuts;
- Minimum Travel to Solid: ≥ 150% of the designated minimum static deflection;
- Ratio of Mean Coil Diameter to Compressed Length at The Designated Minimum Static Deflection: ≥ 0.8:1;
- Snubbing: Snub the springs to prevent bounce at start-up;
- Vertical Resilient Limit Stops: To prevent spring extension when unloaded, to serve as blocking during erection and which remain out of contact during normal operation.

3.27 Finishes to Services

3.27.1 General

Requirement: If exposed to view (including in plant rooms), paint new services and equipment.

Exceptions: Do not paint chromium or nickel plating, anodised aluminium, GRP, stainless steel, non-metallic flexible materials and normally lubricated machined surfaces. Surfaces with finishes applied off-site need not be re-painted on-site provided the corrosion resistance of the finish is not less than that of the respective finish documented.

Standard: Conform to the recommendations of AS/NZS 2311 or AS/NZS 2312.1 as applicable.

3.27.2 Powder Coating

Standard: Conform to the following:

- Aluminium for Architectural Applications: To AS 3715;
- Other Metals: To AS 4506.

3.27.3 Painting Systems

New Unpainted Interior Surfaces: To AS/NZS 2311.

New Unpainted Exterior Surfaces: To AS/NZS 2311.

3.27.4 Paint Application

Coats: Apply the first coat immediately after substrate preparation and before contamination of the substrate can occur. Make sure each coat of paint or clear finish is uniform in colour, gloss, thickness and texture and free of runs, sags, blisters or other discontinuities.

Combinations: Do not combine paints from different manufacturers in a paint system.

Protection: Remove fixtures before starting to paint and re-fix in position undamaged when painting is complete.

3.27.5 Underground Metal Piping

Corrosion Protection: Provide corrosion protection for the following:

- Underground ferrous piping;
- Underground non-ferrous metal piping in corrosive environments.

Protection Methods: Select from the following:

- Cathodic Protection: Sacrificial anodes or impressed current. Incorporate a facility for periodic testing. Conform to the recommendations of AS 2832.1;
- Continuous wrapping using proprietary petroleum taping material;
- Impermeable flexible plastic coating;
- Sealed polyethylene sleeve.

3.27.6 Low VOC Emitting Paints

Paint Types: To the recommendations of AS/NZS 2311.

3.28 Marking and Labelling

3.28.1 General

Requirement: Mark and label services and equipment for identification purposes as follows:

- Locations Exposed to Weather: Provide durable materials;
- Pipes, Conduits and Ducts: To AS 1345 throughout its length, including in concealed spaces;
- Cables: Label to indicate the origin and destination of the cable.

Consistency: Label and mark equipment using a consistent scheme across all services elements of the project.

Identification Colour:

Service	Colour

Sanitary Plumbing and Drainage	Black (N61)
Stormwater Drainage	Black (N61)
Potable Water	Jade Green (G21)
Non-potable Water	Lilac (P23)
Fuel Gas Service	Sand Yellow (Y44)
Fire Services	Signal Red (R13)

3.28.2 Specific Security Labelling Requirements

- The positon of underground pipework, pits, manholes and other hydraulic services that pose security risks are to be marked by location marker plaques on adjacent buildings/structures to allow prompt identification by Prison staff.
- All such plaques shall be securely fixed with tamper proof fixings to the structural elements and shall not pose a risk to the Inmates.
- All Plaques shall be on photo-sensitive anodised aluminium sheets of 1.0 mm minimum thickness and shall be on a silver matt background with lettering and details in red. The finished plaques shall be permanent, fadeless and completely sealed to prevent oxide formation.
- Submit a copy of the proposed labelling scheme, locations and plaque construction methodology including an ancillary elements to the Client for approval prior to procuring, producing or installation.
- All associated plaques/ labelling schemes shall be identified on a consolidated block plan produced in AutoCAD. Hard copy and electronic formats (AutoCAD, PDF) shall be supplied in the Operation and Maintenance Manuals. Submit a copy of the proposed block plan to the Client for approval prior to finalising.

3.28.3 Label Samples and Schedules

Submission Timing: Before marking or labelling.

Schedule: For each item or type of item include the following:

- A description of the item or type of item for identification;
- The proposed text for marking or labelling;
- The proposed location of the marking and labelling.

3.28.4 Electrical Accessories

Circuit Identification: Label isolating switches and outlets to identify circuit origin.

3.28.5 Operable Devices

Requirement: Mark to identify the following:

- Controls;
- Indicators, gauges, meters;
- Isolating switches.

3.28.6 Equipment Concealed in Ceilings

Location: Provide a label on the ceiling, indicating the location of each concealed item requiring access for routine inspection, maintenance and/or operation. In tiled ceilings, locate the label on the ceiling grid closest to the item access point. In flush ceilings, locate adjacent to closest access panel.

3.28.7 Pressure Vessels

General: Mount manufacturer's certificates in glazed frames on a wall next to the vessel.

3.28.8 Valves and Pumps

General: Label to associate pumps with their starters and valves. Screw fix labels to body or attach label to valve handwheels with a key ring.

3.28.9 Labels and Notices

Materials: Select from the following:

- Cast metal;
- For indoor applications only, engraved two-colour laminated plastic;
- Proprietary pre-printed self-adhesive flexible plastic labels with machine printed black lettering;
- Stainless steel or brass minimum 1 mm thick with black filled engraved lettering.

Emergency Functions: To AS 1319.

Colours: Generally, to AS 1345 as appropriate, otherwise black lettering on white background except as follows:

- Danger, Warning Labels: White lettering on red background;
- Main Switch and Caution Labels: Red lettering on white background.

Edges: If labels exceed 1.5 mm thickness, radius or bevel the edges.

Labelling Text and Marking: To correspond to terminology and identifying number of the respective item as shown on the record drawings and documents and in operating and maintenance manuals.

Lettering Heights:

- Danger, Warning and Caution Notices: Minimum 10 mm for main heading, minimum 5 mm for remainder.
- Equipment Labels within Cabinets: Minimum 3.5 mm.
- Equipment Nameplates: Minimum 40 mm.
- Identifying Labels on Outside of Cabinets: Minimum 5 mm.
- Isolating Switches: Minimum 5 mm.
- Valves: Minimum 20 mm.
- Self-Adhesive Flexible Plastic Labels:
    - Labels less than 2000 mm above floor: 3 mm on 6 mm wide tape.
    - Labels minimum 2000 mm above floor: 8 mm on 12 mm wide tape.
    - Other locations: Minimum 3 mm.

Label Locations: Locate labels so that they are easily seen and are either attached to, below or next to the item being marked.

Fixing: Fix labels securely using screws, rivets, proprietary self-adhesive labels or double-sided adhesive tape and as follows:

- If labels are mounted in extruded aluminium sections, use rivets or countersunk screws to fix the extrusions;
- Use aluminium or monel rivets for aluminium labels.

Vapour Barriers: Do not penetrate vapour barriers.

3.28.10 Below Ground Pipe Marker Tape

Requirement: During the process of backfilling lay a plastic warning tape 150 mm above all underground pipes. This tape shall extend for the full length of pipes. Warning tapes shall be 200 mm in width of approved durable plastic material with colour to comply with AS 1345 printed with the words **DANGER – BURIED [SERVICE] PIPE BELOW** repeated continuously. Warning tape shall contain a trace wire which shall be secured and terminate above surface each end.

3.29 Software

Requirement: Provide the software required for the operation and management of hydraulic services systems and equipment.

3.30 Warranties

Requirement: If a warranty is documented, name the principal as warrantee. Register with manufacturers as necessary. Retain copies delivered with components and equipment.

Warranty Period: Start warranty periods at acceptance of installation.

Approval of Installer: If installation is not by manufacturer, and product warranty is conditional on the manufacturer's approval of the installer, submit the manufacturer's written approval of the installing firm.

3.31 Record Drawings

3.31.1 General

Requirement: Show the following:

- Installed locations of building elements, services, plant and equipment;
- Off-the-grid dimensions and depth if applicable;
- Any provisions for the future.

3.31.2 Recording, Format and Submission

Progress Recording: Keep one set of drawings on site at all times, expressly for the purpose of marking changes made during the progress of the works.

Drawing Layout: Use the same borders and title block as the contract drawings.

Quantity and Format: Conform to Submissions.

Endorsement: Sign and date all record drawings.

Accuracy: If errors in, or omissions from, the record drawings are found, amend the drawings and re-issue in the quantity and format documented for Submissions.

Date for Submission: Not later than two (2) weeks after the date for practical completion.

3.31.3 Services Record Drawings

General: To General and Recording, format and submission and the following:

- Extensions and/or Changes to Existing: If a drawing shows extensions and/or alterations to existing installations, include sufficient of the existing installation to make the drawing comprehensible without reference to drawings of the original installation;
- Cold Water Service Mains: Show the pressure available at the initial connection point and the pressure available at the most disadvantaged location on each major section of the works;
- Fire Service Mains: Show the pressure available at the initial connection point and the pressure available at the most disadvantaged location on each major section of the works;
- Stormwater: If storm water pipes are shown, include the pipe size and pipe grade together with the maximum acceptable flow and the actual design flow.

Diagrams: Provide diagrammatic drawings of each system including the following:

- Controls;
- Piping including all valves and valve identification tags;
- Principal items of equipment;
- Single line wiring diagrams;
- Acoustic and thermal insulation;
- Access provisions and space allowances;
- Fixings;
- Fixtures;
- Switchgear and control gear assembly circuit schedules including electrical service characteristics, controls and communications;
- Charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

Subsurface Services: Record information on underground or submerged services to the documented quality level, conforming to AS 5488.

3.32 Operation and Maintenance Manuals

3.32.1 General

Authors and Compilers: Personnel experienced in the maintenance and operation of equipment and systems installed, and with editorial ability.

Referenced Documents: If referenced documents or technical work sections require that manuals be submitted, include corresponding material in the operation and maintenance manuals.

Subdivision: By installation or system, depending on project size.

3.32.2 Contents

Requirement: Include the following:

- Table of Contents: For each volume. Title to match cover;
- Directory: Names, addresses, and telephone and facsimile numbers of principal consultant, sub-consultants, contractor, subcontractors and names of responsible parties;
- Record Drawings: Complete set of record drawings, full size;
- Drawings and Technical Data: As necessary for the efficient operation and maintenance of the installation. Include:
    - Switchgear and control gear assembly circuit schedules including electrical service characteristics, controls and communications;
    - Charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- Installation Description: General description of the installation;
- Systems Descriptions and Performance: Technical description of the systems installed and mode of operation, presented in a clear and concise format readily understandable by the principal's staff. Identify function, normal operating characteristics, and limiting conditions;
- Systems Performance: Technical description of the mode of operation of the systems installed;
- Baseline Data: To AS 1851 and AS/NZS 1668.1;
- Documentation: To AS 1851 including the schedule of essential functionality and performance requirements;
- Digital photographic records of underground services;
- Equipment Descriptions:
    - Name, address, email address and telephone and facsimile numbers of the manufacturer and supplier of items of equipment installed, together with catalogue list numbers;
    - Schedules (system by system) of equipment, stating locations, duties, performance figures and dates of manufacture. Provide a unique code number cross-referenced to the record and diagrammatic drawings and schedules, including spare parts schedule, for each item of equipment installed;
    - Manufacturers' technical literature for equipment installed, assembled specifically for the project, excluding irrelevant matter. Mark each product data sheet to clearly identify specific products and component parts used in the installation, and data applicable to the installation;
    - Supplements to product data to illustrate relations of component parts. Include typed text as necessary.
- Certificates:
    - Certificates from authorities;
    - Copies of manufacturers' warranties;
    - Product certification;
    - Test certificates for each service installation and all equipment;

  - Test report;
  - Test, balancing and commissioning reports;
  - Control system testing and commissioning results.
- 7 day record of all trends at commissioning;
- Operation Procedures:
  - Manufacturers' technical literature as appropriate;
  - Safe starting up, running-in, operating and shutting down procedures for systems installed. Include logical step-by-step sequence of instructions for each procedure;
  - Control sequences and flow diagrams for systems installed;
  - Legend for colour-codes services;
  - Schedules of fixed and variable equipment settings established during commissioning and maintenance;
  - Procedures for seasonal changeovers;
  - If the installation includes cooling towers, a water efficiency management plan.
- Maintenance Procedures:
  - Detailed recommendations for periodic maintenance and procedures, including schedule of maintenance work including frequency and manufacturers' recommended tests;
  - Manufacturer's technical literature as appropriate. Register with manufacturer as necessary. Retain copies delivered with equipment;
  - Safe trouble-shooting, disassembly, repair and reassembly, cleaning, alignment and adjustment, balancing and checking procedures. Provide logical step-by-step sequence of instructions for each procedure;
  - Schedule of spares recommended to be held on site, being those items subject to wear or deterioration and which may involve the principal in extended deliveries when replacements are required. Include complete nomenclature and model numbers, and local sources of supply;
  - Schedule of normal consumable items, local sources of supply, and expected replacement intervals up to a running time of 40, 000 hours. Include lubrication schedules for equipment;
  - Schedules for recording recommissioning data so that changes in the system over time can be identified;
  - Instructions for use of tools and testing equipment;
  - Emergency procedures, including telephone numbers for emergency services, and procedures for fault finding;
  - Safety data sheets (SDS);
  - Instructions and schedules conforming to AS 1851, AS/NZS 3666.2, AS/NZS 3666.3 and AS/NZS 3666.4.
- Maintenance Records:
  - Prototype service records conforming to AS 1851 prepared to include project specific details;

- Prototype periodic maintenance records and report to AS/NZS 3666.2, AS/NZS 3666.3 and AS/NZS 3666.4 as appropriate, prepared to include project specific details;
- For Hard Copies: In binders which match the manuals, loose leaf log book pages designed for recording completion activities including operational and maintenance procedures, materials used, test results, comments for future maintenance actions and notes covering the condition of the installation. Include completed log book pages recording the operational and maintenance activities performed up to the time of practical completion;
- Number of Pages: The greater of 100 pages or enough pages for the maintenance period and a further 12 months.

3.32.3 Format – Electronic Copies

Scope: Provide the same material as documented for hardcopy in electronic format.

Printing: Except for drawings required in the Record Drawings clause provide material that can be legibly printed on A4 size paper.

3.32.4 Format – Hard Copy

General: A4 size loose leaf, in commercial quality, 4 ring binders with hard covers, each indexed, divided and titled. Include the following features:

- Cover: Identify each binder with typed or printed title **OPERATION AND MAINTENANCE MANUAL**, to spine. Identify title of project, volume number, volume subject matter, and date of issue;
- Dividers: Durable divider for each separate element, with typed description of system and major equipment components. Clearly print short titles under laminated plastic tabs;
- Drawings: Fold drawings to A4 size with title visible, insert in plastic sleeves (one per drawing) and accommodate them in the binders;
- Pagination: Number pages;
- Ring Size: 50 mm maximum, with compressor bars;
- Text: Manufacturers' printed data, including associated diagrams, or typewritten, single-sided on bond paper, in clear concise English.

Number of Copies: Three (3).

3.32.5 Date for Submission

Draft Submission: The earlier of the following:

- Two (2) weeks before the date for practical completion;
- Commencement of training on services equipment.

Final Submission: Within two (2) weeks after practical completion.

3.33 Tools and Spare Parts

3.33.1 Spare Parts

General: Provide spare parts listed in the appropriate work sections.

Replacement: Replace spare parts used during the maintenance period.

3.33.2 Tools and Spare Parts Schedule

Submission Timing: At least eight (8) weeks before the date for practical completion.

Requirement: Prepare a schedule of tools, portable instruments and spare parts necessary for maintenance of the installation. For each item state the recommended quantity and the manufacturer's current price. Include the following in the prices:

- Checking receipt, marking and numbering in conformance with the spare parts schedule;
- Packaging and delivery to site;
- Painting, greasing and packing to prevent deterioration during storage;
- Referencing equipment schedules in the operation and maintenance manuals;
- Suitable means of identifying, storing and securing the tools and instruments. Include instructions for use.

Replacement: Replace spare parts used during the maintenance period.

3.34 Testing

3.34.1 Attendance

General: Provide attendance on tests.

3.34.2 Testing Authorities

General: Except for site tests, have tests carried out by a registered testing authority.

Test Instruments: Use instruments calibrated by a registered testing authority.

3.34.3 Test Reports

General: Indicate observations and results of tests and conformance or non-conformance with requirements.

3.34.4 Notice

Inspection: Give sufficient notice for inspection to be made of the commissioning and completion testing of the installation.

3.34.5 Controls

General: Calibrate, set and adjust control instruments, control systems and safety controls.

3.34.6 Circuit Protection

General: Confirm that circuit protective devices are sized and adjusted to protect installed circuits.

3.34.7 Completion Tests

General: Test the works under the contract to demonstrate conformance with the documented performance requirements of the installation.

Functional Checks: Carry out functional and operational checks on energised equipment and circuits and make final adjustments for the correct operation of safety devices and control functions.

Type Test Reports: Required, as evidence of conformance of proprietary equipment.

Sound Pressure Level Measurements: Conform to the following:

- Correction for Background Noise: To AS/NZS 2107;
- External: To AS 1055.1;
- Internal: To AS/NZS 2107;
- Measurement Positions: If a test position is designated only by reference to a room or space, do not take measurements less than 1 m from the floor, ground or walls;
- Sound Pressure Level Analysis: Measure the sound pressure level and the background sound pressure level over the full range of octave band centre frequencies from 31.5 Hz to 8 kHz at the designated positions;
- Sound Pressure Levels: Measure the A-weighted sound pressure levels and the A-weighted background sound pressure levels at the designated positions.

3.34.8 Certification

General: On satisfactory completion of the installation and before the date of practical completion, certify that each installation is operating correctly.

3.35 Training

3.35.1 General

Duration: Instruction to be available for the whole of the commissioning and running-in periods.

Format: Conduct training at agreed times, at system or equipment location. Also provide seminar instruction to cover all major components.

Operation and Maintenance Manuals: Use items and procedures listed in the final draft operation and maintenance manuals as the basis for instruction. Review contents in detail with the principal's staff.

Certification: Provide written certification of attendance and participation in training for each attendee. Provide register of certificates issued.

3.35.2 Demonstrators

General: Use only qualified manufacturer's representatives who are knowledgeable about the installations.

3.35.3 Maintenance

General: Explain and demonstrate to the principal's staff the purpose, function and maintenance of the installations.

3.35.4 Operation

General: Explain and demonstrate to the principal's staff the purpose, function and operation of the installations.

3.35.5 Seasonal Operation

General: For equipment requiring seasonal operation, demonstrate during the appropriate season and within 6 months.

3.36 Final Cleaning

General: Before the date for practical completion, clean throughout, including all exterior and interior surfaces except those totally and permanently concealed from view.

Labels: Remove all labels not required for maintenance.

3.37 Periodic Maintenance of Services

3.37.1 General

Requirement: During the maintenance period, carry out periodic inspections and maintenance work as recommended by manufacturers of supplied equipment, and promptly rectify faults.

Emergencies: Attend emergency calls promptly.

Annual Maintenance: Carry out recommended annual maintenance procedures before the end of the maintenance period.

Maintenance Period: The greater of the defects liability period and the period documented in the Maintenance requirements schedule.

3.37.2 Maintenance Program

General: Submit details of maintenance procedures and program, relating to installed plant and equipment, 6 weeks before the date for practical completion. Indicate dates of service visits. State contact telephone numbers of service operators and describe arrangements for emergency calls.

3.37.3 Maintenance Records

General: Record in binders provided with the Operation and maintenance manuals.

Referenced Documents: If referenced documents or technical work sections require that log books or records be submitted, include this material in the maintenance records.

Certificates: Include test and approval certificates.

Service Visits: Record comments on the functioning of the systems, work carried out, items requiring corrective action, adjustments made and name of service operator. On completion of the visit, obtain the signature of the principal's designated representative on the record of the work undertaken.

3.37.4 Site Control

General: Report to the principal’s designated representative on arriving at and before leaving the site.

3.38 Post-Construction Mandatory Inspections and Maintenance

Requirement: For the duration of the defects liability period, provide inspections and maintenance of safety measures required by the following:

- AS 1851;
- Other statutory requirements applicable to the work.

Records: Provide mandatory records.

Certification: Certify that mandatory inspections and maintenance have been carried out and that the respective items conform to statutory requirements.

Annual Inspection: Perform an annual inspection and maintenance immediately before the end of the defects liability period.

3.39 Pipework Reticulation

General: The following general security measures shall be followed concerning the installation of the hydraulic services. The contractor shall confirm with Client if any additional measures are required for the specific correctional facility prior to commencing detailed design.

Materials

- Plastics shall not be used in water supply or waste systems unless approved by the Client.

PVC-U FOR SANITARY DRAINAGE AND PE FOR WATER SUPPLY IN GROUND APPROVED AS PER MATERIALS SECTION.

Inground Pipework:

- All ingournd pipework shall be straight uninterrupted runs where possible.
- All soil fixtures shall have direct cleaning access from outside the building.
- All accessible pits, grates and clear-outs shall be screw down lockable type with security fasteners. Refer to section 1.20 of this specification for further information also.
- There shall be no interconnection of waste pipes in General and High needs Areas.

Above Ground Pipework:

- Exposed pipework mounted to wall surfaces is generally not accepted. Where it is not possible to reticulate securely within concealed ducts, walls and the like, pipes shall be reticulated within bulkheads. All proposed bulkhead locations shall be approved by the Client prior to installation.

3.40 Sub-metering

General: Sub-metering is required on water supply services to various areas of the complexes to enable accurate monitoring of the water usage. The locations and methodology shall be determined and agreed with the Superintendent on a case by case basis.

4. SERVICE TRENCHING

Steel Shoring and Trench Lining Systems: To AS 4744.1.

Hydraulic Shoring and Trench Lining Equipment: To AS 5047.

4.1 Standards

Earthworks: To AS 3798.

4.2 Tolerances

Finish: Finish the surface to the required level, grade and shape within the following tolerances:

- Under Building Slabs and Load Bearing Elements: + 0, - 25 mm;
- Pavement Subgrades: + 0, - 40 mm;
- Other Ground Surfaces: ± 50 mm, provided the area remains free draining and matches adjacent construction where required. Provide smoothness as normally produced by a scraper blade.

4.3 Submissions

Extent: Submit a plan of trench works noting the location and type of service.

Design Calculations: Submit calculations by a professional engineer to show that proposed excavations and temporary supports, including where applicable supports for adjacent structures, will be stable and safe.

Notice: Advise on proposed duration of open excavation.

Construction: Submit details of proposed equipment and method of excavation.

Stability: If shuttering and/or bracing of the sides of a trench is required for safety and stability, provide proposals.

Geotechnical Data: Provide a geotechnical report supporting the procedures proposed for trenching and/or boring.

Hazards: Identify WHS hazards that may be encountered with deep trenches including toxic gases and liquids.

Boring: Submit proposals for the following:

- Limits on length;
- Existence of other services and method of protection;
- Pressure grouting to voids;
- The effect of pressure grouting on other services, ground heave and proposals for minimising such effects;
- Access to properties outside the site;
- Council permits;
- Service interruptions including a plan for minimising unintended interruptions.

Temporary Shoring: Submit a proposal for any temporary shoring or underpinning required including the progressive removal.

Proof Rolling: Submit method and equipment for proof rolling.

Certified Records of Measurement: Submit a certified copy of the agreed records of measurement.

Imported Fill: Submit certification or test results by a GTA registered laboratory which establish the compliance of imported fill with the contract including the source.

Compaction: Submit certification and/or test results in conformance with the specified level of responsibility to AS 3798.

Disposal Location: Submit the locations and evidence of compliance with the relevant authorities for the disposal of material required to be removed from the site.

4.4 Fill Materials

Suitable Material: To AS 3798 including inorganic, non-perishable material suitably graded and capable of compaction to the documented density.

Unsuitable Materials: Do not use unsuitable material for fill in conformance with AS 3798.

Sulphur Content: Do not provide filling with sulphur content exceeding 0.5% within 500 mm of cement bound elements (for example concrete structures or masonry) unless such elements are protected by impermeable membranes or equivalent means.

Re-use of Excavated Material: Only re-use suitable material in conformance with AS 3798.

Stockpiles: Segregate the earth and rock material and stockpile, for re-use in backfilling operations.

Locations: Do not stockpile excavated material against tree trunks, buildings, fences or obstruct the free flow of water along gutters where stockpiling is permitted along the line of the trench excavation.

Disposal: If stockpiling is not permitted under the contract, dispose of excavated material off-site to AS 3798.

4.5 Borrow or Imported Fill

Borrow or Imported Material: Only when no suitable excavated material is available.

Suitable Material: To AS 3798.

Borrow Pits:

- Location: More than 3 m from any fence line, boundary, edge of excavation, or embankment;
- Strip and stockpile topsoil;
- Provide erosion protection during winning operations of material and make sure drainage is maintained;
- On completion of winning operations grade abrupt changes of slope, re-spread topsoil and apply and maintain hydroseeded grassing.

4.6 Existing Services

4.6.1 Location

Requirement: Before commencing service trenching, locate and mark existing underground services in the areas which will be affected by the service trenching operations.

Utility Services: Contact DIAL BEFORE YOU DIG to identify location of underground utility services pipes and cables.

4.6.2 Excavation

General: Do not excavate by machine within 1 m of existing underground services.

4.7 Existing Surfaces

4.7.1 Concrete and Asphalt Pavements

Method: Saw cut trench set out lines for the full depths of the bound pavement layers except where the set out line is located along expansion joints.

Removal of Concrete and Asphalt: Break out concrete or asphalt pavement material between the trench set out lines, remove and dispose of off-site.

4.7.2 Segmental Paving Units

Removal: Take up segmental paving units both full and cut by hand, between the trench set out lines, and neatly stack on wooden pallets.

Concrete Edging: Break out, remove and dispose of off-site.

Concrete Sub-base: If present, saw cut along the trench set-out lines.

4.7.3 Grass

Removal Method: Neatly cut grass turf between trench set-out lines into 300 mm squares.

Grass Suitable for Re-use: Take up and store the turf and water during the storage period, otherwise remove and dispose of it off-site.

4.7.4 Small Plants, Shrubs and Trees

Small Plants Required for Re-planting: Take up and store. Wrap the root ball in a hessian or plastic bag with drain holes and water during the storage period.

Unsuitable Vegetation: Remove and dispose of off-site.

4.8 Excavating

4.8.1 Excavation

General: Excavate for underground services in conformance with the following:

- To required lines and levels, with uniform grades;
- Straight between access chambers, inspection points and junctions;
- With stable sides;
- Width tolerance: ± 50 mm, unless constrained by adjacent structures.

4.8.2 Trench Widths

General: Keep trench widths to the minimum, consistent with the laying and bedding of the relevant service and construction of access chambers and pits.

4.8.3 Trench Depths

General: As required by the relevant service and its bedding method.

Adjacent to Existing Footings: If excavation is required within the zone of influence of an existing footing, use methods including (temporary) shoring or underpinning that maintain the support of the footing and make sure that the structure and finishes supported by the footing are not damaged.

4.8.4 Obstructions

General: Clear trenches of sharp projections. Cut back roots encountered in trenches to at least 600 mm clear of services. Remove other obstructions including stumps and boulders which may interfere with services or bedding.

Tree Protection: To AS 4970.

4.8.5 Dewatering

General: Keep trenches free of water. Place bedding material, services and backfilling on firm ground, free of surface water.

Pumping: Provide pump-out from adjacent sumps or install well points.

Adjacent Subsidence: Provide recharge points to isolate the dewatering zone.

4.8.6 Excess Excavation

General: If trench excavation exceeds the correct depth, reinstate to the correct depth and bearing value using compacted bedding material or sand stabilised with 1 part of cement to 20 parts of sand by volume.

4.8.7 Stockpiles

Excavated Material for Backfill: If required, segregate the earth and rock material and stockpile, for re-use in backfilling operations.

Locations: Do not stockpile excavated material against tree trunks, buildings, fences or obstruct the free flow of water along gutters where stockpiling is permitted along the line of the trench excavation.

Disposal: If stockpiling is not permitted, dispose of excavated material off-site.

4.8.8 Unsuitable Material

Disposal: Remove unsuitable material from the bottom of the trench or at foundation level and dispose of off-site.

4.8.9 Boring

Subcontractor: If under road boring is required instead of trenches, engage a suitably qualified subcontractor to perform the work.

4.9 Adjacent Structures

4.9.1 Temporary Supports

General: Provide supports to adjacent structures where necessary, sufficient to prevent damage arising from the works.

Lateral Supports: Provide lateral support using shoring.

Vertical Supports: Provide vertical support where necessary using piling or underpinning or both.

4.9.2 Permanent Supports

General: If permanent supports for adjacent structures are necessary and are not described, give notice and obtain instructions.

4.9.3 Encroachments

General: If encroachments from adjacent structures are encountered and are not shown on the drawings, give notice and obtain instructions.

4.10 Adjacent Trees

Protection: Trees shall not be removed or lopped, unless specified and approval to do so is given. Protect trees specified or indicated to be retained from damage by groundworks. Plan underground pipework trenches to avoid tree root systems wherever possible. Co-ordinate trenches prior to commencing works. Take necessary precautions, including the following:

Work on Trees: If it is considered necessary to perform any work on trees, including trimming, lopping, root cutting, repair and removal, apply for permission and await instructions.

Qualified Personnel: Any work permitted to be done on trees to be retained shall be performed by an approved tree surgeon.

Harmful Materials: Do not store or otherwise place bulk materials and harmful materials under or near trees. Do not place spoil from excavations against tree trunks, even for short periods. Prevent wind-blown materials such as cement from harming trees and plants.

Damage: Prevent damage to tree bark. Do not attach stays, guys and the like to trees.

Work under Trees: Do not add or remove topsoil within the drip line of trees. If it is necessary to excavate within the drip line, use hand methods such that root systems are preserved intact and undamaged. Open up excavations under tree canopies for as short a period as possible.

Roots: Do not cut tree roots exceeding 50 mm diameter unless permitted. Where it is necessary to cut tree roots, use means such that the cutting does not unduly disturb the remaining root system. Immediately after cutting, apply a bituminous fungicidal sealant to the cut surface to prevent the incursion of rot or disease.

Coring: Carry out coring by forming 75 mm diameter 300 mm deep core holes at 900 mm centres for the whole of the area affected by backfilling the core holes with sand watered in.

Repair: If approved repair work to be attempted on a tree damaged during work under the Contract, perform the repair work at no extra cost.

Removal: If repair work is considered impracticable, or is attempted and fails, if so directed, remove the tree and root system, make good as necessary and replace the tree as specified below.

Replacement: If so directed, provide, plant and establish a replacement tree of the same species and similar size at no additional cost.

4.11 Trench Backfill

4.11.1 General

Timing: Backfill service trenches as soon as possible after laying and bedding the service, if possible on the same working day.

Marking Services: Underground marking tape to AS/NZS 2648.1.

4.11.2 Placing Fill

4.11.2.1 General

Layers: Place fill in near-horizontal layers of uniform thickness, deposited systematically across the fill area.

Extent: Place and compact fill to the designated dimensions, levels, grades, and cross sections so that the surface is always self-draining.

Edges: At junctions of fill and existing surfaces, do not feather the edges.

Mix: Place fill in a uniform mixture.

Previous Fill: Before placing subsequent fill layers, make sure that previously accepted layers still conform to requirements, including moisture content.

Protection: Protect the works from damage due to compaction operations. Where necessary, limit the size of compaction equipment or compact by hand. Commence compacting each layer at the structure and proceed away from it.

Protective Covering: Do not disturb or damage the protective covering of membranes during backfilling.

4.11.2.2 Placing at Structures

General: Place and compact fill in layers simultaneously on both sides of structures, culverts and pipelines to avoid differential loading. Carefully place first layers of fill over the top of structures.

Concrete: Do not place fill against concrete retaining walls until the concrete has been in place for 28 days unless the structure is supported by struts.

4.11.3 Bedding, Haunch, Side and Overlay Zones

Installation and Material: To the utility authority or utility service requirements. Secure pipes against floatation.

Overlay Zone Thickness: Maximum 300 mm immediately over the utility service.

Topsoil Areas: Complete the backfilling with at least 100 mm of topsoil.

Material in Reactive Clay Areas: In sites classified M, M-D, H1, H1-D, H2, H2-D, E or E-D to AS 2870, re-use excavated site material at a moisture content within ± 1% of that of the adjoining in situ clay.

4.11.4 Selected Material Zone

Extent: The section of trench within the zone, if applicable.

Backfill Material: Selected material free from stones larger than 100 mm maximum dimension and the fraction passing a 19 mm Australian Standard sieve to have a 4 day soaked CBR value, in conformance with AS 1289.6.1.2, and not less than that of the adjacent selected material zone.

4.11.5 Trees

Backfill at Trees: Backfill minimum 300 mm thick, around tree roots with a topsoil mixture. Place and compact in layers of 150 mm minimum depth to a dry density equal to that of the surrounding soil.

Do Not Place Backfill: Above the original ground surface around tree trunks or over the root zone.

Watering: Thoroughly water immediately after backfilling the tree root zone.

4.12 Compaction Requirements for Backfill

4.12.1 General

Control Moisture within Backfill: Adjust the moisture content of fill during compaction within the range of 85 to 115% of the optimum moisture content determined by AS 1289.5.1.1 or AS 1289.5.2.1, as appropriate, to achieve the required density.

Layers: Compact all material in layers not exceeding 150 mm compacted thickness. Compact each layer to the required relative compaction before starting the next layer.

Precautions: If compacting adjacent to utility services, use compaction methods which do not cause damage or misalignment.

4.12.2 Density

Excavated and Stripped Ground Surface: After excavation and/or stripping, compact these surfaces to a minimum depth of 150 mm.

Maximum Rock and Lump Size in Layer After Compaction: To AS 3798.

Fill Batter Faces: Either compact separately, or overfill and cut back. Form roughened surfaces to the faces.

Minimum Relative Compaction: To AS 3798.

4.12.3 Density Tests

Testing Authority: Carry out density tests of pipe bedding and backfilling by a registered testing authority.

Test Methods: Conform to the following:

- Compaction Control Tests: To AS 1289.5.4.1 or AS 1289.5.7.1;
- Field Dry Density: AS 1289.5.3.2 or AS 1289.5.3.5;
- Standard Maximum Dry Density: AS 1289.5.1.1;
- Dry Density Ratio: AS 1289.5.4.1;
- Density Index: AS 1289.5.6.1.

4.12.4 Compaction Control Tests

Compaction Control Tests: To AS 1289.5.4.1 or AS 1289.5.7.1.

4.12.5 Compaction Control Test Frequency

Standard: To AS 3798.

Confined Operations: 1 test per 2 layers per 50 m2.

4.13 Completion

Site Restoration: Where variation of existing ground surfaces is not required as part of the works, restore surfaces to the condition existing at the commencement of the contract.

5. MATERIALS

5.1 General

Requirement: All materials, fittings, accessories and ancillaries are to be new (unless the re-use of existing materials is specified) and of first class design and manufacture, complying with the appropriate and current Australian Standard specification and shall comply with Local Plumbing Authority requirements.

Samples: Provide for the approval of the Superintendent prior to commencing installation, samples of all accessories, fittings and apparatus proposed to be used in the work, and only such items as are approved may be installed. Failure to comply with this provision may result in the unconditional rejection of such items when installed on site. Any rejected materials, fittings, accessories or apparatus shall be removed from the site within 24 hours of such rejection.

Workmanship: The whole of the work shall be carried out by skilled, qualified tradesmen, supervised by the Contractor, and/or his authorised representative. Workmanship shall be of the highest standard and each section of the work shall be properly and neatly executed to the best current trade practice.

5.2 Supply of Materials

Requirement: Supply and fix all materials required to complete the works. All costs associated with replacement of rejected materials shall be borne by the Contractor. All materials shall conform to the latest Australian Standard Specification, Code or Interim Code. If no Australian Standard exists they shall conform to the latest British Standard or the requirements of the American Society for Testing and Materials in that order.

WaterMark Certification: Submit evidence that proposed components are listed in the WaterMark Product Database.

Australian Products: Preference should be given to Australian made products wherever possible, providing their use will not result in a lowering of the project quality.

5.3 Rejection of Unsatisfactory Materials

Requirement: In the event of materials being of a mixed description and quality, the Superintendent shall have power to order to have those portions of the materials, which in their opinion are unsuitable for the works, picked out, marked and stacked where directed, and all defective or unsuitable materials removed from the site.

5.4 Alternative Materials and Equipment

Requirement: Where any material and equipment is specified as being similar or equal to a particular manufacture, the particular brand or product specified is to be allowed for. Should a tenderer desire to use alternative materials or equipment, they shall submit with their tender a description of such material or equipment and advise of the tender price variation that would result from its use. Unless a variation of the work as specified is agreed to before signing of the contract, or is ordered by the Superintendent in accordance with the general condition of contract, the brand or product specified shall be used in the works.

5.5 Dissimilar Materials

Requirement: The Contractor shall be responsible for separating dissimilar metals from direct contact with each other. All necessary gaskets, dielectric couplings, etc., required shall be supplied and installed by the Contractor. All metal screws, clamps, etc. shall be of the same metal and finish as the materials supported.

Pipe Supports: Where clips, brackets and pipe supports are of dissimilar metal to the actual piping used, completely insulate the piping at all fixing points with at least 10 mm thick insulation or 8mm thick vibration resistant rubber wrapped around the pipe prior to fixing in position.

5.6 Manholes

General: Excavate, and install concrete manholes to the dimensions and locations where required by the Local Authority.

Floors and Walls: In situ concrete: 20 MPa, unreinforced unless otherwise shown. Thickness not less than 100 mm, unless otherwise shown or specified.

Brick: Walls of square or rectangular pits not more than 1500 mm deep may be brickwork 230 mm thick in cement mortar, rendered, instead of unreinforced concrete.

Prefabricated Concrete: Walls of spun precast sections not less than 60 mm thick. Floor cast in situ or prefabricated. Provide cored holes as required.

Finish to Exposed Surfaces: Smooth, equal to steel trowelled render or concrete cast in steel forms. Cove of splay internal corners. Bench floors and fall to drain.

Render: 1 cement, 3 sand, minimum thickness 20mm.

Reinforcement: If depth of pit exceeds 1500mm: F718 mesh to AS1304 in floor, and in walls from depth 1200mm downward. Cover 50mm from inner face of walls and lower face of floor. Place main wires in walls horizontally.

Benching: Manholes whether of the precast type or cast in-situ shall have the base of each manhole benched with 4:2:1 concrete to form half pipe channels for straight through or branch flow. In all cases 50 mm cross fall shall be provided at the pipe inverts across the structure.

Covers and Grating: Covers shall be full opening span type. Covers, gratings and frames shall be to AS 3996 and carry current Standards Mark Licence Number and must be lockable.

Access Ladder: Provide and install a galvanised steel ladder for access to the manhole. Ladder shall have sides 75 mm x 10 mm thick with 20 mm diameter rungs set at 300 mm centres. Ladder to be 450 mm wide and fixed to tank wall at 1200 mm centres. All joints to be fully welded.

Step Irons: Provide approved galvanised mild steel step irons at 300 mm centres in walls where manholes, pits and sumps exceed 1200 mm in depth.

Levels: Top level of cover or grating, including frame:

- In Paved Areas: Flush with paving surface;
- Gratings Taking Surface Water Runoff: As necessary to receive the runoff without ponding.

5.7 Drainage Cell

Vertical behind Retaining Walls: Drainage cell for use vertically behind retaining walls extending to ground level shall be Atlantis Drainage Cell System 40 mm thick pre-wrapped with geotextile fabric. Fixing to be in accordance with Manufacturer's recommendation.

Planter Drainage Cell: Drainage cell for use in planter areas shall be Atlantis Drainage Cell System 15 mm thick pre-wrapped geotextile.

Geotextile Wrap: Overlap geotextile minimum 300 mm and ensure geofabric is turned up at edges and tape sealed.

5.8 Copper Piping

5.8.1 Pipes

Standard: To AS 1432 Type A and Type B or as documented, hard drawn.

5.8.2 Jointing

General: Select from the following except where a specific jointing method is documented:

- Brass flanges with brass nuts and bolts (no size limitation);
- Screwed brass unions: ≤ DN 50;
- Compression joints: ≤ DN 50;
- Proprietary grooved joints (no size limitation).

5.8.3 Fittings

Capillary Fittings Including Adaptor Capillary Fittings with Threaded Ends or Compression-Type Connector Ends: To AS 3688, of copper or dezincification-resistant copper alloy.

Compression Fittings Including Adaptor Compression Fittings with Connector-Ends for Screwed or Capillary Joints: To AS 3688, flared type, of copper or dezincification-resistant copper alloy.

Unions: Bronze, proprietary manufacture, with ground or accurately machined face joints.

Flanges: Brazing metal to AS 2129. Expand pipes into flanges and braze.

Bends and Tees: Provide sweep tees and long radius type bends.

Centreline Radius of Bend or Tee Branch: ≥ 1.5 times the pipe diameter.

5.8.4 Permanent Joints

General: Provide brazed slip joints. Provide either capillary fittings, or expand one pipe over the other leaving a minimum clearance and an effective overlap.

5.8.5 Slip Joint Overlap Table

Nominal Pipe Size (DN)	Overlap (mm)
≥ 15, < 20	12
≥ 20, < 32	15
≥ 32, < 50	25
≥ 50, < 80	30
≥ 80, < 125	35
≥ 125, < 200	40

5.8.6 Press-Fit Fittings

5.8.6.1 Water Services

Material: Connection with press-fit fittings shall be of copper or gunmetal.

Leakage Safety: Inspection of un-pressed fittings shall utilise a positive leak path for the whole range 2.2 kPa to 300 kPa when a dry pressure test is performed and 100 kPa to 650 kPa with a wet pressure test. This safety function shall be warranted and facilitated by a channel in the metallic body of the fitting. After pressing, the connection shall be permanent and inseparable.

Seal: The seal shall be of EPDM, with performance characteristics allowing use in solar applications and the fitting body has a cylindrical pipe guide in front of the seal.

Approvals: Fittings shall be Watermark Approved.

5.8.6.2 Gas Services

Material: Connection with press-fit fittings shall be of copper or gunmetal.

Leakage Safety: Inspection of un-pressed fittings shall utilise a positive leak path in the whole range 2.2 kPa to 300 kPa with a dry pressure test. This safety function shall be warranted and facilitated by a channel in the metallic body of the fitting. After pressing, the connection shall be permanent and inseparable.

Seal: The seal is made of HNBR and the fitting body has a cylindrical pipe guide in front of the seal.

Approvals: Fittings carry conformance certifications to international Gas standards DVGW VP 614 and ANSI LC4.

5.9 Galvanized Steel Piping

5.9.1 Pipes

Standard: To AS 1074 Medium Grade or as documented.

5.9.2 Jointing

General: Pipe and fittings shall be hot dipped galvanised; nuts and bolts shall be stainless steel.

Jointing: Select from the following except where a specific jointing method is documented:

- Screwed and socketed up to 50 mm size;
- Galvanized screwed flanges;
- Proprietary grooved joints.

Grooved Joints: Shall be selected from the Victaulic Registered Trade Mark system of fittings and couplings. Couplings shall be constructed of two galvanised ductile iron housings with pressure responsive gasket, Victaulic Style 177 and 75 flexible coupling and Style 107H and 07 rigid couplings with Registered Trade Mark manufacture system of fittings.

Flanges: Table E for AS 2129 completed with an approved rubber type gasket inserted for jointing purposes.

5.9.3 Fittings

Welded Pipe: Butt weld fittings (e.g. bends and tees).

Bends and Tees: Provide sweep tees and long radius type bends.

- Centreline Radius of Bend or Tee Branch: ≥ 1.5 times the pipe diameter.

Steel for Fabricated Pipe Fittings: Same grade and wall thickness as the pipe.

Non-vertical Lines: Eccentric reducing fittings installed to avoid gas binding, liquid retention or both.

5.10 PVC Piping

PVC-U NOTED FOR USE IN SANITARY DRAINAGE SYSTEM. THIS IS A DEPARTURE FROM THE CSNSW FACILITY ASSETS CORRECTIONAL STANDARD.

5.10.1 Standards

Un-plasticised Pipes and Fittings (PVC-U): To AS/NZS 1477.

Oriented PVC (PVC-O) Pipes: To AS/NZS 4441.

Solvent Cement: To AS/NZS 3879.

5.10.2 Installation

Standard: To AS/NZS 2032.

5.10.3 Jointing

Permanent Joints: Jointing shall be by solvent weld cement (high bond solvent cement) as recommended by the manufacturer. Fully moulded fittings only shall be used. Glue on boss or saddle type clamp or strapped on joints shall not be used. Ensure solvent weld joints have been cured for at least 24 hours before testing.

Prohibited: Heating or annealing of pipes and fittings and the burning out of fittings for re-use is unacceptable.

Demountable Joints:

- Piping ≤ DN 50: Threaded fittings;
- Piping > DN 50: Flanges with backing rings.

5.10.4 Best Practice PVC Manufacture

Requirement: All PVC-U pipework shall meet the requirements of Green Building Council Australia (GBCA) Best Practice Guidelines for PVC. The contractor shall obtain from PVC product suppliers a third party verification certificate that their products meets best practice guidelines.

5.11 Polyethylene (PE) Piping

NOTED FOR USE FOR THE IN GROUND PRESSURE SERVICES. THIS IS A DEPARTURE FROM THE CSNSW FACILITY ASSETS CORRECTIONAL STANDARD.

5.11.1 Standards

Pipes: To AS/NZS 4130.

Fittings: To AS/NZS 4129.

Components: To AS/NZS 4131.

5.11.2 Installation

Standard: To AS/NZS 2033.

5.11.3 Jointing

Type: Electrofusion.

5.12 High Density Polyethylene Piping

General: Installation shall be carried out in accordance to AS/NZS 3500.2, AS 2033 and the manufacturer's recommendations.

Jointing: Jointing of pipes and fittings shall be joined with electro fusion welded joints, ring seal sockets, expansion sockets, flanged joints and threaded joints to manufacturer's recommendations. Welded joints are not acceptable

Movement: Expansion and Contraction shall be catered for as recommended by the manufacturer and relevant standards. Suspended installations shall have expansion sockets at maximum 6m fixing distance or deflection legs. Inground installations can be installed rigid, without expansion sockets.

Fixing: Fixing points shall be made at the location of every expansion socket or deflection leg, to direct movements into the desired direction. Fixing points shall be designed to hold the pipe steady in position to ensure proper function of an installation. The strength of fix points shall be designed in accordance with the relevant standards and manufacturers guidelines.

Storage: Pipes stored outside are to be protected against deformation by covering. Pipes may not be stacked to height, which could result in deformation.

5.13 Valves and Fittings

5.13.1 General

Requirement: All valves shall be WaterMark certified by a JAS-ANZ accredited Conformity Assessment Body in accordance with the Plumbing Code of Australia.

5.13.2 Components

Valve Size: Equal to the nominal pipe size, unless a smaller size is specified.

Insulated Valves: Extended shafts or bodies to butterfly and ball valves to allow full thickness of insulation without restricting movement of hand-wheel or lever.

Connections:

- Valves ≤ DN 50: Screwed to AS ISO 7.1;
- Valves > DN 50: Flanged to AS 2129.

Handwheels and Handles: Removable, with the direction of closing marked permanently on handwheels.

Copper Alloy Valves: Dezincification resistant and stamped accordingly.

5.13.3 Installation

Valves: If practicable, install with the stem horizontal.

Non-Return Valves: Provide at least 6 pipe diameters of straight pipe on the upstream side.

Positioning of Valves in Finished Areas and Ducts:

- Be at a height of approximately 300 mm above floor level adjusted to match the joints, where installed within a finished area;
- Be at a height of approximately 1500 mm above finished floor level where installed within a duct;
- Be centrally located within a duct where access is obtained from a ceiling access panel (300 mm x 300 mm minimum typically). Valve position shall ensure ease of maintenance and co-ordination with other services.

5.13.4 Valve Identification

General: Tag all valves for identification purposes. Provide a circular brass disc attached to the valve by a stainless steel wire drawn through the holes in the disc on each valve provided with operating handwheel or lever stamp the valve identification mark on the disc in characters 10 mm high.

Valves Without Operating Handwheels: Mark by aluminium or brass strap 20 mm wide by 90 mm long stamped in the same manner as the valve identification discs. Attach by wire to the body of the valves.

5.13.5 Selection

Working Pressure Rating: Minimum 1.4 MPa and to suit the system pressure range.

Working Temperature Rating: To suit the system operating temperature range.

Valves for Potable Water: To AS/NZS 3500.1.

5.13.6 Gate Valves

Description: Straight-through flow, solid wedge type, inside screw design, medium pattern.

Standards:

- Bronze Valves: To AS 1628;
- Flanged Cast Iron Valves: To AS/NZS 2638.1.

Construction:

- Body:
    - ≤ DN 80: Bronze;
    - > DN 80: Cast iron.
- Seats: Integral seats for bronze valves, replaceable bronze seats for cast iron valves.

5.13.7 Globe Valves

Description: Inside screw design.

Construction:

- Body:
    - ≤ DN 50: Bronze;
    - > DN 50: Steel;
    - Stem and gland: Forged brass.

Bronze Screwed Globe Valves ≤ DN 50: Zetco Figure 2010 or approved equivalent.

Bronze Screwed Globe Valves > DN 50: Zetco Figure 2020 or approved equivalent.

5.13.8 Ball Valves

Description: Full bore pattern with handle parallel to the direction of flow when the valve is fully open.

Construction:

- Body: Bronze;

- Ball: Hard chromed brass;
- Gland Seal: Adjustable;
- Seat: PTFE.

5.13.8.1 Water Applications

DZR Brass Press-fit Ball Valves ≤ DN 50: Zetco Figure 6100 or approved equivalent. Supply Lilac handle for non-potable water applications.

DZR Brass Press-fit Ball Valves Where Publicly Accessible ≤ DN 50: Zetco Figure 6107 or approved equivalent. Supply Lilac handle for non-potable water applications.

DZR Brass Screwed Ball Valves ≤ DN 50: Zetco Isis Figure 1001 or approved equivalent for potable water applications and Zetco Isis Figure 1090 or approved equivalent for non-potable water applications.

DZR Brass Screwed Ball Valves Where Publicly Accessible ≤ DN 50: Zetco Isis Figure 1007 or approved equivalent for potable water applications and Zetco Isis Figure 1027 or approved equivalent for non-potable water applications.

Above Ground Bronze Flanged Ball Valves > DN 50: Zetco Figure 2605 or approved equivalent. Supply Lilac handle for non-potable water applications.

Above Ground Bronze Flanged Ball Valves Where Publicly Accessible > DN 50: Zetco Figure 2607 or approved equivalent. Supply Lilac handle for non-potable water applications.

Below Ground Bronze Screwed Ball Valves ≤ DN 50: Zetco Figure 2506 or approved equivalent.

Below Ground Bronze Flanged Ball Valves DN 65 - DN 100: Zetco Figure 2606 or approved equivalent.

Below Ground Bronze Flanged Ball Valves > DN 100: Zetco Figure 2606 or approved equivalent.

5.13.8.2 Fuel Gas Applications

DZR Brass Press-fit Ball Valves ≤ DN 50: Zetco Figure 6200 or approved equivalent.

DZR Brass Screwed Ball Valves ≤ DN 50: Zetco Figure 1130 or approved equivalent.

Above Ground Ductile Iron Flanged Ball Valves > DN 50: Zetco Figure 2605 or approved equivalent.

Below Ground Brass Screwed Ball Valves ≤ DN 50: Zetco Figure 2501 or approved equivalent.

Below Ground Ductile Iron Flanged Ball Valves DN 65 - DN 150: Zetco Figure 2602 or approved equivalent.

Below Ground Ductile Iron Flanged Ball Valves DN 200: Zetco Figure 2603 or approved equivalent.

5.13.9 Butterfly Valves

Description: Tapped lug type.

Operation:

- ≤ DN 150: Positive locating operating bar, parallel to the disk with notched plate;
- > DN 150: Geared or motorised operator;
- All Sizes Used for Throttling and Balancing: Geared operators.

Construction:

- Body: Cast aluminium or cast iron;
- Shaft: Stainless steel;
- Disc: Bronze generally, stainless steel for condenser water systems.
- Disc Fixing Method: Select from the following:
    - One-piece disc and shaft;
    - Disc keyed and screwed to shaft.
- Seat: Bonded EPDM selected for compatibility with the fluid and water treatment chemicals.

Grooved Gear Operated Butterfly Valves: Victaulic VIC-300 or approved equivalent.

Anti-tamper Switch: Amtron Class A or approved equivalent.

5.13.10 Non-Return Valves

Flanged Valves for Water: To AS 4794.

Disc Type:

- Body: Stainless steel or bronze;
- Disc and spring: Stainless steel.

Swing Type: To AS 1628.

- Body: Bronze;
- Plates: Bronze or stainless steel.

Dual Flap Type:

- Body: Cast iron;
- Pin and spring: Stainless steel;
- Seat: Integral nitrile rubber;
- Plates: Bronze or stainless steel.

DZR Brass Screwed Spring Check Type ≤ DN 50: Zetco Figure 1907 or approved equivalent.

Bronze Screwed Swing Type ≤ DN 50: Zetco Figure 1805 or approved equivalent.

Bronze Flanged Swing Type DN 65 - DN 100: Zetco Figure 1808 or approved equivalent.

Grooved Swing Check >DN 65: Victaulic Series 717 or approved equivalent.

5.13.11 Reduced Pressure Zone Device Valves (RPZD)

Standard: To AS 2845.1.

Construction ≤ DN 50:

- Valve Body: Unleaded bronze;
- Springs: Stainless steel;
- Seat Discs: Chloramine-resistant silicone;

- Diaphragm: Nitrile and nylon;
- O-rings: Chloramine-resistant EPDM.

Construction > DN 50:

- Valve Body: Epoxy coated ductile iron;
- Springs: Stainless steel;
- Seat Discs: Silicone.

RPZD's DN 15 – DN 50: Conbraco 4A or approved equivalent.

RPZD's DN 65 – DN 250: Conbraco 4AE or approved equivalent.

5.13.12 Double Check Detector Assembly (DCDA)

Standard: To AS 2845.1.

Construction:

- Valve Body: Epoxy coated ductile iron;
- Springs: Stainless steel;
- Seats: Bronze;
- Seat Discs: EPDM;
- Flanges: Table 'E';
- Fasteners: Stainless steel.

Support: Provide minimum two galvanized steel cradle supports under the DCDA and gate valves.

Bypass Line: The DCDA shall have a bypass line of a minimum DN 20 with a water meter complying with AS 3565.1.

Isolation Valves: Provide 50mm wide 003 keyed padlocks with 6 mm galvanized steel chain to lock all valves fully open.

Concrete Plinth: Provide 100 mm thick concrete plinth below the DCDA for entire length. Concrete slab shall be 25 mm above surrounding ground.

Pipe Jointing: Join polyethylene pipe to above ground copper pipe with poly electrofusion stub flanges, with stainless steel backing flanges and bolt with stainless steel bolts and nuts to 200 mm bronze brazing flanges each side of DCDA assembly. Provide cement mortar blocks formed around poly to copper/stainless flanged joints.

5.13.13 Thermostatic Mixing Valves

Standard: To AS 4032.1.

Requirement: Provide thermostatic mixing valves that automatically control the temperature at the mixed outlet to a pre-sealed temperature and suitable for the number of outlets served by the individual valve.

Thermostatic mixing valves shall be installed in secure ducts external to individual cells for General and High Needs Areas.

Temperature Setting:

- Inmate Facilities: 43.5°C.
- Sterile accessible environments: 45°C.
- All Other Cases: 50°C.

Controls: Include the following:

- A temperature sensitive automatic control that maintains temperature at the pre-selected setting and rapidly shuts down the flow if either supply system fails, or if the normal discharge water temperature is exceeded;
- Hot water flush facility.

Installation: Installation height shall not exceed 1500 mm from FFL and shall be not less than 300 mm from FFL. Each valve is to be adequately supported independent of all pipework and shall be readily accessible.

Completion: At completion a complete service log sheet for each valve and a certificate of the whole installation must be submitted to the site representative.

Field Testing: To AS 4032.3.

Maintenance: Servicing and maintenance shall be performed 12 months from the date of installation.

Thermostatic Mixing Valve DN 15: Enware Aquablend 1500 ATM700 or approved equivalent.

Thermostatic Mixing Valve DN 20: Enware Aquablend 2000 ATM711 or approved equivalent.

Thermostatic Mixing Valve DN 25: Enware Aquablend 2500 ATM725 or approved equivalent.

5.13.14 Tempering Valves

Standard: To AS 4032.2.

Requirement: Provide tempering valves that automatically control the temperature at the mixed outlet to a pre-sealed temperature and suitable for the number of outlets served by the individual valve.

Prohibited: Tempering valves shall not be used to where the temperature control is required at 45°C or lower.

Installation: Installation height shall not exceed 1500 mm from FFL and shall be not less than 300 mm from FFL. Each valve is to be adequately supported independent of all pipework and shall be readily accessible.

Completion: At completion, a certificate of the whole installation must be submitted to the site representative.

Field Testing: To AS 4032.3.

Maintenance: To the manufacturer's recommendations.

Tempering Valves DN 15 – DN 20: RMC Heatguard or approved equivalent.

5.13.15 Manual Balancing Valves

Description: Continuously adjustable graduated with a limit stop for precise setting of the maximum valve opening, a numeric indication of valve opening position and pressure tappings across the variable orifice.

Accuracy and Repeatability Errors: ± 5% or better over the normal measuring range of the valve.

Handwheel Scale Resolution: < 2.5% of full scale.

Construction:

- Body:
    - ≤ DN 50: Dezincification resistant copper alloy;
    - > DN 50: Cast iron.
- Seat: EPDM.

Manual Balancing Valves ≥ DN 50: IMI Hydronic Engineering STAD-B or approved equivalent.

Manual Balancing Valves > DN 50: IMI Hydronic Engineering STAF or approved equivalent.

5.13.16 Automatic Balancing Valves

Description: Pre-calibrated special purpose valve which automatically controls flow rate within ± 5% tolerance, with an internal spring loaded cartridge control mechanism and external tappings for pressure and temperature.

Construction:

- Body: Dezincification resistant copper alloy;
- Valve plug: Corrosion-resistant acetal plastic;
- Seat: Corrosion-resistant polysulphone plastic;
- Handwheel: Glass fibre reinforced polyamide plastic;
- Other Parts in Contact with Water: Dezincification resistant copper alloy;
- O-rings: EPDM rubber.

Automatic Balancing Valves DN 15 – DN 20: IMI Hydronic Engineering TA-Therm or approved equivalent.

5.13.17 Pressure Reducing Valves

Description: Self-actuated, spring loaded with adjustable setting.

Adjustable Outlet Pressure Range: 150kPa - 500kPa.

Construction:

- Body: Forged brass;
- Spring Chamber: Nylon;
- Adjusting Spring: Zinc plated stainless steel;
- Pressure Plate: Zinc plated stainless steel;
- Diaphragm: EPDM;
- Body Seat: Polysulfone;
- Seat Disc: EPDM;
- Piston: Stainless steel;
- Strainer Screen: Stainless steel.

Pressure Reducing Valves ≤ DN 50: RMC or approved equivalent.

5.13.18 Ball Float Valves

Description: Copper or plastic float with stainless steel or copper alloy linkage.

Copper Alloy Valves: To AS 1910. Bronze body, needle and pins.

Cast Iron Valves: Cast iron body, bronze needle and pins.

5.13.19 Foot Valves

Standards:

- Sealing Whitworth Form Pipe Threads: To AS 1722.1.
- Pipe Thread Pressure Tight Joints: To ISO7.

Manufacturer: Philmac or approved equivalent.

Threads: All threads shall be BSP (Whitworth form).

Sealing Threads: Thread shall be sealed with PTFE tape.

5.13.20 Strainers

Selection: 15 kPa maximum pressure drop.

Construction:

- Body: Bronze or cast iron as documented;
- Screen: Stainless steel.

Strainers > DN 65 Diameter: Fit a 25mm ball valve for blowdown.

DZR Brass Screwed Strainers ≤ DN 50: Zetco Figure 1504 or approved equivalent.

Bronze Flanged Strainers DN 65 - DN 100: Zetco Figure 1525 or approved equivalent.

5.14 Pressure Gauges

5.14.1.1 General

Standard: Bourdon tube type to AS 1349.

Scale Range: Full scale between 130% and 200% of maximum working pressure.

Construction:

- Case: Glass filled nylon. Minimum diameter 100 mm;
- Lens: UV stabilised polycarbonate;
- Dial: UV stabilised polycarbonate;
- Indicating Pointer: Adjustable;
- Configuration: Direct mounting, bottom entry;
- Bourdon Tube Material: Stainless steel for hot water systems. Phosphor bronze for other services.

5.14.1.2 Installation

General: Mount gauges vertically and in locations free from vibration. Provide gauge line connection cocks. If necessary, eliminate needle fluctuations caused by pressure fluctuations, by either of the following:

- An orifice or restrictor;
- A capillary tube pressure pulse damper.

Pressure Gauge Connections: For gauges not permanently connected, seal outlets of isolating valves with flared seal cap nuts.

5.15 Thermometers

Type: Mercury in steel.

Accuracy: Within ± 1% of full scale deflection or better.

Construction:

- Case: Glass filled nylon. Minimum diameter 100 mm;
- Lens: UV stabilised polycarbonate;
- Dial: UV stabilised polycarbonate;
- Indicating Pointer: Adjustable;
- Bulb: Grade 316 stainless steel;
- Configuration: Direct mounting, bottom entry.

Installation: Install thermometers vertically, in locations free from vibration, with the bulb in a thermometer well.

5.16 External Fire Hydrant Valves

General: External fire hydrants shall comprise of NSW Fire & Rescue approved dual 65 mm storz hydrant valves complete with caps and chains, dual head fire hydrant valve riser, tamper resistant dual head hydrant covers, dual head hydrant support posts, and two (2) galvanised protection bollards (where required).

Concrete Anchor: Install each external hydrant on a 100 mm GMS riser complete with a 450 mm x 450 mm x 450 mm concrete base finished 25mm above ground level.

Identification: Paint a white band 100 mm wide on the riser with the letters FH in signal red in 80mm high text.

Siting: Locate hydrants at least 10m away from building unless protected by 90/90/90 fire rated construction to the requirements as specified in AS 2419.1.

Installation: Position valve centre line minimum 750 mm above finished ground level and allow to direct outlets sloping not more than 35 degrees below the horizontal. Valves shall be complete with a storz coupling fittings, brass caps and chains. Valve handwheel shall be 100 mm clear of any obstruction. Two hydrant valves shall be provided on each hydrant riser.

5.17 Internal Fire Hydrant Landing Valves

General: Internal fire hydrants shall comprise of NSW Fire & Rescue approved 65 mm storz hydrant valves located within all fire equipment cabinets, fire isolated stair risers or fire hydrant cabinet locations as generally indicated on the accompanying drawings and complete with caps and chain.

Installation: Position valve centre line minimum 750 mm above finished ground level and allow to direct outlets sloping not more than 35 degrees below the horizontal. Valves shall be complete with a storz coupling fittings, brass caps and chains. Valve handwheel shall be 100 mm clear of any obstruction.

5.18 Fire Hydrant Storz Couplings

General: Storz couplings shall be forged aluminium alloy manufactured to DIN 14303 and fitted to all hydrant system inlets and outlets including boosters, feed hydrants, attack hydrants and hard suction outlets.

Couplings: All couplings must be fitted with delivery washers except hard suction couplings, which must be fitted with a suction washer. All storz couplings shall be fitted with a blank cap.

Thread Connection: 65mm connectors shall be fitted using standard FRNSW thread of 64 mm x 4.88 mm pitch (2V2 x 51/5 TPI). A low strength thread sealant is recommended for use between the connector and pipe thread creating a semi-permanent connection so that a damaged connector may be expediently removed and replaced.

5.19 Fire Hose Reels

Type: Fire hose reels shall be wall mounted 36 m, 19 mm internal diameter fabric reinforced non-kinking rubber hose with adjustable nozzle. The hose reels shall be fitted with a gunmetal hub, red baked enamel mild steel side plates and stainless steel spacing rods and shall be in accordance with AS 1221.

Installation: Locate centre of hub at height of 1500 mm above floor level and ensure that the installation upon completion permits the hose to run smoothly off the reel when pulled in any direction. 100mm minimum clearance to circumference of drum through to door frame.

Fixing: Secure reel hub to masonry walls or steel bollards by means of 10 mm diameter 'Dynabolt' type fixing and to plasterboard walls by means of 10 mm hexagon head galvanised steel coach screws into timber supports. Fire hose reel mounting plates shall be secured in a workmanlike manner free of damage to the surrounding areas. The structure on which fire hose reels are mounted shall be capable of withstanding a force of 1kN.

Water Supply: The hose shall be supplied with water from the water service through a 25 mm screw down loose jumper type valve fitted with a union between valve and reel for maintenance purposes. The nozzle shall be attached to the valve by a device so that it cannot be removed until water supply is turned on.

Pressure Gauge: Install a pressure gauge on the inlet side of the 25 mm control valve to the most disadvantaged fire hose reel.

Operating Instructions: Separate operating instructions shall be permanently secured in a conspicuous upright location.

Operation: The hose shall operate with a minimum flow rate of 0.33 litres per second and a running pressure of 220 kPa at the outlet of the nozzle when the hose is fully extended.

5.20 Installation

5.20.1 General

Requirement: Install piping in straight lines at uniform grades with no sags. Arrange to prevent air locks. Provide sufficient unions, flanges and isolating valves to allow removal of piping and fittings for maintenance or replacement of plant.

Layout: Follow the line of walls, ceilings, etc., and include all necessary offsets and arrange to avoid interference with the building or other services.

Arrangement: Arrange and support piping so that it remains free from vibrations whilst permitting necessary movements. Minimise the number of joints.

Spacing: Provide at least 50 mm clear between pipes, flanges, unions and couplings and between these and building elements, additional to insulation.

Dissimilar Metals: Join dissimilar metals with fittings of electrolytically compatible material and as follows:

- Flanges: Provide insulating flange kit;
- Proprietary Grooved Piping Systems: Provide proprietary thermoplastic lined dielectric isolating fitting.

5.20.2 Connections

Requirement: Arrange connections to plant to permit dismantling of the plant without disturbing other pipes and to permit removal of the plant without cutting or removal of the piping, or cutting or damaging building elements. Provide union on at least one side of each screwed valve and screwed pipeline component requiring removal for inspection or maintenance. Make all connections to plant by one of the following methods:

- Flare compression joints (up to 20 mm copper and only where there is no vibration);
- Screwed brass unions (up to 50 mm size and for pressures up to 800 kPa);
- Bolted flanges (no size limitation);
- Proprietary grooved joints (no size limitation).

5.20.3 Separation of Components

Requirement: Install pipeline components to manufacturer's recommendations and the following:

- Pump Discharge to Check Valve: ≥ 5 diameters of straight pipe. The flexible connection (if used) and reducer (if used) may be included in calculating this length;
- Before Pump Suction: ≥ 5 diameters of straight pipe. The flexible connection (if used) and reducer (if used) may be included in calculating this length.

5.21 Concrete

Type: Concrete shall be mixed in an approved central plant and transported to the site in a pre-mixed condition by means of specially constructed conveyances. Transit mixers will be accepted, provided that they comply in all respects with the requirements of this specification and AS 1379 and its use is approved or machine mixed to AS1480.

Strength: All concrete used in conjunction with this work shall have a minimum strength of 20 mPa at twenty eight days when tested in accordance with AS 1012.8.

5.22 Anchorages

Requirement: Install anchorages in the form of lateral or longitudinal anchor blocks, of not less than 20 MPa concrete, to restrain lateral movement in pipelines at bends and changes of direction on pipework above 100 mm diameter. Bear anchor blocks against the body of the fitting only, clear of joints, and against firm undisturbed ground or compacted filling.

Rubber Ring Joints: Where rubber ring jointed pipes and where the gradient is greater than 1 in 20 (5%), concrete stops shall be provided 150 mm thick and built around the pipe extending from the bottom of the trench up to a height of 300 mm above pipe and recessed 75 mm into each side of the trench.

Submissions: Submit to the Superintendent all details of the inground pipe systems including proposed positions of concrete thrust blocks for approval before installation of pipework commences.

5.23 Concrete Encasing

Requirement: Unless otherwise permitted by the relevant authority, concrete encase the following:

- Vitrified clay sewer pipelines beneath buildings;
- Pipework which cannot be provided with the required minimum cover.

Encasement: Shall consist of 15 MPa concrete, not less than 150 mm above and below the pipe and 150 mm each side or the width of the trench, whichever is the greater.

5.24 Cleaning

General: Remove scale, rust, burrs and grease and make sure that surfaces are clean and dry.

Protection: During construction, prevent the entry of foreign matter into the piping system by temporarily sealing the open ends of pipes and valves with purpose-made covers of pressed steel or rigid plastic.

5.25 Restoration of Surfaces

Requirement: Be entirely responsible for the restoration of any concrete, bitumen, grass or natural surface removed or damaged as a result of the work. Any road, path etc. so affected shall be restored with materials of the same nature and of equal quality as those contained in the original construction and to the same depth. All restoration is to the standard of the authority having jurisdiction. At the end of the maintenance period all restored surfaces shall at least equal in all respects those existing before the commencement of the works.

5.26 Pipe Supports

5.26.1 Support Systems

General: Provide hangers, brackets, saddles, clips, and support system components, incorporating provisions for adjustment of spacing, alignment, grading, and load distribution. Support pipework from associated equipment or building structure. Support valves, strainers and major line fittings so that no load is placed on adjacent pipes or transmitted to them during operation and maintenance. Brackets, clips, and hangers shall be;

- Formed of a suitable material;
- Securely attached to the building structure and not to any other service;
- Designed to withstand the applied loads;
- Protected against corrosion where exposed to corrosive environments;
- Made from compatible materials;
- Clamped securely to prevent movement unless designed to allow for thermal movement;
- Restrained to restrict lateral movement;
- Designed so that pipes and fittings are supported with minimal load being taken by the joints.

Movement and Thermal Expansion: All pipework shall be free to move without causing stresses in the pipework or in the pipe joints.

Support Type: Proprietary metallic-coated steel channel section with clamps and hangers sized to match external diameter of pipe being supported. 'U' clamps shall not be used with PVC pipes. Fixings for PVC shall completely circumvent the pipe without distorting the cross sectional profile of the pipe. Alternative methods of fixings may be used provided the proposed method is detailed, discussed and approved by the Superintendent prior to the commencement of any work dependent upon such an approval. Approved fabricated mild steel brackets shall have ground off neat square ends drilled holes.

Vertical Pipes: Provide anchors and guides to maintain long pipes in position, and supports to balance the mass of the pipe and its contents.

Saddles: Saddle type supports may only be used for pipes no more than DN 25.

Pipe Supports: Clamp piping supports directly to pipes.

Dissimilar Metals: If pipe and support materials are dissimilar, provide industrial grade electrically non-conductive material securely bonded to the pipe to separate them. Provide fixings of electrolytically compatible material.

Copper Pipes: All copper pipes shall be separated from supports by 4mm thick PVC strip of similar approved material.

Uninsulated Pipes: Clamp piping supports directly to pipes, subject to electrical isolation of dissimilar metals.

Insulated Pipes:

- Spacers: Provide spacers at least as thick as the insulation between piping supports and pipes. Extend either side of the support by at least 20 mm;
- Spacer Material: Rigid insulation material of sufficient strength to support the piping and suitable for the temperature application;
- Vapour Barriers: For cold pipes, apply aluminium foil tape over the circumference of the spacer to form a vapour barrier. Fit to spacer before installation of the bracket on the pipe;
- Metal Sheathing: Provide a 0.55 mm thick metallic-coated steel band between the aluminium foil tape and the support for the full width of the spacer.

5.26.2 Support Spacing

Stormwater Drainage Pipes: To AS/NZS 3500.3.

Sanitary Plumbing and Drainage Pipes: To AS/NZS 3500.2.

Trade Waste Drainage Pipes: To AS/NZS 3500.2.

Cold Water Service Pipes: To AS/NZS 3500.1. Provide additional brackets, clips or hangers to prevent pipe movement caused by water pressure effects.

Hot Water Service Pipes: To AS/NZS 3500.4. Provide additional brackets, clips or hangers to prevent pipe movement caused by water pressure effects.

Fuel Gas Service Pipes: To AS 5601. Provide additional brackets, clips or hangers to prevent pipe movement caused by gas pressure effects.

Fire Hydrant Service Pipes: To AS/NZS 3500.1. Provide additional brackets, clips or hangers to prevent pipe movement caused by water pressure effects.

Fire Hose Reel Service Pipes: To AS/NZS 3500.1. Provide additional brackets, clips or hangers to prevent pipe movement caused by water pressure effects.

5.26.3 Hanger Size Table

Outside Diameter of Pipe or Sheathing (mm)	Minimum Hanger Diameter (mm): Light Series	Minimum Hanger Diameter (mm): Heavy Series
< 20	6	6
≥ 20, < 35	10	10
≥ 35, < 65	12	12
≥ 65, < 120	12	16
≥ 120, < 220	16	16
≥ 220, < 275	16	20
≥ 275, < 325	20	24
≥ 325, < 410	24	30

5.27 Acoustic Treatment

Requirement: All elevated drainage systems shall be insulated with acoustic pipe lagging which will be combined with acoustic convoluted open cell foam laminated to an acoustic barrier to National Construction Code requirements. Installation to the pipe shall ensure at all times a tight butt join of the foam and a minimum barrier overlap of 20 mm. All joins are to be taped with a 48 mm wide aluminium tape such as PPC 493 reinforced tape. 'S' trap and other difficult fittings shall be boxed, ensuring that overlaps are maintained on all joints.

5.28 Flexibility

5.28.1 General

Requirement: Pipe anchors, offsets or expansion devices and pipe guides to accommodate expansion and contraction, and to minimise the transmission vibration and noise to building structures.

Anchors and Guides: Locate anchors and guides at equal distances on each side of expansion devices. Weld or securely clamp anchors to bare pipe. If limitations in the strength of structures prevent the use of expansion devices and anchors, arrange piping to move in lateral and linear directions (e.g. at bends) while not deviating from gradients.

5.28.2 Flexible Connections

General: Minimise the transmission of vibration and noise through the piping. Isolate vibrating sources as follows:

- Connections to Major Plant Items: Reinforced rubber type, spherical shape with flanged ends;
- Elsewhere: Flexible reinforced nylon hose.

5.29 Sleeves

5.29.1 General

Location: Provide sleeves that permit normal pipe movement through walls, floors, and other building elements.

5.29.2 Cover Plates

General: Where exposed to view provide cover plates fixed to the pipe or insulation sheathing and free to move with respect to sleeve and building surface.

Material: Non-ferrous metal, finished to match the pipe, or of stainless steel, close fitting and firmly fixed in place.

5.29.3 Cover Plate Sizes Table

Nominal Pipe Size (DN)	Cover Plate Diameter
< 20	65 mm
≥ 20, < 50	100 mm
≥ 50	50 mm larger than pipe

5.30 Joints

5.30.1 General

Requirement: Minimise the number of joints. If practicable, provide welded or brazed joints or a proprietary pipe coupling system.

5.30.2 Demountable Joints

Requirement: Locate as follows:

- At connections to pumps;
- At maintenance locations.

Pipes ≥ DN 65: Flanges or proprietary grooved joint.

5.30.3 Flanged Joints

Metal Flanges: Full face flanges with undistorted machined joint faces, to AS 2129.

Minimum Flange Thickness: 12 mm.

Bolting: To AS 2129 and AS 2528.

Material:

- Corrosive Environments: Material with equivalent corrosion resistance to, and compatible with, the flanges;
- Non-corrosive Environments: Zinc-plated steel.

Flange Jointing Material: Preformed proprietary type at least 0.8 mm thick.

Installation: Install flanges square with the run of pipe and aligned parallel to each other. Do not correct misalignment by bolting.

5.30.4 Screwed Joints

General: To AS ISO 7.1. Do not provide long screws or barrel nipples. Seal threads of screwed connections with degreased PTFE tape or a thread sealing compound.

5.30.5 Grooved Piping Systems

5.30.5.1 Compatibility of Components

Grooved Mechanical Jointing Systems: Provide piping grooved on machines supplied by Victaulic.

Grooved End Product Manufacturer: Certified to ISO 9001.

Piping: For Victaulic jointing systems, provide pipe supplied by an authorised Victaulic distributor.

Grooving: Provide rolled groove pipe.

Grooving Tools: Use tools supplied by the same manufacturer as the grooved components.

Site Rolled Grooves: To be made only by Victaulic trained personnel, stamped, and recorded to Victaulic approved quality control system.

5.30.5.2 Components

Gaskets: Provide gaskets in the Victaulic couplings of style and material selected for the operating temperature and pressure range of the system and for long term compatibility with the pipe contents including chemical water treatment.

Victaulic Advanced Groove System: Provide only on piping ≥ DN 350.

Finish: Painted or galvanized.

5.31 Underground Metal Piping

5.31.1 Proximity to Other Services

General: Separate underground piping from electrical cables and gas pipes, by at least 300 mm.

5.31.2 Installation

Pipe Underlay: Bed piping on a continuous underlay of bedding material, at least 75 mm thick after compaction. Grade the underlay evenly to the gradient of the piping.

Bedding Material: Sand free from material retained on a 13.2 mm sieve.

Chases: If necessary, form chases to prevent projections such as sockets and flanges from bearing on the trench bottom or underlay.

Other Services: Separate underground piping from electrical cables and other services by ≥ 300 mm.

5.31.3 Pipe Surrounds

General: Place the material in the pipe surround in layers less than 200 mm loose thickness and compact without damaging or displacing the piping.

Protection: Lay continuously concrete tiles more than 25 mm thick, or PVC tape at least 3 mm thick, in the overlay, 50 mm to 75 mm clear of the piping, for the length of the piping.

Warning Tape: During backfilling lay plastic warning tape 300 mm above buried piping, for the full length of the piping.

- Type: Minimum 100 mm width.

Valves: Install in underground control boxes.

5.31.4 Corrosion Protection

Protection: Either encase piping in continuous PVC-U watertight pipe or provide continuous wrapping over all pipe and fittings using proprietary petroleum taping material installed in accordance with manufacturer's recommendations.

6. SANITARY FIXTURES & TAPWARE

6.1 General

Fixture & Fitting Selection:

- All fixtures shall be approved for use in a correction facility and shall be vandal resistant and anti-ligature.
- Flow meters and flow control devices (solenoid valves) to be installed to single or group of fixtures for Inmate wet areas. These installations shall adopt simple push button operations for the shower, basin and toilet flushing within the room wired back to the solenoid in a secure duct/location. As a guide, the time function shall be six minutes on – six minutes off for all water supply points within the wet areas. The final time on/off function shall be confirmed with the Client prior to installation and commissioning.
- The system control for the water supply systems to inmate wet areas shall have the ability to control the water to the room/areas to allow shutdown and isolation of the services externally to the room/areas themselves.
- Water hammer arrestors to be installed as required to eliminate water hammer;
- Refer to indicative room data sheets and example fixture schedule for further information on specific room requirements with respect to fixtures, fittings and water supply arrangements. It is noted that the provided information **is a guide only**, to highlight the typical type of fixtures for the given environments. A proposed fixture schedule shall be provided to the Client for approval prior to procurement and installation.
- The current approved suppliers of fixtures are Enware, Britex, SMC Stainless and Stoddart.

6.2 Standards

6.2.1 General

Design for Access and Mobility: To AS 1428.1 and AS 1428.2.

6.2.2 Authorised Products

Standard: Listed in the WaterMark Product Database, unless otherwise required by Local Water Authority.

6.2.3 Labelling

Water Efficiency Labelling: Provide only products conforming to, and labelled to, the Water Efficiency Labelling Scheme (WELS).

6.3 Submissions

6.3.1 Certification

General: Submit evidence that proposed fixtures and tapware are listed in the WaterMark Product Database.

6.4 Products

6.4.1 Laundry Troughs and Tubs

Standard: To AS/NZS 1229.

6.4.2 Sealants

General: Use only sealants that do not support microbial growth.

Colour: To match fixture.

6.4.3 Wash Basins

Standard: To AS/NZS 1730.

6.4.4 Accessories

General: Provide escutcheons and cover plates over visible penetrations. Finish and material to match adjacent fixtures.

6.4.5 Sealants

General: Use only sealants that do not support microbial growth.

Colour: To match fixture.

6.4.6 Tap and Valve Heads

Metal Heads and Handles: Provide brass fittings or a suitable bush to prevent electrolysis and growth.

Plastic Heads and Handles: Provide compact fittings designed to prevent fracture and exposure of jagged or rough edges.

Vandal-Proof Heads: Provide vandal-proof or anti-tampering devices for the designated types.

6.4.7 Water Efficiency

Shower Heads: To AS 3662 and suitable for the pressures and pressure differences of the supplied water.

Water Efficient Tapware: Tested and labelled with their water efficiency rating to AS/NZS 6400.

6.5 Storage and Handling

Accessories: Use manufacturer's brackets and accessories if these are available and suitable for the mounting substrate.

Protection: Deliver fixtures to site protected from damage under site conditions by coatings, coverings and packaging. Remove only sufficient protection to permit installation.

6.6 Installation

6.6.1 General

Requirement: Install to manufacturer's recommendations. Use manufacturer's recommended tools and templates.

Location: Locate to dimensions as documented.

Installation: Install level, plumb and true to line in the required location. Make sure moving parts function freely and without obstruction. Do not modify supplied units.

Seal: Provide resilient seals between fixtures and backnuts.

Fixing: Provide rigid fixing for tapware so that it does not move in normal operation.

Connections: Connect to each fixture supply and waste services. Install plumb and level.

Cutting and Fitting: If it is necessary to cut and/or fit substrate to install an item, carry out this before the surface is finished or painted. Remove items when required for painting and protect until re-installed. Cap or plug the open ends of pipes. Reinstall when painting and finishing is complete.

Substrate and Fixings: Before installation, make sure that the substrate to which the fixtures are to be installed is adequate for the intended loads and fixings methods. In solid walls, confirm adequacy of the material at fixing locations.

6.6.2 Vitreous China Fixtures

General: Undertake preparation, assembly, connections to water supply and sanitary plumbing, application of slurries and sealants in sequence. Install the fixture without stressing its attachment points.

6.7 Completion

6.7.1 Adjustment

General: Inspect and adjust tapware for correct and smooth operation. If adjustment does not rectify incorrect or defective operation, replace units.

6.7.2 Damage

General: Inspect all work and replace or repair to factory condition damaged or marked fixtures and components.

Foreign Matter: Inspect for presence of foreign matter particularly on tap seats. Remove if found. Replace damaged seats.

6.7.3 Protective Coatings

General: Immediately before the date for practical completion, remove all protective coatings and stickers and clean surfaces. Check and clean debris from traps.

7. HYDRAULIC PUMPS

7.1 Submissions

Type Tests: Required.

Standard: To AS 2417.

Accuracy of Measurement: Grade 2 to AS 2417.

Type Test Records: Submit type test curves for each size and type of pump marked with the duty point.

7.2 Components

7.2.1 Control Panels

General: Provide control panels to suit the controls. Mount switches, and indicating lights on the door. Mount motor starters, relays and switchgear and terminals on DIN rails inside the cabinet. Run cables in trunking or looms.

Labelling: Label all components. Number both ends of each cable and number terminal strips to match the circuit diagram. Provide a laminated circuit diagram inside the cabinet.

Metalwork: Vandal proof cabinet constructed from metallic zinc coated steel with powder coat finish. Provide a hinged and lockable door with 2 keys. Keys shall be compatible with the master key type utilised for mechanical equipment items.

Degree of Protection: IP54 or higher.

7.2.2 Controls – Dual Pump Installations

General: Provide controls to alternate the pumps after each cycle of operation, start the idle pump if the other fails, and activate an audible alarm and a flashing warning light to indicate a failure.

Alarm Bells: Mount on an external wall. Provide alarm mute.

Meters: Provide an hours-run meter to each motor.

Selector: Provide an auto-off-on selector for each pump.

Warning Lights: Provide separate lights to indicate power available, run for each pump, fault for each pump and other faults.

7.2.3 Float Switches

Type: Micro switch. Provide one level switch for each liquid level to be detected.

Construction: Double encapsulated hermetic construction designed for long life submerged. Provide a clamp to permit accurate adjustment of levels.

Cable: Low moisture absorption type.

7.2.4 Marking

General: Provide a robust label on each pump or pump set showing design flow rate, head, temperature of pumped medium, casing, impeller, and shaft materials.

7.2.5 Motors

Dimensions and Performance: To IEC 60072-3.

Installation: To AS 60034.7.

Motors Minimum 0.75 kW: Three phase, flange mounted.

Overload Protection: Provide each motor with overload protection.

Performance:

- Efficiency: Motors documented as high efficiency to AS/NZS 1359.5, all other motors to AS/NZS 1359.5.
- Power Factor at Full Rated Output: Minimum 0.72 for single phase motors, minimum 0.83 for three phase motors.

Selection: Provide motors selected for the maximum number of starts per hour of the installed system and to provide efficient, non-overloading pumping sets.

Power Rating: At least the maximum power required by the pump when projecting the system resistance curve to the maximum impeller size for the pump casing size.

Degree of Protection: IP54 or higher.

Shaft: If the impeller is mounted directly on the motor shaft use grade 416 stainless steel for the shaft.

7.2.6 Pressure Vessels

Standard: To AS 2971.

Type: Diaphragm pressure tanks of fabricated steel construction, epoxy coated on metal surfaces in contact with water. Pre-charge the tanks with air.

7.3 Pumps – End Suction Centrifugal

Standard: To ISO 2858 or DIN EN 733.

Type: Close coupled pump accepting standard flange-mounted motors.

Casing Pressure Rating: The greater of 1.6 MPa, and 1.5 times the total of the pump shut-off head plus the static and system pressures.

Casing Material:

- Cast iron to AS 1830 (ISO 185/JL/250), minimum;
- Bronze, grade 836B.

Balancing: Statically and dynamically balance completed rotating assemblies.

Impellers: One piece shrouded type with machined sealing collars constructed from stainless steel or grade 836B bronze.

Shaft: Solid grade 416 stainless steel, machined all over, free of stress concentrations.

Shaft Sleeves: Provide a sleeve extending the full length of the seal housing.

Shaft Seals: Provide mechanical seals compatible with carbon elements rotating against a ceramic stationary face.

7.4 Pumps – Hot Water Circulating

Requirement: Conform to the requirements for Pumps – End Suction Centrifugal except as follows.

Mounting: Suitable for mounting with the shaft vertical or horizontal.

Impellers: May be fixed to the motor shaft.

Radial Bearings: Ceramic sleeve or ball bearing.

Axial Bearings: Carbon/ceramic sleeve or ball bearing.

Pump Housings: Cast iron or bronze.

Casing Arrangement: Back pull-out.

Sealing: Seal motors and electrical connections to protect against ingress of condensation.
Control: Provide time clock for after-hours control.

Control Panel Indicators:

7.5 Pumps – Submersible

Type: Vertical, fully flooded submersible, close coupled, single stage, centrifugal.

Bearings: Deep groove ball type, sealed for life.

Cable: Heavy duty, low water absorption type with replaceable gland seal at the pump.

Casing Material: Cast iron to AS 1830 (ISO 185/JL/250), minimum. Finish outer casing and immersed equipment and fittings with anti-corrosive protective coatings.

Degree of Protection: Water tight enclosure, IP68.

Float Switches: Integral.

Impellers: Cast iron, non-clog type.

Motors: Three phase, with windings protected by thermistors and moisture sensor. Provide automatic reset.

Mounting: Provide duck foot pedestal bases with guide rails or guide wire system.

Nuts and Bolts: Stainless steel.

Shaft Seals: Replaceable double mechanical type with rotating seal rings of silicon carbide.

Shafts: Stainless steel to ASTM A240/A240M.

Suction Screens: Stainless steel or plastic.

7.6 Pressure Booster Pumpsets

7.6.1 Single Pressure Booster System

General: Provide a pump, motor, and pressure vessel package with in-built controls to maintain the pressure at the pump discharge between the maximum and operating pressures.

Construction: Factory-assemble the unit with pump, pressure vessel, control panel, and ancillaries on steel frame mounted on steel baseplate.

7.6.2 Dual Pressure Booster System

General: Provide a dual system consisting of two identical pump and motor sets, each serving its own pressure vessel and operated by an interconnected automatic control mechanism.

Construction: Factory assemble the units with pumps, pressure vessels, control panel, and ancillaries on steel frames mounted on steel baseplates.

Controls: Provide a pressure switch to sense excessively low suction pressure, shut down the pumps, and signal an alarm. Provide manual reset.

7.6.3 Pressure Gauges

General: Provide a pressure gauge to indicate the pressure at the inlet and outlet of the system.

7.6.4 Automatic Tank to Mains Changeover Controls

General: If recovered water including rainwater is used as an alternative supply to mains water, provide automatic changeover controls.

Operation: Use mains water when the water level in the storage tank is below set level or otherwise unavailable, demand is low or would cause excessive pump starts. In all other cases use stored water.

Inclusions: Provide low voltage water level switch, dual check valves to prevent cross connection and motorised valves for mains and stored water changeover and all associated wiring and controls.

7.7 Pumps – Fire Hydrant Service

7.7.1 General

Requirement: The booster pump shall be supplied and installed so as to maintain a minimum running pressure in accordance with AS 2419.1.

Type: The pumpset shall comprise centrifugal back pull out mechanical seal water pumps with cast iron body, bronze impellor and stainless steel shaft, in accordance with AS 2941.

Jacking Pump: A jacking pump with a cast iron body, bronze impellor and stainless steel shaft direct coupled to a weatherproofed 3 phase TEFC electric motor shall be provided to maintain static system pressure.

Ancillaries: All inter-component piping, valves, controls and wiring are to be provided by pump manufacturer with the assembled package and include; dial pressure gauges, pressure switch, flow switch and control panel all necessary Hydraulic control equipment including relays, fuses, starters, switches and wiring for functioning of system, all to SAA Code.

7.7.2 Electric Motor

Type: Shall be 400 V, 3 phase, squirrel cage TEFC.

Power Supply: Electrical connections shall be such as will ensure that power is available to the motor when switches for the distribution of other power throughout the premises are open. Any switches in the power circuit to the motor shall be locked 'ON' and clearly labelled **FIRE HYDRANT BOOSTER PUMP - NOT TO BE SWITCHED OFF**.

Electrical Wiring: All wiring to the electrical motor, including wiring related to the remote control starting system and within the building shall be:

- Enclosed in a duct with a fire resistance rating of 2 hours;

- PVC or elastomer insulated and armoured;
- PVC or elastomer insulated and enclosed in screwed steel conduit;
- Mineral-insulated, copper-sheathed.

7.7.3 Diesel Engine

Type: Shall be air-cooled, four cylinder, electrically started type complete with batteries, starter motor, generator, voltage regulator, exhaust and fuel systems, oil bath, air cleaners, gauges, spare parts and tools.

Controls: The diesel motor shall be mechanically governed, have direct fuel injection and be continuously rated for twenty-four (24) hours operation to deliver not less than the horsepower required from the duty, at the loaded governed speed.

7.7.4 Fuel Storage

Requirement: The fuel storage tank shall be mounted over the engine and shall be of sufficient capacity to run the engine for a minimum of six (6) hours. Sufficient fuel shall be kept on hand to run the engine for at least twenty-four (24) hours. The fuel system shall include a 200 mesh filter, contents gauge and all necessary pipework. The pipework shall be arranged to deliver fuel to the engine fuel pump by gravity without any possibility of air locking.

7.7.5 Exhaust Piping

Requirement: Exhaust gases shall be piped from the motor manifold to discharge to atmosphere in an approved location. Exhaust piping shall be heavy gauge galvanised steel tubing of a diameter recommended by the motor manufacturer.

Insulation: All exhaust piping shall be insulated with a 25 mm thick semi-rigid mineral wool insulation secured with two (2) aluminium clips per section. Piping up to a height of 2000 Mm shall be sheathed over a 26 gauge zinc anneal, secured by pop rivets. Provide a suitable stainless steel silencer of the straight through type in the exhaust piping within the pump room.

7.7.6 Pumps

Requirement: The pumps shall be proven to meet the design duty and to comply with the correct starting procedure, i.e.

- The jacking pump shall automatically maintain the hydrant system pressure;
- The diesel/electric driven hydrant pump shall operate upon a pressure drop below 200 kPa;
- The electric pump shall operate upon a pressure drop below 50 kPa.

Manufacturer Testing: During the guarantee period, the manufacturer reserves the right to carry out, at weekly intervals, test runs of the pumping equipment in accordance with standard approved procedures:

- Starting equipment for the diesel hydrant pump;
- DOL starting equipment for the jacking pump;
- Manual test buttons;
- An alarm gong to indicate booster pump operation with mute switch for the gong;
- Pump run lights for all pumps.

7.8 Installation

7.8.1 Standards

Stormwater Drainage Pumps: Install to AS/NZS 3500.3.

Sanitary Drainage Pumps: Install to AS/NZS 3500.2.

Cold Water Service Pumps: Install to AS/NZS 3500.1.

Hot Water Service Pumps: Install to AS/NZS 3500.1 and AS/NZS 3500.4.

Rainwater Re-use Water Service Pumps: Install to AS/NZS 3500.1.

Fire Hydrant Service Pumps: Install to AS 2419.1 and AS 2941.

Fire Hose Reel Service Pumps: Install to AS 2441 and AS 2941.

7.8.2 Connections

General: Arrange pumps, piping and valves so that individual pumps can be removed with minimal drain down and disturbance to the connected piping. Support pipes independently of pumps.

Connections: Install vibration isolating couplings in the connecting pipes at the pumps. Provide couplings selected for a working pressure at least twice the system design pressure.

7.8.3 Vibration Mounts

General: Provide corrosion-resistant anti-vibration mounts under each pump. Alternatively, if the pumps are installed on a baseplate the mounts may be installed under the baseplate.

7.8.4 Pressure Tappings

General: Provide a pressure tapping on the inlet and discharge of each pump.

7.8.5 Fixing

General: Fix all pumps and pump sets to the supporting structure. Use expanding shield anchors for concrete.

7.9 Commissioning

General: Commission to the manufacturers' recommendations.

7.10 Testing

General: Provide the following tests for each pump and pumpset before the date for practical completion:

- Pump Operation: Test for correct pump rotation and operation;
- Automatic Changeover: Test changeover sequence under all operational combinations;
- Level Controls: Operate pumps, measure levels and adjust if necessary;
- Safety Controls: Simulate fault for each safety control;
- Alarms: Simulate alarm condition. Verify correct alarm raised;
- Motors: Measure motor current and adjust motor overloads to suit;
- Completion Test: Provide a full operational test to verify compliance.

8. STORMWATER DRAINAGE

8.1 General

Requirement: The works specified in this section comprises the supply, installation, testing, and commissioning of the stormwater drainage service.

Scope of Works: The scope of work includes, but is not limited to, the following:

- Developing the stormwater drainage design to completion, as deemed acceptable by the principal to provide a compliant and fully functional system within the regulations and by-laws of all Federal, State, and Local Authorities holding jurisdiction over the works;
- Ascertain the correct depth, position, and suitability of the stormwater connection point prior to the commencement of any work, incorporate adjustments as required to complete the works. No claims for redundant work will be considered due to the failure to comply with this requirement;
- Verify the invert levels and surface levels before excavation or installation of pipework to ensure gravity drainage with correct cover and fall;
- Provide all necessary materials, pipes, junctions, bends, offsets, branches, couplings, brackets, downpipes, outlets, excavation, backfilling, testing, and sundry equipment as required for the installation;
- Coordinate with the builder and other services contractors prior to any setting out and pipe installation taking place. Pipeline positions shall be determined on site in conjunction with all other disciplines to ensure adequate coordination of all services and elements;
- Allow for all necessary diversions and minor adjustments of pipework and equipment as may be necessary to complete the works;
- Test, commission, and certify the complete stormwater drainage installation to meet Authority and Australian Standard requirements, and ensure operational serviceability.

8.2 Standards

Standard: NCC, Local Plumbing Authority and AS/NZS 3500.3 requirements.

8.3 Design Criteria

8.3.1 Performance Requirements

- Eaves Gutter Design ARI - 1:20 year
- Box Gutter and Surface Drainage Design ARI - 1:100 year
- Pipe Sizing Method: Colebrook White
- Maximum Horizontal Pipe Velocity: 2.0 m/sec
- Eaves Gutter Gradient: 1:500
- Box Gutter Gradient: 1:200
- Overflow Provision Capacity: 100% of system design flow
- The stormwater drainage service must be designed, constructed, and installed in such a manner as to:

- Convey stormwater to a point of connection;
- Avoid the likelihood of blockages;
- Avoid the likelihood of leakage and penetration by roots;
- Provide adequate access for maintenance and clearing of blockages;
- Avoid the likelihood of damage to the Local Plumbing Authority drainage system;
- Avoid the likelihood of damage from superimposed loads or ground movements;
- Avoid the likelihood of ingress of sewage and/or liquid trade waste;
- Avoid the likelihood of ingress of surface water and stormwater into a sanitary drainage system;
- Avoid the likelihood of foul air and gases accumulating in the stormwater system;
- Avoid the likelihood of loss to buildings or property;
- Avoid the likelihood of uncontrolled discharge.

8.4 Submissions

8.4.1 Tests

Pre-completion Tests: Submit results from pre-completion leak testing.

Certification: Submit certificate stating that network is leak free upon completion.

8.5 Inspection

Notice: Give notice so that inspection may be made at the following stages:

- Excavated surfaces prior to placing bedding material;
- Concealed or underground services prior to being covered;
- Pipe joints before covering;
- Placing of cast in situ concrete;
- Upon completion.

8.6 Products

8.6.1 Piping

Requirement: As documented in the Pipe Material Schedule.

Fibre Reinforced Cement (FRC): To AS 4139 and the following:

- ≤ 450 mm diameter: Rubber ring joints to AS 4139;
- > 450 mm diameter: With a purpose machined internal spigot and socket system within the pipe wall.

Glass-Reinforced Polyester (GRP): To AS 3571.1.

Polyvinyl Chloride (PVC): To AS/NZS 1254, AS/NZS 1260 or AS 1273, as appropriate and marked Best Environmental Practice (BEP).

Solvent Cement and Priming Fluid: To AS/NZS 3879.

Polyethylene (PE): To AS/NZS 4129, AS/NZS 4130, ISO 8770 or AS/NZS 2033, as appropriate.

Precast Concrete: To AS/NZS 4058.

Rubber Ring Joints/Elastomeric Seals: To AS 1646.

Plastic Pipe for Subsoil Drainage: To AS 2439.1.

Vitrified Clay or Ceramic: To AS 1741.

8.6.2 Concrete and Mortar

Requirement: To AS/NZS 3500.3 and the following:

- Grade: N15;
- Cement: To AS 3972;
- Type: GP, GL or GB.

Bars and Machine Welded Mesh Steel Reinforcement: To AS/NZS 4671.

8.6.3 Filter Material

General: Provide filter materials consisting of natural clean washed sands and gravels and screened crushed rock conforming to AS/NZS 3500.3.

8.6.4 Embedment Material

Requirement: Conform to AS/NZS 3500.3.

8.7 Geotextiles

Requirement: Provide polymeric fabric formed from plastic yarn composed of at least 85% by weight propylene, ethylene amide or vinylidene chloride and containing stabilisers or inhibitors which provide resistance to deterioration due to ultraviolet light.

Subsoil Drainage Filter: Conform to AS/NZS 3500.3.

8.8 Prefabricated Pits

Requirement: Provide precast or prefabricated pits in conformance with AS/NZS 3500.3.

Metal Access Covers and Grates: To AS 3996 and shall be lockable.

8.9 Stormwater Drainage Pumps

Standard: To AS/NZS 3500.3.

Requirement: Conform to pumped discharge system in Hydraulic Pumps section.

8.10 Piping

Laying: Lay lengths separately with the barrel bearing evenly on the prepared bedding.

Sockets: Lay with sockets pointing upstream.

Cleaning: Clean pipe interior of dirt, debris, mortar and other foreign matter.

Protection: Provide temporary caps over the ends of incomplete sections to prevent the entry of foreign matter.

8.11 Stormwater Drainage

8.11.1 Location

General: Provide stormwater drains to connect downpipes, surface drains, subsoil drains and drainage pits to the outlet point or point of connection. Make sure location of piping will not interfere with other services and building elements not yet installed or built. Subject to the preceding and documented layouts, follow the most direct route with the least number of changes in direction.

8.11.2 Laying

General: Lay in straight lines between changes in direction or grade with sockets pointing up hill. If other pipes are adjacent, set each pipe true to line and complete each joint before laying the next pipe. If work is not continuous, cap open ends to prevent entry of foreign matter.

8.11.3 Identification

General: Lay a detectable strip or plastic tape in the trench after pipe laying, testing and initial backfilling.

8.11.4 Pipe Underlay (Bedding)

General: Bed piping on a continuous underlay of bedding material, minimum 75 mm and maximum 150 mm thick after compaction. Grade the underlay evenly to the gradient of the pipeline.

Chases: If required, form chases to prevent projections such as sockets and flanges from bearing on the trench bottom or underlay.

8.11.5 Trench Backfill

General: Backfill the remainder of the trench to the underside of the subgrade with fill material in conformance with Service Trenching section.

8.11.6 Pipe Surrounds

General: Place the material in the pipe surround in layers, maximum 200 mm loose thickness, and compact without damaging or displacing the piping.

8.11.7 Thermal Movement

General: Arrange piping to accommodate thermal expansion. Provide proprietary expansion joints in copper and plastic pipes where pipe flexibility does not allow movement. Make sure movement does not strain branch connections.

8.11.8 Downpipes

Downpipe Termination: Stop downpipe 100 mm above the ground level and discharged into grated pit or drain. Do not connect directly into below ground stormwater pipes.

8.12 Subsoil Drainage

8.12.1 General

Requirement: Provide subsoil drains to intercept groundwater seepage and prevent water build-up behind walls and under floors and pavements. Connect subsoil drains to surface drains or to the stormwater drainage system as applicable.

Piping: As documented in the Pipe Material Schedule.

Trench Width: Minimum 450 mm.

Trench Floor: Grade the trench floor evenly to the gradient of the pipeline. If the trench floor is rock, correct any irregularities with compacted bedding material.

Pipe Depth: Provide the following minimum clear depths, measured to the crown of the pipe, below the following elements:

- Formation level of the pavement, kerb or channel: 100 mm.
- Average gradient of the bottom of footings: 100 mm.
- Finished surface of unpaved ground: 450 mm.

8.12.2 Jointing

General: At junctions of subsoil pipes provide tees, couplings or adaptors to AS 2439.1.

8.12.3 Pipe Underlay (Bedding)

General: Bed piping on a continuous underlay of bedding material, at least 75 mm thick after compaction. Lay the pipe with one line of perforations at the bottom.

Bedding Thickness: Minimum 75 mm, maximum 150 mm, after compaction.

Chases: If necessary, form chases to prevent projections such as sockets and flanges from bearing on the trench bottom or underlay.

8.12.4 Pipe Surrounds

General: Place the material in the pipe surround in layers, maximum 200 mm loose thickness, and compact without damaging or displacing the piping.

Depth of Overlay:

- To the underside of the bases of overlying structures such as pavements, slabs and channels;
- To within 150 mm of the finished surface of unpaved or landscaped areas.

8.12.5 Geotextiles

Marking: To AS 3705.

Protection: Provide heavy duty protective covering. Store clear of the ground and out of direct sunlight. During installation, do not expose the filter fabric to sunlight for more than 14 days.

8.12.6 Filter Socks

General: Provide permeable polyester socks, capable of retaining particles 0.25 mm and greater. Securely fit or join the sock at each joint.

8.13 Pits

8.13.1 Installation

General: Prepare foundation, install pit and connect pipes, to manufacturer's recommendations.

Location: At junctions, changes of gradient and changes of direction of stormwater drains.

8.13.2 Metal Access Covers and Grates

Standard: To AS 3996.

Cover Levels: Top of cover or grate, including frame:

In Paved Areas: Flush with the paving surface;

In Landscaped Areas: 25 mm above finished surface;

Gratings Taking Surface Water Runoff: Locate to receive runoff without ponding. All such grates shall be lockable.

8.14 Pre-completion tests

General: Before backfilling or concealing, carry out the following tests to AS/NZS 3500.3:

- Downpipes within buildings: Air or water pressure test;
- Site stormwater drains and main internal drains: Air or water pressure test;
- Rising mains from pumped discharge: Water pressure test;
- Leaks: If leaks are found, rectify and re-test.

8.15 On Completion

Cleaning: On completion, flush and remove all debris within the systems, remove all external labels and polish all chrome plated finish to remove any marks. Allow to rod all stormwater lines with drain cleaning machine and CCTV all in drainage lines of 80 mm and above to the approval of the Superintendent.

8.16 Maintenance

General: As specified in Maintenance section.

8.17 Selections

8.17.1 Pipe Material Schedule

Property	Stormwater	Sub-soil	Pressure
Pipe Material	PVC-U	Slotted PVC-U	Polyethylene
Grade or Class	SN6	SN6	PN16
Jointing Method	Solvent weld	Solvent weld	Electrofusion
Concrete Encasement	N/A	N/A	N/A

Note: All pipework shall be of the sizes shown on the accompanying drawings. Wherever possible, pipes shall be run parallel with the building slabs, walls etc. and all branch take-offs shall be at right angles.

9. SANITARY PLUMBING & DRAINAGE

9.1 General

Requirement: The works specified in this section comprises the design, supply, installation, testing, and commissioning of the sanitary plumbing and drainage service.

Scope of Works: Includes, but is not limited to, the following:

- Developing the sanitary plumbing and drainage design to completion, as deemed acceptable by the principal to provide a compliant and fully functional system within the regulations and by-laws of all Federal, State, and Local Authorities holding jurisdiction over the works;
- Ascertain the correct depth, position, and suitability of the sewer connection point prior to the commencement of any work, incorporate adjustments as required to complete the works. No claims for redundant work will be considered due to the failure to comply with this requirement;
- Verify the invert levels and surface levels indicated on the drawings before excavation or installation of pipework to ensure gravity connection to supply service with correct cover and fall;
- Provide all necessary materials, pipes, junctions, bends, offsets, branches, couplings, brackets, clearouts, floor wastes, excavation, backfilling, testing, and sundry equipment as required for the installation;
- Coordinate with the builder and other services contractors prior to any setting out and pipe installation taking place. Pipeline positions shall be determined on site in conjunction with all other disciplines to ensure adequate coordination of all services and elements;
- Allow for all necessary diversions of pipework and equipment as may be necessary to complete the works;
- Test, commission, and certify the complete sanitary plumbing and drainage installation to meet Authority and Australian Standard requirements, and ensure operational serviceability.

9.2 Standards

General: The NCC, AS/NZS 3500.2, and Local Water Authority requirements.

Authorised Products: Listed in the WaterMark Product Database, unless otherwise required by Local Water Authority.

9.3 Design Criteria

9.3.1 Performance Requirements

- The sanitary plumbing and drainage system must be designed, constructed, and installed in such a manner as to:
    - Convey sewage or sullage to a sanitary drainage system or an approved disposal system and in a manner that does not create undue noise;
    - Avoid the likelihood of blockage and leakage;
    - Provide ventilation to avoid the likelihood of foul air and gases accumulating in the sanitary drainage and sewerage systems;
    - Avoid the likelihood of the ingress of inappropriate water, sewage, sullage, foul air and gases from the system into the building;

- Provide adequate access for maintenance of mechanical components, operational controls, and for clearing blockages;
- Avoid the likelihood of damage from superimposed loads, ground movement or root penetration;
- Avoid the likelihood of ingress of surface water, subsurface water or stormwater into the system;
- Avoid the likelihood of uncontrolled discharge;
- Avoid the likelihood of damage to existing buildings or site works;
- Provide for the effective and efficient use of water;
- Provide adequate ventilation to avoid hydraulic load imbalance.

9.4 Submissions

9.4.1 Certification

General: Submit evidence that proposed tapware is listed in the WaterMark Product Database.

9.5 Inspection

Notice: Give notice so that inspection may be made at the following stages:

- Excavated surfaces prior to placing bedding material;
- Concealed or underground services prior to being covered;
- Pipe joints before covering;
- Placing of cast in situ concrete;
- Upon completion.

9.6 Sewage Treatment

9.6.1 Septic Tanks

Standard: To AS/NZS 1546.1.

Certification: Required.

Certification Provider: An organisation accredited by the Joint Accreditation System of Australia and New Zealand (JAS-ANZ).

9.6.2 On-site Wastewater Management

Standard: To AS/NZS 1547.

Agricultural Pipes: Perforated plastic pipe to AS 2439.2 Type 3, stiffness class SN2, DN 100.

9.7 Sanitary Plumbing

9.7.1 General

General: Verify location and invert level of piping before commencing installation.

Layout: Arrange piping to conform to the documented layouts as follows:

- Avoid interference with other services and building elements not yet installed or built;
- Follow the most direct route with the least number of changes of direction.
- There shall be no interconnection of waste pipes in General and High Needs Areas.
- Exposed pipework mounted to wall surfaces is generally not accepted. Where it is not possible to reticulate securely within concealed ducts, walls and the like, pipes shall be reticulated within bulkheads. All proposed bulkhead locations shall be approved by the Client prior to finalising the design.

Ducts: If installed in ducts, locate and fix stacks, wastes and pipes independently of other services. Arrange so they are easily accessible and removable throughout their entire length.

9.7.2 Thermal Movement

General: Arrange piping to accommodate thermal expansion. Provide proprietary expansion joints in copper and plastic pipes where pipe flexibility does not allow for movement. Ensure that movement does not strain branch connections.

9.7.3 Vent Pipes

Staying to Roof: If fixings for stays penetrate the roof covering, seal the penetrations and make watertight.

Terminations: Provide vent cowls of the same material as the vent pipe.

9.8 Sanitary Drainage

9.8.1 General

General: Verify location and invert level of piping before commencing installation.

Layout: Arrange piping to conform to the documented layouts as follows:

- All ingournd pipework shall be straight uninterrupted runs where possible.
- All soil fixtures shall have direct cleaning access from outside the building.
- There shall be no interconnection of waste pipes in General and High Needs Areas.

9.8.2 Pipeline Identification

Requirement: Lay detectable plastic warning tape, 300 mm above buried piping, for the full length of the piping.

9.8.3 Raft Slab Supports

Requirement: All sanitary drainage pipelines located on unstable ground shall be fully supported on a continuous reinforced concrete raft suspended from structural slab over, or supported on a sub base certified by a qualified engineer.

9.9 Use of Concrete

Requirement: Provide 20MPa concrete not less than 100 mm thick with exposed surfaces cement rendered as follows:

- Around pipes and fittings as required by Local Water Authority;
- Around and under disconnector traps and gully risers;
- Around exposed pipes and fittings;
- Around inspection boxes and tops of boundary trap/inspection shafts, extending 150mm below ground surface;
- Under and around bases of inclined junctions and bends;
- Under bases of traps;
- Around lines laid to steep gradients such that there is danger of pipe movement or the scouring of trench filling;
- Where regulation cover cannot be provided over drains, surround pipes with 150 mm of 1:2:4 concrete;
- Provide 150 mm thick pads under vertical bends and on the outside of all changes of direction.

9.10 Piping

9.10.1 Finishes

General: Finish exposed piping, including fittings and supports, as follows:

- In Internal Sterile Locations such as Toilet and Kitchen Areas: Chrome plate copper piping to AS 1192 service
- In Concealed but Accessible Spaces (Including Cupboards and Non-Habitable Enclosed Spaces): Leave copper and plastic unpainted except for identification marking. Prime steel piping and iron fittings.

Valves: Finish valves to match connected piping.

9.10.2 Pipeline Tolerances Table

	Permissible Angular Deviation from Alignment	**Permissible Displacement from Alignment**
Horizontal	1:300	15 mm
Vertical	1:500	5 mm

9.10.3 Pipes Penetrating Concrete Beams

Requirement: Where drainage pipes pass through concrete ground beams and concrete suspended slab beams install the pipes after footing trench is dug then provide and install white polystyrene sectional pipe insulation the pipe. Insulation shall be 25 mm thickness and shall be provided in two (2) semi-circular halves. Insulation shall extend 100 mm past concrete waffle pod beams each side. Tape along joints with 75 mm reinforced tape.

9.10.4 Expansion Joints

Requirement: Expansion joints shall be provided at intervals to AS/NZS 3500.2 and in positions to prevent stress in pipework. Provide expansion joints between fixed points more than 2 m apart and at a minimum of 6 m centres where there are not fixed points to the approval of the superintendent.

9.11 Inspection Openings

Requirement: Install inspections shall be provide in the following locations:

- Outside of a building, no further than 2.5 m, along each branch drain connecting one or more water closets or slop hoppers;
- At intervals of not more than 30 m, with a minimum of one inspection opening on each main drain;
- At the connection to Local Water Authority sewer if not provided by Local Water Authority;
- On the downstream end of the drain where any drain passes under a building except where waste fixtures only are concerned;
- Where any new section of drain is connected to an existing drain;
- Immediately at or upstream of the upper bend of a jump-up.

Termination: Extend inspection openings to the surface where indicated on the drawings and as detailed. Internal inspection caps shall be brass, external in landscape gardens to be PVC-U, brass elsewhere including in paved areas.

Sealing: Internal inspection openings to have a rubber seal installed to achieve an airtight seal.

Accessibility: Install inspection openings in pipes so that each section of pipework is accessible in at least one direction. Inspection openings shall be placed in accessible positions.

9.12 Clearouts

9.12.1 General

General: All soil fixtures shall have direct cleaning access from outside the building. All accessible pits, grates and clear-outs shall be screw down lockable type with security fasteners. Refer to Section 1.20 of this specification for further information also.

Requirement: Install 100 mm diameter chrome plated brass clear outs at finished floor level as necessary for rodding maintenance of the drainage lines. Clearouts shall be extended at 60 degrees from the horizontal drainage and be chrome plated where located internally.

Vinyl Floor Sheeting Installation: Where vinyl floor sheeting is laid, provide SPS manufacture, 100 mm chrome plated brass, push-in sheet vinyl floor clear out.

Masonry Installation: Clearouts located in concrete pavement or brick paver shall be terminated flush with finished levels complete with brass or stainless steel, bolted trap screws.

9.13 Overflow Relief Gully

General: Overflow gullies shall only be installed in Sterile Areas.

Requirement: Supply and install an overflow gully where required to provide a safe release from the property connection point and at additional locations as indicated on the accompanying drawings.

Grate: The tops of vertical risers on overflow or disconnector gully traps in external locations shall be fitted with loose grates and finishing collars installed not less than 150 mm below the outlet grating or overflow level of the lowest inlet fitting or fixture connected to the building drainage installation, and not less than 75 mm above ground surface.

Water Seal Charging: Gully is to be charged by a waste fixture as specified in AS/NZS 3500.2 or with a 20 mm hose tap with vacuum breaker backflow prevention device installed over.

9.14 Floor Wastes

General: Supply and install all floor wastes and bucket traps in the locations as required by Local Water Authority.

Type: Floor wastes shall consist of a self-cleansing 'P' trap with 80 mm riser and screwed chrome plated brass grate set at level to ensure adequate drainage of all floor areas. The maximum length of the riser shall be 600 mm. All grates in shower areas shall be screw down lockable type with security fasteners. Refer to Section 1.20 of this specification for further information also.

Approval: A schedule and sample of the proposed floor wastes and bucket traps shall be provided to the Client prior to procurement for approval. The schedule shall identify the locations, room type and product codes as applicable.

Water Seal Charging: Any floor wastes not receiving discharge from fixtures is to be provided with a method of maintaining the water seal as specified in AS/NZS 3500.2 e.g. an electronic trap priming device.

9.15 Mechanical Plant Room Drains

Requirement: In positions indicated in mechanical plant rooms and elsewhere as shown on drawings provide and install floor wastes of dimension and trap seal depth nominated and generally as previously specified, connect with wastes of diameters noted and extend to and connect to floor waste stack and stormwater drains.

Water Seal Charging: Any mechanical plant room floor wastes not receiving discharge from refrigeration condensate lines is to be provided with a method of maintaining the water seal as specified in AS/NZS 3500.2 e.g. an electronic trap priming device.

9.16 Traps

Type: All traps shall be 'Universal' pattern type except where otherwise noted. Like traps shall be of the same brand and style throughout.

Water Trap: Wherever possible fixtures shall have integral traps other than basins. All other concealed fixture traps shall be ‘concealed’ polypropylene universal ‘S’ or ‘P’ type, shall have self-cleaning characteristics, and be of the same size as the outlet of the fitting. Fixture traps shall have a 75 mm deep seal.

Exposed Traps: Exposed traps shall be stainless steel/ brass finished in satin chrome plating. Chrome plating shall be of even thickness, dense and without defect and all unions and inspection openings shall be brass with chrome plate finish where appropriate.

Water Seal Charging: Any floor wastes not receiving discharge from fixtures is to be provided with a method of maintaining the water seal as specified in AS/NZS 3500.2 e.g. an electronic trap priming device.

9.17 Tundishes

General: Tundishes shall only be installed in Sterile Areas unless otherwise approved by the Client.

Requirement: Provide 50 mm x 40 mm chrome plated copper concentric reducers complete with pipe drainage connection to the sewer drainage system.

Exposed Tundishes: Where exposed, tundishes shall be chrome plated complete with screwed outlet and cover dome at wall and floor penetrations.

Mechanical Damage: All tundishes are to be located so they are not subject to mechanical damage.

Water Seal Charging: Any tundishes provided with a water trap and not receiving discharge from refrigeration condensate lines is to be provided with a method of maintaining the water seal as specified in AS/NZS 3500.2 e.g. an electronic trap priming device.

9.18 Air Admittance Valves

Standard: To AS 4936.

Sizing: To AS/NZS 3500.2.

Prohibited: AAV's are not to be used where atmospheric venting is specified or to vent main drainage lines, under bench pump units, sewer pump stations, chambers/pits or the like.

9.19 Vent Pipes

General: Provide and install all stack, group vents and relief vents of sizes shown on drawings and complete with all bends, junctions and reducers.

Roof Sheeting Penetration: Confirm locations of vent penetrations with roofing contractor prior to installation of flashing/roof tiles. All vents passing through roofs shall be fitted with neoprene waterproof seal. The flashings shall be clamped to the pipe with a stainless steel band and fixed to the roofing material with a zincalume steel plate.

Termination: Terminate all vents through roof with a PVC-U cowl generally 3 metres above ground level, 300 mm above roof level and 6 metres clear of openings and fresh air intakes as required by Local Water Authority and to AS/NZS 3500.2 requirements.

9.20 Pre-completion Tests

Requirement: Test to AS/NZS 3500.2, before backfilling or concealing.

Leaks: If leaks are found, rectify and re-test.

9.21 Completion

General: On completion, clean and flush the whole installation.

9.22 Selections

9.22.1 Pipe Material Schedule

Property	Below Ground	Above Ground	Pressure
Pipe Material	PVC-U	PVC-U	Polyethylene
Grade or Class	SN6	SN6	AS 4130 PN16
Jointing Method	Solvent weld	Solvent weld	Electrofusion
Concrete Encasement	N/A	N/A	N/A

Note: All pipework shall be of the sizes shown on the accompanying drawings. Wherever possible, pipes shall be run parallel with the building slabs, walls etc. and all branch take-offs shall be at right angles.

10. TRADE WASTE PLUMBING & DRAINAGE

10.1 General

Requirement: The works specified in this section comprises the design, supply, installation, testing, and commissioning of the trade waste plumbing and drainage services.

Scope of Works: Includes, but is not limited to, the following:

- Developing the trade waste drainage design to completion, as deemed acceptable by the principal to provide a compliant and fully functional system within the regulations and by-laws of all Federal, State, and Local Authorities holding jurisdiction over the works;
- Ascertain the correct depth, position, and suitability of the sewer connection point prior to the commencement of any work, incorporate adjustments as required to complete the works. No claims for redundant work will be considered due to the failure to comply with this requirement;
- Provide pre-treatment devices to the manufacturer's and Local Water Authority requirements;
- Verify the invert levels and surface levels before excavation or installation of pipework to ensure gravity connection to supply service with correct cover and fall;
- Provide all necessary materials, pipes, junctions, bends, offsets, branches, couplings, brackets, clearouts, floor wastes, excavation, backfilling, testing, and sundry equipment as required for the installation;
- Coordinate with the builder and other services contractors prior to any setting out and pipe installation taking place. Pipeline positions shall be determined on site in conjunction with all other disciplines to ensure adequate coordination of all services and elements;
- Allow for all necessary diversions and minor adjustments of pipework and equipment as may be necessary to complete the works;
- Test, commission, and certify the complete trade waste plumbing and drainage installation to meet Authority and Australian Standard requirements, and ensure operational serviceability.

10.2 Standards

General: The NCC, AS/NZS 3500.2, and Local Water Authority requirements.

Authorised Products: Listed in the WaterMark Product Database, unless otherwise required by Local Water Authority.

10.3 Design Criteria

10.3.1 Performance Requirements

- The trade waste drainage service must be designed, constructed, and installed in such a manner as to:
    - Convey trade waste water to an approved treatment system prior to making connection to the sanitary drainage system or an approved disposal system and in a manner that does not create undue noise;
    - Avoid the likelihood of blockage and leakage;
    - Provide ventilation to avoid the likelihood of foul air and gases accumulating in the sanitary drainage and sewerage systems;

- Avoid the likelihood of the ingress of inappropriate water, sewage, sullage, foul air and gases from the system into the building;
- Provide adequate access for maintenance of mechanical components, operational controls, and for clearing blockages;
- Avoid the likelihood of damage from superimposed loads, ground movement or root penetration;
- Avoid the likelihood of ingress of surface water, subsurface water or stormwater into the system;
- Avoid the likelihood of uncontrolled discharge;
- Avoid the likelihood of damage to existing buildings or site works;
- Provide for the effective and efficient use of water;
- Provide adequate ventilation to avoid hydraulic load imbalance.

10.4 Submissions

General: Submit evidence that proposed hydraulic elements are listed in the WaterMark Product Database where required.

10.5 Inspection

Notice: Give notice so that inspection may be made at the following stages:

- Excavated surfaces prior to placing bedding material;
- Concealed or underground services prior to being covered;
- Pipe joints before covering;
- Placing of cast in situ concrete;
- Upon completion.

10.6 Trade Waste Plumbing

10.6.1 General

General: Verify location and invert level of piping before commencing installation.

Layout: Arrange piping to conform to the documented layouts as follows:

- Avoid interference with other services and building elements not yet installed or built;
- Follow the most direct route with the least number of changes of direction.
- There shall be no interconnection of waste pipes in General and High Needs Areas.
- Exposed pipework mounted to wall surfaces is generally not accepted. Where it is not possible to reticulate securely within concealed ducts, walls and the like, pipes shall be reticulated within bulkheads. All proposed bulkhead locations shall be approved by the Client prior to finalising the design.

Ducts: If installed in ducts, locate and fix stacks, wastes and pipes independently of other services. Arrange so they are easily accessible and removable throughout their entire length.

10.6.2 Thermal Movement

General: Arrange piping to accommodate thermal expansion. Provide proprietary expansion joints in copper and plastic pipes where pipe flexibility does not allow for movement. Ensure that movement does not strain branch connections.

10.6.3 Vent Pipes

Staying to Roof: If fixings for stays penetrate the roof covering, seal the penetrations and make watertight.

Terminations: Provide vent cowls of the same material as the vent pipe.

10.7 Trade Waste Drainage

10.7.1 General

General: Verify location and invert level of piping before commencing installation.

Layout: Arrange piping to conform to the documented layouts as follows:

- All ingournd pipework shall be straight uninterrupted runs where possible.
- All soil fixtures shall have direct cleaning access from outside the building.
- There shall be no interconnection of waste pipes in General and High Needs Areas.

10.7.2 Pipeline Identification

General: Lay detectable plastic warning tape, 300 mm above buried piping, for the full length of the piping.

10.8 Piping

10.8.1 Finishes

General: Finish exposed piping, including fittings and supports, as follows:

- In Internal Sterile Locations such as Toilet and Kitchen Areas: Chrome plate copper piping to AS 1192 service
- In Concealed but Accessible Spaces (Including Cupboards and Non-Habitable Enclosed Spaces): Leave copper and plastic unpainted except for identification marking. Prime steel piping and iron fittings.

Valves: Finish valves to match connected piping.

10.8.2 Pipeline Tolerances Table

	Permissible Angular Deviation from Alignment	Permissible Displacement from Alignment
Horizontal	1:300	15 mm
Vertical	1:500	5 mm

10.8.3 Pipes Penetrating Concrete Beams

Requirement: Where drainage pipes pass through concrete ground beams and concrete suspended slab beams install the pipes after footing trench is dug then provide and install white polystyrene sectional pipe insulation the pipe. Insulation shall be 25 mm thickness and shall be provided in two (2) semi-circular halves. Insulation shall extend 100 mm past concrete waffle pod beams each side. Tape along joints with 75 mm reinforced tape.

10.8.4 Expansion Joints

Requirement: Expansion joints shall be provided at intervals to AS/NZS 3500.2 and in positions to prevent stress in pipework. Provide expansion joints between fixed points more than 2 m apart and at a minimum of 6 m centres where there are not fixed points to the approval of the superintendent.

10.9 Clearouts

10.9.1 General

General: All soil fixtures shall have direct cleaning access from outside the building. All accessible pits, grates and clear-outs shall be screw down lockable type with security fasteners. Refer to Section 1.20 of this specification for further information also.

Requirement: Install 100 mm diameter chrome plated brass clear outs at finished floor level as necessary for rodding maintenance of the drainage lines. Clearouts shall be extended at 60 degrees from the horizontal drainage and be chrome plated where located internally.

Vinyl Floor Sheeting Installation: Where vinyl floor sheeting is laid, provide SPS manufacture, 100 mm chrome plated brass, push-in sheet vinyl floor clear out.

Masonry Installation: Clearouts located in concrete pavement or brick paver shall be terminated flush with finished levels complete with brass or stainless steel, bolted trap screws.

10.10 Traps

Type: All traps shall be 'Universal' pattern type except where otherwise noted. Like traps shall be of the same brand and style throughout.

Water Trap: Wherever possible fixtures shall have integral traps other than basins. All other concealed fixture traps shall be ‘concealed’ polypropylene universal ‘S’ or ‘P’ type, shall have self-cleaning characteristics, and be of the same size as the outlet of the fitting. Fixture traps shall have a 75 mm deep seal.

Exposed Traps: Exposed traps shall be stainless steel/ brass finished in satin chrome plating. Chrome plating shall be of even thickness, dense and without defect and all unions and inspection openings shall be brass with chrome plate finish where appropriate.

Water Seal Charging: Any floor wastes not receiving discharge from fixtures is to be provided with a method of maintaining the water seal as specified in AS/NZS 3500.2 e.g. an electronic trap priming device.

10.11 Tundishes

General: Tundishes shall only be installed in Sterile Areas unless otherwise approved by the Client.

Requirement: Provide 50 mm x 40 mm chrome plated copper concentric reducers complete with pipe drainage connection to the sewer drainage system.

Exposed Tundishes: Where exposed, tundishes shall be chrome plated complete with screwed outlet and cover dome at wall and floor penetrations.

Mechanical Damage: All tundishes are to be located so they are not subject to mechanical damage.

Water Seal Charging: Any tundishes provided with a water trap and not receiving discharge from refrigeration condensate lines is to be provided with a method of maintaining the water seal as specified in AS/NZS 3500.2 e.g. an electronic trap priming device.

10.12 Pre-completion Tests

Requirement: Test to AS/NZS 3500.2, before backfilling or concealing.

Leaks: If leaks are found, rectify and re-test.

10.13 Completion

General: On completion clean and flush the whole installation.

10.14 Selections

10.14.1 Pipe Material Schedule

Property	Below Ground	Above Ground	Pressure
Pipe Material	HDPE	HDPE	Polyethylene
Grade or Class			AS 4130 PN16
Jointing Method	Electrofusion	Electrofusion	Electrofusion
Concrete Encasement	N/A	N/A	N/A

Note: All pipework shall be of the sizes shown on the accompanying drawings. Wherever possible, pipes shall be run parallel with the building slabs, walls etc. and all branch take-offs shall be at right angles.

HDPE Pipework: All HDPE pipework shall be UV Resistant high temperature (82ºCelsius) installed to AS/NZS 3500.2 and the manufacturer's recommendations.

11. COLD WATER SERVICE

11.1 General

Requirement: The works specified in this section comprises the design, supply, installation, testing, and commissioning of the cold water service.

Scope of Works: Includes, but is not limited to, the following:

- Developing the cold water design to completion, as deemed acceptable by the principal to provide a compliant and fully functional system within the regulations and by-laws of all Federal, State, and Local Authorities holding jurisdiction over the works;
- Obtain the appropriate water meter from Local Water Authority and install the meter assembly complete with registered Reduced Pressure Zone Device backflow prevention device in the location as indicated on the accompanying drawings in an approved manner;
- Provide a cold water service pressure booster pumpset to AS/NZS 3500.1 and Local Water Authority requirements where necessary;
- Provide a cold water service storage tank to AS/NZS 3500.1 and Local Water Authority requirements as indicated where necessary;
- Provide all necessary pipes, junctions, bends, supports, pumpsets, and sundry equipment as required for the installation;
- Coordinate with the builder and other services contractors prior to any setting out and pipe installation taking place. Pipeline positions shall be determined on site in conjunction with all other disciplines to ensure adequate coordination of all services and elements;
- Test, commission, and certify the complete cold water service installation to meet Authority and Australian Standard requirements, and ensure operational serviceability.

11.2 Standards

11.2.1 General

General: The NCC, AS/NZS 3500.1, and Local Water Authority requirements.

Water Supply: To AS/NZS 3500.1.

Backflow Prevention: To AS/NZS 2845.1 and AS 2845.2.

Copper Pipe: To AS 1432 and AS 4809.

Microbial Control: To AS/NZS 3666.1 and AS/NZS 3666.2 and the recommendations of SAA/SNZ HB 32.

11.2.2 Authorised Products

Standard: Listed in the WaterMark Product Database, unless otherwise required by Local Water Authority.

11.2.3 Labelling

Water Efficiency Labelling: Provide only products conforming to and labelled to the Water Efficiency Labelling Scheme (WELS).

11.3 Design Criteria

11.3.1 Performance Requirements

- Pipe Velocity: 1.6 m/sec
- Maximum Pipe Velocity: 3 m/sec
- Design Water Pressure at Fixtures or Outlets: 250 kPa
- Minimum Water Pressure at Fixtures or Outlets: 50 kPa
- Maximum Water Pressure at Fixtures or Outlets: 500 kPa
- The cold water service must be designed, constructed, and installed in such a manner as to:
    - Avoid the likelihood of contamination of drinking water within both the water service and Local Water Authority's supply;
    - Provide water to fixtures and appliances at flow rates and pressures which are adequate for the correct functioning of those fixtures and appliances under normal conditions and in a manner that does not create undue noise;
    - Avoid the likelihood of leakage or failure including uncontrolled discharges;
    - Facilitate the efficient use of drinking water;
    - Allow adequate access for maintenance of mechanical components and operational controls;

Allow the system, appliances, and backflow prevention devices to be isolated for testing and maintenance, where required.

11.4 Submissions

11.4.1 Certification

WaterMark Certification: Submit evidence that proposed components are listed in the WaterMark Product Database.

11.4.2 Samples

General: Submit samples of accessories identified by proprietary item, including the following:

- Valves;
- Instruments, including gauges.

11.5 Inspection

Notice: Give notice so that inspection may be made at the following stages:

- Excavated surfaces prior to placing bedding material;
- Concealed or underground services prior to being covered;
- Pipe joints before covering;
- Placing of cast in situ concrete;
- Upon completion.

11.6 Components

11.6.1 Pressure Control Valves

General: Provide reduction valves, pressure limiting valves, or ratio valves, which produce the necessary reduction in pressure.

11.6.2 Backflow Prevention Devices

General: As documented in the testable backflow prevention devices schedule.

Standard: To AS/NZS 2845.1 and AS 2845.2.

11.6.3 Line Strainers

Type: Low resistance, Y-form bronze bodied type, with screen of dezincification resistant brass, corrosion-resistant stainless steel, or monel.

Screen Perforations: 0.8 mm maximum.

11.6.4 Pressure Gauges

General: Provide gauges with full scale reading in kPa, a minimum nominal diameter of 63 mm and with a full scale value between 130% and 200% of the working pressure.

Bourdon Tube Gauges: To AS 1349.

Accuracy Grade: Industrial.

Installation: Comply with the recommendations of AS 1349. Isolate from pump pulsations and provide with a gauge cock.

11.6.5 Water Tanks

Cold Water Storage Tanks: To ATS 5200.026.

Materials: To AS/NZS 3500.1.

Polyethylene Water Tanks: To AS/NZS 4766.

Temperature: Do not exceed the rated service temperature of the tank material.

Fly Wire: Provide plastic fly wire covering to overflow and vent pipes.

11.6.6 Water Meters

Standard: To AS 3565.4.

Installation: To the requirements of Local Water Authority.

11.7 Material Fire Hazard Properties

Spread-of-Flame Index: Maximum 9 tested to AS/NZS 1530.3.

Smoke-developed Index: Maximum 8 if Spread-of-Flame is over 5, tested to AS/NZS 1530.3.

Flammability Index of Facing Materials: Maximum 5 tested to AS 1530.2.

Materials with Reflective Foil Facing: Test to AS/NZS 1530.3.

11.8 Piping

11.8.1 Finishes

General: Finish exposed piping, including fittings, cover plates and supports, as follows:

- Chrome plate copper piping to AS 1192 service condition 2, bright in internal locations such as toilet and kitchen areas;
- In concealed but accessible spaces (including cupboards and non-habitable enclosed spaces): Leave copper and plastic unpainted except for identification marking. Prime steel piping and iron fittings;
- Valves: Finish valves to match connected piping.

11.8.2 Fittings and Accessories

General: Provide the fittings required for the proper functioning of the water supply system, including taps, valves, backflow prevention devices, pressure and temperature control devices, strainers, gauges and automatic controls and alarms.

Provision for Dismantling: Arrange piping by the provision of unions or similar so that valves, taps and other maintainable components can be removed for maintenance without disturbing or cutting adjacent piping.

11.8.3 Material Identification Marks

General: Pipes with grade or class identification markings: Install so that the markings are visible for inspection.

11.8.4 Valve Spindles

General: If practicable, install valve spindles in a vertical position.

11.9 Pits

11.9.1 General

Requirement: Install below-ground water meters, stop valves and control valves in concrete access pits with lockable pit covers.

11.9.2 Construction

Internal Dimensions: To give 300 mm clear space all around the fittings in the pit.

Concrete: Grade N20 to AS 1379, 100 mm thick, reinforced with F82 fabric.

Pit Covers: To AS 3996.

11.9.3 Installation

General: Grade floor to a point on one side and drain to the stormwater drainage system. Carry the pit walls up to 50 mm above finished ground level. Cast in the pit cover frame flush with the top. Trowel the top smooth.

11.10 Marking

11.10.1 Notice Plate

General: Provide a notice plate containing condensed emergency instructions, legibly printed or engraved on durable material resistant to defacement, at least 3 mm thick or mounted on board at least 3 mm thick, permanently fixed in a convenient position at the control valves.

11.11 Valve Boxes

11.11.1 General

Requirement: Provide cast iron valve boxes with lockable covers for access to underground gate valves. Provide cast iron sluice valve covers for access to sluice valves.

Identification: Mark the box covers with the word **SV**.

11.11.2 Installation

General: Set beneath each box a shaft formed of PVC-U pipe to give clear access to the valve wheel or spindle. Set top flush with pavement surface, or 15 mm above unpaved surfaces, and encase in formed concrete box 150 mm thick, with top surface trowelled smooth.

11.12 Testing

11.12.1 Pre-completion Tests

Pressure Tests: Before insulation is applied to joints pressure test piping to AS/NZS 3500.1.

Leaks: If found, rectify and re-test.

Cross Connections: Isolate systems individually and check for cross connections.

Backflow Prevention: To AS/NZS 3500.1.

Tapware: Check for leaks.

11.12.2 Completion Test

General: Provide a full operational test to verify conformance.

11.13 Completion

11.13.1 Commissioning

Strainers: Remove, clean and replace strainer baskets.

Cleaning: To AS/NZS 3500.1.

Disinfection: Disinfect to AS/NZS 3500.1.

Cold Water Systems: Test and commission to AS/NZS 3500.1.

Testable Backflow Prevention Devices: Test and commission to AS 2845.3 by a licensed plumber with backflow device accreditation. Tag and certify to the requirements of Local Water Authority.

11.13.2 Charging

Completion: On completion of installation, commissioning, testing and disinfection, fill the system with water, turn on control and isolating valves and the energy supply and leave the water supply system in full operational condition.

11.13.3 Maintenance manuals

Standard: To AS/NZS 3666.2.

11.14 Maintenance

Requirement: Conform to the Hydraulic Maintenance section.

11.15 Selections

11.15.1 Pipe Material Schedule

PE PIPING BELOW GROUND PROPOSED TO BE USED AS NOTED EARLIER IN THE SPECIFICATION.

Pipe sizes less than DN100

Property	Below Ground	Above Ground
Pipe Material	Copper	Copper
Grade or Class	AS 1432 Type B	AS 1432 Type B
Jointing Method	Compression	Compression

Pipe sizes equal to or greater than DN100

Property	Below Ground	Above Ground
Pipe Material	DICL	DICL
Grade or Class	AS 2280	AS 2280
Jointing Method	Spigot/Socket Elastomer Joint	Spigot/Socket Elastomer Joint

Note: Wherever possible, pipes shall be run parallel with the building slabs, walls etc. and all branch take-offs shall be at right angles.

12. HOT WATER SERVICE

12.1 General

Requirement: The works specified in this section comprises the design supply, installation, testing, and commissioning of the hot water service.

Scope of Works: Includes, but is not limited to, the following:

- Developing the hot water service design documentation to completion, as deemed acceptable by the principal to provide a compliant and fully functional system within the regulations and by-laws of all Federal, State, and Local Authorities holding jurisdiction over the works;
- Provide water heating equipment as required to fulfil the design intent
- Provide all necessary pipes, junctions, bends, supports, and sundry equipment as required for the installation;
- Coordinate with the builder and other services contractors prior to any setting out and pipe installation taking place. Pipeline positions shall be determined on site in conjunction with all other disciplines to ensure adequate coordination of all services and elements;
- Test, commission, and certify the complete hot water service installation to meet Authority and Australian Standard requirements, and ensure operational serviceability.

12.2 Standards

12.2.1 General

General: The NCC, AS/NZS 3500.4, and Local Water Authority requirements.

Water Supply: To AS/NZS 3500.1.

Heated Water Supply: To AS/NZS 3500.4.

Testing of Products for Use with Potable Water: To AS/NZS 4020.

Product Authorisation Requirements: To AS 3498.

Design for Access and Mobility: AS 1428.1 and AS 1428.2.

Gas Equipment: To AS 3645.

Backflow Prevention: To AS/NZS 2845.1 and AS 2845.2.

Copper Pipe: To AS 1432 and AS 4809.

Microbial Control: To AS/NZS 3666.1 and AS/NZS 3666.2 and the recommendations of SAA/SNZ HB 32.

12.2.2 Authorised Products

Standard: Listed in the WaterMark Product Database, unless otherwise required by Local Water Authority.

12.2.3 Installation of Glass Wool and Rock Wool Insulation

General: Conform to the ICANZ Industry code of practice for the safe use of glass wool and rock wool insulation.

Marking: Deliver mineral wool products to site in packaging labelled **FBS1 BIO-SOLUBLE INSULATION**.

12.2.4 Labelling

Water Efficiency Labelling: Provide only products conforming to and labelled to the Water Efficiency Labelling Scheme (WELS).

12.3 Design Criteria

12.3.1 Performance Requirements

- Maximum Pipe Velocity Copper Tube: 1 m/sec
- Maximum Pipe Velocity Other Than Copper Tube: 1.6 m/sec
- Design Water Pressure at Fixtures or Outlets: 250 kPa
- Minimum Water Pressure at Fixtures or Outlets: 50 kPa
- Maximum Water Pressure at Fixtures or Outlets: 500 kPa
- Minimum Hot Water Storage Temperature: 60°C
- Maximum Temperature at Ablution Fixtures or Outlets: 50°C
- Maximum Temperature at Ablution Fixtures or Outlets for the Aged, Sick, Children, or Disabled: 45°C
- The hot water service must be designed, constructed, and installed in such a manner as to:
    - Avoid the likelihood of contamination of drinking water within both the on-site installation and the supply;
    - Provide heated water to fixtures and appliances at flow rates and temperatures which are adequate for the correct functioning of those fixtures and appliances under normal conditions and in a manner that does not create undue noise;
    - Avoid the likelihood of leakage or failure, including uncontrolled discharges;
    - Allow adequate access for maintenance of mechanical components and operational controls;
    - Allow the system, appliances, and backflow prevention devices to be isolated for testing and maintenance, where required.

12.4 Inspection

Notice: Give notice so that inspection may be made at the following stages:

- Excavated surfaces prior to placing bedding material;
- Concealed or underground services prior to being covered;
- Pipe joints before covering;
- Placing of cast in situ concrete;
- Upon completion.

12.5 Components

12.5.1 Pressure Control Valves

General: Provide reduction valves, pressure limiting valves, or ratio valves, which produce the necessary reduction in pressure.

12.5.2 Backflow Prevention Devices

General: As documented in the Testable backflow prevention devices schedule.

Standard: To AS/NZS 2845.1 and AS 2845.2.

12.5.3 Line Strainers

Type: Low resistance, Y-form bronze bodied type, with screen of dezincification resistant brass, corrosion-resistant stainless steel, or monel.

Screen Perforations: 0.8 mm maximum.

12.5.4 Pressure Gauges

General: Provide gauges with full scale reading in kPa, a minimum nominal diameter of 63 mm and with a full scale value between 130% and 200% of the working pressure.

Bourdon Tube Gauges: To AS 1349.

Accuracy Grade: Industrial.

Installation: Comply with the recommendations of AS 1349. Isolate from pump pulsations and provide with a gauge cock.

12.5.5 Water Meters

Standard: To AS 3565.4.

Installation: To the requirements of Local Gas Authority .

12.6 Boiling, Chilled and Filtered Water Dispensers

12.6.1 General

Requirement: Install level, plumb and true to line in the required location. Make sure moving parts function freely and without obstruction. Do not modify supplied units. The specific units shall be approved for use in a correctional facility for the given area. A schedule of proposed units and their location shall be issued to the Client for approval prior to procurement and installation.

Manufacturer's Recommendations: Install and use tools and templates as recommended by the manufacturer.

Fixing: Provide rigid fixing for dispenser base so that it does not move in normal operation.

12.6.2 Sealing

Sealants: Provide sealants that do not support microbial growth.

Colour: To match fixture.

Location: Provide resilient seals between fixtures and back nuts.

12.6.3 Cutting and Fitting

General: If it is necessary to cut and/or fit substrate to install an item, carry out before the surface is finished or painted. Remove items when required for painting and protect until reinstalled. Cap or plug the open ends of pipes. Reinstall items when painting and finishing is complete.

12.6.4 Adjustment

General: Inspect and adjust dispensers for correct and smooth operation. If adjustment does not rectify incorrect or defective operation, replace units.

12.6.5 Damage

General: Inspect all work and replace or repair, to factory condition, damaged or marked fixtures and components.

Foreign Matter: Inspect for presence of foreign matter. Remove if found. Replace damaged seals.

12.6.6 Protective Coatings

General: On completion of the dispenser installation remove all protective coatings and stickers and clean surfaces. Check and clean debris from traps.

12.6.7 Warranties

General: Provide manufacturer's warranty for the periods documented.

12.6.8 Maintenance

Requirement: Conform to Hydraulic Maintenance section.

12.7 Material Fire Hazard Properties

Spread-of-Flame Index: Maximum 9 tested to AS/NZS 1530.3.

Smoke-developed Index: Maximum 8 if Spread-of-Flame is over 5, tested to AS/NZS 1530.3.

Flammability Index of Facing Materials: Maximum 5 tested to AS 1530.2.

Materials with Reflective Foil Facing: Test to AS/NZS 1530.3.

12.8 Piping

12.8.1 Finishes

General: Finish exposed piping, including fittings and supports, as follows:

- In Internal Locations Such As Toilet and Kitchen Areas: Chrome plate copper piping to AS 1192 service condition 2, bright;
- In Concealed but Accessible Spaces (Including Cupboards and Non-habitable Enclosed Spaces): Leave copper and plastic unpainted except for identification marking. Prime steel piping and iron fittings.

Valves: Finish valves to match connected piping.

12.8.2 Fittings and Accessories

General: Provide the fittings required for the proper functioning of the water supply system, including taps, valves, backflow prevention devices, pressure and temperature control devices, strainers, gauges and automatic controls and alarms.

Provision for Dismantling: Arrange piping by the provision of unions or similar so that valves, taps and other maintainable components can be removed for maintenance without disturbing or cutting adjacent piping.

12.8.3 Material Identification Marks

Pipes with Grade or Class Identification Markings: Install so that the markings are visible for inspection.

12.8.4 Valve Spindles

General: If practicable, install valve spindles in a vertical position.

12.9 Piping Insulation

12.9.1 General

Requirement: Insulate all non-chrome plated heated water piping, fittings and valves.

Application: Fit insulation tightly to piping surfaces without gaps. Close butt ends of insulation sections. Minimise number of joints. If the insulation is in half-sections, make only half-circumferential joints at any one place. Seal longitudinal seams in foil laminate and fix insulation at maximum 500 mm centres with polypropylene, zinc-coated steel or aluminium straps.

Unions and Other Items Requiring Service: Install the insulation so that it is readily removable.

Fittings: Provide insulation with thermal resistance at least equal to that of the adjacent piping insulation.

12.9.2 Insulation Material

General: Provide insulation material as documented.

12.9.3 Elastomeric Foam Insulation

Adhesives: Adhesive fix all longitudinal and butt joints. Adhere to the pipe at end joints, for a distance of 25 mm, to compartmentalise each section. Use only solvent-based adhesive supplied by insulation manufacturer and designed specifically for the material being used.

12.9.4 Sheathing

General: Provide metal sheathing to all piping insulation:

- In plant rooms;
- Where exposed to weather;
- Where exposed to view;
- Where subject to mechanical damage;
- On valves, pipeline components and pumps in sheathed piping.

Metal Sheathing: Cover piping with 0.5 mm thick metallic-coated steel sheet sheathing sprung over the insulation in one piece with laps at least 30 mm wide, and fastened with self-tapping screws or snap head rivets at 150 mm maximum centres. Preform the sheathing to match the shape of the insulated pipe and fittings.

Position laps to avoid water penetration. In external locations weatherproof the joints and fixings using non-setting mastic.

Alternative Protection for Elastomeric Foam: Where exposed to sunlight but not exposed to mechanical damage, provide 2 coats of tintable, water-based, rubberised, UV resistant, flexible paint finish to outdoor installations.

12.9.5 Surface Preparation

General: Clean the surfaces to remove scale, rust, grease and dirt and prepare surfaces to suit the insulation. Restore surface coatings, which have been damaged or affected by welding.

12.9.6 Insulation at Pipe Supports

General: Provide supports formed to fit around the insulation.

Pipes under DN 25: Either:

- Fit supports directly to pipe and form insulation around the support;
- Support as for pipes DN 25 or over.

Pipes DN 25 or over: Either:

- Protect the insulation at the support point with metal sheathing extending sufficient distance both sides of the support so the insulation thickness is reduced by less than 10%;
- Replace the insulation at the support point with a shaped timber or cork spacer block. Butt the insulation up to the spacer block and seal with silicone compound. Clad the block and insulation in 0.5 mm metallic-coated steel sheet extending 100 mm both sides of the support.

12.9.7 Insulation of Piping to Solar Water Heating Systems

Standard: AS/NZS 2712.

Insulation Material: Insulate flow and return piping between solar collectors and storage vessels as follows:

- Material temperature rating: Minimum 150°C;
- Protection: Protected against ultraviolet light mechanical damage, water penetration and the growth of bacteria, mould and mildew.

Sealing: Seal all but joints and longitudinal joints and seams with the insulation manufacturer's recommended adhesive. Seal the insulation to the pipe at both ends and each termination.

12.10 Insulation Materials

12.10.1 General

Standard: To AS/NZS 4859.1.

Material R-Value of Insulation: ≥ Total R-Value in AS/NZS 3500.4 for the type and location of the pipe.

12.10.2 Polyolefin Foam

Type: Closed cell cross-linked polyolefin foam produced using a hydrocarbon blowing agent.

Insulation Surface Facing: Heat-bonded aluminium foil laminate.

12.10.3 Glass Wool and Rock Wool and Polyester

Description: Select from the following:

- Glass wool or rock wool resin-bonded to form tubular sections;
- Polyester in moulded tubular sections.

12.10.4 Elastomeric Foam Insulation

Type: Chemically blown closed cell nitrile rubber in tubular sections for pipe insulation, in sheets for insulating pipe fittings, and in sheets or rolls for large pipes, tanks, vessels and heat exchangers. Provide with smooth natural finish and vapour barrier properties.

Physical Properties:

- Free of ozone depleting gases in manufacture and composition;
- Moisture Absorption: Non-hygroscopic;
- Water Vapour Permeability: Maximum 0.065 ng/Pa.m.s.

12.10.5 Aluminium Foil Laminate Sheet

Standard: To AS/NZS 4200.1.

Material: Glass fibre reinforced, aluminium foil-paper laminate.

Duty Classification to AS/NZS 4200.1: Heavy duty.

12.10.6 Adhesives and Sealants

Requirement: Provide low VOC adhesives and sealants to manufacturer's recommendations.

12.10.7 Aluminium Foil Laminate Tape

Adhesive: Non-toxic, high tack synthetic pressure sensitive type.

Liner: Silicone coated paper.

Backing: Aluminium foil laminate.

Minimum Width: 50 mm.

Minimum Mechanical Properties: Polyethylene tape serial number F11 to AS 1599.

12.11 Testing

12.11.1 Pre-completion Tests

Pressure Tests: Before insulation is applied to joints pressure test piping to AS/NZS 3500.4.

Leaks: If found, rectify and re-test.

Cross Connections: Isolate systems individually and check for cross connections.

Backflow Prevention: To AS/NZS 3500.1.

Tapware: Check for leaks.

12.11.2 Completion Test

General: Provide a full operational test to verify conformance.

12.12 Completion

12.12.1 Commissioning

Strainers: Remove, clean and replace strainer baskets.

Cleaning: To AS/NZS 3500.1.

Disinfection: Disinfect to AS/NZS 3500.1.

Heated Water Systems: Test and commission to AS/NZS 3500.4.

Testable Backflow Prevention Devices: Test and commission to AS 2845.3 by a licensed plumber with backflow device accreditation. Tag and certify to the requirements of Local Water Authority.

12.12.2 Charging

Completion: On completion of installation, commissioning, testing and disinfection, fill the system with water, turn on control and isolating valves and the energy supply and leave the water supply system in full operational condition.

12.12.3 Maintenance Manuals

Standard: To AS/NZS 3666.2.

12.13 Maintenance

Requirement: Conform to the Hydraulic Maintenance section.

12.14 Selections

12.14.1 Pipe Material Schedule

Property	Above Ground	Above Ground within Masonry Walls	Above Ground within Non-masonry Walls
Pipe Material	Copper	Pre-lagged Copper	Pre-lagged Copper
Grade or Class	AS 1432 Type B	AS 1432 Type B	AS 1432 Type B
Jointing Method	Compression	Compression	Compression
Concrete Encasement	N/A	N/A	N/A

Note: All pipework shall be of the sizes shown on the accompanying drawings. Wherever possible, pipes shall be run parallel with the building slabs, walls etc. and all branch take-offs shall be at right angles.

13. RAINWATER RE-USE WATER SERVICE

13.1 General

NO RAINWATER REUSE IN THIS PROJECT

Requirement: The works sp sign, supply, installation, testing, and commissioning of the rainwa

Scope of Works: Includes, but is not limited to, the following:

- Install rainwater tank/s with 3 hour peak capacity where an alternative water supply (such as a second authority supply main) is not present or available.
- Developing the rainwater re-use water service design documentation to completion, as deemed acceptable by the principal to provide a compliant and fully functional system within the regulations and by-laws of all Federal, State, and Local Authorities holding jurisdiction over the works;
- Provide all necessary pipes, junctions, bends, supports, pumpsets, and sundry equipment as required for the installation to supply the follow usages:
- Provide appropriate measures so as to avoid likelihood of contamination, preventing the possibility of cross connection between rainwater and the authority's potable water system. This shall be provided by means, which are appropriate to the hazard, as outlined in AS/NZS 3500.1.
- Coordinate with the builder and other services contractors prior to any setting out and pipe installation taking place. Pipeline positions shall be determined on site in conjunction with all other disciplines to ensure adequate coordination of all services and elements;
- Test, commission, and certify the complete rainwater re-use water service installation to meet Authority and Australian Standard requirements, and ensure operational serviceability.

13.2 Standards

General: The NCC, AS/NZS 3500.1, and Local Water Authority requirements.

Stormwater Drainage: To AS/NZS 3500.3.

Rainwater Supply: To AS/NZS 3500.1.

Metal Tanks and Rainwater Goods: To AS/NZS 2179.1.

Design and Installation: To the recommendations of SAA HB 230.

13.3 Design Criteria

13.3.1 Performance Requirements

- Pipe Velocity: 1.6 m/sec
- Maximum Pipe Velocity: 3 m/sec
- Design Water Pressure at Fixtures or Outlets: 250 kPa
- Minimum Water Pressure at Fixtures or Outlets: 50 kPa
- Maximum Water Pressure at Fixtures or Outlets: 500 kPa
- The rainwater re-use water service must be designed, constructed, and installed in such a manner as to:

- Avoid the likelihood of contamination of drinking water;
- Provide non drinking water to fixtures and appliances at flow rates and pressures which are adequate for the correct functioning of those fixtures and appliances under normal conditions and in a manner that does not create undue noise;
- Avoid the likelihood of leakage or failure including uncontrolled discharges;
- Allow adequate access for maintenance of mechanical components and operational controls;

Allow the system, appliances, and backflow prevention devices to be isolated for testing and maintenance, where required.

13.4 Authorised Products

Standard: Listed in the WaterMark Product Database, unless otherwise required by Local Water Authority.

Tanks: To ATS 5200.026.

Tank Marking: Display the WaterMark symbol and other marking required by ATS 5200.026.

13.5 Inspection

Notice: Give notice so that inspection may be made at the following stages:

- Excavated surfaces prior to placing bedding material;
- Concealed or underground services prior to being covered;
- Pipe joints before covering;
- Placing of cast in situ concrete;
- Upon completion.

13.6 Rainwater Tanks

13.6.1 General

Requirement: Provide structurally sound and watertight tanks.

Openings: Designed to resist human load bearing forces and to prevent the inappropriate entry of humans, animals, insects surface water, ground water, and rubbish. All openings shall have tamper proofs locks installed.

Accessories: Provide the accessories needed to complete the installation. Include the following:

- Inlet and outlet connections;
- Floating outlet to draw water from the upper part of the tank;
- Tight fitting lids or screens with maximum 1 mm mesh at all openings;
- Flap valves at every opening to the tank;
- Calmed inlet to the tank to prevent stirring sediment;
- Overflow siphon to skim surface contaminants.

Accessory Materials: Select from:

- Ultraviolet light resistant plastic;
- Corrosion-resistant metal. Do not use copper or copper alloys with metallic-coated steel tanks;
- The same material as the tank.

Access Opening: Provide a vermin-proof, childproof access opening above the high water level and cover with either a strainer or a lid fixed securely to the tank.

13.6.2 Warranties

Requirement: Provide a manufacturer's warranty on the tanks.

13.6.3 Underground Tanks

General: Provide tanks designed for installation underground and to withstand the anticipated loading from above and to prevent the entry of ground and surface water.

Separation from Waste Treatment Installations: To AS/NZS 1547.

13.6.4 Connections

General: Reinforce the tank wall to resist loads imposed by the connected piping.

Outlet Size:

- Tanks ≤ 6,600 L: 20 mm minimum;
- Tanks > 6,600 L: 25 mm minimum.

Overflow: Sized to handle not less than the maximum rate of rainwater inflow.

13.7 Polyethylene Tanks

Standard: To AS/NZS 4766.

13.8 Coated Steel Tanks

13.8.1 Tank Roof

Type: Select from the following:

- Conical;
- Flat and back propped internally with a tightly fitting length of PVC-U downpipe.

13.8.2 Material

General: Conform to the following:

- Top and Sides: Metallic-coated steel with polymer film to AS 2070 on the inside and pre-painted on the outside;
- Base: Metallic-coated steel with polymer film to AS 2070 on inside and outside.

Component	Minimum base metal thickness (mm)		Steel grade to AS 1397	Coating class to AS 1397	Profile/Pitch x no. of corrugations
	≤ 3 m diameter or ≤ 17 000 L	> 3 m diameter or > 17 000 L			
Base	0.6	0.8	G 300	Z 275 or AZ 150	Flat
Walls	0.6	0.8	G 300	Z 600 or AZ 200	76 x 8
Top	0.6	0.6	G 300	Z 275	Flat
				AZ 150	Conical

13.8.3 Jointing

General: Conform to the recommendations of the metallic-coated steel manufacturer.

13.9 Reinforced Concrete Tanks

Type: Precast or in situ.

Standard: To AS 3735.

Design and Certification of Construction: By a professional engineer.

13.10 Bladder Tanks

Type: Proprietary plastic bladder type.

Material: Reinforced polymer conforming to AS 2070, resistant to puncture and microbial attack.

13.11 Rainwater Filtration

13.11.1 Tank Inlet

General: Provide an easily cleanable filter to treat rainwater before the entry to the tank.

Mesh Size: Maximum 1 mm.

13.11.2 Tank Outlet

Filtration and Treatment: As documented.

Drinking Water Filters: To AS/NZS 3497 and the requirements of the statutory authorities having jurisdiction.

13.12 Pumpset

Requirement: Conform to the Hydraulic Pumps section.

13.13 Installation

13.13.1 General

Requirement: Provide structural support to withstand the mass of the tank when full without deformation or excessive settling.

Connecting Piping: Support independently of the tank. Provide a 300 mm long section of reinforced flexible hose to prevent piping exerting a load on the tank.

Overflow: Pipe to discharge away from the tank.

Arrangement: Prevent the entry of sunlight to the interior of the tank.

13.13.2 Backflow Prevention

Standard: To AS/NZS 3500.1 and the requirements of Local Water Authority.

Requirement: Prevent backflow from the rainwater storage system to other potable water supplies.

13.14 Above Ground Tank Installation

13.14.1 General

Restraint: Restrain the tank to prevent movement, when empty, caused by wind and other loads.

Base: Provide a level base with gaps not exceeding 10 mm, free of sharp projections and projecting beyond the edge of the tank at all points.

13.14.2 Polyethylene Tanks

Support: Trim and compact the ground and place a level bed of sand at least 50 mm thick.

13.14.3 Coated Steel Tanks

Support: Fully support the tank on a self-draining timber or concrete base.

Corrosion protection:

- Prevent contact with dissimilar metals;
- Arrange so that no part of the tank is below ground level and so that adjacent ground surfaces fall away from the tank;
- Do not use sharp objects inside the tank. Remove swarf with a magnet if drilling or cutting.

13.14.4 Reinforced Concrete Tanks

Support: Trim and compact the ground.

13.14.5 Bladder Tanks

Support: Locate on level base free from sharp objects. Install with manufacturer's supporting frame.

Relief: Provide over-pressurising relief and air vent.

13.15 Underground Tank Installation

13.15.1 General

Access: Arrange to permit easy inspection, cleaning and draining.

Sealing: Prevent the entry of groundwater, surface run-off and other contaminants. Prevent entry of stormwater surcharge via the tank overflow.

Access Openings: Lockable, 150 mm to 450 mm diameter. Unless watertight, locate openings 150 mm above finished surface level. Conform to Work health and Safety requirements.

External Pressure: Prevent superimposed external pressure exceeding 0.25 m head of water (2.5 kPa) above the manufacturer's maximum recommended fill level.

13.15.2 Excavation and Backfilling

General: Keep excavations free of surface water. After placing the tank, backfill with sand.

13.15.3 Sand Backfilling

Type: Chemically inert sand, free from foreign matter such as salt, organic matter and clay lumps, and graded.

Placing: Place sand backfilling in layers not more than 200 mm thick.

13.15.4 Ballasting

General: If ballasting is necessary to prevent flotation, fill the tank with water before backfilling and provide a concrete ballast collar.

13.16 Marking

Labelling: If rainwater is not treated to potable quality, label rainwater piping and outlets to AS/NZS 3500.1.

13.17 Commissioning

Cleaning: Flush the rainwater system. Wash and flush tanks to remove manufacturing and other contaminants.

13.18 Maintenance

Requirement: Conform to the Hydraulic Maintenance section.

13.19 Selections

13.19.1 Pipe Material Schedule

Property	Below Ground	Above Ground
Pipe Material	Copper	Copper
Grade or Class	AS 1432 Type B	AS 1432 Type B
Jointing Method	Compression	Compression
Concrete Encasement	N/A	N/A

Note: All pipework shall be of the sizes shown on the accompanying drawings. Wherever possible, pipes shall be run parallel with the building slabs, walls etc. and all branch take-offs shall be at right angles.

14. FUEL GAS SERVICE

14.1 General

Requirement: The works specified in this section comprises the supply, installation, testing, and commissioning of the fuel gas service.

Scope of Works: Includes, but is not limited to, the following:

- Developing the fuel gas service design documentation to completion, as deemed acceptable by the principal to provide a compliant and fully functional system within the regulations and by-laws of all Federal, State, and Local Authorities holding jurisdiction over the works;
- Install boundary gas pressure regulator and meter assembly as supplied by Local Gas Authority to AS 5601 requirements where required;
- Ensure ignition sources are not present in gas meter cupboards. This includes MDL's, GPO's, water meter monitoring systems and the like;
- Supply and install fuel gas appliances as required;
- Provide all necessary pipes, junctions, bends, supports, and sundry equipment as required for the installation;
- Coordinate with the builder and other services contractors prior to any setting out and pipe installation taking place. Pipeline positions shall be determined on site in conjunction with all other disciplines to ensure adequate coordination of all services and elements;
- Test, commission, and certify the complete natural gas service installation to meet Authority and Australian Standard requirements, and ensure operational serviceability.

14.2 Standards

Reticulated Gas Systems: To AS 5601.

Gas Equipment: To AS 3645.

Industrial and Commercial Gas-fired Appliances: To AS 3814.

Steel Mains and Services Maximum Operating Pressure Not More Than 1,050 kPa: To AS/NZS 4645.2.

Flue Cowls: To AS 4566.

14.3 Design Criteria

14.3.1 Performance Requirements

- Maximum Gas Pressure Within Buildings: 5 kPa
- Maximum Boundary Regulator Gas Pressure: 5 kPa
- Maximum Volume Boundary Metering Gas Pressure: 5 kPa
- Minimum Natural Gas Pressure at Appliance Inlets: 1.38 kPa
- Minimum LPG Gas Pressure at Appliance Inlets: 2.75 kPa
- The fuel gas service must be designed, constructed, and installed in such a manner as to:

- Provide natural gas to appliances at flow rates and pressures which are adequate for the correct functioning of those fixtures and appliances under normal conditions;
- Avoid the likelihood of leakage or failure including uncontrolled discharges;
- Allow adequate access for maintenance of mechanical components and operational controls;
- Allow the system and appliances to be isolated for testing and maintenance, where required.

14.4 Submissions

14.4.1 Certificate of Appliance Approval

Appliances with Gas Inputs under 500 MJ/hour: For each appliance where an approval code exists, submit a certificate from the manufacturer stating that the appliance has AGA/ALPGA approval for operation with the designated gas type.

14.4.2 Tests

Other tests: Submit results, as follows:

- Storage Tanks: Submit evidence of production testing to AS 1210.

14.5 Inspection

Notice: Give notice so that inspection may be made at the following stages:

- Excavated surfaces prior to placing bedding material;
- Concealed or underground services prior to being covered;
- Pipe joints before covering;
- Placing of cast in situ concrete;
- Upon completion.

14.6 Piping

14.6.1 Concealment

General: If practicable, install piping so that it is concealed within service ducts or non-habitable enclosed spaces and does not appear on external walls. Otherwise, provide metal piping mounted on metal brackets and provide metal cover plates at penetrations.

14.6.2 Finishes

General: Finish exposed piping, including fittings and supports, as follows:

- In Internal Sterile Locations such as Toilet and Kitchen Areas: Chrome plate copper piping to AS 1192 service condition 2, bright;
- In Concealed but Accessible Spaces (Including Cupboards and Non-habitable Enclosed Spaces): Leave copper and plastic unpainted except for identification marking. Prime steel piping and iron fittings.

Valves: Finish valves to match connected piping.

14.6.3 Interlock with Mechanical Ventilation Equipment

Requirement: Where gas equipment and appliance ventilation is provided by mechanical equipment provide and install an approved gas solenoid valve and electrically wire within electrical conduit between the valve and electrical fan in the flue duct so that the solenoid valve is off if the fan is not running.

Solenoid Valve: Install solenoid valve with ball valve preceding a hexagon bronze ground faced gas unions each side of the solenoid valve.

14.6.4 Emergency Isolation

Standard: AS 5601.

Requirement: In each room containing gas appliances without flame safeguard systems, provide an emergency shut off system consisting of a solenoid valve and labelled trip button.

Trip Button Location: Readily accessible, on the egress path from the room in a position where it will not be accidentally operated.

14.7 Valve Boxes

14.7.1 General

Requirement: Provide cast iron valve boxes with lockable covers for access to underground gate valves.

Identification: Mark the box covers with the word **GAS**.

14.7.2 Installation

General: Set beneath each box a shaft formed of PVC-U pipe to give clear access to the valve wheel or spindle. Set top flush with pavement surface, or 15 mm above unpaved surfaces, and encase in formed concrete box 150 mm thick, with top surface trowelled smooth.

14.8 Wall Boxes

14.8.1 General

Requirement: Provide wall boxes to house above ground valves and regulators. Wall boxes secured with metal thread security screws. Provide handle free anti-ligature stainless steel access panels in non-sterile areas. Access panels or wall boxes shall not be installed in bedrooms

Product sample to be supplied to the Client for approval prior to procurement and installation.

14.8.2 Construction

Body: 1.2 mm galvanized steel plate continuous welded box construction with leading edge folded twice at 90 to form 25 mm x 25 mm frontal surround.

Fixing: Fix to masonry backing with four 10 mm galvanized masonry bolts.

Drainage and Ventilation Relief: Set the bottom of the box to fall outward. Form four 10 mm diameter holes in the frontal surround section at box floor level.

Sleeves: Provide, to the box floor inlet and outlet pipes, sleeves formed of 1.2 mm thick steel pipe with 1.2 mm galvanized flanges to pipe diameter plus 50 mm. Bed each flange on epoxy mortar and rivet to the floor of the box with four 3 mm diameter rivets.

Doors to Boxes: Metal frame, glazed with 2.5 mm clear float glass. Provide lock, keys and two 100 mm brass anti-ligature hinges.

Ventilation: In accordance with the requirements of AS5601.1

14.9 LPG Storage Systems

14.9.1 Tank LPG Storage

Tank Colour: White.

Certificate Holders: Provide a galvanized steel pipe, one end fitted with a brass plug, one end threaded and fitted with a threaded brass cap. Weld to the tank support member.

14.9.2 Cylinder LPG Storage

Fittings: Supply cylinders with regulators which have AGA/ALPGA approval.

14.9.3 Hoods

General: Provide a weatherproof protective steel cover to the valve and regulators of 450 L capacity cylinders, together with hinge pins, padlock and key.

Function: For storage of current storage system approval and test certificates.

Marking: Mark the threaded cap with the phrase **LPG CERTIFICATES**.

14.9.4 Notices and Signs

General: In accordance with the requirements of AS5601.1

14.10 Connection to Gas Appliances

Requirement: Appliances and auxiliary equipment shall only be connected to the gas supply after they have been approved by the authorities holding jurisdiction.

Workmanship: Pipework and fittings used in connecting appliances shall be installed neatly. Control valves and unions or other approved fittings to provide easy means of appliance connection and disconnection shall be provided at all gas connections to gas burning equipment and gas appliances.

14.11 Flame Failure

Requirement: All gas appliances supplied by builder shall have 100% flame failure safety shut-off devices of approved manufacture including over pressure safety regulations assembly.

14.12 Flues

Installation: The flue pipes and fittings shall be securely held and supported by non-combustible brackets for fastenings suitable for the design and weight of the flue system material and to maintain the required clearance from building construction.

Plant Room Installation: Where within plant rooms flue pipes shall be of stainless steel double skin. The appliance and draught diverter shall not support the weight of flue pipes or fittings.

Slip Joint: A slip joint shall be installed in the flue system near the appliance flue outlet to facilitate removal of appliance for service.

Fire Rated Shaft: Where flue pipes are to be installed inside a two hour fire rated shaft the flue pipe shall be fabricated from 316 grade stainless steel sheet metal, 1.20 mm thick. Provide flanged and bolted joint to join lengths of flue pipe and bolt flanges together with stainless steel bolts and nuts. Provide flange casket at each unit of flanges. All joints to be stainless steel welded.

Roof Flashing: Flues passing through roofs or walls shall be flashed and made watertight.

14.13 Marking

General: During backfilling lay plastic warning tape 300 mm above buried piping, for the full length of the piping.

Warning Tape: Minimum 100 mm width, with **GAS PIPE UNDER** marked continuously.

Marker Plates: Provide galvanized steel or brass marker plates at ground level at each change of direction in the underground pipeline, engraved to show the direction of the line and name of the service. Inset marker plates in 150 mm x 150 mm x 150 mm concrete blocks, with the tops set flush with ground level.

14.14 Pre-completion Testing

General: Immediately before putting the fuel gas installation into operation, test the installation to AS 5601.

14.15 Manuals

Requirement: Prepare manuals to include recommendations for the operation, care and maintenance of gas appliances, storage tanks, valves, regulators, and their associated fittings.

14.16 Commissioning

14.16.1 General

Requirement: On completion of installation and testing, turn on isolating and control valves, and purge and charge the system.

Purging: Conform to the recommendations of AS 5601.

Appliances: Commission appliances. Conform to the recommendations of AS 5601.

14.16.2 Charging

Requirement: Immediately before the date of practical completion, fully charge the system with gas.

LPG Systems: Fill gas storage containers and replace gas used in testing.

14.17 Maintenance

Requirement: Conform to the Hydraulic Maintenance section.

14.18 Selections

14.18.1 Pipe Material Schedule

Property	Below Ground	Above Ground
Pipe Material	Copper	Copper
Grade or Class	AS 1432 Type B	AS 1432 Type B
Jointing Method	Compression	Compression
Concrete Encasement	N/A	N/A

PE AS NOTED ABOVE IN THE SPECIFICATION TO BE PROPOSED FOR USE BELOW GROUND.

Note: All pipework shall be of the sizes shown on the accompanying drawings. Wherever possible, pipes shall be run parallel with the building slabs, walls etc. and all branch take-offs shall be at right angles.

15. FIRE HYDRANT SERVICE

15.1 General

Requirement: The works specified in this section comprises the supply, installation, testing, and commissioning of the fire hydrant service.

Scope of Works: Includes, but is not limited to, the following:

- Developing the fire hydrant service design to completion, as deemed acceptable by the principal to provide a compliant and fully functional system within the regulations and by-laws of all Federal, State, and Local Authorities holding jurisdiction over the works;
- Provide all necessary pipes, junctions, bends, supports, pumpsets, water storage and sundry equipment as required for the installation;
- Supply and install fire hydrants as required to comply with AS2419.1;
- Coordinate with the builder and other services contractors prior to any setting out and pipe installation taking place. Pipeline positions shall be determined on site in conjunction with all other disciplines to ensure adequate coordination of all services and elements;
- Test, commission, and certify the complete fire hydrant service installation to meet Authority and Australian Standard requirements, and ensure operational serviceability;
- Following commissioning, supply and fix maintenance tags to all fire hydrants.

15.2 Standards

General: BCA E1.3, NSW Fire & Rescue, Local Water Authority, and AS 2419.1 requirements.

Design, Construction, and Performance: To AS 2419.1.

Installation: To AS 2419.1.

Pumpsets: To AS 2941.

15.3 Design Criteria

15.3.1 Performance Requirements

- Maximum Pipe Velocity: 4 m/sec
- Maximum System Pipe Friction Losses: 150 kPa
- Minimum Fire Hydrant Flow Rate: 10 L/sec
- Minimum Unassisted Feed Fire Hydrant Residual Pressure: 150 kPa
- Minimum Unassisted Attack Fire Hydrant Residual Pressure: 250 kPa
- Maximum System Dynamic Pressure: 1200 kPa
- Maximum System Static Pressure: 1300 kPa
- Fire protection services are to have an emergency water supply and ring main arrangements to provide redundancy;

- Fire hydrants shall be located in sufficient quantities and appropriate locations, as required by the relevant fire authority and in keeping with the facilities operational needs.
- Hydrants are to be located a minimum of 2 meters from all gates;
- The fire hydrant service must be designed, constructed, and installed in such a manner as to:
    - Avoid the likelihood of contamination of drinking water;
    - Provide water to fire-fighting equipment at a flow rate and pressure that is adequate for the correct functioning of the equipment;
    - Avoid the likelihood of leakage or failure including uncontrolled discharges;
    - Allow adequate access for maintenance of mechanical components and operational controls;
    - Allow the system and backflow prevention devices to be isolated for testing and maintenance.

15.4 Inspection

Notice: Give notice so that inspection may be made at the following stages:

- Excavated surfaces prior to placing bedding material;
- Concealed or underground services prior to being covered including all thrust blocks;
- Pipe joints before covering;
- Placing of cast in situ concrete;
- Upon completion.

15.5 Products

15.5.1 Authorised Products

Requirement: Provide equipment listed in the ActivFire Register of Fire Protection Equipment.

15.5.2 Piping

Piping Material: As documented.

15.5.3 Valves

15.5.3.1 Isolating Valves

Below-ground Metal Seated Isolating Valves: To AS/NZS 2638.1.

Below-ground Resilient Seated Isolating Valves: To AS/NZS 2638.2.

15.5.3.2 Fire Hydrant Valves

Standard: To AS 2419.2.

Requirement: Provide fire hydrant valves as follows:

- To the requirements of NSW Fire & Rescue;
- Copper alloy construction;

- Matching non-ferrous dust cap and chain.

Valve Monitors: To AS 4118.1.4.

15.5.4 Pumpset

Standard: To AS 2419.1 and AS 2941.

Requirement: Conform to the Hydraulic Pumps section.

15.5.5 Fire Brigade Booster Assembly

Standard: To AS 2419.3.

Type: Provide a proprietary booster assembly with a cast bronze body, DN 65 inlets suitable for quick connect couplings, back pressure valves, pressure gauge, drain valve, and main stop valve.

Requirement: Backflow prevention.

Number of Booster Valves: As documented.

Signage and Block Plan: To AS 2419.1.

15.5.6 Fire Hydrant Service Block Plan

General: Provide a fire hydrant block plan consisting of minimum A3 size photo-sensitised aluminium plate, showing a diagram of the complete fire hydrant/hose reel system located in the fire hydrant booster cabinet, enclosure, recess, fire control room, and pump room in a conspicuous location.

Requirement: The block plan shall comply with AS 2419.1 and NSW Fire & Rescue requirements and be of 3 mm thick 316 grade stainless steel construction with minimum dimensions measuring 840 mm long and 600 mm high.

Installation: Provide and install two hot dip galvanized steel supports all as detailed on drawing and secure into position with bulk concrete. Provide two (2) 50 mm equal stainless steel angle section for each block plan concreted into ground and secure plan with stainless steel bolts and nuts.

15.5.7 Notice of Pressure

Requirement: A fade resistant engraved sign shall be fixed in a prominent position, on the booster assembly. The following working shall be marked on the sign it upper case lettering 25 mm high and in contrasting colour with that of the background:

- Working Pressure [ ] kPa
- System Pressure [ ] kPa

15.6 Installation

15.6.1 Valves

General: Locate valves to permit satisfactory operation and maintenance.

Requirement: All isolating valves shall be provided with 50 mm wide 003 keyed padlocks with 6 mm galvanized steel chain to secure all isolation valves in the fully open position. Attach plates inscribed with the words **FIRE MAIN VALVE - SECURE OPEN** in 8 mm lettering.

15.6.2 Thrust Blocks

Requirement: Provide concrete thrust blocks constructed in a wedge shape set into the trench sides and base to a thickness to provide sufficient anchorage to adequately prevent movement of pipework due to the effects of water pressure and water hammer.

Location: Thrust blocks shall be installed in the following locations:

- All bends or junctions;
- Termination of piping;
- Valves installed in piping;
- Reducing fitting in the direction of the smaller pipe;
- Changes of direction in excess of 5°;
- Grades in excess of 1:5.

15.6.3 Fire Rating of Pipework Supports

Requirement: Unless protected by an automatic sprinkler system or fire resisting construction of not less than 60/60/60, fire hydrant pipe supports shall have an FRL of not less than -/60/60 while maintaining a pipe-support temperature of not less than 500°c when tested in accordance with AS 1530.4.

15.7 Commissioning

System: To AS 2419.1.

Baseline Data: Provide baseline data to AS 1851.

15.8 Maintenance

Requirement: Conform to the Hydraulic Maintenance section.

15.9 Selections

15.9.1 Pipe Material Schedule

Property	Below Ground	Above Ground
Pipe Material	Ductile Iron Pipes & Fittings	Ductile Iron Pipes & Fittings
Grade or Class	AS 2280	AS 2280

PE AS NOTED ABOVE IN THE SPECIFICATION TO BE PROPOSED FOR USE BELOW GROUND.

Note: All pipework shall be of the sizes shown on the accompanying drawings. Wherever possible, pipes shall be run parallel with the building slabs, walls etc. and all branch take-offs shall be at right angles.

16. FIRE HOSE REEL SERVICE

16.1 General

Requirement: The works specified in this section comprises the supply, installation, testing, and commissioning of the fire hose reel service.

Scope of Works: Includes, but is not limited to, the following:

- Developing the fire hose reel design to completion, as deemed acceptable by the principal to provide a compliant and fully functional system within the regulations and by-laws of all Federal, State, and Local Authorities holding jurisdiction over the works;
- Provide a fire hose reel service making connection to the metered potable cold water supply via a registered double check valve backflow prevention device;
- Extend specified service complete with all fittings, valves, brackets, and sundry items to complete the installation to all fire hose reels at the locations as required to achieve coverage as per the NCC and AA 2441
- Provide additional backflow prevention devices to all fire hose reels located in a position susceptible to backflow or cross connection hazard areas. The installed backflow prevention device shall be commensurate with the hazard level as specified in AS/NZS 3500.1;
- Coordinate with the builder and other services contractors prior to any setting out and pipe installation taking place. Pipeline positions shall be determined on site in conjunction with all other disciplines to ensure adequate coordination of all services and elements;
- Test, commission, and certify the complete fire hose reel service installation to meet Authority and Australian Standard requirements, and ensure operational serviceability;
- Following commissioning, supply, and fix maintenance tags to all fire hose reels.

16.2 Standards

General: BCA E1.4, AS2441, and Local Water Authority requirements.

Design, Construction, and Performance: To AS/NZS 1221.

Installation: To AS 2441.

Pumpsets: To AS 2941.

16.3 Design Criteria

16.3.1 Performance Requirements

- Minimum Hose Reel Discharge Pressure: 220 kPa
- Minimum Hose Reel Flow Rate (19 mm Hose): 0.33 L/sec
- Minimum Hose Reel Flow Rate (25 mm Hose): 0.44 L/sec
- The fire hose service must be designed, constructed, and installed in such a manner as to:
    - Avoid the likelihood of contamination of drinking water;

- Provide water to fire-fighting equipment at a flow rate and pressure that is adequate for the correct functioning of the equipment;
- Avoid the likelihood of leakage or failure including uncontrolled discharges;
- Allow adequate access for maintenance of mechanical components and operational controls;

- Allows the system and backflow prevention devices to be isolated for testing and maintenance.

16.4 Inspection

Notice: Give notice so that inspection may be made at the following stages:

- Excavated surfaces prior to placing bedding material;
- Concealed or underground services prior to being covered;
- Pipe joints before covering;
- Placing of cast in situ concrete;
- Upon completion.

16.5 Products

16.5.1 Authorised Products

Requirement: Provide equipment listed in the ActivFire Register of Fire Protection Equipment.

16.5.2 Fire Hose Reels

Standard: To AS/NZS 1221.

Certification: Required.

Standard: An organisation accredited by the Joint Accreditation System of Australia and New Zealand (JAS-ANZ).

16.5.3 Pumpset

Standard: To AS 2419.1 and AS 2941.

Requirement: Conform to the Hydraulic Pumps section.

16.6 Installation

16.6.1 Fire Hose Reels

Standard: To AS 2441.

Protection from Damage: To AS 2441.

16.6.2 Valves

Requirement: All isolating valves and backflow prevention devices that can isolate flow in the hose reel water supply service shall be secured in the open position by leather straps and padlocks, or have its operating handle removed. All valves shall be fitted with durable, corrosion resistant tag with **FIRE SERVICE VALVE – CLOSE ONLY TO SERVICE FIRE HOSE REELS** in 8 mm high upper case text.

16.7 Commissioning

Procedure: To AS 2441.

Results: Submit commissioning and testing results.

Baseline Data: Provide baseline data to AS 1851.

16.8 Maintenance

<MAINTENANCE>>Requirement: Conform to the Hydraulic Maintenance section.

16.9 Selections

16.9.1 Pipe Material Schedule

Property	Below Ground	Above Ground
Pipe Material	Copper	Copper
Grade or Class	AS 1432 Type B	AS 1432 Type B
Jointing Method	Compression	Compression

Note: All pipework shall be of the sizes shown on the accompanying drawings. Wherever possible, pipes shall be run parallel with the building slabs, walls etc. and all branch take-offs shall be at right angles.

16.9.2 Fire Hose Reel Schedule

Property	A	B	C
Manufacturer	Galvin Engineering	Galvin Engineering	Galvin Engineering
Mounting Type	Wall mounted	RHS support post	Wall mounted
Enclosure Type	Exposed	Cupboard	Pre-fabricated cabinet
Reel Type	Fixed guide arm	Swing guide arm	Swing guide arm
Reel Material	Zincalume steel	Zincalume steel	Stainless steel
Reel Diameter (mm)	545	545	545
Nozzle Type	Type 1 (jet)	Type 2 (jet/spray)	Type 1 (jet)
Nozzle Material	Brass	Brass	Brass
Hose Length (m)	36	36	36

17. MAINTENANCE

17.1 General

Requirement: Maintain the hydraulic systems for the documented maintenance period so that the performance, reliability, service life, energy efficiency and safety of the system is equal to or better than that at the beginning of the maintenance period, in parallel with and including:

- Periodic and statutory maintenance, cleaning and replacement of consumables;
- Emergency repairs;
- Condition reporting.

Maintenance Period: 12 months.

17.2 Submissions

17.2.1 Certification

Annual Certification: Inspect and submit certification for all items required to be inspected annually under statutory requirements.

17.2.2 Records

Maintenance Records: Conform to the General Requirements section.

Periodic maintenance and performance report: At the frequency documented, submit reports summarising the maintenance performed and the performance of the hydraulic installation in the preceding period. Set out the report in a form that permits comparison with previous reports. Include the following as minimum requirements:

- Dates and number of site labour hours for periodic maintenance. Exclude travelling time;
- Dates, number of site labour hours and nature of work for emergency repairs. Exclude travelling time;
- Dates and number of site labour hours for defects liability rectification if within the defects liability period. Exclude travelling time;
- List of any motors for which the motor current varied by more than 10% from the current measured during commissioning;
- For each separately metered item, the water or gas use for each month of the reporting period.

17.3 Inspection

Requirement: Give notice so that an inspection may be held simultaneously with the final programmed maintenance visit.

17.4 Product Selection

Proprietary Items: Select products, as consumables or replacement items, of the same make, model and type as those being replaced.

Substitutions: Where the existing product is no longer available, provide products with at least the same performance and construction characteristics.

17.5 Emergency Repairs

17.5.1 General

Requirement: Respond to call outs for breakdowns or other faults requiring emergency repairs. Rectify faults and replace faulty materials and equipment.

Remedial Work: Carry out any remedial work, including temporary work, necessary to restore each system to safe and satisfactory operation. Verify each system is operating correctly before leaving the site. Do not leave the plant in an unsafe condition.

Temporary Work: Promptly replace temporary work with permanent rectification.

17.5.2 Contact Details

Emergency Contract: Provide contact details including after hours and emergency mobile and/or pager details, to permit notification of emergency conditions.

17.5.3 Response Time

Period: Attend site for emergency service within the documented response time.

Response Period: Starts at the time of notification to the contactor's nominated contact point.

17.6 Periodic Maintenance

17.6.1 General

Microbial Control Maintenance: To AS/NZS 3666.2.

Routine Visits: Make routine service visits at the frequency documented. Service items of equipment in conformance with the maintenance schedules in the operation and maintenance manuals.

Notification of Defects: When defects in the installation are identified, give notice.

Requirement: Provide maintenance work including, but not limited to, the following:

- Carry out the manufacturers' recommended maintenance;
- Attend to reported defects and complaints;
- Check for and repair corrosion;
- Check for and rectify any unsafe conditions;
- Replace faulty or damaged parts and consumable components;
- Check anti-vibration supports, brackets and clamps, holding down bolts and flexible connections, for deterioration and for freedom of movement of assembly;
- Identification of Pipes, Conduits and Ducts Maintenance: To AS 1345;
- Safety Signs Maintenance: To AS 1319.

17.6.2 Cleaning

Requirement: At the end of the maintenance period:

- Remove waste and clean all parts of the installation;

- Remove temporary protective coatings, packaging and labels;
- Clean screens and strainer baskets.

17.6.3 Piped Systems

Tasks: Perform the following:

- Check equipment items and record values for operation, calibration, performance compliance, temperature, and energy consumption;
- Rectify all water leaks regardless of size. Clean and repair any water damage;
- Check condition of insulation and repair as required;
- Provide service tags recording inspections and tests.

17.6.4 Cold and Heated Water

Maintenance of Tanks and Piping for Potable Water: To AS/NZS 3500.1 and AS/NZS 3500.4.

Ball Float Valves: Check and adjust for no overflow.

Heated Water Systems:

- Conform to the recommendations of AS/NZS 3500.4;
- Inspection and Maintenance: To AS/NZS 3666.2;
- Provide service tags recording inspections and tests.

Leaks: Inspect cold and heated water systems at least annually for the following:

- Leaks, including leaks from cisterns;
- Other defects;
- Safe condition;
- Conformance to the PCA and Local Water Authority requirements.

Leaks and Defects: Report if found and rectify.

Strainers: Inspect and clean at least annually.

17.6.5 Tapware

Requirement: Inspect for leaks and damage. If leaks are found, service O-rings, replace washers and reseat to rectify.

17.6.6 Hydraulic Pumps

Pumps and Pump Seals: Check and rectify if defective.

Safety and Other Controls: Check for correct operation and adjust if necessary.

Sewage Pumps and Pits: Perform the following at least six monthly:

- Inspect including seals on lids;
- Clean and test level controls.

17.6.7 Backflow Prevention

General: Maintain to AS 2845.3 and AS/NZS 3500.1.

Service Tags: Record inspections and tests.

17.6.8 Thermostatic Mixing Valves

Field Testing and Maintenance: To AS 4032.3.

Service Tags: Record inspections and tests.

17.6.9 Tempering Valves

Field Testing and Maintenance: To AS 4032.3.

Service Tags: Record inspections and tests.

17.6.10 Boiling, Chilled and Filtered Water Dispensers

Service: Maintain to manufacturer's recommendations. Provide all consumables including, but not limited to, replacement filter cartridges.

Service Tags: Record inspections and tests.

17.6.11 Water Filter Cartridges and Media

Requirement: Replace at the manufacturer's recommended frequency or sooner if flow is reduced or pressure drop is excessive.

17.6.12 Fuel Gas Service

Requirement: Maintain fuel gas services so that they are:

- Free from leaks and other defects;
- Efficient and safe;
- In conformance with AS/NZS 5601.1 and Local Gas Authority requirements.

Maintenance: Perform the following annually:

- Inspect all gas reticulation including fixings, isolating valves, regulators and safety enclosures;
- Pressure test the whole installation for leaks;
- Provide service tags recording inspections and tests.

17.6.13 Gas Appliances

Service: Conform to AS 3814. Inspect each appliance for correct operation including flame fail safe valve, thermocouple, thermostat and burners.

17.6.14 Sanitary Plumbing and Drainage

Requirement: Maintain as follows:

- At least annually: Inspect for leaks, repair and report;
- At other times: Attend and clear blockages within 24 hours of notification. Submit a report on the cause of the blockage.

System Performance: Conform to the PCA and Local Water Authority requirements.

17.6.15 Trade Waste Drainage

Requirement: Annually inspect and clean odour vent filters.

17.6.16 Stormwater Drainage

Requirement: Regularly clean and inspection as follows:

- Annually at the end of autumn: Inspect guttering and other rainwater goods. Remove leaves and other potential blockages. Clean leaf screens;
- At other times: Attend and clear blockages within 24 hours of notification.

System Performance: Conform to the PCA and Local Plumbing Authority requirements.

17.6.17 Rainwater Storage Systems

Requirement: Provide annual maintenance to SAA HB 230 Table 10.1 at the following times:

- Maintenance Period Shorter Than 12 Months: Within a month of the end of the defects liability period;
- Maintenance Period 12 Months or Longer: Annually.

Service Tags: Record inspections and tests.

17.6.18 Hydrant and Hose Reel Services

Hydrants: To AS 1851.

Hose Reels: To AS 1851.

Pumpset Systems: To AS 1851.

17.6.19 Water Conservation

Requirement: Conform to SAA HB 233.

17.6.20 Automatic Controls

Requirement: Perform the following:

- Check operation and safety controls for variable speed drives. Check and record output frequency. Adjust if incorrect. Rectify defects;
- Record readings of thermometers, gauges, meters, current draw of motors and heaters, sample readings, control set points and controlled space conditions;
- Check sensor calibration. Recalibrate if incorrect;
- Check electrical and control systems, including safety limits for temperature, pressure and humidity. Adjust if incorrect. Rectify defects;
- Provide service tags recording inspections and tests.

17.6.21 Electrical Systems

Requirement: Perform the following:

- Check for hot joints, burnt insulation, burn contacts and repair;

- Check electrical connections for tightness. Tighten loose connections;
- Check operation of all electrical components. Rectify defects;
- Check indicating lights and replace defective lamps;
- Check and record motor currents;
- Check overload settings. Adjust if necessary;
- Check and report any changes to controls and wiring;
- Provide service tags recording inspections and tests.

Standards:

- Electrical Equipment Generally: To AS/NZS 3760;
- Switchboards: To AS 2467;

Repair and Overhaul of Rotating Electrical Equipment: To AS 4307.1.

17.7 End of Maintenance Period Service

Requirement: Within a month of the end of the maintenance period, undertake all work scheduled to be carried out on an annual basis.

17.8 Completion

17.8.1 Maintenance Records

Service Records: Record maintenance undertaken in the schedules in the operation and maintenance manuals.

Maintenance Reports: Prepare maintenance reports as documented.

17.8.2 Restitution after Maintenance Tasks

Requirement: Restore removed, damaged, contaminated or soiled services and building elements when the maintenance task is complete.

Standard: Equal to the condition of the original installation.

APPENDIX A – SAMPLE ROOM DATA SHEETS

Room Name	Description	Tamper Control	Notes
Archive Room	Area for records storage.	None	
Armoury	Fire arms storage & cleaning.	None	
Armoury	Riot control equipment.	None	
Baby Change	A room for parents to wash and change their babies.	None	Hot water, cold water to baby bath via TMV Floor waste V.C baby bath, taps & faucet set V.C hand basin, taps & faucet basin set
Bathroom	One bathroom in each accommodation pod.	Standard	Hot & cold water supply to basins, bath and showers. Cold water to toilets. Floor waste x 4 Vitreous china toilets, basins, bath and showers. A concealed cistern is to be used and all pipe work needs to be enclosed – for toilets and hand basins. Anti hanging and vandal resistant taps and shower roses. Provide a bath to female bathrooms only.
Battery Room	Space to provide battery storage for uninterrupted power supply to facility.	None	
Bedroom - Dual - Min. Sec.	A bedroom with two inmates.	Standard	Cold water to toilet & basin Tempered water to showers Approved floor waste in shower area Vc pan with seat and lid, vc basin. 400x400 ss mirror.
Bedroom - Single Min. Sec.	A bedroom for one inmate.	Standard	Cold water to toilet & basin Tempered water to showers Approved floor waste in shower area Vc pan with seat and lid, vc basin. 400x400 ss mirror.
Booking - Legal Visits	Used as a non-contact interview room between inmates and legal counsel.	Standard	
Breast Feeding	A room for parents to breast, or otherwise prepare and feed their babies.	None	Hot water, cold water to sink via TMV. Floor waste Stainless steel sink and tap set

Room Name	Description	Tamper Control	Notes
Business Unit - Industries	Supports the provision of industries for inmates.	Standard	Cold water to WC. Cold and tempered water to wash trough Floor wastes in WC area. Four capped off wastes to one workshop. S.S toilet suite x 2, stainless steel urinal, and stainless steel wash trough. Detention standard taps with a bubbler unit to trough. Inmate services toilets, recessed into the wall.
Cell - Access	A cell capable to house disabled inmates to AS1428.	High	Cold water to toilet & basin. Tempered water to shower via TMV. Secure approved floor wastes in shower and toilet area. S/S toilet unit, with an 'open front' seat and no lid. S/S basin. Adjustable shower head on flexible cable. 3mm thick ss touch button water operation panels with pre- timed settings. Disabled shower seat. Timed shower – 6 minute shower and 10 minute intervals between
Cell - Detox/Form 7	A cell for one or two inmates requireing close supervision.	High	Cold water to combo unit. Tempered water to shower Secure approved floor waste S.S combo unit (WC basin), with no seat. Anti hanging shower rose. 3mm thick ss touch button water operation with pre-timed settings. Timed shower – 6 minute shower and 10 minute intervals between.
Cell - Dry	A cell for one inmate without hydraulic fittings.	High	Floor waste or grated drain to be provided outside of cell
Cell - Dual - Corner	A cell for two inmates.	High	Cold water to toilet & basin. Tempered water to shower. Secure approved floor waste in shower area S.S combo unit, with an 'open front' seat and no lid. Anti hanging shower rose. 3mm thick ss touch button water operation with pre- timed settings. Timed shower – 6 minute shower and 10 minute intervals between
Cell - Dual	A cell for two inmates.	High	Cold water to toilet & basin. Tempered water to shower. Secure approved floor waste in shower area S.S combo unit, with an 'open front' seat and no lid. Anti hanging shower rose. 3mm thick ss touch button water operation with pre- timed settings. Timed shower – 6 minute shower and 10 minute intervals between
Cell - Holding - Access	A secure room for a disabled inmate.	High	Cold water to ss pan and ss basin Secure approved floor waste Disabled S/S toilet, with seat. S/S basin. 3mm thick s/s touch button water operation with pre- timed settings.
Cell - Holding - Glazed Fronted	A secure room for one or more inmates at reception or court cells.	High	Cold water to Combo unit Secure approved floor waste or secure grate outside doorway. S.S combo unit, with no seat. 3mm thick ss touch button water operation with pre- timed settings.
Cell - Holding - Transit	A secure room for one or more inmates. Shower facility included.	High	Cold water to Combo unit Secure approved floor waste S.S combo unit, with no seat. 3mm thick ss touch button water operation with pre- timed settings.

Room Name	Description	Tamper Control	Notes
Cell - Holding - With Shower	A secure room for one or more inmates. Shower facility included.	High	Cold water to Combo unit. Tempered water to shower. Secure approved floor waste S.S combo unit, with no seat. 3mm thick ss touch button water operation with pre- timed settings. Anti hanging shower rose. Shower operation controlled externally by officer.
Cell - Holding	A secure room for one or more inmates.	High	Cold water to Combo unit Secure approved floor waste S.S combo unit, with no seat. 3mm thick ss touch button water operation with pre- timed settings.
Cell - Management	A cell for one or two inmates requireing close supervision.	High	Cold water to combo unit. Tempered water to shower. Secure approved floor waste S.S combo unit, with no seat. Anti hanging shower rose. 3mm thick ss touch button water operation with pre- timed settings.
Cell - Protection - Dual	A cell for two inmates.	High	Cold water to toilet & basin. Tempered water to shower. Secure approved floor waste in shower area S.S combo unit, with an 'open front' seat and no lid. Anti hanging shower rose. 3mm thick ss touch button water operation with pre- timed settings. Timed shower – 6 minute shower and 10 minute intervals between
Cell - Protection - Single	A cell for one inmate.	High	Cold water to toilet & basin. Tempered water to shower. Secure approved floor waste in shower area S.S combo unit, with an 'open front' seat and no lid. Anti hanging shower rose. 3mm thick ss touch button water operation with pre- timed settings. Timed shower – 6 minute shower and 10 minute intervals between
Cell - Safe	A cell for two inmates requiring close supervision.	High	Cold water to combo unit Secure approved floor waste S.S combo unit, with no seat. 3mm thick ss touch button water operation with pre- timed settings.
Cell - Segregation	A cell for one inmate.	High	Cold water to toilet & basin. Tempered water to shower. Secure approved floor waste in shower area S.S combo unit – no seat. Anti hanging shower rose. 3mm thick ss touch button water operation with pre- timed settings. Timed shower – 6 minute shower and 10 minute intervals between
Cell - Single	A cell for one inmate.	High	Cold water to toilet & basin. Tempered water to shower. Secure approved floor waste in shower area S.S combo unit, with an 'open front' seat and no lid. Anti hanging shower rose. 3mm thick ss touch button water operation with pre- timed settings. Timed shower – 6 minute shower and 10 minute intervals between
Change/Search Cubicle	Alcove for inmates to change and for conducting inmate search.	Standard	

Room Name	Description	Tamper Control	Notes
Circulation - Inmate Accom.	External corridor for inmates entering and departing the Accommodation block.	Standard	
Circulation - Internal Corridor	Secure internal corridor for inmate movement.	Standard	
Circulation - Movement Control	Secure corridor to unit that serves support services.	Standard	
Circulation - Visits Corridor	Inmate corridor to non-contact visits.	Standard	
Circulation - Visitors Corridor	Visitor corridor to non-contact visits.	Standard	
Clean Linen Store	Storage area for clean laundry items.	Standard	
Clean Utility	Clean utility.	Standard	Hot and cold water to basin and sink Waste from basin and sink
Cleaner	Cleaners room.	Standard	Hot & Cold water to cleaner sink. Cold connection for cleaning product dispenser V.C. Cleaners sink with floor waste grate. Detention standard tap and faucet wall mounted sink set
Communications Cupboard	Provides a secure and temperature controlled space for the housing of IC&T and security equipment	None	
Conference Room	A room for meetings of up to 18 people.	None	
Control Room	Centre for monitoring, control & surveillance of complex	None	Hot & cold supply to sink. SS sink & boiling water unit
Cool Room - Bulk Food	Refrigerated storage of meat and smallgoods.	Standard	External tundish to accept evaporator condensate Internal floor to fall to external floor waste
Cool Room - Dispatch	Refrigerated storage of meat and smallgoods.	Standard	External tundish to accept evaporator condensate Internal floor to fall to external floor waste
Cool Room - Fruit & Veg	Refrigerated storage of meat and smallgoods.	Standard	External tundish to accept evaporator condensate Internal floor to fall to external floor waste
Cool Room - Meat Goods	Refrigerated storage of meat and smallgoods.	Standard	External tundish to accept evaporator condensate Internal floor to fall to external floor waste

Room Name	Description	Tamper Control	Notes
Cool Room - Milk & Dairy	Refrigerated storage of meat and smallgoods.	Standard	External tundish to accept evaporator condensate Internal floor to fall to external floor waste
Cool Room - Preparation	Refrigerated storage of meat and smallgoods.	Standard	External tundish to accept evaporator condensate Internal floor to fall to external floor waste
Courtyard	Courtyard	None	
Crate/Trolley Wash & Store	Crate & trolley wash/empty bread and milk crate storage.	Standard	Hot & Cold water Wet area floor drained to removable basket trap waste Hot & Cold hose cocks
Dayroom - Protection	A space outside the cell for movement and daytime use by selected inmates.	Standard	Cold & tempered water to sink SS sink. Detention standard taps and faucet
Dayroom - Segregation	A space outside the cell for movement and occasional daytime inmate use.	Standard	Cold & tempered water to sink SS sink. Detention standard taps and faucet
Dayroom - (Max. Security)	Large central, communal living space.	Standard	Cold water to BWU. Cold & hot water to sink. FHR S.S. sink bench unit to tea making area, detention standard taps and faucet to sink. FHR in masonry recess with door
Dental Suite	Dental clinic	Standard	Hot & cold water to sink / hand basin FW at basin Stainless steel sink, vc clinic basin. Wrist taps and goose neck faucet sink sets.
Dining - Living - Kitchen (Min. Security)	A shared open space for the residents of the unit.	Standard	Hot and cold water to ss sink, to under bench BWU Ss sink, tap set with mixing spout
Dirty In	Containment area for soiled laundry items.	Standard	FHR
Dirty Utility (Sterile Room)	A room to clean and sterilise dental equipment.	Standard	Hot & cold water to sink and hand basin. Ss sink with tap set. Vc Clinic basin with elbow taps and goose neck spout with floor waste
Dispatch Clean	Dispatch area for clean laundry items.	Standard	
Dispensary (Awaiting Review)	Drug dispensing room with no windows apart from a service window.	Standard	Hot & cold water to basin, to sink. SF06 VC hand basin, standard taps & faucet sink set. Stainless steel sink – 1 bowl.

Room Name	Description	Tamper Control	Notes
Dog Food Preparation	Dog food and bait preparation room.	None	Hot and cold to sink and washing machine set. Drainage for washing machine Tap sets for sink and washing machine
Dog Kennel	Dog kennel	None	Grated drain outside of kennel
Dog Run	Dog exercise area	None	
Dog Wash	Dog wash bay	None	Cold and tempered water on outside of wall Floor waste Tap sets
Drug Dispensing Room	A room to dispense medication.	Standard	Hot and cold to sink Small ss sink, tap set
Entry - Visitors to Visits Building	Visitors entry/exit corridor	Standard	
Entry - Waiting - Clinic	Waiting area to clinic use	Standard	
Entry Corridor	Entry and corridor to internal rooms.	None	
Entry Lock - Visits Area	Security lock before entry into inmate processing and change areas in visits.	Standard	
Equipment Room	Equipment room for the control room.	None	
Female Inmate Search/Shower	Search and shower room.	Standard	Tempered water to shower Secure floor waste Detention tapware and shower head
Female SHR/WC	Female showers and toilets.	Standard	Tempered water to shower and basin Cold water to toilets Secure floor waste vc pan x 2, shower set x 1, basin x 1
Foyer - Administration	Waiting for official visitors.	None	
Foyer - Business Unit	An entry foyer and muster space for each workshop.	Standard	Cold to wash trough and BWU, hot and cold to ss sink Ss trough with 3 taps and 1 bubbler, sink with standard tap set BWU underbench to CSNSW standard
Foyer - Inmate Visitors	Entry for inmate visitors.	Standard	Fire hose reel within 4m of exit

Room Name	Description	Tamper Control	Notes
Foyer - Staff & Official Visitors	Entry for staff and official visitors.	None	Fire hose reel within 4m of exit
Freezer Room	Storage of frozen goods.	Standard	External tundish to accept evaporator condensate Internal floor to fall to external floor waste
Garbage Area	Bin storage area	Standard	Hot and cold water Removable basket trap floor waste Hot & Cold hose cocks
General Manager's Assistant Office	Admin office to GM	None	
General Manager's Office	Secure office for General Manager, occasional meetings for up to 6 people.	None	Hot and cold to ss sink, basin and shower, cold to toilet and BWU FW in en suite. Ss sink, BWU, toilet, basin and shower / tap sets.
Gym	Staff gym	None	To chilled water unit 'Zip' drinking fountain or equal with draind font
IDS - Aboriginal Resource Room	Meeting room	Standard	Cold and hot to sink, cold to BWU Stainless Steel sink and BWU. Detention standard taps and faucet sink set.
IDS - Arts & Crafts	Learning space for wet and dry activities.	Standard	Cold water to art trough and basin Floor waste 2.2M s/steel trough, hand basin. Tap sets, flexible hose to trough
IDS - Chapel Space	Meeting room for religious purposes.	Standard	
IDS - Classroom - Group Room	General learning space	Standard	
IDS - Computer Classroom	Learning space	Standard	
IDS - Gymnasium	Inmate gym - open and mesh sides.	Standard	Cold water to chilled water fountain Drinking fountain Chilled water unit.
IDS - Library	Inmate library	Standard	
IDS - Multipurpose	Flexible learning space	Standard	

Room Name	Description	Tamper Control	Notes
Inmate Property Store	Storage for inmate property.	None	In adjacent laundry: Hot and cold to tub & washing machine. Floor waste Ss tub Drainage for washing machine
Inmate Valuables Store	Inmate valuables store	None	
Interview - Justice Health	Staff/inmate interview room	Standard	Hot & cold water to basin Clinic basin, elbow taps, goose neck spout
Interview - Police Charge Room	A space within the Booking area where the Police can charge an offender.	Standard	Hot and cold water to sink. Stainless steel sink as part of the finger print bench. Detention standard tap set.
Interview - Visits	Staff/inmate interview room	Standard	
Interview Room	Staff/inmate interview room	Standard	
IT Room - Store	IT storeroom	None	
Key Issue/Return	Security lock with key, radio, and duress storage	None	
Key Room	Secure store and work room	None	Hot and cold water to basin vc handbasin
Kiosk/Kitchenette	Food servery	Standard	Cold water to BWU, Hot & cold water to sink BWU, Stainless steel sinks, taps and swivel faucet set.
Kitchen	Staff amenities kitchen	None	Hot and cold water to sink and BWU S/S sink, BWU/chilled water unit
Laundry - Booking	Laundry for inmate court clothes.	Standard	Hot & cold water to tub & washing machine Floor waste Stainless steel tub, 70 litre. Detention standard taps & faucet sink & tub sets Drainage for washing machine
Laundry/Cleaner Max. Sec. Acc.	Laundry and cleaning facilities.	Standard	Hot & cold water to tub and cleaners sink. Cold to mixing station cabinet. Floor waste S.S laundry tub unit and V.C. cleaners sink with grate, detention standard taps and faucet to tub & sink. Cleaners sink taps offset to one side.

Room Name	Description	Tamper Control	Notes
Laundry/Cleaner Min. Sec. Acc.	Laundry and cleaning facilities.	Standard	Hot & cold water to tub, cleaners sink & washing machine. Floor waste S.S laundry tub unit and V.C. cleaners sink with grate, detention standard taps and faucet to tub & sink. Cleaners sink taps offset to one side. Drainage for washing machine
Laundry	Laundry for 600 inmate facility.	Standard	Hot and cold to washing machines, cold to ozone dispensers, safety shower. Washing machines Floor wastes Location dependant on final layout. Gas Hot water units and Dryers Drainage for washing machine
Lunch Room - Kit & Ldry - Inmates	Lunch room for inmates	Standard	Hot & cold water to sink, cold water to BWU Boiling water unit. Bench cupboard and stainless steel sink, detention standard taps & faucet sink set
Lunch Room - W'Shops - Inmates	Inmate lunch room (can also be used as a training room)	Standard	Outside of room against glazed wall: Hot & Cold water to sink. Cold water to BWU. Outside of room against glazed wall: Stainless steel sink, detention standard taps & faucet sink set. Boiling water unit.
Male SHR/WC	Male showers and toilets	None	Cold water to toilet, urinal. Cold and tempered water to shower and basin Floorwaste vc pan x 1, ss urinal trough x 1, shower set x 1, basin x 1
Multi-Use Room	A large multi-purpose space for inmates	Standard	Hot and cold water to sink Ss sink, boiling/chilled water unit (CSNSW model)
Nap Room	Small bedroom for children	Standard	
Office - Area Manager	Office space	None	
Office - Bail Payment & Deposits	Secure office	None	
Office - Business Unit	Office space for a small single workshop or a large office to oversight two adjoining workshops	None	Cold water to BWU. Hot and cold water to sink BWU, Stainless steel sink, taps and swivel faucet set
Office - Chapel	Office Space	None	
Office - Clerical - Business Unit	Office Space	Standard	

Room Name	Description	Tamper Control	Notes
Office - Clerical - MGR. of Industries	Office Space	Standard	
Office - Consulting (Awaiting Update)	Provides an office for confidential medical consultation between an inmate and staff of medical specialist.	Standard	Cold water to BWU Hot & Cold water to sink Stainless steel sink. BWU. Detention standard taps & Faucet sink set
Office - Dual	Office space	None	
Office - General	Area for general clerical duties	None	
Office - Gym	Secure officer post	None	Hot and cold water to sink, cold to BWU Ss sink in bench, BWU
Office - Kitchen & Laundry	Office space	Standard	Cold water to BWU. Hot and cold water to sink. BWU, Stainless steel sink, taps and swivel faucet set.
Office - Large	Office space	None	
Office - Librarian	Office space	None	
Office - Manager of Industries	Office space	None	
Office - Night Senior & Officer Post	Senior Officer room and movement control post.	None	Hot and cold to sink. Cold to BWU. Ss sink, BWU.
Office - Nurses Station	Nurses' station/office	None	Hot and cold to sink FW at basin. Clinical basin, with elbow taps and goose neck spout.
Office - Records	Data entry space	None	
Office - Store	Large office	Standard	
Office - Warrants	Office space for up to 3 staff	None	

Room Name	Description	Tamper Control	Notes
Office - Welfare	Office space	None	Hot & cold water to handbasin V.C. basin, detention taps & faucet basin set
Office	Office space	None	
Officer Post - Booking	Open office area with counters for the processing of inmates and their property and the issue of prisoners clothing.	Standard	
Officer Post - Gatehouse Staff Entry	Secure officer post	None	Hot and cold water to ss sink. Cold to BWU. Small ss sink and BWU.
Officer Post - Gatehouse Visitor Entry	Open officer post	Standard	
Officer Post - Movement Control	Officers' control post	Standard	Hot and cold to sink, cold to BWU Ss sink, BWU
Officer Post - Open	Officers' open control post	Standard	
Officer Post - Visitor Entry	Officer post	None	Hot and cold to sink. Cold to BWU. Small ss sink in bench unit.
Officer Post	Officers' control post	None	
Officer Post - Retreat	Officers' control post retreat	None	Hot and cold water to sink, cold to BWU Ss sink in bench cupboard
Plant Room - Services	Air conditioning plant room	None	Cold to hose cock, plus other as required floor waste, condensate drainage as required FW at tap. Hydraulic plant as required
Procedure Treatment (Awaiting Update)	Accident and emergency room to do minor procedures.	Standard	Hot and cold water to basins. Stainless steel tub and draining board. Wrist taps and faucet sink set x2 and handbasin.
Processing - Entry Lock (XRAY) Staff and Visitor Areas	Two separate secure spaces where staff/official visitors and inmate's visitors are screened prior to gaining access into the centre.	None	

Room Name	Description	Tamper Control	Notes
Processing Area - Booking	Inmate circulation	Standard	
Reception - Administration	Staff reception area and counter	None	
Reheating / Retherm Area	Re-therm (reheating) area to AS4674	Standard	Internal floor to fall to waste. Connected to external grease trap
Sandwich Plating	Portioning of bulk food into individual meal trays and production of sandwiches.	Standard	Hot & Cold water to hand basin and sinks Floor to fall to floor wastes Sinks, basins, tapware. Isolators to hand basin & sink water supplies
Search - Business Unit	Inmate search area	Standard	
Search Cubible - Booking	Alcove for conducting inmate search.	Standard	
Secure Lock	Dog circulation area	None	
Services - Elect. Distribution Board	Electrical distribution board cupboard	None	
Services - Fire Hose Reel	Fire hose reel cupboard	Dependent on location	Fire Hose Reel and Hydrant valve (if required)
Sick Ward - Clinic (2 Bed)	Sick bay ward for two inmates	Standard	Cold water to combo unit. Tempered water to shower and clinical basin outside of room. Secure floor waste. Ss combo unit (wc and basin), shower, timed controls, clinical basin.
Sick Ward Ensuite	An ensuite bathroom for the 2 bed sick ward.	Standard	Cold water to toilet/basin combo unit. Tempered water to shower Floor waste SS combo unit. Anti hanging shower rose. SS touch sensor activation panel for basin, wc & shower (pre-set timer operation)
Sitting Area	A sitting area for parents.	Standard	Cold water to BWU, Hot & cold water to sink BWU, Stainless steel sink, taps and swivel faucet set
Staff Facilities - Staff Room	Staff lunchroom	None	Cold water to BWU. Hot & Cold water to sink Ss sink with tap set, BWU

Room Name	Description	Tamper Control	Notes
Staff Facilities - Tea Making	Staff tea preparation area	None	Cold water to BWU. Hot & Cold water to sink Ss sink with tap set, BWU
Staff Locker Room	Staff locker room	None	
Staff Room	Staff amenities	None	
Store - Accom. - Max. Sec.	Secure store	Standard	
Store - Chapel	Store room	None	
Store - Chemical	Storage of chemicals for laundry use.	Standard	Cold water tap Centre floor waste Hose tap
Store - Command	Area for storing command post equipment.	None	
Store - Dry Goods	Storage area for goods not requiring to be refrigerated.	Standard	Internal floor to fall to external floor waste
Store - External - Max. Sec.	A store for sports equipment.	?	
Store - General Use	General storeroom	?	
Store - Gym	Store for the gymnasium.	?	
Store - Medical Records	Storeroom for files with workspace.	None	
Store - Pharmacy	Pharmacy store	None	
Store - Pottery	Store room	Standard	
Store - Resource	Store room	Standard	
Store - Tools	A secure tool store to hold tools and equipment for the workforce in each business unit.	Standard	
Toilet - Inmate	Inmate toilet	High	Cold water to WC and hand basin Floor waste Stainless steel handbasin & toilet suite with an 'open front' seat and no lid. A concealed cistern is to be used and all pipe work needs to be encased – for toilet pan and hand basin. Detention standard taps & faucet basin set.

Room Name	Description	Tamper Control	Notes
Toilet - Officer	Officer toilet	None	Cold water to WC, hot and cold to hand basin Floor waste V.C hand basin & toilet suite. Standard tap set.
Toilet - Staff	Staff toilet	None	Cold water to WC, hot and cold to hand basin Floor waste V.C hand basin & toilet suite. Standard tap set.
Toilet - Visitor	Visitor toilet	None	Cold water to WC, hot and cold to hand basin Floor waste V.C hand basin & toilet suite with concealed cistern. Standard tap set.
Toilet - Access	Access toilet for disabled.	None	Cold water to WC, tempered water to basin Floor waste V.C Toilet pan and hand basin, disabled tap. A concealed cistern is to be used and all pipe work needs to be encased – for both the toilet pan, and the hand basin. All items, and their placement, must comply with AS 1428.
Toilet - Inmates - Industries	Inmate toilet area	Standard	Cold water to WC pans and urinal, tempered water to basin and ss trough (outside room). Cold water to bubbler. Floor waste vc toilet pans, handbasins, ss trough, tap sets and bubbler.
Toilet/Lockers - Inmate - Food Services & Laundry	Inmate toilet and change room.	Standard	Cold water to WC, tempered water to basin Floor waste vc toilet pans and handbasins
Toilets - Female Visitors	WC facility for female visitors.	None	Cold water to WCs, hot and cold to hand basins Floor wastes as required V.C hand basins & toilet suites with concealed cisterns. Standard tap sets.
Toilets - Male Visitors	WC facility for male visitors.	None	Cold water to WCs and urinal, hot and cold to hand basins Floor wastes as required V.C hand basins, toilet suites with concealed cisterns, ss urinal set down into floor slab. Standard tap sets.
Toilet/Shower - Access - Inmate	Access toilet and shower for diabled.	High	Cold water to WC, tempered water to basin and shower Floor waste s/s toilet pan and hand basin, disabled taps. A concealed cistern is to be used and all pipe work needs to be encased. Shower set with adjustable rose. All items, and their placement, must comply with AS 1428.
Toilet/Shower - Access - Staff	Access toilet and shower for diabled.	None	Cold water to WC, tempered water to basin and shower Floor waste V.C Toilet pan and hand basin, disabled taps. A concealed cistern is to be used and all pipe work needs to be encased. Shower set with adjustable rose. All items, and their placement, must comply with AS 1428.
Training/Command	A room for training, lectures and meetings of up to 9 people.	None	

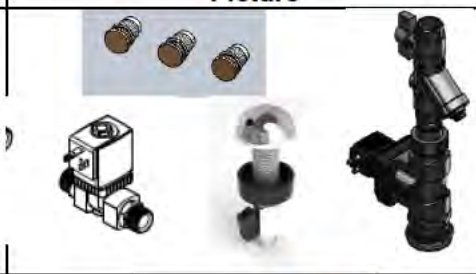
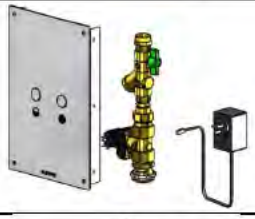
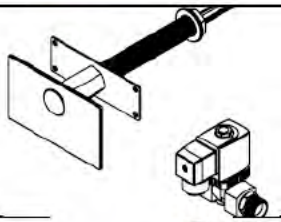
Room Name	Description	Tamper Control	Notes
Urinalysis	Sample gathering and testing room.	Standard	Cold to toilet, hot and cold to basin and sink Secure floor waste near toilet and basin. Disabled vc access wc and basin, detention tapware to basin, ss sink with tap set with goose neck spout.
Utility Room	Store room for resources.	None	
Vehicle Lock	Area for searching of vehicles entering the centre.	None	Cold water hose cock Floor wastes and grated drains as indicated on drawings
Vehicle Wash Bay	Vehicle wash area	None	Hot and cold water From wastes or Grates as necessary Tap set
Video Conferencing, Court Studio	Soundproof interview room with video technology.	Standard	
Video Conferencing, Professional Studio	Small soundproof phone booth	Standard	
Video Equipment	Access corridor for equipment access	None	
Video Reception	Small officer post to supervise the video link process.	None	
Visiting - Children's Play Area	A play area for children.	Standard	
Visiting - Contact Visiting Area	Indoor area where inmates and their visitors can mix.	Standard	Cold water to BWU and drinking fountain Hot and cold water to sink Ss sink, tap set, chilled water drinking unit.
Visiting - Dress	Inmate charge area	High	Hot and cold water to hand basin Ss hand basin with detention tapware
Visiting - Monitor Room	A secure room	None	

Room Name	Description	Tamper Control	Notes
Visiting - Non Contact	Used as non contact between inmates and visitors.	Standard	
Visiting - Secure Visit	Secure visiting room.	High	
Visiting - Undress	Inmate change area.	Standard	
Visitor Exit Lock	Security lock for visitor exit	None	
Visitor Waiting - Gatehouse	Waiting area for visitors after processing	None	
Waiting Area - Health	A semi-open holding space in which to secure inmates.	Standard	
XRAY Operator - Health Care (Awaiting Update)	Room adjacent to X-ray procedure room (with direct visibility to patient(inmate) within the adjacent X-ray procedure equipment) for remote control of X-ray equipment and for processing of CR plates, image QA functions, review and other clerical duties.	None	NO sprinklers, only smoke and fire detectors
Yard - Cell - Seg. and Prot.	A secure covered yard.	High	
Yard - Exercise - Seg. and Prot.	A secure covered exercise yard.	High	Cold water to combo unit Floor waste Stainless steel toilet/basin combo unit
Yard - Housing General	A secure open exercise yard.	High	Cold water to combo unit Secure drainage grate/s as required. Stainless steel toilet/basin combo unit

APPENDIX B – EXAMPLE FIXTURE SCHEDULE

In addition to the general information below, the Contractor shall also identify the quantity and location of each fixture in their schedule when issuing to the Client for approval.

Item	Description	Picture
combo unit	Britex Centurion Security Combination Unit with Access Panels to one side and Integral Toilet Roll Holder. Heavy Duty construction with large safety radius and re-enforcement bars to perimeter of pan and basin. Penetration holes provided to accommodate security tapware and flush button to rear platform of basin. Config of R/H, L/H & nominated degree offset toilet pans, P Trap Supplied with DET617 basin outlet. SCU	
combo unit	Britex Centurion Security Combination Unit with Access Panels to one side and Integral Toilet Roll Holder. Heavy Duty construction with large safety radius and re-enforcement bars to perimeter of pan and basin. Penetration holes provided to accommodate security tapware and flush button to rear platform of basin. Config of R/H, L/H, S Trap Supplied with DET617 basin outlet. SCU-C-90-L-S	
Inmate Ambulant WC	Britex Centurion Security Pan with Access Panels to both sides. S/P Trap, 14mm safety radius front edge, fully shrouded to rear wall complete with corrections approved fasteners. PC-AM SGR016AMB – for ambulant WC	
Inmate Accessible Duct mounted / Recessed WC	Britex Centurion Security Pan with Access Panels to both sides. S/P Trap, 14mm safety radius front edge, fully shrouded to rear wall complete with corrections approved fasteners. PCD Grabrail Arch detail.	
Staff/ low security WC	Caroma wall faced floor pan 4.5/3 ltr, with soft close seat, S trap (50-100mm),	
Low wall faced Ambulant/Accessible WC	Enware increased height. Caroma wall faced floor pan 4.5/3 ltr, with soft close seat, S trap (50-100mm), SGR016AMB – for ambulant WC	

Item	Description	Picture
combo flush valve assembly with solenoid valve	Enware Dual flush WC + Warm/ Cold basin, piezo activated integral of S/S basin slash back. 792546 – Blue 792476 – WC – half/ full flush solenoid valves (2) WMS8300S – WC flush valve assembly DET617 detention hob mounted basin outlet	
Dual flush	Enware dual flush WC with solenoid, Y strainer, isolation, air break assembly. Piezo integral of combi unit. EMF410M-3	
Accessible dual flush	Enware dual flush WC, wall mounted, Half/full flush, complete with isolation, strainers, air break and unions. Min 1" supply required. 370 x 250mm. EMF411M-3 Wall depth min 90mm	
Shower minimum Security	Enware Detention anti ligature shower set DET354 with DET660 8 lpm shower rose with metal face plate.	
Holding cell Shower	Enware detention anti ligature Shower rose, metallic face plate, extended tail 8 lpm.	
Shower Holding cell duct mounted	Enware touch activated shower control module, pre mixed warm (via AQUABLEND TMV) duct mounted. 125 x 75mm. WMS9010 Smartflow WMS compatible	
Basin Bubble	Enware timed flow basin/ bubble out let 15 second run time, with DET617 outlet Supplied by S/S combi manufacturer. DET688	

TENDER FORM

Tender Schedule

Tender form for the Hydraulic Services for:

Correctional Facilities Performance Specification

(INSERT CORRECTIONAL FACILITY NAME HERE)

We, the undersigned, hereby tender for the supply, delivery, installation, commissioning and testing of the Hydraulic Services for Correctional Facilities Performance Specification in accordance with Northrop Consulting Engineers' specification no. NL180226-HY01 revision A, dated 04.04.2018, and accompanying drawings.

We unconditionally guarantee the performance of the installation and completion of the works in accordance with this specification, accompanying drawings and statutory regulations.

Itemised Lump Sum Tender Price: .....
(Dollars, in words)

$ ..... (including GST)

Tenderer Name: .....

Tenderer Address: .....

.....

Signed: ..... Date: .....

This tender shall be valid for sixty (60) days following this date.

Hydraulic Services Items Schedule

The amounts included in the Lump Sum Tender Price, including overhead costs and profit margins, are as follows:

1.	Sanitary Fixtures and Tapware	$
2.	Utility Authority Service Connections and Applications	$
3.	Stormwater Drainage	$
4.	Sanitary Plumbing and Drainage	$
5.	Trade Waste Drainage	$
6.	Cold Water Service	$
7.	Hot / Warm Water Service	$
8.	Rainwater Re-use Water Service	$
9.	Landscape Irrigation	$
10.	Fuel Gas Service	$
11.	Fire Hydrant Service	$
12.	Fire Hose Reel Service	$
13.	Fire Extinguishers and Fire Blankets	$
14.	Mechanical HVAC Drainage and Water Services	$
15.	Workshop Drawings	$
16.	Testing and Commissioning	$
17.	Certification	$
18.	As Installed Drawings and Operations & Maintenance Manuals	$
19.	Twelve (12) Months Service, Testing, and Maintenance	$
20.	Other works (detailed below)	$
	Sub Total	$
	GST	$
	Total Fixed Lump Sum	$

Tenderer Name: .....

Signed: ..... Date: .....

RETURN BRIEF

CESSNOCK CORRECTIONAL CENTRE

240 BED MINIMUM SECURITY EXPANSION

MECHANICAL SERVICES

JHA

CONSULTING ENGINEERS

DOCUMENT CONTROL SHEET

Project Number	180147
Project Name	Cessnock Correctional Centre, 240 bed Minimum Security Expansion
Description	Mechanical Services Return Brief
Key Contact	Helen Li

Prepared By

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Authorised	Hadi Jalgha

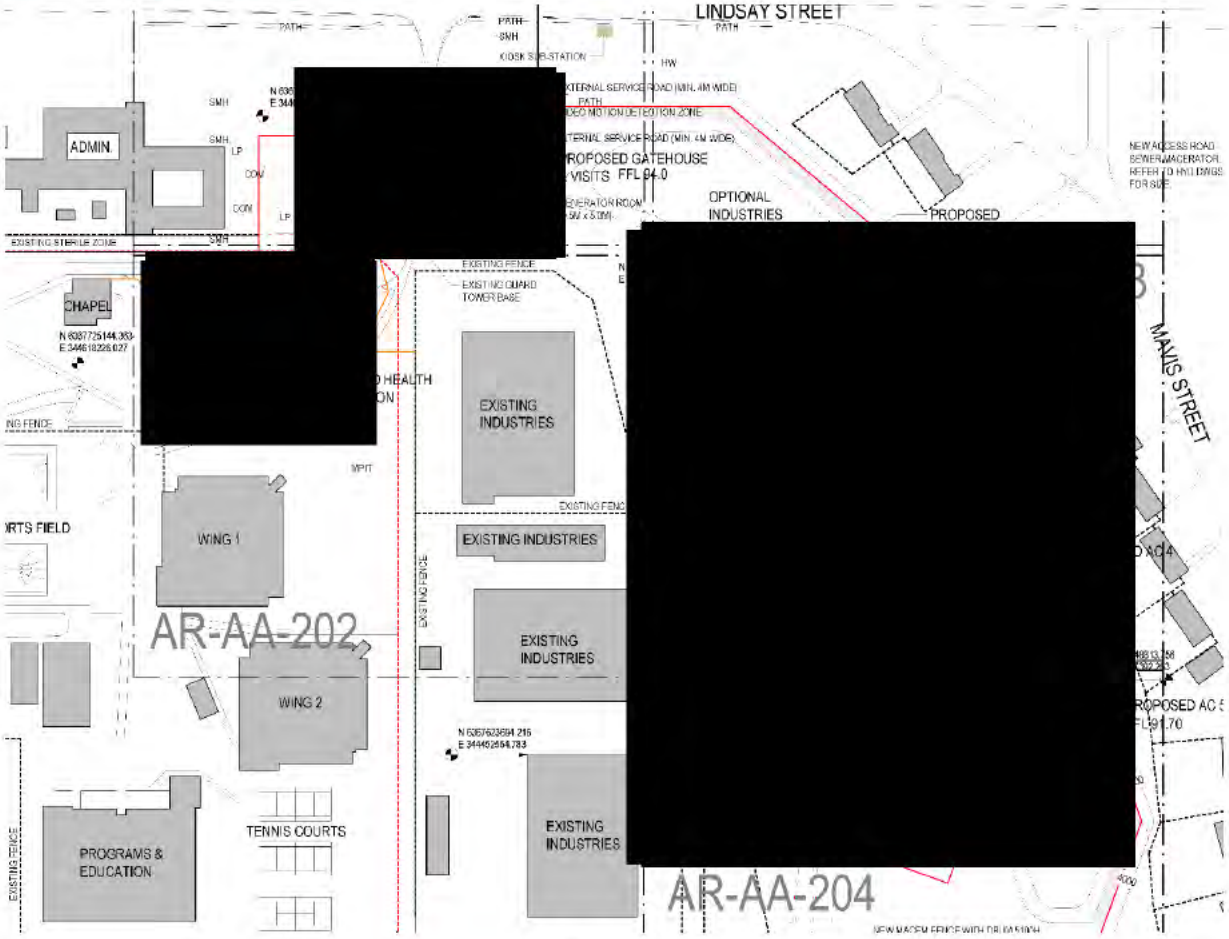
Revision History

Issued To	Revision and Date	
Lend Lease – Gary Lyle	REV	1
	DATE	25/05/2018
	REV	
	DATE	
	REV	
	DATE	

CONTENTS

1 PROJECT DESCRIPTION

1.1 PROJECT SCOPE



Site plan

It is proposed that a 240 bed minimum security expansion be constructed on a site directly bounding the existing industries zone, which currently serves as part of the existing Cessnock Correctional Centre. These new expansion works will incorporate a new gatehouse, entry and linking zone and common facilities to serve and form a larger minimum security centre of approximately 760 beds.

The works proposed are identified on the above site plan and are further described as follows:

- A new purpose-designed Gatehouse (with new MCR and Security Server) constructed outside the perimeter of the currently operating prison which incorporates a new minimum security visits centre capable of serving the whole 760 bed minimum security centre;
- A new Inmate Reception & Health (Clinic) building to be constructed within the existing site in place of the existing visits building serving the whole 760 bed minimum security centre;
- A new + upgraded secure perimeter configured to suit the proposed new 280 bed minimum security expansion, the new Gatehouse location, new Reception / Clinic building location and the integration with the existing remand centre and industries precinct to form a single centre;
- Construction of 240 additional beds, consisting of five (5) minimum security residential accommodation units each consisting of 48 beds with future capacity for construction of a 6th unit;
- A New Programs building with movement control Officer Post to service the bed expansion zone;
- New recreational spaces, central field, fitness stations, landscape elements and courtesy fencing;

- New internal service road(s) configured to provide emergency and maintenance vehicle access for the combined centre site;
- New and upgraded internal pedestrian links to provide access and inmate movement control across the new centre configuration;
- A new visitors car park providing access to the new gatehouse;
- Demolition of the existing minimum security Visits building and surrounding external spaces

The CSNSW Functional Design Brief requested additional architectural master planning consideration be given to;

- Future expansion provision for 1 additional 48 bed accommodation building in the new minimum precinct;
- Industry Unit(s) future expansion

2 INTRODUCTION/ ROLES & RESPONSIBILITIES

JHA have been engaged by Lend Lease to progress the concept design to a schematic design level to assist design resolution during the Early Contractor Involvement (ECI) phase of the project. JHA's specific role over the duration of the project can be summarised as follows:

ECI Phase: JHA and the services Contractors will jointly undertake the schematic design of electrical services to a level suitable for the Contractors to reasonably price on a design & construct basis, plus allow the Principal to understand the scope of services offered. JHA will further serve as an advisor and representative to the overall Lend Lease team on all technical items.

Delivery Phase (Post ECI): JHA's specific role during the delivery phase is to provide technical advice to the Contractors (and the general Lend Lease team) on all electrical services throughout the proposed new works. JHA's further role is to review all electrical design, documentation and installation to ensure that they are fully compliant with Lend Lease's contractual obligations and that they are consistent with a Correctional Centre of this nature and scale.

The Contractors have been engaged by Lend Lease and is responsible for the design, documentation, certification, installation, commissioning and warranty of the electrical services throughout the proposed new works.

JHA and the Contractors will be working collaboratively, along with the broader Lend Lease team, to ensure that a fully compliant Correctional Centre is delivered.

3 PURPOSE OF DOCUMENT

This return brief is a document which captures the design decisions that have been made during the ECI phase of the project. This return document should be read in conjunction with the developed JHA drawings and performance specifications.

This brief does not intend to repeat in detail the contents of the contract documents, rather, the brief looks to offer the following:

- A summary of decisions and departures reached during the ECI phase as the design evolves into schematic design
- Give a summarised overview of the contact requirements
- Clarify/ expand on briefing requirements as developed with the CNSW
- Clearly identify departures to the contract documents (additions and deletions) and the rationale as to why
- Clearly identify issues which require further resolution with the CNSW

It is important to note that the purpose of this report is to 'de-risk' the electrical scope and provide certainty for all parties as the project progresses. To this end, the JHA Return Brief will supersede the original contract documents. While care has been taken to be clear and accurate, should the unlikely event occur where there is conflict between the two documents the JHA Return Brief will take contractual precedence.

It should be further noted that the schematic design drawings which supplement this report are also not exhaustive. The purpose of the drawings is to provide certainty as to the extent and configuration of the electrical services. Due to the Architectural drawings being developed concurrently with the electrical drawings, detailed layouts could not be prepared. Similarly, due to time constraints and continual development it was not intended to reproduce information which was already clear within room data sheets. Consequently, the design development drawings produced offer supplementary information over and above room data sheets only.

4 MECHANICAL SERVICES

4.1 DESIGN STANDARDS

The mechanical services design will comply with the following standards:

Australian Standards	The Use of Ventilation and Air Conditioning in Buildings – Mechanical Ventilation in buildings.	AS/NZS 1668.2:2012
	The Use of Ventilation and Air Conditioning in Buildings – Fire and smoke control in buildings.	AS/NZS 1668.1:2015
	Air-handling and water systems of Buildings.	AS/NZS 3666
	Fire Smoke and Air Dampers - Specification	AS/NZS 1682.1:2015
	Fire Smoke and Air Dampers – Installation	AS/NZS 1862.2:2015
	Fire Detection Warning Control and Intercom Systems – System Design Installation and Commissioning	AS/NZS 1670.1:2015
	Ductwork for Air Handling Systems in Buildings	AS/NZS 4254
	Air Filters for use in Air Conditioning and General Ventilation	AS/NZS 1324
	Refrigerating Systems and Heat Pumps – Safety and Environmental Requirements	AS NZS 5149.1-2016
	Other relevant and referenced Australian Standards	
Authorities	National Construction Code (NCC)	2017
	BCA Report	TBA
	Acoustic Report	TBA
	DA Condition	TBA
	Fire Engineering Report	TBA
	Northrop Mechanical Services Specification NSW Correctional Facilities Performance Specification Rev A (with track changes)	Dated 04.04.1028 Rev A
	Facility Assets Correctional Standard (Health Care) -	Revision Mar 2018

4.2 GENERAL/ SCOPE OF WORKS

The scope of the mechanical services for the proposed new minimum security expansion is broadly summarised as follows:

- Detailed design, documentation and certification
- Air conditioning system
- Outside air system
- Toilet exhaust system
- Laundry exhaust system
- General ventilation system to store rooms and plant rooms
- Smoke exhaust system
- BMS system

4.3 AIR CONDITIONING SYSTEM

4.3.1 AIR CONDITIONING TO ACCOMMDATION BUILDING AND CELLS IN HEALTH BUILDING

Bedrooms and Living/Dining areas in Accommodation Building and Observation Cells/Ward in Health/Reception Building will be provided with tempered air. Supply air to be 16 ^{o}C below the outside ambient temperature in Summer and 16^{o}C above outside ambient temperature in Winter.

The air conditioning system to Accommodation Building comprises of four reverse cycle roof top packaged air conditioning units located in the mezzanine plant room. Heath building will have one packaged unit located in the adjacent plant room. The condensers will be equipped with EC fans ducted to outside through facade louvres at high level. Each unit will be incorporated with economy cycle for free cooling when ambient condition is suitable.

Typical Package A/C Unit

Tempered air will be distributed to bedrooms and Day rooms through risers, horizontal ductwork in bulkhead and grilles. Return air will be extracted back to plant room through door grilles, return grilles and risers.

Supply/return air ducts to each Observation Cell/Ward will run inside the services riser connected to side way supply grille at low level/return grille at high level.

Each packaged unit will be equipped with a wall mounted control panel located inside the plant room providing control for on/off switch, temperature display and temperature reset as minimum.

The return air ductwork in Accommodation Building and supply and exhaust ductwork for Cells/ward will also be used as smoke exhaust as detailed in Section 4.8.

4.3.2 AIR CONDITIONING TO GATE HOUSE

Air conditioning to Indoor Visit and Foyer/Waiting in Gate house will be provided by three reverse cycle packaged air conditioning units located in the plant room. Each unit will be incorporated with economy cycle for free cooling when ambient condition is suitable. The condensers will be equipped with EC fans ducted to outside through façade louvres at high level.

Air will be supplied to the space through horizontal ductwork and grille and return air will be extracted back through return air grille and ductwork.

Each packaged unit will be equipped with a wall mounted control panel located inside the plant room providing control for on/off switch, temperature display and temperature reset as minimum.

Typical Package A/C Unit

Air conditioning to Family Rooms and Indoor Play will be provided by an air cooled split ceiling ducted reverse cycle air conditioning unit. Condenser and wired remote controller will be located inside the plant room.

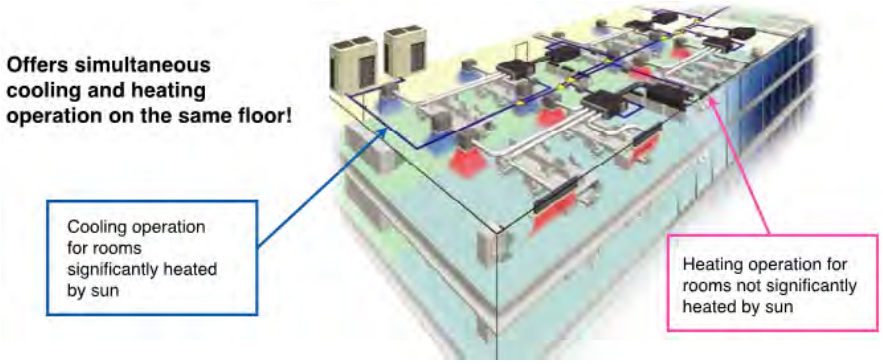
Equipment rooms such as Gun Safe, Armoury and Main Control Room (MCR) will be provided with air cooled split A/C units with condensers located inside the main plant room.

Each indoor unit will be provided with a wired remote controller for temperature control and operate 24/7.

Typical Split Air Conditioning Unit

4.3.1 AIR CONDITIONING TO PROGRAM BUILDING AND HEALTH/RECEPTION BUILDING

The air conditioning system to Program Building and Health/Reception Building (excluding cells) will be VRF (variable refrigerant flow) Heat Recovery System, which can provide simultaneous operation of cooling and heating to each individual space. Each system comprises of indoor fan coil units (ceiling ducted or wall mounted) and outdoor condensers located in the plant room. Condensers will be ducted to outside horizontally through façade louvres.



Typical VRF Heat Recovery System Schematic Diagram

Typical VRF Ceiling Ducted and Wall Mounted Indoor Unit

Each indoor unit will be equipped with a wired remote control panel for individual control. The control panel will provide control for on/off switch, temperature display, temperature reset, mode selector, fan speed selector, time clock as minimum. The VRF system will have a touch screen central controller to allow the facility manager and the maintenance staff easily control and monitoring VRF system.

Typical Indoor Unit Wired Remote Controller Typical Touch Screen Central Controller

4.3.1 AIR CONDITIONING TO COMMS ROOMS

Comms room in each building will be provided with two air cooled split cooling only air conditioning units comprising wall mounted or ducted indoor units and outdoor condensers located in the plant rooms.

Each indoor unit will be equipped with a wired remote controller for temperature control and operate 24/7. Two units will operate on duty/standby arrangement, changeover weekly.

Typical Split Air Conditioning Unit

4.4 OUTSIDE AIR SYSTEM

All occupied spaces will be mechanically ventilated in accordance with AS 1668.2 requirement.

Outside air will be ducted to A/C unit return plenum boxes or supply grilles.

4.5 TOILET EXHAUST SYSTEM

Toilet exhaust systems will be provided to toilets & cleaner rooms to comply with AS 1668.2 requirement.

Each system will comprise a ceiling ducted exhaust fan connected to ductwork and grilles. Exhaust air will be discharged to outside horizontally through façade louvre.

4.6 LAUNDRY EXHAUST SYSTEM

Mechanical exhaust systems will be provided to laundry room to comply with AS 1668.2 and dryer manufacture's requirement.

Each system will comprise a ceiling ducted exhaust fan connected to ductwork and grilles. Exhaust air will be discharged to outside horizontally through façade louvre.

4.7 GENERAL VENTILATION SYSTEM TO STORE ROOMS AND PLANT ROOMS

General ventilation system will be provided to store rooms and plant rooms as per AS 1668.2 requirement or natural ventilation in compliance with NCC requirement.

Each mechanical ventilation system will comprise a ceiling ducted exhaust fan connected to ductwork and grilles. Exhaust air will be discharged to outside horizontally through façade louvre.

4.8 SMOKE EXHAUST SYSTEM

Mechanical smoke exhaust will be provided as a fire and safety system to Accommodation Buildings and Observation Cells & Ward in Health Building. The system will be designed in accordance with NCC 2017, AS 1668.1:2015 and Fire Engineering Report.

4.8.1 ACCOMMODATION BUILDING SMOKE EXHAUST

Accommodation Building will have four fire compartments each including Living/Dining area, bedrooms and bathrooms. Each fire compartment is required to have two smoke exhaust fans and two smoke intakes sized at 2,000 L/s per fan as per Fire Engineering Report. Ground and first floor will share the same smoke exhaust complete with sub ducts and motorised dampers.

The smoke exhaust system comprises four smoke exhaust fans connected to associated return/smoke exhaust risers, sub ducts, MVCDs and return air plenum/grilles above kitchen area.

Make up air will be via external louvre at low level of each Dayroom complete with motorised damper and secure bar grille.

4.8.2 OBSERVATION CELLS AND WARD SMOKE EXHAUST

The four Observation Cells and Ward will be provided with smoke exhaust system comprising a smoke exhaust fan connected to cell exhaust duct and grilles. The fan will operate as general cell exhaust in normal mode and increase the exhaust air in fire mode as per Fire Engineering Report requirement below:

- Each Observation Cell: from 70 L/s in normal mode to 200 L/s in fire mode
- Each Ward: from 140 L/s in normal mode to 400 L/s in fire mode.

Make up air will be provided through a supply air fan connected to cell supply duct and grille at low level in each room.

4.9 BMCS SYSTEM

New Building Management and Control System (BMCS) will be designed to be used by building management and maintenance staff to monitor and control all Building Services systems and energy metering equipment. The existing BMS system will remain as it is. The BMS head end will be located in the existing Admin office where existing BMS head end located.

Refer to Appendix A for indicative point schedule which is considered to be the minimum necessary to perform all the functions as described. It is by no means an exhaustive list. The D&C contractor is to provide all the points as listed and any additional point that is necessary to perform all the functions as required in the pricing and detail design.

4.10 SCHEDULE OF EQUIPMENT

4.10.1 ROOF TOP PACKAGED AIR CONDITIONING UNITS

Item No:		PAC-A-1	PAC-A-2	PAC-H-1
Number Off		5	5	1
Unit Type :		Reverse cycle packaged unit	Reverse cycle packaged unit	Reverse Cycle packaged unit
Area Served:		Accommodation Building Bedrooms	Accommodation Building Dayrooms	Health/Reception Building Cells & Ward
Estimated Total Cooling Capacity:	kW	56	53	9.0
Estimated Sensible Cooling Capacity:	kW	39	45	7.2
Estimated Heating Capacity:	kW	30	27	4.5
Supply Air Quantity:	l/s	2500	2800	420
Outside Air Quantity	l/s	360	360	420
Estimated External Static Pressure	Pa	300	300	200
Notes		Unit to be controlled by supply air temperature, 16ºC below ambient in summer and 16ºC above ambient in Winter	Unit to be controlled by supply air temperature, 16ºC below ambient in summer and 16ºC above ambient in Winter	Unit to be controlled by supply air temperature, 16ºC below ambient in summer and 16ºC above ambient in Winter

Notes:

1. All units provided shall be in compliance with NCC Section J and shall use refrigerants with an ODP of zero.
2. All units shall be Temperzone or approved equal and equipped with EC fan for condenser ducted to outside.
3. All units shall be equipped with filter panels, MVCDs for economy cycle.
4. All units shall be equipped with wired remote control panels located inside the plant room providing control for on/off switch, temperature display and temperature reset as minimum.

ROOF TOP PACKAGED AIR CONDITIONING UNITS - CONTINUED

Item No:		PAC-G-1	PAC-G-2	PAC-G-3
Number Off		1	1	1
Unit Type :		Reverse cycle packaged unit	Reverse cycle packaged unit	Reverse cycle packaged unit
Area Served:		Gate House Indoor indoor Visits	Gate House NC Visits	Gate House Foyer/Waiting
Estimated Total Cooling Capacity:	kW	75	34	48
Estimated Sensible Cooling Capacity:	kW	60	28	39
Estimated Heating Capacity:	kW	40	20	25
Supply Air Quantity:	l/s	4300	2500	2800
Outside Air Quantity	l/s	1300	400	450
Estimated External Static Pressure	Pa	300	300	300
Notes		Unit to be controlled by return air temperature	Unit to be controlled by return air temperature	Unit to be controlled by return air temperature

Notes:

1. All units provided shall be in compliance with NCC Section J and shall use refrigerants with an ODP of zero.
2. All units shall be Temperzone or approved equal and equipped with EC fan for condenser ducted to outside.
3. All units shall be equipped with filter panels, MVCDs for economy cycle.
4. All units shall be equipped with wired remote control panels located inside the plant room providing control for on/off switch, temperature display and temperature reset as minimum.

4.10.2 AIR COOLED SPLIT AIR CONDITIONING UNITS

Item No:		ACU-A-1	ACU-A-2	ACU-P-1	ACU-P-2
VRF System		VRF-H-1	VRF-H-1	1	1
Unit Type :		Cooling only wall mounted	Cooling only wall mounted	Cooling only wall mounted	Cooling only wall mounted
Area Served:		Accommodation Building Comms Room	Accommodation Building Comms Room	Program Building Comms Room	Program Building Comms Room
Estimated Total Cooling Capacity:	kW	6	6	6	6
Estimated Sensible Cooling Capacity:	kW	6	6	6	6
Estimated Heating Capacity:	kW	n/a	n/a	n/a	n/a
Supply Air Quantity:	l/s	300	300	300	300
Outside Air Quantity	l/s	n/a	n/a	n/a	n/a
Estimated External Static Pressure	Pa	n/a	n/a	n/a	n/a
Notes		Two units operate on duty/standby arrangement		Two units operate on duty/standby arrangement	

Notes:

1. All units provided shall be in compliance with NCC Section J and shall use refrigerants with an ODP of zero.
2. All units shall be equipped with wired remote control panels.

AIR COOLED SPLIT AIR CONDITIONING UNITS - CONTINUED

Item No:		ACU-H-1	ACU-H-2	ACU-G-1	ACU-G-2
Number Off		1	1	1	1
Unit Type :		Cooling only wall mounted	Cooling only wall mounted	Cooling only ceiling ducted	Cooling only ceiling ducted
Area Served:		Health/Reception Building Comms Room	Health/Reception Building Comms Room	Gate House L1 Comms Room	Gate House L1 Comms Room
Estimated Total Cooling Capacity:	kW	6	6	20	20
Estimated Sensible Cooling Capacity:	kW	6	6	20	20
Estimated Heating Capacity:	kW	n/a	n/a	n/a	n/a
Supply Air Quantity:	l/s	300	300	1300	1300
Outside Air Quantity	l/s	n/a	n/a	n/a	n/a
Estimated External Static Pressure	Pa	n/a	n/a	n/a	n/a
Notes		Two units operate on duty/standby arrangement		Two units operate on duty/standby arrangement	

Notes:

1. All units provided shall be in compliance with NCC Section J and shall use refrigerants with an ODP of zero.
2. All units shall be equipped with wired remote control panels.

AIR COOLED SPLIT AIR CONDITIONING UNITS - CONTINUED

Item No:		ACU-G-3	ACU-G-4	ACU-G-5	ACU-G-6
Number Off		1	1	1	1
Unit Type :		Reverse cycle ceiling ducted	Reverse cycle ceiling ducted	Reverse cycle wall mounted	Reverse cycle wall mounted
Area Served:		Gate House L1 MCR	Gate House Family Room & Play Room	Gate House Armoury	Gate House Gun Safe
Estimated Total Cooling Capacity:	kW	8.5	13	2.5	2.0
Estimated Sensible Cooling Capacity:	kW	6.8	10	2.0	0.6
Estimated Heating Capacity:	kW	4.0	7	1.2	1.0
Supply Air Quantity:	l/s	400	850	200	150
Outside Air Quantity	l/s	30	210	n/a	n/a
Estimated External Static Pressure	Pa	150	250	n/a	n/a
Notes					

Notes:

1. All units provided shall be in compliance with NCC Section J and shall use refrigerants with an ODP of zero.
2. All units shall be equipped with wired remote control panels.

4.10.3 VRF HEAT RECOVERY SYSTEM – OUTDOOR CONDENSERS

Item No:		CU-P-1	CU-H-1	CH-H-2
Area Served:		Program Building FCU-P-1 to FCU-P-18	Health/Reception FCU-H-1 to FCU-H-5	Health/Reception FCU-H-6 to FCU-H-15
Minimum Cooling Total Capacity:	kW	93	35	90
Minimum Cooling Sensible Capacity:	kW	75	28	72
Minimum Heating Capacity:	kW	47	18	45
Condenser Air On:	DB/WB°C	37	37	37
Refrigerant:		R410A	R410A	R410A

Notes:

1. All units to be Daikin VRV or approved equal.
2. All units shall be in compliance with BCA Section J and shall use refrigerants with an ODP of zero.
3. Each VRF system shall be provided with a central controller located inside the plant room and gateway card for BMS interface.

4.10.4 VRF HEAT RECOVERY SYSTEM –INDOOR FAN COIL UNITS

Item No:		FCU-P-1	FCU-P-2	FCU-P-3	FCU-P-4
VRF Condenser		CU-P-1	CU-P-1	CU-P-1	CU-P-1
Unit Type :		Ceiling ducted	Ceiling ducted	Ceiling ducted	Ceiling ducted
Area Served:		Program Building Interview	Program Building Interview	Program Building Interview	Program Building Interview
Estimated Total Cooling Capacity:	kW	2.5	2.5	2.5	2.5
Estimated Sensible Cooling Capacity:	kW	2.0	2.0	2.0	2.0
Estimated Heating Capacity:	kW	1.0	1.0	1.0	1.0
Supply Air Quantity:	l/s	150	150	150	150
Outside Air Quantity	l/s	40	40	40	40
Estimated External Static Pressure	Pa	100	100	100	100
Notes		1. All units provided shall be in compliance with NCC Section J and shall use refrigerants with an ODP of zero. 2. All indoor units shall be equipped with wired remote control panels. 3. All ceiling ducted unit shall be provided with filter panels.			

Item No:		FCU-P-5	FCU-P-6	FCU-P-7	FCU-P-8
Number Off		CU-P-1	CU-P-1	CU-P-1	CU-P-1
Unit Type :		Ceiling ducted	Ceiling ducted	Ceiling ducted	Ceiling ducted
Area Served:		Program Building Interview	Program Building Workstation	Program Building Breakout	Program Building Senior Psych
Estimated Total Cooling Capacity:	kW	2.5	7.5	4.0	2.0
Estimated Sensible Cooling Capacity:	kW	2.0	6.0	3.2	1.6
Estimated Heating Capacity:	kW	1.0	4.0	2.0	1.0
Supply Air Quantity:	l/s	150	300	250	150
Outside Air Quantity	l/s	40	50	80	20
Estimated External Static Pressure	Pa	100	150	150	100
Notes		1. All units provided shall be in compliance with NCC Section J and shall use refrigerants with an ODP of zero. 2. All indoor units shall be equipped with wired remote control panels. 3. All ceiling ducted unit shall be provided with filter panels.			

VRF HEAT RECOVERY SYSTEM - CONTINUED

Item No:		FCU-P-9	FCU-P-10	FCU-P-11	FCU-P-12
Number Off		CU-P-1	CU-P-1	CU-P-1	CU-P-1
Unit Type :		Ceiling ducted	Ceiling ducted	Ceiling ducted	Ceiling ducted
Area Served:		Program Building Psych Office	Program Building SAPO Office	Program Building Library	Program Building Multipurpose Room
Estimated Total Cooling Capacity:	kW	2.0	2.0	5.0	18.0
Estimated Sensible Cooling Capacity:	kW	1.6	1.6	4.0	15.0
Estimated Heating Capacity:	kW	1.0	1.0	2.5	9.0
Supply Air Quantity:	l/s	150	150	300	900
Outside Air Quantity	l/s	20	20	60	300
Estimated External Static Pressure	Pa	100	100	150	150
Notes		1. All units provided shall be in compliance with NCC Section J and shall use refrigerants with an ODP of zero. 2. All indoor units shall be equipped with wired remote control panels. 3. All ceiling ducted unit shall be provided with filter panels.			

Item No:		FCU-P-13	FCU-P-14	FCU-P-15	FCU-P-16
Number Off		CU-P-1	CU-P-1	CU-P-1	CU-P-1
Unit Type :		Ceiling ducted	Ceiling ducted	Ceiling ducted	Ceiling ducted
Area Served:		Program Building Classroom 1	Program Building Classroom 2	Program Building Computer Room	Program Building AV
Estimated Total Cooling Capacity:	kW	9.0	9.0	9.0	2.0
Estimated Sensible Cooling Capacity:	kW	7.5	7.5	7.5	1.6
Estimated Heating Capacity:	kW	5.0	5.0	5.0	1.0
Supply Air Quantity:	l/s	450	450	450	100
Outside Air Quantity	l/s	130	130	130	20
Estimated External Static Pressure	Pa	150	150	150	100
Notes		1. All units provided shall be in compliance with NCC Section J and shall use refrigerants with an ODP of zero. 2. All indoor units shall be equipped with wired remote control panels. 3. All ceiling ducted unit shall be provided with filter panels.			

VRF HEAT RECOVERY SYSTEM - CONTINUED

Item No:		FCU-P-17	FCU-P-18		
Number Off		CU-P-1	CU-P-1		
Unit Type :		Ceiling ducted	Ceiling ducted		
Area Served:		Program Building Office Post	Program Building Manage Office		
Estimated Total Cooling Capacity:	kW	9.0	2.0		
Estimated Sensible Cooling Capacity:	kW	7.5	1.6		
Estimated Heating Capacity:	kW	5.0	1.0		
Supply Air Quantity:	l/s	450	100		
Outside Air Quantity	l/s	50	20		
Estimated External Static Pressure	Pa	150	100		
Notes		1. All units provided shall be in compliance with NCC Section J and shall use refrigerants with an ODP of zero. 2. All indoor units shall be equipped with wired remote control panels. 3. All ceiling ducted unit shall be provided with filter panels.			

Item No:		FCU-H-1	FCU-H-2	FCU-H-3	FCU-H-4
Number Off		CU-H-1	CU-H-1	CU-H-1	CU-H-1
Unit Type :		Ceiling ducted	Ceiling ducted	Ceiling ducted	Ceiling ducted
Area Served:		Health/Reception Building Interview	Health/Reception Building Interview	Health/Reception Building Interview	Health/Reception Building Legal & AVL
Estimated Total Cooling Capacity:	kW	2.5	2.5	2.5	4.5
Estimated Sensible Cooling Capacity:	kW	2.0	2.0	2.0	3.6
Estimated Heating Capacity:	kW	1.0	1.0	1.0	3.0
Supply Air Quantity:	l/s	150	150	150	300
Outside Air Quantity	l/s	40	40	40	60
Estimated External Static Pressure	Pa	100	100	100	150
Notes		1. All units provided shall be in compliance with NCC Section J and shall use refrigerants with an ODP of zero. 2. All indoor units shall be equipped with wired remote control panels. 3. All ceiling ducted unit shall be provided with filter panels.			

VRF HEAT RECOVERY SYSTEM - CONTINUED

Item No:		FCU-H-5	FCU-H-6	FCU-H-7	FCU-H-8
Number Off		CU-H-1	CU-H-2	CU-H-2	CU-H-2
Unit Type :		Ceiling ducted	Ceiling ducted	Ceiling ducted	Ceiling ducted
Area Served:		Health/Reception Building Office Post/Wait/Hold	Health/Reception Building Office	Health/Reception Building Officex3	Health/Reception Building Staff Breakout/corridor
Estimated Total Cooling Capacity:	kW	23.0	2.5	6.0	9.0
Estimated Sensible Cooling Capacity:	kW	18.5	2.0	5.4	7.2
Estimated Heating Capacity:	kW	12.0	1.2	3.0	4.0
Supply Air Quantity:	l/s	900	150	300	500
Outside Air Quantity	l/s	300	20	60	120
Estimated External Static Pressure	Pa	200	100	150	150
Notes		1. All units provided shall be in compliance with NCC Section J and shall use refrigerants with an ODP of zero. 2. All indoor units shall be equipped with wired remote control panels. 3. All ceiling ducted unit shall be provided with filter panels.			

Item No:		FCU-H-9	FCU-H-10	FCU-H-11	FCU-H-12
Number Off		CU-H-2	CU-H-2	CU-H-2	CU-H-2
Unit Type :		Ceiling ducted	Ceiling ducted	Ceiling ducted	Wall mounted
Area Served:		Health/Reception Building Medication Admin	Health/Reception Building Wait/Corridor/ hold	Health/Reception Building Nurse Station/Office Post/Corridor/ Dayroom/Triage	Health/Reception Building Medical Records
Estimated Total Cooling Capacity:	kW	6.5	21.0	21.0	5.0
Estimated Sensible Cooling Capacity:	kW	5.2	16.8	16.8	4.8
Estimated Heating Capacity:	kW	3.5	10.0	10.0	2.5
Supply Air Quantity:	l/s	300	900	900	300
Outside Air Quantity	l/s	40	300	200	40
Estimated External Static Pressure	Pa	150	200	200	n/a
Notes		1. All units provided shall be in compliance with NCC Section J and shall use refrigerants with an ODP of zero. 2. All indoor units shall be equipped with wired remote control panels. 3. All ceiling ducted unit shall be provided with filter panels.			

VRF HEAT RECOVERY SYSTEM - CONTINUED

Item No:		FCU-H-13	FCU-H-14	FCU-H-15	FCU-H-16
Number Off		CU-H-2	CU-H-2	CU-H-2	CU-H-2
Unit Type :		Ceiling ducted	Ceiling ducted	Ceiling ducted	Ceiling ducted
Area Served:		Health/Reception Building Dental	Health/Reception Building Consultx2	Health/Reception Building Consultx2	Health/Reception Building Consultx2
Estimated Total Cooling Capacity:	kW	6.5	4.0	4.0	4.0
Estimated Sensible Cooling Capacity:	kW	5.2	3.2	3.2	3.2
Estimated Heating Capacity:	kW	3.5	2.0	2.0	2.0
Supply Air Quantity:	l/s	300	250	250	250
Outside Air Quantity	l/s	40	40	40	40
Estimated External Static Pressure	Pa	150	150	150	150
Notes		1. All units provided shall be in compliance with NCC Section J and shall use refrigerants with an ODP of zero. 2. All indoor units shall be equipped with wired remote control panels. 3. All ceiling ducted unit shall be provided with filter panels.			

Item No:		FCU-H-17			
Number Off		CU-H-2			
Unit Type :		Wall mounted			
Area Served:		Health/Reception Building Equipment			
Estimated Total Cooling Capacity:	kW	2.5			
Estimated Sensible Cooling Capacity:	kW	2.0			
Estimated Heating Capacity:	kW	1.5			
Supply Air Quantity:	l/s	150			
Outside Air Quantity	l/s	n/a			
Estimated External Static Pressure	Pa	n/a			
Notes		1. All units provided shall be in compliance with NCC Section J and shall use refrigerants with an ODP of zero. 2. All indoor units shall be equipped with wired remote control panels. 3. All ceiling ducted unit shall be provided with filter panels.			

4.10.5 VENTILATION FANS

Item No:		TEF-A-1	TEF-A-2	EAF-A-1
Area Served:		Accommodation Building Toilets	Accommodation Building Toilets	Accommodation Building Laundry Rooms
Flow Rate:	l/s	400	400	300
Estimated Pressure:	Pa	150	150	150
Fan Type:		Ducted inline	Ducted inline	Ducted inline

Item No:		SEF-A-1	SEF-A-2	SEF-A-3
Area Served:		Accommodation Building Smoke Exhaust	Accommodation Building Smoke Exhaust	Accommodation Building Smoke Exhaust
Flow Rate:	l/s	2000	2000	2000
Estimated Pressure:	Pa	300	300	300
Fan Type:		Ducted Smoke exhaust	Ducted Smoke exhaust	Ducted Smoke exhaust

Item No:		SEF-A-4		
Area Served:		Accommodation Building Smoke Exhaust		
Flow Rate:	l/s	2000		
Estimated Pressure:	Pa	300		
Fan Type:		Ducted Smoke exhaust		

Item No:		TEF-G-1	TEF-G-2	TEF-G-3
Area Served:		Gate House Toilets/search/change/ locker	Gate House Toilets/search/change/ locker	Gate House Foyer Toilets
Flow Rate:	l/s	400	400	400
Estimated Pressure:	Pa	200	150	150
Fan Type:		Ducted inline	Ducted inline	Ducted inline

Item No:		TEF-G-4	TEF-H-1	TEF-H-2
Area Served:		Gate House L1 Toilet	Health/Reception Toilet (Health Section)	Health/Reception Toilet (Reception Section)
Flow Rate:	l/s	200	400	200
Estimated Pressure:	Pa	80	200	150
Fan Type:		Ducted inline	Ducted inline	Ducted inline

Item No:		EAF-H-1	EAF-H-2	EAF-H-3
Area Served:		Health/Reception Laundry	Health/Reception Property Store	Health/Reception Dirty Utility
Flow Rate:	l/s	150	400	110
Estimated Pressure:	Pa	150	150	80
Fan Type:		Ducted inline	Ducted inline	Ducted inline

Item No:		EAF-H-4	SEF-H-1	SAF-H-1
Area Served:		Health/Reception Sterile Store/Equip Store	Health/Reception Cell Smoke Exhaust	Health/Reception Smoke Exhaust Make Air
Flow Rate:	l/s	200	1200	1100
Estimated Pressure:	Pa	100	250	250
Fan Type:		Ducted inline	Ducted inline	Ducted inline

Item No:		OAF-H-1	OAF-H-2	
Area Served:		Health/Reception Sterile Store/Equip Store	Health/Reception Cell Smoke Exhaust	
Flow Rate:	l/s	500	900	
Estimated Pressure:	Pa	200	300	
Fan Type:		Ducted inline	Ducted inline	

Item No:		TEF-P-1	OAF-P-1	OAF-P-2
Area Served:		Program Building Toilet Exhaust	Program Building Interview/office	Health/Reception classrooms
Flow Rate:	l/s	250	400	400
Estimated Pressure:	Pa	150	250	250
Fan Type:		Ducted inline	Ducted inline	Ducted inline

APPENDIX A – BMS POINT SCHEDULE

Input / Output Points Schedule

The following input / output points schedule is provided as an indication of the extent of BMCS points for each piece of equipment

Item	HLI	Point type digital		Point type analogue		Comments
HYDRAULIC SERVICES						
Potable Cold Water Pumps		DI	DO	AI	AO	**Points per building**
Run Indication			X			3 off at cold water pump enclosure
Fault Signal			X			3 off at cold water pump enclosure
Power outage			X			1 off for system
Potable Cold Water Tanks		DI	DO	AI	AO	**Points per building**
High Level Alarm Tank 1			X			1 off per tank within enclosure
High Level Alarm Tank 2			X			
Low Level Alarm Tank 1			X			1 off per tank within enclosure
Low Level Alarm Tank 2			X			
Master Water Meter		DI	DO	AI	AO	**Points per building**
Pulse meter reading			X			1 off at main meter
Private Water Meters		DI	DO	AI	AO	**Points per building**
Pulse meter reading			X			1 off per building
Water Filters		DI	DO	AI	AO	**Points per building**
Filter reading			X			1 off at each filter (2 total)
Filter no flow			X			1 off at each filter (2 total)
Hot Water System		DI	DO	AI	AO	**Points per building**
Hot Water Return Pump 1 Run			X			1 off per building
Hot Water Return Pump 1 Fail			X			1 off per building
Hot Water Return Pump 2 Run			X			1 off per building
Hot Water Return Pump 2 Fail			X			1 off per building

Item	HLI	Point type digital		Point type analogue		Comments
Power Outage			X			
Sewer Macerator - Muffin Monster		**DI**	**DO**	**AI**	**AO**	**Points per System**
Pump Run			X			1 off each pump
Pump Fail			X			1 off each pump
Pump pit high level alarm			X			1 off for system
Power Outage			X			1 off for control panel
Water Management System		**DI**	**DO**	**AI**	**AO**	**Points per System**
HUB Fault Alert			X			4 off per Accommodation building
ELECTRICAL SERVICES						
Generator		**DI**	**DO**	**AI**	**AO**	**Points per building**
2.a. Generator Fuel Low			**X**			Generator unit control panel (1 off)
2.b. Generator Lube Oil System leak			**X**			Generator unit control panel (1 off)
2.c. Generator Batteries			**X**			Generator unit control panel (1 off)
2.d. Generator Automatic Transfer Switches			**X**			Generator unit control panel (1 off)
2.e. Generator High Water Temperature			**X**			Generator unit control panel (1 off)
2.d Additionally allowed Generator signal #1			**X**			Generator unit control panel (2 off)
Exit and Emergency Lighting		**DI**	**DO**	**AI**	**AO**	
3a. External Lighting Control		X				5 off at gatehouse main switchboard and 1 at each building plus provision for future buildings
3b. Internal Lighting Control		X				1 per building plus provision for future buildings
3c. Internal power services Control		X				1 per Accommodation buildings only (provision as per Facility design guide subject to confirmation by CSNSW)
Main Electrical Switchboard		**DI**	**DO**	**AI**	**AO**	
4.a. Phase Failure Alarm			x			Gatehouse building MSB
4.b. Power Surge Diverter			x			Gatehouse building MSB

Item	HLI	Point type digital		Point type analogue		Comments
4.C Mains power failure		x				Gatehouse MSB
Electric meters.		DI	DO	AI	AO	
5a. Smart meters			x			Gatehouse MSB 20 off and 3 off within each building
UPS System		DI	DO	AI	AO	
6a. UPS loss of mains; 6b. UPS on batteries; 6c. UPS on by pass; 6d. UPS fault; 6e. Spare			X			5 inputs for each UPS: one unit for each building and 2 for gatehouse building.
FIRE PROTECTION						
Fire Panel (Fire trip, Fault, Isolate)	X					3 off at Gatehouse Building and one off point at each building including future buildings
MECHANICAL						
Accommodation Block						
Packaged AC Unit 2 off						
ACU Start/Stop			X			
ACU Status		X				mismatch
ACU Fault		X				
ACU Cooling Stage 1 Enable			X			
ACU Cooling Stage 2 Enable			X			
Supply Air Temperature				X		
Return Air Temperature				X		
Outside Air Enthalpy				X		
Filter Differential Sensor		X				
Outside Air MVCD				X		
Return Air MVCD				X		
Smoke Exhaust Fan x 4 off						
Fan Start / Stop			X			
Fan Status		X				mismatch

Item	HLI	Point type digital		Point type analogue		Comments
Fan Failure		X				
VSD					X	
OA MVCD x 2 off					X	
Toilet Exhaust Fan x 2 off						
Fan Start / Stop			X			
Fan Status		X				mismatch
Fan Failure			X			
Laundry Exhaust Fan x 1 off						
Fan Start / Stop			X			
Fan Status		X				mismatch
Fan Failure			X			
Comms AC x 2 off						
AC Start/Stop Status						HLI interface with controller
AC Failure						HLI interface with controller
High Temperature Alarm		X				
Gatehouse						
Packaged AC Unit x 3 off						
ACU Start/Stop			X			
ACU Status		X				mismatch
ACU Fault		X				
ACU Cooling Stage 1 Enable			X			
ACU Cooling Stage 2 Enable			X			
Supply Air Temperature				X		
Return Air Temperature				X		
Outside Air Enthalpy				X		

Item	HLI	Point type digital		Point type analogue		Comments
Filter Differential Sensor		X				
Outside Air MVCD				X		
Return Air MVCD				X		
Main Comms AC x 2 off						
AC Start/Stop Status						HLI interface with controller
AC Failure						HLI interface with controller
Room Temperature						HLI interface with controller
Temperature Reset						HLI interface with controller
High Temperature Alarm		X				
Filter Differential P Sensor		X				
Split AC x 4 off						
AC Start/Stop Status						HLI interface with controller
AC Failure						HLI interface with controller
Toilet Exhaust Fan x 4 off						
Fan Start / Stop			X			
Fan Status		X				mismatch
Fan Failure			X			
Health/Reception						
Packaged AC Unit x 1 off						
ACU Start/Stop			X			
ACU Status		X				mismatch
ACU Fault		X				
ACU Cooling Stage 1 Enable			X			
ACU Cooling Stage 2 Enable			X			
Supply Air Temperature				X		
Return Air Temperature				X		
Outside Air Enthalpy				X		
Filter Differential Sensor		X				
Outside Air MVCD				X		
Return Air MVCD				X		

Item	HLI	Point type digital		Point type analogue		Comments
Smoke Exhaust Fan x 1 and Makeup Air Fan x 1						
Fan Start / Stop			X			
Fan Status		X				mismatch
Fan Failure		X				
VSD					X	
MVCD			X			
VRF AC Controller x 17						
AC On/Off						HLI interface
AC Heating/Cooling Mode						HLI interface
AC Room Temperature						HLI interface
AC Room Temperature Reset						HLI interface
AC Failure Alarm						HLI interface
Toilet Exhaust Fan x 2 off						
Fan Start / Stop			X			
Fan Status		X				mismatch
Fan Failure			X			
Outside Air Fan x 2 off						
Fan Start / Stop			X			
Fan Status		X				mismatch
Fan Failure			X			
Ventilation Fan x 4 off						
Fan Start / Stop			X			
Fan Status		X				mismatch
Fan Failure			X			
Comms AC x 2 off						
AC Start/Stop Status						HLI Interface with controller
AC Failure						HLI Interface with controller
High Temperature Alarm		X				

Item	HLI	Point type digital		Point type analogue		Comments
Split AC x 2 off						
AC Start/Stop Status						HLI Interface with controller
AC Failure						HLI Interface with controller
Medical Gas to Dental and Ward		X				Allow for 10 points
Program						
VRF AC Controller x 16 off						
AC On/Off						HLI interface
AC Heating/Cooling Mode						HLI interface
AC Room Temperature						HLI interface
AC Room Temperature Reset						HLI interface
AC Failure Alarm						HLI interface
Toilet Exhaust Fan x 1 off						
Fan Start / Stop			X			
Fan Status		X				mismatch
Fan Failure			X			
Outside Air Fan x 2 off						
Fan Start / Stop			X			
Fan Status		X				mismatch
Fan Failure			X			
Comms AC x 2 off						
AC Start/Stop Status						HLI Interface with controller
AC Failure						HLI Interface with controller
High Temperature Alarm		X				

APPENDIX B – DEPARTURE SCHEDULE

CESSNOCK CORRECTIONAL CENTRE – DEPARTURES/NON-COMPLIANCE REGISTER

Item No	Northrop Performance Specification Reference	Non-Compliance	Reason for Non-Compliance	Comment
M01	Summer Tempered Air (supply air to be 10deg below the outside ambient temperature	Supply air to be 16 deg C below outside air ambient temperature	Approx..25 day over 36 deg C, Achieve minimum comfort condition of 26 deg max in summers	
M02	Winter temperature air (supply air to be 10 deg C above the outside ambient temperature	Supply air to be 16 deg C above the outside ambient temperature	Approx..102 days below 6 deg C To achieve minimum comfort condition of 18 deg min in winters	
M03	The tempered air supply shall be served by indirect evaporative coolers and indirect ducted gas heaters complete with booster fans all located in plant enclosures. Motorized dampers shall be provided to allow the switching between cooling and heating modes. Alternative systems may be considered depending on their ability to deal with 100% outside air requirements.	The tempered air will be provided by reverse cycle packaged air conditioning units with economy cycle,	Same as above	
M04	As in most cases, cells are fire isolated from adjoining cells and as the system is required to run in 'fire mode' fire dampers are not permitted for use. Sub-ducts and smoke dampers shall be provided on all supply air and exhaust ducts entering the cells. Access to smoke dampers shall be from a lockable cupboard accessed from the corridor.	Fire engineering alternative solution to for cell smoke exhaust without sub duct and smoke damper	Minimize the cost and spatial requirement	
M05	The Observation Cell shall be provided with a smoke exhaust and makeup air system. Makeup air shall be provided via motorised dampers from an adjoining secure outdoor area.	Make up air via supply air fan	Utilize the cell supply air system for make-up air and minimize the cost	

CESSNOCK CORRECTIONAL CENTRE – DEPARTURES/NON-COMPLIANCE REGISTER

Item No	Northrop Performance Specification Reference	Non-Compliance	Reason for Non-Compliance	Comment
M06	Secure grilles as per Northrop RDS	Secure grilles to un supervised secure area only. All other areas will use temper proof stand grilles	Cessnock 240 bed is minimum secure site as per Project Brief.	

APPENDIX C – NORTHROP MECHANICAL SERVICES PERFORMANCE SPECIFICATION

Amended Northrop Mechanical Services Performance Specification - JHA Issue 01 - 25.05.2018

Mechanical Services Specification

NSW Correctional Facilities Performance Specification

MECHANICAL SPECIFICATION

PREPARED FOR
Justice Infrastructure & Assets - NSW Department of Justice
Level 2, 50 Phillip Street
Sydney NSW 2000

Tel: 02 8061 9315

PREPARED BY
Northrop Consulting Engineers

2-6 Shea Street
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Ref: NL180226-HM01
Rev: A
Date: 04.04.2018

MECHANICAL SERVICES SPECIFICATION

Activity Schedule

Date	Revision	Issue	Prepared By	Approved By
13.03.2018	1	For Review and Comment	DJ	MS
04.04.2018	A	Tender	DJ	MS

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1. PREAMBLE

1.1 Introduction

Northrop has been engaged by the NSW Justice Department to formulate several Building Services Specification for the following five (5) prisons in NSW which have been listed later in this specification. While Room Data sheets have been provided no Architectural drawings have been provided at this time. Therefore, the information contained herein is based on all possible scenarios for building services design, inclusive of but not limited to; refurbishment, extensions and new buildings. This specification has been written in conjunction with other Northrop Consulting Engineer documentation for the following building services:

- Electrical
- Hydraulic
- Fire

1.2 Coordinated Approach

There has been a coordinated approach between the above mentioned services which has endeavoured to engage several stake holders at several levels within the NSW Department of Corrective Services, documentation available on prisons construction and so on. It is worth noting that there is no specific design guideline that identifies design and construction of building services in a prison. There are however documents provided by the Department relating to room data sheets that provide an insight into the expectation of what building services are required to be installed within a particular space together with examples of some recently documented NSW prison projects.

To this end, Northrop has considered several design scenarios with the thought that we are just one part of developing a successful project outcome. It is the responsibility of the D&C Services contractor to seek out the following, but not limited to project stakeholders to ensure a cost effective, robust and reliable service is provided:

- NSW Department of Justice
- Architect
- Existing site specific Fire Safety Officers (and/or Orders)
- BCA Certifier
- Fire Safety Engineer
- Building Services Consultants
- Local Fire Brigade
- Local Council

1.3 Building Services Performance Specification

This Performance Specification has been prepared to allow the calling of Design and Construction (D&C) tenders for the building services related to new and refurbishment works at various NSW correctional facilities. This specification describes minimum standards for the design, supply, installation, and commissioning of selected elements of building services, which will materially impact on the future occupancy of the buildings.

The information contained within is intended to provide an overview of various systems which will be installed within the correctional centre. It is the contractor's responsibility to select system types based on the performance requirements and undertake any life cycle and payback analysis. Note that there are no detailed building services drawings accompanying this specification.

1.4 General

This part of the specification shall be read in conjunction with the general conditions of contract, preliminary clauses, and technical clauses included in the main specification that follows.

The Mechanical services works shall comprise of the design, coordination, workshop documentation, supply, construction, installation, testing, commissioning, quality assurance, certification, and maintenance during defects liability period of the complete mechanical services works whether specified herein or not.

This document is to be read as a performance brief for the Mechanical services. Where ambiguous, inconsistent or contradictory information is present in the documentation, it is the contractor's responsibility to highlight those and seek clarification during the tendering process. Where assumptions are made or where alternatives exist, the more expensive option shall be priced for.

The Contractor shall be responsible for completion of the design of the mechanical services to satisfy the requirements of this specification, Client Briefs, relevant codes and standards, and any other ancillary requirements made known at the time of tender. The Contractor shall prepare design concepts, detailed design drawings and shop drawings for the final mechanical services required, including coordination with the latest architectural layouts and all other building services' documentation.

The Contractor shall guarantee that the complete mechanical services installation will perform all functions required.

The mechanical services shall be designed and installed in accordance with the current National Construction Code (NCC) and current Australian Standards. Where alternative solutions are required they shall be addressed within the contractors design certification and shall be fully agreed with the relevant authorities prior to the design proceeding.

The documents include this performance specification, Corrective Services NSW Standards, Room Data Sheets, Security Brief, other services trade drawings, and associated architectural drawings which combined identify the full extent of work.

The Contractor shall fully inform themselves of the nature of work, carry out a mandatory site visit and to take into account any conditions likely to affect the extent or performance of the works specified herein prior to submission of tender.

The Contractor by tendering shall be deemed to have thoroughly inspected the site prior to tender and to have taken into account any conditions likely to affect the extent or performance of the works e.g. beam locations, cable routes, penetration locations, existing services, etc.

1.5 Definitions

- 'AS' or 'AS/NZS' when followed by numbers or letters means an Australian Standard published by Standards Australia (e.g. AS 1668)
- 'Approved' means approved in writing by the Superintendent and/or Regulating Authority
- 'Architect' shall mean Architect
- 'Authority' means any Local, State or Commonwealth statutory body holding jurisdiction over work herein specified under current regulations and statutes
- 'BCA' means the Building Code of Australia – Volumes 1 and 2, which forms part of the National Construction Code.
- 'Client' shall mean Justice Infrastructure and Assets (JIA) - NSW Department of Justice
- 'CSNSW' shall mean Corrective Services NSW
- 'Contractor' means the person or the persons, firm, company or corporation whose tender has been accepted by the Client and includes their legal representatives, successors and permitted assigns to design, install, test, and commission the mechanical services specified herein and on the accompanying drawings
- 'Day' means a period of 24 hours
- 'Equal' means equivalent in performance, quality and approved
- 'Fire Resistance Level (FRL)' means the grading periods in minutes determined in accordance with Specification A2.3 of the BCA Volume 1, for the following criteria -
    - Structural adequacy
    - Integrity; and
    - Insulation, and expressed in that order
- 'General Access Area' means areas that are generally accessed by Prisoners.
- 'High Needs Area' means individual segregation cells or cell blocks.
- 'Install' means accept the delivery of items supplied by others and install them in accordance with the documents.
- 'Mechanical Engineer' nominated by the Principal
- 'Materials' means all plant, instruments, components, equipment, assemblies and sub-assemblies, parts and other items required for permanent incorporation of the works
- 'May' means that there is an option
- 'NCC' means the National Construction Code, which comprises the Building Code of Australia - Volumes 1 and 2.
- 'Inmate' means a person sentenced or awaiting sentence by the Court to a term of imprisonment to be detained in a prison

- ‘Provide’ means obtain, manufacture, deliver, install, as applicable, and do everything necessary to complete the work in accordance with this specification
- ‘Required’ means necessary by the contract documents, statutory Authority, law, or as required by site conditions to complete the works
- ‘Shall’ means that the statement is mandatory
- ‘Should’ means that the statement is recommended
- ‘Site’ means the lands and other places on, under, in or through which the works are to be carried out by the Contractor
- ‘Specification’ means this document
- ‘Submit’ means submit to the mechanical engineer, project manager, or other person(s) as indicated in the general conditions for inspection, information, etc.
- ‘Superintendent’ means the person as nominated by JIA or as nominated in the main building contract
- ‘Supply’ means obtain, manufacture, as applicable, and deliver

1.6 Design Compliance

The work shall comply with these listed regulations, whether or not specific reference is made in this Specification.

A brief summary of key Standards and Codes that generally apply to these works is as follows. Where specific parts are not mentioned, the entire series of the associated Standard shall apply.

• Reference	**Title**
AS/NZS 1324	Methods of test for Air Filters for use in Air Conditioning and General ventilation
AS/NZS 1202	AC Motor starters
AS/NZS 1319	Safety signs for the occupational environment.
AS/NZS 1324	Air Filters for use in Air Conditioning and General Ventilation
AS/NZS 1345	Identification of the contents of piping, Conduits and Ducts
AS/NZS 1359	Electric motors
AS/NZS 1366.2	Rigid cellular plastics sheets for thermal insulation – Rigid cellular polyisocyanurate.
AS/NZS 1397	Steel sheet and Strip
AS/NZS 1432	Copper Tubes for water, Gas and Sanitation
AS/NZS 1530	Methods for fire tests on building materials, components and structures.
AS/NZS 1565	Copper and copper alloys Ingots and castings
AS/NZS 1571	Copper seamless tubes for heat exchangers
AS/NZS 1628	Water supply – Copper alloy gate, globe and non-return valves
AS/NZS 1675	Current transformers Measurement and Protection
AS/NZS 1668	The use of ventilation and air conditioning in buildings
AS/NZS 1682	Fire Dampers
AS/NZS 1851	Maintenance of Fire protection Equipment
AS/NZS 2107	Acoustics – Recommended Design Sound Levels and reverberation Times for Building Interiors
AS/NZS 2129	Flanges for pipes valves and fittings
AS/NZS 2279	Disturbances in mains supply networks
AS/NZS 2665	Smoke/heat venting systems – Design, installation and commissioning.
AS/NZS 2784	V Belt Drives
AS/NZS 3000	Electrical Installations: Wiring Rules
AS/NZS 3102	Approval and test specification for electrical duct heaters.
AS/NZS 3439	Low voltage switchgear and control gear assemblies.
AS/NZS 3500	Plumbing and Drainage
AS/NZS 3666	Air handling and water systems of building Microbial control

AS/NZS 3688	Water supply – copper and copper alloy body compression and capillary fittings and threaded connectors.
AS/NZS 4041	Pressure Piping
AS/NZS 4130	Polyethylene (PE) pipes for pressure applications
AS/NZS 4254	Ductwork for air handling systems in buildings.
AS/NZS 4426	Thermal insulation of pipework, ductwork and equipment selection, installation and finish.
AS/NZS 4859.1	Materials for the thermal installation of building general criteria and technical provisions.
AS/NZS 5601	Gas Installations
AS/NZS 60335	Household and similar electrical appliances – Safety – General requirements.
AS/NZS ISO 817	Refrigerants – Designation and safety classification
AS/NZS ISO 5149	Refrigerating systems and heat pumps – Safety and environmental requirements

Facility Assets Correctional Standards

Reference	Edition	Title
D12/095474	2012	Administration
D12/095505	2012	Booking
D12/095486	2012	Food Services
D12/095519	2012	Functional Purpose and Design
D12/095514	2012	Gatehouse
D12/095469	2012	General Storage
D12/494388	2012	Grounds Maintenance
D12/095487	2012	Health Care
D12/095502	2012	Housing - General
D12/095496	2012	Housing - Special
D12/095476	2012	Industries
D12/095484	2012	Laundry
D12/095458	2012	Maintenance Facility
D12/594885	2012	Maintenance
D12/095478	2012	Programs / Services
D12/095480	2012	Recreation
D12/095508	2012	Security
D12/095472	2012	Staff
D12/095482	2012	Visiting

D12/214222	2012	Court Cells
D12/214304	2012	Residential Security
D12/494532	2012	CCTV Systems
D12/493566	2012	Lifeskills Kitchen
D12/494876	2012	Suppliers and Products
D12/286803	2012	Training Kitchen
D18/07512	2018	DJ Local Area Network Standard
D17/384404	2017	MATV / IPTV Scope for Prison Bed Capacity Program
	2017	Audio-visual Systems Specification
D18/077742	2018	DJ Telecommunications Cabling and Infrastructure Facilities Standard

1.7 Authorities

The complete installation and all works being carried out shall comply with the requirements and regulations of all Statutory Authorities and Codes relevant to the works, including:

- The National Construction Code (Building Code of Australia);
- Standards Australia;
- The Local Fire Brigade;
- Work Health & Safety;
- Local City/Shire Council;
- Any other authority having jurisdiction over all or part of the installations to ensure that the equipment and installation, when manufactured and installed, shall comply with the relevant rules and regulations.

Observe all requirements and regulations of the Lifts and Scaffolds Act.

The Contractor is responsible for lodging all applications, seeking all approvals, and payment of all fees and charges legally demandable for relevant services prior to the commencement of works to meet the project construction programme.

Where standards and regulations are mentioned in this specification they shall include all amendments and interpretations.

On completion, the whole of the equipment and installation is to be inspected by the appropriate authority's representative.

The Contractor shall obtain and fill in all notices required by the relevant Authorities where necessary and pay all fees in connection therewith and shall submit for approval all necessary drawings and obtain all consents required to permit execution of the works.

The Contractor shall procure all necessary permits and approvals from Authorities and shall advise the Superintendent if obtainment of any permits is likely to delay building construction.

The Contractor shall provide certificate of compliance indicating a satisfactory installation from all relevant Authorities.

1.8 Project Description

The following provides a description of the works involved at each NSW Correctional Facility.

Bathurst Correctional Centre

The Bathurst Correctional Centre is currently a minimum and medium security facility for male offenders housing 495 medium security and 165 minimum security inmates. It is located 200km west of Sydney.

The proposed new 220 bed maximum security male facility is intended to be operated in conjunction with the existing medium security facility.

The works are to be completed to enable acceptance of prisoners in April 2020.

The works are generally summarised as:

- A new 220 bed maximum security compound with Gatehouse, Administration, Staff Amenities, Reception, Accommodation, Industries and Programs, 10 bed Segregation and Clinic buildings all located to the south east of the existing compound.
- The installation of a pedestrian and vehicle lock between the existing medium security compound and the new maximum security compound. This will require an opening in the existing heritage perimeter wall.
- New facilities located outside the secure perimeter for Central Stores and Grounds Maintenance.
- New facilities located within the minimum security compound for Kitchen and Laundry.

Metropolitan Remand and Reception Centre (MRRC)

The Metropolitan Remand and Reception Centre (MRRC) is currently a maximum security facility for male offenders housing 1,086 maximum security inmates. It is located 21km west of Sydney CBD.

The proposed new 440 bed maximum security male facility is intended to be operated in conjunction with the existing facility.

The works are to be completed to enable acceptance of prisoners in June 2020.

The works are generally summarised as:

- A new 440 bed maximum security compound with Accommodation, Recreation, Satellite Clinic and Programs buildings all located in the South East corner of the existing secure facility.
- Refurbishment works to parts of the existing facility. These works will upgrade some existing functionality and services, including security services, within the centre, and provide additional space to utilise the shared Visits, Segregation, Retherm Kitchen, Laundry, Property Stores and Clinic facilities; and
- New facilities located outside the secure perimeter for Staff Parking; and

Dillwynia

The Dillwynia Correctional Centre is currently a minimum/medium security correctional centre for women offenders housing 300 00 at a medium security classification of which 44 a high risk operating beds. Dillwynia is located within the John Morony Correctional Complex at Windsor 56km west of Sydney CBD.

The proposed new 248 bed female maximum security expansion is to be operated in conjunction with the existing medium security facility.

The works are to be completed to enable acceptance of prisoners in April 2020.
The works are generally summarised as:

- A new 248 bed medium security compound with Accommodation, Satellite Clinic, Visits, Reception, Industries, Segregation and Programs; and
- Refurbishment works to parts of the existing facility. These works will upgrade some existing functionality and services, including security services within the centre.

Outer Metropolitan Multi-Purpose Correctional Centre (OMMPCC)
The Outer Metro Multi-Purpose Correctional Centre is currently a multi-purpose correctional centre housing 380 inmates and is located within the John Morony Correctional Complex at Windsor approximately 56km west of the Sydney CBD.

The Outer Metro Multi-Purpose Correctional Centre at John Morony is to provide an upgrade and refurbishment resulting in a total of 150 minimum and 100 medium security beds whilst retaining the existing 70 bed honour house and 80 bed modular accommodation.

The works are to be completed to enable the acceptance of prisoners in 2020.

The Works are generally summarised as:

- The demolition of old and subsequent construction of replacement accommodation blocks with the main correctional centre
- The master planning of a 70-bed minimum security block adjacent to the existing Honour House, 1 x 48 bed minimum security accommodation block plus 1 x 48 medium security accommodation block and a programs building adjacent the 80 modular accommodation.
- Construction of a new visits centre for the Honour House and upgrades to the gatehouse, main visits area and security.

Cessnock 280

The Cessnock Correctional Centre is currently a Medium and Minimum security facility for male and female inmates, the Cessnock Correctional Centre is located within the Cessnock Correctional Complex that is located approximately 150km north west of the Sydney CBD.

The Cessnock Correctional Centre is to be expanded with the addition of a 280-bed minimum security accommodation and supporting infrastructure.

The Works are to be completed to enable the acceptance of prisoners in 2020.

The Works are generally summarised as:

- An extension of the existing Cessnock correctional centre with an additional 280 minimum security beds, and associated infrastructure including a Gatehouse, Health/Reception and Programs building will be

constructed to the east and south of the existing centre and are being designed to support the existing centre.

- The Accommodation will be comprised of five accommodation blocks each with forty eight beds
- A new access through the gatehouse to the existing industry buildings will also be included.

The mechanical systems may vary from site to site due to climatic conditions, etc.

It is the intention that the D&C contractor prepares design documentation based on the performance requirements outlined within this specification in conjunction with associated architectural design drawings.

Security, system reliability, ease of maintenance and energy efficiency are a high priority for the project.

2. DESIGN BRIEF

2.1 General

The Design Activities must be carried out with Best Design Practices with emphasis on energy efficiency, ESD principals, adaptability, reliability, durability, safety and allowance for future expansion and reconfiguration.

The engineering services must complement the delivery of the Correction Services.

The Contractor shall carry out all necessary calculations required for the design of the systems. Design drawings shall be provided for approval, prior to the Contractor's commencement of manufacture. Calculations and details relating to any aspect of the mechanical services shall be made available for review by the Client's Consultant prior to the installation proceeding.

All works shall be carried out using only personnel with appropriate training, skills and experience and where required by authorities, all licences and registrations. The responsibility for the design and installation, the correctness, adequacy and economy of the mechanical services lie with the Contractor. All requirements stated in this Specification shall be treated as a minimum. In all cases, the requirements of the Building Code of Australia and all relevant Australian Standards must be met.

2.2 Flexibility and Adaptability of Building Services

Correctional Facilities may be subject to potential for an ongoing program of modification, alteration and upgrades over the life of the facility.

As such, the building services must be designed to be readily adaptable and flexible. Designs must therefore be completed ensuring minimal disruption to the facility, consider security implications and be at a minimum cost.

Correction Facilities include a wide variety of buildings and spaces for a number of different uses. The design must allow for isolation and separation of services, to the degree necessary and appropriate, to allow for part work, maintenance and upgrades. For example, works to an Programs Building must not inhibit use of an Accommodation Block.

2.3 Building Services Plant Space and Reticulation

2.3.1 Plant Space

Engineering Plant and equipment installations must be arranged such that Plant and equipment that requires scheduled maintenance servicing is located outside of inmate occupied areas.

Where riser shafts are used, all riser shafts must be fully accessible for the height of the riser. Plant and equipment requiring access in services cupboards must be limited to a maximum height of 2.2m above floor level. No Plant or equipment will be located in riser shafts or the like such that access is impeded.

Plant and equipment must be located to avoid vibration and electromagnetic interference. Plant and equipment accommodation must also take into account the acoustic requirements of adjoining occupied areas.

Access to equipment in plant rooms must be via normal walk-in access and must not require the use of specialised access equipment or temporary scaffolding. Permanent access platforms and ladders must be provided where safe maintenance access is not possible from floor level.

Plant and equipment access must take into account the access needs for the replacement of all major components. Access and removal routes must be planned.

Fresh air intakes (including openable windows) must be arranged to minimise the risk of air recirculation under prevailing wind conditions, or cross contamination from nearby exhaust vents and flues.

2.3.2 Security and Protection of External Equipment

Consideration must be given to access for all services, and where possible not require access through or via inmate accessible areas. Where plant and equipment is required to be located within inmate areas, it shall be secured in lockable cupboards, behind secure ceilings or in secure cages where located externally.

Plant and equipment locations shall not be located in such a way as to allow a route for access to building roofs.

All plant, equipment and ductwork shall be designed based on the philosophies and details outlined within the security consultants report. The security consultant shall provide partition plans outlining the relevant rating of each partition, ceiling, etc and associated security grille details to be adopted by the mechanical contractor.

When placing services equipment outside the building but within inmate areas, the Contractor must make all necessary provision for security and protection against theft and vandalism, i.e. lockable security cages surrounding air cooled condenser units.

2.3.3 Services Reticulation

Service routes must be designed such that clearly identified routes are provided for piping and cabling installations from plant areas to final usage points.

Zoned ceiling spaces for the reticulation of services with appropriate access must be provided. All services must be segregated to suit the function and type of service.

Cables must be segregated into high voltage, low voltage, communications, fire services and security services.

All services must be fully supported along their length. No service will be supported by an accessible or lightweight ceiling structure.

Ensure that there are no possible ligature points in inmate areas.

2.3.4 Future Expansion

The Contractor shall design all mechanical systems within Accommodation Buildings to permit future expansion of up to 50% increase in inmate capacity through outside air and internal load provisions. The mechanical systems including ductwork shall be sized to allow for the future increased capacity with outside air commissioned to the initial occupancy requirements.

2.3.5 Vermin Proofing

All external openings to plant and equipment are to be treated with vermin and bird proofing. In particular, all external cabling and the like are to be adequately protected from attack by bird and other wildlife in the vicinity.

2.4 Safety in Design

The Contractor must comply with the requirements of Work Health and Safety Act 2011 (WHS Act) – in particular section 22 of the Act. The WHS Act is supported by Work Health and Safety Regulation 2011, Codes of Practice and guidance material. The WHS Act has safety duties which apply to anyone who has control of the design or manufacture of plant, a workplace or a system (including anyone who has the authority to make decisions about design or manufacture).

Safety in Design from an operational and lifecycle maintenance perspective is a requirement of this Contract. The Contractor must design the facility so that – when constructed – it is safe and does not pose risks to the health,

safety and welfare of people working or contained there, when using the workplace for a purpose for which it was intended.

The Contractor must complete Safety in Design reviews throughout all of the design phases under this contract. The Safety in Design assessment must consider the principles of “so far as reasonably practicable” and apply a hierarchy of controls, risk reduction and mitigation.

Engage with the Department of Justice and use a structured methodology for identifying risks (phase 1) and for eliminating and managing risks (phase 2).

Use a risk analysis approach, and risk workshops to consider the scope of the Project as a work environment. Identify the range of workers/inmates who will be employed/contained at the site, and their work tasks. Progressively develop the design using the “Preliminary Hazard Analysis” which identifies a range of different types of hazards and risks as part of managing risk. In iterative design reports, identify the design team’s response to identified hazards and safety risks, including providing clear and traceable evidence that the design has been refined and changed to eliminate or reduce identified safety hazards. For each design decision that carries a legacy maintenance or repair requirement, consider the design solution for the perspective of a safe working environment.

Document and submit copies of the design team’s “Preliminary Hazard Analysis” and the response to identified hazards including evidence that the design has been refined and changed to eliminate or reduce identified hazards.

2.5 Design Conditions

The performance of the ventilation systems within the limits of the specified plant capacities shall be verified on the basis of the design criteria and building details stated in this section of the specification.

The equipment offered for installation must also meet the required acoustical performance criteria as stated in the relevant section of the specification.

Design criteria for the mechanical services air conditioning systems are as follows:

2.5.1 Outside Design Conditions

Outdoor Conditions		
Location	**Summer**	**Winter**
MRRC (Silverwater)	34.6°CDB, 23.9°CWB	5.8°DB
Dillwynia (Berkshire Park)	37.1°CDB, 23.4°CWB	1.2°DB
OMMPCC (Berkshire Park)	37.1°CDB, 23.4°CWB	1.2°DB
Bathurst	33.4°CDB, 20.4°CWB	-2.1°DB
Cessnock	36.8°CDB, 23.4°CWB	1.9 °DB

2.5.2 Inside Design Conditions

Staffed Areas

Summer	Maximum 24°C DB; 40% - 60% rh [no direct control of rh]
Winter	Minimum 21°C DB

Cells

Summer	Tempered Air (Supply air to be ~~10~~ 16 °C below the outside ambient temperature) i.e. Cessnock = 26.8 °C DB
Winter	Tempered Air (Supply air to be ~~10~~ 16 °C above the outside ambient temperature) i.e. Cessnock = 11.9 °C DB

The above conditions are typical for staffed areas with air conditioning and cells with tempered air. *Section 2.10 Building and Room Requirements Summary* includes an exhaustive list of room requirements including associated occupancy and equipment loads.

2.5.3 Occupancy and Internal Heat Loads

The following typical indoor design criteria is proposed for the occupancy and internal heat loads:

Area	Population density	Outdoor air (L/s.person)	Lighting density (W/m2)	Power Density (W/m2)
Internal Areas	Refer to Section 2.10	10L/s	10	Refer to Section 2.10

The above conditions are typical for staffed areas with air conditioning and cells with tempered air. *Section 2.10 Building and Room Requirements Summary* includes an exhaustive list of room requirements including associated occupancy and equipment loads.

2.5.4 Building thermal performance

Building elements shall be as per Section J report.

2.5.5 Infiltration

Allow for the following infiltration rates:

Area	Infiltration Rate ACH
Perimeter Zone	0.5
Entry Lobbies	1.0

2.5.6 Internal people loads to be used as a minimum:

Area	Activity Level	Sensible Heat (W/person)	Latent Heat (W/person)
Offices/Staffed Areas	Standing, walking slowly	70	60
Cells	Standing, walking slowly	50	80
Dining Halls	Sedentary work	68	92
Workshops	Heavy Work	144	286

For areas not covered by the above table refer to *Table 45 Heat Gain From People* in AIRAH Application Manual DA09.

2.5.7 Hours of Operation

All areas shall operate 24/7.

2.5.8 Safety Margin

Allow 10% safety margin on final cooling load calculation and 20% safety margin on heating load calculation.

2.5.9 Cooling load calculation

Contractor shall undertake cooling and heating load calculations using CAMEL software or approved equivalent.

2.6 Existing Infrastructure

Condition and Adequacy of Existing Systems:

- Each individual sites service connections shall be assessed for suitability and adequacy to facilitate the new works. Allow to complete all necessary investigations, council liaising, fees and charges as part of the due diligence exercise. It is noted that some preliminary investigations have been completed for a number of sites. Where available, the Contractor shall use these initial Authority assessments/investigations as the basis for their design assessment. The Contractor shall request copies of such reports and assessments at the commencement of the project.
- The initial investigations, due diligence and assessment shall commence immediately after engagement.
- If the existing conditions do not conform or meet the needs to facilitate the new works, submit proposals to rectify the deficiencies including related costing, time and other impacts caused by the proposed works.
- Subject to the rectification works on existing systems, achieve the performance in the contract documents in conjunction with the design intent of this specification.

2.7 Mechanical System Design

2.7.1 Energy Efficiency

The mechanical systems shall be selected with due consideration to whole of life cycle costs.

Energy efficiency standards such as MEPS (Minimum Energy Performance Standards) relating to air conditioning equipment shall be adhered to.

Compliance with BCA Section J DTS provisions is mandatory including but not limited to: minimum COP requirements, fan and pump motor power limits, thermal insulation and duct construction. Performance based Solutions may be adopted providing all Mechanical Services required by this approach are included in the Tender.

The following additional energy savings initiatives shall be incorporated into the mechanical services design:

- Economy cycles;
- Optimum start/stop cycles;
- Not employ control strategies requiring reheat for zone control;
- Incorporation of sensible thermal zoning configurations;
- Incorporate demand-based systems where possible, i.e. CO2 control in areas with fluctuating occupancy and
- Where possible incorporate energy recovery.

2.7.2 Accommodation Blocks

2.7.2.1 *Cells*

All cells shall incorporate exhaust extraction to wet areas and supply air via a grille located below the inmate's desk. The tempered air supply shall be served by ~~indirect evaporative coolers and indirect ducted gas heaters complete with booster fans all located in plant enclosures. Motorised dampers shall be provided to allow the switching between cooling and heating modes. Alternative systems may be considered depending on their ability to deal with 100% outside air requirements~~ reverse cycle roof top packaged air conditioning units with economy cycle.

The exhaust fans serving the cells shall be a dual-purpose fan which will operate as a toilet exhaust system during normal operation but also run in the event of a fire to assist with smoke extraction in the event that a fire starts within the cell.

As in most cases, cells are fire isolated from adjoining cells and as the system is required to run in 'fire mode' fire dampers are not permitted for use. ~~Sub-ducts and smoke dampers shall be provided on all supply air and exhaust ducts entering the cells. Access to smoke dampers shall be from a lockable cupboard accessed from the corridor.~~ Fire engineering report will be provided as alternative solution to remove the need of installing sub ducts and smoke dampers.

Systems required to operate in 'fire mode' shall be served by an "essential electrical supply". Smoke detectors installed by the fire trade shall be located within exhaust ducts and not within the cells to avoid vandalism.

Provide security grilles in all ducts entering secure accommodation. The grilles shall be constructed from minimum 3mm thick stainless steel perforated plate with maximum 3.25mm holes at 6.35mm spacing to achieve minimum 50% free area with finishes applied. The grille shall be fixed to a 3mm thick steel header box fixed into floors, ceilings and walls in an approved manner. Final details to be approved by the security consultant.

Where required for security purposes provide security grilles in all ducts crossing secure walls consisting of 10mm steel bars at 125mm centres, fixed into ductwork in a minimum 5mm steel frame. Final details to be approved by the security consultant.

Bedrooms in minimum security accommodation block will be provided with tempered air with door grille for air relieve to adjacent Living/Dining. Exhaust/smoke exhaust system is not required.

2.7.2.2 *Day Rooms*

Day rooms shall be air conditioned by packaged reverse cycle systems complete with economy cycle ~~or indirect evaporative coolers and indirect ducted gas heaters located in plant enclosures. Motorised dampers shall be provided to allow the switching between cooling and heating modes in the case of the evaporative and ducted gas system. Alternative systems may be considered depending on their suitability.~~

The day rooms shall be provided with smoke exhaust systems located at the highest level possible within the space with two smoke intakes each sized at 50% of the total smoke exhaust rate. A make-up air path shall be provided ~~to the lowest floor within the day room complete with smoke dampers.~~through external louvre at low level of Dayroom complete with motorized dampers and secure bar grille.

Systems required to operate in 'fire mode' shall be served by an "essential electrical supply". Smoke detectors installed by the fire trade shall be located within exhaust ducts and not within the cells to avoid vandalism.

Provide security grilles in all ducts entering secure accommodation. The grilles shall be constructed from minimum 3mm thick stainless steel perforated plate with maximum 3.25mm holes at 6.35mm spacing to achieve minimum 50% free area with finishes applied. The grille shall be fixed to a 3mm thick steel header box fixed into floors, ceilings and walls in an approved manner. Final details to be approved by the security consultant.

Where required for security purposes provide security grilles in all ducts crossing secure walls consisting of 10mm steel bars at 125mm centres, fixed into ductwork in a minimum 5mm steel frame. Final details to be approved by the security consultant.

2.7.2.3 *Air-Conditioned Areas*

All staffed areas within the accommodation block including but not limited to: Officer Post, Interview Room and AVL Suite shall be provided with air conditioning via reverse cycle ducted heating and cooling systems with outside air ducted from outside the building. Physically distinct areas such as rooms having different load characteristics and differing thermal zones shall be separately controlled and incorporate a room temperature sensor.

Communications rooms shall be provided with air conditioning systems arranged in a N+1 configuration. The two

systems shall cycle once a week. Alarms shall be generated at the BMS upon a unit fault. Mechanical ventilation shall be provided to the communications room.

Where required for security purposes provide security grilles in all ducts crossing secure walls consisting of 10mm steel bars at 125mm centres, fixed into ductwork in a minimum 5mm steel frame. Final details to be approved by the security consultant.

Mechanical ventilation shall be provided to bathrooms, kitchen/tea rooms and the like.

Where cells incorporate a private yard (usually in Segregation units) natural ventilation shall be provided.

2.7.3 Programs

All occupied areas within the Programs block including but not limited to: Officer Post, Offices, Interview Room, Multi-faith Room, Meals, Breakout, Programs Rooms and Meeting Rooms shall be provided with air conditioning via reverse cycle ducted heating and cooling systems with outside air ducted from outside the building. Physically distinct areas such as rooms having different load characteristics and differing thermal zones shall be separately controlled and incorporate a room temperature sensor.

Communications rooms shall be provided with air conditioning systems arranged in a N+1 configuration. The two systems shall cycle once a week. Alarms shall be generated at the BMS upon a unit fault. Mechanical ventilation shall be provided to the communications room.

Where required for security purposes provide security grilles in all ducts crossing secure walls consisting of 10mm steel bars at 125mm centres, fixed into ductwork in a minimum 5mm steel frame. Final details to be approved by the security consultant.

Mechanical ventilation shall be provided to bathrooms, kitchen/tea rooms and the like.

2.7.4 Industries

All occupied areas within the Industries block including but not limited to: Officer Post, Inmate Clerk, Offices, Interview Room, and Meals areas shall be provided with air conditioning via reverse cycle ducted heating and cooling systems with outside air ducted from outside the building. Physically distinct areas such as rooms having different load characteristics and differing thermal zones shall be separately controlled and incorporate a room temperature sensor.

Communications rooms shall be provided with air conditioning systems arranged in a N+1 configuration. The two systems shall cycle once a week. Alarms shall be generated at the BMS upon a unit fault. Mechanical ventilation shall be provided to the communications room.

The inmate training rooms shall be provided with filtered outside air and no air conditioning.

Mechanical ventilation shall be provided to bathrooms, storage areas, kitchen/tea rooms and the like.

Commercial kitchen exhaust extraction shall be provided in the Retherm Kitchen. Makeup air shall be provided via an evaporative cooling system.

Cool rooms and freezer rooms shall be provided with associated refrigeration systems, controls, alarms, etc to form a complete system. Room construction shall be compliant with BCA and incorporate slab heating to prevent condensation.

Where required for security purposes provide security grilles in all ducts crossing secure walls consisting of 10mm steel bars at 125mm centres, fixed into ductwork in a minimum 5mm steel frame. Final details to be approved by the security consultant.

2.7.5 Health

All occupied areas within the Health block including but not limited to: Officer Post, Dispensary, Medicines, Offices, Meeting Rooms, Treatment Rooms, Consultation Rooms, Interview Rooms, Utilities, Breakouts and Kitchen/Meals areas shall be provided with air conditioning via reverse cycle ducted heating and cooling systems

with outside air ducted from outside the building. Physically distinct areas such as rooms having different load characteristics and differing thermal zones shall be separately controlled and incorporate a room temperature sensor.

Holding cells shall be designed as per the cell requirements outlined in the Accommodation section. Due to the individual nature of the holding cell, it is considered acceptable to service it from the surrounding air conditioning system.

Observation cells shall be designed as per the cell requirements outlined in the Accommodation section. Due to the individual nature of the holding cell, it is considered acceptable to service it from the surrounding air conditioning system. The Observation Cell shall be provided with a smoke exhaust and makeup air system. Makeup air shall be provided via motorised dampers from an adjoining secure outdoor area.

Communications rooms shall be provided with air conditioning systems arranged in a N+1 configuration. The two systems shall cycle once a week. Alarms shall be generated at the BMS upon a unit fault. Mechanical ventilation shall be provided to the communications room.

Treatment rooms shall be provided with medical gases.

Mechanical ventilation shall be provided to bathrooms, storage areas, kitchen/tea rooms and the like.

Provide security grilles in all ducts entering secure accommodation. The grilles shall be constructed from minimum 3mm thick stainless steel perforated plate with maximum 3.25mm holes at 6.35mm spacing to achieve minimum 50% free area with finishes applied. The grille shall be fixed to a 3mm thick steel header box fixed into floors, ceilings and walls in an approved manner. Final details to be approved by the security consultant.

Where required for security purposes provide security grilles in all ducts crossing secure walls consisting of 10mm steel bars at 125mm centres, fixed into ductwork in a minimum 5mm steel frame. Final details to be approved by the security consultant.

2.7.6 Visits

All occupied areas within the Visits block including but not limited to: Waiting, Prisoner Waiting, Contact Visits, Non-Contact Visits, Legal, Dress/Undress, Offices, Meeting Rooms, Interview Rooms, and Kitchen/Tea areas shall be provided with air conditioning via reverse cycle ducted heating and cooling systems with outside air ducted from outside the building. Physically distinct areas such as rooms having different load characteristics and differing thermal zones shall be separately controlled and incorporate a room temperature sensor.

Where a holding cell exists in the Visitors block they shall be designed as per the cell requirements outlined in the Accommodation section. Due to the individual nature of the holding cell, it is considered acceptable to service it from the surrounding air conditioning system.

Communications rooms shall be provided with air conditioning systems arranged in a N+1 configuration. The two systems shall cycle once a week. Alarms shall be generated at the BMS upon a unit fault. Mechanical ventilation shall be provided to the communications room.

Mechanical ventilation shall be provided to bathrooms, baby change rooms, storage areas, kitchen/tea rooms and the like.

Provide security grilles in all ducts entering secure areas, such as: Prisoner Waiting, Dress/Undress and associated store rooms. The grilles shall be constructed from minimum 3mm thick stainless steel perforated plate with maximum 3.25mm holes at 6.35mm spacing to achieve minimum 50% free area with finishes applied. The grille shall be fixed to a 3mm thick steel header box fixed into floors, ceilings and walls in an approved manner. Final details to be approved by the security consultant.

Where required for security purposes provide security grilles in all ducts crossing secure walls consisting of 10mm steel bars at 125mm centres, fixed into ductwork in a minimum 5mm steel frame. Final details to be approved by the security consultant.

2.7.7 Gatehouse/Administration

All occupied areas within the Gatehouse block including but not limited to: Officer Post, Waiting, Armory, Key Dist/Ready Room, Locker Room, Control Room, Offices, Meeting Rooms, Interview Rooms, Print Rooms, Meals and Kitchen/Tea areas shall be provided with air conditioning via reverse cycle ducted heating and cooling systems with outside air ducted from outside the building. Physically distinct areas such as rooms having different load characteristics and differing thermal zones shall be separately controlled and incorporate a room temperature sensor.

Communications rooms and Carrier rooms shall be provided with air conditioning systems arranged in a N+1 configuration. The two systems shall cycle once a week. Alarms shall be generated at the BMS upon a unit fault. Mechanical ventilation shall be provided to the communications room.

UPS/Electrical Rooms shall be provided with air conditioning systems. Alarms shall be generated at the BMS upon a unit fault. Mechanical ventilation shall be provided to the communications room.

Mechanical ventilation shall be provided to bathrooms, storage areas, locker rooms, kitchen/tea rooms and the like.

Where required for security purposes provide security grilles in all ducts crossing secure walls consisting of 10mm steel bars at 125mm centres, fixed into ductwork in a minimum 5mm steel frame. Final details to be approved by the security consultant.

2.7.8 Reception

All occupied areas within the Reception block including but not limited to: Officer Post, Property Store, Processing, Secure Waiting, Offices, Meeting Rooms, Interview Rooms, Print Rooms, Meals and Kitchen/Tea areas shall be provided with air conditioning via reverse cycle ducted heating and cooling systems with outside air ducted from outside the building. Physically distinct areas such as rooms having different load characteristics and differing thermal zones shall be separately controlled and incorporate a room temperature sensor.

Where a holding cell exists in the Reception block they shall be designed as per the cell requirements outlined in the Accommodation section. Due to the individual nature of the holding cell, it is considered acceptable to service it from the surrounding air conditioning system.

Communications rooms shall be provided with air conditioning systems arranged in a N+1 configuration. The two systems shall cycle once a week. Alarms shall be generated at the BMS upon a unit fault. Mechanical ventilation shall be provided to the communications room.

Mechanical ventilation shall be provided to bathrooms, storage areas, kitchen/tea rooms and the like.

Provide security grilles in all ducts entering secure areas, such as: Holding Cells and Secure Stores. The grilles shall be constructed from minimum 3mm thick stainless steel perforated plate with maximum 3.25mm holes at 6.35mm spacing to achieve minimum 50% free area with finishes applied. The grille shall be fixed to a 3mm thick steel header box fixed into floors, ceilings and walls in an approved manner. Final details to be approved by the security consultant.

Where required for security purposes provide security grilles in all ducts crossing secure walls consisting of 10mm steel bars at 125mm centres, fixed into ductwork in a minimum 5mm steel frame. Final details to be approved by the security consultant.

2.7.9 Sports/Gym/Recreation

The Officers Post shall be provided with air conditioning via reverse cycle ducted heating and cooling systems with outside air ducted from outside the building. Physically distinct areas such as rooms having different load characteristics and differing thermal zones shall be separately controlled and incorporate a room temperature sensor.

Communications rooms shall be provided with air conditioning systems arranged in a N+1 configuration. The two systems shall cycle once a week. Alarms shall be generated at the BMS upon a unit fault. Mechanical ventilation shall be provided to the communications room.

UPS/Electrical Rooms shall be provided with air conditioning systems. Alarms shall be generated at the BMS upon a unit fault. Mechanical ventilation shall be provided to the communications room.

Mechanical ventilation shall be provided to bathrooms, change rooms, storage areas and the like.

Indoor Court areas shall be provided with natural ventilation.

Provide security grilles in all ducts entering secure areas, such as: Holding Cells and Secure Stores. The grilles shall be constructed from minimum 3mm thick stainless steel perforated plate with maximum 3.25mm holes at 6.35mm spacing to achieve minimum 50% free area with finishes applied. The grille shall be fixed to a 3mm thick steel header box fixed into floors, ceilings and walls in an approved manner. Final details to be approved by the security consultant.

Where required for security purposes provide security grilles in all ducts crossing secure walls consisting of 10mm steel bars at 125mm centres, fixed into ductwork in a minimum 5mm steel frame. Final details to be approved by the security consultant.

2.7.10 Dust and Fume Extraction Systems

Where the final architectural design incorporates specialised areas such as timber/metal work trade workshops, proprietary dust and fume extractions systems shall be incorporated.

2.7.11 Duct and Air Distribution

Ductwork for air-conditioning, heating, exhaust and general ventilation purposes shall be designed so that the following duct velocities are not exceeded:

Supply Air in Risers & Plantrooms	7.5 m/s
Supply Air on Floors	6.5 m/s
Return Air	6.5 m/s
Exhaust Air	7.5 m/s

Maximum friction rate 0.8 Pa per meter of duct.

2.7.11.1 *Elbows and Vanes*

Radius elbows with throat radius less than duct width shall have turning vanes located in accordance with AS 4254 as follows:

R/W = 0.2 - 0.5 1 vane

R/W = 0.1 - 0.19 2 vanes

R/W < 0.1 3 vanes

Square elbows shall have turning vanes in accordance with AS 4254 unless specifically indicated to have no vanes.

2.7.12 Noise and Vibration

The resultant noise generated from the commissioned engineering services systems and any other source, including environmental influences, shall be less than the maximum levels specified in *AS/NZS 2107:2000: Acoustics - Recommended design sound levels and reverberation times for building interiors.*

2.7.13 Refrigerants

All plant items using refrigerants must be selected for zero ozone depleting and low hydrocarbon global warming potential.

2.8 Building Management System (BMS)

2.8.1 System Overview

The BMS will be designed to be used by building management and maintenance staff to monitor and control all the HVAC and Energy Metering equipment.

All BMCS hardware provided will be native BACnet.

The main functions of the system will be:-

- To provide a broad range of data gathering, monitoring and automatic control capabilities suitable for HVAC plant.
- To provide a software based control system which has the flexibility to be easily expanded and modified, in the light of ongoing operating experience, including all necessary standard software packages for modifying s DDC control programs.
- To provide an operating system which will provide the housekeeping, communication and scheduling services necessary to manage field hardware communications.
- To provide a centralised alarm handling system for the building.

2.8.2 Design Parameters

2.8.2.1 *Availability*

The proposed BMS will have a system level availability exceeding 99.5% per year and an individual point availability exceeding 99.9% per year.

Each controller will be capable of operating independently of other controllers and the BMS head end. Failure of the BMS head end or other controllers will not result in the loss of automatic control functions in the controller.

The system will have no single point of failure that will result in the loss of all automatic control functions.

2.8.2.2 *Continuous Operation*

The system will be required to operate 24 hours per day 365 days per year to provide continuous monitoring and control.

2.8.2.3 *Expandability*

The system when installed will include a built-in unused physical point hardware and software capacity of 10% spare points at each field controller for each type of I/O point (i.e., AI, AO, BI, BO) over and above those listed in the point schedule.

Spare capacity will be capable of being addressed by the controllers and have physical terminals even though they are not being used. This will facilitate expansion of the system to include points which are not initially connected to the BMS but may be determined as necessary at a later date.

Expansion will be accomplished without additional head end changes and without degradation in system response times specified.

System will be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.

2.9 Design life Expectancies

System or Item of Equipment or Element	Minimum Design Service Life
Fans	20 years
Packaged air-conditioning plant	15 years
Indirect evaporative Coolers	15 years
Indirect ducted gas furnaces	15 years
Dampers	20 years
Ductwork	30 years
Valves	30 years
Valve actuators	15 years
Switchboards	30 years

2.10 Design Constraints

The mechanical services design must consider the following design, construction and ongoing maintenance constraints.

- Ensure that there are no possible ligature points in inmate areas.
- Mechanical plant and equipment should be located in dedicated plant areas and not be accessed from inmate areas.
- Air cooled condensing units located within inmate areas shall be located within lockable security cages.
- Any air grille, duct, etc penetrating a secure area shall be protected with an approved security grille.

2.11 Building and Room Requirements Summary

The following building and room summaries are typical and do not necessarily represent the complete list of all rooms which may be included in specific buildings. For an exhaustive list of all possible room types refer to Appendix A.

2.11.1 Accommodation Block – In Situ

Room Name	Description	Ventilation Type	Conditioning Type	Comments	Estimated Population Density (m^2/p) (*)	Estimated Power Density (W/m^2) (**)
Single Cell	1x Inmate	Mechanical 90L/s Exhaust, 80L/s Supply Air	Refer to Section 2.5.2 - Inside Design Conditions	Exhaust fan to double as smoke exhaust fan	8.5 (***)	30
Double Cell	2x Inmate	Mechanical 90L/s Exhaust, 80L/s Supply Air	Refer to Section 2.5.2 - Inside Design Conditions	Exhaust fan to double as smoke exhaust fan	6.5 (***)	30
Dormitory	<25 inmates	Mechanical	Refer to Section 2.5.2 - Inside Design Conditions		5 (***)	30
Access Cell	1xAccessible inmate	Mechanical 90L/s Exhaust, 80L/s Supply Air	Refer to Section 2.5.2 - Inside Design Conditions	Exhaust fan to double as smoke exhaust fan	8.5 (***)	30
Holding Cell	No Overnight	Mechanical 90L/s Exhaust, 80L/s Supply Air	Refer to Section 2.5.2 - Inside Design Conditions	Exhaust fan to double as smoke exhaust fan	8.5	30
Interview Rm	Staff/inmate interview room	Mechanical	Heating/Cooling		3	20
Bathroom	One bathroom in each accommodation pod.	Mechanical				
Officer Post	Officers' control post	Mechanical	Heating/Cooling		5	20
Yard		Natural	N/A		N/A	N/A
Day Room	Large central, communal living space.	Hybrid	Heating/Cooling		5 (***)	20
AVL Suite		Mechanical	Heating/Cooling		2.5	As per final design
Comms	Provides a secure and temperature controlled space for the housing of IC&T and	Mechanical	Cooling (100% Redundancy)	24 hour operation	1 Person	As per final design

	security equipment					
Plant	Air conditioning plant room	Natural				
Passage/ Corridor		From adjacent space	From adjacent space			
Kitchen/Tea		Mechanical	Heating/Cooling			
Store		Mechanical				

(*) To be confirmed during detailed design

(**) To be confirmed during detailed design

(***) Area to be designed to permit an increase in inmate capacity of up to 50% (refer to section *2.3.4 future expansion*).

2.11.2 Accommodation Block – Modular

Modular accommodation blocks will be prefabricated. Contractor to allow for modular construction of the mechanical systems and co-ordination with the Construction Manager to ensure a seamless installation.

Room Name	Description	Ventilation Type	Conditioning Type	Comments	Estimated Population Density (m^2/p) (*)	Estimated Power Density (W/m^2) (**)
Single Cell	1x Inmate	Mechanical 90L/s Exhaust, 80L/s Supply Air	Refer to Section 2.5.2 - Inside Design Conditions	Exhaust fan to double as smoke exhaust fan	8.5 (***)	30
Double Cell	2x Inmate	Mechanical 90L/s Exhaust, 80L/s Supply Air	Refer to Section 2.5.2 - Inside Design Conditions	Exhaust fan to double as smoke exhaust fan	6.5 (***)	30
Dormitory	<25 inmates	Mechanical	Refer to Section 2.5.2 - Inside Design Conditions		5 (***)	30
Access Cell	1xAccessible inmate	Mechanical 90L/s Exhaust, 80L/s Supply Air	Refer to Section 2.5.2 - Inside Design Conditions	Exhaust fan to double as smoke exhaust fan	8.5	30
Holding Cell	No Overnight	Mechanical 90L/s Exhaust, 80L/s Supply Air	Refer to Section 2.5.2 - Inside Design Conditions	Exhaust fan to double as smoke exhaust fan	8.5	30
Interview Rm	Staff/inmate interview room	Mechanical	Heating/Cooling		3	20
Bathroom	One bathroom in each accommodation pod.	Mechanical				
Officer Post	Officers' control post	Mechanical	Heating/Cooling		5	20
Yard		Natural	N/A		N/A	N/A

Day Room	Large central, communal living space.	Hybrid	Heating/Cooling		5 (***)	20
AVL Suite		Mechanical	Heating/Cooling		2.5	As per final design
Comms	Provides a secure and temperature controlled space for the housing of IC&T and security equipment	Mechanical	Cooling (100% Redundancy)	24 hour operation	1 Person	As per final design
Plant	Air conditioning plant room	Natural				
Passage/ Corridor		From adjacent space	From adjacent space			
Kitchen/Tea		Mechanical	Heating/Cooling			

(*) To be confirmed during detailed design

(**) To be confirmed during detailed design

(***) Area to be designed to permit an increase in inmate capacity of up to 50% (refer to section *2.3.4future expansion*).

2.11.3 Segregation

Room Name	Description	Ventilation Type	Conditioning Type	Comments	Estimated Population Density (m^2/p) (*)	Estimated Power Density (W/m^2) (**)
Single Cell	1x Inmate	Mechanical 90L/s Exhaust, 80L/s Supply Air	Refer to Section 2.5.2 - Inside Design Conditions	Exhaust fan to double as smoke exhaust fan	8.5 (***)	30
Access Cell	1xAccessible inmate	Mechanical 90L/s Exhaust, 80L/s Supply Air	Refer to Section 2.5.2 - Inside Design Conditions	Exhaust fan to double as smoke exhaust fan	8.5 (***)	30
Interview Rm	Staff/inmate interview room	Mechanical	Heating/Cooling		3	20
Bathroom	One bathroom in each accommodation pod.	Mechanical				
Officer Post	Officers' control post	Mechanical	Heating/Cooling		5	20
Yard		Natural	N/A		N/A	N/A
Day Room	Large central, communal living space.	Hybrid	Heating/Cooling		5 (***)	20
AVL Suite		Mechanical	Heating/Cooling		2.5	As per final design

Comms	Provides a secure and temperature controlled space for the housing of IC&T and security equipment	Mechanical	Cooling (100% Redundancy)	24 hour operation	1 Person	As per final design
Plant	Air conditioning plant room	Natural				
Passage/ Corridor		From adjacent space	From adjacent space			
Kitchen/Tea		Mechanical	Heating/Cooling			
Store		Mechanical				
Dispensary	Issue/Store Drugs	Mechanical	Heating/Cooling	Stand alone system	3	20

(*) To be confirmed during detailed design

(**) To be confirmed during detailed design

(***) Area to be designed to permit an increase in inmate capacity of up to 50% (refer to section *2.3.4 future expansion*).

2.11.4 Programs

Room Name	Description	Ventilation Type	Conditioning Type	Comments	Estimated Population Density (m^2/p) (*)	Estimated Power Density (W/m^2) (**)
Officer Post	Officers' control post	Mechanical	Heating/Cooling		5	20
Office small	1x Occupant	Mechanical	Heating/Cooling		2.5	20
Office medium	2-5 Occupant	Mechanical	Heating/Cooling		2.5	20
Office large	6-20 Occupant	Mechanical	Heating/Cooling		2.5	20
Bathroom	One bathroom in each accommodation pod.	Mechanical				
Multi-faith	40 Occupants	Mechanical	Heating/Cooling		40 people	20
Programs 1	Classroom - 20 Occupants	Mechanical	Heating/Cooling		20 people	20
Programs 2	Computer Room - 20 Occupants	Mechanical	Heating/Cooling		20 people	As per final design
Kitchen/Tea		Mechanical	Heating/Cooling		5	30
Meeting		Mechanical	Heating/Cooling		2.5	20
Yard		Natural	N/A		N/A	N/A

Break out space		Mechanical	Heating/Cooling		5	30
Meals		Mechanical	Heating/Cooling		5	20
Interview	Staff/inmate interview room	Mechanical	Heating/Cooling		3	20
Store		Mechanical				
Comms	Provides a secure and temperature controlled space for the housing of IC&T and security equipment	Mechanical	Cooling (100% Redundancy)	24 hour operation	1 Person	As per final design
Plant	Air conditioning plant room	Natural				

(*) To be confirmed during detailed design

(**) To be confirmed during detailed design

2.11.5 Industries (Kitchen &/or Laundry)

Room Name	Description	Ventilation Type	Conditioning Type	Comments	Estimated Population Density (m^2/p) (*)	Estimated Power Density (W/m^2) (**)
Officer Post	Officers' control post	Mechanical	Heating/Cooling		5	10
Office small	1x Occupant	Mechanical	Heating/Cooling		2.5	20
Office medium	2-5 Occupant	Mechanical	Heating/Cooling		2.5	20
Office large	6-20 Occupant	Mechanical	Heating/Cooling		2.5	20
Inmate Clerk		Mechanical	Heating/Cooling		2.5	20
Training Room	20 Occupants	Mechanical			20 people	20
Meals	Includes Kitchen/Tea	Mechanical	Heating/Cooling		2.5	30
Bathroom	One bathroom in each accommodation pod.	Mechanical				
Store		Mechanical				
Chemical Store	Storage of chemicals for laundry use.	Mechanical				

Freezer	Freezer storage of meat and smallgoods.		Cooling: (-)25 to (-)18 °C temp. data logging			
Coolroom	Refrigerated storage of meat and smallgoods.		Cooling: (+)2 °C temp. data logging			
Dry Store		Mechanical				
Wash zone						
Retherm Ovens	4-10 Ovens	Mechanical Commercial Hood	Makeup air via evaporative cooling		5	110
Washing/ Drying	5-15 Machines	Mechanical			5	110
Interview	Staff/inmate interview room	Mechanical	Heating/Cooling		3	20
Comms	Provides a secure and temperature controlled space for the housing of IC&T and security equipment	Mechanical	Cooling (100% Redundancy)	24 hour operation	1 Person	As per final design
Plant	Air conditioning plant room	Natural				

(*) To be confirmed during detailed design

(**) To be confirmed during detailed design

2.11.6 External Stores / Industries (Other)

Room Name	Description	Ventilation Type	Conditioning Type	Comments	Estimated Population Density (m^2/p) (*)	Estimated Power Density (W/m^2) (**)
Officer Post	Officers' control post	Mechanical	Heating/Cooling		5	10
Office small	1x Occupant	Mechanical	Heating/Cooling		2.5	20
Office medium	2-5 Occupant	Mechanical	Heating/Cooling		2.5	20
Office large	6-20 Occupant	Mechanical	Heating/Cooling		2.5	20
Inmate Clerk		Mechanical	Heating/Cooling		2.5	20
Kitchen/Tea		Mechanical	Heating/Cooling		2.5	30
Tool store		Natural				
Yard		Natural	N/A	N/A	N/A	N/A

Training Room	30 Occupants	Mechanical			30 people	20
Meals	Includes Kitchen	Mechanical	Heating/Cooling		2.5	30
Interview	Staff/inmate interview room	Mechanical	Heating/Cooling		3	20
Store						
Comms	Provides a secure and temperature controlled space for the housing of IC&T and security equipment	Mechanical	Cooling (100% Redundancy)	24 hour operation	1 Person	As per final design
Plant	Air conditioning plant room	Natural				

(*) To be confirmed during detailed design

(**) To be confirmed during detailed design

2.11.7 Health

Room Name	Description	Ventilation Type	Conditioning Type	Comments	Estimated Population Density (m^2/p) (*)	Estimated Power Density (W/m^2) (**)
Officer Post	Officers' control post	Mechanical	Heating/Cooling		5	10
Office small	1x Occupant	Mechanical	Heating/Cooling		2.5	20
Office medium	2-5 Occupant	Mechanical	Heating/Cooling		2.5	20
Office large	6-20 Occupant	Mechanical	Heating/Cooling		2.5	20
Bathroom	One bathroom in each accommodation pod.	Mechanical				
Dispensary	Issue Drugs	Mechanical	Heating/Cooling	Stand alone system	3	20
Medicine	Store & sort drugs	Mechanical	Heating/Cooling		3	20
Consultation		Mechanical	Heating/Cooling		3	20
Treatment		Mechanical Med Gases	Heating/Cooling		3	20
Utilities	Cleaning Medical Eq.	Mechanical	Heating/Cooling		3	20
Kitchen/Meals/ Tea		Mechanical	Heating/Cooling		2.5	20
Meeting		Mechanical	Heating/Cooling		2.5	20

Yard		Natural				
Break out space		Mechanical	Heating/Cooling		2.5	20
Holding Cell	No Overnight	Mechanical 90L/s Exhaust, 80L/s Supply Air	Heating/Cooling		8.5	30
Observation Cell	1x Inmate overnight	Mechanical 90L/s Exhaust, 80L/s Supply Air	Heating/Cooling	Separate Smoke Exhaust & Makeup Air	8.5	30
Interview	Staff/inmate interview room	Mechanical	Heating/Cooling		3	20
Store		Mechanical				
Comms	Provides a secure and temperature controlled space for the housing of IC&T and security equipment	Mechanical	Cooling (100% Redundancy)	24 hour operation	1 Person	As per final design
Plant	Air conditioning plant room	Natural				

(*) To be confirmed during detailed design

(**) To be confirmed during detailed design

2.11.8 Visits

Room Name	Description	Ventilation Type	Conditioning Type	Comments	Estimated Population Density (m^2/p) (*)	Estimated Power Density (W/m^2) (**)
Officer Post	Officers' control post	Mechanical	Heating/Cooling		5	10
Office small	1x Occupant	Mechanical	Heating/Cooling		2.5	20
Office medium	2-5 Occupant	Mechanical	Heating/Cooling		2.5	20
Office large	6-20 Occupant	Mechanical	Heating/Cooling		2.5	20
Bathroom		Mechanical			1	6
Baby Change		Mechanical	Via Makeup Air		1	6
Passage		Mechanical	Heating/Cooling			
Waiting Room		Mechanical	Heating/Cooling		2.5	20
Contact Visits	100-200 People	Mechanical	Heating/Cooling		200 people	20
Non-Contact		Mechanical	Heating/Cooling		2.0	20
Legal		Mechanical	Heating/Cooling		2.5	20
Holding Cell	No Overnight	Mechanical	Heating/Cooling		8.5	30
Dress/ Undress	Change clothes and Search	Mechanical	Heating/Cooling		2	10
Kitchen/Tea		Mechanical	Heating/Cooling		2.5	20
Meeting		Mechanical	Heating/Cooling		2.5	20
Yard		Natural				
Meals		Mechanical	Heating/Cooling		2.5	20
Interview	Staff/inmate interview room	Mechanical	Heating/Cooling		3	20
Store						
Comms	Provides a secure and temperature controlled space for the housing of IC&T and security equipment	Mechanical	Cooling (100% Redundancy)	24 hour operation	1 Person	As per final design
Plant	Air conditioning plant room	Natural				

(*) To be confirmed during detailed design

(**) To be confirmed during detailed design

2.11.9 Gatehouse

Room Name	Description	Ventilation Type	Conditioning Type	Comments	Estimated Population Density (m^2/p) (*)	Estimated Power Density (W/m^2) (**)
Officer Post	Officers' control post	Mechanical	Heating/Cooling		5	10
Office small	1x Occupant	Mechanical	Heating/Cooling		2.5	20
Office medium	2-5 Occupant	Mechanical	Heating/Cooling		2.5	20
Office large	6-20 Occupant	Mechanical	Heating/Cooling		2.5	20
Bathroom	One bathroom in each accommodation pod.	Mechanical				
Waiting Room		Mechanical	Heating/Cooling		2.5	20
Armoury		Mechanical	Heating/Cooling		5 People	20
Key Dist/ Ready Room		Mechanical	Heating/Cooling		5 People	20
Locker Room	Staff Change	Mechanical	Heating/Cooling		2.5	20
Control Room	Security Screens	Mechanical	Heating/Cooling	24 hour operation - stand alone system	2.5	As per final design
Server Room	Security System	Mechanical	Cooling CRAC Units (100% Redundancy)	24 hour operation	2 Person	As per final design
Carrier Room	Communications	Mechanical	Cooling (100% Redundancy)	24 hour operation	1 Person	As per final design
UPS/Elec		Mechanical	Cooling	24 hour operation	1 Person	As per final design
Print Room		Mechanical	Heating/Cooling		10	30
Kitchen/Tea		Mechanical	Heating/Cooling		2.5	20
Meeting	5-20 Occupant	Mechanical	Heating/Cooling		20 people	20
Meals		Mechanical	Heating/Cooling		2.5	20
Interview	Staff/inmate interview room	Mechanical	Heating/Cooling		3	20
Store		Mechanical				

Plant	Air conditioning plant room	Natural				

(*) To be confirmed during detailed design

(**) To be confirmed during detailed design

2.11.10 Administration

Room Name	Description	Ventilation Type	Conditioning Type	Comments	Estimated Population Density (m^2/p) (*)	Estimated Power Density (W/m^2) (**)
Officer Post	Officers' control post	Mechanical	Heating/Cooling		5	10
Office small	1x Occupant	Mechanical	Heating/Cooling		2.5	20
Office medium	2-5 Occupant	Mechanical	Heating/Cooling		2.5	20
Office large	6-20 Occupant	Mechanical	Heating/Cooling		2.5	20
Bathroom	One bathroom in each accommodation pod.	Mechanical				
Armoury		Mechanical	Heating/Cooling		5 People	20
Key Dist/ Ready Room		Mechanical	Heating/Cooling		5 People	20
Locker Room	Staff Change	Mechanical	Heating/Cooling		2.5	20
Control Room	Security Screens	Mechanical	Heating/Cooling		2.5	20
Server Room	Security System	Mechanical	Cooling CRAC Units (100% Redundancy)	24 hour operation	2 Person	As per final design
Print Room		Mechanical	Heating/Cooling		10	30
Kitchen/Tea		Mechanical	Heating/Cooling		2.5	20
Meeting	5-20 Occupant	Mechanical	Heating/Cooling		20 people	20
Meals		Mechanical	Heating/Cooling		2.5	20
Interview	Staff/inmate interview room	Mechanical	Heating/Cooling		3	20
Store		Mechanical				
Comms	Provides a secure and temperature controlled space for the housing of	Mechanical	Cooling (100% Redundancy)	24 hour operation	1 Person	As per final design

	IC&T and security equipment					
Plant	Air conditioning plant room	Natural				

(*) To be confirmed during detailed design

(**) To be confirmed during detailed design

2.11.11 Reception

Room Name	Description	Ventilation Type	Conditioning Type	Comments	Estimated Population Density (m^2/p) (*)	Estimated Power Density (W/m^2) (**)
Officer Post	Officers' control post	Mechanical	Heating/Cooling		5	10
Office small	1x Occupant	Mechanical	Heating/Cooling		2.5	20
Office medium	2-5 Occupant	Mechanical	Heating/Cooling		2.5	20
Office large	6-20 Occupant	Mechanical	Heating/Cooling		2.5	20
Bathroom	One bathroom in each accommodation pod.	Mechanical				
Secure Store		Mechanical				
Property Store		Mechanical	Heating/Cooling		10	20
Secure Waiting		Mechanical	Heating/Cooling		8.5	15
Holding Cell		Mechanical	Heating/Cooling		8.5	30
Processing		Mechanical	Heating/Cooling		10	20
Kitchen/Tea		Mechanical	Heating/Cooling		2.5	20
Meeting	5-20 Occupant	Mechanical	Heating/Cooling		20 People	20
Meals		Mechanical	Heating/Cooling		2.5	20
Interview	Staff/inmate interview room	Mechanical	Heating/Cooling		3	20
Store		Mechanical				
Comms	Provides a secure and temperature controlled space for the housing of IC&T and security equipment	Mechanical	Cooling (100% Redundancy)	24 hour operation	1 Person	As per final design

Plant	Air conditioning plant room	Natural				

(*) To be confirmed during detailed design

(**) To be confirmed during detailed design

2.11.12 Sports / Gym / Recreation

Room Name	Description	Ventilation Type	Conditioning Type	Comments	Estimated Population Density (m^2/p) (*)	Estimated Power Density (W/m^2) (**)
Officer Post	Officers' control post	Mechanical	Heating/Cooling		5	10
Change room	Alcove for inmates to change and for conducting inmate search.	Mechanical				
Store		Natural				
Comms	Provides a secure and temperature controlled space for the housing of IC&T and security equipment	Mechanical	Cooling (100% Redundancy)	24 hour operation	1 Person	As per final design
UPS		Mechanical	Cooling	24 hour operation	1 Person	As per final design
Plant	Air conditioning plant room	Natural				
Court Indoor	Sports Area	Natural				
Bathroom	One bathroom in each accommodation pod.	Mechanical				

(*) To be confirmed during detailed design

(**) To be confirmed during detailed design

3. GENERAL REQUIREMENTS

3.1 Extent of Work

This is a performance specification and has been prepared on the basis that the contractor is responsible for the design, documentation, supply, installation, commissioning, maintenance, warranties, defect liability and shop drawings of the intended services.

The works shall include the provision of new air conditioning and ventilation systems to all new buildings and modifications to existing systems where existing buildings are being upgraded/extended.

For items that are outside the scope of this specification that are proposed, they must be of the highest industry standard and conform to the design intent of the project.

The extent of work includes design, manufacture, supply, installation, testing, commissioning, preventive maintenance and defects liability for the following including all work that is necessary to meet the design intent.:-

1. As required provide Variable Refrigerant Flow (VRF) ducted and non-ducted fan coil units complete with condensers, branch boxes, refrigerant pipes, valves, hangers, fittings and insulation for a complete installation.
2. As required provide packaged reverse cycle air conditioning systems complete with mixing plenums, mounting frames, etc for a complete installation.
3. As required provide reverse cycle ducted and non-ducted fan coil units complete with condensers, refrigerant pipes, valves, hangers, fittings and insulation for a complete installation.
4. Where refrigerant based air conditioning systems are used, provide outdoor air processing units where high a proportion of outside air exists to ensure adequate coil on temperature is maintained.
5. Provide indirect evaporative coolers for the accommodation buildings, complete with indirect ducted gas furnaces, inline fans (where required to overcome the system resistance), fire dampers, filters, ductwork, mixing box, motorised bypass dampers to bypass the evaporative cooler when not required, switching relays, valves, VCDs, diffusers and accessories for a complete installation.
6. Provide dual purpose exhaust systems for the accommodation buildings complete with distribution ducting from individual cells to outside, motorised smoke dampers, subducts located within each cell riser, switching relays, valves, VCDs, diffusers and accessories for a complete installation. In normal operation the system shall provide exhaust ventilation of the cell's toilet/shower. In the event of a fire the system shall run at an increased speed (nominally 2 times normal flowrate) to aid in smoke removal. The final flowrates and fire requirements to be confirmed in conjunction with the building certifier during detailed design.
7. Provide smoke control ventilation systems in the accommodation buildings including fans, smoke dampers and actuators, interface panel, and all distribution air devices for a complete installation.
8. Where required by the individual project, provide the following ventilation systems in accordance with this specification and the relevant standards:
    - Kitchen exhaust systems including canopies
    - Smoke exhaust systems
    - Toilet exhaust systems
    - General ventilation systems
9. Where required by the individual project provide carpark ventilation systems including:

- Car park supply and exhaust fans with variable speed drive
- Sound Attenuators
- loading dock exhaust
- All associated wiring, dampers and controls to form a complete system

10. Provide drain, overflow and bleed-off piping from equipment and ductwork as required to properly remove condensation. Note that condensation drain shall be oversized to minimize risk of blockage in gravity drains and shall be based on 32mm diameter condensate drain minimum.
11. Provide cold water piping complete with backflow prevention device from valved terminations for makeup water to expansion devices, evaporative coolers and the like.
12. Provide all ductwork air distribution systems. Air distribution systems shall include all air intake, supply return and exhaust ductwork, air distribution devices, grilles, motorised and manual dampers, filters and air handling equipment for complete HVAC installation.
13. Where required for security purposes provide security grilles in all ducts entering secure accommodation. The grilles shall be constructed from minimum 3mm thick stainless steel perforated plate with maximum 3.25mm holes at 6.35mm spacing to achieve minimum 50% free area with finishes applied. The grille shall be fixed to a 3mm thick steel header box fixed into floors, ceilings and walls in an approved manner. Final details to be approved by the security consultant.
14. Where required for security purposes provide security grilles in all ducts crossing secure walls consisting of 10mm steel bars at 125mm centres, fixed into ductwork in a minimum 5mm steel frame. Final details to be approved by the security consultant.
15. Provide miscellaneous ventilation supply and exhaust distribution systems including all air distribution devices and VSDs for a complete installation.
16. Provide all supports and anchorage as necessary. Ensure no hanging or ligature points in General Access Areas.
17. Provide all Variable Speed Drives.
18. Provide all flexible connections, anti-vibration mounts, inertia bases, duct attenuators and acoustical plenums for a complete installation;
19. Provide thermal and acoustic insulation;
20. Acoustic attenuators as required to meet the room design criteria.
21. Provide plinth surrounds for all floor mounted plant;
22. Static pressure calculations of all water and air systems to verify pump and fan duties against actual installed equipment;
23. Co-ordination of access panels;
24. Certification of fire damper installation and any fire rated ductwork;
25. Maintenance and servicing of all equipment during the defects liability period;
26. Over-flashing of ducts, pipes and the like penetrating the roof and external walls;
27. Trim angles around ductwork penetrations exposed to view;
28. Supply only of door grilles (unsecure type);

29. Provide plinth surrounds for all floor mounted plant.

30. Sound attenuator serving kitchen exhaust ducts shall be provided with grease proof Mylar coating.

31. Coordination of work with other trades.

32. Electrical (Mechanical)

    - Provide new or modify existing mechanical services switchboard(s) for the air conditioning and ventilation systems.
    - Provide new or modify existing mechanical services essential switchboard(s) for the smoke exhaust systems.
    - Connection of Power Supply to all mechanical equipment from the mechanical switchboards
    - Provide electrical meters in the mechanical switchboards for all major equipment capable of being connected to the BMCS or metering system.
    - Provision of terminal strips within the mechanical services switchboards for fan run, fan stop and fan fault indicator lights and for fan AUTO-OFF-ON control switches. The Fire Services Trade shall provide fire trip signals from the Fire Indicator Panel. Terminate and connect to the terminal strips. Allow for full coordination of this work with the Fire Services Trade.

33. BMCS system

    - For new facilities a new BMCS system shall be provided as part of the mechanical package.
    - For existing facilities the BMCS system shall be extended/modified as part of the mechanical package.

34. Painting and labelling of the completed installation.

35. Supply of sleeves, holding bolts, conduits and any other fittings or fixings required to be built in during construction.

36. Hoisting of all equipment and provision of all required scaffolding.

37. Replacement of all air filters and strainers immediately prior to handover;

38. Pre-commissioning cleaning of all pipework systems in accordance with BSRIA BG 29/2012.

39. During pre-commissioning cleaning of pipework systems, the mechanical contractor shall ensure water is not flushed through terminal devices (coils) or central plant (plate heat exchangers). This is to include water introduced to allow sequential pressure testing of the system.

40. Testing and commissioning of all equipment;

41. Commissioning of all pipework systems in accordance with BSRIA BG 2/2010;

42. Commissioning of all air systems in accordance with BSRIA 49/2015;

43. Provide 2 hard copy and 3 softcopy (USB format) of operating and maintenance instructions including "as installed" drawings in PDF, AutoCAD, and Revit formats, completed test reports, and spare parts and equipment data. The BMCS manual shall be provided separately.

44. Provide 12 months' Defects Liability. In addition to the warranties required under the Defects Liability Period provide warranties on all services and systems, including installed reticulation systems, BMCS systems, wiring systems and communication systems. Include the details of such warranties within the As Built Documentation. All warranties must include parts, labour, delivery, any re-testing and/or commissioning, removal and disposal of faulty parts. All warranty periods must commence on the date of

handover, the contractor must make any necessary arrangements with equipment suppliers to ensure of this requirement is met

45. Provide 12 month Preventative Maintenance contract for all mechanical services, including the provision of three (3) sets of replacement air filters.

46. Provide Design Certification and Installation Certification of the installation, to suit the Client's requirements.

3.2 Existing Services

The Contractor shall in general decommission, isolate, demolish and remove as required from the site, all existing redundant equipment including minor associated components that shall become redundant as a result of the corresponding existing services.

The works above mentioned have been documented to the advantage of the Contractor and it shall form part of the Contractor's duty of care and above all compliance statement and contract that any services known to be existing and requiring modification, alteration or otherwise removal shall be allowed for in their costs as part of this Specification's tender form.

3.3 Interfaces with Other Trades

Please note that the Extent of Work, Other HVAC Trade Inclusions and Associated Works by Others Trades sections are intended as a guide only as to the possible division of the works of this trade and those of other trades under the Contract.

3.3.1 Electrical/Mechanical

Interface	Electrical	Mechanical
Mechanical switchboard	Provide essential and non-essential 3-phase, 400 volts, neutral and earth submains from the main switchboard to the mechanical switchboards. Terminate and connect submains to the mechanical switchboard.	Provide all mechanical switchboards.
Circuit Breaker cascading and discrimination	Provide Circuit Breaker Manufacturing details to the Mechanical Sub-contractor to allow cascade and discrimination throughout the building.	Installation of circuit breakers in mechanical switchboard to comply with the cascade and discrimination strategy throughout the building.
Lighting and power	Provision of lighting and general power outlets in the plantrooms.	
Power Supply	Provision of power to fan coil units, toilet exhaust, Communications room and condenser units.	
Sensors	Motion sensors and associated control signals for speed control of local extract fans, and central exhaust fans.	

3.3.2 Generator/Mechanical

Interface	Generator	Mechanical
Acoustic Attenuation	Coordinate location of generator with required acoustic attenuators. Provide exhaust attenuation to comply with outside noise level requirements.	Provide acoustic attenuators for generator room inlet and outlet to comply with outside noise level requirements.
Contactor for isolating plant that does not run on the generator	Wiring from Load Management System to terminals in mechanical switchboard	Provide contactor and labeled terminals in the mechanical switchboard.

3.3.3 Metering/Mechanical

Interface	Metering	Mechanical

Mechanical Meters	Provide technical requirements of meters suitable for connection to metering system. Connection of the mechanical switchboard meters to the metering system including all cabling. Arrange for testing of the mechanical switchboard meters to verify that the meters are correctly reporting to the metering system.	Provide electrical meters in the mechanical switchboard. Provide meter calibration data. Run mechanical plant to verify that meters are correctly reporting to the BMCS/metering system.

3.3.4 Hydraulic/Mechanical

Interface	**Hydraulic**	**Mechanical**
AHU condensate drains	Provision of trapped floor wastes and tundishes adjacent to AHU's connected to the sewer.	Provide piping from the AHU's to the tundishes provided. Ensure that there is sufficient fall and leave a AS3500 compliant air gap.
FCU condensate drains	Provide tundishes for condensate drains	Provide condensate piping and condensate pumps if required to the tundish.
Humidifier drain downs	Provision of a pump out unit and tundish adjacent to any major computer room suitable for accepting hot (100°C) water blowdown from the CRAC unit humidifiers.	Provision of pipework from the CRAC units to the tundish and leave a AS3500 compliant air gap.
Evaporative Coolers	Water supply including isolation valve and back flow prevention	Final connection to unit.
Gas Heaters	Provision of natural gas to the gas heater including termination	Provide gas requirements.

3.3.5 Fire/Mechanical

Interface	**Fire**	**Mechanical**
General Fire Alarm	Wire from the Fire Indicator Panel and connect to terminal strip in mechanical services switchboard in each location as required.	Provide control wiring, terminal strip, relays and interlocks associated to receive 24V dry contact from FIP.
Fire Indicator Panel (FIP)	Provide FIP complete with interface logic & field based hardware to interface with mechanical services switchboard.	Provide the Fire Services Contractor with the information required for the FIP to interface with the mechanical services switchboard/s.
Fire Fan Control Panel	Provide FFCP complete with interface logic & field based hardware to interface with mechanical services switchboard.	Provide the Fire Services Contractor with the information required for the FIP to

Interface	Fire	Mechanical
		interface with the mechanical services switchboard/s.
Air handling plant fire mode operation	Wire from the Fire Indicator Panel/fire fan control panel and connect to terminal strip in mechanical services switchboard.	Provide control wiring, terminal strip, relays and interlocks associated with the air handling plant fire mode operation in the mechanical services switchboard.
Air handling plant equipment	Provide all fire detection hardware required to interface with the mechanical air handling system to ensure correct operation during fire mode.	Provide information to the Fire Services contractor pertaining to mechanical duct work locations for fire detection hardware to be installed.
Fire smoke dampers	Wire from the Fire Indicator Panel and connect to terminal strip in mechanical services damper control panel in each location as required.	Provide control wiring, terminal strip, relays and interlocks associated with fire/smoke dampers in air ducts, plenums and penetrations.
Smoke Control (&/or Ventilation)	Wire from the Fire Indicator Panel/fire fan control panel and connect to terminal strip in mechanical services switchboard. Provide the following signals: • Exhaust Fan Run • Exhaust Fan Stop • Supply Fans Run • Supply Fans Stop Pick-up the fan status signals from the terminal strip in the mechanical switchboard.	Provide control wiring, terminal strip, relays and interlocks associated with the smoke control (&/or ventilation) plant fire mode operation in the mechanical switchboard. Provide fan status signals within the Fire Fan Control Panel (FFCP).
Smoke detectors in air handling units ductwork and plenums	Provision of a complete smoke detection system to serve the air conditioning systems and the ventilation systems in accordance with AS 1670.1, including supply air and return air smoke detectors, required exit smoke detectors and provision of an integrated Fire Indicator Panel and Fire Fan Control Panel (FFCP).	Provide access panels for access to smoke detectors etc. Provide openings and penetrations for the passage of wiring, conduit, smoke detectors, etc. Provision of collars and sealing of penetrations.
Sprinklers in air handling units ductwork and plenums, etc	Provision of a sprinkler and piping complete with duct box connected to sprinkler system network piping.	Provide access panels for access to sprinkler heads. Provide openings and penetrations for the passage of fire services pipework, sprinklers, etc. Provision of collars and sealing of penetrations.
Full Fire Function Matrix (FFFM)	Complete FFFM.	Coordinate with the Fire Services contractor all equipment required to operate in fire mode.

Interface	Fire	Mechanical
		Review FFFM for sign off during commissioning.
Tactical Fire Plan	Prepare the tactical fire plan for the building.	Provide the information required for the tactical fire plan.
Commissioning (Full Function Fire Test)	Arrange for integrated testing of the fire system.	Provide all personnel and equipment necessary for commissioning of all mechanical systems fire mode operations.

3.3.6 Builder/Mechanical

Interface	Builder	Mechanical
Ceiling Tiles		Removal and replacement of ceiling tiles for commissioning of ceiling mounted equipment.
Openings through the building structure for the passage of ductwork, pipework and the like.	Provide clear openings through the building structure.	Submit details of openings required. Fire stopping of penetrations through fire rated floors, walls and the like by pipework, conduit, etc. Provision of fire dampers for all duct penetrations through fire rated walls and floors.
Access panels for the inspection, adjustment, access and maintenance of equipment	Provide access openings and panels in walls, masonry shafts and ceilings.	Provide a marked up drawing of required access panels required prior to commencement on site.
General lighting, temporary power and water for construction purposes	Provide access lighting, temporary power and water for construction purposes.	Provide task lighting.
Water, gas and electricity for commissioning and test running of the plant and equipment.	Provide water, gas and electricity for commissioning and test running of the plant and equipment.	Submit commissioning plans and schedules.
Perimeter kerbs around cooling tower enclosure	Provide 150mm perimeter kerbs around the cooling tower enclosure.	Provide detailed drawings within 4 weeks of issue of contract.
Roof or External Wall penetrations		Install deck-tights, over flashing and under flashing of ducts, pipes and the like penetrating external walls and roof.
Concrete piers for the cooling towers	Pouring of concrete piers for the cooling towers .	Provide pier frames.
Concrete plinths under floor mounted plant and equipment	Pouring of concrete plinths under floor mounted plant and equipment.	Provide plinth frames.
Platforms, ladders and catwalks	Provide ladders and catwalks as required for maintenance access.	Provide drawings of platforms ladders and catwalks required to access plant and equipment.
Outside Air Louvres	Provide outside air louvres.	Blank off unused sections of outside air louvres. Provide outside air plenums.

Interface	Builder	Mechanical
Door Grilles (un-secure type)	Install door grilles.	Supply door grilles.
Door Grilles (secure type)	Provide and Install secure door grilles.	Advice regarding open area.
Security Grilles	Approval of security grilles.	Provide compliant grilles
External openings in accommodation buildings	Provide and install external natural ventilation openings.	Provide advice regarding free area.
Cranage		Provide all cranage for mechanical plant.
Fire Rated Ductwork		Fire rating of ductwork.
Ductwork and pipework supports		Provision of all ductwork and pipework supports.
Acoustic Treatment of Duct and Plenums/Rooms	Provision and installation of all acoustic to plenums and walls (eg. Generator Room)	Provision and installation of acoustic insulation on all ductwork and all specified silencers.

3.3.7 BMCS/Mechanical

Interface	BMCS	Mechanical
Monitoring and Control of Mechanical Systems	Wiring from the BMCS field device to the terminal strip in the mechanical switchboard	Provide all interface points between the mechanical installation and the BMCS via dedicated segregated and labelled BMCS terminal strips within all mechanical services switchboards
Commissioning	Commission complete air conditioning and ventilation system in conjunction with the Mechanical subcontractor.	Commission complete air conditioning and ventilation system in conjunction with the BMCS subcontractor. Record and advise BMCS subcontractor of all set points determined during commissioning for VAVs, fan static pressure, damper positions required to maintain required outside air rates at various supply fan speeds, chilled and hot water system pressures etc.
Temperature sensors	Supply pipe wells to mechanical contractor for installation. Provide temperature sensors and wire back to BMCS field device	Provide tappings and install all pipe wells supplied by the BMCS subcontractor.
Pressure transducers	Supply pressure transducers to mechanical contractor for installation. Wire from sensor back to BMCS field device.	Provide valved pressure tappings in pipework for pressure transducers and install pipework to transducer ports as listed in the point's schedule.

Interface	BMCS	Mechanical
Control Valves	Supply all control valves to mechanical contractor to install. Provide power supply and control signals from BMCS field device to control valves.	Install and insulate all control valves supplied by the BMCS subcontractor

3.3.8 Lift/Mechanical

Interface	Lift	Mechanical
Lift Ventilation	Provide details of lift ventilation requirements	Provision of lift well ventilation grilles in the top of each lift well. Grills need to provide cross flow ventilation and must be stormproof (100% to 99% water effectiveness at a core velocity of up to 3.5 m/s) as the top of the well contains 415 volt equipment. The minimum ventilation area is 1% of the cross sectional area of the lift well.

3.4 Drawings

3.4.1 Shop Drawings

Provide shop drawings for review prior to ordering of equipment.

Drawings shall be provided in .DWG or .DXF or Revit 2017 format.

3.5 Detailed Drawings

Provide detailed drawings showing locations and sizes of access openings, penetrations, plinths, drain points, and any other item required to be provided by other trades.

3.6 Samples

Samples shall be provided as specified. Samples are intended to provide a reference for acceptable plant, equipment, materials, workmanship, finish, quality and the like of the finally installed items. Samples will be accepted and retained on site until released for incorporation into the final works, or will be rejected for resubmission.

Submit samples to allow fourteen working days for comment and adequate time for alterations and resubmission.

3.7 Obvious Work

The mechanical services documents show the design intent and general arrangement of equipment. They do not show minor works or obvious works and items that are necessary to provide fully functioning systems in full compliance with the design intent and the technical requirements of the documents. Provide such obvious work.

Make all necessary alterations to the general arrangement and system design to accommodate any equipment offered and accepted as an alternative to the specified equipment.

Coordinate the work with other trades.

3.8 Equipment Bases

Concrete equipment bases shall be of the general arrangement shown on the drawings or detailed in this specification and shall extend 75mm beyond the extremities of the equipment. Surfaces shall be shaped and graded for drainage where required and edges shall be rounded or bevelled. Where equipment needs to be elevated for drainage or other purposes, check dimensions nominated and make such changes as are necessary to ensure satisfactory installation of equipment.

Check holding down bolts in equipment bases on the job to ensure correct positioning. Where equipment bases are provided by others, provide detailed dimensioned drawings and adequate site supervision to ensure that the bases are installed in accordance with requirements.

3.9 Spring Mounted Inertia Blocks

Provide spring mounted inertia blocks where specified or shown on the drawings. Design the inertia blocks to suit the equipment mounted on them with due regard to weight and speed and the requirements of this Specification's clause *Noise and Vibration*. Provide rounded or bevelled edges and adequate reinforcing. Make provision for the spring supports, either by suitable shaping of the block or by the provision of rigid brackets.

3.10 Fastenings

Fix equipment of significant weight with expanding masonry anchors in drilled holes suitably selected to take the load of the equipment concerned.

Fix conduits with suitable fixing screws bedded in properly plugged holes. Plug holes with Rawlplugs, Rawloks, Rawlsets or Rawltamps, suitably selected for the load concerned. Fixing by means of explosive powered fasteners is not permitted without approval.

3.11 Maintenance Access

Practical maintenance access to all parts requiring maintenance is essential for ongoing efficiency. The following specific requirements apply:

- Maintenance access to all moving parts is required. Maintenance access needs to be practical, with sufficient space and ease of access for maintenance to be conducted without significant physical discomfort, personal risk, or potential damage to plant and equipment.
- Access panels to ductwork must be arranged with opening doors or clip-sealed panels and must not require tools to open or close.
- All damper sets must have access panels so that the actual position and closure of the dampers can be readily inspected.
- All coils must have access panels to permit cleaning.
- The location of appropriate access points to VAV terminals above ceiling grids must be marked via small indicators on the metal grid network, and the associated ceiling tiles must be able to be moved without interference with or from ductwork, lighting fittings, cables, etc. Consideration should be given to sealing the edges of these tiles so that movement does not cause the normal amounts of dust.

- Operational indicators. It should be possible to unambiguously interpret the operation of valves and dampers from visual inspection. To this end the following measures are required:
    - All valves must have indicators that show the position of the valve.
    - All damper motors must have indicators that show the position of the dampers.
    - Upon setting of damper cams on damper motor spindles both spindle and cam connection should be permanently marked (e.g. via a hacksaw scribe) to show the correct alignment. This enables detection of a spindle that is loose and no longer operating the damper cam.
    - Actuators and associated position indications must be visible from the plant room floor. Where this is not possible, access platforms should be required to enable access and inspection without the need to climb on ductwork, etc.
    - Signage indicating valve or damper position must be permanent and must accurately and unambiguously indicate the positions of the fully closed and fully open settings for the dampers.
    - It should be possible to locate all plant and equipment with ease, and no items should be located such that they may become lost or forgotten due to difficulty of access or lack of visibility.

3.12 National Refrigeration and Air Conditioning Licensing Scheme

The Mechanical Trade must have a Refrigerant Handling License when carrying out work associated with the handling of CFC, HCFC, HFC or PFC refrigerants.

A Refrigerant Trading Authorisation must be held by the Mechanical Trade for acquiring, possessing, or disposing of CFC, HCFC, HFC or PFC.

3.13 Refrigeration Systems and Heat Pumps – Safety and Environmental Requirements

The installation shall be design and installed in accordance with the following standards:

a) AS 817-2016 – Refrigeration Designation and Safety Classification
b) AS 5149.1-2016 – Refrigeration Systems and Heat Pumps – Safety and Environmental Requirements – Definitions, Classifications, and Selection Criteria.
c) AS 5149.2-2016 – Refrigeration Systems and Heat Pumps – Safety and Environmental Requirements – Design, Construction, Testing, Marking, and Documentation.
d) AS 5149.3-2016 – Refrigeration Systems and Heat Pumps – Safety and Environmental Requirements – Installation Site.

No variations will be accepted for modifications, enhancements, or adjustments to the mechanical services, or building works for failure to comply with the above requirements.

4. PACKAGED AIR COOLED AIR CONDITIONING UNITS

4.1 General

Packaged air conditioning units shall be air cooled, factory assembled units to the manufacturer's standard design, containing air handling, refrigeration and electrical equipment in factory fabricated casings.

All units shall be reverse cycle type, unless otherwise specified.

Capacity ratings shall be derived from tests, which have been conducted in accordance with ANSI/ASHRAE Standard 37, Methods of Testing for Rating Unitary Air Conditioning and Heat Pump Equipment, or other established test method.

4.2 Energy Efficiency Requirements

Package air conditioning units shall have a COP not less than that scheduled at the specified duties. Where no minimum COP has been specified the packaged air conditioning units shall comply with MEPS or NCC Section J as applicable.

Packaged air conditioning unit (except non-ducted units with a supply air capacity less than 1000L/s) supply air fans shall have an absorbed fan motor power of less than or equal to the scheduled value at the scheduled duty. At a minimum where no fan power is scheduled the fan power shall be less than and equal to that required by NCC section J

4.3 Casings

Casings shall be machine folded sheet metal, reinforced where necessary with stiffening channels or angles, capable of supporting and retaining the components of the assembly without excessive noise and vibration.

Casings shall be treated to resist corrosion and finished externally with the manufacturer's standard factory applied paint system. Casings exposed to weather shall have top surfaces sloped for drainage. Equipment exposed to public view shall have a decorative finish.

Casings shall be internally insulated as necessary to control noise emission and prevent condensation. Insulation materials shall have a spread of flame index not greater than 0 and a smoke developed index not greater than 3 when tested on the exposed face in accordance with AS 1530.3.

Internal equipment shall be accessible for service and removal in the installed location. Provide doors or readily removable panels to permit convenient service access to the components. Access panels shall be secured by fasteners which are suitable for repetitive use.

4.4 Supply Fans

Supply fans shall be double inlet centrifugal type, dynamically balanced to AS 3709 quality grade G6.3. Fan and motor bearings shall be ball bearings designed for a life not less than 25,000 hours. Bearings shall be grease packed, sealed type or regreasable bearings in grease relief housings with grease nipples.

Supply fans shall be direct driven or belt driven. Fans shall deliver the scheduled air quantity against the resistance of the installed system. Provide nonstandard motors and drives where necessary to achieve the scheduled performance.

Direct driven fans shall be capable of operation at high, medium and low speed as selected on the unit's control switch.

4.5 Refrigerant

The refrigerant used shall have an ozone depletion potential (ODP) of 0.

4.6 Refrigeration System

Each refrigeration compressor shall be mounted on spring isolators and shall have an independent refrigeration circuit. Internal refrigeration circuits shall be factory installed with all necessary fittings, high and low pressure cutouts, charging valve, and insulation. The system shall be factory charged with oil and refrigerant and factory tested.

The refrigeration system shall have not less than the scheduled number of cooling stages. Capacity control may be provided by a compressor unloading device.

Refrigeration compressors shall have crankcase heaters.

4.7 Evaporator Coils

Evaporator coils shall be copper tube aluminium fin type, mounted to ensure drainage of condensate and prevent air by-passing the coils.

Multiple circuit units shall have their evaporator circuits interlaced to cool the total unit air flow when a reduced number of refrigeration circuits are operating.

4.8 Condensate Drain

Condensate shall be collected and piped through the unit casing. Condensate drain pans shall be copper, stainless steel, plastic or fibreglass. Alternatively, they may be galvanised steel protected with bituminous or epoxy paint. Pans shall be insulated to prevent sweating.

Provide a trapped and insulated copper or PVC drain pipe with a minimum diameter of 32mm to a visible discharge at an approved drain point. Provide inspection ports to allow cleaning. The trap shall ensure correct condensate drainage and maintenance of a water seal during unit start up and operation.

4.9 Electrical Equipment

Electrical equipment and wiring shall be factory wired into an electrical control panel with a terminal strip for field wiring. Electrical equipment shall comply with Australian regulations. The control panel shall be sealed to prevent induction of dust by negative pressures inside the unit. Factory fitted electrical equipment shall include:

- Starter and overload protection for the evaporator fan
- Starter, overload and integral over temperature protection for each compressor
- High discharge pressure protection for each compressor
- Compressor short cycling protection by a timer or a lockout relay on compressor safety controls
- Any other equipment normally provided with the standard unit or recommended by the manufacturer for the particular installation

Electrical devices for associated field mounted equipment may be mounted on the unit control panel if space is available. Otherwise, provide a separate switchboard.

Provide an isolating switch adjacent to the unit if necessary to comply with regulations.

4.10 Condensers

Condensers shall have a seamless copper tube, aluminium finned condensing coil, sub-cooling coil and a separate refrigerant circuit matched to each compressor in the unit.

Guards shall be fitted where necessary to prevent accidental contact with moving parts and to protect coil fins against damage.

Provide an isolating switch adjacent to the condenser where necessary to comply with AS 3000.

Propeller type condenser fans shall be constructed from corrosion resistant materials and shall be balanced for vibration free operation. Fan motors shall be weatherproofed, shall have built in thermal protection and shall be resiliently mounted. Bearings shall be sealed ball bearings.

Protect condenser coil with factory applied air drying phenolic coating resistant to dilute acids, dilute alkalis, solvents, inorganic salts and salt laden air.

Centrifugal condenser fans shall be belt driven, forward curved, double inlet type constructed from corrosion resistant materials and shall be dynamically balanced to AS 3709 quality grade G6.3. The drive assembly and motor shall be fully weatherproofed. Fan and motor bearings shall be sealed for full life operation. Motors shall have built in thermal protection. Fans shall deliver the rated air quantity against the resistance of the air intake and discharge system.

4.11 Performance

The coefficient of performance (COP) of the refrigeration system shall not be less than 3.0 when operating with 19°C evaporator entering wet bulb temperature and 35°C condenser entering air temperature.

Units shall be capable of continuous cooling operation at maximum rated air flow with 25°C evaporator entering wet bulb temperature and 45°C condenser entering dry bulb temperature, and with 14°C evaporator entering wet bulb temperature and 20°C ambient temperature at the condenser without forming frost on the evaporator coil.

4.12 Low Ambient Option

Packaged units serving equipment rooms shall be capable of continuous cooling operation at maximum rated air flow with an evaporator entering wet bulb temperature of 24°C and condenser entering air temperatures from -5°C to 45°C.

4.13 Reverse Cycle Units

Reverse cycle packaged air conditioning units shall automatically change between the cooling and the heating cycles under the control of the room thermostat. Defrosting of the outdoor coil shall be automatically controlled and the indoor supply air temperature shall not drop below 20°C during the defrosting period.

4.14 Filters

Refer to separate section FILTERS.

5. SPLIT AIR CONDITIONING UNITS

5.1 General

Split air conditioning units shall be air cooled, factory assembled units to the manufacturer's standard design, containing air handling, refrigeration and electrical equipment in factory fabricated casings. The indoor unit shall house the supply fan and evaporator coil, while the outdoor unit shall house the compressor(s), condenser coils(s), and condenser fans.

All units shall be reverse cycle type, unless otherwise specified.

Capacity ratings shall be derived from tests, which have been conducted in accordance with ANSI/ASHRAE Standard 37, Methods of Testing for Rating Unitary Air Conditioning and Heat Pump Equipment, or other established test method.

5.2 Energy Efficiency Requirements

Package air conditioning units shall have a COP not less than that scheduled at the specified duties. Where no minimum COP has been specified the packaged air conditioning units shall comply with MEPS or NCC Section J as applicable.

Packaged air conditioning unit (except non ducted units with a supply air capacity less than 1000L/s) supply air fans shall have an absorbed fan motor power of less than or equal to the scheduled value at the scheduled duty. At a minimum where no fan power is scheduled the fan power shall be less than and equal to that required by NCC section J

5.3 Casings

Casings shall be machine folded sheet metal, reinforced where necessary with stiffening channels or angles, capable of supporting and retaining the components of the assembly without excessive noise and vibration.

Casings shall be treated to resist corrosion and finished externally with the manufacturer's standard factory applied paint system. Casings exposed to weather shall have top surfaces sloped for drainage. Equipment exposed to public view shall have a decorative finish.

Casings shall be internally insulated as necessary to control noise emission and prevent condensation. Insulation materials shall have a spread of flame index not greater than 0 and a smoke developed index not greater than 3 when tested on the exposed face in accordance with AS 1530.3.

Internal equipment shall be accessible for service and removal in the installed location. Provide doors or readily removable panels to permit convenient service access to the components. Access panels shall be secured by fasteners which are suitable for repetitive use.

5.4 Refrigerant

The refrigerant used shall have an ozone depletion potential (ODP) of 0.

5.5 Refrigeration System

Each refrigeration compressor shall be mounted on spring isolators and shall have an independent refrigeration circuit. Internal refrigeration circuits shall be factory installed with all necessary fittings, high and low pressure cutouts, charging valve, and insulation. The system shall be factory charged with oil and refrigerant and factory tested.

The refrigeration system shall have not less than the scheduled number of cooling stages. Capacity control may be provided by a compressor unloading device.

Refrigeration compressors shall have crankcase heaters.

5.6 Indoor Units

The indoor fan coil unit shall be of the type scheduled.

Ducted fan coil units shall be suitable for connection of supply and return air ductwork.

Free blow fan coil units shall incorporate decorative supply and return air grilles. Supply air grilles shall have adjustable vertical and horizontal vanes to control the direction of air flow. A control panel shall be provided on free blow fan coil units incorporating an on/off switch, thermostat set point adjustment and a fan speed controller (if applicable).

Cassette type fan coil units shall be mounted through the ceiling, semi exposed and supported from the structure above. Supply air diffusers shall be arranged to discharge air along the ceiling. On cassette type fan coil units the control panel shall be incorporated into a small prewired console suitable for wall mounting, or be a hand held remote type, as scheduled elsewhere. The wiring harness for these controls shall be neatly installed in mini-strip ducting.

5.7 Supply Fans

Supply fans shall be double inlet centrifugal type, dynamically balanced to AS 3709 quality grade G6.3. Fan and motor bearings shall be ball bearings designed for a life not less than 25,000 hours. Bearings shall be grease packed, sealed type or regreasable bearings in grease relief housings with grease nipples.

Supply fans shall be direct driven. Fans shall deliver the scheduled air quantity against the resistance of the installed system. Provide non-standard motors and drives where necessary to achieve the scheduled performance.

Direct driven fans shall be capable of operation at high, medium and low speed as selected on the unit's control switch.

5.8 Evaporator Coils

Evaporator coils shall be copper tube aluminium fin type, mounted to ensure drainage of condensate and prevent air by-passing the coils.

Multiple circuit units shall have their evaporator circuits interlaced to cool the total unit air flow when a reduced number of refrigeration circuits are operating.

Coils shall be fixed so as to be easily withdrawn from the unit casing. The face velocity over the cooling coil shall not exceed 2.5m/s.

5.9 Condensate Drain

Condensate shall be collected and piped through the unit casing. Condensate drain pans shall be copper, stainless steel, plastic or fibreglass. Alternatively, they may be galvanised steel protected with bituminous or epoxy paint. Pans shall be insulated to prevent sweating.

Provide a trapped and insulated copper or PVC drain pipe with a minimum diameter of 32mm to a visible discharge at an approved drain point. Provide inspection ports to allow cleaning. The trap shall ensure correct condensate drainage and maintenance of a water seal during unit start up and operation.

5.9.1 Drip Trays

Provide, under each unit mounted above the ceiling, a drip tray extending sufficiently beyond the extremities of the unit to ensure that any leakage or condensate will not drip onto the ceiling. Drip trays shall be formed from galvanised sheet metal with turned up and rolled edges. Joints shall be sealed water proof.

N.B. Drip trays are to be provided regardless of condensate pump and package unit safety features.

5.9.2 Condensate pumps

Provide condensate drain pump units where necessary to ensure effective drainage of condensate from fan coil units. Condensate pumps shall be Blue Diamond or approved equal.

Condensate pump/tank units shall be installed below a drain outlet in the drip tray. The condensate drain trap from the unit shall be piped to discharge immediately over the drip tray outlet. Where necessary to gain sufficient depth, the trap may be positioned outside the drip tray, provided it is insulated to prevent condensation.

Provide a fault relay from an overflow switch on the drip tray to shut down the air conditioning unit should the condensate pump fail.

5.10 Electrical Equipment

Electrical equipment and wiring shall be factory wired into an electrical control panel with a terminal strip for field wiring. Electrical equipment shall comply with Australian regulations. The control panel shall be sealed to prevent induction of dust by negative pressures inside the unit.

Factory fitted electrical equipment shall include:

- Starter and overload protection for the evaporator fan
- Starter, overload and integral over temperature protection for each compressor
- High discharge pressure protection for each compressor
- Compressor short cycling protection by a timer or a lockout relay on compressor safety controls
- Any other equipment normally provided with the standard unit or recommended by the manufacturer for the particular installation

Electrical devices for associated field mounted equipment may be mounted on the unit control panel if space is available. Otherwise, provide a separate switchboard.

Provide an isolating switch adjacent to the unit if necessary to comply with regulations.

5.11 Outdoor Condensing Units

Condensers shall have a seamless copper tube, aluminium finned condensing coil, sub-cooling coil and a separate refrigerant circuit matched to each compressor in the unit.

Protect condenser coil with factory applied air drying phenolic coating resistant to dilute acids, dilute alkalis, solvents, inorganic salts and salt laden air.

Guards shall be fitted where necessary to prevent accidental contact with moving parts and to protect coil fins against damage.

Provide an isolating switch adjacent to the condenser where necessary to comply with AS 3000.

Propeller type condenser fans shall be constructed from corrosion resistant materials and shall be balanced for vibration free operation. Fan motors shall be weatherproofed, shall have built in thermal protection and shall be resiliently mounted. Bearings shall be sealed ball bearings.

Refrigerant sub-cooling shall be sufficient to prevent flashing of liquid refrigerant and a sub-cooling coil shall be included if necessary.

The unit shall have vertical or horizontal air discharge, to suit the mounting location. Provide a wind deflector on condensers which are exposed to wind pressure.

5.12 Performance

The coefficient of performance (COP) of the refrigeration system shall not be less than 3.0 when operating with 19°C evaporator entering wet bulb temperature and 35°C condenser entering air temperature.

Units shall be capable of continuous cooling operation at maximum rated air flow with 25°C evaporator entering wet bulb temperature and 45°C condenser entering dry bulb temperature, and with 14°C evaporator entering wet bulb temperature and 20°C ambient temperature at the condenser without forming frost on the evaporator coil.

5.13 Low Ambient Option

Packaged units serving equipment rooms shall be capable of continuous cooling operation at maximum rated air flow with an evaporator entering wet bulb temperature of 24°C and condenser entering air temperatures from -5°C to 45°C.

5.14 Reverse Cycle Units

Reverse cycle packaged split air conditioning units shall automatically change between the cooling and the heating cycles under the control of the room thermostat. Defrosting of the outdoor coil shall be automatically controlled and the indoor supply air temperature shall not drop below 20°C during the defrosting period.

5.15 Refrigeration Piping

Refrigeration piping installed on site shall be in accordance with the manufacturer's instructions. Provide the necessary oil traps at the base of gas risers and at the recommended intervals up the riser.

Each site-installed refrigeration circuit shall include a filter/drier, sight glass/moisture indicator, liquid and hot gas shut off valves. Filter dryers in reverse cycle units shall be of the bi-directional type.

Refrigeration pipes shall comply with AS 1571, "Copper - Seamless Tubes for Air Conditioning and Refrigeration".

Annealed copper tubing, if used, shall be straightened to display a neat appearance. Tubes may be bent to a mean radius not less than three pipe diameters. Flattening of the pipe at bends shall not exceed 12.5% of diameter.

Pipe joints and fittings shall be soldered using silver alloy hard solders complying with AS 1167 and having not less than 5% silver. Pass dry nitrogen through the piping system when brazing or soldering.

Fix pipes to the structure using standard pipe fixing devices and protect pipes against chafing at clamp locations by wrapping with PVC tape or other approved method.

Pressure test pipes prior to application of insulation.

Insulate pipes with 13mm minimum thickness insulation with an effective vapour barrier. Insulation inside the building shall have a spread of flame index of 0 and a smoke developed index not greater than 3 in accordance with AS 1530 Part 3.

Clean and charge pipes with refrigerants in accordance with manufacturer's recommendations and Australian Standards.

Identify pipes in accordance with AS 1345.

5.16 Filters

Refer to separate section FILTERS.

6. COMPUTER ROOM AIR CONDITIONING UNITS

6.1 General

The units shall be of the type specifically designed for computer applications and shall be "Edpac", "Liebert/Atlas", "Hiross" or approved equal.

Each unit shall have the capacity specified under the nominated conditions.

6.2 Construction

Each unit shall have a minimum 2.0mm thick steel welded frame with minimum 1.2mm thick steel panels. The complete unit casing shall be corrosion protected and the exterior shall be of high quality standard colour baked enamel finish. Unit casing panels shall be braced as necessary to form a rigid construction and shall be attached to the frame via heavy duty lift-off hinges to provide complete access to equipment. Panels shall be gasketted for air tightness. Door/panel catches shall be heavy duty, simple to operate and shall close the panel firmly on the air seal gasket. Sufficient catches shall be provided to ensure the panels are sealed completely around their perimeter. Panels which rattle or which do not seal properly will not be accepted.

Because of space limitations, preference will be given to units requiring access from the front and sides only.

6.3 Cooling System (Air Cooled)

Each unit shall be equipped with at least two serviceable hermetic compressors, operating a minimum of two independent evaporator circuits.

Compressors shall have pressure lubrication, an oil strainer and suction and discharge shut-off valves. Each circuit shall have a sight glass and moisture indicator, high pressure (manual reset) and low pressure (automatic reset) cut-out switch, thermal expansion valve, liquid line filter drier and interconnecting piping to form a complete refrigeration circuit.

The unit shall be supplied with its refrigerant circuits charged with a dry gas and sealed.

The cooling coils shall be copper tube, copper or aluminium fin type, fitted with a stainless steel condensate drain pan with trapped drain pipe extended to the unit casing.

Compressors shall incorporate a positive method of protection against liquid slugging.

6.3.1 Air Cooled Condenser

The air cooled condenser shall be Carrier or approved equal, installed where shown on the drawing. The condenser shall be a matching section for the packaged air conditioning unit and shall have a total capacity not less than that required to handle the heat rejection of compressors in the system, with entering and leaving conditions, and outside dry bulb temperatures as nominated in the Table of Performance.

The unit shall be a completely packaged blow through type and shall have horizontal air flow through a vertical coil.

Where mounted subject to external wind pressures the unit shall be fitted with a wind deflector. The unit shall be a completely packaged draw through type with coils vertical or in a Vee configuration and fans discharging upwards.

The casing shall be 1.6mm galvanised sheet metal with a baked enamel finish. The unit shall have seamless copper tube aluminium plate type finned condensing coil and sub-cooling coil, propeller fans with aluminium or steel blades with suitable protective coating, zinc plated steel centre hub, and corrosion protected fan shaft. Each

fan shall have direct coupled, permanently split capacitor type motor with bearings sealed for full life operation. Motors shall be resiliently mounted and designed for weather protection. Motors shall have built in overload protection.

The condenser shall be mounted on a suitable mild steel angle stand. The angle frame shall be provided with a weatherproof finish.

The condenser unit shall be located to prevent air short-cycling back to the condenser inlet.

6.4 Heating System (Electric)

Each unit shall incorporate finned electric heating elements.

6.5 Humidifying System

Each unit shall incorporate an evaporator by-pass to limit the discharge air dry bulb temperature and humidity within the specified limits. The units shall have a humidifier installed in the by-pass air stream.

The humidifier shall be of one of the following types:

- Evaporative type using a solenoid valve controlled water supply evenly distributed over a disposable media panel.
- Infra red heating type using high intensity radiation to evaporate water in a pan. The pan shall be fitted with an automatic flushing device.
- Immersed electrode type producing steam from cold water in a disposable cartridge.

Metal parts in contact with water shall be stainless steel.

The humidifier shall be suitable for the connection of mains pressure cold water and operation of the unit shall be completely automatic. Any inlet water filters and/or purifiers considered necessary by the equipment supplier shall be included in the quotation.

The humidifier shall be readily accessible for maintenance.

Immersed elements in open pan type humidifiers are not acceptable.

6.6 Air Handling Section

Fans shall be double inlet centrifugal type statically and dynamically balanced with adjustable speed drive. The adjustable pulley shall be fitted with three grub screws to ensure that the final setting cannot work loose. Alternatively, the adjustable pulley may be replaced with a fixed pulley after final balancing of the system.

Bearings shall be heavy duty permanently lubricated self-aligning ball bearing type. Each fan drive shall incorporate two belts.

6.7 Filters

The units shall be fitted with removable panel filters. Filters shall be Type 1, Class A as defined by AS 1324. The filters shall be rated not less than 50% efficient by the N.B.S. Atmospheric Dust Spot Test. The filters shall be serviceable from the front or top (preferably) or from either end of the unit casing, and shall have frames and holding frames complete with airtight seals to ensure no air by-passes the filter medium.

Filter removal shall be such as to prevent any dirt being dislodged into the space.

6.8 Electrical & Controls

Each unit shall incorporate an electrical sub-board with circuit breakers, contactors, overloads and controls for the unit completely factory wired within the unit and connected as required to a terminal strip for field wiring.

Any additional equipment necessary for the satisfactory operation of the particular brand of unit in this application such as speed control for the air cooled condenser fans, automatic pump down cycles, or the like, shall be incorporated.

A compressor lead/lag sequence switch shall be provided.

Timers shall be fitted to limit the number of starts of each refrigerant compressor to not more than 12 per hour.

The unit operation shall be automatically controlled by an electric or integrated solid state control system including temperature and humidity controls and visual display of operating modes and alarms. The visual display shall be incorporated on a control panel on the front of each machine. Each panel shall incorporate the following functions:

a) Separate stop and start push buttons.

b) Alarm Mute button.

c) Alarm indication (red) for:

- i) Loss of air flow.
- ii) Filter pressure drop.
- iii) High space temperature.
- iv) Low under floor supply temperature
- v) High space humidity.
- vi) Low space humidity.
- vii) High head pressure - Compressor No. 1
- viii) High head pressure - Compressor No. 2

d) Operating indication (white or green) for:

- i) Fan.
- ii) Compressors (1 and 2)
- iii) Heating.
- iv) Humidification.
- v) Dehumidification.

If not supplied standard or available as an optional extra, the supplier shall nominate with his quotation what alarms and indicators are available for his units.

6.9 Mounting

Each unit shall be supported off the floor slab by a suitable steel stand. The stands shall be designed to support the units at raised floor level and shall have a means of height adjustment so that the unit bases may be levelled with the raised floor. For units with fans mounted in the bottom of the unit each stand shall incorporate an air turn

"scoop" to direct the air under the raised floor. The stand shall be cold galvanised. Neoprene anti-vibration pads shall be fitted between the unit and the stands.

6.10 Air Scoop

Where indicated on the drawings the unit stand shall incorporate an "air scoop" to direct the air under the raised floor.

6.11 Commissioning

The units shall be factory tested and then, to the satisfaction of the Engineer, the unit supplier shall commission and test the units on site and shall submit test data to the Engineer.

6.12 Spare Parts

The Contractor shall have readily available in the capital city of each state a complete stock of spare parts for the units.

6.13 Energy Efficiency Requirements

Package air conditioning units shall have a COP not less than that scheduled at the specified duties. Where no minimum COP has been specified the packaged air conditioning units shall comply with MEPS or NCC Section J as applicable.

Packaged air conditioning unit (except non ducted units with a supply air capacity less than 1000L/s) supply air fans shall have an absorbed fan motor power of less than or equal to the scheduled value at the scheduled duty. At a minimum where no fan power is scheduled the fan power shall be less than and equal to that required by NCC section J

7. FAN COIL UNITS

7.1 Fans

Fans shall be of the forward curved type, belt or direct driven by single or three phase motors as scheduled.

Fan wheels shall be dynamically balanced and positively secured to shafts.

Bearings shall be grease packed ball type, sealed for full life operation without maintenance.

Belt driven units shall have an adjustable vee belt pulley. The fan motor shall operate at 1440 rpm and shall be mounted to enable easy belt tensioning.

Where indicated in the schedule, motors shall have three speed windings and a three speed on off switch suitable for wall mounting.

7.2 Energy Efficiency Requirements

Air handling unit supply air fans shall have an absorbed fan motor power of less than or equal to the scheduled value at the scheduled duty. At a minimum where no fan power is scheduled the fan power shall be less than and equal to that required by NCC section J.

7.3 Casings

Casings shall be constructed of not less than 1.2mm thick galvanised steel, reinforced to prevent drumming. Casings shall be internally insulated with a minimum thickness of 50mm fibreglass or rockwool insulation with perforated foil facing.

Each unit shall have access panels for normal servicing and maintenance. Panels shall have fixings that are suitable for repetitive use and shall have airtight seals.

Condensate from cooling coils shall be collected and piped through the unit casing. Condensate drain pans shall be pitched for positive drainage when the unit is level and shall extend for the full width and length of the cooling coil including headers and return bends. Pans shall be non ferrous metal, stainless steel, plastic or fibreglass. Alternatively, they may be galvanised steel protected with bituminous or epoxy paint. Pans shall be insulated to prevent sweating.

Units exposed to view from occupied areas shall have a console type enclosure with external, factory applied, powder coat finish.

7.4 Chilled Water and Hot Water Coils

Water cooling and heating coils shall be constructed of copper tubes expanded into aluminium fins to provide a firm mechanical bond between fins and tubes.

Pipe connections shall be of the flare type. Coils shall be factory tested to a pressure of 2000kPa. Coils shall be fixed so as to be easily withdrawn from the unit casing. The face velocity over the cooling coil shall not exceed 2.5m/s.

7.5 Condensate Drain

Condensate shall be collected and piped through the unit casing. Condensate drain pans shall be copper, stainless steel, plastic or fibreglass. Alternatively, they may be galvanised steel protected with bituminous or epoxy paint. Pans shall be insulated to prevent sweating.

Provide a trapped and insulated copper or PVC drain pipe with a minimum diameter of 32mm to a visible discharge at an approved drain point. Provide inspection ports to allow cleaning. The trap shall ensure correct condensate drainage and maintenance of a water seal during unit start up and operation.

7.6 Drip Trays

Provide, under each unit mounted above the ceiling, a drip tray extending sufficiently beyond the extremities of the unit to ensure that any leakage or condensate will not drip onto the ceiling. Drip trays shall be formed from galvanised sheet metal with turned up and rolled edges. Joints shall be sealed water proof.

Provide a secondary drain pan under the control valve and pipe it to the condensate drain.

7.7 Condensate pumps

Provide condensate drain pump units where necessary to ensure effective drainage of condensate from fan coil units. Condensate pumps shall be Sauermann EE 1650 Integrated Pump/Tank Units as supplied by Air Solutions International Pty Ltd or approved equal.

Condensate pump/tank units shall be installed below a drain outlet in the drip tray. The condensate drain trap from the unit shall be piped to discharge immediately over the drip tray outlet. Where necessary to gain sufficient depth, the trap may be positioned outside the drip tray, provided it is insulated to prevent condensation.

Provide a fault relay from an overflow switch on the drip tray to shut down the air conditioning unit should the condensate pump fail.

7.8 Filters

Filters shall be arranged to filter all air passing through the unit and shall be suitably sealed to prevent by pass. Filter media shall be supported in frames that prevent excessive deformation during operation.

Filters shall be easy to remove and replace without the use of tools when the unit is in its installed location.

7.8.1 Filter - Belt Driven Units

The filter in belt driven units shall be of the washable dry media type with Vilair P15/350 media or approved equal. The clean resistance of the filter shall not exceed 55Pa at the scheduled air flow of the unit.

7.8.2 Filter - Direct Driven Units

The filter in direct driven units shall be of the washable dry media type with Vilair P15/150 media or approved equal. The clean resistance of the filter shall not exceed 15Pa at the scheduled air flow of the unit.

7.8.3 Filter

Filters shall be 50mm deep, dry media panel type with the filter media fitted in a flat, pleated or vee shape in aluminium or galvanised steel supporting frames.

When tested with test dust No. 4 in accordance with AS 1132.4 or ASHRAE 52-76 Arrestance Test at a nominal face velocity of 1.8m/s, filters shall have an average arrestance efficiency not less than 80% and a minimum dust holding capacity of 350g per 1000L/s rated capacity at a final resistance of 125Pa. The resistance of the clean filter shall not exceed 55Pa at the scheduled air flow of the unit.

7.9 Installation

Fix fan coil units to the structure by means of rubber in shear vibration isolators having an efficiency not less than 95%. Level the units by adjusting the mountings.

Provide a trapped and insulated copper or PVC drain pipe with a minimum diameter of 25mm to a visible discharge over the nominated drain point. Provide inspection ports to allow cleaning. The trap shall be deep enough to ensure correct condensate drainage and maintenance of a water seal during unit start up and operation.

Provide a secondary drain pan under the control valve and pipe it to the condensate drain.

8. VARIABLE REFRIGERANT FLOW (VRF) AIR CONDITIONING UNITS

8.1 General

Variable refrigerant volume air conditioning units shall be of Daikin or Mitsubishi Electric manufacture and be factory assembled units to the manufacturer's standard design, containing air handling, refrigeration and electrical equipment in factory fabricated casings.

8.2 Casing

Casings shall be machine folded sheet metal, reinforced where necessary with stiffening channels or angles, capable of supporting and retaining the components of the assembly without excessive noise and vibration.

Casings shall be treated to resist corrosion and finished externally with the manufacturer's standard factory applied paint system. Casings exposed to weather shall have top surfaces sloped for drainage. Equipment exposed to public view shall have a decorative finish.

Casings shall be internally insulated as necessary to control noise emission and prevent condensation. Insulation materials shall have a spread of flame index not greater than 0 and a smoke developed index not greater than 3 when tested on the exposed face in accordance with AS 1530.3.

Internal equipment shall be accessible for service and removal in the installed location. Provide doors or readily removable panels to permit convenient service access to the components. Access panels shall be secured by fasteners which are suitable for repetitive use.

8.3 Supply Fans

Supply fans shall be double inlet centrifugal type, dynamically balanced to AS 3709 quality grade G6.3. Fan and motor bearings shall be ball bearings designed for a life not less than 25,000 hours. Bearings shall be grease packed, sealed type or re-greasable bearings in grease relief housings with grease nipples.

Supply fans shall be direct or belt driven as scheduled. Fans shall deliver the scheduled air quantity against the resistance of the installed system. Provide non-standard motors and drives where necessary to achieve the scheduled performance.

Direct driven fans shall be capable of operation at high, medium and low speed as selected on the unit's control switch.

Belt driven fans shall have an adjustable pulley. The fan speed shall be adjusted on site to match the resistance of the installed system.

8.4 Filters

Filters shall be mounted so as to filter both outside and return air and avoid being wetted by condensate dripping from the coil. Filters shall be positively located and sealed to prevent air by pass and shall be easy to remove and replace without the use of tools.

Initial pressure loss shall not exceed 80Pa when operated at a maximum face velocity of 2.5m/s.

Filters shall comply with the following:

Minimum performance rating (below 1500 L/s)	F4
(at or above 1500 L/s)	F5
Filter Type	1
Filter Class	A

8.5 Refrigerant

The refrigerant used shall have an ozone depletion potential (ODP) of 0.

8.6 Outdoor Units

The outdoor units shall consist of up to three (3) hermetically sealed scroll compressors. One compressor shall be fitted with an inverter drive to allow the total compressor capacity control down to 18%. The outdoor unit shall incorporate an oil separator, oil return control, as required for the satisfactory operation of the plant over the full range of operational loads and conditions.

Condensers shall have a seamless copper tube, aluminium finned condensing coil. The aluminium fins shall be provided with a proprietary fin coating to protect against corrosion.

Guards shall be fitted where necessary to prevent accidental contact with moving parts and to protect coil fins against damage.

Propeller type condenser fans shall be constructed from corrosion resistant materials and shall be balanced for vibration free operation. Fan motors shall be weatherproofed, shall have built in thermal protection and shall be resiliently mounted. Bearings shall be sealed ball bearings.

8.7 Expansion Device

Each fan coil unit shall be fitted with an electronic expansion device.

8.8 Evaporator Coils

Evaporator coils shall be copper tube aluminium fin type, mounted to ensure drainage of condensate and prevent air by-passing the coils.

8.9 Condensate Drain

Condensate shall be collected and piped through the unit casing. Condensate drain pans shall be copper, stainless steel, plastic or fibreglass. Alternatively, they may be galvanised steel protected with bituminous or epoxy paint. Pans shall be insulated to prevent sweating.

Provide a trapped and insulated copper or PVC drain pipe with a minimum diameter of 32mm to a visible discharge at an approved drain point. Provide inspection ports to allow cleaning. The trap shall ensure correct condensate drainage and maintenance of a water seal during unit start up and operation.

8.10 Drip Trays

Provide, under each unit mounted above the ceiling, a drip tray extending sufficiently beyond the extremities of the unit to ensure that any leakage or condensate will not drip onto the ceiling. Drip trays shall be formed from galvanised sheet metal with turned up and rolled edges. Joints shall be sealed water proof.

8.11 Condensate Pumps

Provide condensate drain pump units where necessary to ensure effective drainage of condensate from fan coil units. Condensate pumps shall be Sauermann EE 1650 Integrated Pump/Tank Units as supplied by Air Solutions International Pty Ltd or approved equal.

Condensate pump/tank units shall be installed below a drain outlet in the drip tray. The condensate drain trap from the unit shall be piped to discharge immediately over the drip tray outlet. Where necessary to gain sufficient depth, the trap may be positioned outside the drip tray, provided it is insulated to prevent condensation.

8.12 Electrical Equipment

Electrical equipment and wiring shall be factory wired into an electrical control panel with a terminal strip for field wiring. Electrical equipment shall comply with Australian regulations. The control panel shall be sealed to prevent induction of dust by negative pressures inside the unit.

Factory fitted electrical equipment shall include:

- Starter and overload protection for the evaporator fan
- Starter, overload and integral over temperature protection for each compressor
- High discharge pressure protection for each compressor
- Compressor short cycling protection by a timer or a lockout relay on compressor safety controls
- Any other equipment normally provided with the standard unit or recommended by the manufacturer for the particular installation

Electrical devices for associated field mounted equipment may be mounted on the unit control panel if space is available. Otherwise, provide a separate switchboard.

Provide an isolating switch adjacent to the unit if necessary to comply with regulations.

8.13 Ducted Fan Coil Units

Ducted fan coil units shall be suitable for connection of supply and return air ductwork.

8.14 Free Blow Fan Coil Units

Free blow fan coil units shall incorporate decorative supply and return air grilles. Supply air grilles shall have adjustable vertical and horizontal vanes to control the direction of air flow.

8.15 Control Panel

A control panel shall be provided on the fan coil unit incorporating an on/off switch, thermostat set point adjustment and a fan speed controller (if applicable).

8.16 Cassette Fan Coil Units

Cassette type fan coil units shall be mounted through the ceiling, semi exposed and supported from the structure above. Supply air diffusers shall be arranged to discharge air along the ceiling.

8.17 Cassette Unit - Remote Control Panel

On cassette type fan coil units the control panel shall be incorporated into a small prewired console suitable for wall mounting. The wiring harness for these controls shall be neatly installed in mini-strip ducting.

8.18 Fan Control Option

A refrigerant discharge pressure sensor shall be provided to control the condenser fans to allow packaged unit operation at low ambient temperatures.

8.19 Corrosion Protection

Condenser and evaporator coils shall be corrosion protected by a coating of Heresite, Kirby Kote, or approved equal, applied in accordance with the manufacturer's recommendations. The coating shall completely cover the fins, tubes, headers and frames of the coil.

8.20 Mounting Frame

Provide a galvanised steel mounting frame under the condenser.

8.21 Refrigeration Piping

Refrigeration piping installed on site shall be in accordance with the manufacturer's instructions. Provide the necessary oil traps at the base of gas risers and at the recommended intervals up the riser.

Each site-installed refrigeration circuit shall include a filter/drier, sight glass/moisture indicator, liquid and hot gas shut off valves. Filter dryers in reverse cycle units shall be of the bi-directional type.

Refrigeration pipes shall comply with AS 1571, "Copper - Seamless Tubes for Air Conditioning and Refrigeration".

Annealed copper tubing, if used, shall be straightened to display a neat appearance. Tubes may be bent to a mean radius not less than three pipe diameters. Flattening of the pipe at bends shall not exceed 12.5% of diameter.

Pipe joints and fittings shall be soldered using silver alloy hard solders complying with AS 1167 and having not less than 5% silver. Pass dry nitrogen through the piping system when brazing or soldering.

Fix pipes to the structure using standard pipe fixing devices and protect pipes against chafing at clamp locations by wrapping with PVC tape or other approved method.

Insulate suction pipes with 13mm minimum thickness insulation with an effective vapour barrier. Insulation inside the building shall have a spread of flame index of 0 and a smoke developed index not greater than 3 in accordance with AS 1530 Part 3.

8.22 Refrigerant Pipe Support Spacing Table

Nominal pipe size, DN	Maximum spacing (m)	
	Horizontal	Vertical
10	1	2
15, 20	1.5	2.5
25	2	3
32	2.5	3

40	2.5	4
50	3	4

8.23 Hanger Size Table

Outside diameter of pipe or sheathing	Minimum hanger diameter (mm)	
	Light series	Heavy series
< 20	6	6
20 - 35	10	10
35 - 65	12	12
65 - 120	12	16

8.24 Flexibility

Provide pipe anchors and pipe guides which accommodate expansion and contraction, and minimise the transmission of vibration and noise to building structures. Locate anchors and guides at equal distances on each side of expansion devices. Securely fix anchors to bare pipe. Arrange piping to move in lateral and linear directions (e.g. at bends) while not deviating from necessary gradients.

9. FANS

9.1 General

Fans shall be manufactured to a fully developed design, currently in production, readily available, and supported by complete service facilities and spare parts. Statically and dynamically balance rotating parts on assembly.

Arrange fans and accessories to allow adequate service access for maintenance and removal and/or replacement of assemblies and component parts with minimum disturbance of other items of plant.

Fans shall deliver the scheduled air quantity against the resistance of the installed system. Fan static pressure (excluding cowl loss where applicable) and motor power are scheduled for tendering purposes only and shall be adjusted as required to suit the installed system.

The sound power level of the fan at the specified duty shall not exceed the level nominated in the fan schedule, nor the level nominated in the manufacturer's catalogue data.

Rotating parts shall be dynamically balanced to AS 3709 quality grade G6.3 for the maximum rated speed of the fan.

Fans shall be supported on spring or rubber-in-shear vibration isolators giving a minimum isolating efficiency of 95%.

Fans used for smoke exhausts shall meet the requirements fo AS1668.1

9.2 Efficiency Requirements

Fans shall have an absorbed fan motor power of less than or equal to the scheduled value at the scheduled duty. At a minimum where no fan power is scheduled the fan power shall be less than or equal to that required by NCC section J as applicable.

9.3 Centrifugal Fans

9.3.1 Performance and Type

Centrifugal fans shall be as manufactured by G.E.C. Woods, Fantech, D. Richardson, Chicago Blower Australia, or approved equal.

Centrifugal fans shall be of the S.I.S.W. or D.I.D.W. type as noted in the centrifugal fan schedule. Impellers shall be aerofoil blade type where indicated in the schedule. Otherwise, impellers may be backward inclined or backward curved flat blade type. Fan outlet velocities and tip speeds shall not exceed those indicated in the fan schedule.

9.3.2 Construction

Fan casings shall be rigidly constructed to prevent drumming and vibration during operation. Fan casings with impellers 650 mm diameter or greater shall have access panels. Seal panels airtight with neoprene gaskets. Fit flanged outlets to casings of fans with impellers 250 mm diameter or greater. Provide split type casings to fans having impellers greater than 1200 mm diameter. Fan inlet cones shall be removable. Fan and drive shall be mounted on a rigid integral steel chassis.

Fan impellers shall be steel, constructed for rotational speeds at least 120% of the duty nominated in the fan schedule. Key impellers to drive shafts with a taper-lock fixing device or taper key to BS 4235.

Drive shafts shall be sized for a first critical resonant speed at least 120% of design maximum operating speed. Countersink ends of shaft centres for the application of a tachometer.

Fan wheel and shaft assemblies shall be dynamically balanced to AS 3709 quality grade G6.3 for the maximum rated speed of the wheel. Submit a certificate of balance.

Belt driven, single inlet fans shall have an overhung impeller with the bearings accessible from the drive end similar to arrangement 1. Provide a positive device, such as a washer and set screw, into a tapped hole in the end of the shaft, for retaining the impeller on the drive shaft.

9.3.3 Bearings

Bearings shall be double row, self-aligning, to AS 2729, designed for a calculated life not less than 100,000 hours (ISO B10, 90 survival). Bearings shall be spherical roller type on shaft diameters 30mm or larger and ball type on shaft diameters less than 30mm. Bearings shall be mounted in grease relief housings with dust seals, similar to those manufactured by the S.K.F. Ball Bearing Co. Ltd. Bearing housings shall be factory dowelled to the bearing support members and shall be fitted with grease nipples. Extend the nipples where necessary for ready service access.

9.3.4 Drives

Fans shall be driven by at least two V-belts, sized to transmit the starting torque of the motor without slip. Belt sections shall be in accordance with AS 2784. "B" section belts shall be used for motors above 1.5 kW. "A" section belts may be used for smaller motors.

Pulleys shall be Taper-Lock type and shall be keyed to shafts. Provide adjustment of belt drive tension by movement of the motor on slide rails or by pivoting support, provided that the weight of the motor shall not be used to provide belt tension.

9.3.5 Motors

Motors shall be as specified in clause “ELECTRICAL”.

Motor selections shall include at least 20% margin of safety on the estimated power requirement of the fan. Motor ratings in the fan schedules are for tendering purposes only.

9.3.6 Guards

Fit rigid removable belt guards to belt drives, accessible fan inlets and discharges in compliance with the requirements of statutory authorities. Guards shall be easily removable for service and shall be designed for minimum restriction to air flow. Fixed sections of guards shall be securely bracketed to the fan. Removable sections shall be fixed with hexagonal headed machine screws.

Belt guards on D.W.D.I. fans shall be constructed from open mesh or perforated metal to minimise obstruction of the fan inlet. Guards on fan inlets and discharges shall be wire mesh.

Provide openings in guards to enable shaft speed measurement.

9.3.7 Painting

Paint each fan assembly, including belt guards, motors, slide rails, base plate etc. as specified in clause “PAINTING”.

9.3.8 Mounting

Each fan and its motor shall be mounted on an integral steel base and the whole assembly shall be mounted on spring or rubber-in-shear vibration isolators, as scheduled, giving a minimum isolating efficiency of 95%. Spring

isolators shall be mounted on rubber pads and, when loaded, shall have a length / diameter ratio not exceeding 1.25.

9.3.9 Centrifugal Kitchen Exhaust Fans

In addition to the above specification, centrifugal kitchen exhaust fans shall have a 25mm socket and plug in the bottom of the scroll for drainage and an access panel in the scroll to enable cleaning the interior, impeller and inlet cones.

Mount the complete fan assembly over a 1.6mm galvanised tray. The tray shall have edges turned up a minimum 25mm and shall be fitted with a galvanised drain socket and plug.

9.3.10 Forward curved fans

Fans shall be Ventitech Sigma, Richardson Baby Multi-vane or approved equal.

Forward curved fans shall be of the centrifugal multi-vane type.

9.3.11 In line Centrifugal fans

In-line centrifugal fans shall be as manufactured by G.E.C. Woods, Fantech, or Ductline and shall be of the type indicated in the schedule.

9.3.12 In line Mixed Flow Fans

In-line mixed flow fans shall be Axcent type as manufactured by G.E.C Woods, or approved equal.

Fans used for car park smoke exhaust duty shall meet the requirements of BCA Table E2.2a.

9.4 Axial Fans

Axial fans shall be as manufactured by G.E.C. Woods, Fantech, D. Richardson, Chicago Blower Australia, or approved equal.

Fans shall have diameters not less than those scheduled.

Rotating parts shall be dynamically balanced after assembly to AS 3709 quality grade G6.3 for the maximum rated speed of the fan. Submit a certificate of balance.

9.4.1 Bearings

Fan motors shall have grease lubricated ball bearings designed for quiet operation. Grease nipples shall be mounted in accessible positions on the outside of the fan housing and piped to the bearings to allow greasing without removing any components.

9.4.2 Motors

Motors shall be the same as used for performance and sound level testing of the fan and shall comply with clause “ELECTRICAL”.

Motor selections shall include at least 20% margin of safety on the estimated power requirement of the fan. Motor ratings in the schedules are for tendering purposes only.

Electrical connections to the motor shall be extended via a conduit to a terminal box on the outside of the fan casing.

9.4.3 Impellers

Impellers shall have aerofoil blades and blade pitch shall be readily and accurately adjustable on site without affecting the dynamic balance.

9.4.4 Casings

The fan casing shall extend for the length of the fan and motor. Provide access doors in fans greater than 300mm diameter, suitably placed for internal fan inspection and maintenance.

9.4.5 Accessories

Provide the manufacturer's standard inlet cones if the fan does not have a ducted connection at least two fan diameters in length.

Provide the manufacturer's standard heavy gauge galvanised wire guards on accessible fan intakes and discharges. Guards shall be easily removable for access and shall be designed to prevent accidental contact with moving parts under the full weight of a man.

Provide the manufacturer's standard casing flanges to suit the connections of fans to equipment. Isolate fans from fixed equipment by use of flexible connections.

9.4.6 Support

Support fans on spring or rubber-in-shear vibration isolators, as indicated in the schedule. Spring isolator assemblies shall include bracing to resist the axial and torsional thrust of the fan. Bracing shall be vibration isolated from the structure.

9.4.7 Factory Finish

Fans shall be painted as specified in clause "PAINTING".

9.4.8 Variable Pitch Impellers

Fans scheduled as variable pitch shall be capable of modulating the pitch angle of the impeller blades while the fan is running by means of a 20 to 105kPa pneumatic control signal.

9.5 Roof Mounted Exhaust Fans

Roof mounted exhaust fans shall be as manufactured by G.E.C. Woods, Fantech, or approved equal.

Fan housings shall form a weatherproof enclosure arranged for side or vertical discharge as indicated in the documents. The housing shall incorporate a weatherproof base suitable for mounting on a kerb. Exposed parts and fixings shall be made of corrosion resistant materials.

Motors shall be single or three phase as specified in the motors and starters schedule and shall have integral thermal protection. Bearings shall be grease packed sealed ball bearings.

Rotating parts shall be dynamically balanced to AS 3709 quality grade G6.3 for the maximum rated speed of the fan. Submit a certificate of balance.

9.5.1 Impellers

Impellers shall be of the axial or centrifugal type, as scheduled.

Centrifugal impellers shall be backward curved, centrifugal or mixed flow type.

Axial impellers shall be of the non-overloading aerofoil type unless scheduled as propeller type.

9.5.2 Non-Return Dampers

Provide non-return dampers where scheduled. The dampers may be on either the intake or discharge side of the fan. The dampers shall be of the type supplied by the fan manufacturer and the performance specified for the fan shall be the net performance after allowing for damper losses.

9.5.3 Belt Drives

Provide vee belt drives where scheduled. Belt drives shall be capable of transmitting 125% of the rated motor torque and provision shall be made for adjusting belt tension.

9.5.4 Propeller Fans

Propeller fans shall be as manufactured by G.E.C. Woods or approved equal.

Motors shall be totally enclosed. The fan and motor shall be isolated from the mountings by rubber isolators.

All components shall be corrosion resistant or provided with a suitable corrosion resistant finish.

Provide the following accessories:

- Wire inlet or discharge guards
- Louvre shutters
- Fan chambers
- Low-loss grilles
- Diaphragm plates
- Butterfly shutters and wind shields

The specified performance figures shall be achieved with all accessories in place.

9.6 Air Curtain Fans

Air Curtain Fans shall be "Conditionaire" as supplied by Conditionaire Engineering Pty. Ltd., or approved equal.

Fans shall have a scroll spreading at the discharge to a long and narrow vaned discharge opening, so constructed that discharge slots can be mounted end to end without restricting fan intakes. Fans shall deliver the scheduled air quantity evenly over the length of the discharge opening. Fans shall be mounted to ensure that the door is fully screened over the whole of its open area.

Air curtain fans shall be mounted strictly in accordance with the manufacturer's instructions.

10. FILTERS

10.1 General

Terms used in this clause are in accordance with AS 1324.

Filters shall handle the scheduled air quantity at not greater than the specified face velocity. Filters and components shall be readily available in this country.

Submit the results of a test, performed within the last three years, in accordance with AS 1324 by a NATA registered laboratory for each type of filter. ASHRAE 52 and EN779 are acceptable equivalent tests.

Install filters in accordance with the manufacturer's recommendations. Seal filter connections to prevent air by-passing the filter media.

Provide adequate access to each filter for inspection and maintenance.

10.2 Flat Panel Filters

Flat Panel filters shall be

- Dry, replaceable media (Type 1, Class B) as defined by AS 1324.1

Flat panel filters shall consist of a mounting frame and the filter cell. The mounting frame shall have provision for mounting in banks and incorporates spring clips. The frame shall be constructed of aluminium or galvabond steel and fitted with a sealing strip to avoid air leakage when the filter cell is in place.

The filter cell shall comprise of a galvanised steel frame containing the filter media held in place between two galvabond pieces of steel mesh.

The assembly shall not permit air to by-pass the filter media.

10.2.1 G2 Flat Panel Filters

When tested in accordance with AS 1324 at a gross face velocity of 1.8m/s:

- The performance rating of the filters shall be G2
- The initial resistance shall be no greater than 34Pa
- The dust holding capacity shall be no less than 484g per m^2 when tested to a final resistance of 250Pa

10.2.2 F5 Flat Panel Filters

When tested in accordance with AS 1324 at a gross face velocity of 1.8m/s:

- The performance rating of the filters shall be F5
- The initial resistance shall be no greater than 55Pa
- The dust holding capacity shall be no less than 511g per m^2 when tested to a final resistance of 250Pa

10.3 F5 Pleated V-Form Filters

F5 pleated V-form filters shall be:

- Dry, fully disposable (Type 1, Class A); or

- Dry, replaceable media (Type 1, Class B) as defined by AS 1324.1

The filter medium shall be retained in a pleated or vee shape in a 50mm deep supporting frame. The assembly shall not permit air to by-pass the filter media.

When tested in accordance with AS 1324 at a gross face velocity of 2.5m/s:

- The performance rating of the filters shall be F5
- The initial resistance shall be no greater than 86 Pa
- The dust holding capacity shall be no less than 382g per m^2 when tested to a final resistance of 250Pa

10.4 F5 Deep Bed Filters

F5 deep bed filters shall be:

- Dry, permanent frame with replaceable medium type (Type 1, Class B) as defined by AS 1324).

The filter medium shall be formed into standard sized cells of deep vee, bag or pocket shape. Provide media support frames as necessary to ensure that cells retain their shape at all air flow rates from 0 to 2.5m/s face velocity. Media support frames shall have no sharp edges which could abrade the media and shall be manufactured from stainless steel or aluminium, or shall be rendered corrosion resistant by galvanising, epoxy painting, or plastic coating.

The media support frame shall fit into a standard holding frame with a positive seal to prevent air by-pass.

When tested in accordance with AS 1324 at a gross face velocity of 2.5m/s:

- The performance rating of the filters shall be F5
- The initial resistance shall be no greater than 45 Pa
- The dust holding capacity shall be no less than 3600g per m^2 when tested to a final resistance of 450Pa

10.5 Mounting

10.5.1 Location

Filters shall be mounted so as to filter both outside and return air and avoid being wetted by condensate dripping from the coil.

10.5.2 Holding Frames

Provide holding frames to support dry media filter cells. Fix holding frames into air handling equipment and seal gaps to prevent air by-passing the filters. Fit filter cells into holding frames with quick acting clips or clamps.

In multi cell filter banks, provide stiffeners as necessary to prevent banks of holding frames deflecting more than 1/180th of the width or height of the filter bank at a differential pressure of 500Pa.

Permanent holding frames shall be manufactured from stainless steel, hot dip galvanised steel or zincanneal, etch primed and coated with epoxy or enamel paint. Stiffeners shall have an equally corrosion resistant finish.

10.5.3 Channel Slides

In side access filter housings, provide channel slides for mounting of filters. Provide air tight, hinged access door(s) to permit removal and replacement of filters through the side(s) of the housing. Provide soft sponge gaskets or approved equal at each end of the filter slides to prevent air by-passing the filters.

10.6 Differential Pressure Gauge

Provide a differential pressure gauge, located adjacent to the filter, for each filter bank to indicate air resistance across the filter. Mark the face of the gauge to indicate clean and dirty air resistance.

10.7 Protection of Filters

Protect filters against excess dust and debris during building work and initial starting of air handling units. Install a sheet of low efficiency filter media over the face of the filters and vacuum clean the interior of conditioners prior to initial start. Remove the temporary media when excessive levels of dust during initial running have subsided.

11. DUCTWORK

11.1 Sheet Metal Ductwork and Fittings

Ductwork shall be rectangular, round or oval as shown on the drawings.

Sheet metal ductwork and fittings shall comply with AS 4254 “Ductwork for Air Handling Systems in Buildings” and shall be constructed to a Static Pressure Class appropriate to the duty but not less than Static Pressure Class 500.

Rectangular ductwork shall be cross-broken or beaded in accordance with AS 4254.

Joints shall be of the internal beaded sleeve type in accordance with AS 4254.

The requirements of clause “INSULATION” in this specification override the requirements of AS 4254 Clause 2.7.

11.1.1 Pressure Testing

Pressure test ductwork with a static pressure classification exceeding 500Pa. Test progressively prior to application of insulation and prior to ducts being built in or concealed. When tested at the pressure classification, leakage shall not exceed 2% of the specified air quantity for the system. Leakage from each branch of the system shall not exceed 2% of the total air handled by that branch.

11.1.2 Design and Sizing of Ductwork

11.1.2.1 *Layout*

Ductwork shall be neatly and logically laid out and designed to connect all offtakes with the least number of bends and transitions. The layout shall strictly conform to and be installed within the limits imposed by the building and equipment detail existing and/or as shown on drawings supplied with the specification.

11.1.2.2 *Section*

In any event the ratio of width to depth of rectangular ductwork shall not exceed 7:1.

11.1.2.3 *Size*

Ductwork for air-conditioning, heating, exhaust and general ventilation purposes shall be designed so that the following duct velocities are not exceeded:

Supply Air in Risers & Plantrooms	7.5 m/s
Supply Air on Floors	6.5 m/s
Return Air	6.5 m/s
Exhaust Air	7.5 m/s

Maximum friction rate 0.8 Pa per meter of duct.

11.1.2.4 *Elbows and Vanes*

Radius elbows with throat radius less than duct width shall have turning vanes located in accordance with AS 4254 as follows:

R/W = 0.2 - 0.5 1 vane

R/W = 0.1 - 0.19	2 vanes
R/W < 0.1	3 vanes

Square elbows shall have turning vanes in accordance with AS 4254 unless specifically indicated to have no vanes.

11.1.2.5 *Branch Connections*

Branch connections to rectangular ducts shall be as detailed in AS 4254 in accordance with the following:

- Straight tap branches may be used for connections to individual outlets only
- Parallel flow branches shall be used where indicated on the drawings and may be used in other appropriate locations
- 45° entry branches shall be used for other rectangular connections

11.1.2.6 *Riser Take Offs*

Provide riser take offs with air scoop where shown on the drawings. Construction shall be as detailed on the standard drawings.

11.1.2.7 *Air Scoop and Splitter*

Provide riser take offs with air scoop where shown on the drawings. Construction shall be as detailed on the standard drawings.

11.1.2.8 *Flexible Connections*

Connect ductwork to vibrating equipment such as fans etc., with flexible connecting sections.

Flexible connections shall comply with the requirements of AS 1668.1.

Flexible connections in systems handling more than 1000L/s, and in systems serving more than one fire compartment, shall have a spread of flame index not greater than 0 and a smoke developed index not greater than 3 as determined in accordance with AS 1530.3.

Flexible connections to smoke spill fans shall be capable of operating at 200°C for two hours (or 300°C for 30 minutes) as required by AS 1668.1.

Other flexible connections shall be heavy vinyl coated fabric.

When exposed to the weather and direct sunlight, flexible connections shall be covered with galvanised steel angles.

11.1.3 Material

Sheet metal ductwork shall be fabricated from prime quality lockforming galvanised steel, Grade G2 or G3 to AS 2338 with Z275 coating to AS 1397. Other options permitted by AS 4254 Clause 2.3.1(b) shall not be used without approval.

On ductwork outside the building or exposed to weather, top surfaces shall be sloped for drainage of rainwater. Transverse joint reinforcement, intermediate reinforcement and flanges shall be hot dipped galvanised. Reinforcement and flanges shall be riveted to the ductwork. Spot welding is not acceptable. Seal joints between reinforcement and the duct, with silicone sealant.

11.1.3.1 *Sealing*

Seal ducts in accordance with AS 4254. Seal drive slip joints airtight at corners using metal tongues and duct sealant.

Submit a copy of a NATA laboratory test certificate to verify compliance of sealants with the AS 1530 test.

Sealants shall be low VOC in accordance with section SEALANTS.

Acceptable Duct sealants are:

- Emer-duct Sealer Firecheck
- Expandite Duct Sealant
- Norton Silverseal, Type 669
- 3M Scotch - Seal Duct Sealer 6991 SE
- Fosters High Velocity Duct Sealant 32-14

Acceptable Silicone sealants are:

- Bear Brand Silicone Sealant for Metals and Masonry
- Selleys Silicone Building Sealant

11.1.4 Construction

11.1.4.1 *Joints*

All joints shall be air tight and free from sharp internal edges. All laps shall be made in the direction of flow.

Circumferential joints required to assemble ductwork shall be flanged with steel angles and bolted or may be riveted and soldered. Slip joints may be used on rectangular ductwork provided the longest side is no greater than 1000mm.

Longitudinal joints shall be lapped and riveted or spot welded at not greater than 75mm. Longitudinal joints in ducts used for air-conditioning or ventilation may be formed with a double lock seam (Pittsburg or equivalent joint).

Flanged joints shall be assembled with a neat gasket of rubber, neoprene or other material approved by the Engineer. Flanged joints shall be provided with 50mm minimum spigot design to enter the mating duct in the direction of flow.

11.1.4.2 *Dampers*

Provide volume control dampers at all duct branches and wherever required for balancing of the system.

Dampers at parallel flow branches shall be of the stream splitter type.

Dampers in other branches shall be of the opposed blade type with a cast metal locking quadrant.

11.1.4.3 *Duct Access Panels*

Provide duct access panels where shown on the drawings and where required for satisfactory inspection and service purposes. Access panels shall be as indicated on the standard drawings.

Provide access panels in fresh air ductwork between the intake and the filter in the following locations or as required by the local statutory authority:

- At each change in direction of ductwork
- At each duct junction
- In horizontal runs at intervals of not more than 3m
- For inspection and installation of equipment concealed in ducting, e.g. fire dampers, motorised dampers, VAV boxes, control sensors and smoke detectors.
- At such other positions as shown on the drawings

Access panels shall be manufactured from sheet steel two gauges heavier than the ductwork.

Where access panels are located within ductwork having external thermal or acoustic insulation double skin type shall be used, sandwiching a layer of thermal or acoustic insulation, as appropriate, of the same thermal performance as the ductwork external insulation. Acceptable proprietary manufactured panels may also be used. Subject to restrictions imposed by duct dimensions access openings shall not be smaller than 375 by 300mm. The duct opening and the access door itself shall be reinforced to prevent distortion. A rebated rubber or neoprene sealing strip shall be provided together with clamping type latches to ensure an air and moisture seal between the door and the duct.

11.1.4.4 *Pitot Holes in Ductwork*

Provide 12mm diameter holes, closed off with rubber grommets or other approved means to allow testing with a Pitot tube.

Locate the holes in straight lengths of duct where air flow is most favourable for accurate measurement. Where practical there shall be 10 equivalent diameters of straight duct up-stream and 1.5 equivalent diameters down-stream.

Locate the holes in circular ducts with a spacing of 90° on the circumference.

Locate the holes in rectangular ducts, evenly spaced across the duct with a half space at each end, according to the table below.

Up to 300mm	2 holes
301mm to 450 mm	3 holes
451mm to 630mm	4 holes
631mm to 1220mm	5 holes
Above 1220mm	6 holes

Provide holes in locations as necessary to check air balance, where directed, and in the following locations:

- Downstream of each supply air take-off from the main riser
- Downstream of each main air handling unit
- Upstream of each variable volume box

11.1.5 Installation

11.1.5.1 *Penetrations*

Ductwork shall be designed and installed to utilise the penetrations provided by others as shown on the drawings. Where the Contractor requires to change the detail, either size or location, of penetrations shown on the drawings or where additional penetrations are required, he shall advise the extent of such changes or additions with his tender. The Contractor shall otherwise cut and/or enlarge all new existing penetrations as necessary to complete his work.

Penetrations shall not be cut in structural steel members or existing building or plant or equipment without prior approval from the Engineer.

The Contractor shall make good around all penetrations and shall finish the making good in a manner at least equal to the surrounding work and to the satisfaction of the Engineer.

Neat, galvanised steel machine-formed collars or escutcheon plates shall be installed at all duct penetrations through walls, partitions, ceilings, equipment enclosures and the like. Such collars or escutcheon plates shall be fixed to the duct and shall extend to completely cover and overlap the edge of the penetration.

11.1.5.2 *Flashing Collars*

Provide galvanised steel over-flashing collars to ductwork penetrating roofs or external walls and where necessary for waterproofing.

11.1.6 Round and Oval Ductwork

Round ductwork may be of the spiral seam or longitudinal seam type.

On round and oval ductwork exposed to view in occupied areas, line up the spiral lock seams at circumferential joints and conceal the joint with a spirally wound strip of 0.15mm thick galvanised sheet metal, positioned such that the ends of the strip are not visible from floor level. Pop rivet the metal to the duct each end. Apply silicone sealant to the seams and wipe smooth.

Supports for round and oval ductwork exposed to view in occupied areas shall not have external straps or angles. Provide internal reinforcement where required by AS 4254.

11.1.6.1 *Acoustically Lined Round Duct*

Acoustically lined round duct shall have an internal cylinder, equal to the main duct internal diameter, manufactured from perforated zincanneal with at least 10-12% perforations.

The base metal thickness of the cylinder shall be:

- Up to 900mm diameter
    - 0.6mm
- 950mm to 1200mm
    - 0.8mm
- 1250mm to 1500mm
    - 1.0mm

This cylinder shall be insulated with 75mm thick fibreglass or mineral wool, as specified in clause “INSULATION”, covered with a layer of scrim and bound sufficiently tightly to allow a snug fit inside the external duct. The ends of the insulation shall be well covered with no loose ends exposed.

The external duct shall be 100mm greater in diameter than the main duct with reducing couplings on each end to bring the size down to that of the main duct.

11.2 Kitchen Exhaust Ductwork

11.2.1 General

Ductwork serving kitchen exhaust hoods and its method of installation shall comply with the requirements of AS 1668 and the requirements of any local authority.

The ductwork material and thickness shall comply with clause “SHEET METAL DUCTWORK AND FITTINGS”, except that the minimum material thickness shall be 1.2mm for galvanised steel and 0.9mm for stainless steel.

Seal kitchen exhaust ductwork in accordance with AS 4254.

Incorporate a grease arresting gutter fitted with a 25mm drain socket and plug at the bottom of each vertical duct.

Provide access panels in kitchen exhaust ductwork in the following locations or as required by the local statutory authority:

- At each change in direction of ductwork
- At each duct junction
- In horizontal runs at intervals of not more than 3m
- At the bottom of vertical risers
- At such other positions as shown on the drawings

Access panels shall be liquid tight and the seals shall be fire proof and capable of resisting the effects of cooking oils and grease.

Duct connections to the top of exhaust hoods shall not be located directly over hood exhaust openings (filter locations).

11.2.2 Sprinklers in Ducts

Sprinkler heads will be installed in the kitchen exhaust ductwork. Provide an access panel at each sprinkler head location. Cut the penetration for each sprinkler head and re-seal the duct after installation.

11.3 Flexible Ducts

11.3.1 General

Flexible ducts shall comply with AS 4254.1 and be constructed in accordance with Clause 2.3.1. Under conditions of fire or intense heat, flexible ducts shall not give off toxic emissions and shall comply with clause 2.4.3. All flexible ductwork shall be tested in accordance with Clause 2.4, ‘Test Criteria’ and shall meet the general, mechanical, and fire performance criteria of this clause.

Flexible ductwork shall be factory fabricated from a resilient 0.9mm minimum diameter hard drawn and oil tempered mechanical spring steel wire helix, wound to a pitch not exceeding one third of the duct diameter, which is mechanically interlocked with a strip of reinforced aluminium foil laminate, to form a continuous flexible tube. The laminate reinforcement shall provide a high resistance to tearing and puncturing.

Flexible ducts shall comply with AS 1668.1 and AS 4254.

Submit NATA approved test laboratory's current test certificate prior to installation showing the test results for compliance with Clauses 2.3.1 and 2.4.

11.3.2 Insulation

Flexible ducts used for air conditioning supply air shall be insulated in accordance with Section J5.2 of the BCA, and AS4254.1 Clause 2.6.

For flexible ductwork of no more than 3 m in length to an outlet or from and inlet, achieve a minimum R-Value of 1. In all other applications flexible duct insulation shall, achieve the minimum R-Values listed in the table below.

Location of ductwork and fittings	**Minimum material R-Value for ductwork and fittings in climate zone 5 and 6**
Within a conditioned space	1.2
All other locations	2.0

11.3.3 Insulated and Foil Faced (AS 1668)

Flexible ducts shall be insulated as required in Section INSULATION then wrapped with reinforced aluminium foil laminate and vapour sealed.

11.3.4 Spigots for Flexible Ducts

Spigots shall be circular or oval to suit the size of the flexible ducts. Spigots shall be manufactured from spun aluminium or 0.8mm minimum thickness galvanised steel and shall be fitted with a volume control damper. The damper blade shall be manufactured from 0.8mm minimum thickness galvanised steel or cast metal and shall be adjustable by a metal shaft with a cast metal quadrant assembly. The quadrant arm shall be in line with the damper blade to indicate the damper position and shall be secured by a wing nut. The quadrant shall extend clear of the duct insulation.

11.3.5 Installation

Fix flexible ducts to spigots and make joints in accordance with AS 4254.1, clause 2.5 “Installation”.

Flexible duct connections shall be sealed air tight to a collar or spigot, with a minimum 0.15 mm thick and 48 mm wide duct tape, with a minimum of three overlapping, tensioned, crease-free wraps. Each layer of duct tape shall overlap the previous layer by 40%-60% of the tape width.

Connections to circular collars shall be permanently fasted by means of a drawband/banding system located over the top of the air seal behind the retention system on the collar. Fix flexible ducts to oval spigots with self-tapping screws and 25mm diameter galvanised steel washers at a maximum of 75mm centres, with an air seal provided over the top of the mechanical fixing.

Install ducts fully extended with bends not less than one duct diameter throat radius.

Flexible ducts may be supported by the ceiling but shall be provided with additional support where necessary to prevent the weight of the duct imposing a strain on connections to spigots and diffusers. Supports shall comply with AS 4254, clause 2.5.3 “Hangers, support and load distribution systems”.

It is recommended that flexible duct be installed in lengths not exceeding 6m between a duct spigot and a terminal device. Where run exceeds 6m, solid duct should be installed. Solid duct should comply with Section INSULATION.

11.4 Fabric Ductwork

11.4.1 Materials and Surface Treatments

Materials utilised in the construction of ductwork shall be tested and comply with AS1530.3 for simultaneous determination of ignitability, flame propagation, heat release and smoke release.

Test	Index
Ignitability	0
Smoke Developed	0 – 1
Spread of Flame	0
Heat Evolved	0

It shall be the Subcontractors responsibility to ensure that all details are in full compliance with AS1668 Part 1 and the BCA in regard to types and materials used.

11.4.2 Textile Ductwork

As woven by KE Fibertec AS (as supplied by Air Solutions International, (0395322615) or approved equivalent, manufactured from washable 1005 polyester TREVIRA CS, in a preferred colour to suit construction method. Fabric shall be heat set and permeability stabilized, and not to shrink more than 0.5% when washed in accordance with the manufacturer's maintenance instructions.

11.4.3 Supply Air Orifices

The round and/or ½ round (D-Shaped) and/or ¼ round fabric duct shall be constructed of Trevira® CS polyester, and shall be UL classified as an air distribution device in accordance with the flammability requirements of NFPA 90A-1993. Provide discharge nozzles in fabric that throw air perpendicular to the length of the duct. The internal working pressure rating shall be as indicated on fabric duct schedule.

The percentage of air total airflow discharged through the nozzles shall be as shown on fabric duct schedule.

Nozzles shall be mounted in fabric in direction(s) as shown on fabric ducts schedule.

The duct velocity rating shall be as indicated on fabric duct schedule.

The duct must be suitable for continuous operation at a temperature range of -40°F to +140°F.

Ducts with slots, mesh or other openings, which do not discharge air perpendicular to the length of duct, shall not be accepted.

11.4.4 Product Data

Submit manufacturer's shop drawings indicating size and placement of ducts, and mounting instructions.

Submit manufacturer's technical product data for fabric ducts including schedule of ducts with room location, number furnished, model number, size, fabric, finish, mounting hardware included, and accessories furnished.

Submit manufacturer's performance data for each fabric duct, including airflow rate, inlet velocity, room air/supply air temperature difference, static pressure, total pressure at inlet, throw and/or velocity in near zone, filtration ratings.

11.4.5 Support System

Safe-track or D-Alu mounting system of extruded aluminium sections manufactured by KFibertec (as supplied by Air Solutions International) or approved equivalent. Safe-track shall be supported with 22mm dia. Aluminium strap-ups as supplied as an integral part of the suspension system.

11.4.6 Safe-Strap-U

25 micron anodised aluminium.

11.4.7 Construction

Textile ductwork shall have a permeability rating for the application as nominated by the manufacturer.

Ducting shall be restrained on the Safe-track with a factory supplied fabric safe-bulb and fitted with zips to enable easy removal and reinstatement of the ductwork for cleaning purposes.

11.4.8 Installation

The appointed Subcontractor has responsibility to thoroughly check and co-ordinate duct routes, to avoid clashes with structures and services.

All ductwork shall be securely supported off the building structure using bolts or screw fixings.

Explosive fasteners shall not be acceptable.

To achieve the longest service life the following precautions shall be observed:

- The system must hang freely so that the textile material does not rub against fixed objects, thereby causing damage.
- The system must hang still as pulsations can damage the textile material. Violent jolts must also be avoided when starting up the system as this can cause the suspension system or fabric duct to come loose and sustain serious damage.
- The system must be protected when being installed and removed so that the fabric materials are not damaged.

11.4.9 Maintenance

The system shall be washed, centrifuged and dried at recommended intervals according to the manufacturer's instructions to prevent the fabric ducts from getting damaged.

It is recommended to use a pre-filter of at least Class F7 for all outdoor air. Improving the pre-filtering will reduce the washing frequency.

11.5 Plenum Ducts

Submit details prior to construction.

11.5.1 Casing – Sheet Metal Construction

11.5.1.1 *Casing*

Construction: Zinc-coated steel panels, folded to 450 mm maximum width with 50 mm edges and 15 mm returns.

Joints: Weld, or fold and bolt together by means of galvanized nuts, bolts and washers. Seal joints air tight and water tight with silicone sealant.

Material thickness: 1.6 mm minimum. Provide 50 x 50 x 5 mm galvanized steel bracing angles.

11.5.2 Casing – Sandwich Panel Construction

11.5.2.1 *Casing*

Prefabricated coolroom panels consisting of a sheet of insulation bonded at high temperature to metal skin on both sides.

11.5.2.2 *Materials*

Insulation: Single layer rigid cellular polystyrene sheet to AS 1366.3, class M, of thickness to suit fan pressure and panel span. Insulation to comply with Section INSULATION.

Metal skin: 0.6 mm minimum thickness zinc-coated steel sheet, factory prepainted.

11.5.2.3 *Joints*

Provide aluminium extrusions internally and externally at panel junctions and between panels and building structures. Apply a continuous bead of silicone sealant along extrusions to form an air tight seal.

11.5.2.4 *Penetrations*

Pipes, conduits: Provide flanged sleeves. Fill the void between the sleeve and the panel with a one part polyurethane sealant.

Ducts: Frame penetrations with aluminium channels.

11.5.2.5 *Access*

General: Provide access panels or doors to each compartment.

Construction: The same as the casing. Provide aluminium extrusions around the edge.

Minimum clear opening: 1350mm high x 600 mm.

Door swing: Against air pressure.

Cold bridging: Minimise.

Frames: Form from aluminium extrusions.

Door hardware: Provide clamping-type latches and handles which can be operated from both the inside and outside of the door.

Seals: Silicone rubber or soft neoprene gaskets mechanically fixed to doors and panels to ensure an air tight seal when latched in the closed position.

11.6 Miscellaneous Ductwork

11.6.1 Sub-Ducts

Provide sub-ducts at entry points into fire rated shafts to comply with AS 1668 Part 1.

11.6.2 Fire Rated Ductwork

Sheet metal ducts and plenums denoted on the drawings as being fire rated shall have a construction that shall give a fire rating in accordance with AS 1668, Part 1, Clause 2.2.3.

The construction method shall have a current approval in principle by the National Building Technology Centre (or C.S.I.R.O. Division of Building Construction and Engineering).

The ducts and plenums to be fire rated shall be encased with a framework of formed metal support channels and furring channels of sizes and at spacings recommended by the supplier of the fire rated construction.

A 50mm layer of ceramic type spray shall be applied over the walls of the duct or plenum, and then an expanded metal lath shall be attached to the furring channels. A second coat of ceramic type spray shall be applied to give a minimum overall thickness of 75mm spray.

The exposed sides of the duct or plenum shall then be sheathed with 0.8mm galvanised steel.

Where the width of ducts or plenums is such that they exceed the recommended support spacings, intermediate fire rated supports shall be placed in the centre of the duct or plenum with a sheet metal sleeve around the support being sealed to the duct or plenum.

11.6.3 Masonry Ducts

In masonry ducts:

- Provide turning vanes in square throated bends
- Provide volume control dampers at duct branches for balancing the system
- Seal airtight the joints between sheet metal ducts and masonry ducts

11.6.4 Vertical Discharge or Intake Ducts

Provide flashing collars and bird screens where vertical discharge or intake ducts that are exposed to weather penetrate the roof. Provide a copper drain line run to the nearest drain point to internally drain the ducts.

Grade these ducts to the drain point and seal joints and seams in the exposed section watertight with silicone sealant.

Internally paint each duct as specified under clause PAINTING.

11.6.5 Cooling Tower/Evaporative Condenser Intake and/or Discharge Ductwork

Grade the ductwork and seal joints and seams so that condensate and carry-over will be drained back into the unit.

Solder seams and joints air and water tight or alternatively, fill seams and joints during manufacture of the ductwork with duct sealant. Provide access panels for inspection and maintenance. Locate panels so as not to collect or obstruct the flow of condensate in the duct. Paint the ductwork internally as specified under clause PAINTING.

11.6.6 Ductwork - PVC Type

Manufacture PVC ductwork from impervious unplasticised PVC material.

Expansion joints and flexible connections shall be flanged type constructed from either neoprene sheet, or plasticised PVC sheet of suitable thickness.

Construct ducts from PVC sheeting to a thickness tabled hereafter.

Duct Diameter (mm)	or	Max Side (mm)	Min. Thickness (mm)
Up to 380		Up to 380	3

381 to 610	381 to 635	4
611 to 890	636 to 914	5
Above 890	Above 914	6

NOTE: Submit materials and types of joints and fittings for approval, prior to ordering.

The ductwork shall be made by heating the material in a suitable oven and then forming or bending to the required size to avoid thinning of material and high stress concentration. Seams shall be welded by using a controlled hot air welding torch with a filler rod of the parent material.

Rectangular ducts shall be formed by bending sheets to allow use of a minimum number of longitudinal welds, to provide the seams preferably in the middle of the side of smaller dimension.

Welds shall be "V" type, one run of 3mm thick welding rod shall be used for 3mm thick material, and 3 runs of 3mm thick welding rod for material 4mm and 6mm thickness. Welds shall not be made in the corner at the abutment of two sides excepting bends, tees or transitions. The minimum inside bending radius shall be 5mm but in no case shall be less than the material thickness. Bends, tees and transitions may be welded at the abutment of two sides where welds shall conform to the specification outlined herebefore.

Rules governing heel radius and vanes in bends, tees and branches shall be as specified for SHEET METAL DUCTWORK.

Butterfly dampers shall be used for air balancing, with parts inside the ducts constructed from suitable PVC.

On rectangular ducts having the largest side 900mm and over, stiffeners shall be placed between each joint, by welding 38mm wide strips of 6mm PVC around the outside of the ducts at 600mm centres.

Support straps and fixing lugs shall be welded to the duct sides, adjacent to a flange or stiffener, at not more than 1.5m centres on horizontal runs and immediately under the flange at not more than 2.5m centres on vertical runs.

Joints shall be of the slip socket type, formed by expanding one end of the duct in circular ducting up to 350mm diameter. In other instances the socket shall be formed by welding a collar over one end of the duct, thus providing a socket entry of not less than 50mm in length for the mating end which then is inserted into the expanded section and/or socket, finishing with a weld and/or solvent, as recommended by the supplier, to provide good stiffening in itself and a perfectly airtight joint.

Flanges shall be 9mm thick for ducts up to 760mm diameter or largest side and 12mm thick for ducts over 760mm diameter or largest side.

11.6.7 Diesel Engine Exhaust Ductwork

The ductwork shall be stainless steel 321 grade Duraduct of 0.50mm thickness, as manufactured by Spiral Tubing Pty. Ltd., or approved equal.

The ductwork shall be insulated and sheathed in accordance with clause INSULATION.

Submit details of erection for approval before installation.

11.6.8 Two and Three Sided Ducts

Where noted on the drawings, certain rectangular ducts shall be of two or three sided sheet metal construction with the remaining sides being formed by the cast in situ concrete walls or slabs. Where the sheet metal sides join the concrete walls or slabs they shall be fixed at approximately 250mm centres and caulked airtight to 38mm x 38mm x 3mm galvanised steel angles which have been secured to the concrete with loxins or similar on approximately 450mm centres and caulked airtight to the wall or slab.

Circumferential joints and reinforcing shall be as specified for rectangular ductwork. Fit turning vanes to bends.

11.6.9 Lint Exhaust Ducts

Construct the following ducts with radiused bends without turning vanes.

- Ducts for laundry exhaust and linen room exhaust.

11.7 Dampers

11.7.1 General

Provide damper sets where shown on the drawings and where necessary for balancing the system.

Dampers shall be free of rattles, fluttering or slack movement, and be capable of adjustment over the desired range without excessive self-generated noise or the need for special tools. Blades shall not have sharp edges and shall be sufficiently rigid to eliminate movement when locked.

11.7.2 Types

The type of volume damper to be used for each application shall be as follows:-

- Volume control dampers in ductwork and behind outlets and grilles shall be as specified in the relevant clauses.
- Manually adjustable dampers shall be opposed blade type.
- Motorised dampers for unison control of outside and return air shall be parallel multi blade type.
- Cooling coil by-pass dampers shall be opposed blade type.
- Motorised zone mixing dampers shall be opposed blade type.
- Motorised smoke exhaust or smoke control dampers shall be parallel blade type.
- Motorised multi-blade 2-position outdoor air dampers for control of tenants' supplementary outdoor air shall be parallel blade type.
- Manual multi-blade damper sets for control of minimum outdoor air supply shall be parallel blade type.
- Motorised 2-position dampers serving floor supply and return duct branches shall be parallel blade type.

11.7.3 Materials

Outside air dampers shall be constructed from aluminium or stainless steel. Other dampers shall be constructed from galvanised steel, aluminium or stainless steel.

For motorised dampers and outside air dampers the spindles shall be stainless steel to AS 2837, Grade 304.

Galvanised steel shall be prime quality lock forming galvanised steel grade G2 or G3 to AS 2338 with Z275 coating to AS 1397.

Aluminium shall be 6063 T5 or 6351 T5 alloy.

Stainless steel sheet metal shall conform to AS 1449, Grade 304.

11.7.4 Construction

11.7.4.1 *Frames*

Damper frames shall be folded to channel or hat sections not less than 130mm wide and punched to allow for bolting to a mating flange, in fill panel, etc. The corners shall be fully welded. The maximum size of damper modules shall be 1200 x 1200mm.

Galvanised steel shall be 2.6mm minimum thickness.

Stainless steel shall be 2.0mm minimum thickness.

11.7.4.2 *Blades*

Damper blades shall not deflect more than 1/180 of the blade length at a differential pressure of 750Pa across a closed damper.

Blades shall not exceed 1200mm long x 250mm wide. Drive blades shall be positively fixed to drive shafts by taper pins, or equal to avoid rotation and slackness. Longitudinal movement shall be limited to 0.5mm maximum.

11.7.4.3 *Spindles*

Spindles may be of the stub type or run the full length of the blades. Spindles shall be fixed to the damper blades. Machine the end to accept the operating mechanism without slip.

Spindles shall be not less than 10mm diameter for blade lengths up to 600mm and 13mm for longer blades.

11.7.4.4 *Bearings*

Bearings shall be self-aligning type manufactured from oil impregnated sintered bronze or oil impregnated plastic.

11.7.4.5 *Linkages*

In multi blade dampers, the blades shall be interconnected by means of a suitable bar linkage for ganged operation and shall be free of slackness. The linkages shall be located at the side of the damper module, out of the air stream.

Linkages shall be gear trains or steel flat bar with brass link pins held in position by circlips.

11.7.4.6 *Operating Temperature*

Dampers in contact with smoke spill air shall be able to withstand the temperature specified in AS 1668.

11.7.4.7 *Finish*

Welded joints etc. on galvanised dampers shall be painted with zinc rich paint.

Dampers shall not be painted.

11.7.5 Manually Adjustable Dampers

Manually adjustable damper sets shall have an accessible lockable metal quadrant for adjustment and locking in any desired position. Label the OPEN and CLOSED positions clearly and permanently.

11.7.6 Motorised Dampers

Install motorised dampers with blades horizontal and such that linkages and bearings can be removed for servicing. Otherwise, the whole module shall be removable.

Mount motors in an accessible position. The mounting shall be rigid enough to prevent flexing or distortion of the damper during operation. Provide jack shafts between multiple modules to ensure that blades operate in unison.

Drive arms shall be designed to withstand the greatest torque applied by the fitted actuator.

11.7.7 Installation

Dampers shall be installed with sufficient bracing to eliminate any flexing, distortion, binding etc.

11.7.8 Tight Shut off Dampers

Motorised dampers installed in the following locations, shall have "tight" shut off:

- Stair pressurisation systems
- Smoke spill fans
- Return air (recycle air) in a smoke spill system
- By-pass around a fan in a VAV system

These dampers shall have blade edge and end seals and shall have a guaranteed leakage rate not exceeding 50L/sm2 at a static pressure of 500Pa. Submit certification of this performance requirement.

11.7.9 Outside Air Dampers - Two section

Outside air dampers shall be constructed of two sections. One section shall be of the motorised two position type, adjusted to provide the minimum outside air quantity in the open position and to close tightly, as required under fire conditions, or when the system shuts down.

The other section shall be motorised to modulate the outside air flow between minimum and maximum.

11.7.10 Fire and Smoke Dampers

Fire and smoke dampers shall comply with AS 1682 and shall have a free cross section area not less than 85% of the face area.

Dampers shall be labelled to comply with AS 1682 Section 5.

Submit test certificates from an independent testing authority registered for the appropriate tests, evidencing compliance with AS 1682 Section 4 for air leakage and fire resistance.

Installation shall comply with AS 1668 Part 1. The expansion space around the fire damper frame shall be packed with Bradford Insulation Rockwool Fireseal or approved equal.

Thermally released links shall be frangible bulbs or fusible links to AS 1890. Dampers shall be capable of being tested for closure without actuation of the thermally released links.

11.7.11 Non-Return Dampers

Non-return dampers shall be AGC Series 60 as supplied by Celmec International or approved equal.

Dampers shall be constructed from marine grade aluminium in modules up to 750mm wide x 1500mm high. Blades shall not exceed 750 x 75mm and shall be supported on 6mm shafts and nylon bush bearings. For dampers larger than 750 x 1500mm, provide two or more modules.

Blades shall close by gravity and have a backflow leakage not greater than 250 L/s.m2 at a pressure differential of 500Pa.

11.8 Thermal Insulation

Duct insulation shall comply with the requirements of Section INSULATION in this specification.

11.9 Noise Control

The Contractor shall be responsible to design, construct and install ductwork in a manner to prevent or limit to acceptable levels, the transmission of noise through the ductwork.

Connections to fans or other equipment which vibrates shall be made with suitable flexible connections utilising neoprene sheet, heavy duty canvas, or other approved material suitable for the particular application.

Ductwork shall be constructed and installed suitably braced and reinforced to eliminate all drumming or panting.

Internal insulation, absorptive splitters, commercially produced silencers and other devices shall be included in the ductwork as required to prevent or limit noise transmission.

Deadener compound or anti-drumming compound shall only be applied by approval from the Engineer.

12. INSULATION

12.1 General

Insulation must be provided on ductwork and fittings, used for heating or cooling, including evaporative cooling, heating hot water and chilled water piping, condensate, flues, exhaust pipes, tanks, vessels and plant. Thermal insulation performance is to comply with AS/NZS 4859.1. Ductwork insulation is to comply with AS 4254-2012.

12.1.1 Zero Ozone Depletion Potential (ODP)

All insulation used is to have zero ODP in both its composition and manufacture.

The sub-contractor is to provide a product data sheet confirming zero ODP for each insulation product used.

12.1.2 Green Star

For Green Star projects all products including insulation, tapes, adhesives, and sealants are to comply with Green Star requirements including Zero ODP and low VOC.

12.1.3 Code of Practice

Perform insulation work in accordance with the Worksafe Standard “National Code of Practice for the Safe Use of Synthetic Mineral Fibres.” For installation of Glass wool or Rock Wool comply with the Insulation Council of Australia and New Zealand (ICANZ) industry Code of Practice for Safe Use.

12.2 Insulation Materials

Materials used with insulation shall be as follows.

Glasswool Insulation

Created by spinning fibers of molten glass, containing up to 80% recycled content, bonded together to form batts and blankets for thermal, acoustic and condensation control.

Rockwool insulation

Created by spinning a molten mixture of natural rock and recycled products into fine wool like fibers which are bonded together using a thermosetting resin. Used for thermal, acoustic and condensation control.

Polyester

Insulation manufactured from thermally bonded polyester fibres. Used for thermal, acoustic and condensation control.

Polystyrene

Class SL polystyrene foam, self extinguishing grade to complying with AS 1366, Part 3.

Polyolefin Foam

Closed-cell cross linked, factory bonded to pure, reinforced aluminium foil. Non fibrous and will not allow bacteria to grow.

Elastrometric Foam

Closed-cell nitrile rubber structure with an in-built vapour barrier. Non fibrous and will not allow bacteria to grow.

12.3 Insulation Definitions

Vapour Barrier

System to have a classification of High to AS/NZS 4200.1.

Material R-Value

The thermal resistance of a component calculated by dividing its thickness by its thermal conductivity measured as (m^2.K/W).

Total R-Value

Total R-Value is the sum of the Material R-Values and any internal air space R-Values.

System R-Value

Sum of the total R-Value and surface film resistances

Foil Facing

Factory applied aluminium foil laminate, equal to Sisalation 450 or Bradford Thermofoil 750.

Perforated

Perforated to provide at least 10% open area.

Foil Tape

To be Aluminum foil with 3 way fiberglass scrim and a pressure sensitive adhesive. Mechanical properties to comply with AS 4254-2002.

Adhesives

Adhesives, vapour coatings and sealers shall give a permanent bond and/or seal and shall be selected and applied in accordance with the manufacturer's recommendations. It is recommended to use a water based fire retardant adhesive, to comply with fire hazard properties.

Mastic

Mastic vapour barrier to have a permeance to AS/NZS 1301.419s condition B, or ASTM E96/EPDM.

- Chilled water pipes: ≤ 15ng/N.s.
- Cold water pipes: ≤ 50ng/N.s.

Fixing Pins

Metal or plastic pins of a length to suit the insulation thickness with minimum 38mm diameter speed clips. Metal pins may be welded to metal surfaces or shall have a minimum 38mm diameter base for adhesive fixing.

Fix pins to masonry with masonry adhesive. Alternatively, weld pins onto a strip of sheet metal at 300mm centres and fix with masonry adhesive at 500mm centres. To comply with AS 4254.

12.4 Fire Hazard Properties

Insulating materials shall comply with the requirements of the relevant BCA and shall have early fire hazard properties not exceeding the following indices:-

- Spread of Flame 0 AS 1530 Part 3

- Smoke Developed 3 AS 1530 Part 3

Facing material shall comply with the following

- Flammability Index 5 AS 1530 Part 2

Assembled dust systems shall comply with the following

- Pass the UL 181 burning test

For compliance with AS 1668 Part 1, clauses 3.7:-

Insulation in smoke spill ducts, shall:

- be deemed non combustible
- have a fusing temperature greater than 500^{o}C
- if internal, be faced with perforated sheet metal
- insulation shall be Bradford Fire Seal Damper strip, or approved equal.

Submit a NATA approved laboratory's current test certificate verifying compliance with these requirements, prior to installation.

12.5 Alternative Insulation Materials & Methods

Alternative materials or methods shall not have lower quality or characteristics in relation to the following:

- Thermal performance
- Density
- Suitability for the operating temperature range
- Durability during and after installation
- Corrosion resistance

12.6 External Duct Insulation

Externally insulate ductwork where indicated on the drawings with flexible batts or blanket, fibreglass, or polyester insulation, factory faced with aluminium foil laminate.

External insulation shall:

- be factory faced with aluminium foil laminate,
- be equal to
    - Sisalation 450, or
    - Bradford Thermofoil 750 or approved equal.
- be equal to Table 1 -External Ductwork Insulation

External Ductwork Insulation - Climate Zone 4, 6 & 7			
		External Ductwrap	
Location of Ductwork and Fittings	**BCA Minimum Material R-Value**	**Product**	**Thickness (mm)**
Within a Conditioned Space	1.2	Multitel/Flexitel	50
		FI 22 Ductwrap	50
All Other Locations	2	Multitel/Flexitel	75
		FI 22 Ductwrap	75
Where Exposed to Direct Sunlight	3	Use Internal Insulation	

Table 1 -External Ductwork Insulation

12.6.1 Fixing

Cut and fit the insulation to the duct so that edges are tightly butted. Vapour seal the joints with 100mm wide foil tape.

On duct faces exceeding 380mm width, retain the insulation with fixing pins at maximum 300mm centres. Fixing pins are not required on the top surface of horizontal ducts. Vapour seal each pin penetration with a 100mm square piece of foil tape.

For Polyolefin foam or Elastrometric foam provide pins spaced 50mm from all edges and spaced a maximum of 300mm apart in all directions.

External insulation shall not be applied to internally insulated ductwork or ductwork exposed to view in air conditioned spaces.

12.6.2 Duct Mounted Hot Water Coils

Insulate frames, headers and return bends on duct mounted hot water coils.

12.7 Internal Duct Insulation

Internally insulate ductwork where indicated on the drawings.

Internal insulation shall:

- be factory faced with perforated aluminium foil laminate,
- have a minimum density of 32kg/m3,
- be equal to the Table 2 - Internal Ductwork Insulation

Internal Ductwork Insulation - Climate Zone 4, 6 & 7			
		Internal Ductliner	
Location of Ductwork and Fittings	BCA Minimum Material R-Value	Product	Thickness (mm)
Within a Conditioned Space	1.2	Supertel	40
		FI 48 Ductliner	38
All Other Locations	2	Supertel	75
		FI 48 Ductliner	75
Where Exposed to Direct Sunlight	3	Exetel	100
		FI 48 Ductliner	100

Table 2 - Internal Ductwork Insulation

12.7.1 Sound Absorption

Insulation shall have not less than the following sound absorption coefficients with perforated aluminium foil laminate when tested in accordance with AS ISO 354 2006

Insulation with Specified Facing	Absorption Coefficient at Octave Band Centre Frequencies, Hz				
Thickness,mm	125	250	500	1k	2k
25	0.10	0.25	0.68	0.96	1.01
50	0.26	0.66	1.09	1.09	1.05

12.7.2 Fixing

Insulation shall be retained in position by weld pins and speed clips at 300mm centres and by sheet metal angles at the corners of the duct. The insulation and facing shall be installed in one piece along the length of the duct. Where this is not possible, the edges of adjacent pieces of insulation and facing shall be cut straight and tightly butted together. The joint shall be taped and covered with a sheet metal cover strip with edges turned down and riveted to the corner angles. At the ends of each duct section, the insulation and facing shall be held in position by sheet metal channel sections riveted to the duct. Internal surfaces shall be cleaned of all foreign material before installation.

Corner angles, cover strips and channel sections shall be manufactured from 0.6mm thick galvanised or zincanneal sheet metal, with feathered edges to clamp down on the insulation.

12.8 Flexible Duct Installation

Install flexible ductwork where indicated on the drawings.

Flexible duct insulation shall:

- Be equal to the Table 3 - Flexible Ductwork Insulation.

			Bradford		Fletcher	
Length	**Location of Ductwork and Fittings**	**BCA Minimum Material R-Value**	**Product**	**Thickness (mm)**	**Product**	**Thickness (mm)**
< 3m		1	R1.0 Specitel	40	FI 11 Ductflex R1.0	45
>3m	Within a conditioned space	1.2	R1.2 Specitel	50	FI 11 Ductflex R1.5	63
	Where Exposed to Direct Sunlight	3	R-3.0 Building Blanket	130		
	All Other Locations	2	R-2.0 Building Blanket	90	FI 11 Ductflex R2.0	85
			WebFlex 4 Zero	70	WebFlex 4 Zero	70

Table 3 - Flexible Ductwork Insulation

12.9 Pipe Insulation - General

Insulation should not be applied to piping joints until pressure testing is complete.

12.10 Chilled Water & Air Conditioning Refrigeration Pipes

Chilled water and refrigeration pipework (Only between 2°C and 20°C for refrigeration pipework) insulation shall comply with Table 4 - Chilled Water and A/C Refrigerant Pipework. The table is for DN pipe sizes up to 220mm.

Chilled Water and A/C Refrigerant Pipework - Climate Zone 4, 6 & 7			**Thermobreak Tube**		**FR/Armaflex**		**Polystyrene SL Grade**	
Capacity	**Location**	**Min R-value**	**Pipe Nominal Diameter up to 220 (mm)**	**Thickness (mm)**	**Pipe Nominal Diameter up to 115 (mm)**	**Thickness (mm)**	**Pipe Nominal Diameter up to 225 (mm)**	**Thickness (mm)**
≤65kW	Located internally	0.6	≤45	15	≤15	13	All	25
			>45	20	>15	19		
	Located within a wall space, an enclosed sub-floor area or an enclosed roof space	0.7	≤20	15	≤65	19	≤150	25
			>20&≤150	20	>65	25	>150	38
			>150	25				
		0.8	≤60	20	≤30	19	≤65	25

Chilled Water and A/C Refrigerant Pipework - Climate Zone 4, 6 & 7			Thermobreak Tube		FR/Armaflex		Polystyrene SL Grade	
Capacity	Location	Min R-value	Pipe Nominal Diameter up to 220 (mm)	Thickness (mm)	Pipe Nominal Diameter up to 115 (mm)	Thickness (mm)	Pipe Nominal Diameter up to 225 (mm)	Thickness (mm)
	Located outside the building or in an unenclosed sub-floor area or an unenclosed roof space.		>60	25	>30	25	>65	38
>65kW & ≤250kW	Located internally	1.3	≤20	25	≤15	25	≤65	38
			>20&≤60	30	>15&≤60	32	>65	50
			>60&≤165	35	>60	38		
			>165	40				
	Located within a wall space, an enclosed sub-floor area or an enclosed roof space	1.4	≤15	25	≤42	32	≤50	38
			>15&≤40	30	>42&≤100	38	>50	50
			>40&≤100	35	>100	50		
			>100	40				
	Located outside the building or in an unenclosed sub-floor area or an unenclosed roof space.	1.5	≤30	30	≤30	32	≤40	38
			>30&≤70	35	>30&≤75	38	>40&≤175	50
			>70&≤170	40	>75	50	>175	63
			>170	50				
>250kW	Located internally	1.7	≤20	30	≤20	32	≤25	38
			>20&≤40	35	>20&≤40	38	>25&≤90	50
			>40&≤80	40	>40	50	>90	63
			>80	50				
	Located within a wall space, an enclosed sub-floor area or an enclosed roof space	1.8	≤15	30	≤35	38	≤20	38
			>15&≤35	35	>35	50	>20&≤80	50
			>35&≤65	40			>80	63
			>65	50				

Chilled Water and A/C Refrigerant Pipework - Climate Zone 4, 6 & 7			Thermobreak Tube		FR/Armaflex		Polystyrene SL Grade	
Capacity	Location	Min R-value	Pipe Nominal Diameter up to 220 (mm)	Thickness (mm)	Pipe Nominal Diameter up to 115 (mm)	Thickness (mm)	Pipe Nominal Diameter up to 225 (mm)	Thickness (mm)
	Located outside the building or in an unenclosed sub-floor area or an unenclosed roof space.	1.9	≤25	35	≤25	38	≤50	50
			>25&≤50	40	>25&≤60	50	>50	63
			>50&≤200	50	>60	57		
			>200	55				

Table 4 - Chilled Water and A/C Refrigerant Pipework

Insulation material shall:

- be foil faced, preformed moulded section SL grade polystyrene, or
- FR/Armaflex self seal, or
- Thermobreak Tube or equivalent

Apply a 2mm thick coating of adhesive to pipes before fixing the insulation.

Glue the insulation to the pipe with 50mm bands of adhesive at each end of each preformed insulation section to form a vapour stop. On straight lengths, stagger the longitudinal joints. Glue the circumferential and longitudinal joints. Vapour seal the faced insulation joints with foil tape. Do not insulate pipework inside conditioner cold chambers.

At bends and tees, mitre cut the insulation sections and glue to the abutting insulation and pipework to form a vapour stop.

At hangers, glue the insulation to the face of the hanger device. Vapour seal the foil facing to the sleeve surrounding the wood block with foil tape.

Stop the permanent insulation sufficiently far from flanges and other removable fittings to allow dismantling.

Insulate over flanges and unions with preformed insulation sections, overlapping the adjacent permanent insulation and vapour sealed to it with a non setting mastic. Fill the spaces with loose filler such as greased styrene foam beads. Secure the insulation sections with metal bands.

Insulate valves and strainers by gluing cut sections of polystyrene into removable metal boxes shaped to enclose the fitting. Fill the spaces with loose filler such as greased styrene foam beads. Fasten the metal boxes with quick release toggles. Vapour seal the joints with a non setting mastic.

At penetrations through fire rated walls, insulation within 300mm of the wall shall be Sekisui Fi-Block Rockwool or approved equal, faced with reinforced aluminium foil, vapour sealed to the adjoining insulation with foil tape. Sheath the Rockwool insulation and fill the gap between the sheathing and the sleeve in the wall with Bradford Rockwool Fireseal Batt, or approved equal.

In “exposed” locations such as plantrooms or any other locations where the pipe is visible when standing at floor level, or where exposed to the weather, sheath each section of insulation in accordance with subclause METAL SHEATHING.

Insulate pipe runouts 20mm diameter and smaller with FR Armaflex self seal, or Thermobreak Tube or approved equal. Glue the longitudinal and circumferential joints along their full length and glue the ends of the insulation to the pipe using and Armaflex 520 low VOC adhesive or approved equal.

12.11 Cold Storage Refrigeration Pipes

Insulate refrigeration pipework, including valves and fittings with FRArmaflex self seal, Thermobreak Tube, or equivalent having a minimum wall thickness as shown in the Refrigerant Piping minimum insulation thickness table below. Glue the longitudinal and circumferential joints along their full length and glue the ends of the insulation to the pipe.

Finish circumferential joints by wrapping with 50mm wide pressure sensitive pre-glued tape.

In “exposed” locations such as plantrooms or any other locations where the pipe is visible when standing at floor level, or where exposed to the weather, sheath each section of insulation in accordance with subclause METAL SHEATHING.

Refrigeration pipework (Only below 2ºC) shall comply with Table 5 - Refrigerant Piping Below 2°C

Refrigerant Piping - minimum insulation thickness - All Climate Zones					
			Thermobreak Tube (-80 to +105°C)	**FR/Armaflex (-50 to +105°C)**	**Polystyrene SL Grade**
Temperature (°C)	**Nominal Pipe Size (mm)**	**Minimum Material R-Value**	**Minimum Insulation Thickness**		
Refrigerant not more than 2	15 to 40	1.3	30	32	38
	50 to 70	1.7	40	50	50
	100 to 125	2	50	Contact company for thicknesses above 114	63
	150	2	55		63
	200	2.7	70		100
Refrigerant more than 2 but not more then 20	As Per Cooling Water Table				

Table 5 - Refrigerant Piping Below 2°C

12.12 Condensate Drain Pipes

Insulate condensate drain pipes with FR/Armaflex self seal, Thermobreak Tube or equivalent pipe insulation having a minimum wall thickness of 13mm. Glue the longitudinal and circumferential joints along their full length and glue the ends of the insulation to the pipe.

12.13 Diesel Engine Exhaust Ductwork

Insulate diesel engine exhaust ductwork and mufflers. The insulation material shall:

- be 50mm thick
- have a conductivity not greater than 0.20 W/mK at a mean temperature of 600^{o}C
- be capable of withstanding temperatures up to 650^{o}C
- be Bradford Insulation - Fibertex Rockwool, or approved equal.

Wrap the insulation around the ductwork/muffler, secure with tie wires and sheath with aluminium sheet. Finish the insulation under the roof level where the length of flue above roof level is 2m or less. Otherwise, insulate and sheath to within 300mm of the top of the flue. Flash and seal the sheathing above roof level.

13. DIFFUSERS, REGISTERS & GRILLES

13.1 General

Coordinate ceiling mounted fittings with the ceiling tiles and suspension system.

Volume controls and sheet metal surfaces, visible through the face of air terminal fittings, shall be painted matt black.

Diffusers, registers and grilles shall be finished in baked enamel or anodized as documented, in a colour to match the mounting surface. Coordinate final finish and colour with architect.

Submit a sample of each type of diffuser to be used in the project and obtain approval before ordering.

13.2 Volume Controls

Where feasible, the flow rate of each outlet and grille shall be controlled by a volume control damper in the ductwork remote from the grille.

Provide multi blade stream splitter damper volume controls behind registers mounted on the side of ducts. Multi blade stream splitter damper volume controls shall have a sheet metal frame enclosure around multiple adjustable turning vanes to ensure that air diverted by the vanes is directed evenly over the full face of the outlet.

Provide individually adjustable multi blade dampers behind return and exhaust air grilles, adjusted to provide minimum noise at the grille.

13.3 Ceiling Diffusers

Flexible duct connections to diffusers shall be provided via an internally insulated plenum box, similar to Holyoake type CH, Bradflo type ADCI or approved equal. Where low profile cushion head boxes are used, provide turning vanes or perforated plates shall be fitted within the box to ensure even air distribution.

Ceiling diffusers shall have a nominal face size of 600 x 600mm unless otherwise noted. Reducing necks shall be fitted to achieve a performance equivalent to the neck sizes indicated on the drawings.

13.3.1 Swirl Diffusers

Ceiling Radial Induction Swirl Diffusers shall be Holyoake Model CFP or approved equal.

Ceiling Swirl Diffusers shall be designed for use in Variable Air Volume [VAV] systems with Radial, High Induction, Circular Air Flow Pattern.

Ceiling Swirl Diffusers shall maintain a COANDA effect at reduced volume and provide uniform temperature gradients throughout the occupied space.

Diffusers shall be finished in powder coat and fitted with accessories and dampers where indicated by the manufacturer.

Each diffuser shall incorporate a circular swirl diffuser imbedded in a square face panel sized to fit into half a tile space within a 1200x600 ceiling tile. The swirl diffusers shall be suitable for T-bar ceiling installations. Square Radial Swirl Diffusers shall be finished in powder coat (colour as nominated by architect). Diffusers shall be fitted with accessories and dampers where indicated.

A low profile cushion head box (250mm high measured from face of grill to top of cushion head box) with spigot (oval if required to fit within 250mm height) is to connect the diffuser to flexible supply ductwork. A perforated plate is to be fitted within the box to ensure even air distribution.

Adjust air volume by adjustment of a butterfly damper in the flexible duct spigot at the main duct take off.

Submit a NATA certified test report detailing the results of tests conducted in accordance with AS 2946. The report shall include a drawing of the tested diffuser showing dimensions of items which would affect performance. Test results shall include horizontal air throws when tested with a flat ceiling, static pressure and sound power levels, for a range of air quantities from 30 to 100% of the manufacturer's recommended maximum. Include also the minimum air flow without dumping when the diffuser supplies cold air at a temperature differential of 15°C.

Gyprock frames to be used for diffusers that are installed in gyprock ceilings.

13.3.2 Louvre Face Diffusers

Diffusers shall have neatly mitred, tightly butted corners and shall be finished in baked enamel or powder coating to nominated colours. Diffusers shall have a removable face.

Diffusers shall have the blow patterns indicated on the drawings and shall have the necessary louvred core styles, or shall be properly blanked, to give the required direction of blow without draughts.

Flexible duct connections to diffusers shall be provided via an internally insulated plenum box with turning vanes, arranged to provide even distribution of air onto the back of the diffuser, similar to Holyoake Industries model TVAI-90.

Ceiling diffusers shall have a nominal face size of 600 x 600mm. Reducing necks shall be fitted to achieve a performance equivalent to the neck sizes indicated on the drawings.

Ceiling diffusers shall be of the lay in border type to suit exposed ceiling Tee bars similar to Ventitech model CT.

13.3.3 Circular Diffusers

Circular diffusers shall be of the drop bevel border type similar to Ventitech model RA and shall have a powder coated finish to selected colour.

Flexible duct connections to diffusers shall be provided via an internally insulated plenum box with turning vanes, arranged to provide even distribution of air to the back of the diffuser, similar to Holyoake Industries model TVAI-90

13.3.4 Linear Slot Diffusers

Linear slot ceiling diffusers shall consist of parallel, inverted T members supported and spaced to form continuous discharge slots with the number of slots and lengths as shown on the drawings. Slots shall be nominally 20mm wide. The outer flange of the diffuser shall overlap the ceiling opening by nominally 25mm and shall be neatly mitred at the ends of each length. Each length of diffuser shall be installed without any visible means of fastening and shall be adjusted for a close fit against the finished ceiling. Joints in long diffusers shall incorporate an aligning device to ensure that sections are aligned and abutted neatly.

The exposed face of the diffuser shall be finished in baked enamel or powder coating to a nominated colour.

Diffusers shall have adjustable air pattern controlling vanes capable of producing vertical or horizontal air diffusion in either direction. Adjust the air pattern vanes to obtain a horizontal air discharge pattern unless instructed otherwise. Air volume shall not be adjusted by the pattern control vanes.

Air shall be supplied to the active lengths of each diffuser via insulated cushion heads as shown on the Standard Drawings. The design of the cushion heads shall ensure even distribution of air flow along the active length of the diffuser without introduction of excess noise. The end closures on cushion heads shall project between the inverted T members to ensure that all supply air from the plenum passes through the face of the diffuser. Cushion heads shall be adequately supported to ensure that the weight of the connected flexible duct does not cause misalignment.

13.4 Jet Diffusers

Jet diffusers shall be Air Grilles Australia model J-D or approved equal. The core of the diffuser shall be rotatable to provide a jet or diffused blow.

13.5 Registers

Registers shall be finished in a baked enamel or powder coat finish in a nominated colour. The frame shall have a nominal 25mm border with neatly mitred corners and shall incorporate concealed fixings. Registers shall be adjusted for a close fit against the finished surface. Provide a suitable gasket if the border acts as the seal against air leakage.

Adjust volume controls and register control vanes to give a satisfactory distribution of air without draughts.

13.5.1 Universal Type

Universal registers shall have two sets of adjustable aerofoil shaped vanes. The front set of vanes shall be horizontal and the rear set of vanes shall be vertical. The spacing of the horizontal and vertical vanes shall not exceed 20mm and the vane depth/vane spacing ratio shall not be less than 1.0.

Universal registers shall be used for:

- Duct mounted supply air

13.5.2 Single Vane Type

Single vane registers shall have a single set of adjustable, airfoil shaped, horizontal vanes. The spacing of the vanes shall not exceed 20mm and the vane depth/vane spacing ratio shall not be less than 1.0.

Single vane registers shall be used for:

- Car park supply air

13.6 Grilles

13.6.1 Egg Crate Grilles

Egg crate grilles shall consist of a 12mm x 12mm grid, 12mm deep, egg crate type aluminium core fixed in an extruded aluminium frame. The frame shall have a nominal 25mm border with neatly mitred corners and shall incorporate concealed fixings.

Grilles shall be finished in baked enamel or powder coating to a nominated colour.

Egg crate grilles shall be used for:

- Ceiling mounted return air grilles
- Ceiling mounted exhaust grilles
- Stairwell pressurisation system supply grilles
- Smoke exhaust system grilles

13.6.2 Chevron Grilles

Chevron grilles shall have extruded aluminium, inverted vee, sight proof, horizontal blades fixed in an extruded aluminium frame. Blade spacing shall not exceed 30mm. The frame shall have a nominal 25mm border with neatly mitred corners and shall incorporate concealed fixings.

The static pressure loss through a 150mm high grille shall not exceed 25Pa when operating at a face velocity of 1.25m/s.

Grilles which are visible from occupied space on both sides shall have a border on both sides and a telescopic frame, adjustable to the width of the partition in which they are mounted. For walls too thick to suit the grille, provide a half chevron grille on each side of the wall.

Grilles shall have a natural anodised finish.

Chevron grilles shall be used for:

- Door grilles
- Wall mounted return air grilles visible from both sides of the wall

13.6.3 Half Chevron Grilles

Half chevron grilles shall have extruded aluminium, half chevron, horizontal blades fixed in an extruded aluminium frame. Blade spacing shall not exceed 30mm. The frame shall have a nominal 25mm border with neatly mitred corners and shall incorporate concealed fixings.

Grilles which are visible from the occupied space on both sides shall have a border on both sides and a telescopic frame, adjustable to the width of the partition in which they are mounted.

The static pressure loss through a 150mm high grille shall not exceed 20Pa when operating at a face velocity of 1.25m/s.

Grilles shall have a natural anodised finish.

Half chevron grilles shall be used for wall mounted return air grilles visible from one side only. Install high level grilles inverted to prevent see through from the normal view point.

13.6.4 Lightproof Grilles

Lightproof grilles shall have extruded aluminium, double chevron, horizontal blades fixed in an extruded aluminium frame. Blade spacing shall not exceed 30mm. The frame shall have a nominal 25mm border with neatly mitred corners and shall incorporate concealed fixings.

The static pressure loss through a 150mm high grille shall not exceed 25Pa when operating at a face velocity of 0.75m/s.

Grilles shall have a black baked enamel or powder coat finish.

13.6.5 Heavy Duty Grilles

Heavy duty grilles shall consist of a grating formed from 25mm x 3mm flat steel bars at 40mm centres welded to 6.5mm square twisted cross bars at 100mm centres and hot dip galvanised after assembly. Grating shall be as supplied by Webforge Pty. Ltd., P.M. Andersen Industries, or approved equal. Mount the grating in a hot dip galvanised 25mm x 25mm x 3mm angle frame fixed into the wall or duct opening. Provide an opposed blade damper behind the grille.

Heavy duty grilles shall be used for:

- Loading dock exhaust grilles
- Car park exhaust grilles

Mount low level exhaust grilles with their bottom edges within 100mm of floor level.

13.6.6 Hinged Return Air Grilles to Fan Coil Units

Return air grilles to fan coil units shall consist of a 12mm x 12mm x 12mm egg crate grille mounted in an inner frame, hinged into an outer frame and fitted with a concealed spring catch to allow easy access to the filter.

Grilles shall be finished in baked enamel or powder coating to a nominated colour.

13.7 External Louvres – Horizontal Blade Type

External weatherproof louvres shall have extruded aluminium blades mounted horizontally in an extruded aluminium frame to form a louvre with a minimum depth of 75mm. The frame shall have a nominal 75mm border with neatly mitred corners and shall incorporate concealed fixings.

Blades shall incorporate at least one hooked edge and shall slope at a nominal 45^{o} angle to shed water outside the louvre. Blade spacing shall not exceed blade height. Unsupported blade length shall not exceed 1200mm.

Provide a vermin screen, complying with clause “VERMIN SCREENS”, on the internal face of each louvre. The louvre and vermin screen combination shall have not more than 25 Pa resistance at an air flow of 1,600 L/s per square metre of face area.

Louvres shall have a colour anodised finish of a nominated colour.

13.8 Vermin Screens

Provide vermin screens over external air openings.

Vermin screens behind aluminium louvres shall be constructed from 12mm x 12mm x 1.6mm diameter crimped aluminium mesh in aluminium frames.

Vermin screens over other openings shall be constructed from 12mm x 12mm x 0.8mm diameter galvanised steel weld mesh in galvanised steel frames.

13.9 Colour Anodising

Colour anodising shall be by patent "hard" anodising processes equal to Alcan "Analoc 500", Comalco "Duracolor" or "Kalcolor", Alcoa "Duranodic 300" or Atlas "Permanodic".

14. PIPEWORK

14.1 Coordination

The tender drawings do not necessarily show all fittings, nor indicate accurate locations for pipework. Before commencing work, verify the exact positions of fixtures, plant, appliances and the like to which the pipework is to be connected. Provide piping and fittings as necessary to complete the systems.

Coordinate the pipe systems with other services and submit shop drawings.

14.2 Existing Services

Obtain approval from the base building Builder to connect into the existing service, and perform the work to minimise the effect of interruptions.

14.3 Workmanship

Appropriately qualified personnel shall supervise the installation of pipework.

Systems shall be suitable for the temperatures and pressures (including pump shut-off head) to which the piping system could be subjected.

Take precautions against fire and damage from welding operations as specified in AS 1674.

During welding and brazing, safeguard surrounding areas against fire and keep on hand at least two appropriate portable fire extinguishers. When welding above openings, provide fire proof covers to prevent hot material falling to lower levels.

During construction, temporarily seal open ends of pipes and valves to prevent the entry of foreign matter into the pipework system.

Remove loose scale, dirt, and the like from the pipework and leave the system free from foreign matter on completion.

Install pipework in straight lines and uniform grades without sags. Arrange pipework runs adjacent to, and horizontally parallel with each other and with walls, beams, and the like. Keep at least 150mm above ground surface if under suspended ground floors. Provide at least 25mm spacing from adjacent pipes and 50mm spacing from electrical cables, measured clear of pipe insulation.

Use long radius elbows or bends where practicable in preference to short radius elbows. Do not use mitred fittings without approval.

14.4 Penetrations

Where pipes pass through building elements, provide metal or plastic sleeves of a diameter to clear the pipe and insulation.

In floors draining to floor wastes and floors which are subject to washing down, sleeves shall be 1.2mm copper, projecting 100mm above the finished floor level.

In fire rated elements, sleeves shall be metal. If the pipe is not insulated, pack the space between the pipe and sleeve with an approved fire resistant material. If the pipe is insulated, the insulation within the sleeve shall be FR/Armaflex with Intumex 'L' wrap, installed in accordance with the manufacturer's instructions.

In acoustic rated building elements, pack the annular space with mineral wool insulation.

In penetrations required to be airtight or watertight, seal the annular space packing with self-extinguishing silicone sealant.

Where pipework emerges from finished surfaces in public view, provide ornamental cover plates of nonferrous metal or stainless steel, of nominal diameter 50 mm greater than the diameter of the pipe (including any insulation), close-fitting and firmly fixed in place.

Flash penetrations through roofs and similar external elements of the building.

14.5 Flexibility

Install pipework with bends, offsets and spring hangers to absorb vibration and expansion without developing excessive stresses in the pipework, connected equipment, or the supporting structure, in accordance with AS 4041.

If the designed operating temperature range of metal pipework exceeds 35°C, cold spring the pipe 50% of the calculated total expansion for the length under consideration.

Provide sufficient pipe anchors and pipe guides of adequate strength to ensure that expansion, contraction, vibration, and the like forces are accommodated. Weld or securely clamp anchors to the bare pipe.

Support each vertical riser pipe at rigid support(s) to anchor the pipe and resist expansion and gravitational forces. Provide guide supports to allow expansion movement at nominal 3.5m spacings up to DN50 pipe size and at nominal 6.0m spacings above DN50.

Where pipework is connected to vibrating equipment, arrange the pipework to allow flexibility.

Provide spring hangers to take up movement due to spring mounted equipment and expansion. Spring hangers shall be selected to limit changes of load on the supporting structure to ±25% of initial load.

Provide rubber isolating hangers in other locations where necessary to prevent transmission of vibration from the pipe system to the supporting structure.

Proprietary expansion devises and flexible connection devices shall not be used without approval.

14.6 Chases

Cut chases with a power saw unless otherwise approved. Do not chase reinforced concrete without approval.

Pipework chased into masonry or concrete shall not cross any movement joint, and shall be insulated or covered with a suitable flexible material so that expansion and contraction can take place without damage to the pipework or to the surrounding element and its surface finish.

14.7 Supports

Support horizontal piping at joints, at changes of direction and at evenly spaced intervals not exceeding those listed in the table below.

Hanger rods for single pipes shall be not less than the listed diameters.

Hanger rod diameters for multiple pipes shall be adequate to support the fluid filled pipes with every second hanger disconnected.

Pipe Size (mm)	Steel	Copper Type A&B	Copper Type C&D	PVC	Hanger Rod Diameter (mm)

10	-	0.8	0.6	0.50	6
15	1.5	1.2	1.0	0.60	6
20	2.0	1.5	1.2	0.70	6
25	2.2	1.7	1.4	0.75	10
32	2.6	2.0	-	0.85	10
40	3.0	2.3	-	1.00	10
50	3.3	2.5	-	1.15	10
65	3.7	2.8	-	1.30	12.5
80	4.0	3.1	-	1.40	12.5
90	4.2	3.2	-	1.55	12.5
100	4.3	3.3	-	1.75	16
125	4.8	3.7	-	1.75	16
150	5.2	4.0	-	1.75	16
200	6.0	-	-	2.40	19
250	7.0	-	-	2.40	19
300	8.0	-	-	2.40	19
350	8.3	-	-	-	22
400	8.5	-	-	-	to BS 3974
450	9.0	-	-	-	to BS 3974
500	10.0	-	-	-	to BS 3974

Fix pipe supports to masonry with galvanised steel or nonferrous metal bolts, cast-in or screwed into expanding metal masonry anchors. Do not use explosive powered fixings.

Attach hanger type supports to the pipe with clamped metal clips as follows:

To uninsulated pipe:

- Clamp the clip direct to steel pipe. Provide tape under clips on copper pipe.

To insulated pipe

- Provide a spacer between the clip and the pipe, of length not less than twice the clip width and of thickness equal to the insulation

14.7.1 Spacer Materials

For cold pipe systems:

- Wood or high density cork, wrapped with aluminium foil vapour barrier

For hot pipe systems:

- Wood, or high density cork or metal spiders

14.7.2 Clips and Saddles

Do not use saddle type supports for pipes 50 mm and over. The minimum cross section of metal material forming clips and saddles shall be as specified in the following table:

Clip material:	Outside diameter of pipe or sheathing:	Strap dimensions (mm) (width x thickness):
Copper	0 - DN50	25 x 1.6
Steel	0 - DN30	25 x 1
Steel	DN31 - DN75	25 x 3
Steel	DN76 - DN250	40 x 6
Steel	over DN250	to BS 3974

14.7.3 Proprietary Support Systems

Approved proprietary support systems may be used.

14.8 Joints

14.8.1 General

Minimise the number of joints by using the longest practical lengths of pipe.

Permanent joints shall be welded or brazed. Victaulic joints may be used for steel pipes.

Provide demountable joints only at connections to equipment such as coils, valves, instruments or the like.

Provide flanged joints or Victaulic couplings for pipe sizes DN65 and over. Screwed joints or unions may be used for pipe sizes under DN65.

On copper pipes, capillary and compression fittings shall comply with AS3688.

14.8.2 Flanged Joints

Flanges shall be low carbon steel for steel pipes and bronze brazing flanges for copper pipes. Flanged joints shall comply with AS 129 for the design pressure and temperature.

Flanges shall be welding neck or slip on type with a square corner at the bore of the pipe to ensure that, where flanges are mated, there will be no internal recess in the bore to collect sediment. Flange reducer fittings are not acceptable.

Flanged joints shall be assembled with a preformed, proprietary type, full face gasket, asbestos free and not less than 0.8mm thick, suitable for the service conditions. Flange bolts shall be cadmium plated steel.

Steel screw flanges shall only be used if permission is granted and shall be heavy pattern low carbon steel type with taper threads.

14.8.3 Screwed joints

Screwed joints may be used for demountable connections only. Screwed joints shall be taper to taper or taper to parallel in accordance with AS 1722. Taper to parallel joints shall not be used where pressure can exceed 1400kPa on AS1074 medium pipes or 1720kPa on heavy pipes. Screwed joints shall not be used where pressure can exceed 2400kPa on medium pipes or 3100kPa on heavy pipes.

Seal the threads of screwed connections with PTFE tape or hemp and jointing paste.

14.8.4 Screwed Unions

Screwed unions may be used for connections to screwed fittings such as valves. Use screwed steel unions for steel to steel connections and screw to capillary bronze unions for steel to copper connections. Unions shall have hexagonal nuts and bronze seats.

14.8.5 Dissimilar Metals

Do not install dissimilar metals likely to generate electrolytic, galvanic or corrosive action in direct contact with each other. Make junctions between copper and steel with bronze to steel flanges or screw to capillary bronze unions.

14.9 Copper Piping

14.9.1 Use of Copper In Lieu of Steel

Note: Copper piping in accordance with nominated specification below may be used in lieu of steel piping if permission is granted. Pipe sizes shall be increased where necessary to avoid increase in friction losses. (Note: This will usually require an increase of one nominal pipe size for piping less than DN50.)

14.9.2 General

Piping shall be best quality phosphorous deoxidised copper, complying with AS 1432 or AS 1572. The materials, wall thicknesses and design pressures shall comply with the table below. Test pressure shall be 1.5 times design pressure.

14.9.2.1 *Condenser Water Systems - Copper*

Working Pressure	Size	Pipe Standard	Grade
Up To 700 KPa	Up To DN150	AS1432	Type B
	Up To DN200	AS1432	Type A
	Up To DN225	AS1572	2.64mm
	Up To DN250	AS1572	3.25mm
Up To 1400 KPa	Up To DN40	AS1432	Type B
Up To 2100 KPa	Up To DN25	AS1432	Type B

14.9.2.2 *Heating Water Systems - Copper*

Working Pressure	Size	Pipe Standard	Grade
Up to 700 kPa	Up to DN150	AS1432	Type B
	Up to DN200	AS1432	Type A
	Up to DN225	AS1572	2.64mm
	Up to DN250	AS1572	3.25mm
Up to 1400 kPa	Up to DN50	AS1432	Type B
Up to 2100 kPa	Up to DN32	AS1432	Type B

14.9.2.3 *Chilled Water Systems – Copper*

Working Pressure	Size	Pipe Standard	Grade
Up To 700 KPa	Up To DN200	AS1432	Type B
	Up To DN250	AS1572	2.64mm
Up To 1400 KPa	Up To DN65	AS1432	Type B
Up To 2100 KPa	Up To DN40	AS1432	Type B

Working Pressure	Size	Pipe Standard	Grade
Up To 700 KPa	Up To DN150	AS1432	Type B
	Up To DN200	AS1432	Type A
	Up To DN225	AS1572	2.64mm

Fabricate copper piping in accordance with AS 1135.

Braze joints and provide demountable connections at valves and equipment.

Join lengths of pipe using capillary fittings, or expand one tube over the other leaving a minimum of clearance and an effective overlap not less than the following table:

Pipe size (DN)	15 - 20	25 – 32	40 - 50	65 - 80	100 - 125	150 - 200
Overlap (mm)	12	15	25	30	35	40

15. ELECTRICAL

15.1 General

Electrical installation work and equipment shall comply with the requirements of the latest relevant Standards, the local supply authority and any other authority having jurisdiction over the works.

Switchgear, control gear, fittings and accessories shall be of uniform type and manufacture throughout the whole of the installation.

Complete the work and submit ready for test certificates to the supply authority in time to allow inspection and tests to be completed and power available for the setting into operation of the systems according to the agreed programme.

15.2 Drawings - Electrical

Prepare and submit drawings in accordance with requirements specified elsewhere in this specification. The drawings shall include:

- wiring diagrams for power and control circuits
- symbol identification in accordance with AS 1102
- size of cables
- cable identification and terminal numbering
- contact configuration diagrams with manufacturer's terminal numbers for plug in relays
- ratings of fuse combination units, HRC fuses, circuit breakers, contactors, starters, relays and motors
- manufacturer's name and catalogue number of equipment
- interface with monitoring and control systems, fire alarm and detection equipment and the like

Switchboard drawings indicating:

- the general arrangement of equipment
- full details of cabinet construction and dimensions
- front elevation of switchboard
- vertical section through each compartment
- sheet metal details
- finishing process details
- weights of switchboards heavier than 500kg
- the method of supporting busbars and equipment
- a description of materials to be used
- clearances between live parts, and live parts and earth
- busbars dimensions and ratings

- the size and wording of labels

15.3 Electrical Supply

15.3.1 Electrical Characteristics

The electrical supply to the installation will be 400 volt, three phase, neutral and earth, 50 hertz.

15.3.2 Phase Sequence

Maintain the same phase sequence throughout the installation. Use the following designations:-

- A phase - Red
- B phase - White
- C phase - Blue
- neutral - Black
- earth - Green/yellow

15.3.3 Balance of Load

Balance the load as closely as practicable between the individual phases of supply.

15.4 Earthing

Provide earthing to:-

- exposed metal parts forming part of this installation.
- metal conduits, frames, cable trays, trunking and ducts.
- cable sheaths, armouring and screening.
- equipment enclosures and switchboards.

Earthing conductors:-

- shall be copper, of adequate cross-section and continuous throughout their entire length.
- shall be 2.5mm^2 minimum cross-section area.
- may be the copper sheathing to MIMS conductors where permitted by the Wiring Rules.

15.5 Wiring Methods

Wiring methods shall comply with the following schedule:-

Location	**Wiring Methods**
Plantrooms	a, b, d, g
Accessible False Ceilings	a, b, d, f, g
Non-accessible False Ceilings	c, e, g
Exterior	c, e

Columns & Walls in occupied areas	h

Where:-

a) = Multi core TPS on cable tray

b) = Single core TPS 10mm^2 and larger in trefoil groups on cable tray

c) = TPI in screwed galvanised steel conduit on surface

d) = TPI or TPS in cable troughing

e) = TPI in PVC or steel conduit within slab

f) = TPS smaller than 10mm^2 unenclosed fixed to structure

g) = TPI in rigid PVC conduit on surface

h) = TPS in cast-in conduit

Provide separate circuits from the switchboard to each item of equipment.

15.6 Cables

15.6.1 General

Cables shall:-

- have stranded copper conductors
- be of minimum size 2.5mm^2
- be insulated with 0.6/1 kV grade PVC compound, type V75 or higher for cables larger than 25mm^2
- be insulated with 450/750 V Grade PVC compound type V90 or higher for cables equal to or less than 25mm^2
- comply with AS/NZS 5000

15.6.2 Fire Rated Cables

Polymeric fire rated cable shall:

- comply with AS/NZS 5000
- meet the nominated classification rating complying with AS/NZS 3013
- be suitable for installation in fire hazardous locations as required by the Regulations.

15.6.3 Electronic Instrument Cables

Cables for wiring to thermistors, thermocouples, electronic sensors, digital control equipment, etc., shall be of types as necessary for the application and shall be screened if necessary to prevent spurious signal pick up.

15.6.4 TPS Cables

TPS cables shall:-

- incorporate an earth conductor for multicore cables up to 6mm^2.
- be multi-core for sizes up to 10mm^2.

15.6.5 Derating

Cables shall be derated for installation conditions such as grouping, enclosure, location, etc. as set out in the wiring rules.

15.6.6 Cable Terminations

Cables shall:-

- be terminated with copper lug terminals, bolted or crimped to the conductor, except where tunnel terminals are provided on equipment.
- be numbered at switchboard and control panel terminals using slip-on coloured ferrules corresponding with wiring diagrams.

15.7 Installation of Cables

15.7.1 General

Cables shall:-

- be installed so that they can readily be withdrawn and reinstalled.
- be installed without any joints.
- be installed on the loop-in, loop-out principle when enclosed in conduit.
- be fixed and supported with purpose made clips, cleats or saddles when installed on cable trays or ladders.
- be installed in trefoil formation when single core cables of size 10mm^2 and above are used.
- pass through ferrous metal panels in circuit or multi phase groups or singly via a brass plate with suitably sized holes.
- be installed to permit adequate air circulation around each cable unless appropriate derating factors have been used in cable sizing.
- be installed on square grid patterns parallel to walls etc.
- not be bent through radii less than minimum bending radii specified by the manufacturer.

15.7.2 TPI Cables Installation

TPI cables shall be enclosed within conduits or cable troughing.

15.7.3 TPS Cables Installation

TPS cables shall:-

- be enclosed in conduit when run in rendered walls or concrete.
- be enclosed in conduit in locations where they are liable to mechanical damage.
- not be secured when installed in inaccessible locations such as cavities and stud partitions.
- be fixed to the slab/roof structure when installed in accessible false ceiling spaces by means of approved clips and/or saddles.
- be installed on cable trays or in wiring ducts where multiple runs are installed over common routes.

- be tied together in circuit or sub-main groups for single core conductors.
- be fitted with a cable gland where they penetrate equipment enclosures.

15.7.4 Fire Rated Cables

Fire rated cables, other than MIMS, shall:

- be installed in accordance with AS/NZS 3013 to provide a fire resistance exposure of 120 minutes
- be protected against mechanical damage relative to type of cable installed, location where installed, method of installation and requirements for emergency system served
- be fixed with double point saddles except where installed and supported on continuous cable trays
- be secured to the building structure in positions which are secure against damage
- be secured with steel bolts and anchors; plastic fixings are not acceptable
- not be installed below pipes, ducts, trays, etc., which may dislodge in a fire situation and impair the operation
- be fitted with fire rated junction boxes where connections are unavoidable
- be installed in trefoil configuration where single core cables are utilised
- be installed in earth galvanised steel conduit where required to achieve EMC shielding requirements

15.7.5 Electronic Instrument Cables Installation

Cables for electronic equipment shall be installed separately from low voltage cables and within separate enclosures.

15.8 Conduit

Conduit shall:-

- be 20mm minimum diameter, circular section.
- contain a maximum of two circuits.
- be installed with fittings and draw wires to suit the loop-in method of wiring before wiring of a particular section is commenced.
- not be longer than 20m between draw-in boxes.
- have not more than two right angle bends or sets between draw-in boxes.
- be installed in a manner which will not necessitate penetration of damp courses or influence the entry of moisture into the building.
- be equipped with flexible couplings at construction joints.
- be concealed from view in occupied areas by running in ceiling spaces, concrete slabs, air space of stud or cavity walls or chased into rendered masonry walls.
- be located clear of the thermal insulation where installed in ceiling spaces.
- be rigid PVC conduit where cast into concrete.
- have a minimum 25mm cover in masonry walls or columns.

- be set at changes of direction where concealed within the structure.
- be set using approved type conduit benders which prevent flattening of the conduit.
- terminate at steel or PVC wall boxes for flush wall outlets and switches.

Conduit exposed to view shall be:-

- installed in straight runs which are parallel or normal to the building structure.
- installed to avoid the formation of moisture traps, but where dipped sections cannot be avoided, the lowest point in the run shall be drilled 3mm diameter to form a drain.
- secured by spacer bar type saddles providing 3mm clearance of the fixing surface.
- painted a selected colour.

Flexible conduit shall be:-

- provided between fixed conduit and equipment which is subject to vibration.
- FGS Sealflex or Ultraflex where subject to mechanical damage or where required for earth continuity (eg. across construction joints).
- fitted with standard metal terminators.
- connected to concealed fixed conduit via a flush mounted junction box with a terminator secured by locknuts to the cover plate.

Steel Conduit shall:-

- be galvanised.
- be cut square, threaded with the minimum number of threads being cut consistent with the union, painted over the threads with conductive paint, reamed to remove burrs, and adequately terminated into threaded connections or lock nuts. Proprietary alternative systems to threaded connections may be offered for approval where they provide equal or better performance to threaded connections
- be fixed at 1200mm (maximum) centres where surface run.

Rigid PVC conduit shall:-

- be high impact, cold setting, heavy duty complying with AS 2053.
- be joined together and to fittings with an approved solvent cement.
- not be used in the following locations:-
- where exposed to mechanical damage.
- where subject to ambient or contact temperature in excess of 50oC.
- for surface runs exposed to view.
- in hazardous locations.
- be provided with one approved expansion joint for each straight section of surface run conduit exceeding 6m in length.
- be fixed by galvanised or PVC saddles at 600mm (maximum) centres where surface run.

- be fixed to a timber batten where installed across rafters or joists in accessible ceilings.

where cast into concrete:-

- be spaced not closer than 25mm apart.
- be placed above the bottom reinforcing bars.
- have at least 25mm concrete cover.
- be accurately positioned and aligned where they emerge from the concrete and fixed by fastening the upstands to approved rigid supports.
- be attended during pouring of concrete and be adjusted or repaired if they are dislodged or damaged.

15.9 Cable Trays

Cable trays shall:

- be provided to support multiple runs of cables
- be perforated sheet steel electro-zinc plated with 40% (minimum) of its surface area open for air circulation
- be fitted with the manufacturer's standard bends, risers, curves, reducers and fishplates
- have cut ends coated with cold galvanised paint
- be fixed to approved steel brackets and hangers where horizontally installed
- be fixed such that there is an air space of 50mm minimum to the structure to which they are secured
- be supported such that the maximum deflection between adjacent supports does not exceed 10mm when fully loaded
- be installed parallel or at right angles to the building structure and planning grids
- be sized so that they are loaded to a maximum of 80% of their capacity (width) including spaces between cables for derating purposes
- be provided with sun screens where exposed to sunlight
- be high sided type for cable loads in excess of 20kg per metre
- be positioned to enable clear access to cables for inspection and maintenance
- where installed in plantrooms and locations exposed to possible damage:
    - be Laddertray
    - be provided with covers where cables are exposed to damage
    - be polyester coated in colour as nominated under clause PAINTING
    - have rungs spaced at 150mm centres

15.10 Cable Ladders

Cable ladders shall:

- be used where cable loadings exceed 125kg per metre

- be fabricated from galvanised steel or aluminium sections
- conform to NEMA Standard VE1
- be fitted with manufacturer's standard accessories (bends, risers, splices, etc.).
- incorporate rungs at 300mm (max.) centres
- not be drilled for suspension fittings, saddles, fixings, etc. Factory made perforations and slots in steel components prior to galvanising shall be used for this purpose
- incorporate facility for longitudinal expansion at splice joints
- be provided with sun screens where exposed to sunlight
- have cut ends painted with cold galvanising paint

Supports for cable ladders shall:

- be designed for a safety factor of 2.1
- be spaced to co-ordinate with building structure and other services
- be spaced to limit the deflection between the supports of a loaded cable ladder to less than 1 in 400 where exposed to view and 1 in 250 where located in areas concealed from view (e.g. under floor, false ceiling spaces etc.)
- be designed to withstand a side force of 450 N at any point with a maximum mid span deflection of 1 in 200 of the span between supports

15.11 Switchboards

15.11.1 General

Switchboards shall incorporate electrical equipment as necessary for the operation of the mechanical services. Control equipment shall not be remotely located from switchboards without prior approval.

Switchboards shall be:-

- of overall dimensions to suit the available space.
- constructed and contain equipment to the approval of the local supply authority.
- manufactured by an approved specialist mechanical services switchboard company.

15.11.2 Requirements

Generally switchboards shall:

- Be of metal construction and of sufficient size to allow ready and safe access to all components for maintenance including recognition of sufficiently sized cabling zones;
- Be constructed and contain components suited for their application and to authority approval;
- When installed in external environments be fitted with appropriate maintenance lighting, and weather proofing;
- Where locked, fitted with hardware and keyed to the building master keying system;

- Comply with the following forms of construction described by AS/NZS 3439.1 (insulated cables, bus bars and switchgear housing shall not be considered as separation):
    - Form 1 for less than 150amp capacity;
    - Form 2b for 150amp to 500amp;
    - Form 3a for 500amp to 1000amp;
    - Form 3b for greater than 1000amp;
    - Form 4a Essential services separated from Non essential services
- Include dead front welded metal construction;
- Include circuit breakers controlling incoming and outgoing supplies;
- Provision of busbars and main switches to increase the capacity by an additional 20%;
- Provision of a minimum spare breaker capacity equal to 20% of the installed outgoing circuits, including busbar and chassis arrangements ready for future breaker installation to new plant and/or services;
- Separation of power and controls sections; and
- Provision of cable zones of sufficient capacity to take the additional requirements noted above inclusive of terminations.

15.11.3 AS 3439 Compliance

Switchboards shall comply with AS 3439 in accordance with the following requirements.

Switchboards shall:-

- be "enclosed type for stationary indoor installation" unless outdoor installation is indicated on the drawings or in switchboard schedules.
- be cubicle type for floor standing switchboards and box type for wall mounted switchboards
- be rear connected if the drawings indicate a free standing floor mounted switchboard with access space at the rear, and front connected otherwise
- have IP43 degree of protection in accordance with AS 60526 where installed indoors and IP55 where installed outdoors
- be constructed such that visual inspection, adjustment of settings, replacement of fuses and indicator lamps, measurement of voltages and currents can be carried out when the switchboard is in service.
- be type tested assemblies (TTA) or partially type tested assemblies (PTTA) or have a method of construction which has been type tested or derived by calculation in accordance with the requirements of AS/NZS 3439.1. Submit type test and routine test certificates.
- have fixed equipment unless removable or withdrawable parts are specified in following clauses.

15.11.4 Prospective Short Circuit Current

The mechanical services switchboard and the installation connected thereto, shall be capable of withstanding the stresses caused by the prospective short-circuit current for a period of one second.

15.11.5 Circuit Protection

Switchboards shall incorporate a mains isolator on each incoming supply and circuit breaker protection on each sub circuit. HRC fuses may be used for fault limiting.

15.11.6 General Arrangement

Switchboards shall:-

- be of the flush fronted type with only indicators and equipment for operational use protruding through the front panel.
- be arranged so that the distance between floor level and top of switchboard does not exceed 2250mm.
- have hinged lockable doors at the front of equipment mounting cubicles.
- have a fascia panel along the top front on which shall be mounted switches, pilot lights and meters. The fascia shall be hinged at the top or a separate hinged panel shall be provided to allow access to wiring and connections.
- have main isolator units mounted on a fixed section of the face of the panel or behind a separate hinged door through which the operating handle or toggle protrudes and the ON/OFF indication is visible.
- contain cable entries and/or gland plates, sized to suit the incoming and outgoing cables and positioned to suit the site conditions.
- have fixed or removable lifting lugs for switchboards heavier than 250kg.

15.11.6.1 *Wall Mounted Switchboards*

Switchboards without rear access shall have:-

- cable or busbar droppers in slotted PVC cable ducts on the front of the mounting panel.
- equipment connections at the front of the mounting panel.
- outgoing cables installed in slotted PVC cable ducts on the front of the mounting panel.

15.11.7 Mounting of Switchboard Equipment

Equipment in switchboards shall be:-

- mounted on fixing rails or insulating panels.
- mounted to enable easy access for tong testing, service and replacement without disturbing adjacent units.

Miniature circuit breakers shall be:-

- secured by clip-in type fixings as provided by the circuit breaker manufacturer.
- mounted so that the toggle operation to the "on" position is upwards for vertically mounted breakers and to the right for horizontally mounted breakers.

Auto/Off/Test switches shall be mounted within the equipment cubicles.

15.11.8 Cabinet Construction

Switchboard cabinets shall:-

- be of folded and welded construction.

- have external continuous seam welds, ground flush after fabrication.
- have top and bottom vents with internal fine bronze wire mesh.

Doors shall be 1.6mm minimum thickness steel with folded edges and shall have:-

- gaskets.
- chromium plated metal lift-off pintle type hinges.
- a heavy duty metal latch with two keys.
- metal latching bars on doors larger than one metre high.

15.11.9 Finishes

Switchboards shall be painted with automotive lacquer or powder coat with a high gloss finish. If painting is on site, paints must comply with low VOC requirement as per PAINTING section. External handles, bolts and fittings shall be stainless steel or chromium plated.

15.11.10 Busbars

Busbars shall:-

- comply with AS/NZS 3439.
- be manufactured from high conductivity hard drawn copper bar with rounded edges.
- be of minimum size 12mm x 3mm.
- have neutral busbars of the same current rating and size as the phase busbars.
- be insulated with phase coloured PVC.

15.11.11 Wiring in Switchboards

Arrange wiring in switchboards to permit tong testing.

Instrument, indicator and control wiring shall be:-

- PVC insulated, stranded copper, minimum size 1.5mm2, V75 grade, 0.6/1kV.
- supported by ducting for groups of cables and plastic clips for single cables.
- identified by engraved ferrules fixed to the wire at each terminal connection.
- terminated with insulated crimping lugs.

15.11.12 Labelling

Labelling shall:-

- be machine engraved Traffolyte with minimum 5mm high lettering.
- be provided on each switchboard to identify:-
    - the switchboard number.
    - controls, links, contactors, relays, starters and switches.

15.11.13 Installation of Switchboards

Install switchboards plumb and level. Fix in position with masonry anchors and galvanised screws or bolts with galvanised flat washers through drilled fixing holes

15.12 Electrical Power Equipment

15.12.1 Circuit Breakers

Circuit Breakers shall:-

- be of the same manufacture throughout the installation
- be selected where possible to fully discriminate and cascade and offer fault current limiting features in the range
- be automatic, inverse time, instantaneous type.
- comply with AS60947.2 and AS 60898.1 for miniature circuit breakers.
- have an interrupting rating not less than the prospective short circuit current.

Residual current devices (RCD's) shall:

- be provided on nominated final sub circuits
- be rated for 30 mA operation
- be integrated with a miniature circuit breaker with over current and short circuit current protection
- be arranged within the switchboard so that the test button is accessible without the need to remove covers
- comply with AS/NZS 61008 and AS/NZS 61009
- not trip on power failure
- recognise and not trip where dc leakage currents are present.

Moulded case circuit breakers (MCCB's) shall:

- incorporate similar features as listed for miniature circuit breakers
- be provided with extension rotary handles at the face of the panels
- comply with AS 60947.2.
- be rated at a minimum breaking capacity greater than the design prospective fault level as indicated in the Switchboard Schedules or switchboard single line drawings
- include electronic trip units unless stated otherwise
- for MCCB's greater than 250 A be provided with digital ammeters integral to the trip unit.
- plug in MCCBs shall be interlocked such that it shall not be possible to remove a plug in MCCB from its plug in base without first switching the MCCB to the OFF position
- plug in MCCBs shall be interlocked such that it shall not be possible to insert a plug in MCCB to its
- plug in base unless the MCCB is in the OFF position

- on 4 pole models the neutral (N) pole shall be of an early make late break design, such that abnormal transient voltages cannot occur between phase and neutral lines during opening and closing operations.

15.12.2 Switches and Isolators

Switches and isolators in power circuits shall

- comply with AS/NZS 3947.3 and AS/NZS 3133
- Rated for AC-23 utilisation category

15.12.3 Local Isolating Switches

Motors shall be provided with an isolating switch within view of the motor. For motors rated up to 45kW the isolating switch shall be rated for interrupting the locked rotor current of the motor.

Isolating switches shall be polycarbonate protected type with IP55 enclosures and incorporate facility for locking in the off position.

15.12.4 Contactors

Contactors shall:-

- comply with AS 60947.1 and AS 60947.4.1.
- be rated for AC-3 utilisation category unless used in non-inductive circuits in which case AC-1 utilisation category is acceptable be rated for AC-23 utilisation category in inductive circuits.
- be rated for uninterrupted duty.
- be rated in addition for intermittent duty class 0.1 or higher where used for control of electric duct heaters or for other applications where frequent operation is expected.
- have a rated short time withstand current not less than the prospective short circuit current at the point of installation.
- have renewable contacts and operating coils.
- be of Sprecher and Schuh, Siemens, Nilsen or approved equal manufacture.

15.13 Electrical Control Equipment

15.13.1 Control Switching Devices

Switching devices in control circuits shall:-

- comply with AS 60947.5 as relevant to the particular device.
- have rated operational currents suitable for the particular application.

15.13.2 Contactor Relays

Contactor relays shall have:-

- renewable contactors and operating coils.
- silver plated contact tips.

- rated operating coil voltage and rating of contacts to match the application in a format which has been tested by the manufacturer.
- surge suppression on operating coils where necessary to protect electronic equipment which supplies the coil circuit.
- a contact configuration diagram on the cover of plug in relays.

15.13.3 Indicator Lights

Indicator lights shall:

- comply with IEC 73.
- be ultra bright light emitting diode (LED) type with a minimum design life of 50,000 hours equal to Telemecanique ZB series or higher range
- be capable of being replaced from the front.
- be provided with an indicator lamp test circuit where more than 10 indicators are provided on a switchboard.
- have coloured lenses of 19mm diameter minimum.
- have lens colour BLUE for "Fire Relay Trip".
- have lens colours for other purposes as indicated on drawings.

15.14 Motor Starters

Motor starters shall be direct-on-line type unless otherwise scheduled or specified and shall be rated in accordance with AS 60947 for:

- the starting and operating current of the associated motor.
- AC-3 utilisation category.
- 8 hour duty and class 0.1 (minimum) intermittent duty.
- AS 60947.4.1 Type 2 coordination with the associated short circuit protection devices for motors of 37.5kW and larger and Type 1 co-ordination for all others.
- Motor starters shall incorporate overload protection of the type specified in clause OVERLOAD PROTECTION.

15.14.1 Direct-on-Line Starters

Direct-on-line motor starters shall comply with AS 60947.4 and shall have a rated mechanical life not less than ten million operations and a rated AC-3 electrical life not less than one million operations.

15.14.2 Star Delta Starters (Open Transition)

Open transition star-delta starters shall comply with AS 60947, shall be automatically operated and shall incorporate mechanical interlocking to prevent concurrent closure of the star and delta contactors. Automatic change from star to delta connection shall be achieved by an adjustable time delay relay with a time range up to 45 seconds.

Overload protection devices shall protect the motor in both star and delta connection.

15.14.3 Star Delta Starters (Closed Transition)

Closed transition star delta starters shall comply with AS 1202 Part 2, shall be automatically operated and shall incorporate mechanical interlocking to prevent concurrent closure of the star and delta contactors. Automatic change from star to delta connection shall be achieved by an adjustable time delay relay with a time range up to 45 seconds. The resistance transition circuit shall be closed momentarily during the changeover.

Overload protection devices shall protect the motor in both star and delta connection.

Over temperature protection of the resistor bank shall be provided and shall be arranged to trip the line contactor.

15.14.4 Auto Transformer Starters

Auto transformer starters shall comply with AS 60947 and shall be of the three transformer type with taps for 50%, 65% and 80% voltage. Transformers shall be mounted in a ventilated section of the switchboard and shall incorporate thermistor or thermostat type overtemperature protection embedded in the windings.

Automatic, Korndorfer closed transition starting shall be used and concurrent closure of the start and run contactors shall be prevented by means of mechanical interlocking.

Starter ratings shall suit the characteristics of the associated motor and driven equipment, including a starting time in excess of 15 seconds if necessary.

15.15 Overload Protection

15.15.1 General

Motors shall be provided with overload protection of the type specified herein.

Where practical the overload protection device shall be incorporated within the motor starter or contactor.

15.15.2 Thermal Overload Relays

Class B thermal overload relays complying with AS 60947.4 shall be fitted to three phase motors, (including motors which are provided with thermistor protection).

Thermal overload relays shall have the following features:

- block type for mounting direct to the contactor up to 37kW rating and for separate mounting above that size.
- same manufacture as contactor or starter.
- rated to suit contactor sizes.
- fitted with interchangeable heaters to suit motor current rating and with factory calibrated adjustment dial to select actual setting required.
- ambient temperature compensation.
- tunnel type clamp terminals for up to 37kW rating.
- single phasing protection, by way of differential trip action between bimetal heater elements on each phase.
- visual trip indication.
- manual reset.

15.15.3 Thermistors & Thermistor Relays

Thermistors shall be provided in motors used for variable speed drive and in motors 37 kW and larger. Thermal overload relays shall also be provided for these motors.

Thermistors shall comply with AS 1023 Part 1 and shall provide type TP2 protection of the motor.

Thermistors shall be wired in series to a suitable matched thermistor control unit complying with AS 1023 Part 1 and fitted with manual reset button and visual trip indication.

The active circuit to the thermistor control unit shall be from a source which is not interrupted by normal stop-start operations or fire trips.

On airstream mounted smoke spill fan motors, provide controls to nullify the thermistor protection during operation in smoke spill mode.

15.15.4 Single Phase Motor Protection

Single phase motors shall be protected by manual reset class A thermal overload switches complying with AS 60947.4 or manual reset inherent overheat protectors complying with AS 1023 Part 3.

15.15.5 Electronic Overload Relays

Electronic thermal overload relays shall be provided to protect hermetic motors rated 55kW and above and motors rated 110kW and above. Relays shall monitor the motor current on three phases and shall incorporate phase failure and asymmetry detection, thermistor protection including open/short circuit thermistor monitoring and LED trip indication of thermal overload, phase failure or asymmetry and thermistor trips.

Adjustable settings shall be provided for motor current and tripping time.

Relays shall be Sprecher and Schuh model CEF or approved equal.

15.16 Motors

All motors supplied shall satisfy the minimum standards for “high efficiency” motors defined in Table 3.1 and 3.2 of AS/NZS 1359.5: 2004 should be applied.

Motors shall have rated power adequate for the driven equipment under all conditions of operation. The ratings nominated in the schedules are for tendering purposes and shall be adjusted where necessary to ensure that motors are selected for at least 120% of the power required by the driven equipment when operated at the specified load.

Single phase motors shall comply with AS 1360.11 and shall be rated for continuous duty.

Motors rated at 0.37kW and above shall be three phase squirrel cage induction type complying with AS 1359 and shall:

- be four pole unless specified otherwise.
- be S1 duty type in accordance with AS 1359.101.
- have a minimum degree of protection in accordance with AS 60529 which shall be the greater of:-
    - as specified in the clause relating to the driven equipment or,
    - IP56 if exposed to weather or,
    - IP44 if cooling method IC410 or IC411 is specified or,
    - IP22 minimum.

- have a cooling method IC01, IC0410 or IC0411 in accordance with AS 1359.106 unless specified otherwise.
- have a mounting arrangement and type of construction IM1001 in accordance with AS 1359.107 Code II unless an alternative arrangement is necessary to suit the method of installation.
- be mounted on slide rails when used in belt driven applications.
- have ball or roller bearings in grease relief housings with standard grease nipples for motor frame designations above 132. Bearings in frame designations 132 and below may be sealed type. Bearings in motors where two or more motors are mounted on a single inertia base shall be maximum capacity deep groove ball type.
- unless specified otherwise, be rated for standard service and operating conditions as nominated in AS 1359.101, except for motors required to operate in the smoke-spill air stream in accordance with AS 1668.1, which shall be rated for operation at 300°C for a single fire compartment 200°C ambient for fan serving more than one fire compartment.
- have Class F (minimum) insulation.
- have a starting torque adequate for the driven equipment when started by the specified method.
- have a locked rotor kVA not exceeding the values in column 3 of table 41.2 of AS 1359.41 for motors rated at 37kW and above unless otherwise approved.
- be fitted with PTC thermistors providing class 1 protection matched to the motors insulation class and complying with AS 1023.1 for motors rated at 37kW and above and motors operated at variable speed.
- where thermistors are incorporated, the motor shall have a segregated terminal box to separate power and thermistor terminals. Thermistors shall be installed in pockets placed into each of the stator windings during manufacture with each thermistor wired separately back to the terminal box. (Refer also to clause "Overload Protection").

Motors for variable speed drives shall be rated such that they will not be loaded more than 95% at maximum rated speed and will not overheat at any speed up to rated speed when driving a load with a centrifugal characteristic. The full load power factor shall be greater than 0.7.

15.17 Variable Speed Drive Controllers

15.17.1 General Description

The Variable Speed Drives (VSDs) shall be a dedicated HVAC engineered design, not a general purpose product.

All VSDs shall be from the same manufacturer and series/type with a common operator keypad and display.

The VSD shall be contained within a minimum IP54 full integrated enclosure suitable for plantroom installation incorporating all the accessories necessary to meet this specification without using a secondary enclosure.

Each VSD complete with any options necessary to meet this specification shall be fully tested at the manufacturer's works, including driving a motor connected to a dynamometer at full load during the automated test procedure.

The VSD must conform to recognised International Standards and be manufactured to ISO 9001 quality standards.

The VSD shall be supported locally by the manufacturer who will provide full technical support and trouble shooting capability from their local facility. Spares holding and service support shall be provided locally by the manufacturer or their approved service partner.

The manufacturer shall demonstrate a continuous period of manufacture and development for at least 20 years.

The VSD shall be of the variable voltage, variable frequency type. It shall convert fixed voltage/frequency three phase AC mains supply input to variable voltage/variable frequency output for controlling the speed of three phase AC motors. VSDs that only control the output voltage will not be approved.

VSDs shall be suitable for use in either a stand alone mode, complete with all necessary control functionality and protection, or as part of a centrally controlled system via a serial communication network to the BMS via an in-built EIA485 port or other high level interface as required.

15.17.2 Mains Supply, Motor and Application Compatibility

The VSD shall be rated for 3 phase *415* V +/-10%, 50/60Hz +/-5% mains supply.

The VSD shall comply with IEC 61800-5-1 Second Edition. The VSD supplier shall confirm what type of short circuit input protection devices can be used for compliance with this safety standard.

With the motor operating at rated nominal speed, full load the VSD shall be able to deliver full rated motor voltage (415V) and full rated motor power over the +/-10% mains voltage range.

The VSD shall be suitable for controlling any IEC standard design motor and shall not require the motor to be derated or cause the motor temperature to rise above the Class B rise expected on normal mains supply.

If the VSD cannot maintain Class B temperature rise then the motor shall be oversized and derated or an external blower for cooling the motor shall be required.

The VSD shall be able to automatically tune itself to the motor to optimise motor performance and efficiency, improve start capabilities and compensate for motor cable variances. This function shall be carried out with the motor at standstill (i.e. without spinning the motor) and without the need to decouple the motor from the driven load.

The output voltage to frequency ratio shall be suitable for fan and centrifugal pump control. An automatic energy optimization function shall be incorporated to dynamically optimize the voltage to the motor throughout the operating range of application. This function is to ensure the magnetization of the motor is optimum at all speeds and loads to minimize motor energy consumption.

Where there is a requirement for variable speed chillers elsewhere in this specification the VSD supplied for chiller control shall comply with all paragraphs of this Variable Speed Drives section. The VSD shall have the capability to run the compressor type used in the chiller, be programmable for an output voltage to frequency ratio suitable for the compressor type and include an automatic energy optimisation function to dynamically optimise the voltage to the compressor motor throughout the operating range.

The VSD shall minimise motor audible noise though the use of a self adjusting switching frequency. The switching frequency shall be automatically adjusted to optimise motor and VSD operation while reducing motor audible noise. VSDs with fixed switching frequencies will not be approved.

For direct drive fan applications the VSD shall be capable of providing full motor torque at any selected frequency between 20Hz and nominal motor frequency while also providing an automatic energy optimised variable torque voltage/frequency curve for operation at reduced speeds below this selected frequency.

The VSD shall be capable of controlling parallel motors of mixed ratings and allow disconnection of any motor whilst running without causing tripping.

In the event of power loss or the opening of an input or output power contactor, no damage to the controller shall result. On restoration of power or reclosing of contacts, the controller shall automatically return to normal operation.

15.17.3 Electromagnetic Compatibility

15.17.3.1 *Harmonics*

Within its enclosure the VSD shall include DC link harmonic filtering with both inductive and capacitive elements to control the mains borne harmonics to within the value prescribed by the electricity distributor.

VSDs not incorporating DC chokes should include 5% AC input chokes within its enclosure to give a similar harmonic reduction performance.

If AC input chokes are used, the VSD manufacturer must advise the percentage voltage drop across them when the VSD is operating at full load.

Incorporation of either DC or AC chokes should ensure the harmonic emission requirements of AS 61800.3 2nd Edition 2005 are complied with. For relevant powers the VSD shall also comply with IEC 61000-3-12.

The VSD shall exhibit near unity displacement fundamental power factor at all loads and speeds.

The VSD supplier shall provide details of all harmonic currents up to and including the 40th when operating at full load and provide an estimation of the total harmonic voltage distortion resulting at the point(s) of common coupling due to the installation of all the VSDs on the project. Details of the loads, supply transformer, impedances and other relevant supply network data will be supplied to enable this calculation to be made. If this estimation concludes the total harmonic voltage distortion is expected to be above the value prescribed by the electricity distributor the VSD manufacturer shall propose additional passive or active advanced harmonic filters to reduce the harmonic distortion to within the value prescribed by the electricity distributor.

15.17.3.2 *Radio Frequency Interference*

The VSD shall be CE marked in accordance with the European Union EMC Directive legislation and C-Tick marked in accordance with Australian Communications Authority (ACA) regulations.

Within its enclosure the VSD shall include a radio frequency suppression filter to ensure:

- The VSD complies with the conducted emission requirements of AS/NZ 61800.3 2nd Edition 2004 Category C1 with 50m motor cable.

  OR

- The VSD complies with the conducted emission requirements of AS/NZ 61800.3 2nd Edition 2004 Category C2 with 50m motor cable if at the time of submission for approval the electrical installer verifies in writing that they meet the definition of “professional” as per that standard.

The VSD manufacturer shall supply correct EMC installation recommendations to ensure compliance with this specification.

15.17.3.3 *Immunity*

The VSD shall comply with the immunity requirements of AS/NZ 61800.3 2nd Edition 2004 Second Environment levels.

15.17.4 Protection

The VSD shall provide protection against the following conditions:

a) Output earth fault
b) Output short circuit fault
c) Loss of mains phase (programmable as described below)
d) Loss of motor phase (3 phase measurement)
e) Over voltage
f) Under voltage

The VSD shall monitor the output current on all three motor phases and the current protection feature shall be sufficiently fast to allow the VSD to survive a continuous short circuit on the output terminals without damage to any of the VSD components.

The output circuit shall be of such a design to allow unlimited switching of the motor circuit at any load or speed without interlocks and without causing damage to the VSD.

It shall be possible to program a current limit to protect the driven equipment from excessive overloads during either running or starting. If the VSD output current reaches this limit any further attempt to increase the current will cause the VSD to reduce its output frequency to reduce the load. If desired it shall be possible to program a timer which will cause the VSD to trip after operating in this current limit condition for the programmed time.

In order to ensure continued operation of equipment during extended periods of overload it shall be possible to program the VSD to periodically reduce its output current to a programmed value during these periods, allowing the VSD to continue to run the equipment without tripping.

A loss of mains phase function should protect the VSD from damage and indicate the phase loss condition. The VSD should be programmable so that during an input phase loss condition the VSD can trip and display an alarm, issue a warning while running at reduced capacity or issue a warning while running at setpoint speed.

The VSD shall not exhibit an inrush current when connected to the mains supply or given a start signal.

The VSD shall model the motor in its software to predict motor overheating for use with motors not fitted with thermistors. When overheat is predicted an alarm or warning shall be initiated.

The VSD shall include a thermistor input as standard for use with motors fitted with thermistors to provide motor thermal protection without the need for external thermistor interface relays.

Galvanic isolation shall be provided between the VSDs power and control circuits in accordance with the PELV (Protective Extra Low Voltage) requirements defined in AS/NZ 61800-5-1 to ensure operator safety and to protect the BMS interface. VSDs not including galvanic or optical isolation on both analogue and digital I/O shall include additional isolation modules.

The VSD shall not include any button on the keypad allowing the motor direction to be reversed.

15.17.5 VSD Ratings and Selection

The VSD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and deliver 120% of rated motor torque for up to 0.5 seconds while starting.

The VSD shall be selected such that its nominal current rating is greater than or equal to the motor's full load current.

The VSD shall be selected based on operating in a maximum peak ambient temperature of 50°C at its nominal current rating when used with Australian high efficiency motors as per AS/NZS 1359.5-2004. It shall be suitable for operation in conditions with a relative humidity up to 95%. To ensure continued operation of the plant during times of extreme ambient temperature conditions it shall be capable of operation at reduced performance in temperatures from -10°C to +55°C.

The VSDs efficiency shall be minimum 96% at 100% load and 94% at 50% load.

VSD acoustic noise shall not exceed the lower of the noise levels defined for motors elsewhere in this specification or the following measured at a distance of 1m from the VSD when operating at full load:

a) ≤90kW 70dBA

b) ≥110kW 85dBA

15.17.6 Control Functions

15.17.6.1 *General Control Functions*

A run permissive function shall be provided to accept a “system ready” signal to ensure the VSD does not start until dampers or other auxiliary equipment are in the proper state for VSD operation. The run permissive function shall be capable of initiating an output signal as a start command to actuate external equipment before allowing the VSD to start (e.g. damper actuator).

The VSD shall automatically adjust the acceleration and deceleration rate to ensure “no trip” ramping in case too rapid acceleration or deceleration is called for.

The VSD shall be capable of automatically connecting to a spinning fan, forward or reverse running, without tripping.

It shall be possible to program four bypass speed ranges to avoid operating at speeds/flows which result in mechanical or air resonance conditions. An automated procedure for setting these speed ranges shall be provided to simplify commissioning.

It shall be possible to program a minimum of 8 preset speeds, selectable via digital inputs and the high level interface, to override the speed control signal for duties such as night setback, smoke extract and morning boost settings.

The VSD shall be able to automatically reset in the event of an alarm condition with the ability to program the number of reset attempts (up to 20 or infinite) and the time between each attempt.

The VSD shall have a programmable automatic “sleep” mode function complete with boost facility, which operates when loads are below minimum settings. When the VSDs speed is being controlled by its PID controller, it shall be possible to program a “wake-up” feedback value that will cause the VSD to start. To avoid excessive cycling of the driven equipment, it shall be possible to program a minimum run time before sleep mode can be initiated and a minimum sleep time.

The VSD shall include a motor preheat function to prevent condensation forming in the motor during shutdown periods.

The VSD shall display and log in non-volatile memory the total kWh consumed and total motor running hours without additional instrumentation and provide the facility to reset these counters.

The VSD shall be able to store application load profile data to assist in analysing the system demand and energy consumption over time.

The VSD shall include a cascade controller which allows the VSD, utilising its PID controller and output relays, to control a multi-pump system with the duty pump speed controlled and one or two assist pumps fixed speed.

15.17.6.2 *PID Control*

The VSD shall include a full 3-zone, 3 setpoint, 3 feedback PID controller as standard to provide closed loop control of the driven equipment direct from up to 3 signal transmitters without the need for external signal conditioning.

a) It shall be programmable to compare the feedback signals to a common setpoint or to individual setpoints.

b) It shall be programmable to select either the maximum or minimum feedback signal as the controlling signal or to calculate the controlling feedback signal as the average of all feedback signals or the difference between a pair of signals.

c) It shall incorporate an auto-tune feature to self tune the P and I terms to facilitate easy commissioning.

d) It shall be possible to apply individual scaling to each feedback.

The PID controller shall incorporate a flow compensation function to dynamically adjust the setpoint based on flow to automatically compensate for varying pressure drops in the system at different flow rates when using a sensor installed near the outlet of a pump, instead of out in the controlled system, as the feedback signal.

The VSD shall have three additional auto-tune PID controllers which can provide setpoint reset or control damper and valve actuators in the system.

15.17.6.3 *Fire Safety Function*

The VSD shall have a digital input which can be used to override all other local or remote commands in the event of a fire command from the fire safety system.

The VSD shall display Firemode whenever this input is active.

The VSD should be programmable such that depending on the application and system design the fire command should force the VSD into one of the following operating states:

a) Start and run, or continue to run, at a speed in the forward direction.

b) Start and run, or continue to run, at a speed in the reverse direction.

c) Stop

The speed/setpoint at which the VSD shall run when the fire command is active should be set by either a dedicated programmable preset reference or defined analogue input signal. All other preset references or analogue input signals should be ignored.

The VSD should be programmable to allow operation in either open loop or closed loop, using its internal PID controller, when the fire command is active.

When the fire command is active the VSD should operate as per the programmed function above overriding all of its warnings and alarms and motor protection features in order to secure continued operation until such time that the fire command is manually overridden or that a fire has rendered the VSD inoperable.

To meet different application and system design requirements the reaction of the VSD to serious fault conditions, such as earth fault or short circuit fault on the VSDs output, should be programmable to the following:

a) The VSD should trip but then continuously attempt to automatically reset and restart, even if that risks potential damage to the VSD

b) The VSD should trip but require a manual reset

To enable testing of the fire system without overriding the VSDs warning and alarm protection systems, it shall be possible to programme the VSD to temporarily respond to alarms as per normal operation when the test fire command is active.

All VSDs used as part of the fire safety system shall be configured to require a password before any parameter changes can be made.

15.17.6.4 *Time Clock*

A real time clock shall be an integral part of the VSD.

Ten programmable time periods with individually selectable on and off functions shall be available. The clock shall be capable of initiating functions including start/stop, change of speed and change of setpoint (e.g. for night setback) and of controlling output relays for control of external equipment.

It shall be possible to program unique events that only occur during normal working days, others that occur on non-working days and others that occur on specific days and dates. The manufacturer shall provide a free PC based software to setup the calendar for this schedule.

It shall be possible to program preventative maintenance reminders based on date and time, VSD running hours and VSD operating hours.

When the VSD is integrated into the BMS via a high level interface it shall be possible to synchronise the VSDs clock with that of the system's master clock. With this synchronising function included, battery backup of the VSDs clock is optional. If the VSD is not integrated into the BMS via a high level interface, the VSDs clock shall be equipped with a battery backup.

15.17.7 Control I/O, Signals and Status Indicators and High Level Interface

As standard the VSD shall provide the following minimum programmable I/O points:

a) 6 x digital inputs

b) 2 x digital outputs (provided by relays with changeover volt free contacts (rated for 240V AC) and on/off delay timers)

c) 2 x analogue inputs (each selectable for voltage or current signals, direct or reverse acting, with the minimum and maximum range independently scaleable from 0-10V DC and 0-20mA)

d) 1 x analogue output (0/4-20mA)

The VSD shall have the facility to expand its I/O capability through the addition of option modules. These should be available as factory mounted modules, with the complete VSD including the modules tested at the manufacturer's works and also available as simple field mounted options using rigid connectors to plug into the VSD. The following I/O points should be provided by these option modules:

a) Additional digital inputs

b) Additional digital outputs including additional relay outputs

c) Additional analogue inputs

d) Additional analogue outputs (0/4-20mA and 0-10V DC)

e) Pt1000/Ni1000 temperature sensor inputs

It shall be possible to read the status of all digital and analogue inputs (including those on I/O expansion modules) via the high level interface making them available as remote inputs for the BMS.

It shall be possible to control all digital and analogue outputs (including those on the I/O expansion modules) via the high level interface making them available as remote outputs for control by the BMS. When controlled by the BMS in the event of the high level interface network failing the digital/analogue outputs shall override to a programmable default condition/value.

All digital inputs shall be programmable to the following functions as a minimum: ramp start/stop; coast stop; reset; hand start; auto start; preset speed select; external interlock; run permissive; fire mode.

All digital outputs shall be programmable to provide the following status signals as a minimum: ready; running; tripped/alarm; hand mode; auto mode. These signals shall also be available via the high level interface irrespective of the digital outputs' programmed functions.

Analogue inputs shall include a "signal loss" detection algorithm with ability to program the action after the loss of signal and a time delay to eliminate nuisance signal loss indications.

Analogue inputs shall incorporate a programmable low pass filter to compensate for electrical noise on the signal.

All analogue outputs shall be programmable to represent the following as a minimum: motor current; motor power; sensor feedback; motor speed; output from the additional PID controllers. It shall be possible to scale the minimum and maximum values of these outputs.

The VSD shall provide a fan operating status/interlock signal with the function deriving this signal capable of detecting the loss of running load indicative of mechanical failures resulting from a broken belt or coupling etc. To ensure against nuisance indications this function must be based on motor torque, not current, and must include a proof timer to avoid brief periods of no load from falsely triggering this indication. The VSD shall be programmable to signal this condition via a keypad warning, relay output and via the high level interface to the BMS. Only when the VSDs loss of load function complies with this clause completely can it be used in place of a differential pressure/flow switch for fan operating status/interlock.

The VSD shall provide a pump operating status/interlock signal with the function deriving this signal capable of independently detecting no-flow and dry pump conditions and operation off the end of the pump curve. To ensure against nuisance indications the no-flow and dry pump conditions must be based on motor power and speed. Proof timers must be included to avoid brief periods of any of the conditions being detected from falsely triggering this indication. The VSD shall be programmable to signal any of the conditions via a keypad warning, relay output and via the high level interface to the BMS. Only when the VSDs pump operating status function complies with this clause completely can it be used in place of a differential pressure/flow switch for pump operating status/interlock.

The VSD shall include a standard EIA485 communications port. The VSD shall be capable of connecting to the following high level interfaces for integration into the BMS network:

a) Johnson Controls Metasys N2
b) Siemens Apogee FLN (P1)
c) Modbus RTU
d) LonWorks FTP certified to LonMark standard 3.3
e) BACnet MSTP

15.17.8 Installation, Commissioning and Service

All VSDs to be installed in accordance with the manufacturer's recommendations and as close as possible to the motor being controlled.

When the VSD is installed within sight and within 10m of the motor, as an alternative to the local motor disconnect switch specified elsewhere in this specification, the VSD shall incorporate a factory fitted mains disconnect switch with auxiliary contacts available for status indication.

The VSD shall incorporate a keypad with LCD alpha-numeric and graphical backlit display providing the following:

a) Hand-Off-Auto keys to start and stop the VSD and determine the source of control. It shall be possible to disable these keys or password protect them from undesired operation.
b) Reset key to enable local/manual resetting of alarms.
c) "Info" key to provide "on-line" context sensitive assistance for programming and troubleshooting.
d) A red Alarm light, a yellow Warning light and a green power On light.
e) Password protected keypad providing two levels of password protection.
f) Display all information in clear language (e.g. Earth Fault). Numeric codes alone will not be accepted.
g) Display five simultaneous meter displays/operating variables.

h) Display setpoints and feedbacks (e.g. static duct pressure or condenser water return temperature) in appropriate engineering units (e.g. Pa, kPa, bar, mbar, in WG, psi, °C, °F).

i) Display the value of each analogue input and output for system setup and troubleshooting.

j) Display the status of each digital input and output for system setup and troubleshooting.

k) Display the current date and time.

l) Display of plant equipment identification name/number (e.g. AHU-B-4, SCHWP-3)

The VSD shall include a quick setup menu with factory preset typical HVAC parameters provided. It shall also include individual Fan, Pump and Compressor menus specifically designed to facilitate easy start up of these applications.

The VSD shall be capable of running with no motor connected for testing and commissioning.

The VSD shall store the last 10 alarms in an alarm log which remains available after a power cycle of the VSD. A description of the alarm and time and date of the alarm shall be recorded.

The VSD shall have a standard USB port for direct connection of a PC to the VSD. The manufacturer shall provide PC software to enable the as commissioned configuration of the VSD to be simply saved and documented through the USB port.

The VSD shall have temperature controlled cooling fan(s) to minimize audible noise, minimize losses and ensure optimum fan lifetime.

No rear access shall be necessary during normal servicing.

16. BUILDING MANAGEMENT SYSTEM

16.1 Overview of the System

The BMCS will be designed to be used by building management and maintenance staff to monitor and control all the HVAC and Energy Metering equipment.

All BMCS hardware provided will be native BACnet.

The main functions of the system will be:-

- To provide a broad range of data gathering, monitoring and automatic control capabilities suitable for HVAC plant.
- To provide a software based control system which has the flexibility to be easily expanded and modified, in the light of ongoing operating experience, including all necessary standard software packages for modifying s DDC control programs.
- To provide an operating system which will provide the housekeeping, communication and scheduling services necessary to manage field hardware communications.
- To provide a centralised alarm handling system for the building.

16.2 Extent of Work

The work to be performed will include the design, supply, installation, testing, commissioning, handover, warranty and maintenance of the BMCS. Whilst this Specification defines the design and performance of the system, it will be necessary for the supplier to perform detailed engineering design work, modification and configuration of the total system to enable the supplier's particular equipment to meet all of the requirements of this Specification. Unless otherwise expressly instructed the BMCS subcontractor will include in the contract sum the cost of any other works, expenditures, taxes, duties, royalties, fees and other charges even if not mentioned or described in the tender documents which are necessary to carry out and complete the Works in this Specification. Specifically, the work will include but not be limited to: -

1. Provide all hardware, software and any other points which may be required for this efficient operation of the systems in accordance with the technical schedules, drawings and provisions of this specification to provide a completely integrated operating system.
2. Provide all wiring associated with the BMCS system. This includes all power reticulation, control, field, communication and interface wiring to other building services at required locations. Location of all equipment to be approved by the Principal Contractor prior to installation.
3. Prepare BMCS point schedules, points grouping database, functional specification, wiring diagrams, data base schedules, and Direct Digital Controller programs to allow all monitoring and control processing.
4. Provide the latest graphics package for the BMCS system with real time point displays, changes-of-state on high quality colour graphics. If there is any new version of the manufacturer's system software released at any time up till the end of the warranty period the system shall be upgraded to the latest version at no cost.
5. Provide a web browser interface that will enable remote users to access the BMS. Provide connection of the system to the internet.
6. Provide all damper motors and linkages listed in the motorised damper schedule.
7. Provide all necessary sensing and output devices (i.e. temperature, pressure, electrical, flow, humidity sensors, control output relays and analogue transducers, etc.) including wells and attachments where required which are necessary to meet the requirements of this specification.
8. Supply VAV box motors, controllers, linkages and transducers to box manufacturer for installation onto box. Stroking, testing and commissioning in conjunction with box manufacturer. The BMCS subcontractor shall connect to box motor (or to controller strip if applicable) on site and verify operation of box controls.

9. Provide temperature sensors for each VAV box. Allow four (4) metres of extra cable for each space temperature sensor. This extra cable is to be coiled neatly in the ceiling space and secured by cable ties to a cable support from the slab over.
10. Provide all control valves, linkages and actuators as detailed in the technical schedule. Allow for minor possible variations in the coil valve flow coefficients as the valves (except bypass valves) in the Technical Schedule are rated for a pressure drop of 35 kPa. Actual pressure drops to be confirmed with the mechanical services subcontractor and the final valve selection must be based on a pressure drop of 100-200% of coil pressure drop.
11. Provide workstations and associated software and printers in an agreed location.
12. Provide an alarm dialler modem capable of sending SMS messages to a mobile phone. Liaise with the Building Manager to determine which alarm signals are to be routed to the modem.
13. Provide lockable enclosures to house any field equipment, transducers etc. required to be installed under this contract.
14. Provide control panels on each floor/building complete with all necessary switches, fuses, transformers etc. to supply 24 volts a.c. to the floor controls.
15. Provide all necessary equipment, conduits and construction materials, etc., as necessary but not specifically detailed to achieve a fully functional system acceptable to the Principal Contractor.
16. Calculate cable sizes, transformer sizes, relay voltages, wattage etc. to achieve the required functions and to suit the equipment provided.
17. Paint and label all equipment to the satisfaction of the Principal Contractor.
18. Prepare penetration drawings and obtain approval prior to undertaking the works. Fire rate penetrations where necessary.
19. Undertake cutting and chasing of holes and openings in walls, floors etc. checking that any block-outs etc installed by others are in the correct locations.
20. Supply information detailed in the submission section. The BMCS subcontractor will be required to coordinate shop drawings, installation and commissioning with the Principal Contractor and other services.
21. Create Direct Digital Controller programs to provide the control functionality specified in SECTION 3. All software is to be written in the supplier's local office and the operation of all software routines must be satisfactorily demonstrated via a suitable test rig (both analogue and digital inputs and outputs) in the suppliers Canberra office before the software is installed on site. As each stage of the installation is completed allow for intersystem testing on site and demonstration of all monitoring and control points, software functions and additional features provided by the system to the Principal Contractor. To be demonstrated by 3 weeks prior to practical completion.
22. Carry out any additional works listed in the point's schedule and provide spare capacity as detailed in this specification.
23. Undertake comprehensive pre-commissioning, commissioning and quality monitoring in accordance with ASHRAE Guideline 1 or CIBSE Commissioning Codes. A 12 month tuning process will be undertaken with minimum quarterly reviews and full re-commissioning at 12 months. See TESTING AND COMMISSIONING section for details and required documentation.
24. Undertake fine tuning of the controls. It is to be noted that the Principal Contractor shall have the right to "fine tune" the control strategies during the contract and maintenance periods based on previous operating and design experience. Due allowance such as possibly minor software modifications, adjustments to set points and time delays etc. during the commissioning period shall be made by the BMCS subcontractor for this work. During the defects liability period the Principal Contractor may require minor software modifications to improve plant performance. Allowances are to be made in the tender price for these works.
25. Allow for attendance as required to achieve the successful completion of the combined fire/mechanical matrix commissioning.
26. In conjunction with the mechanical subcontractor determine damper positions to maintain the required outside air flow rates at various supply air fan speeds and return air fan schedules to maintain correct building pressure.
27. Set up trending for all main plant prior to practical completion.

28. Where equipment is to be supplied free issue to other subcontractors for installation into their works it is the BMCS subcontractor's responsibility to coordinate with these trades to ensure the equipment is available for installation on site when required by the relevant trade subcontractor.
29. Where there is an analogue interface with equipment supplied by others this is generally specified in the point's list as being 4-20mA. Allow to coordinate with the equipment supplier and to provide the actual analogue interface to suit the supplied equipment. Where a single point is allocated to drive multiple loads allow to provide any signal amplification devices necessary to drive the load.
30. Coordinate with Mechanical sub-contractor for interconnection with the Building Monitoring System. Terminate to BMCS terminal strips in the mechanical switchboards.
31. Termination to volt free contacts in hydraulics switchboards provided by the hydraulic trade
32. Termination to volt free contacts in electrical switchboards provided by the electrical trade
33. Termination to volt free contacts in lift switchboards provided by the lift trade
34. Termination to volt free contacts at the mechanical switchboards for all FIP and FFCP points covered under the Points Schedule for control and monitoring.
35. Conduct point to point proof testing of all BMCS points in conjunction with the other trades.
36. Provide high level interface BACnet interface to all VSD's.
37. Provide a high level interface to the chillers and the cooling tower water treatment system.
38. Provide a high level interface (including all interface cabling) from the BMCS to the metering system that will allow transfer of VSD energy meter data and chiller energy meter data from the BMCS to the metering system.
39. Clean up and remove BMCS subcontractor waste.
40. Provide 12 months defects liability and warranty.
41. Maintain the installation throughout the Defects Liability Period.
42. Provide full training to operations staff for all monitoring and control functions and additional features provided by the system.
43. Supply Operating and Maintenance Manuals. (hard copy and electronic)

16.3 Equipment Generally

Where possible all field equipment (input and output devices) is to be sourced from the same manufacturer. In order to keep the requirements for spares to a minimum all Direct Digital Control panels shall be identical.

All control equipment, materials shall be submitted for approval to the Principal Contractor.

Control equipment shall be located generally as indicated on the tender drawings and points list however; actual locations on site are to be to the approval of the Principal Contractor.

16.4 Performance Guarantee

The BMCS subcontractor shall guarantee that the complete BMCS will perform all functions specified within the design limits including all DDC control loops and the BMCS subcontractor shall accept responsibility for the overall design and equipment selection.

16.5 Authority Requirements

The complete BMCS installation shall comply with all relevant Australian Standards and Authority requirements including Building Code of Australia, AS1668, Work Cover (WCA), SAA Wiring Rules.

16.6 Apprentice Electricians on Site

The subcontractor shall fully comply with the National Supervision Policy Guideline for Electrotechnology Apprenticeships published by the ElectroComms Standards Body of Australia Ltd, trading as EE-O_2 Training Standards, December 2002.

16.7 Submissions

The following submissions are required by the Principal Contractor during the course of the project:

16.7.1 Programs and Forms

Within one month of the award of the contract provide draft commissioning forms and procedures for approval. Provide installation and commissioning programs co-ordinate with all other interface trades when requested.

16.7.2 Software

Before detailed programming commences the following software related components must be submitted: -

- Graphics
- Functional specification which must include a comprehensive English language description, flow charts etc. for each software module in sufficient detail to allow persons unfamiliar with the building to be able to understand all aspects of the systems operation. This description must also detail all fire and power fail modes of operation.
- Point schedule for each DDC panel.

A workshop shall be held to discuss points of contention in the functional specification. The workshop shall include the representatives from the BMCS subcontractor, the intended facilities manager, the NABERS energy consultant and the mechanical consultant.

A final working document should be agreed upon, to be used as the basis for all programming. Only after this document is approved shall programming be permitted to commence. Contractor deviations from this document are not permitted without documentation revision and approval.

16.7.3 Hardware

Before site installation commences the following hardware related components must be approved: -

- Field devices (sensors, actuators, transducers etc)

- DDC panel wiring diagrams including wiring to field devices and control panels, switchboards etc. these diagrams must show all terminal and wire numbers.
- System architecture diagram.
- Equipment exposed to view in tenanted or public spaces.
- Control Valves

16.7.4 Operations and Maintenance Manuals

Provide five copies of each operations and Maintenance Manuals as per the OPERATIONS AND MAINTENANCE MANUAL section.

Draft operations and maintenance manuals to be provided at least 10 weeks prior to practical completion and at least one week prior to the start of commissioning.

Final copies of approved maintenance manuals to be provided 4 weeks prior to practical completion.

16.8 BMS Graphic Pages

The system computers will have a colour data graphics system where all or any combination of points in the system will be able to be programmed into the display by the subcontractor. Each graphic display must be able to contain a minimum of 250 dynamic data points. Enough graphic displays must be provided to adequately represent the BMCS. The current status/value of those points will be displayed in colour and shall be dynamic. The point update time must be no longer than 3 seconds.

Text type display pages shall also be dynamic with point status/value updated in less than 3 seconds.

When an operator calls up a new graphic display page the graphic display including update of real time data shall be displayed in completed form within 10 seconds.

It shall also be possible to change state (i.e. start/stop) and set points/throttling ranges, time delays etc. on the graphics via the mouse. ***).*** As far as possible all major calculations (such as reset schedules) and associated control variables should be visible on screen irrespective of whether these can be user-adjusted. This enables users to understand why a certain control is functioning as observed.

The display graphics shall be structured as follows:-

- Master system display page with selector buttons to enter the displays for the major disciplines i.e. electrical, mechanical etc.
- Each major discipline master display page is to have selector buttons for each major plant item i.e. AHU's, chiller plant, generator plant, typical floor layout etc.
- If the major plant items consist of a number of individual components selector buttons shall be provided to allow the display of each component along with its required parameters
- Within each graphic display page selector buttons are to be provided to allow selection of the graphic display of related equipment i.e. floor above and floor below buttons for typical floors or condenser water graphic from chiller plant graphic etc.

Provide a loop tuning graphic for each control loop. Loop tuning graphics are to display the set point, time scale, input value, output value and all PID parameters to allow the loop's response to be readily visualised and modified. Facilities are to be provided on the loop tuning graphic to modify the set point and all PID parameters. Access to switch between P, PI and PID control modes shall be restricted to authorised personnel only.

The system is to be complete with facilities to allow operators to edit existing graphics and create new graphics via the use of the systems drawing tools and symbols library.

16.9 Reports

16.9.1 Customised Report Generator

The system will support the creation of trend log, historical log, statistical, summary, custom and all point reports.

The system will be configured to provide all required BMS reports and will be complete with all necessary software tools to allow operations personnel to allocate spare, unused, screen buttons to dedicated customised reports for any group of points or to include information on any selected points or groups of points into spreadsheet or word processing programmes.

The following reports will be provided. Note that this list is not comprehensive and may be altered to meet the needs of the eventual control system operation.

16.10 BMCS Integrated Variable Speed Drives

Variable Speed Drives (VSD's) shall be integrated into the BMCS system utilising a BACnet communication protocol that enables a full "read & write" seamless interface between the VSD & BMS.

The VSD's selected, shall be supplied and installed by the mechanical services subcontractor. The BMCS subcontractor & selected VSD Manufacturer shall bear full responsibility for delivering & maintaining this "interoperability" solution.

The VSD shall provide, via serial communication, access to the following VSD features as a minimum.

- Motor Current
- Motor kW
- Total Motor kWH
- Total Motor Run Hours
- Manual/Off/Auto position feedback
- Full PI control access, set point adjust etc (Where used for Pressure/temp control eg: VAV Systems, Cooling Towers, Secondary Chilled Water Systems etc)
- Specific alarm indication (General Alarm not acceptable)
- Sleep Mode function for Cooling Tower Fan and Pressure Boosting Systems
- Run & Trip status
- Airflow status/alarm (Utilizing VSD CT's)
- Dirty Filter status/alarm (Utilizing VSD high frequency alarm)
- Fault Log history (Minimum last 10 faults/alarms)
- Remote dial in capability for service diagnosis and remote fault reset

The VSD shall provide the following selectable physical I/O to the BMS system.

- 8 x DI 0/24V DC (PNP) Read only / status points
- 2 x Relay Outputs (1 x 240V, 1 x 50V) Read/status or on/off control points (eg: damper/valve open/close control)
- 1 x AI 0/4-20mA Read/Write points (eg: temperature/Pressure sensors, set points, etc)
- 2 x AI 0-10V or thermistor Read/Write points (eg: temperature/Pressure sensors, set points, etc)
- 2 x AO/DO 0/4-20mA or 0-24V DC Read/Write points
- 1 x 0-24V DC pulse Output
- Cascade control for multi staging up to 5no. fan or pump applications (optional - where selected)

The VSD shall include the appropriate communication board & protocol, to enable BACnet

communication with the BMCS system. The BMCS subcontractor shall provide all necessary hardware and software required to interface with the VSD either directly through compatible protocols or gateway interface.

The VSD shall be capable of operating via serial bus communication and hard wired digital inputs simultaneously.

All VSD's shall be inclusive of automatic reset in the event of loss of power supply.

16.11 Technical Specifications – BMCS

16.11.1 General

The BMCS shall be complete in every respect and should comprise the latest and most reliable hardware and software techniques available. Solid state circuitry and modular construction shall be employed throughout. Flexibility of the system is an important requirement so that future additions or modifications to the system can be accomplished without resorting to the addition of trunk wires, rewiring of control panel modules, rewriting of system operation software or the addition of other than plug-in modules or components or additional software packages.

All equipment shall be calibrated and have their nameplates etc. (where applicable) in S.I. metric units.

All equipment shall be mounted in such a way as to permit easy servicing in situ and easy removal.

The BMCS communications protocol shall be fully BacNet compatible

16.11.1.1 *Overview of the System*

The main functions of the system will be:-

- To provide a broad range of data gathering, monitoring and automatic control capabilities suitable for HVAC, Electrical Services, Hydraulic Services, Diesel Services etc.
- To provide a software based control system which has the flexibility to be easily expanded and modified, by the user, in the light of ongoing operating experience, including all necessary standard software packages to allow operations staff (at the completion of the fourth level of training) to add, delete and modify DDC panels and their associated points and to carry out software modifications.
- To provide an Operating System which will provide the housekeeping, communication and scheduling services necessary to manage field hardware communications.

A schedule of monitoring points and controlled devices is defined (Hardware Point Schedule). The system shall be capable of handling the number of hardware points specified including the specified spare capacity. The system shall be supplied with sufficient software points to handle the specified hardware points and spare hardware points.

All direct digital controllers shall connect to and communicate to the system computers via a multidrop communications cable.

16.11.1.2 *Upgrade Capability*

The field hardware will be of a modular nature so that upgrade and additions to the system will be at minimal cost for as required additions.

As the system is software based, revision of operating strategies must be easily carried out.

16.11.1.3 *Reliability and Through Life Support*

The BMCS hardware and software will be field proven and will have been in reliable operation in Australia for at least 2 years.

The system shall be guaranteed to be supported by local suppliers and technical staff for at least a 10 year period.

16.11.2 Web Browser

The system will be provided with a web browser interface that will enable remote users to access the BMS. The web browser interface will provide the same interface and view of the system as is provided by the Graphical User Interface on site. The web browser interface will allow users to perform the following tasks depending on their access level :

- View graphics screens with real time data that automatically updates
- Update schedules
- Change setpoints
- View trends
- Generate reports
- Acknowledge alarms

The web browser will only require web browser software to operate. It will not require any additional software or graphics to operate.

The web browser client shall support the following functions at a minimum:

1. User log-on identification and password. If an unauthorized user attempts access a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented;

2. Graphical screens developed for the GUI shall be the same screens used for the web browser client. Any animated graphical objects supported by the GUI shall be supported by the web browser interface;

3. HTML programming shall not be required to display system graphics or data on a web page. HTML editing of the web page shall be allowed if the user desires a specific look or format;

4. Storage of the graphical screens, reporting macros and other key user system interfaces shall be resident in the system, without requiring any graphics to be stored on any workstation. Systems that require graphics storage on each workstation are not acceptable;

5. Real-time values displayed on a web page shall update automatically without requiring a manual “refresh” of the web page.

Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:

1. Modify common application objects, such as schedules, calendars and set points in a graphical manner;

2. Set holidays by using a graphical calendar, without requiring any keyboard entry from the operator;

3. Start and stop commands for binary objects by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required;

4. Specification of a user’s (as determined by the log-on user identification) home page with the ability to limit a specific user to just their defined home page. From the home page, links to other views or pages in the system shall be possible if allowed by the system administrator; and

5. Specify the Uniform Resource Locator (URL) for desired hypertext links from graphic screens on the web browser client shall support hypertext links to other locations on the internet or on intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

16.11.3 Environment

The equipment will be designed to operate over a temperature range between 0°C to 50°C and a humidity range between 20% and 80% non-condensing. There will be where necessary, guarding against conducted (including power voltage transients) and radiated electromagnetic interference. If the equipment supplied radiates Radio Frequency Interference noise the supplier will detail at what level that noise is radiated. The supplier will take all steps necessary to isolate the system from conducted and radiated electromagnetic interference if it causes or is likely to cause the system to malfunction in any way. The supplier will ensure that all installed equipment is adequately isolated from vibration.

All field unit enclosures will be dust proof and will have sufficient surface area to satisfactorily dissipate all internal heat without the requirement for any fan forced ventilation.

16.11.4 Communication

Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to ANSI/ASHRAE Standard 135-2004, BACnet.

Install new wiring and network devices as required to provide a complete and workable control network.

Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.

Internetwork operator interface and value passing shall be transparent to internetwork architecture.

An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, and control algorithms shall be viewable and editable from each internetwork controller.

Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute control strategies specified in Section **Error! Reference source not found.**. An authorized operator shall be able t o edit cross-controller links by typing a standard object address or by using a point-and-click interface.

Controllers with real-time clocks shall use the BACnet Time Synchronization service. System shall automatically synchronize system clocks daily from an operator-designated controller via the internetwork. If applicable, system shall automatically adjust for daylight saving and standard time.

System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.

Web server shall reside on high-speed network with building controllers. Each standard browser connected to server shall be able to access all system information.

Web server or workstation and controllers shall communicate using BACnet protocol. Web server or workstation and control network backbone shall communicate using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing as specified in ANSI/ASHRAE 135-2004, BACnet Annex J.

16.11.5 Computer Workstation Facilities

16.11.5.1 *General*

The system computers will monitor the application of the field hardware as well as field communications and change of state reporting. There will be a battery backed up Master Clock with the time being easily displayed and changed. The new time will be sent to all controllers in the system. The Master Clock will be accurate to within two seconds per day.

The system computers system will have a data base save/restore feature where the entire contents of memory can be copied on to a DVD for back-up and also to the systems hard disc for normal operation. The contents must be dumped in a format which allows them to be re-entered via the standard system loader. This operation must not inhibit system function.

An alarm processing system which shall bring up alarms on the workstation shall be provided. The individual point configuration screen display must provide an alarm routing section so that any alarms generated by that point will be sent to only the nominated workstations and or printers.

The system computers shall have a weekly schedule where the operator shall be able to create programmed master time schedules to automatically execute several functions which would ordinarily require operator control or operator modification to a number of time schedules. Master time schedules may be defined to start and stop groups of equipment normally controlled by individual time schedules and initiate data gathering functions. Holiday schedules shall be declared on a 365 day basis on one screen and then linked as required to any or all time schedules. Facility to pre programme daylight saving time adjustments to be provided.

Discrimination of all stop/start time settings shall be in one minute intervals. Each time schedule shall be capable of being programmed for four start and four stop commands over any 24 hour period.

In the system computers the user shall be able to segregate the input/output devices into independent operator stations with specific system responsibilities. This means that system monitoring shall support V.D.U. screens or printers dedicated to a particular part of the system monitoring.

The system shall allow the operator to allocate any point in the field irrespective of which controller it is from to any display page or graphic.

It shall be possible to output any or all information from the system at any terminal i.e. VDU or printer at any time by operator selection at keyboard.

All point data must be able to update on screen for all display pages, point group listings and systems.

It shall also be possible to fully access each Direct Digital Controller remotely from the system computers.

The system is to incorporate a suite of programmes (similar to Microsoft Office) which will provide spreadsheet, word processing, relational database management system etc. for use by operations personnel.

The system is to incorporate an SQL interface query function using a relational database management system and the database is to be configured in such a manner that this relational database management system has direct access to all points within the system.

16.11.5.2 *Essential Functionality*

As a minimum the BMS will provide the following essential functionality:

- Display operating system, BMS and third party application windows on operator request;
- Display graphics and dynamic data points, without interfering with the on-line operation of the system;

- Display graphic screen associated with most recent, highest priority unacknowledged alarm on request by the operator;
- Print any window contents on demand;
- Capacity for minimum 4 off Graphics Screens to open simultaneously. All open windows updating in real time. Each window displaying an average of 30 tags.

16.11.5.3 *Display Functionality*

As a minimum the BMS will provide the following display functionality:

- 'Always on top' windows to display summary information and provide jumps to various screens;
- Display all BMS Windows (Graphics Screens, logs, graphs, reports, plots, administration
- screens, help screens etc. within a reserved area of the screen (not covered by the 'always on top' windows) as requested by the operator;
- Graphical displays of plant status and operation;
- Alarm and status monitoring via the graphic screens;
- Trend logging and event logging;
- Gathering of management information

16.11.5.4 *Operator Functions*

As a minimum the system will provide for authorised operators to perform the following functions:

- Display point status information;
- Alter system control parameters, including set points;
- Manually initiate time and event programs;
- Display system logs and reports;
- Alter time schedules and create new time schedules;
- Alter event programs and create new event programs by simple mouse-driven graphics;
- Assign operator access levels and sign-on codes;
- Review historical data;
- Create and modify trend logs;
- Create or modify historical logging files;
- Create and modify graphics screens;
- Alter controller control strategies and create new control strategies;
- Assign new input / output points;
- Alter existing, or assign new descriptors or action messages.

16.11.5.5 *Operating System*

The operating system will be Windows based to provide a multi-tasking, multi-user system. The following features will be provided:-

- Pop-up window alarm messages.
- User-definable fields in menus.
- Integration capability with other applications and systems.
- On-line help, displayed in pop-up windows to simplify training and operator tasks.

16.11.5.6 *Local Area Network*

The system shall operate on a coax or fibre optic local area network (LAN) using a minimum 10 MBit/sec transmission speed. The LAN shall be a commonly available and multisourced system such as ETHERNET or IBM Token Ring or approved equal technologies. Provide required LAN cabling, external lines and related charges for the life of the lease.

16.11.5.7 *System Prompting*

The BMCS software will provide English language identification and prompting for both operator inputs and system outputs. Point identification shall compose of at least twenty (20) English characters for each identification level. A minimum of three levels of identification shall be provided eg. system name, plant name, point name. The English language prompting will be designed to eliminate the need for reference to operator's manuals and shall literally step the operator through input sequences.

All reports and displays will be in the English language. The system for the experienced operator will provide a direct command route to specific functions (eg for adding, modifying or deleting a point in the system).

16.11.5.8 *On-Line Programmability*

The system computers will have a programming facility for the user to write programs in an editing mode before the program is saved prior to being down line loaded to a Direct Digital Controller. The operator shall be able to carry out all software changes on the system including change of data base and change in software strategies from the system computers on-line without disruption to the BMCS operation.

The changes will be accomplished without any regeneration of system software or firmware.

Constants shall not be used in any programme. All set points, hysteresis values, chiller sequencing state change set points, time delay limits, kilowatt hour meter factors etc are to be operator definable from the screen. All routines utilising time delays must display the time remaining before the delay elapses (10 second intervals is acceptable), the current stage of operation and the next stage of operation that will commence at the end of time delay.

It shall be possible for the operator to carry out any or all software entries, functions, instructions, commands, changes to the system including point overrides, alarm and limit assignments, event sequencing, software interlocks, alarm summaries, lockout summaries, trend logs, event initiated programmes and user defined programs using only the operator's manual and/or system prompting without the need to resort to the supplier or manufacturer. This shall include all changes to the data base.

16.11.5.9 *Levels of System Accessibility*

The system computers shall have a password system which shall control access to the system, field points and reports. There shall be a feature where one or all of the passwords can be reviewed to show levels of access along with names. Each password shall consist of at least a four digit personal identification number and the operators initials. The system shall support not less than 50 individual operator passwords.

At least 4 levels of accessibility by password will be in the system. The first level is for operations personnel. The second level is for operations supervisors. The third level is for system management personnel. The fourth level is for system programming personnel. By using these levels, authorised personnel will only have access to their authorised level of system operation when using a password.

16.11.5.10 *Logging Facilities*

The system computers will have a relational database management facility for the storage and analysis of any nominated data on to the hard disk drive (eg for trend logging, historical logging, etc.).

The system shall provide the following point histories saved to the hard disk drive as a minimum:-

- All analogue points every one minute (30 days hard disk storage)
- All analogue points every five minute average (12 months hard disk storage)
- All binary point changes of state (12 months hard disk storage)

The system shall incorporate spread sheet and data manipulation software packages such that for example, colour graphical representation of real time data or trend logs can be provided with several variables displayed on single colour graphic displays.

Logged data shall be accessible via the normal BMS interface in a seamless manner. The displays shall be dynamic such that variables continuously update their values. Play back of previously archived logs from the C.D. ROM must be via a simple mouse driven command allowing any point or group of points to be displayed over an operator selectable time span. Transmission of log and archive data shall not affect normal system operation.

All data/displays shall be displayed on the VDU or printed on demand or on a time basis.

In addition to trend and historical logs the system shall also maintain the following logs:

- current point alarm log
- run time log for each plant item
- all point status log
- manual override log

16.11.6 Workstation Schedule (minimum requirements)

16.11.6.1 *Workstations*

Supply 3 x BMCS operator workstations including all building-to-building local area network requirements in agreed locations:

These user work stations will not be used as equipment for commissioning, and will be installed at the date of compliance of the building. The workstations shall comply with the following minimum specifications:

Processor	Intel Core 2 Duo 2GHz
RAM	4GB
HDD	500GB
CD/DVD Read/Write	1
FDD	1 x 1.44MB
VDU	24” Wide Screen Flat Panel LCD
Graphic Card	128MB
Construction	Tower, USB Keyboard, Optical Mouse, integrated or separate speakers
Cache	2GBkB
Operator Interface	Keyboard, Mouse

Off Site Access	Internet connected, broadband connection at least 1Mbs
Network Interface card	10/100/1000MB
Alarm Dial Out Modem	56k bps
Spare Serial Ports	1
Spare Parallel Ports	1
Spare USB ports	8
Internal Network Interface Adaptor	1

1.1.1.1 Software

The work stations shall be loaded with the following software:

1. Appropriate building management system software complete in all respects to reflect the commissioned systems at the date of completion;
2. Microsoft Windows 7;
3. Microsoft Office 2010 incorporating Word, Excel, PowerPoint and Outlook;
4. Auto Cad Light, Adobe Writer, and recognized virus software;

1.1.1.2 Printers

The developer is to supply one printer per user workstation. Printers shall comply with the following minimum specifications:

1. Colour laser jet functionality;
2. A3 and A4 size printing;
3. Minimum 8 ppm black/colour;
4. 10/100 network interface;
5. Separate colour cartridges; and
6. Spare set of cartridges.

16.11.7 Alarm Generation

Should an item of equipment fail to start or stop as directed by the computer or if analogue limits are exceeded after an operator selectable time delay has elapsed, an alarm will be raised and recorded at the selected workstations. Analogue points must have a minimum of four associated alarm limits - low warning, low alarm, high warning and high alarm. Points in alarm on any graphic display must be highlighted by a change in colour from points not in alarm and shall flash until acknowledged.

The system shall be capable of generating both hardware alarms i.e. when physical equipment goes into alarm, and software alarms i.e. alarms relating to a logical set of conditions where software is used to generate the alarms. Provision shall also be made in the system to prevent secondary alarms from occurring if a primary device goes into alarm.

It shall be possible to allocate an alarm message for every alarm using up to a full screen of text.

All alarm displays shall contain the full character identification of the point, point status, engineering units, time, date and the alarm message if applicable. Alarm sorting by area, type, time and date etc. shall be provided.

All alarms will be displayed on the VDU, logged to disk. All alarms must be acknowledged by the operator, and this acknowledgment is to be recorded in a printed transaction log identifying the operator, time and date. All general BMCS alarms will be displayed and printed at the BMCS operator station. The system must be capable of recognising at least four priority levels of alarms. The alarms and their type are to be developed with the building operator during commissioning. Any communication loss between controllers or lack of paper in the alarm printer will be treated as a critical alarm.

All alarms shall automatically be displayed on all appropriate logged in Operator's VDU's and on the alarm printer.

16.11.8 Spare Capacity

The system when installed will include a built-in unused physical point hardware and software capacity of 10% spare points at each field controller for each type of I/O point (i.e., AI, AO, BI, BO) over and above those listed in the point schedule.

Spare capacity must be capable of being addressed by the controllers and have physical terminals even though they are not being used. This will facilitate expansion of the system to include points which are not initially connected to the BMCS but may be determined as necessary at a later date.

Expansion shall be accomplished without additional head end changes and without degradation in system response times specified.

16.12 Controllers

16.12.1 Hardware

16.12.1.1 *General Arrangement*

Field controllers shall be sensibly arranged to serve discrete systems and maximise reliability.

As a minimum there will be separate field controllers for:

- Each AHU,
- Heating Hot Water System
- Chilled Water System
- Condenser water system
- Carpark exhaust system
- Each floor

16.12.1.2 *General*

Provide Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), Smart Actuators (SA), and Smart Sensors (SS) as required to achieve performance specified in Section 3. Every device in the system which executes control logic and directly controls HVAC equipment must conform to a standard BACnet Device profile as specified in ANSI/ASHRAE 135-2004, BACnet Annex L. Unless otherwise specified, hardwired actuators and sensors may be used in lieu of BACnet Smart Actuators and Smart Sensors.

16.12.1.3 *Building Controllers (BCs)*

Each BC shall conform to BACnet Building Controller (B-BC) device profile as specified in ANSI/ASHRAE 135-2004, BACnet Annex L and shall be listed as a certified B-BC in the BACnet Testing Laboratories (BTL) Product Listing.

16.12.1.4 *Advanced Application Controllers (AACs)*

Each AAC shall conform to BACnet Advanced Application Controller (B-AAC) device profile as specified in ANSI/ASHRAE 135-2004, BACnet Annex L and shall be listed as a certified B-AAC in the BACnet Testing Laboratories (BTL) Product Listing.

16.12.1.5 *Application Specific Controllers (ASCs)*

Each ASC shall conform to BACnet Application Specific Controller (B-ASC) device profile as specified in ANSI/ASHRAE 135-2004, BACnet Annex L and shall be listed as a certified B-ASC in the BACnet Testing Laboratories (BTL) Product Listing.

16.12.1.6 *Smart Actuators (SAs)*

Each SA shall conform to BACnet Smart Actuator (B-SA) device profile as specified in ANSI/ASHRAE 135-2004, BACnet Annex L and shall be listed as a certified B-SA in the BACnet Testing Laboratories (BTL) Product Listing.

16.12.1.7 *Smart Sensors (SSs)*

Each SS shall conform to BACnet Smart Sensor (B-SS) device profile as specified in ANSI/ASHRAE 135-2004, BACnet Annex L and shall be listed as a certified B-SS in the BACnet Testing Laboratories (BTL) Product Listing.

16.12.1.8 *Environment*

Controller hardware shall be suitable for anticipated ambient conditions.

Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at -29°C to 60°C (-20°F to 140°F).

Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at 0°C to 50°C (32°F to 120°F).

16.12.1.9 *Keypad*

Provide a local keypad and display for each BC and AAC. Operator shall be able to use keypad to view and edit data. Keypad and display shall require password to prevent unauthorized use. If the manufacturer does not normally provide a keypad and display for each BC and AAC, provide the software and any interface cabling needed to use a laptop computer as a Portable Operator's Terminal for the system.

16.12.1.10 *Real-Time Clock*

Controllers that perform scheduling shall have a real-time clock.

16.12.1.11 *Serviceability*

Controllers shall have diagnostic LEDs for power, communication, and processor.

Wires shall be connected to a field-removable modular terminal strip or to a termination card connected by a ribbon cable.

Each BC and AAC shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation. System shall continuously check controller network and generate alarm for each controller that fails to respond.

16.12.1.12 *Memory*

Controller memory shall support operating system, database, and programming requirements.

Each BC and AAC shall retain BIOS and application programming for at least 72 hours in the event of power loss.

Each ASC and SA shall use non-volatile memory and shall retain BIOS and application programming in the event of power loss. System shall automatically download dynamic control parameters following power loss.

16.12.1.13 *Immunity to Power and Noise*

Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).

16.12.1.14 *Transformer*

ASC power supply shall be fused or current limiting and shall be rated at a minimum of 125% of ASC power consumption.

16.12.1.15 *Cabinets*

House BMCS controllers inside approved lockable metal cabinets/enclosures. All cabinets will be proprietary manufactured, fully welded construction, minimum IP52 rated and rigidly supported in an approved manner and location.

Controllers will be secured to a equipment mounting panel/plate provided inside the respective cabinet/enclosure and be rigidly supported thereon. Mounting of controllers on the back of panel doors is not acceptable.

Panel doors shall be hinged type and openable without the use of a special tool via locking “L” shaped handle. Doors shall be fitted with approved neoprene sealing strips firmly attached to the panel and arranged such that the strip forms a continuous seal with the body of the cabinet. All doors will be keyed alike. Door widths shall not exceed 600mm.

Each cabinet will be clearly labelled in an approved manner.

All cabinets will be painted and finished in an approved colour.

Each cabinet will be provided with a document holder(s) attached to the inside of the cabinet door(s). The BMCS subcontractor will provide an A3 engineering drawing(s) etc. inside the document holder showing DDC panel terminal numbers, cable numbers, point descriptor and destination terminal numbers for all cables connected to field controllers housed inside that cabinet.

16.12.2 Communication

16.12.2.1 *BACnet Communication*

Each BC shall reside on or be connected to a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing.

BACnet routing shall be performed by BCs or other BACnet device routers as necessary to connect BCs to networks of AACs and ASCs.

Each AAC shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol with BACnet/IP addressing, or it shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.

Each ASC shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.

Each SA shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.

Each SS shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol with BACnet/IP addressing, or it shall reside on a BACnet network using ARCNET or MS/TP Data Link/Physical layer protocol.

16.12.2.2 *Service Port*

Each controller shall provide a service communication port for connection to a Portable Operator's Terminal. Connection shall be extended to space temperature sensor ports where shown on drawings.

Signal Management. BC and ASC operating systems shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and to allow for central monitoring and alarms.

16.12.2.3 *Data Sharing*

Each BC and AAC shall share data as required with each networked BC and AAC.

16.12.2.4 *Stand-Alone Operation*

Each piece of equipment specified in this specification shall be controlled by a single controller to provide stand-alone control in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network.

16.12.3 Input and Output Interface

16.12.3.1 *General*

Hard-wire input and output points to BCs, AACs, ASCs, or SAs.

16.12.3.2 *Protection*

Shorting an input or output point to itself, to another point, or to ground shall cause no controller damage. Input or output point contact with up to 24 V for any duration shall cause no controller damage.

16.12.3.3 *Binary Inputs*

Binary inputs shall monitor the on and off signal from a remote device. Binary inputs shall provide a wetting current of at least 12 mA and shall be protected against contact bounce and noise. Binary inputs shall sense dry contact closure without application of power external to the controller.

16.12.3.4 *Pulse Accumulation Inputs*

Pulse accumulation inputs shall conform to binary input requirements and shall accumulate up to 10 pulses per second.

16.12.3.5 *Analogue Inputs*

Analogue inputs shall monitor low-voltage (0-10 Vdc), current (4-20 mA), or resistance (thermistor or RTD) signals. Analogue inputs shall be compatible with and field configurable to commonly available sensing devices.

16.12.3.6 *Binary Outputs*

Binary outputs shall send an on-or-off signal for on and off control. Building Controller binary outputs shall have three-position (on-off-auto) override switches and status lights. Outputs shall be selectable for normally open or normally closed operation.

16.12.3.7 *Analogue Outputs*

Analogue outputs shall send a modulating 0-10 Vdc or 4-20 mA signal as required to properly control output devices. Each Building Controller analogue output shall have a two-position (auto-manual) switch, a manually adjustable potentiometer, and status lights. Analogue outputs shall not drift more than 0.4% of range annually.

16.12.3.8 *Tri-State Outputs*

Control three-point floating electronic actuators without feedback with tri-state outputs (two coordinated binary outputs). Tri-State outputs may be used to provide analogue output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.

16.12.3.9 *Universal Inputs and Outputs*

Inputs and outputs that can be designated as either binary or analogue in software shall conform to the provisions of this section that are appropriate for their designated use.

16.12.4 Software

16.12.4.1 *General*

The Direct Digital Controllers will be able to be programmed in the field by a lap top computer and by down line loading from the system computers.

16.12.4.2 *Functionality*

The Direct Digital Controllers will have basic energy management programmes which will include complete electrical energy management, time programming, control and display operations, process initiations and terminations, alarm identification, arithmetic operations, binary and relational logic, formula computations, control signal compensation and closed loop control.

The Direct Digital Controllers will include the following software packages:-

- Adaptive optimum plant start/stop
- Fire trip delayed restart
- Outside air cycle control
- Air handler control and management
- Shutdown of unoccupied areas after hours
- Supply air temperature reset
- Chiller sequencing and management
- Chilled water temperature reset
- Power fail delayed restart
- Scheduled start/stop
- Pulse monitoring to provide both long term accumulation and pulse rate readings
- Sliding window electrical demand monitoring and load shedding (including chiller current limiting)
- Power fail load and unload
- User defined programs
- Calculation of all psychrometric properties of air by using dry bulb temperature and relative humidity sensors
- Decisions based on psychrometric calculations
- Proportional, integral, derivative (PID) control algorithms (P up to PID selectable)
- Night purge
- Run time totalisation

These packages will be adapted to the operational requirements of the installed services.

16.12.4.3 *Diagnostics*

The Direct Digital Controllers will be able to produce diagnostic routines such that any combination of digital and analog points can be used in 'if', 'and' and 'or' statements to generate English language messages at the system computers giving reasons for the occurrence of particular problems.

16.12.4.4 *Time Schedules*

A backup time schedule shall be provided in all Direct Digital Controllers should communications be lost with the system computers.

16.12.4.5 *Hour Run*

Hours run totals will be derived by integration with respect to time of the contact closure status for the appropriate piece of equipment or by start/stop command for the equipment if status is not monitored.

16.12.4.6 *Digital Inputs*

The Direct Digital Controllers will be capable of monitoring normally open or normally closed contacts. The system will also have on-line capabilityof inverting data bits from keyboard via software to correspond to correct field status.

16.12.4.7 *Control Loops*

In the case of control loops the measured variable shall be capable of being controlled in a stable manner to the following end to end accuracy's:

- Temperature: +/- 0.3°C
- Pressure: +/- 2% of operating pressure (+/- 5 Pa for air pressure)
- Air Flow: +/- 10% of nominal flow
- Relative humidity: +/- 3% RH

16.12.4.8 *Scan Rate*

The scan rate for each point must be operator adjustable within the range of 1 to 300 seconds.

16.12.4.9 *Change in Value*

The maximum change in value allowable before the new value is displayed at the system computer must be adjustable for each analogue point.

16.12.4.10 *Pulse Inputs*

The scan rate for all momentary input signals must be adjustable to ensure the system registers all momentary inputs.

16.12.4.11 *DDC Diagnostics*

Direct Digital Controllers must include resident diagnostic software to run continuously and report any DDC panel malfunction to the system computers.

16.12.4.12 *DDC Status*

Each Direct Digital Controller shall verify its current database against the backup database in the system computer whenever any Direct Digital Controller is isolated, suffers a communications loss or power failure.

16.12.5 Field Equipment (Input Devices)

16.12.5.1 *General*

All sensing equipment necessary for the system and all items indicated in the point schedule as being supplied within the scope of these works will be supplied, installed, connected and tested as part of these works. Sensing equipment shall be of the type that does not require calibration.

All sensing equipment will be complete with mounting brackets, protective cover, terminal connectors, leads and similar items necessary for the complete installation. All external sensors shall be weatherproof and mounted so that they are not directly influenced by the sun.

Zero and span adjustments will be provided in software for each analogue transducer.

All sensing equipment is to be labelled with its field controller hardware address and point descriptor.

All sensing equipment measuring system variables must be converted to meaningful process variables and displayed in S.I. units.

Any differential measurement required by the system must be carried out by single two port differential measuring sensors. The use of two single sensors for differential measurements is not permitted.

All transducers shall provide a linear output and be protected against polarity reversal and short circuits.

16.12.5.2 *Temperature*

All analogue measurements of temperature including air temperature and water temperature will be made by 1000 ohm resistance bulb or approved equal, to provide an output that is linearly related to temperature. The span of the resistance bulb will cover the temperature range to be encountered. The accuracy of the read out at the central station will be +/-0.3 degrees Celsius over the measuring range.

Fluid temperatures will be measured by sensors installed vertically in brass or stainless steel wells, of sufficient length to ensure accurate measurement, compatible with the piping system and the fluid. Heat conducting compounds shall be used where sensors are installed in wells. Wall sensors shall be mounted on an appropriate insulating base and all penetrations through the mounting surface shall be sealed.

16.12.5.3 *Relative Humidity*

Relative humidity measurements will be by solid state type sensor. The total accuracy of measurement (including hysteresis) will be +/-3%RH over the measuring range. The span will cover the relative humidity range to be measured.

Sensors shall suffer no loss of accuracy over the full range of ambient temperature.

16.12.5.4 *Pressure*

All analogue pressure measuring devices including air, water and oil pressure sensors will have solid state sensing elements. The element will not be chemically affected by the process it is measuring. The accuracy of the sensor/transducer will be +/-2% over the measuring range (±6 Pa for air pressure).

The pressure sensor will be capable of handling the maximum expected system pressure with no loss in reading at central control station and shall be selected so that the design pressure occurs at approximately 2/3 of the sensor range.

16.12.5.5 *Flow Sensors – Annubar Type*

Flow sensors will be of the Annubar type to provide sensor/ transducer accuracy of +/- 1.0% over the nominal flow range, with a turndown ratio of at least 10:1.

The flow sensor will be capable of handling the maximum expected system pressure with no loss in reading at the central station and shall be selected so that the design flow occurs at approximately 2/3 of the sensor range.

16.12.5.6 *Flow Sensors – Magnetic Type*

Magnetic type induction flow sensors shall consist of a sensor through which the measured liquid flows and an electronic unit where the low-level signal from the sensor is modified to a standardized form suitable for further processing in various industrial electronic devices.

The flow sensor shall include a 4-20 mA output. The output signal shall be proportional to the volume flow rate of the measured liquid. The flow sensor shall be capable of taking measurements in both flow directions, with high measurement accuracy over a wide range of flow rates.

The electronic unit shall be fitted with a backlit liquid crystal display with two lines of 16 alpha numeric characters and show flow rate in either percent of flow or direct engineering units. In addition the display shall show cumulative volume, configuration data and error messages.

Standard system accuracy shall be ±0.5% of rate from 0.3 to 12 m/s

16.12.5.7 *Air Flow*

Air flow in ducts will be sensed at such a point, and in such a manner, as to accurately reflect total air flow within the design range of the measured system, regardless of turbulence or duct geometry. Sensors shall be differential pressure (pitot) type with averaging grid to measure velocity to achieve sensor/transducer accuracy of +/- 3.0% over the measuring range. The sensors shall not impose a resistance of more than 25 Pa on the system. Air flow shall be calculated via a software program in the Direct Digital Controllers.

Air flow sensors will be capable of handling the maximum expected system pressure with no loss in reading at the central station and shall be selected so that the design flow occurs at approximately 2/3 of the sensor range.

16.12.5.8 *Current, Voltage and Power Factor*

All necessary transducers provided as part of these works shall achieve an accuracy of +/- 1% over the measuring range.

The span will cover the range of the measured variable.

16.12.5.9 *Electronic Thermostats*

Electronic thermostats shall be 1000 ohm resistance bulb or stabilised thermistor type or approved equal. The span of the resistance bulb etc. shall cover the temperature range to be measured without a loss in reading or control. Sensors shall be linear over the full working range of the sensor.

Sensor accuracy shall be +/- 0.2C.

Thermostat set points shall be adjustable over the range 15-30C. Throttling ranges shall be adjustable from 0.5-4C.

Thermostat covers shall be fully enclosed but vented, non-adjustable type and shall be lockable.

Thermostats shall be mounted on an appropriate insulating base and all penetrations through the mounting surface shall be sealed.

Thermostat output shall be 0-10V DC, suitable for inputting directly into the BMCS to give a signal proportional to temperature.

16.12.5.10 *Flow Switches*

Water and air flow switches supplied and installed as part of these works will be suitable for vertical or horizontal mounting and provided with a means of adjusting sensitivity of operation. Flow switches shall be installed in sufficient straight length of duct or pipe as recommended by the manufacturer to achieve smooth consistent readings without turbulence.

16.12.5.11 *Pressure Switches*

Electric pressure switches supplied and installed as part of these works will have bellows or diaphragm sensing elements with micro switch actuation. The operating set point and differential or dead band will be adjustable.

16.12.5.12 *Wells*

Wells shall be sized to suit the particular pipe diameter (including insulation thickness) into which it is to be installed. Wells shall be permanently marked in an approved manner (eg. engraved) with the sensor name prior to handing over to the mechanical subcontractor to enable the mechanical subcontractor to identify the required location for the particular well.

16.12.6 Field Equipment (Ouput Devices)

16.12.6.1 *Binary Outputs*

Interposing relays for binary output control functions in the Direct Digital Controllers must comply with SAA requirements for electrical isolation and shall be suitable for switching the load at either 240 Volt a.c. or 24 Volt D.C. as required.

16.12.6.2 *Analogue Output Transducers*

Analogue transducers will be supplied where conversion from the BMCS output signal to another control variable is required (eg., current, pneumatic, etc.). Transducers will be of the feedback type, to ensure output remains constant irrespective of load.

16.12.6.3 *Electric Valve and Damper Actuators*

Actuators shall be of the electric/electronic type suitable for proportional operation.

Actuators shall be overload protected and non-stall type, fitted with end of travel limit switches and shall be suitable for operation on 24V a.c. power.

Actuators shall be of corrosion proof construction.

Damper actuators shall have suitable, adjustable linkage assembly for connection to standard round, hexagonal and square section damper shafts.

Maximum time for damper actuators to operate through their full travel shall be 90 seconds or as required by AS1668.1.

Damper actuators shall be sized to operate damper area of not more than 70% of the maximum area specified by manufacturer for that particular actuator for the duty air velocity.

Valve actuators must provide sufficient torque to ensure tight shutoff and stable spindle control under all operating conditions.

Actuators shall be capable of continuous operation in any of the modes above.

Actuator operation shall be inaudible in any tenanted space.

Spring return shall be fitted if required for fire mode operation.

Actuator connection to damper drive shafts for direct coupled actuators shall be via a single "V" bolt or by two grub screws, connection by single grub screws is not acceptable. The attachment system to the damper drive shaft must ensure that there is no slippage under any operating condition.

All actuators shall incorporate a system to allow manual positioning. This system shall be either via a manual cranking device or via a pushbutton to disengage the drive train.

All actuators must have indicators that show the position of the valve/actuator.

16.12.6.4 *Electric VAV Box Actuators*

Electric Variable Air Volume (VAV) box motors shall be of the electric/electronic type suitable for proportional control.

Actuators shall be of corrosion proof construction.

Actuators shall be suitable for 24V A.C. power and shall have adjustable linkage/assembly for connection to standard VAV box damper shafts. Maximum time for motor to operate through its full travel shall be 90 seconds.

Actuator connection to damper drive shafts for direct coupled actuators shall be via a single "V" bolt or by two grub screws, connection by single grub screws is not acceptable.

Linkages shall be adjusted for smooth operation through the full control range.

Actuator operation shall be inaudible in any tenanted space.

Actuators shall be suitable for 3 mode operation as follows:

- drive damper fully closed (fire mode)
- drive damper fully closed (after hours)
- proportionally control of the damper between a minimum and maximum position. Both positions to be adjustable at the actuator and at the Direct Digital Controller.

16.12.7 CONTROL VALVES

16.12.7.1 *General*

Control valves shall be selected to comply with the duties nominated in the control valve schedule. Valves shall be normally closed, single seated and tight shut-off at the close off pressure nominated in the technical schedule. In no case shall the pressure drop be greater than that recommended by the control valve manufacturer for good control, low noise level and low wear rate. Valve trim materials shall be selected to give satisfactory life for the operational and system conditions for the controlled medium.

16.12.7.2 *Two Way Valves*

Two way valves shall be of the equal percentage type.

16.12.7.3 *Three Way Valves*

Three way valves shall be of the linear characteristic type specifically rated for mixing applications.

16.12.7.4 *Valves up to 20mm*

Valves up to 20mm may have flare or compression fittings and integral seats.

16.12.7.5 *Valves up to 50mm*

- Shall have replaceable trim.
- Shall be of the plug type.
- Shall have bronze, cast iron or cast steel body with flanged or screwed ends.

16.12.7.6 *Valves over 50mm*

- Shall have replaceable trim.
- Shall be of the vee ported type.
- Shall have bronze, cast iron or cast steel body with flanged ends.

16.12.7.7 *Butterfly Valves*

- Shall have replaceable trim.
- Shall have cast iron or cast steel body and shall be suitable for flanged connection.

16.12.7.8 *Steam Valves*

- Steam valves shall be of a type specially selected for steam duty.

16.12.7.9 *Trim*

- For applications below 100ºC trim shall be stainless steel with teflon packing or shall be composition disc with bronze or brass seat, stainless steel stem and teflon packing.
- For applications over 100ºC or steam trim shall be stainless steel.
- Butterfly valves shall have aluminium bronze disc and EPDM or BUNA N (Class SB) seat.
- All valves shall have stainless steel shafts.

16.12.7.10 *Operational Indicators*

All valves must have indicators that show the position of the valve.
The indicators shall be visible from the plantroom floor or access platforms.

16.12.8 Installation Standards

16.12.8.1 *Electrical Standards*

The entire electrical installation will be in accordance with the current regulations and requirements of all relevant statutory authorities.

The requirements of the S.A.A. wiring rules (AS3000) and the local Supply Authority will be taken as the minimum standard for this installation.

16.12.8.2 *Cabling and Wiring*

The communication control data medium shall be to the manufacturer's published recommendations with, as a minimum IBM Type 1 data grade medium (DGM) cable of two twisted pairs of No. 22 AWG solid conductors enclosed in a braided shield with an appropriate sheath (i.e., RS-422, RS-485, etc.).

All analogue input/output and binary input points shall be wired in minimum 0.5mm2 twisted pair shielded cable.

All other conductors will be stranded, P.V.C. insulated minimum 600 Volt grade, minimum size of 1.0 sq. mm. (i.e., 7 x 0.05) control wiring and minimum size of 2.5 sq. mm. power wiring. The power wiring (240V and 24V ac) will be sized such that there will be no greater than a 5% voltage drop over any power run under full load

conditions or as specified by AS3000 whichever is the lower. Cables will be run without joints to the equipment connections. Any jointed or damaged wiring will be rejected.

Cable insulation colours for P.V.C. insulated cables and T.P.S. cables will conform to the following:

1.	Phase	-	Red, White, Blue
2.	Earth	-	Green with Yellow Trace
3.	Control		
	240V Active	-	White
	240V Neutral	-	Black
	24V AC Active	-	Orange
	24V Neutral	-	Orange with Black or Brown Trace

A separate terminal will be provided for each terminal connected field wire. Each terminal will have a separate number. Each wire connected to a terminal strip will have a slip-on type plastic numbered collar attached to each end of the wire at termination points for identification purposes (clip on type numbering collars will not be used). All numbers will correspond to those shown in the Points List or approved alternative system of numbering. Wiring will be numbered at each end as shown on the diagrams with source and destination numbers. Terminal strips will have 25 percent spare terminals.

All wiring and terminal strips for different voltages will be segregated.

All wiring will be protected over the whole of its length by the following methods:-

*	Wiring within plantrooms and inside risers	:	Galvanised screwed steel conduit or galvanised steel cable duct.
*	Wiring exposed to weather and surface runs in fire stairs and basements.	:	Galvanised screwed steel conduit.
*	Wiring outside plantroom	:	P.V.C. high impact class 'B' conduit or galvanised steel duct.

When approved, cables may be run in concealed spaces as open wiring in T.P.S., however, wiring must be neat and supported at regular intervals.

16.12.8.3 *Conduit and Conduit Fittings*

All conduits will be concealed by running in slab or false ceiling spaces, by chasing into walls, by running in cavities, etc., but where unavoidably exposed to view they will be grouped in a logical manner and be run as directed on site. Minimum size for conduits will be 20mm diameter. All conduits will have space for a minimum of

20 percent additional cables to be drawn through the conduit without disturbing original cables or exceeding the limits specified in AS 3000.

Final conduit connections will be firmly anchored by locknuts.

Cable draw wires in boxes will be used in conduit runs over 20m in length and wherever necessary. Cables will be drawn into conduit after the conduits have been erected in position.

All conduits and fittings will be rendered thoroughly watertight. Metal conduit will have close fitting tapered threads screwed hard up. All joints will be sealed with metallic paint to prevent water entry. Conduit cast-in will be P.V.C. and securely fixed to the steel reinforcement with heavy binding wire to prevent movement of the conduit during pouring and vibrating of the concrete.

Where necessary, open ends of conduit will be closed with metal end caps as soon as they are installed. All boxes not provided with cover plates will be suitably sealed to prevent the ingress of concrete or water and so arranged that they may easily be located after the removal of formwork.

Fastenings to timber will be made with wood screws or bolts, to metal with metal thread screws and to masonry with patent metal expanding fasteners. Wood or plastic plugs in masonry will not be accepted. Where fasteners are installed in damp situations or are exposed to weather, they will be galvanised. Structural members of the building will not be cut into without the Manager's approval.

Approved saddles will be spaced not more than 1 metre apart and additional saddles will be provided where they are necessary to prevent sagging of the conduit.

Metal conduits will be class 'B' heavy gauge welded, screwed steel galvanised. Conduit fittings will be of the solid cast type.

Rigid P.V.C conduit will be class 'B' high impact, suitable for plain connections complying with AS.C173. All joints between conduits and fittings will be made using approved solvent cement. Screwed joints will not be accepted. Rigid P.V.C conduit and fittings will not be used where subject to ambient or contact temperatures exceeding 60°C.

Conduits will be provided with approved expansion joints where any straight section exceeds 10m in length. The correct sizes of internal springs will be inserted in the conduit before making normal cold sets and bends.

Flexible PVC or corrugated conduits may only be used for final connections to field equipment external to plantrooms and risers and in no case shall the lengths of these conduits exceed 300mm.

Armoured flexible conduit shall be used for the last 300mm (maximum) onto field equipment located within plantrooms or risers.

16.12.8.4 *Sheet Steel Duct*

Zinc coated sheet steel ducting will be provided wherever specified. All ducting will have a tight fitting lid secured to sides of duct. Attention is drawn to AS 3000 regarding arrangement of cables.

Note: Only purpose made bends tees, etc., will be used. site manufactured bends, etc., will not be accepted.

16.12.8.5 *Earthing*

All metal enclosures, conduits, ducts, etc., will be earthed with standard copper earthing conductors to the earth bar in the enclosure. Earthing conductors will be provided with solderless lugs where they are clamped to the earth bar. All shielded cable will be earthed at one end. The cable shield will be earthed to the reference ground of the system in accordance with the manufacturers technical requirements.

16.12.8.6 *Mounting Brackets, Etc.*

All mounting brackets, bolts, etc., located outside the building will be hot dip galvanised, after all drilling or machining has been performed.

Mounting brackets inside the building may be of mild steel painted with an approved rust inhibiting paint.

16.12.8.7 *Labelling*

All equipment (including control valves) shall be labelled using "Traffolite" machine engraved labels (black on white) with screw fastening. All labelling will be a minimum of 5mm lettering and be to the approval of the Manager.

Identification numbers shall coincide with those shown on the shop drawings.

Labels shall be fixed to the instrument or to the surface on which it is mounted, but shall not be fixed to instrument covers.

All BMCS conduits, cable ducts etc shall be labelled using approved purpose made self adhesive plastic labels with minimum 15mm high lettering. Specifically:-

- BMCS UPS conduit/s shall be provided with labelling "BMCS 240 VAC UPS" at approved intervals.
- BMCS comms conduit/s shall be provided with labelling "BMCS COMMS - KEEP POWER AWAY" at approved intervals.
- BMCS cable duct/s shall be provided with labelling "BMCS CABLES - KEEP POWER AWAY" at approved intervals.

16.12.8.8 *Reuse of Existing Conduits and Ducts*

Dispensation may be given in the scope of works section for refurbishment projects to re-use existing conduits and ducts.

If any existing conduits or ducts are to be reused the subcontractor shall replace any damaged portions of the installation to provide an equivalent standard of installation to the use of new materials throughout.

16.13 Commissioning of Control Systems

Commission equipment supplied by other trades in co-operation with the relevant trade representative. Attend the site as required to complete the commissioning.

When a system is operating satisfactorily, test the system and submit a copy of the recorded test results. Request the supply of standard forms for test procedures and recording of results. Acceptance tests will be witnessed when the test results are considered to be satisfactory.

Provide labour, materials and instruments for carrying out acceptance tests.

Instruments shall be calibrated not more than 6 months prior to use, by a testing authority, N.A.T.A. certified to test the particular instrument. If there is reasonable doubt as to the accuracy of an instrument, the instrument

shall be re-calibrated, or alternatively any quantities measured with the disputed instrument shall be re-measured with another approved instrument.

Two tests of equipment will be witnessed if necessary. If the equipment fails the second test and no serious endeavour has been made correct the fault, witnessing of further tests will be charged at current hourly rates plus expenses and such charges will be deducted from payments.

Tests shall include the following:

- Verification that input and output points are correctly connected e.g. by manual intervention in outputs and inputs while observing system operation
- Verification of correct sequences of operation by simulating appropriate inputs

17. PAINTING

17.1 General

Paint equipment which is exposed to view from floor level, (or catwalks where provided) located in plantrooms, fan rooms, equipment rooms, car parks, open air areas and similar locations.

Paint shall be of approved quality, brought to site in the manufacturer's sealed containers and applied by experienced tradesmen. Coats of paint on any one item shall be of the same type and manufacture and shall be applied as recommended by the manufacturer.

The equipment colour schedule is a guide to the number of colours required. The final colour scheme shall be as instructed.

17.2 Galvanised Steel

Clean galvanised steel surfaces of grease or other contaminant and artificially weather before painting.

17.3 Painting (Within the Building)

Clean surfaces of grease, rust, scale welding flux and the like. Apply one phosphate type priming coat and two finishing coats of the colour designated in the following schedule. The finishing coats shall be full gloss enamel and shall be as smooth and free of brush marks as possible.

17.4 Painting (Exposed To Weather)

Clean surfaces of grease, rust, scale welding flux and the like. Apply one coat of heavy duty anti corrosive primer (Emergard or approved equal), one coat of anti corrosive protecting coating (Emer-coat or approved equal) and one coat of heavy duty anti corrosive gloss enamel of the colour designated in the following schedule.

17.4.1 Vertical Discharge/Intake Ducts

Vertical ducts which are open to weather at the top shall be internally painted as specified in clause PAINTING (EXPOSED TO WEATHER).

17.5 Cooling Tower or Evaporative Condenser Discharge Ducts

Clean the internal surfaces, seal joints and seams and apply three coats of Emer-coat special as supplied by Emery Chemicals or approved equal to the internal surfaces of the duct.

17.6 Switchboards and Control Panels

Paint switchboards and control panels at the factory with Dulon automotive lacquer of colour designated in the following schedule. Protect switchboards and control panels during installation. Retouch chips, marks and scratches.

17.7 Equipment Colour Schedule

Paint numbers refer to AS 2700 1985, Colour Standards for General Purposes.

17.7.1 B25 Aqua

- Conditioner Casing

- Evaporative Condenser (Excluding Belt Guard)
- Fans (Excluding Belt Guards)

17.7.2 B15 Mid Blue

- Refrigeration Machines
- Compressors and Motors (Excluding Coupling Guard)
- Condenser Pumps and Motors (Excluding Coupling Guards)
- Chilled Water Pumps and Motors (Excluding Coupling Guards)
- Hot Water Pumps and Motors (Excluding Coupling Guards)
- Air Compressor, Motor and Receiver (Excluding Belt Guard)
- Shell and Tube Condenser
- Liquid Receiver
- Refrigeration Gauge Panel (Exterior)
- Pneumatic Gauge Panel (Exterior)

17.7.3 Y54 Oatmeal

- Exposed Ductwork

17.7.4 X15 Orange

- Electrical Switchboard (Exterior)
- Electrical Troughing and Conduits
- Pneumatic Panel (Exterior). When forming an Extension of the
- Electrical Switchboard.

17.7.5 Y35 Off White

- Electrical Switchboard (Interior)
- Refrigeration Gauge Panel (Interior)
- Pneumatic Panel (Interior)
- Piping, Excluding Oil Piping, Valves, Strainers etc.

17.7.6 R13 Signal Red

- Coupling Guards
- Belt Guards
- Valves (Excluding Hand Wheels)
- Strainers, etc.
- Exposed Pneumatic Damper Motors

- Hot Gas Mufflers

17.7.7 N52 Mid Grey

- Plinths, including Floating Bases

17.7.8 X53 Golden Tan

- Oil Pumps, Piping and Storage Vessel

17.7.9 Black

- Brackets, Drains, Valve Handwheels

17.8 Labelling

After painting, identify ducts and pipework with Safetyman labels in accordance with AS 1345 - Rules for the Identification of Piping, Conduits and Ducts. Locate labels at approximately 3m intervals in plantrooms and provide labels at each service access opening into pipe shafts. Where pipes run together group the labels together.

Identify air handling units, fans, pumps, boilers, refrigeration machines, expansion tanks and other equipment as instructed with either an engraved laminate or photo etched aluminium label. Characters on labels shall be at least 10mm high and shall include a unique alpha numeric tag which is assigned to the equipment in documentation and switchboard labels. Screw fix the labels in positions which are clearly visible.

18. NOISE & VIBRATION

18.1 General

Install, balance and adjust air systems and water systems to avoid noise generation at dampers and valves.

The plans and specification indicate the extent of acoustic treatment and vibration isolation required to obtain the noise level ratings in the occupied areas as specified hereafter, calculated on the basis of the sound power levels of the individual items of equipment specified or nominated in the manufacturer's catalogue data.

Where noise limitation and reduction is critical, the maximum sound power levels of the individual items of equipment are specified.

If equipment is installed with a sound power level greater than the brand of equipment specified or greater than the sound power level specified, examine the acoustic treatment provided in the light of the particular equipment selection and provide any additional treatment necessary to maintain the noise levels within the specified limits.

The resultant noise generated from the commissioned engineering services systems and any other source, including environmental influences, shall be less than the maximum levels specified in *AS/NZS 2107:2000: Acoustics - Recommended design sound levels and reverberation times for building interiors.*

Specifically sound levels shall not exceed:

- 45dB(A) in general office areas
- 40dB(A) in meeting rooms

18.2 Noise Measurements

If noise from the plant is excessive due to noisy bearings, scraping of rotating parts in guards or housings or similar malfunctions, repair or replace the equipment. Perform noise measurements if instructed to do so. If such measurements show that noise from items of equipment exceeds the sound power levels specified, or alternatively if no sound power level is specified and the noise exceeds the manufacturer's catalogue data, then no payments will be made to cover the cost of noise measurements.

If the noise measurement tests are performed in accordance with instructions and it is determined that noise from items of equipment does not exceed the specified sound power levels or alternatively does not exceed the manufacturer's catalogue rating, then payments will be made to cover the cost of noise measurements.

Carry out noise measurements at the completion of the installation and after the system has been balanced. Noise measurements shall be made with a sound level meter and octave band filter set of approved manufacture. Calibrate the meter prior to and after noise measurements.

Noise measurements shall be made no closer than 1 metre from any air outlet or intake or wall, and at a height of at least 1 metre from the floor.

18.3 Vibration Isolation

Take the following minimum precautions to prevent the generation and transmission of vibration to the building structure.

18.3.1 Machinery

Machinery shall be statically and dynamically balanced and shall be isolated from the building structure as scheduled.

Select vibration isolators with due regard to the weight and speed of the equipment to be isolated and with isolating efficiencies as specified for the particular equipment or in any case, not less than 95%. Springs shall have a length when loaded approximately equal to their diameter.

Springs shall be unhoused steel compression type having a height to diameter ratio less than 2 in the loaded condition and a horizontal stiffness approximately equal to the vertical stiffness. The loaded deflection shall not exceed 70% of the maximum deflection. The surge frequency of the spring coils shall not be within 20% of any periodic forcing frequency.

The springs shall be seated on two ribbed neoprene pads at least 8mm thick with a separating galvanised steel shim, loaded in the range 200 to 300kPa.

Holding down bolts shall generally not be used. If they are considered essential in any particular case they shall be used only in an approved arrangement which avoids bridging out of pads.

Mounts shall be provided with an approved levelling arrangement and mounts under any item of equipment shall be selected and loaded to have the same deflection.

The equipment shall be "snubbed" if necessary to prevent bounce at start up.

When inertia blocks are required, coordinate the selection of vibration isolators and the mass of the inertia block to give the required isolation efficiency.

18.3.2 Cables

The connection of electrical cables to vibrating machinery shall be sufficiently flexible to prevent transmission of vibration.

18.3.3 Piping

Piping shall be designed to have sufficient flexibility where connected to vibrating machinery and shall be effectively isolated from the building structure where necessary to prevent the transmission of vibration.

18.3.4 Ductwork

Ductwork and fittings shall be designed and constructed so as to prevent any excessive generation of air noise, vibration of fittings, or drumming of ductwork.

19. TESTING & COMMISSIONING

19.1 General Requirements

The Mechanical Sub-contractor shall make sufficient allowances for the following:

- Full building commissioning to relevant CIBSE or ASHRAE Guidelines in addition to relevant Australian Standards and tests including AS ISO 5802 as required by local Authorities.
- Preparation of formal commissioning plan as specified below.

19.2 Commissioning Requirements

The Mechanical Sub-contractor and nominated commissioning personnel shall comply with the following minimum requirements:

- A comprehensive pre-commissioning, commissioning, and quality monitoring program and procedures in accordance with the CIBSE Commissioning Codes shall be provided by the Mechanical Services sub-contractor, commissioning personnel, trades and other relevant parties that are required to get involved in this process.
- The Mechanical services sub-contractor shall prepare and coordinate the commissioning process with the Principle Contractor and other trades to the requirements of the codes nominated above.
- The Mechanical services design team and subcontractors are required to transfer information and documentation to the building owner/manager regarding:
    - **Design intent**: Description of the Mechanical systems, including basic functions/operation and energy saving features. Also a simplified diagram of the system, the recommended maintenance frequency and a list of likely and tell-tale signs of system failure and notes on inefficient operation.
    - **As installed details**: A complete set of As-Built drawings for the Mechanical systems and a comprehensive O&M manual.
    - **Training of building management staff**: Provide training to building staff on how to operate and maintain the commissioned features and systems. Training to cover; design intent, controls set-up, programming, alarms and trouble shooting, O&M manuals, building operation (start-up, normal operation, unoccupied operation, seasonal changeover and shutdown), other system interactions, energy efficiency, OH&S, maintenance, and occupant satisfaction.

All details and documentation needed to comply with the above shall be provided with adequate time allocated for review by the manager and the modification and corrections to the project program as required.
In addition to the above, the Mechanical services subcontractor shall prepare a 12 month building commissioning fine tuning program and scope of works to occur after handover, which shall incorporate (4) four quarterly reviews and final recommissioning. This is to be submitted one month before handover to the manager for review, and incorporation into the building O & M manuals.

19.3 Commissioning Procedures

19.3.1 Air Handling Systems

I. Set adjustable controllers in air outlets to produce the required air flow pattern.

II. Adjust air quantities to within -0% to +10% of the design air quantities and make such further minor adjustments to air conditioning supply air quantities as are later found necessary to maintain satisfactory

space conditions. Flow balancing procedures must be configured to ensure that the use of flow restriction in the balancing process is minimised.

III. Measure total air quantities for air conditioning units with the design air quantity through the cooling coil and with outside air dampers set at their minimum position.

IV. Adjust outside and return air dampers to give the design air quantities at minimum and maximum positions and any intermediate position noted on the drawings.

V. Measure the air quantities in main and major branch ducts by pitot traverse. Provide pitot traverse stations and carry out pitot traverses where instructed and as found necessary to accurately determine correct air distribution.

VI. Measure the air quantities at outlets using a measuring hood (or other approved method) for ceiling outlets, and using anemometer traverse for registers and grilles, to a tolerance of ±5%. Correlate the sum of outlet air quantities against pitot readings. Data which shows a variation of greater than 5% between air quantities measured by pitot traverse and the relevant total of outlet measurements will not be accepted.

After the distribution system has been balanced, prove that the total air quantity for each system is within the allowable tolerance of -0 to +10% by correlating readings for at least three of the following methods of measurement which are listed in order of preference:-

a) Pitot traverse in main supply duct in accordance with BS 1042.

b) Sum of pitot traverses in branch ducts.

c) Fan air volume determined from fan curves and measured fan speed and static pressure. (Check fan dimensions and impeller clearances against manufacturer's drawings.)

d) Anemometer measurement taken 25mm off the face of the air leaving side of the filter or coil, averaged over the area, with an appropriate correction factor applied (factor usually in order of 0.8 x reading on anemometer to obtain actual air quantity.)

e) Sum of air quantities measured at outlets with appropriate correction factor applied.

f) Actual pressure drop compared to manufacturer's A.R.I. rated air pressure drop through the cooling and/or heating coils.

g) Actual fan power consumption vs expected fan power consumption at the specified duty. (Check fan dimensions and impeller clearances against manufacturer's drawings.)

Calculate power consumption using the following formulae:-

$$\text{Actual Full Load Amps} = \frac{\text{Nameplate Full Load Amps x Volts}}{\text{Actual Volts}}$$

$$\text{Actual Power} = \frac{\text{Nameplate Power x (Operating Amps - No load Amps x 0.5)}}{\text{(Actual F.L. Amps - No load Amps x 0.5)}}$$

The duty of all fans, and motors should be verified during commissioning. Where the required duty is substantially below the equipment capacity, the equipment should be replaced with equipment of lower capacity or otherwise modified to efficiently deliver the required capacity.

Submit test sheets, accompanied by calibration curves, factors, fan speeds, motor voltage and current draw, together with diagrams of ventilation systems on A4 sheets and marked up A3 workshop drawings of air conditioning systems identifying each:-

- Outlet, return or exhaust grille, exhaust hood etc.
- Main duct and major branch duct pitot traverse location.

- Air handling unit or fan.

19.3.2 Variable Air Volume System

The recommended air balancing procedure for the variable volume system is as follows:

i. Open all VAV boxes by setting the system to morning warm up mode and open all system balancing dampers. Open the outside air and relief air dampers. Close the return air damper.
ii. Set the supply air fan, using manual speed control to achieve the highest possible volume. It should be possible to achieve about 110% of design volume using the 20% spare capacity of the fan motor while the VAV boxes and balancing dampers are open.
iii. Adjust the return air fan/damper to achieve design volume.
iv. Proportional balance the air flow to each floor using the dampers at the riser take-offs and pitot readings in the main branch ducts.
v. Proportional balance the air on the floors at VAV boxes for 100% zone flow position set point.
vi. Read and note the static pressure at the control sensing points.
vii. Determine total supply air quantity by summation of floor take-offs and measurement of conditioner total. This should be greater than the design diversified air quantity due to all boxes being open.
viii. With the outside air and relief air economy cycle dampers in the closed positions, manually adjust the minimum outside air, minimum relief air dampers and return air dampers to provide the design minimum outside air flow.
ix. Read and note the differential pressure across the minimum outside air damper.
x. Set the outside air differential pressure controller to maintain the value noted in (ix) by modulating the return air damper.
xi. Set the relief air damper differential pressure controller to maintain the same differential pressure as the pressure across the minimum outside air damper by modulating the return air fan/damper.
xii. Set the supply fan static pressure controller to the value noted in step (ix) and set its throttling range to approximately 10% of the measured static pressure. Switch the supply and return fans to automatic control.
xiii. Set VAV boxes on automatic control and check that peak air quantities can be achieved on any zone, paying particular attention to index runs. Adjust the static pressure controller if necessary.

19.3.3 Smoke Control Systems

Test Smoke Control systems in accordance with AS 1668.1.

19.3.4 Stair Pressurisation Systems

Test Stair Pressurisation Systems in accordance with AS 1668.1.

19.3.5 Reticulation Systems

Adjust water quantities within the following allowable tolerances:-

a)	Pumps	-	+0% to +20%
b)	Hot water distribution to coils	-	+0% to +10%
c)	Condenser water distribution	-	+0% to +10%
d)	Chilled water distribution to coils	-	+0% to +10%

Balance the systems with control valves fully open. Compute water quantities from the pressure drops across double regulating valves where these are installed. Otherwise, compute water quantities from the pressure drops across control valves using the manufacturer's nominated flow coefficient.

The flow balancing procedure must be configured to ensure that the use of flow restriction in the balancing process is minimised.

Record the test results and submit a report showing the following information.

a) The measured water flow rates, pressure drops across control valves, flow coefficient for each valve and tables/charts as necessary to determine flow from pressure drops.

b) The entering and leaving water temperatures at each item of heating or cooling plant and the calculated heating or cooling capacity.

c) The entering and leaving air temperatures and air quantities across heating and cooling coils in major air conditioning units measured at the same time as item b) and the calculated total cooling or heating capacity.

d) The measured suction and discharge pressures at each pump marked on a copy of the manufacturer's performance curve to show the water quantity delivered.

Verify the duty of all pumps and motors during commissioning. Where the required duty is substantially below the equipment capacity, the equipment should be replaced with equipment of lower capacity or otherwise modified to efficiently deliver the required capacity.

19.3.6 Electrical Systems.

Adjust each thermal overload for 10% above the actual full load current but not more than the rated full load current of the motor.

Submit a report showing the nameplate rating, the measured current draw on each phase and the thermal overload setting for each motor and electric heater.

Where thermistors are used, check the operation of the thermistor and the calibration of the thermistor relay.

19.3.7 Boilers.

Check the boiler capacity by noting the entering and leaving water temperatures when each boiler is operating at its highest firing rate. Calculate the capacity using the water quantity determined in other tests.

Check the CO_2 content of the flue gas and take such corrective action as is necessary to maintain this within the range 10% to 13% under stable, high load conditions of operation or as required by the gas supply authority. Read the flue gas temperature under these conditions and include these readings in the report.

Check boiler control systems and safety devices for correct operation and include set points in the report.

Inspect fire box and smoke box refractory linings for damage during transit and initial firing and include condition in the report.

19.3.8 Cooling Towers

Clean strainers and check the operation of the cooling tower fans, sump thermostats, float valves, chemical dosing/water treatment and bleed off rate and submit test results.

Verify the cooling tower performance against the manufacturers specification and the project requirements.

19.3.9 Chillers

Verify the chiller performance against the manufacturers specification and the project requirements.

19.3.10 Refrigerant Leak Detection

Test that the system detects refrigerant, and generates an alarm signal to the BMCS and starts ventilation system. Submit test results.

19.3.11 Valves and Dampers

Valves and dampers shall be tested to ensure that they provide good control across the full control signal range. This may in some cases require replacement of valves and/or adjustment of control ranges. The effectiveness of closure of all valves and dampers must be verified during commissioning and included in the report.

19.3.12 Flexible Duct

Flexible duct should be checked to ensure that it is not stacked, crushed or bent in too tight a radius and verified in the report. Flexible duct runs should be not more than 6m and no more than 3m on index runs.

19.3.13 Control Systems

Check control systems for correct sequence of operation. Liaise with BMCS sub-contractor to rectify any faults.

Calibrate pressure gauges against a N.A.T.A. certified test gauge as detailed in clause PRESSURE GAUGES. Calibrate thermostats, adjust throttling ranges and set thermostats and other controls to indicate the correct set points.

Submit a report showing actual set points, proportional bands, differentials, operating ranges, make and break points, sequence of operation, etc., for each device installed, together with any other information requested. Devices detailed in the report shall include relevant references to drawings, device number, air handling unit, zone, floor, etc.

Record the time taken for safety thermostats to trip when the setting is exceeded.

19.3.14 Seasonal Testing

Carry out seasonal testing for each stage to ensure the plant is operating correctly in both summer, autumn, winter and spring. Check temperatures within each major zone of the building. Check system operation. Rectify any faults or defects observed.

Include a proposed schedule for seasonal tests in the Commissioning Plan.

19.4 Witness Testing

Full commissioning results must be submitted no less than 5 days prior to arranged witness testing date. If commissioning results are not approved due to unacceptable commissioning figures prior to the date of witness testing, the witness testing date will be moved to no less than 5 days after the resubmission.

19.4.1 Air Handling Systems

Total air flow from each air handling system is to be compared against approved commissioning balance figures during witness testing.

19.4.2 Smoke Control Systems

Smoke Control Systems will require witness testing with full simulated operation and testing in accordance with AS 1668.1.

19.4.3 Stair Pressurisation Systems

Stair pressurisation systems will require witness testing with full simulated operation and testing in accordance with AS 1668.1.

19.4.4 Reticulation Systems

Prior to witness testing of water reticulation systems, the testing method must be verified, and any charts/tables required for interpretation of readings to correlating flows must be submitted.

All pump flows including primary chilled water, secondary chilled water, condenser water and heating hot water are to be compared against approved commissioning balance figures during witness testing.

All central Air Handling Units heating and cooling coils heating hot water and chilled water flow rates are to be compared against approved commissioning balance figures during witness testing.

A minimum of 10% of on floor Fan Coil Units heating hot water and chilled water flow rates are to be compared against approved commissioning balance figures during witness testing.

If an unacceptable number of flow rates to plant cannot be rectified to within flow tolerances immediately, witness testing will immediately cease and the associated plant will be re-commissioned with the test results re-submitted. Witness testing will then be required. Up to two visits for witness testing of the same system will be allowed for. All following visits will be charged at hourly rates at the Contractors expense.

19.4.5 Boilers.

Each boiler capacity is to be witness tested by testing the entering and leaving heating hot water temperatures for each boiler. Capacity is then to be calculated using heating hot water flow rate as measured from the heating hot water pumps associated with each cooling tower.

19.4.6 Cooling Towers

Each cooling tower capacity is to be witness tested by testing the entering and leaving condenser water temperatures for each cooling tower. Capacity is then to be calculated using condenser water flow rate as measured from the condenser water pumps associated with each cooling tower.

19.4.7 Chillers

Each chiller capacity is to be witness tested by testing the entering and leaving chilled water temperature for each chiller. Capacity is then to be calculated using primary chilled water flow rate as measured from the primary chilled water pump associated with each chillers primary circuit.

19.4.8 Valves and Dampers

At least three (3) dampers are to be forced open and closed during witness testing and viewed while operating. While the dampers are closed the damper seal is to be proven using smoke or otherwise.

19.4.9 Flexible Duct

The flexible duct of at least 10% of terminals is to be inspected during witness testing to ensure it is not stacked, bent or crushed.

19.4.10 Control Systems

Full system operation is to be demonstrated during witness testing, including random operation tests such as morning warm up, after hours operation etc.

19.5 System Operational Training and Building Users Guide

Training is to be provided by the Contractor for Building Maintenance Staff to operate the various installations.

To enable Building Maintenance staff to understand the operation and facilities in the building the Contractor shall produce a comprehensive Building Users Guide.

20. PREVENTIVE MAINTENANCE

Itemise the cost of preventive maintenance as a separate price in the tender.

Provide monthly preventive maintenance for twelve months, starting one month after the date of practical completion.

Prior to commencement of the maintenance period, submit a maintenance schedule for appraisal, setting out maintenance procedures and frequencies to ensure trouble free operation and maintain plant operating efficiency. Include the maintenance schedule in the operation and maintenance manuals.

Perform maintenance in accordance with statutory regulations and in accordance with the schedule.

Perform maintenance at times and in a manner which will cause the least inconvenience to the normal operation of the building.

Notify the owner's representative of intent to perform service at least three days prior to each visit. Obtain the representative's signature on a service report at the end of each visit and leave a copy on site. The service report shall detail the work carried out and shall list any adjustments and/or rectification work found to be necessary.

Unsigned reports will not be recognised and the owner, at the end of the maintenance period, may elect to:-

- have additional services carried out to make up the number of signed reports; or
- deduct the cost of disputed visits at the rate of 1/12 of the preventive maintenance sum for each disputed visit.

At least fourteen days before carrying out the final service, request that an inspection be arranged to coincide with this service.

The maintenance schedule shall include the procedures set out in the following preventive maintenance schedule which shall be modified as necessary to cover the maintenance requirements of the actual plant and equipment installed.

20.1 Preventive Maintenance Schedule

20.1.1 Fire Protection Features

Maintain fire protection features of air handling systems in accordance with statutory regulations and AS 1851 Part 6.

20.1.2 Air Handling Units

	Frequency (Months)
a) Maintain air handling systems in accordance with statutory regulations	
b) Inspect the units generally and perform any service work necessary to ensure the correct operation and performance of the plant. Check operation of internal lights and repair as necessary. Check fans for loose belts, excessive noise, excessive motor or bearing temperature. Check for air leakage in flexible duct connections, inspection holes and joints - adjust and repair as necessary. Check filters, coils and drains. Clean if necessary. Check operation of motorised dampers. Rectify if necessary.	4
c) Check and lubricate bearings of fans, motors and motorised dampers in accordance with manufacturer's recommendations. Examine drive belts	6

and pulleys for wear and cracking. Adjust belt tension. Replace belt guards.	
d) Clean off corrosion and paint with anti-corrosive coating.	12

20.1.3 Ventilation Systems

	Frequency (Months)
a) Maintain ventilation systems in accordance with statutory regulations	
b) Inspect the system generally and perform any service work necessary to ensure the correct operation and performance of the plant. Check fans for loose belts, excessive noise, excessive motor or bearing temperature. Check flexible joints for air leaks and repair as necessary. Check that filters are secure with no air by pass. Clean if necessary. Check operation of motorised dampers. Rectify if necessary.	1
c) Check and lubricate bearings of fans, motors and motorised dampers in accordance with manufacturer's recommendations. Examine drive belts and pulleys for wear and cracking. Adjust belt tension. Replace belt guards.	6
d) Clean off corrosion and paint with anti-corrosive coating.	12
e) Inspect kitchen exhaust ducts internally. Clean if necessary.	12

20.1.4 Refrigeration Plant.

	Frequency (Months)
a) Record suction, discharge and oil pressures. Record oil levels in compressors and adjust if necessary. Record refrigerant level. Check for and repair any gas leaks. Check liquid line sight glass. Inspect coil surfaces and clean if necessary.	1
b) Check functioning of operational and safety controls and superheat. Record trip and superheat settings. Leak test the refrigeration system	6
c) Remove water box covers of condensers, clean and inspect tubes, tube plates and water chests. Check cathodic protection system. Change compressor oil and filter. Analyse old oil and report results. Provide new refrigerant drier cores. Lubricate bearings in accordance with manufacturer's recommendations. Check vibration isolators and security of pipe supports.	12

20.1.5 Electrical

	Frequency (Months)
a) Check for correct operation of indicator lights, abnormal noise or vibration of contactors, odour or other signs of electrical faults. Repair if necessary.	1

b) Clean and adjust contacts of circuit breakers, starters and auto-controls. Check tightness of wiring connections. Check and record delay periods of time delays, cut-in and cut-out conditions on pressure and temperature controls. Check operation of overloads and circuit protection devices.	12

20.1.6 Controls

Check calibratable devices at least once during the maintenance period and recalibrate if necessary. Include a list of devices checked at each visit on the service report.

	Frequency (Months)
a) General	
a. Check with building operator for any abnormal operation and correct as necessary.	1
b) Air Compressors	
a. Check operation, noting start/stop pressures and cycle time. Check oil level and top up if necessary.	1
b. Operate safety relief valve. Check that auto-drain is working correctly.	3
c. Check belt drive and adjust if necessary.	6
d. Change oil. Clean or renew air and oil filter elements.	12
c) Dryer and Reducing Station	
a. Observe correct operation and pressures	1
b. Check operation of drains.	3
c. Renew filter elements. Clean dryer condenser coil.	12
d) Pneumatic Controls	
a. Observe gauges. Investigate and correct any abnormal readings.	1
b. Check flexible pipes, connections and valves for leaks. Calibrate central plant controllers.	6
e) Conditioners	
a. Operate control valves and dampers through their full range and confirm correct sequencing. Check correct operation of fan volume controls.	3
f) Master Zones	
a. Check sensor calibration and correct operation of VAV box.	3
g) Non Master Zones	
a. Check space temperature in 1/12th of total zones. Investigate any abnormal temperatures.	1
h) Water Temperature Sensors	
a. Check sensor calibration.	3

i) Digital Controls

a. Workstations

i.	Check back-up battery condition.	3
ii.	Clean disk drive heads.	6

b. Field Processing Units

i.	Inspect internally. Check for obvious defects and correct operation of L.E.D.'s.	1
ii.	Check back-up battery condition.	3
iii.	Internally vacuum clean all equipment and check connectors.	6

c. Uninterruptible Power Supply

i.	Check battery condition.	1
ii.	Isolate normal supply and confirm correct operation.	6

21. OPERATING & MAINTENANCE MANUALS

21.1 Hardcopy Documents

Provide two (2) hard copies of an operating and maintenance manual, written in clear concise English, containing a title page with the supplier's name, address, and telephone number, a table of contents, and the data specified in this clause.

The manual shall be A4 size, printed or typed on durable printing paper, each page consecutively numbered, neatly bound in durable vinyl or similar hard cover, permanently labelled with the project name, details of Consulting Engineer and Mechanical Contractor, and date of issue.

Place diagrams on the same page as the relevant text, or on the facing page, or on gatefold pages at the end of the volume. Provide dividers between sections with plastic-covered labelled tags.

Provide the information necessary for the satisfactory long-term operation and regular maintenance of the installation, including:

Description: Outline description of the installation, and detailed descriptions of equipment items, quoting product names, type and serial numbers, dates of manufacture, etc.;

Maintenance: Recommended maintenance periods and planned preventive maintenance procedures;

Essential Services Maintenance: Provide a separate section covering mandatory maintenance requirements of fire precaution features as determined in AS 1851.6 and AS 1670.

Emergencies: Emergency procedures, including a fault-finding guide;

Manufacturers' literature: Copies of manufacturers' warranties or guarantees, service manuals, brochures, recommendations, etc.;

Technical Details: Provide a detailed technical description of each unit or function, easily understandable by a trained technician not familiar with the equipment, with performance data and illustrations where appropriate. Include the following where applicable:

- Wiring diagrams and control system diagrams.
- Recommendation of spare parts.
- Adjustment instructions for individual items and for the installation as a whole;
- Procedures for dismantling and reassembling the installation.

Testing and Commissioning Results: Provide all commissioning and test data sheets.

Drawings Full Size: A copy of each work-as-executed drawing, equipment drawing, schematic drawing, and the like relevant to the installation. “Work as executed” drawings shall be to a scale of 1:100 minimum with preference for 1:50 or larger, all on the same sized standard sheets. Provide an additional 2 copies of the drawings on Vertiplan B1 Verticlamps.

Drawings A3 Size: An A3 copy of each work-as-executed drawing, equipment drawing, schematic drawing, and the like relevant to the installation.

21.2 Electronic Documents

The contractor shall supply the following electronic documents on disk (2 copies):

- As installed drawings to the Project Managers CAD format requirements and in pdf format.

- An electronic version of the Operation and Maintenance Manual (including scanned/electronic copies all of the information listed above) in pdf format.

These documents shall be copied onto the BMCS hard disk for future reference.

21.3 Timing

Draft maintenance manuals to be provided for approval 6 weeks prior to practical completion.

Final copies of approved maintenance manuals to be provided prior to practical completion.

22. PRACTICAL COMPLETION & DEFECTS LIABILITY

22.1 Practical Completion

The date of practical completion shall be the date of practical completion of the Head Contract. For this purpose the installation or part thereof shall have been placed into commercial operation, or shall have been ready to be used substantially for the purpose for which it is intended. Preliminary operating instructions shall have been provided sufficient to ensure safe and reasonable use of the installation.

Minor works necessary to complete the works including painting, labelling, rectification of minor installation and/or commissioning defects and provision of final operation and maintenance manuals shall be finalised within a reasonable time to be agreed at the time of giving practical completion. Payment of retention money or release of Bank Guarantee due at the date of practical completion will not be authorised until the above minor works are finalised and a certificate has been issued to this effect.

In cases where any of the above minor works are incomplete at the time of practical completion under the Head Contract, the granting of practical completion under the sub-contact will be provisional upon finalisation of the minor work above within the agreed time and shall not diminish the Builder's rights under the sub-contract and Head Contract.

Where the above minor works are carried out while the works are being used or occupied, co-operate with the building occupants to carry out the minor works with minimum interruption and minimum interference.

22.1.1 Defects Liability

The defects liability period for a stage of the works shall be 12 calendar months from the date of issue of a "Certificate of Practical Completion" certifying that stage of the works to be fully completed. Equipment installed in any stage and not put into commercial use at the completion of that stage shall not be included in the defects liability period for that stage.

During the defects liability period, replace or otherwise make good:-

- parts which prove faulty in design, workmanship or material or do not comply with the specified operating conditions and performance.
- damage which results from such defect or from work to remedy such defect and which becomes apparent during the defects liability period.

Provide labour and costs for the removal and replacement of defective parts or components. Adjust and test equipment replaced during the Defects Liability Period to show that the system of which it forms part is giving commercial operation and the replaced items are giving the specified operating conditions and performance. Equipment repaired or replaced during the Defects Liability Period shall have a twelve month defects liability period commencing from the date of acceptance of the replacement. This clause shall apply irrespective of the fact that such part or parts may have been previously accepted.

Where the manufacturers of items of equipment give standard warranty periods in excess of the defects liability period, assign such warranties to the Proprietor prior to final completion.

During the defects liability period perform such rectification work as may be instructed in writing within seven days of such notices or, on failure, the right is reserved to engage others to finish such work without further notice and deduct the costs of same from amounts otherwise due or payable, or to recover such costs if they exceed the amounts due or payable. Such action shall not vitiate any of the responsibilities implied by this specification.

22.2 Final Completion

Final completion shall mean the end of the defects liability period or when defects notified during the defects liability period have been made good, whichever shall last occur.

23. APPENDIX A – MECHANICAL ROOM SUMMARY

Room Name	Description	Ventilation Type	Conditioning Type	Comments	Estimated Population Density (m^2/p) (*)	Estimated Power Density (W/m^2) (**)
Archive Room	Area for records storage.	Mechanical	Heating/Cooling		2	As per final design
Armoury	Fire arms storage & cleaning.	Mechanical	Heating/Cooling		5 People	20
Armoury	Riot control equipment.	Mechanical	Heating/Cooling		5 People	20
Baby Change	A room for parents to wash and change their babies.	Mechanical	Via Makeup Air		1	10
Bathroom	One bathroom in each accommodation pod.	Mechanical			1	6
Battery Room	Space to provide battery storage for uninterrupted power supply to facility.	Mechanical as per AS2676.2	Heating/Cooling		25	10
Bedroom - Dual - Min. Sec.	A bedroom with two inmates.	Natural	Refer to Section 2.7.2 - Inside Design Conditions		10	30
Bedroom - Single Min. Sec.	A bedroom for one inmate.	Natural	Refer to Section 2.7.2 - Inside Design Conditions		10	30
Booking - Legal Visits	Used as a non-contact interview room between inmates and legal counsel.	Mechanical	Heating/Cooling		1	15
Breast Feeding	A room for parents to breast, or otherwise prepare and feed their babies.	Mechanical	Heating/Cooling		1	10

Room Name	Description	Ventilation Type	Conditioning Type	Comments	Estimated Population Density (m^2/p) (*)	Estimated Power Density (W/m^2) (**)
Business Unit - Industries	Supports the provision of industries for inmates.	Hybrid	Heating	Heating: To be assessed on the location of the facility	3	9
Cell - Access	A cell capable to house disabled inmates to AS1428.	Mechanical (90L/s Exhaust, 80L/s Supply Air)	Refer to Section 2.7.2 - Inside Design Conditions	Exhaust fan to double as smoke exhaust fan	8.5	30
Cell - Detox/Form 7	A cell for one or two inmates requiring close supervision.	Mechanical (90L/s Exhaust, 80L/s Supply Air)	Refer to Section 2.7.2 - Inside Design Conditions	Exhaust fan to double as smoke exhaust fan	8.5	30
Cell - Dry	A cell for one inmate without hydraulic fittings.	Mechanical (90L/s Exhaust, 80L/s Supply Air)	Refer to Section 2.7.2 - Inside Design Conditions	Exhaust fan to double as smoke exhaust fan	8.5	30
Cell - Dual - Corner	A cell for two inmates.	Mechanical (90L/s Exhaust, 80L/s Supply Air)	Refer to Section 2.7.2 - Inside Design Conditions	Exhaust fan to double as smoke exhaust fan	8.5	30
Cell - Dual	A cell for two inmates.	Mechanical (90L/s Exhaust, 80L/s Supply Air)	Refer to Section 2.7.2 - Inside Design Conditions	Exhaust fan to double as smoke exhaust fan	8.5	30
Cell - Holding - Access	A secure room for a disabled inmate.	Mechanical (90L/s Exhaust, 80L/s Supply Air)	Refer to Section 2.7.2 - Inside Design Conditions		8.5	30
Cell - Holding - Glazed Fronted	A secure room for one or more inmates at reception or court cells.	Mechanical (90L/s Exhaust, 80L/s Supply Air)	Refer to Section 2.7.2 - Inside Design Conditions	Tempered Air: A/C in court cells	8.5	30
Cell - Holding - Transit	A secure room for one or more inmates. Shower facility included.	Mechanical (90L/s Exhaust, 80L/s Supply Air)	Refer to Section 2.7.2 - Inside Design Conditions		8.5	30

Room Name	Description	Ventilation Type	Conditioning Type	Comments	Estimated Population Density (m^2/p) (*)	Estimated Power Density (W/m^2) (**)
Cell - Holding - With Shower	A secure room for one or more inmates. Shower facility included.	Mechanical (90L/s Exhaust, 80L/s Supply Air)	Refer to Section 2.7.2 - Inside Design Conditions		8.5	30
Cell - Holding	A secure room for one or more inmates.	Mechanical (90L/s Exhaust, 80L/s Supply Air)	Refer to Section 2.7.2 - Inside Design Conditions		8.5	30
Cell - Management	A cell for one or two inmates requiring close supervision.	Mechanical (90L/s Exhaust, 80L/s Supply Air)	Refer to Section 2.7.2 - Inside Design Conditions	Exhaust fan to double as smoke exhaust fan	8.5	30
Cell - Protection - Dual	A cell for two inmates.	Mechanical (90L/s Exhaust, 80L/s Supply Air)	Refer to Section 2.7.2 - Inside Design Conditions	Exhaust fan to double as smoke exhaust fan	8.5	30
Cell - Protection - Single	A cell for one inmate.	Mechanical (90L/s Exhaust, 80L/s Supply Air)	Refer to Section 2.7.2 - Inside Design Conditions	Exhaust fan to double as smoke exhaust fan	8.5	30
Cell - Safe	A cell for two inmates requiring close supervision.	Mechanical (90L/s Exhaust, 80L/s Supply Air)	Refer to Section 2.7.2 - Inside Design Conditions	Exhaust fan to double as smoke exhaust fan	8.5	30
Cell - Segregation	A cell for one inmate.	Mechanical (90L/s Exhaust, 80L/s Supply Air)	Refer to Section 2.7.2 - Inside Design Conditions	Exhaust fan to double as smoke exhaust fan	8.5	30
Cell - Single	A cell for one inmate.	Mechanical (90L/s Exhaust, 80L/s Supply Air)	Refer to Section 2.7.2 - Inside Design Conditions	Exhaust fan to double as smoke exhaust fan	8.5	30
Change/Search Cubicle	Alcove for inmates to change and for conducting inmate search.	Mechanical	Heating/Cooling		2	10

Room Name	Description	Ventilation Type	Conditioning Type	Comments	Estimated Population Density (m^2/p) (*)	Estimated Power Density (W/m^2) (**)
Circulation - Inmate Accom.	External corridor for inmates entering/departing Accommodation block.	Natural				
Circulation - Internal Corridor	Secure internal corridor for inmate movement.	Mechanical	Heating/Cooling		1.5	8
Circulation - Movement Control	Secure corridor to unit that serves support services.	Natural			1.5	8
Circulation - Visits Corridor	Inmate corridor to non-contact visits.	Mechanical	Heating/Cooling		1.5	8
Circulation - Visitors Corridor	Visitor corridor to non-contact visits.	Mechanical	Heating/Cooling		1.5	8
Clean Linen Store	Storage area for clean laundry items.	Mechanical	Heating/Cooling		3.5	10
Clean Utility	Clean utility.	Mechanical			3.5	5
Cleaner	Cleaners room.	Mechanical			1	5
Communications Cupboard	Provides a secure and temperature controlled space for the housing of IC&T and security equipment	Mechanical	Cooling (100% Redundancy)	Ventilation: 24 hour operation	1 Person	As per final design
Conference Room	A room for meetings of up to 18 people.	Mechanical	Heating/Cooling		1	As per final design
Control Room	Centre for monitoring, control & surveillance of complex	Mechanical	Heating/Cooling	Ventilation: 24 hour operation - stand alone system	2.5	As per final design

Room Name	Description	Ventilation Type	Conditioning Type	Comments	Estimated Population Density (m^2/p) (*)	Estimated Power Density (W/m^2) (**)
Cool Room - Bulk Food	Refrigerated storage of meat and smallgoods.		Cooling	Cooling: (+)2 °C temp. data logging		
Cool Room - Dispatch	Refrigerated storage of meat and smallgoods.		Cooling	Cooling: (+)2 °C temp. data logging		
Cool Room - Fruit & Veg	Refrigerated storage of meat and smallgoods.		Cooling	Cooling: (+)2 °C temp. data logging		
Cool Room - Meat Goods	Refrigerated storage of meat and smallgoods.		Cooling	Cooling: (+)2 °C temp. data logging		
Cool Room - Milk & Dairy	Refrigerated storage of meat and smallgoods.		Cooling	Cooling: (+)2 °C temp. data logging		
Cool Room - Preparation	Refrigerated storage of meat and smallgoods.		Cooling	Cooling: (+)2 °C temp. data logging		
Crate/Trolley Wash & Store	Crate & trolley wash/empty bread and milk crate storage.	Mechanical	Evaporative Cooling from adjacent kitchen		5	20
Dayroom - Protection	A space outside the cell for movement and daytime use by selected inmates.	Hybrid	Heating/Cooling		5	20
Dayroom - Segregation	A space outside the cell for movement and occasional daytime inmate use.	Hybrid	Heating/Cooling		5	20

Room Name	Description	Ventilation Type	Conditioning Type	Comments	Estimated Population Density (m^2/p) (*)	Estimated Power Density (W/m^2) (**)
Dayroom - (Max. Security)	Large central, communal living space.	Hybrid	Heating/Cooling		5	20
Dental Suite	Dental clinic	Mechanical	Heating/Cooling	Conditioning: Ability to adjust room temp. to lower setting than other rooms.	5	As per final design
Dining - Living - Kitchen (Min. Security)	A shared open space for the residents of the unit.	Mechanical	Heating/Cooling		5	20
Dirty In	Containment area for soiled laundry items.	Mechanical	Heating/Cooling	Spillage from laundry area	3.5	15
Dirty Utility (Sterile Room)	A room to clean and sterilise dental equipment.	Mechanical	Heating/Cooling		3.5	15
Dispatch Clean	Dispatch area for clean laundry items.	Mechanical	Heating/Cooling	Spillage from laundry area	3.5	15
Dispensary (Awaiting Review)	Drug dispensing room with no windows apart from a service window.	Mechanical	Heating/Cooling		3	20
Dog Food Preparation	Dog food and bait preparation room.	Mechanical	Heating/Cooling		3.5	15
Dog Kennel	Dog kennel	Natural				
Dog Wash	Dog wash bay	Natural				

Room Name	Description	Ventilation Type	Conditioning Type	Comments	Estimated Population Density (m^2/p) (*)	Estimated Power Density (W/m^2) (**)
Drug Dispensing Room	A room to dispense medication.	Mechanical	Heating/Cooling	Stand alone system	3	20
Entry - Visitors to Visits Building	Visitors entry/exit corridor	Mechanical	Heating/Cooling		2.5	20
Entry - Waiting - Clinic	Waiting area to clinic use	Mechanical	Heating/Cooling		1.5	10
Entry Corridor	Entry and corridor to internal rooms.	Mechanical	Heating/Cooling		1.5	10
Entry Lock - Visits Area	Security lock before entry into inmate processing and change areas in visits.	Mechanical	Heating/Cooling		1.5	10
Equipment Room	Equipment room for the control room.	Mechanical	Heating/Cooling	Independent 24 hr operating A/C units within the room	2	As per final design
Female Inmate Search/Shower	Search and shower room.	Mechanical	Heating/Cooling		2	10
Female SHR/WC	Female showers and toilets.	Mechanical				
Foyer - Administration	Waiting for official visitors.	Mechanical	Heating/Cooling		3.5	15
Foyer - Business Unit	An entry foyer and muster space for each workshop.	Hybrid			3.5	15
Foyer - Inmate Visitors	Entry for inmate visitors.	Mechanical	Heating/Cooling	Timed to suit operating hours	2.5	20
Foyer - Staff & Official Visitors	Entry for staff and official visitors.	Mechanical	Heating/Cooling		2.5	20

Room Name	Description	Ventilation Type	Conditioning Type	Comments	Estimated Population Density (m^2/p) (*)	Estimated Power Density (W/m^2) (**)
Freezer Room	Storage of frozen goods.		Cooling	Cooling: (-)25 – 18 °C temp. data logging.	10	10
Garbage Area	Bin storage area	Mechanical				
General Manager's Assistant Office	Admin office to GM	Mechanical	Heating/Cooling		10	15
General Manager's Office	Secure office for General Manager, occasional meetings for up to 6 people.	Mechanical	Heating/Cooling		10	15
Gym	Staff gym	Mechanical	Heating/Cooling		3.5	15
IDS - Aboriginal Resource Room	Meeting room	Mechanical	Heating/Cooling		1	10
IDS - Arts & Crafts	Learning space for wet and dry activities.	Mechanical			3.5	15
IDS - Chapel Space	Meeting room for religious purposes.	Mechanical	Heating/Cooling		0.6	10
IDS - Classroom - Group Room	General learning space	Mechanical	Heating/Cooling		3.5	10
IDS - Computer Classroom	Learning space	Mechanical	Heating/Cooling		3.5	As per final design
IDS - Gymnasium	Inmate gym - open and mesh sides.	Natural				
IDS - Library	Inmate library	Mechanical	Heating/Cooling		5	15
IDS - Multipurpose	Flexible learning space	Mechanical	Heating/Cooling		2	15

Room Name	Description	Ventilation Type	Conditioning Type	Comments	Estimated Population Density (m^2/p) (*)	Estimated Power Density (W/m^2) (**)
Inmate Property Store	Storage for inmate property.	Mechanical	Heating/Cooling		10	20
Inmate Valuables Store	Inmate valuables store	Mechanical	Heating/Cooling		10	20
Interview - Justice Health	Staff/inmate interview room	Mechanical	Heating/Cooling		3	15
Interview - Police Charge Room	A space within the Booking area where the Police can charge an offender.	Mechanical	Heating/Cooling		3	20
Interview - Visits	Staff/inmate interview room	Mechanical	Heating/Cooling		3	20
Interview Room	Staff/inmate interview room	Mechanical	Heating/Cooling		3	20
IT Room - Store	IT storeroom	Mechanical	Cooling (100% Redundancy)	24 hour operation	1 Person	As per final design
Key Issue/Return	Security lock with key, radio, and duress storage	Mechanical	Heating/Cooling		5 People	20
Key Room	Secure store and work room	Mechanical	Heating/Cooling		5 People	20
Kiosk/Kitchenette	Food servery	Mechanical	Heating/Cooling		3.5	20
Kitchen	Staff amenities kitchen	Mechanical	Heating/Cooling		3.5	20
Laundry - Booking	Laundry for inmate court clothes.	Mechanical		Ventilation: Direct exhaust to clothes dryer	10	As per final design

Room Name	Description	Ventilation Type	Conditioning Type	Comments	Estimated Population Density (m^2/p) (*)	Estimated Power Density (W/m^2) (**)
Laundry/Cleaner Max. Sec. Acc.	Laundry and cleaning facilities.	Mechanical			10	As per final design
Laundry/Cleaner Min. Sec. Acc.	Laundry and cleaning facilities.	Mechanical		Ventilation: Direct exhaust to clothes dryer	10	As per final design
Laundry	Laundry for 600 inmate facility.	Mechanical		Ventilation: Exhaust to dryers, clean-to-dirty air flow (refer AS4146)	10	As per final design
Lunch Room - Kit & Ldry - Inmates	Lunch room for inmates	Mechanical	Heating/Cooling		3.5	20
Lunch Room - W'Shops - Inmates	Inmate lunch room (can also be used as a training room)	Mechanical	Heating/Cooling		3.5	20
Male SHR/WC	Male showers and toilets	Mechanical				
Multi-Use Room	A large multi-purpose space for inmates	Mechanical	Heating/Cooling		2	10
Nap Room	Small bedroom for children	Mechanical	Heating/Cooling		10	10
Office - Area Manager	Office space	Mechanical	Heating/Cooling		10	15
Office - Bail Payment & Deposits	Secure office	Mechanical	Heating/Cooling		10	15
Office - Business Unit	Office space for a small single workshop or a large office to oversight two adjoining workshops	Mechanical	Heating/Cooling		10	15

Room Name	Description	Ventilation Type	Conditioning Type	Comments	Estimated Population Density (m^2/p) (*)	Estimated Power Density (W/m^2) (**)
Office - Chapel	Office Space	Mechanical	Heating/Cooling		10	15
Office - Clerical - Business Unit	Office Space	Mechanical	Heating/Cooling		10	15
Office - Clerical - MGR. of Industries	Office Space	Mechanical	Heating/Cooling		10	15
Office - Consulting (Awaiting Update)	Provides an office for confidential medical consultation between an inmate and staff of medical specialist.	Mechanical	Heating/Cooling		10	15
Office - Dual	Office space	Mechanical	Heating/Cooling		10	15
Office - General	Area for general clerical duties	Mechanical	Heating/Cooling		10	15
Office - Gym	Secure officer post	Mechanical	Heating/Cooling		10	15
Office - Kitchen & Laundry	Office space	Mechanical	Heating/Cooling		10	15
Office - Large	Office space	Mechanical	Heating/Cooling		10	15
Office - Librarian	Office space	Mechanical	Heating/Cooling		10	15
Office - Manager of Industries	Office space	Mechanical	Heating/Cooling		10	15
Office - Night Senior & Officer Post	Senior Officer room and movement control post.	Mechanical	Heating/Cooling	Separate 24 hour operation	10	15
Office - Nurses Station	Nurses' station/office	Mechanical	Heating/Cooling		10	15

Room Name	Description	Ventilation Type	Conditioning Type	Comments	Estimated Population Density (m^2/p) (*)	Estimated Power Density (W/m^2) (**)
Office - Records	Data entry space	Mechanical	Heating/Cooling		10	15
Office - Store	Large office	Mechanical	Heating/Cooling		10	15
Office - Warrants	Office space for up to 3 staff	Mechanical	Heating/Cooling		3 People	15
Office - Welfare	Office space	Mechanical	Heating/Cooling		10	15
Office	Office space	Mechanical	Heating/Cooling		10	15
Officer Post - Booking	Open office area with counters for the processing of inmates and their property and the issue of prisoners clothing.	Mechanical	Heating/Cooling		5	15
Officer Post - Gatehouse Staff Entry	Secure officer post	Mechanical	Heating/Cooling	24 hour operation	5	15
Officer Post - Gatehouse Visitor Entry	Open officer post	Mechanical	Heating/Cooling		5	15
Officer Post - Movement Control	Officers' control post	Mechanical	Heating/Cooling		5	15
Officer Post - Open	Officers' open control post	Mechanical	Heating/Cooling		5	15
Officer Post - Visitor Entry	Officer post	Mechanical	Heating/Cooling		5	15
Officer Post	Officers' control post	Mechanical	Heating/Cooling		5	10

Room Name	Description	Ventilation Type	Conditioning Type	Comments	Estimated Population Density (m^2/p) (*)	Estimated Power Density (W/m^2) (**)
Officer Post - Retreat	Officers' control post retreat	Mechanical	Heating/Cooling		5	15
Plant Room - Services	Air conditioning plant room	Natural				
Procedure Treatment (Awaiting Update)	Accident and emergency room to do minor procedures.	Mechanical	Heating/Cooling		10	20
Processing - Entry Lock (XRAY) Staff and Visitor Areas	Two separate secure spaces where staff/official visitors and inmate's visitors are screened prior to gaining access into the centre.	Mechanical	Heating/Cooling		2.5	As per final design
Processing Area - Booking	Inmate circulation	Mechanical	Heating/Cooling		2.5	15
Reception - Administration	Staff reception area and counter	Mechanical	Heating/Cooling		3.5	15
Reheating/Retherm Area	Re-therm (reheating) area to AS4674	Mechanical Commercial Exhaust			3.5	10
Sandwich Plating	Portioning of bulk food into individual meal trays and production of sandwiches.		Cooling	Room to be maintained at 18±1.5°C	3.5	25
Search - Business Unit	Inmate search area	Mechanical			2	15
Search Cubicle - Booking	Alcove for conducting inmate search.	Mechanical	Heating/Cooling		2	10
Secure Lock	Dog circulation area	Natural				

Room Name	Description	Ventilation Type	Conditioning Type	Comments	Estimated Population Density (m^2/p) (*)	Estimated Power Density (W/m^2) (**)
Services - Elect. Distribution Board	Electrical distribution board cupboard	Mechanical	Cooling	24 hour operation		As per final design
Services - Fire Hose Reel	Fire hose reel cupboard					
Sick Ward - Clinic (2 Bed)	Sick bay ward for two inmates	Mechanical	Heating/Cooling		5	15
Sick Ward Ensuite	An ensuite bathroom for the 2 bed sick ward.	Mechanical	Via makeup air			
Sitting Area	A sitting area for parents.	Mechanical	Heating/Cooling		5	10
Staff Facilities - Staff Room	Staff lunchroom	Mechanical	Heating/Cooling		2.5	20
Staff Facilities - Tea Making	Staff tea preparation area	Mechanical			2.5	20
Staff Locker Room	Staff locker room	Mechanical	Heating/Cooling		2.5	20
Staff Room	Staff amenities	Mechanical	Heating/Cooling		2.5	20
Store - Accom. - Max. Sec.	Secure store	Mechanical				
Store - Chapel	Store room	Mechanical				
Store - Chemical	Storage of chemicals for laundry use.	Mechanical				
Store - Command	Area for storing command post equipment.	Mechanical				
Store - Dry Goods	Storage area for goods not requiring to be refrigerated.	Mechanical		Ventilation to current health standards		
Store - External - Max. Sec.	A store for sports equipment.	Natural				

Room Name	Description	Ventilation Type	Conditioning Type	Comments	Estimated Population Density (m^2/p) (*)	Estimated Power Density (W/m^2) (**)
Store - General Use	General storeroom	Mechanical				
Store - Gym	Store for the gymnasium.	Natural				
Store - Medical Records	Storeroom for files with workspace.	Mechanical	Heating/Cooling			
Store - Pharmacy	Pharmacy store	Mechanical	Heating/Cooling	Cooling: 24 hour operation - maintained below 25°C	5	15
Store - Pottery	Store room	Hybrid				
Store - Resource	Store room	Mechanical				
Store - Tools	A secure tool store to hold tools and equipment for the workforce in each business unit.	Natural				
Toilet - Inmate	Inmate toilet	Mechanical				
Toilet - Officer	Officer toilet	Mechanical				
Toilet - Staff	Staff toilet	Mechanical				
Toilet - Visitor	Visitor toilet	Mechanical				
Toilet - Access	Access toilet for disabled.	Mechanical				
Toilet - Inmates - Industries	Inmate toilet area	Mechanical				
Toilet/Lockers - Inmate - Food Services & Laundry	Inmate toilet and change room.	Mechanical				
Toilets - Female Visitors	WC facility for female visitors.	Mechanical				
Toilets - Male Visitors	WC facility for male visitors.	Mechanical				
Toilet/Shower - Access - Inmate	Access toilet and shower for disabled.	Mechanical				

Room Name	Description	Ventilation Type	Conditioning Type	Comments	Estimated Population Density (m^2/p) (*)	Estimated Power Density (W/m^2) (**)
Toilet/Shower - Access - Staff	Access toilet and shower for disabled.	Mechanical				
Training/Command	A room for training, lectures and meetings of up to 9 people.	Mechanical	Heating/Cooling		3.5	15
Urinalysis	Sample gathering and testing room.	Mechanical	Heating/Cooling		5	15
Utility Room	Store room for resources.	Mechanical	Heating/Cooling		2	10
Vehicle Lock	Area for searching of vehicles entering the centre.	Mechanical to AS1668.2		Ventilation: Exhaust for vehicle fumes		
Vehicle Wash Bay	Vehicle wash area	Natural				
Video Conferencing, Court Studio	Soundproof interview room with video technology.	Mechanical	Heating/Cooling		1.5	As per final design
Video Conferencing, Professional Studio	Small soundproof phone booth	Mechanical	Heating/Cooling		1.5	As per final design
Video Equipment	Access corridor for equipment access	Mechanical	Heating/Cooling		1.5	As per final design
Video Reception	Small officer post to supervise the video link process.	Mechanical	Heating/Cooling		2.5	As per final design
Visiting - Children's Play Area	A play area for children.	Mechanical	Heating/Cooling		2	10

Room Name	Description	Ventilation Type	Conditioning Type	Comments	Estimated Population Density (m^2/p) (*)	Estimated Power Density (W/m^2) (**)
Visiting - Contact Visiting Area	Indoor area where inmates and their visitors can mix.	Mechanical	Heating/Cooling		100-200 People	20
Visiting - Dress	Inmate change area	Mechanical	Heating/Cooling		2	10
Visiting - Monitor Room	A secure room	Mechanical	Heating/Cooling		1.5	As per final design
Visiting - Non Contact	Used as non contact between inmates and visitors.	Mechanical	Heating/Cooling		2	20
Visiting - Secure Visit	Secure visiting room.	Mechanical	Heating/Cooling		2	20
Visiting - Undress	Inmate change area.	Mechanical	Heating/Cooling		2	10
Visitor Exit Lock	Security lock for visitor exit	Mechanical	Heating/Cooling		2	10
Visitor Waiting - Gatehouse	Waiting area for visitors after processing	Mechanical	Heating/Cooling		2.5	10
Waiting Area - Health	A semi-open holding space in which to secure inmates.	Mechanical	Heating/Cooling		2.5	10

Room Name	Description	Ventilation Type	Conditioning Type	Comments	Estimated Population Density (m^2/p) (*)	Estimated Power Density (W/m^2) (**)
XRAY Operator - Health Care (Awaiting Update)	Room adjacent to X-ray procedure room (*with direct visibility to patient(inmate) within the adjacent X-ray procedure equipment*) for remote control of X-ray equipment and for processing of CR plates, image QA functions, review and other clerical duties.	Mechanical	Heating/Cooling		5	As per final design

(*) To be confirmed during detailed design

(**) To be confirmed during detailed design

TENDER FORM 1

Tender form for the Mechanical Services for:

Correctional Facilities Performance Specification

(INSERT CORRECTIONAL FACILITY NAME HERE)

We, the undersigned, hereby tender for the supply, delivery, installation, commissioning and testing of the Mechanical Services for Correctional Facilities Performance Specification in accordance with Northrop Consulting Engineers' specification no. NL180226-HM02 revision A, dated 04.04.2018.

We unconditionally guarantee the performance of the installation and completion of the works in accordance with this specification, accompanying drawings and statutory regulations.

Itemised Lump Sum Tender Price: .....
(Dollars, in words)

$ ..... (including GST)

Tenderer Name: .....

Tenderer Address: .....

.....

Signed: ..... Date: .....

This tender shall be valid for sixty (60) days following this date.

TENDER FORM 2

The amounts included in the Lump Sum Tender Price, including overhead costs and profit margins, are as follows:

Lump Sum Tender Prices

a)	Provision of DX Air conditioning systems	$_____
b)	Provision of Indirect Evaporative Coolers	$_____
c)	Provision of Indirect Ducted Gas Furnaces	$_____
d)	Provision of ductwork	$_____
e)	Provision of ductwork insulation	$_____
f)	Provision of refigerant pipework incl. fittings	$_____
g)	Provision of pipework insulation	$_____
h)	Provision of pipework sheathing	$_____
a)	Provision of fans	$_____
b)	Provision of dampers	$_____
c)	Provision of security grilles	$_____
d)	Provision of security cages	$_____
e)	Provision of grilles/diffusers	$_____
f)	Electrical	$_____
g)	Painting	$_____
h)	Commissioning	$_____
i)	Design	$_____
j)	12 months tuning and final (Paid progressively)	$_____
k)	Maintenance and Warranty (Paid progressively)	$_____
l)	Provision of shop & 'as installed' drawings	$_____
m)	Provision of operating & maintenance manual	$_____
n)	Associated building works	$_____
o)	Cranage, hoisting and the like	$_____
p)	BMS	$_____
q)	Others (please list)	$_
		_____GST
		$_____
	Total Tender Price	$_____

Total Tender Price (in words)___

_____

Tenderer Name:.....

Signed: ..... Date: .....

TENDER FORM 3

Manufacturers Proposed

Item of Equipment	Manufacturer, Supplier or Subcontractor	Range or type	Model No.
Evaporative Coolers			
Gas Heaters			
DX Air conditioning systems			
Fans			
Heat Exchangers			
Pipework Insulation			
Ductwork Insulation			
General Grilles and Diffusers			
Specialist Grilles and Diffusers			
Volume Control/Fire Dampers			
Circuit Breakers (MCC)			
Motor Control Centres/Switchgear			
BMCS Controls/DDC System			

Tenderer Name:.....

Signed: ..... Date: .....