6 BRINDABELLA CIRCUIT

BUILDING USERS' GUIDE

BRINDABELLA BUSINESS PARK

Canberra Airport, ACT 2609

Date of Practical Completion: June 2022

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Number	Date	Description
0	27/5/2022	First draft for review
1	14/9/2022	Second draft, amended for review

BRINDABELLA BUSINESS PARK

ConstructionControl

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EXECUTIVE SUMMARY

This guide has been developed to enable the 6 Brindabella Circuit users, occupants and tenant representatives to access information with regards to the building systems, facilities, transport options and the Brindabella Business Park's infrastructure to help ensure that the building operates according to the design intent.

6 Brindabella Circuit is located within the Brindabella Business Park at the Canberra International Airport. The site infrastructure has been spaced to allow for open communal areas such as Restaurant facilities and sporting fields.

6 Brindabella Circuit consists of two six-storey buildings; North Building and South Building, each measuring approximately 10,000m². Each building has a central atrium with glass backed lifts, glazed communication stairs and walkways to connect all occupants of both buildings.

6 Brindabella Circuit's Mechanical, Electrical and Hydraulic systems are at the front line in green building.

The Mechanical system comprises of a heating hot water, chilled water and condenser water system serving air handling units, water cooled packaged air conditioning units and variable volume terminal units to provide air conditioning to the building. The ventilation system is comprised of carpark ventilation systems, general exhaust systems, toilet exhaust systems and fire safety systems.

The Electrical system features high efficiency fittings powered by a Dali lighting control system which is programmable for automatic operation. The Hydraulic system utilises AAA rated fixtures and fitting along a recycled grey water system for the flushing of toilets and urinals and supply to the floor waste charging solenoids.

Although the building has been designed to comply with environmental standards, the Tenants play an important role in ensuring that these targets are met in practice. In particular, energy and water consumption, levels of waste production and transport related greenhouse gas emissions are greatly influenced by the way in which a building's occupants use the building and/or facilities. This guide also explains ways by which users and tenants can ensure that the building continues to operate efficiently and sustainably.

SECTION 1: ENERGY & ENVIRONMENTAL STRATEGY

SECTION 1.1: Overview

6 Brindabella Circuit is set to achieve 5 Star Green Star - Design and As Built rating using the Version 1.3 rating tool and WELL Core v2 Gold Certification under the WELL Building Standard v2 certification tool.

The building performance against Energy Efficiency in Government Operations (EEGO) policy requirements have been reviewed and analysis demonstrates that a NABERS 5.5 Star Base Building Energy rating and a NABERS 4.5 Star Base Building Water rating can be achieved with the building operating as per the FRB, which is deemed compliant with this policy.

The FRB requires a NABERS Energy Rating of 5 Star in design and operation.

SECTION 1.2: Building Design Features

6 Brindabella Circuit incorporates a number of sustainability initiatives which serve to reduce the project's impact on the environment and reduce energy usage / minimise the costs associated with the running of the building. These are detailed within the Green Star Design & As-Built Appraisal Report (Appendix A), key elements are briefly discussed below.

SECTION 1.3: Emissions

A building generates carbon emissions and pollution to the water course or atmosphere throughout its materials procurement, construction and on-going operation. The project design of 6 Brindabella Circuit aims to reduce these emissions at various stages by adopting the following design initiatives.

Refrigerant Emissions: The refrigerant used has low Ozone Depletion Potential and is monitored by a refrigerant leak detection to alarm occupants in the event of a leak to the system.

Stormwater: Stormwater discharged from site meets specified pollution targets.

Light Pollution: Outdoor lighting complies with AS 4282:1997, and light trespass upward and across the project boundary has been minimised.

Microbial Control: The building heat rejection systems have been designed to include control measures to prevent Legionella.

SECTION 1.4: Water Efficiency and Recycling Features of the Building

Fixtures and fittings that reduce potable water consumption have been used throughout the project for all water basins, water closets and shower heads. By utilising these fittings, the occupant amenity potable water efficiency will be equivalent to high efficiency WELS ratings as defined under the Water Efficiency Labelling & Standards (WELS) scheme.

Water meters have been provided to monitor water consumption.

Rainwater tanks are installed to collect and reuse rainwater.

Drip irrigation with moisture sensors is installed to minimise irrigation wastage of water.

SECTION 1.5: Indoor Environmental Quality

The quality of the indoor working environment is an important aspect of building design. Ensuring high quality indoor environments leads to happier, healthier occupant who are more productive. The design targets a number of IEQ design strategies which provides the Building User with methods to control their comfort and wellbeing, such as:

1. Blinds
    - Provision of blinds to external windows reduces daylight glare.
2. Lighting Control
    - Occupants are provided with individual control of lighting.
3. Air Conditioning
    - High level of fresh air in the mechanical system;
    - High thermal comfort of occupants through the bespoke design of mechanical services systems.

The design strategies incorporates the use of the following for the Building User's comfort and wellbeing:

1. Used paints with low VOC contents;
2. Used sealants and adhesives with low or no VOC content.

SECTION 1.6: Transport

6 Brindabella Circuit is located in the centre of Brindabella Business Park, adjacent to the Canberra Airport and provided a number of strategies to discourage the use of single-occupant vehicle for commuting as this has a significant impact on the environment in terms of emissions and reliance upon fossil fuels. The design incorporates the following strategies:

- Reduced number and small car parking spaces
- Secure bicycle parking is provided
- Site is accessible to Public Transport

SECTION 1.7: Tenant Environmental Impact Reduction

To ensure that energy targets and environmental strategies are met, it is essential that tenants have an active role in the efficient running and maintenance of 6 Brindabella Circuit.

The following initiatives should be undertaken by the tenant;

- Using energy efficient office equipment, (PC screens, printers, photocopiers, etc.). Ensure printers and photocopiers have power saving modes.
- Implementing strategies that prevent tenant supplementary cooling/heating systems from operating unnecessarily. This can be achieved through giving accurate occupation times of the building or run on timers. Out of hours HVAC control is via a web-based control system connected to the Building Management and Control System (BMCS). Please refer to Appendix A for the BMCS Functional Description.
- The adoption of a rigorous maintenance programme that ensures ductwork is kept clean and filters regularly changed, and that testing of the HVAC system is conducted. This may cause minor disruptions on a monthly to quarterly basis.
- Turning off computers and electronic equipment at the end of the day.
- Closing doors to office and meeting areas to reduce demand on the mechanical heating/cooling system.

SECTION 2: MONITORING & TARGETING

Energy monitoring meters have been installed within 6 Brindabella Circuit to enable energy consumption to be monitored, and compared to targets. When the targets are exceeded, it is expected that these meters will assist with identifying the cause. The following extract from the Atelier 10 NABERS IDR Report, Revision 5, May 2022, the following energy targets can be assumed:

Table 1.1 Building Performance

Energy Breakdown	Total Values		Normalised to NLA	Total Energy Consumption
	Electricity (kWh/yr)	***Diesel (L)***	Electricity(kWh/m2/yr)	***(MJ/yr)***
Common Area Lighting	14,694	-	0.76	52,898
Carpark Lighting	25,574	-	1.33	92,065
Exterior Lighting	3,958	-	0.21	14,250
Heating	202,687	-	10.50	729,672
HVAC cooling Energy	129,528	-	6.71	466,299
HVAC heat rejection	0	-	0.00	0
HVAC Pumps	91,961	-	4.77	331,060
HVAC Fans	203,210	-	10.53	731,558
Miscellaneous Fans	65,616	-	3.40	236,217
Vertical Transportation	132,472	-	6.87	476,898
Tenant Supplementary Cooling	27,399	-	1.42	98,636
Base Building Split Systems	9,797	-	0.51	35,271
Domestic Hot Water	105,753	-	5.48	380,710
Generator	17,520	-	0.91	63,072
Safety, Security & Emergency	65,700		3.41	236,520
Diesel use (generator & fire pump)		300		10770
TOTAL ENERGY USE	**1,095,868**	**10,770**		**987,078 kg CO_2/yr**
% of energy use	**99.75%**	**0.25%**		
On-site Renewable	**212,193**	-		**190,970 kg CO2/yr**
Building Energy minus Renewables	**883,675**	**10,770**		**796,105 kg CO2/yr**
NABERS 5 Star Baseline	**971,000**	**7,970**		**874,490 kg CO2/yr**

Based on the estimated energy consumption of the combined base building services using dynamic energy modelling and the calculated energy intensity (with sufficient buffers) presented in the table above, the project is expected to achieve a **minimum NABERS Energy rating of 5 Stars.**

NABERS Estimated Energy Ratings	*Estimated Values*
Base Building	**5 Star**
% Improvement over target rating	**26%**

SECTION 2.1: Metering

6 Brindabella Circuit is committed to ongoing energy monitoring. As required by Green Star, a commissioning agent will manage the monitoring of energy use for a period of 12 months. The monitoring of meters will then need to be undertaken by another party.

It is recommended that the Tenant nominates one employee to be responsible for the monthly collection and analysis of data. As all the meters are connected to the BMS this will be a simple task. Following is a brief summary of the steps that will be required for monitoring energy usage:

- Read the calculation tables from the BMS.
- Calculate the energy used since the last meter reading, by subtracting the previous meter reading from the current one.
- Compare the energy used with the “monthly” target column.
- Try and identify potential causes for any discrepancies. These may include:
- Occupancy hours were different to those allowed for in the computer model.
- High external temperatures (this is only relevant to the computer room) as it will cause increased air-conditioning usage.
- Office unoccupied (i.e. over Christmas and Easter break).
- Equipment (such as computers) left on unnecessarily.
- If necessary, seek assistance from project manager.
- Share the above findings with Managers and other staff, and set new targets. Strive for continual improvement, not just achievement of static targets.

SECTION 3: BUILDING SERVICES

SECTION 3.1: Mechanical

SECTION 3.1.1: Energy & Environmental Strategy

The 6 Brindabella Circuit building has been equipped with passive and active energy saving features in the building and building services.

The passive energy strategy incorporated in the building design includes:

- Building fabric with satisfactory R insulation values for less energy loss/gain from outside (external walls, roof and under-slab spaces), and
- Window shading and glass qualities to reduce the solar energy influence.

The active energy strategy measures include:

- Economy cycle for building air-conditioning and ventilation system. Use full outdoor air whenever the ambient conditions are cool enough to contribute to treating the indoor heat load requirements.
- Adjustable supply air temperature and adjustable chilled and heating hot water temperature in accordance to the ambient conditions. Fully automated facility changing the set points in accordance to the required cooling/heating capacity.
- Variable speed drives for motors energizing fans and pumps to reduce the energy consumption in partial load whenever the full capacity of the equipment is not required.
- Variable air volume system using a variable volume of supply air for meeting the indoor conditions in spaces with different cooling/heating requirements. Allows reduction of the supply air volume in spaces where full heating/cooling capacity is not required.
- Air distribution infuser technology (induction diffuser) which will provide greater ventilation rates by inducing the return air with a lower volume of primary air. Less primary air equals to less fan energy required.

The overall environmental impact of the mechanical services as per the above description will result in energy savings.

The total energy rating of the building has been modelled as per the NABERS protocol to achieve 5.5 stars.

SECTION 3.1.2: SECTION 2.2: Air Cooled 4-Pipe Chillers

6 Brindabella Business Park has been provided with three (3x) air cooled 4-pipe chillers of *Aermec* manufacture as follows:

Unit Designation	Area Served	Chiller Model
CH-01	Chilled Water System	NRP-2606-A-4-PF-RE
CH-02	Chilled Water System	NRP-2606-A-4-PF-RE
CH-02	Chilled Water System	NRP-2606-A-4-PF-RE

Each chiller is located on the North Building Roof supported via proprietary frames, concrete plinths and isolation mounts.

Cooling and heating capacity is achieved within each chiller via utilisation of the refrigerant cycle whereby refrigerant undergoes liquid/gas transformations within the controlled system. Heat rejection is via condenser fans discharging air to the atmosphere above.

Each chiller fan is provided with a variable speed drive (VSD) for speed control via the BMS.

Chilled Water (CHW) and Heating Hot Water (HHW) pipework passes across the roof at low and high level, dropping down service risers and connecting to the associated plant and equipment installed throughout the site.

The reticulated chilled and heating hot water pipework serving each chiller comprises flexible connections, testing points and isolation valves. Differential pressure sensors have been installed in both the CHW / HHW inlet and outlet pipework.

Energy meters complete with temperature sensors have been installed within the supply and return CHW / HHW pipework.

Primary Chilled Water Pumps

The installation includes three (3x) *Lowara* primary chilled water pumps as follows:

Unit Designation	Area Served	Pump Model
PCHWP-1	Primary CHW System	LNEE 80-160/92/P25VCC4
PCHWP-2	Primary CHW System	LNEE 80-160/92/P25VCC4
PCHWP-3	Primary CHW System	LNEE 80-160/92/P25VCC4

Each pump is floor mounted on the north building roof adjacent to the associated chiller and supported via concrete plinths and anti vibration mounts.

Each primary chilled water pump reticulates CHW to the associated chiller via the return pipework.

The reticulated CHW pipework serving each pump comprises flexible connections, testing points, strainers, check valves and isolation valves.

Each primary chilled water pump has been provided with a variable speed drive (VSD) for speed control via the BMS.

Secondary Chilled Water Pumps

The installation includes three (3x) *Grundfos* primary chilled water pumps as follows:

Unit Designation	Area Served	Pump Model
SCHWP-1	Secondary CHW System	NBG 100-80-160/177 AE2SBQQE
SCHWP-2	Secondary CHW System	NBG 100-80-160/177 AE2SBQQE
SCHWP-3	Secondary CHW System	NBG 100-80-160/177 AE2SBQQE

Each pump is floor mounted on the north building roof supported via concrete plinths and anti vibration mounts.

Each secondary chilled water pump reticulates CHW from the chiller supply pipework to the North and South Buildings via the associated supply CHW circuit. The CHW serves the air handling units and fan coil units installed throughout the site.

The reticulated CHW pipework serving each pump comprises flexible connections, testing points, strainers, check valves and isolation valves.

Each secondary chilled water pump has been provided with a variable speed drive (VSD) for speed control via the BMS. Differential pressure sensors have been installed in the CHW inlet and outlet pipework.

A chemical dosage pot has been installed between the SCHWP-3 inlet and outlet pipework. The chemical dosing pot has been installed for the controlled addition of inhibitors to protect pipes and equipment against corrosion.

Chemical additives are added directly into the dosing pot during routine maintenance and at commissioning.

Primary Heating Water Pumps

The installation includes three (3x) *Lowara* primary heating water pumps as follows:

Unit Designation	Area Served	Pump Model
PHHWP-1	Primary HHW System	LNEE 65-160/75/P25VCS4
PHHWP-2	Primary HHW System	LNEE 65-160/75/P25VCS4
PHHWP-3	Primary HHW System	LNEE 65-160/75/P25VCS4

Each pump is floor mounted on the north building roof adjacent to the associated chiller and supported via concrete plinths and anti vibration mounts.

Each primary heating hot water pump reticulates HHW to each associated chiller via the return pipework.

The reticulated HHW pipework serving each pump comprises flexible connections, testing points, strainers, check valves and isolation valves.

Each primary heating hot water pump has been provided with a variable speed drive (VSD) for speed control via the BMS.

Secondary Heating Water Pumps

The installation includes three (3x) *Grundfos* primary heating water pumps as follows:

Unit Designation	Area Served	Pump Model
SHHWP-1	Secondary HHW System	NBG 65-50-160/172 AE2SBQQE
SHHWP-2	Secondary HHW System	NBG 65-50-160/172 AE2SBQQE
SHHWP-3	Secondary HHW System	NBG 65-50-160/172 AE2SBQQE

Each pump is floor mounted on the north building roof supported via concrete plinths and anti vibration mounts.

Each secondary heating hot water pump reticulates HHW from the chiller supply pipework to the North and South Buildings via the supply HHW circuits. The HHW serves the air handling units, fan coil units and VAV reheat coils installed throughout the site.

The reticulated HHW pipework serving each pump comprises flexible connections, testing points, strainers, check valves and isolation valves.

Each secondary heating hot water pump has been provided with a variable speed drive (VSD) for speed control via the BMS. Differential pressure sensors have been installed in the HHW inlet and outlet pipework.

A chemical dosage pot has been installed between the SHHWP-3 inlet and outlet pipework. The chemical dosing pot has been installed for the controlled addition of inhibitors to protect pipes and equipment against corrosion.

Chemical additives are added directly into the dosing pot during routine maintenance and at commissioning.

Ancillaries

The CHW / HHW system has been provided with a two (2x) buffer tanks, two (2x) expansion tanks and two (2x) air / dirt separators, as follows:

Designation	Manufacture	Model	System / Type
T-CHW	Masterflow	AVBT3500-MC	Chilled Water / Buffer Tank
T-HHW	Masterflow	AVBT3500-MC	Heating Water / Buffer Tank
ET	Masterflow	Aquaflex 10AF500	Chilled Water / Expansion Tank
ET	Masterflow	Aquaflex 10AF500	Heating Water / Expansion Tank
ADS	Optivent	OOVAD250-SS	Chilled Water Air / DIrt Separator
ADS	Optivent	OOVAD150-SS	Heating Water Air / DIrt Separator

Buffer Tanks

The buffer tanks are floor mounted on the roof plant located centrally to the chillers and supported via concrete plinths and the proprietary mounting frames. Each buffer tank has a capacity of 3500L.

Each buffer tank stores water during expansion and contraction of the associated CHW/HHW system and assists in providing stable water temperature to each chiller.

Reticulated pipework comprises a normal closed bypass system, isolation valves and temperature sensors.

Energy meters complete with temperature sensors have been installed within the supply and return CHW / HHW pipework adjacent to each tank.

Expansion Tanks

The expansion tanks are floor mounted on the roof plant supported via concrete plinths and the proprietary mounting frame.

Each expansion tank stores water during expansion and contraction of the CHW/HHW system.

The pipework reticulated to each ET comprises a cold water mains connections complete with a backflow prevention device and a pressure reducing valve (PRV) rated at 150kPa.

Air / Dirt Separators

Each air / dirt separator is installed at the roof level within the return CHW / HHW pipework.

The air / dirt separator function is to assist with the collection and removal of dissolved gases and dirt particles from the piping system.

Each air / dirt separator is provided with an air relief vent and the associated pipework comprises a normal closed bypass system, isolation valves and temperature sensors.

SECTION 3.1.3: SECTION 2.3: CHW / HHW Air Handling Units

6 Brindabella Business Park has been provided with eight (8x) CHW / HHW Air Handling Units (AHU's) of *G.J. Walker* manufacture as follows:

Unit Designation	Area Served	Model
N-AHU-N	North Building L3 / North Perimeter	ASH 132
N-AHU-W	North Building L2 / West Perimeter	ASH 132
N-AHU-C	North Building L4 / Central Zone	ASH 132
N-AHU-L	North Building Ground / Lobby	ASH 18
S-AHU-N	South Building L2 / North Perimeter	ASH 110
S-AHU-W	South Building L3 / South Perimeter	ASH 156
S-AHU-C	South Building L4 / Central Zone	ASH 156
S-AHU-L	South Building Ground / Lobby	ASH 18

Each AHU is located within the associated plantroom on a concrete plinth complete with anti-vibration mounts.

Each AHU incorporates an integral supply air fan, motorised dampers, pressure sensor and temperature sensor. Each system is connected to flow and return pipework associated with the CHW and HHW coils.

The purpose of the heating coil is to provide heating into the system. HHW flow and return pipework is routed within the plant room from the chillers incorporating motorised valves.

The purpose of the cooling coil is to provide cooling into the system. CHW flow and return pipework is routed within the plant room from the chillers incorporating motorised valves.

Each AHU incorporates acoustically insulated supply air sheet metal ductwork from the unit, rising up within the plant room and entering the ceiling space above.

Air is supplied into each area via ceiling mounted diffusers connected to the the main acoustically insulated sheet metal supply air ductwork from the associated VAV terminal unit (via flexible duct) within the ceiling space. Each flexible duct connection incorporates a damper for air flow adjustment.

Each AHU incorporates a bank of disposable deep bed filters accessed via a door on the side of each AHU.

Outside air is incorporated directly into each AHU via a fixed volume control damper connected to the rear of each AHU. Outside air is introduced into each plant room via louvered screens.

Each AHU incorporates 100% outside air economy cycle via motorised control dampers. Economy cycle control is programmed via the BMS. Refer to the accompanying functional controls description for full controls details.

Attenuators have been installed within the return air ductwork associated with each AHU to assist with noise reduction within the occupied spaces and surrounding areas.

Fire and Smoke Dampers have been installed throughout the AHU sheet metal ductwork systems. Refer to the accompanying As Installed Drawings for further location details and schedules.

Return Air Fans

Return is delivered into each AHU via ten (10x) *Fantech* inline fans as follows:

Unit Designation	Area Served	Model
N-RAF-2.1	N L1 RA	AP0806CP12/28
N-RAF-2.2	N L2 RA	AP0806CP12/28
N-RAF-3.1	N L3 RA	AP0806CP12/28
N-RAF-4.1	N L4 RA	AP0806CP12/28
N-RAF-5.1	N L5 RA	AP0806CP12/27
S-RAF-1.1	S L1 RA	AP0806CP12/33
S-RAF-2.1	N-AHU-C	AP0806CP12/33
S-RAF-3.1	N-AHU-S	AP0806CP12/33
S-RAF-4.1	N-AHU-C	AP0806CP12/33
S-RAF-5.1	Common AHU RA	AP0806CP12/27

Each fan is mounted at high level within the associated plantroom supported from the structure above complete with isolation mounts.

Return air is drawn each system via ceiling and wall mounted grilles located within each respective area.

Return air is delivered directly into each AHU via sheet metal ductwork and return air risers located within the associated plantroom.

SECTION 3.1.4: ChW / HHW Fan Coil Units

6 Brindabella Business Park has been provided with eight (8x) ChW / HHW fan coil units of *G.J. Walker* manufacture as follows:

Unit Designation	Area Served	Model
N-FCU-EOT	North EOT	CMDH 900 EC
N-FCU-G.1	Retail	CMDH 900 EC
N-FCU-G.2	Retail	CMLH 1800 EC
N-FCU-G.3	Retail	CMLH 1200 EC
S-FCU-G.1	Retail	CMLH 1200 EC
S-FCU-G.2	Retail	CMLH 1200 EC
S-FCU-G.3	Retail	CMLH 1200 EC
S-FCU-G.4	Retail	CMLH 1800 EC

Each fan coil unit is mounted within the ceiling space via spring isolation hangers from the structure above.

Air is supplied into each area via ceiling mounted diffusers connected to the main acoustically insulated sheet metal supply air ductwork via flexible duct within the ceiling space. Each flexible duct connection incorporates a damper for air flow adjustment.

Open ended sheet metal ductwork is connected to each fan coil plenum for return air path via the ceiling space. The filter plenum connected to the rear of each fan coil unit, comprising removable disposable panel filters. These are accessible from the ceiling space adjacent to each unit. Outside air is incorporated into each plenum via ductwork connection to outside air

louvres located with the building facade and ceiling mounted linear grilles installed within the external building eaves.

Chilled water and heating hot water is reticulated to each FCU via connection to chiller CHW/HHW pipework within the ceiling space. The water connections include motorised control valves, manual balancing valves and isolation valves.

Each fan coil unit is monitored and controlled via the BMS. Refer to the accompanying functional description for full control details.

SECTION 3.1.5: Variable Air Volume Units

6 Brindabella Business Park has been provided with one hundred and eighty six (186x) *Holyoake* variable air volume (VAV) terminal units as follows:

North Building

Unit Designation	Area Served	Model
N-VAV-G.1.1	Ground Floor North	HCVL200
N-VAV-G.1.2	Ground Floor North	HCVL200
N-VAV-G.2.1	Ground Floor North	HCVLHW300
N-VAV-G.2.2	Ground Floor North	HCVLHW300
N-N-1.1	Level 1 North	HCVLHW300
N-N-1.2	Level 1 North	HCVLHW300
N-N-1.3	Level 1 North	HCVLHW300
N-N-1.4	Level 1 North	HCVLHW225
N-W-1.1	Level 1 West Zone	HCVLHW300

N-W-1.2	Level 1 West Zone	HCVLHW300
N-W-1.3	Level 1 West Zone	HCVLHW300
N-W-1.4	Level 1 West Zone	HCVL175
N-C-1.01	Level 1 Central Zone	HCVL175
N-C-1.02	Level 1 Central Zone	HCVL175
N-C-1.03	Level 1 Central Zone	HCVL175
N-C-1.04	Level 1 Central Zone	HCVL175
N-C-1.05	Level 1 Central Zone	HCVL175
N-C-1.06	Level 1 Central Zone	HCVL200
N-C-1.07	Level 1 Central Zone	HCVL175
N-C-1.08	Level 1 Central Zone	HCVL200
N-C-1.09	Level 1 Central Zone	HCVL200
N-N-2.1	Level 2 North	HCVLHW300
N-N-2.2	Level 2 North	HCVLHW300
N-N-2.3	Level 2 North	HCVLHW300
N-N-2.4	Level 2 North	HCVLHW225
N-W-2.1	Level 2 West Zone	HCVLHW300
N-W-2.2	Level 2 West Zone	HCVLHW300

N-W-2.3	Level 2 West Zone	HCVLHW300
N-W-2.4	Level 2 West Zone	HCVL175
N-C-2.01	Level 2 Central Zone	HCVL175
N-C-2.02	Level 2 Central Zone	HCVL175
N-C-2.03	Level 2 Central Zone	HCVL175
N-C-2.04	Level 2 Central Zone	HCVL175
N-C-2.05	Level 2 Central Zone	HCVL175
N-C-2.06	Level 2 Central Zone	HCVL200
N-C-2.07	Level 2 Central Zone	HCVL175
N-C-2.08	Level 2 Central Zone	HCVL200
N-C-2.09	Level 2 Central Zone	HCVL200
N-N-3.1	Level 3 North	HCVLHW300
N-N-3.2	Level 3 North	HCVLHW300
N-N-3.3	Level 3 North	HCVLHW300
N-N-3.4	Level 3 North	HCVLHW225
N-W-3.1	Level 3 West Zone	HCVLHW300
N-W-3.2	Level 3 West Zone	HCVLHW300
N-W-3.3	Level 3 West Zone	HCVLHW300

N-W-3.4	Level 3 West Zone	HCVL175
N-C-3.01	Level 3 Central Zone	HCVL175
N-C-3.02	Level 3 Central Zone	HCVL175
N-C-3.03	Level 3 Central Zone	HCVL175
N-C-3.04	Level 3 Central Zone	HCVL175
N-C-3.05	Level 3 Central Zone	HCVL175
N-C-3.06	Level 3 Central Zone	HCVL200
N-C-3.07	Level 3 Central Zone	HCVL175
N-C-3.08	Level 3 Central Zone	HCVL200
N-C-3.09	Level 3 Central Zone	HCVL200
N-N-4.1	Level 4 North	HCVLHW300
N-N-4.2	Level 4 North	HCVLHW300
N-N-4.3	Level 4 North	HCVLHW300
N-N-4.4	Level 4 North	HCVLHW225
N-W-4.1	Level 4 West Zone	HCVLHW300
N-W-4.2	Level 4 West Zone	HCVLHW300
N-W-4.3	Level 4 West Zone	HCVLHW300
N-W-4.4	Level 4 West Zone	HCVL175

N-C-4.01	Level 4 Central Zone	HCVL175
N-C-4.02	Level 4 Central Zone	HCVL175
N-C-4.03	Level 4 Central Zone	HCVL175
N-C-4.04	Level 4 Central Zone	HCVL175
N-C-4.05	Level 4 Central Zone	HCVL175
N-C-4.06	Level 4 Central Zone	HCVL200
N-C-4.07	Level 4 Central Zone	HCVL175
N-C-4.08	Level 4 Central Zone	HCVL200
N-C-4.09	Level 4 Central Zone	HCVL200
N-N-5.1	Level 5 North	HCVLHW300
N-N-5.2	Level 5 North	HCVLHW300
N-N-5.3	Level 5 North	HCVLHW300
N-N-5.4	Level 5 North	HCVLHW225
N-W-5.1	Level 5 West Zone	HCVLHW300
N-W-5.2	Level 5 West Zone	HCVLHW300
N-W-5.3	Level 5 West Zone	HCVLHW300
N-W-5.4	Level 5 West Zone	HCVLHW200
N-C-5.01	Level 5 Central Zone	HCVLHW175

N-C-5.02	Level 5 Central Zone	HCVLHW175
N-C-5.03	Level 5 Central Zone	HCVLHW175
N-C-5.04	Level 5 Central Zone	HCVLHW175
N-C-5.05	Level 5 Central Zone	HCVLHW175
N-C-5.06	Level 5 Central Zone	HCVLHW200
N-C-5.07	Level 5 Central Zone	HCVLHW200
N-C-5.08	Level 5 Central Zone	HCVLHW200
N-C-5.09	Level 5 Central Zone	HCVLHW200

South Building

Unit Designation	Area Served	Model
S-VAV-G.1.1	Ground Floor	HCVL225
S-VAV-G.1.2	Ground Floor	HCVL225
S-VAV-G.2.1	Ground Floor	HCVLHW300
S-VAV-G.2.2	Ground Floor	HCVLHW175
S-VAV-G.3.1	Ground Floor	HCVL175
S-VAV-G.3.2	Ground Floor	HCVL200
S-VAV-G.3.3	Ground Floor	HCVL175

S-N-1.1	Level 1 North	HCVLHW250
S-N-1.2	Level 1 North	HCVLHW250
S-N-1.3	Level 1 North	HCVLHW250
S-N-1.4	Level 1 North	HCVLHW200
S-W-1.1	Level 1 West Zone	HCVLHW300
S-W-1.2	Level 1 West Zone	HCVLHW350
S-W-1.3	Level 1 West Zone	HCVLHW350
S-W-1.4	Level 1 West Zone	HCVLHW250
S-C-1.01	Level 1 Central Zone	HCVL175
S-C-1.02	Level 1 Central Zone	HCVL175
S-C-1.03	Level 1 Central Zone	HCVL175
S-C-1.04	Level 1 Central Zone	HCVL175
S-C-1.05	Level 1 Central Zone	HCVL175
S-C-1.06	Level 1 Central Zone	HCVL175
S-C-1.07	Level 1 Central Zone	HCVL200
S-C-1.08	Level 1 Central Zone	HCVL200
S-C-1.09	Level 1 Central Zone	HCVL200
S-C-1.10	Level 1 Central Zone	HCVL200

S-N-2.1	Level 2 North	HCVLHW250
S-N-2.2	Level 2 North	HCVLHW250
S-N-2.3	Level 2 North	HCVLHW250
S-N-2.4	Level 2 North	HCVLHW200
S-W-2.1	Level 2 West Zone	HCVLHW300
S-W-2.2	Level 2 West Zone	HCVLHW350
S-W-2.3	Level 2 West Zone	HCVLHW350
S-W-2.4	Level 2 West Zone	HCVLHW250
S-C-2.01	Level 2 Central Zone	HCVL175
S-C-2.02	Level 2 Central Zone	HCVL175
S-C-2.03	Level 2 Central Zone	HCVL175
S-C-2.04	Level 2 Central Zone	HCVL175
S-C-2.05	Level 2 Central Zone	HCVL175
S-C-2.06	Level 2 Central Zone	HCVL175
S-C-2.07	Level 2 Central Zone	HCVL200
S-C-2.08	Level 2 Central Zone	HCVL200
S-C-2.09	Level 2 Central Zone	HCVL200
S-C-2.10	Level 2 Central Zone	HCVL200

S-N-3.1	Level 3 North	HCVLHW250
S-N-3.2	Level 3 North	HCVLHW250
S-N-3.3	Level 3 North	HCVLHW250
S-N-3.4	Level 3 North	HCVLHW200
S-W-3.1	Level 3 West Zone	HCVLHW300
S-W-3.2	Level 3 West Zone	HCVLHW350
S-W-3.3	Level 3 West Zone	HCVLHW350
S-W-3.4	Level 3 West Zone	HCVLHW250
S-C-3.01	Level 3 Central Zone	HCVL175
S-C-3.02	Level 3 Central Zone	HCVL175
S-C-3.03	Level 3 Central Zone	HCVL175
S-C-3.04	Level 3 Central Zone	HCVL175
S-C-3.05	Level 3 Central Zone	HCVL175
S-C-3.06	Level 3 Central Zone	HCVL175
S-C-3.07	Level 3 Central Zone	HCVL200
S-C-3.08	Level 3 Central Zone	HCVL200
S-C-3.09	Level 3 Central Zone	HCVL200
S-C-3.10	Level 3 Central Zone	HCVL200

S-N-4.1	Level 4 North	HCVLHW250
S-N-4.2	Level 4 North	HCVLHW250
S-N-4.3	Level 4 North	HCVLHW250
S-N-4.4	Level North	HCVLHW200
S-W-4.1	Level 4 West Zone	HCVLHW300
S-W-4.2	Level 4 West Zone	HCVLHW350
S-W-4.3	Level 4West Zone	HCVLHW350
S-W-4.4	Level 4 West Zone	HCVLHW250
S-C-4.01	Level 4 Central Zone	HCVL175
S-C-4.02	Level 4 Central Zone	HCVL175
S-C-4.03	Level 4 Central Zone	HCVL175
S-C-4.04	Level 4 Central Zone	HCVL175
S-C-4.05	Level 4 Central Zone	HCVL175
S-C-4.06	Level 4 Central Zone	HCVL175
S-C-4.07	Level 4 Central Zone	HCVL200
S-C-4.08	Level 4 Central Zone	HCVL200
S-C-4.09	Level 4 Central Zone	HCVL200
S-C-4.10	Level 4 Central Zone	HCVL200

S-N-5.1	Level 5 North	HCVLHW300
S-N-5.2	Level 5 North	HCVLHW250
S-N-5.3	Level 5 North	HCVLHW250
S-N-5.4	Level 5 North	HCVLHW225
S-W-5.1	Level 5 West Zone	HCVLHW300
S-W-5.2	Level 5 West Zone	HCVLHW350
S-W-5.3	Level 5 West Zone	HCVLHW350
S-W-5.4	Level 5 West Zone	HCVLHW225
S-C-5.01	Level 5 Central Zone	HCVLHW200
S-C-5.02	Level 5 Central Zone	HCVLHW200
S-C-5.03	Level 5 Central Zone	HCVLHW200
S-C-5.04	Level 5 Central Zone	HCVLHW200
S-C-5.05	Level 5 Central Zone	HCVLHW200
S-C-5.06	Level 5 Central Zone	HCVLHW175
S-C-5.07	Level 5 Central Zone	HCVLHW200
S-C-5.08	Level 5 Central Zone	HCVLHW200
S-C-5.09	Level 5 Central Zone	HCVLHW200

S-C-5.10	Level 5 Central Zone	HCVLHW200

Each VAV unit is mounted within the ceiling space via hangers from the structure above.

Air is supplied into each space via a series of ceiling mounted diffusers connected to each main length of acoustically insulated sheet metal supply air duct (via flexible duct) within the ceiling space.

Air is drawn into each VAV via the associated AHU system. Refer to the accompanying As Installed Drawings for further details.

Each HCBLHW model VAV incorporates a heating hot water coil for zone reheat.

SECTION 3.1.6: Wall Mounted Air Conditioning Systems

6 Brindabella Business Park has been provided with four (4x) air cooled, reverse cycle, split wall mounted air conditioning systems of *Mitsubishi Electric* manufacture as follows:

Unit Designation	Area Served	Indoor / Outdoor Model
AC-B1.1 / CU-B1.1	South BSN	PKA-M71KAL / PUZ-ZM71VHA
AC-B1.2 / CU-B1.2	BSN & Security	PKA-M71KAL / PUZ-ZM71VHA
AC-B1.3 / CU-B1.3	DAS (Duty)	PKA-M100KAL / PUZ-ZM100VKA
AC-B1.4 / CU-B1.4	DAS (Standby)	PKA-M100KAL / PUZ-ZM100VKA

Each unit is mounted at high level on the wall with refrigerant pipework entering the ceiling space above.

Air is supplied into each space via a louvre at the bottom of the unit, with return air at the top, incorporating a drop down hatch for access to the washable filter.

Refrigerant pipework is routed within the ceiling space, connecting to each associated condensing unit located within the Basement complete with support frames and anti-vibration mounts.

SECTION 3.1.7: Outside Air Systems

6 Brindabella Business Park has been provided with three (3x) outside air systems, each comprising a *Fanteach* inline fan, sheet metal ductwork and exhaust grilles.

The fans are summarised below:

Fan Designation	Area Served	Fan Model
N-OAF-G1	General Outside Air	PCE314DD
N-TOAF-R.1	Tenant Outside Air	PUD564DD
S-TOAF-R.1	Tenant Outside Air	PUD564DD

N-OAF-G1

The fan is mounted within the ceiling space supported via threaded rod hangers from the structure above.

Air is drawn into each system via a weatherproof louvre installed within the building facade. Sheet metal ductwork connects the louvre to the fan.

A series of future blanked tenant outside air connections have been installed at each level for future connection (by others).

The outside air ductwork comprises fire dampers, smoke dampers and motorised control valves at each level.

The fan has been provided with a variable speed drive (VSD) for airflow adjustment via the BMS.

N-TOAF-R.1, S-TOAF-R.1

Each fan is mounted on the roof plantroom complete with steel support frame and isolation mounts.

Air is drawn into each system via open ended sheet metal ductwork connected directly to each fan on the roof.

A series of future blanked tenant outside air connections have been installed at each level for future connection (by others).

A series of future blanked tenant toilet exhaust connections have been installed at each level for future connection.

The outside air ductwork comprises fire dampers, smoke dampers and motorised control valves at each level.

Each fan has been provided with a variable speed drive (VSD) for airflow adjustment via the BMS.

SECTION 3.1.8: General Ducted Exhaust Systems

6 Brindabella Business Park has been provided with six (6x) general ducted exhaust systems, each comprising a *Fantech* fan, sheet metal ductwork and exhaust air grilles.

The fans are summarised below:

Fan Designation	Area Served	Fan Model	Fan Model
EAF-B1.1	Main Switchroom	AP0312JP6T/1D2	Inline
EAF-B1.2	Grease Trap Room	TD2000/315SIL	Inline
N-EAF-EOT	EOT	PUD456DD	Inline
EAF-G.1	Basement UPS	FPMD404	Inline
N-GEF-R.1	North Offices	HUD566	Roof Mounted

S-GEF-R.1	Southern Offices	AP0564LP12/22	Inline

N-EAF-B1.1, N-EAF-B1.2, EAF-G.1

Each fan is mounted within the ceiling space supported via threaded rod hangers from the structure above complete with isolation mounts.

Air is exhausted from each area via duct mounted exhaust grilles and open fire dampers installed within wall cavities. Sheet metal ductwork passes through the carpark at high level connecting each grille and fire damper to the fan.

Air is exhausted to the atmosphere via open ended sheet metal ductwork exhausting at the ground level.

EAF-G.1 is of flameproof construction complete axial impellers and a galvanised steel casing finished complete with red powder-coating. The fan motor is of squirrel cage induction type.

N-EAF-EOT

The fan is mounted within the ceiling space supported via threaded rod hanger from the structure above complete with isolation mounts.

Air is exhausted from each area via a series of ceiling mounted eggcrate grilles connected to the main sheet metal duct via flexible ductwork. Each length of flexible duct incorporates a butterfly damper for airflow adjustment.

Air is exhausted to the atmosphere via a weatherproof louvre installed within the building facade.

N-GEF-R.1

The fan is mounted on the roof level supported via sheet metal ductwork directly below.

The fan is of vertical discharge arrangement constructed of galvanised steel complete with fixed flow impellers and motor mounted out of the airstream.

A series of future blanked tenant general exhaust connections have been installed at each level for future connection (by others).

The exhaust ductwork comprises fire dampers, smoke dampers and motorised control dampers at each level.

Air is exhausted to the atmosphere directly via each fan.

The fan has been provided with a variable speed drive (VSD) for airflow adjustment via the BMS.

S-GEF-R.1

The fan is mounted on the roof plantroom complete with steel support frame and isolation mounts.

The fan is of inline arrangement constructed of galvanised steel complete with adjustable pitch impellers.

A series of future blanked tenant general exhaust connections have been installed at each level for future connection (by others).

The exhaust ductwork comprises fire dampers, smoke dampers and motorised control valves at each level.

Air is exhausted to the atmosphere via open ended sheet metal ductwork connected directly to the fan on the roof.

The fan has been provided with a variable speed drive (VSD) for airflow adjustment via the BMS.

SECTION 3.1.9: Carpark Exhaust System

6 Brindabella Business Park has been provided one (1x) carpark exhaust system comprising a *Fantech* inline fan, sheet metal ductwork and duct mounted exhaust grilles.

The fan is summarised below:

Fan Designation	Area Served	Fan Model
CPEF-B1.1	Basement Carpark	AP0804CA9/27

The fan is mounted at high level within the carpark supported via the structure above complete with isolation mounts.

Air is exhausted from the area via a series of duct mounted exhaust grilles. Sheet metal ductwork passes through the carpark at high level connecting each grille to the fan. Each grille connection incorporates an opposed blade damper behind for airflow adjustment.

Air is exhausted to the atmosphere via open ended sheet metal ductwork exhausting at ground level.

Make-up air is provided to the area via natural ventilation of the carpark.

SECTION 3.1.10: Stair Pressurisation Systems

6 Brindabella Business Park has been provided with four (4x) stair pressurisation systems, each comprising a *Fantech* inline fan, sheet metal ductwork and exhaust grilles.

The fans are summarised below:

Fan Designation	Area Served	Fan Model
N-SPF-R.1	North Stair 1	AP1256CA9/19
N-SPF-R.2	North Stair 2	AP1256CA9/19
S-SPF-R.1	South Stair 1	AP1256CA9/19
S-SPF-R.2	South Stair 1	AP1256CA9/19

Each fan is mounted on the roof plantroom complete with steel support frame and isolation mounts.

Air is drawn into the system via open ended sheet metal ductwork connected directly to the fan on the roof.

Air is supplied into the associated staircase via louvered openings at each level stair landing. Sheet metal ductwork connects the fan to the stair pressurisation riser.

Each fan has been provided with a variable speed drive (VSD) for airflow adjustment via the BMS.

SECTION 3.1.11: Smoke Spill Exhaust Systems

6 Brindabella Business Park has been provided with twelve (12x) smoke spill exhaust systems, each comprising a *Fantech* roof mounted fan, sheet metal ductwork and exhaust grilles.

The fans are summarised below:

Fan Designation	Area Served	Fan Model
N-SEF-R.1	Atrium Smoke Exhaust	RSS1256CA12/33
N-SEF-R.2	Atrium Smoke Exhaust	RSS1256CA12/33
N-SEF-R.3	Atrium Smoke Exhaust	RSS1256CA12/33
N-SEF-R.4	Atrium Smoke Exhaust	RSS1256CA12/33
N-SEF-R.5	Atrium Smoke Exhaust	RSS1256CA12/33
N-SEF-R.6	Atrium Smoke Exhaust	RSS1256CA12/33
S-SEF-R.1	Atrium Smoke Exhaust	RSS1256CA12/33
S-SEF-R.2	Atrium Smoke Exhaust	RSS1256CA12/33
S-SEF-R.3	Atrium Smoke Exhaust	RSS1256CA12/33
S-SEF-R.4	Atrium Smoke Exhaust	RSS1256CA12/33
S-SEF-R.5	Atrium Smoke Exhaust	RSS1256CA12/33
S-SEF-R.6	Atrium Smoke Exhaust	RSS1256CA12/33

Each fan is mounted on the roof level supported via sheet metal ductwork directly below.

Each fan is of vertical discharge arrangement designed for high capacity smoke spill and constructed of galvanised steel complete with adjustable pitch impellers.

Air is exhausted directly from the associated area via the glazed atrium openings at high level.

Air is exhausted to the atmosphere directly via each fan.

Each fan has been provided with a variable speed drive (VSD) for airflow adjustment via the BMS.

SECTION 3.1.12: Toilet Ducted Exhaust Systems

6 Brindabella Business Park has been provided with two (2x) toilet ducted exhaust systems, each comprising a *Fanteach* fan, sheet metal ductwork and ceiling mounted exhaust grilles.

The fans are summarised below:

Fan Designation	Area Served	Fan Model	Fan Model
N-TEF-R.1	Base Building & Tenant Northern Toilets	RVE0714LP12/31	Roof Mounted
S-TEF-R.1	Base Building & Tenant Southern Toilets	AP0804CP6/22	Inline

N-TEF-R.1

The fan is mounted on the roof level supported via sheet metal ductwork directly below.

The fan is of vertical discharge arrangement constructed of galvanised steel complete with adjustable pitch impellers and shutters.

Air is exhausted from each area via a series of ceiling mounted exhaust grilles. Sheet metal ductwork is installed within a common riser, penetrating the riser at each level and passing into the associated level ceiling space. Each grille is connected to the sheet metal ductwork (via flexible ductwork) within the ceiling space. Each flexible duct connection incorporates a damper for airflow adjustment.

A series of future blanked tenant toilet exhaust connections have been installed at each level for future connection.

The exhaust ductwork comprises fire dampers, smoke dampers and motorised control valves at each level.

Air is exhausted to the atmosphere directly via each fan.

Make-up air is provided to each area via door grilles.

The fan has been provided with a variable speed drive (VSD) for airflow adjustment via the BMS.

S-TEF-R.1

The fan is mounted on the roof plantroom complete with steel support frame and isolation mounts.

The fan is of inline arrangement constructed of galvanised steel complete with adjustable pitch impellers.

Air is exhausted from each area via a series of ceiling mounted exhaust grilles. Sheet metal ductwork is installed within a common riser, penetrating the riser at each level and passing into the associated level ceiling space. Each grille is connected to the sheet metal ductwork (via flexible ductwork) within the ceiling space. Each flexible duct connection incorporates a damper for airflow adjustment.

A series of future blanked tenant toilet exhaust connections have been installed at each level for future connection.

The exhaust ductwork comprises fire dampers, smoke dampers and motorised control valves at each level.

Air is exhausted to the atmosphere via open ended sheet metal ductwork connected directly to the fan on the roof.

Make-up air is provided to each area via door grilles.

The fan has been provided with a variable speed drive (VSD) for airflow adjustment via the BMS.

SECTION 3.1.13: Kitchen Exhaust Systems

6 Brindabella Business Park has been provided with two (2x) kitchen exhaust systems, each comprising a *Fanteach* centrifugal fan and sheet metal ductwork.

The fans are summarised below:

Fan Designation	Area Served	Fan Model
N-KEF-R.1	Future Retail	40LSW
S-KEF-R.1	Future Retail	40LSW

Each fan is mounted on the roof level and supported via structure below complete with isolation mounts.

Each fan is of centrifugal arrangement constructed of mild steel complete with backward inclined laminar impellers and direct drive motors.

A series of future blanked tenant kitchen exhaust connections have been installed at the ground level for future connection (by others).

Air is exhausted to the atmosphere directly via each fan.

The fan has been provided with a variable speed drive (VSD) for airflow adjustment via the BMS.

SECTION 3.2: Hydraulics

SECTION 3.2.1: Stormwater System

6 Brindabella Business Park has been provided with a new stormwater system to manage rainfall water run-off from the new buildings, landscape sumps and the subsoil drainage system.

Rainwater outlets (RWO) and Overflow (O/F) outlets are connected to roof gutters, canopy gutters and box gutters via stormwater pipework at the roof level. The stormwater downpipes run below the roof level, dropping down the building and connecting to the existing underground stormwater pit systems.

The 100mm dia overflow pipework terminates through the building facade complete with rectangular outlets, discharging directly to ground below.

Rainwater outlets comprise a siphonic high capacity overflow system to discharge to the atmosphere at ground level.

A series of RWO's have been installed at ground level throughout the site connecting to the existing underground stormwater pit systems.

A series of floor grates have been installed throughout the basement level connecting to reticulated stormwater pipework. The pipework passes under-slab connecting to a *Qmax* stormwater pump well / station, **model FRP1530**. The pump incorporates an integrated valve chamber, dual pumps (for duty/standby) and is provided with a wall mounted controller complete with water level alarms and auto-dialer fault notifications. Stormwater from the well is pumped via the associated piping systems to the ground level connecting into the reticulated main stormwater lines.

A series of 900x900 and 600x600 sumps (SWP's) complete with stainless steel grates have been installed around the perimeter of the site. 300mm, 225mm, 150mm and 100mm diameter stormwater pipework passes underground connecting each sump to the associated existing main sump.

The existing 300mm dia stormwater service has been connected into the above new below ground stormwater service.

Wide strip drains and rainwater outlets have been connected to the above new below ground stormwater service.

Stormwater pipework has been provided with adequate sloping in accordance with AS 3500, the National Plumbing and Drainage Code.

SECTION 3.2.2: Sewer Drainage Systems

6 Brindabella Business Park has been provided with new sewer drainage systems serving the site. The pipework incorporates tundishes, traps and flexible connections as detailed on the accompanying As Installed Drawings.

The sewer pipework reticulates within the wall cavities, under-slab and ceiling voids within each area. The pipework is connected to the sanitary fittings and fixtures installed through the site.

The reticulated sewer pipework combines into a series of common main sewage pipework lines, passing underground and connecting the sewer manholes (SMH) located on the eastern perimeter of the site. The common main sewer pipework from each SMH passes underground and terminates into an existing main sewer manhole extended to the Brindabella Circuit.

Sewer connection points have been installed throughout the basement level connecting to reticulated sewer pipework. The pipework passes under-slab connecting to a *Qmax* sewer pump well, **model FRP1525**. The pump incorporates an integrated valve chamber, dual pumps (for duty/standby) and is provided with a wall mounted controller complete with water level alarms and auto-dialer fault notifications. Sewage from the well is pumped via the associated piping systems to the ground level connecting into the reticulated main sewer pipework lines.

Discharge pipework from the basement grease interceptor trap is connected to the above pump well.

The sewerage pipework has been provided with access inspection openings to comply with local regulations. The installation complies with AS 3500, the National Plumbing and Drainage Code.

SECTION 3.2.3: Grease Arrestor

6 Brindabella Business Park has been provided with one (1x) *Halgan* 5,000L grease interceptor trap, **model MGTS**, located at the south western side of the building within the basement.

The grease arrestor is designed to intercept most greases and solids before they enter a wastewater disposal system. The interceptor trap incorporates the following:

- Heavy duty class D gatic lid
- Neoprene rubber seal
- Gas tight lids
- Sealed gully trap adjacent
- Inspection opening to surface on the inlet side
- Chamber vent and breather vent
- Acid resistant concrete walls and base
- Inlet and outlet connections to the disconnector gully
- Airtight sampling point with screw on lid
- Permanently fixed rigid baffle adjacent to the inlet pipe location.

The invert of the outlet pipe is lower than the invert level of the inlet pipe to ensure that the grease is trapped correctly.

Sewer drainage pipework from the Ground Floor tenancies and Cafe Avion combine into a series of 110mm trade waste lines which connect to the grease interceptor trap. The outlet pipe connects to the basement pumping well via the reticulated sewer drainage piping systems.

Safe access has been provided around the grease arrestor for maintenance purposes.

The sewerage pipework has been provided with access inspection openings to comply with SA Water regulations. The installation complies with AS 3500, the National Plumbing and Drainage Code.

SECTION 3.2.4: Cold Water Systems

6 Brindabella Business Park has been provided with new cold water reticulation to serve the sanitary fittings throughout.

New domestic cold water pipework has been connected to the new water meter pit located on the eastern perimeter of the site.

The new domestic cold water pipework passes underground from the new water pit, rising into the wall cavities of each building served. The pipework passes through each building via the wall cavities, under-slab and ceiling voids connecting to the sanitary fittings and fixtures installed throughout the site.

The new cold water pipework serving the basement is reticulated under the ground floor slab and within the basement soffit, penetrating the slab to connect to fittings and fixtures.

A series of isolation shut-off valves have been provided to the cold water mains supply to the building.

Domestic cold water pipework has been provided with a *LWG backflow* reduced pressure valve assembly, **model 375**. Each valve is located within the respective building plantroom.

The installation complies with AS 3500; the National Plumbing and Drainage Code.

SECTION 3.2.5: Domestic Hot Water Units

6 Brindabella Business Park has been provided with four (4x) electric flow hot water units to serve the buildings as follows:

Description	Manufacturer	Model Number
HWU-1	Rheem	616315
HWU-2	Rheem	616315
HWU-3	Rheem	616315
HWU-4	Rheem	616315

Each unit is floor mounted on a concrete plinth within the respective building roof plantroom.

Domestic cold water (CW) pipework passes at a high level through the respective building roof plantroom, dropping down and terminating adjacent to each hot water unit. Each unit has been connected to the CW pipework complete with an isolation valve.

Hot water flow (HW) and return (HWR) pipework connected to each hot water heater passes through the plantroom, dropping down risers and connecting to the sanitary fittings and fixtures installed throughout the site.

Thermostatic mixing valves are provided for all showers and hand basins. Each associated valve set is located above the ceiling for ease of access and maintenance.

The installation complies with AS 3500, the National Plumbing and Drainage Code and AS 5601; the Australian Gas Code.

Circulating Pump

The installation includes four (4x) domestic hot water (DHW) dual circulating pumps, as follows:

Description	Manufacturer	Model Number
Pump 1	Grundfos	UPS 20-60N
Pump 2	Grundfos	UPS 20-60N
Pump 3	Grundfos	UPS 20-60N
Pump 4	Grundfos	UPS 20-60N

Each pump is mounted within the respective DHW return pipework. Each pump reticulates HWR back to the associated hot water unit.

The installation complies with AS 3500, the National Plumbing and Drainage Code and AS 5601; the Australian Gas Code.

SECTION 3.2.6: Natural Gas System

6 Brindabella Business Park has been provided with new natural gas pipework terminating 225mm from the property boundary complete with an inground ball valve.

The natural gas pipework passes underground from the perimeter of the site, rising up into each associated building via the wall cavities.

Natural gas pipework is reticulated through the wall cavities and ceiling void, terminating within the Cafe Avion ceiling space for future connection by others.

Natural gas pipework is reticulated through the ceiling voids and wall cavities, rising up to the rooftop plantroom and terminating adjacent to the associated central hot water plant equipment complete with isolation valves.

SECTION 3.2.7: Sanitary Fixtures and Tapware

6 Brindabella Business Park has been provided with new WC's, basins and tapware as detailed below:

Location	Type	Product Description	Manufacturer	Model
FX-102	Shower	Brodware Halo Shower Set, Chrome	Brodware	101
FX-110	Shower	Shower T-Rail, Right Hand Slider, Set with 2 m Hose, 7.5L per minute	RBA	1852373
FX-110	Shower	Shower T-Rail, Left Hand Slider, Set with 2 m Hose, 7.5L per minute	RBA	1852374
FX-115	Floor / Shower Waste	Tile Insert Waste, 130 x 130 x 23 mm - 100 mm	Mizu	306725
FX-121	Tile Insert	100mm Stainless Steel Tile Insert, Stainless Steel Channel and Fitted 20DP	Kado	306652
FX-121	Tile Insert	100mm Tile Insert & Channel Stainless Steel 23 Deep - MTL	Kado	306671
SA-101	Basin	Caroma Cube 500 Under Counter Basin O/Flow, White	Caroma	1807418
SA-102	Sink	Caroma Cleaners Sink Only, 580mm x 435mm, White	Caroma	1817530
SA-103	Wall Basin	Caroma Cube Wall Basin with Overflow Left Hand Shelf 1 Taphole White	Caroma	1807531
SA-104	Bottle Trap	Mizu Drift Bottle Trap 40mm, Brushed Nickel	Mizu	2263850
SA-202	Basin Mixer	Caroma Skandic Care Basin Mixer, Warn / Cold, Chrome Plate	Caroma	1815197

SA-203	Bath / Shower Mixer	Caroma Skandic Bath / Shower Mixer, Chrome Plate	Caroma	1815198
SA-204	Trap	Bradley Australia Tubular Automatic Trap	Bradley Australia	101
SA-301 & SA-302	Toilet Suite	Urbane II Cleanflush Invisi Series II Wall Faced Suite, with GermGard	Caroma	1806487
SA-303	Toilet Suite Panel	Smart Command Invisi II Panel, Black Glass	Caroma	101
SA-304	Toilet Suite Kit	Electronic Urinal Series II Rough in Kit - Cube & Leda	Caroma	1817348
SA-304	Urinal	Caroma Cube 0.8L Urinal Electronic Fit Out Kit	Caroma	1817349
SA-305	Toilet Suite	Wolfen 800 Back to Wall Rimless Pan with Single Flap Seat White	Wolfen	9508846
SA-305	Back Rest	Wolfen Back Rest with Fixed Arms White and Stainless Steel	Wolfen	9507171
SA-305	Flap Seat	Wolfen Single Flap Seat Blue	Wolfen	9508008
SA-305	Inwall Cistern	Caroma Invisi II Inwall Cistern with Adjustable Flush Pipe	Caroma	1804843
SA-307	Toilet Suite	Liano Cleanflush Easy Height Invisi Series II Aall FAced Toilet Suite	Caroma	1809027

All Sanitary ware has been supplied by *Reece*.

Each sanitary and tapware fixture is provided with mini isolation cocks to enable shut-off of water supply.

SECTION 3.2.8: Water Reticulation

6 Brindabella Business Park has been provided with pipework throughout as follows:

Type	Application	Jointing	Bracketing	Insulation
UPVC	Sewer / Stormwater	Cleaning Fluid, Solvent Cement	Hanging/offset brackets.	Acoustically wrap

HDPE	Sewer Stacks	Welded	Hanging / offset brackets	Acoustically wrap
Copper	Domestic Water, Gas, Drainage	Welded or Compression	Hanging / offset / Unistrut system	
Cross linked Polyethylene	Domestic Cold water, Rainwater, Recycled water,	Compression	As per the manufactured bracketing system	
Cross Linked Polyethylene – Aluminum lined	Gas	Compression	As per the manufactured bracketing system	
Concrete	Stormwater	Rubber ring	N/A	N/A
Blue line Poly	Domestic Cold water, Recycled cold water.	Welded	N/A	N/A
Medium Density Polyethylene	Gas	compression	N/A	N/A
Stainless Steel	Domestic Cold water, Rainwater, Recycled water, gas	Press Fit		
Stainless Steel	Sanitary Drainage	Rubber Ring		N/A

SECTION 3.2.9: Fire Hydrants

6 Brindabella Business Park has been provided with twenty six (26x) double head fire hydrants located throughout the site.

Each fire hydrant is installed in-accordance with the requirements of AS2419.1; Fire Hydrant Installation.

A new 150mm diameter mains cold water connection is connected to the new fire booster valve assembly located on the eastern perimeter of the site adjacent to the new mains water pit. The fire booster valve assembly connects directly to the mains water pit complete with isolation valves.

A series of new 150mm fire service cold water pipework lines are reticulated underground from the booster assembly, rising up into each associated building and connecting to each fire hydrant.

Refer to the accompanying As Installed Drawings for hydrant locations.

Each hydrant has a rated performance of 20L/s (at 200kPa).

The installation is in accordance with the requirements of AS2414 Fire hydrant Installation.

SECTION 3.2.10: Fire Hose Reels

6 Brindabella Business Park has been provided with ten (10x) fire hose reels located throughout the site.

Refer to the accompanying As Installed Drawings for fire hose reel locations.

A series of 40mm diameter cold water connections from the fire service pipework is reticulated to each fire hose reel.

The installation is in accordance with the requirements of AS1221; Fire Hose Reels and AS2441; Installation of Fire Hose Reels.

SECTION 3.3: Electrical

6 Brindabella Circuit is designed using state-of-the-art technologies for areas such as lighting, controls and metering, allowing great flexibility throughout its lifetime as well as significant energy savings.

SECTION 3.3.1: Low Voltage Power System

6 Brindabella Business Park has been provided with a new chamber substation providing a three-phase continuous duty low voltage power system.

The camber sub station comprises three (3x) transformers, relays and corresponding ACBs. The transformers feed a bus bar providing energy to the Main Switchboards and substation light and power.

The service provides nominally 400 Volts phase to phase, 230 Volts phase to neutral, 3-phase and neutral, 50 Hertz as provided by the local Supply Authority.

A 100mm diameter HDPVC underground conduit has been installed within the substation complete with draw wires for future use.

Refer to the accompanying As Installed Drawings for wiring diagrams and substation layout.

SECTION 2.3: Standby Diesel Generation System

6 Brindabella Business Park has been provided with one (1x) *Himoinsa* 1400kVA/1120kW standby diesel generation system complete with a 4,999 litres bulk fuel storage tank sufficient for 24 hours operation at full load, acoustic enclosure, controls pipework, penetrations, exhaust system, fuel transfer and polishing systems, remote refuelling enclosure, refuelling pipework, monitoring, alarming and ancillary equipment.

Diesel Generator Engine

The diesel engine is a direct injection diesel type of *Mitsubishi* manufacture, model **S12R PTA2**.

The engine is fitted with an automatic forced feed lubricating oil system with positive pressure to all working parts. There are no moving parts which require lubrication prior to the starting of the engine. The lubricating oil filter system incorporates a suction strainer and full flow replaceable element filter designed to remove any particles of size greater than 5 micron.

Alternator

The set alternator is a *Meccalte* model **ECO43 VL4A** brushless, self-regulating screen protected type, having axial flow forced air-ventilation and rated to provide overload capacity of 10% for 1 hour.

Battery and Charger

The standby diesel generation system has been provided with a starting battery of heavy duty sealed type, suitable to crank the set continuously for 30 seconds initially, and for a further similar period after 2 minutes.

The battery charger of *Deep Sea* manufacture, model DSE947MKII is connected to the essential services power supply. It is of constant potential type with built-in current protection.

Remote Status Indicator Panel (MIMIC Panel)

A mimic panel has been provided with the following functions:

Mains Available

Generator Stand-by

Generator Operational

Generator Fault

Battery Alarm

Alarm

Remote Refuelling Point

A remote refuelling point has been provided as part of the installation and is located on the southern side of the building perimeter.

The remote refuelling point includes the following:

Indicator panel incorporating:

overflow alarm indicator

bulk fuel storage tank level indicator

'Camlock' complete with lockable cap for fitting of a base building padlock.

Isolation ball valve and inline non-return valve.

15L (minimum) overflow catch can.

All refuelling pipework, supports and fixings have been included to provide a complete system.

Bulk Storage Tank

The installation includes one (1x) 4,999 litre *Fuel Chief* manufacture self bunded baffled and 4 hour fire rated bulk fuel tank, model **SuperVault SVR-4999**.

The Bulk Storage Tank is located adjacent to the Generator along the southern perimeter of the building.

Remote fuel level monitoring is via the BMS.

Generator Control

The generator will start up and operate under the following conditions:

Loss of mains supply

Manual operation without changeover

Upon loss of mains supply, the following will occur:

Generator start up after the defined time interval

Generator control system to provide acknowledgement signal to the changeover switch for the generator to take up load

Changeover switch to operate

Changeover switch to provide an acknowledgement signal to the Lift Services switchboard(s) /controller(s) for the initiation of shedding in essential mode

Changeover switch to provide an acknowledgment signal to the BMS for the initiation of mechanical services load shedding in essential mode

Upon manual operation of generator without changeover, the following will occur:

Generator start up after the defined time interval

Changeover switch to provide acknowledgement signal to BMS

Load Bank

A 600 kW resistive load bank has been provided for testing the generator set. The unit of *Viking Power System* manufacture, model **VPS60L-LBR-PLC/600M** has the following specifications:

Load Rating: 600kW @ 415 volt AC +/- 10% , 50Hz, 3 wire connection.

Load Steps: PLC controlled load step selection allowing single step load changes in 5KW increments from 0 - 600kW.

Load Modes: Manual load step application and programmable auto load test sequence mode

Fan Motor: 7.5KW, 400 VOLT +/- 10%, 50Hz ,4 pole TEFC, IP54. DOL start with thermal overload

IP65 Stainless Steel Load Resistors

Circuit Breaker Load Step Protection

Multi Function PLC Colour Touchscreen

Low-Watts Density Load Resistors

Over Temperature & Fan Fail Protection

Manual or Automatic Load Testing Control

SECTION 3.3.2: Main Switchboards

6 Brindabella Business Park has been provided with three (3x) *RN Baker* manufacture purpose built Main Switch Board (MSB) for power distribution as follows:

Designation	Area Served	Power Feed Origin
MSB-1	House Services	Chamber SubStation
MSB-2	Tenant Services	Chamber SubStation
MSB-3	CSB Services	Chamber SubStation

The MSBs are located within the North Building Basement. Each MSB is floor mounted on a new concrete plinth. Power is connected to the boards from the new incoming underground consumer mains fed from the new pad mounted transformer located within the chamber substation.

Each MSB incorporates all necessary safety elements as required by the Australian Standards. Each board has been provided with a breaker switch as per limits shown on the SLD's. Each board is rated as IP55 to AS/NZS 61439.2-2016.

Removable aluminium gland plates are provided over the cable entry.

The Incoming ACB, Feeder MCCB's & associated controls are each contained in separate individual modules within each Switchboard. Modules are arranged in vertical tier formations.

Cable compartments are provided above the incomer ACB Module & between each vertical tier of MCCB Modules.

Individual hinged front doors provide access to ACBs, MCCBs plus associated controls. Cable compartments are secured by lockable handles.

MCCB feeder doors are fitted with extended rotary handles for the operation of associated MCCB's located within each module.

Refer to the accompanying As Installed Drawings for the single line diagrams and general board arrangements.

The installation complies with AS3000: Electrical Installations.

SECTION 2.5: Power Factor Correction

6 Brindabella Business Park has been provided with two (2x) low voltage power factor correction units (PFC) connected to the electrical system. One PFC unit is connected to House MSB and the second PFC is connected to the Tenant MSB

Each unit of *Circutor* manufacture comprises a **Computer Max 6** power factor regulator and an **Optim FR P&P** capacitor bank with detuned filters. These units are 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 installation complies with the AS/NZS 3000:2008 Section 4.15.3.3, Control of capacitor bank discharge and with AS/NZS IEC 61439 Low-Voltage Switchgear and Controlgear Assemblies.

SECTION 3.3.3: Distribution Boards

6 Brindabella Business Park has been provided with twenty seven (27x) purpose built Distribution Boards (DB's) and two (2x) Meter Panels (MP's) for power to lighting, general power circuits and retail metering.

Each board and panel is of *RN Baker* manufacture as summarised below:

Power Source: MSB-1

Designation	Located / Serves	Power Feed Origin
HDB-COMMS	Basement / Comms Room DB	House Services MSB-1
HDB-NB	North Building / Basement	House Services MSB-1
HDB-NG	North Building / Ground	House Services MSB-1
HDB-SG	South Building / Ground	House Services MSB-1
HDB-N1	North Building / Level 1	House Services MSB-1
HDB-S1	South Building / Level 1	House Services MSB-1
HDB-N5	North Building / Level 5	House Services MSB-1
HDB-S5	South Building / Level 5	House Services MSB-1
DB-PV-N	North Building / Photo V Roof	House Services MSB-1
DV-PV-S	South Building / Photo V Roof	House Services MSB-1

Power Source: MSB-2

Designation	Located / Serves	Power Feed Origin
TDB-NG.1	North Building / Tenancies Ground Level	Tenant Services MSB-2
TDB-SG.1	South Building / Tenancies Ground Level	Tenant Services MSB-2
TDB-N1.1	North Building / Tenancies Level 1	Tenant Services MSB-2

TDB-S1.1	South Building / Tenancies Level 1	Tenant Services MSB-2
TDB-N2.1	North Building / Tenancies Level 2	Tenant Services MSB-2
TDB-S2.1	South Building / Tenancies Level 2	Tenant Services MSB-2
TDB-N3.1	North Building / Tenancies Level 3	Tenant Services MSB-2
TDB-S3.1	South Building / Tenancies Level 3	Tenant Services MSB-2
TDB-N4.1	North Building / Tenancies Level 4	Tenant Services MSB-2
TDB-S4.1	South Building / Tenancies Level 4	Tenant Services MSB-2
TDB-N5.1	North Building / Tenancies Level 5	Tenant Services MSB-2
TDB-S5.1	South Building / Tenancies Level 5	Tenant Services MSB-2
DB-RETAIL 1	Ground Level / Retail 1	Tenant Services MSB-2
DB-RETAIL 2	Ground Level / Retail 2	Tenant Services MSB-2
DB-RETAIL 3	Ground Level / Retail 3	Tenant Services MSB-2
DB-RETAIL 4	Ground Level / Retail 4	Tenant Services MSB-2
DB-RETAIL 5	Ground Level / Retail 5	Tenant Services MSB-2
MP-N	North Building Basement / Metering Panel	Tenant Services MSB-2
MP-S	South Building Ground / Metering Panel	Tenant Services MSB-2

Each board is constructed as single sided, indoor, free standing, fully enclosed; metal clad, which require front access to individual distribution sections & cable compartments. Refer to the accompanying As Installed Drawings for location details.

The electricity supply to the distribution boards is feed from the main switchboard, including breaker switch. A feed from the main distribution board supplies the remaining distribution boards.

All cabling to distribution boards (above and below) is on cable tray and covered with a top-hat painted the same colour as the switchboards.

Each DB incorporates all necessary safety elements as required by the Australian Standards. Each board has been provided with a breaker switch as per limits shown on the SLD's. Each board is rated as IP44, to AS/NZS 61439.3-2016.

The distribution of electricity to the lighting systems, power outlets, security systems and other electrical appliances is provided from each distribution board. The distribution boards are equipped with miniature DIN rail mounted circuit breakers and residual current circuit breakers (RCBO's) for the protection of sub circuits.

Removable aluminium gland plates are provided over each entry cable entry.

Individual hinged front doors provide access to distribution boards & cable compartments which are secured by recessed lockable handles.

Separate earth and neutral bars are located internally within each distribution module.

Each distribution board is provided with a legend card.

The installation complies with AS3000: Electrical Installations.

Refer to the accompanying As Installed Drawings for the single line diagrams and general board arrangements.

SECTION 3.3.4: Photovoltaic System

6 Brindabella Business Park has been provided with two (2x) Photovoltaic (PV) electricity generation systems, each comprising five hundred and forty eight (548x) roof mounted PV Modules, two (2x) AC / DC Power Inverter and two hundred and seventy five (275x) optimizers.

Photovoltaic Arrays

The buildings have been provided with five hundred and forty eight (548x) PV Modules arranged into six (6x) PV Arrays. The PV Modules are mounted on the roof of the buildings, at a gradient to effectively track the sun when at the highest point in the sky for maximum efficiency and electricity generation. The solar arrays are of polycrystalline construction with advanced glass and surface texture to enable high performance in low-light situations.

The PV Modules are of *Longi Solar* manufacture, **LR4-60HBD-365M** model.

Each PV Module has been provided with a DC Isolator.

Inverters

The inverter converts the generated Direct Current electricity to Alternating Current electricity for connection to the Electricity Network.

Each inverter is of *SolarEdge* manufacture, model **SE82.8K**.

Each inverter has been provided with an inverter isolator.

Surge Diverter

Each system has been provided with an surge diverter unit to protect the Electricity Network from over / under voltage and frequency.

The status of the main contactor (open / closed) is monitored and if it remains closed after a trip occurs for any reason an alarm lamp is illuminated on the switchboard and the remote monitoring contact closes to notify the system owner.

General

Power cabling connects the inverters to the IPV Distribution Board and Main Site Switchboard which feeds back to the Electricity Network and distributes power through the building via existing sub-circuits.

The system is provided with cable trays, cable ladders, supports, all ancillary equipment to complete the installation.

The system complies with AS3000: Electrical Installations.

Refer to the accompanying As Installed Drawings for the single line diagrams and general board arrangements.

SECTION 3.3.5: Power and Energy Monitoring System (PEMS)

6 Brindabella Business Park has been provided with a new Power and Energy Monitoring System (PEMS) devices including current transformers, monitoring devices, wiring systems terminations, ethernet gateways, device licences, software packages, coordination with the BMS trade for access and installation of new software platforms, reporting and logging, preparation of graphical displays, user training and testing, programming and commissioning of the EMS systems.

The EMS is connected to the Building Management System (BMS).

Multi Function Meters

TE Crompton Instruments multi function meters, model **Integra 1221** have been provided to monitor the following functions:

Voltage (line to line, line to neutral) per phase.

Current per phase.

Thermal demand current, 15 minute averaging.

kW, kVAr, kVA.

Power factor.

Frequency.

Sliding window demand for kW, kVA.

Individual and total harmonic distortion to 15th harmonic.

Total harmonic distortion (THD).

Power monitoring units have been provided as part of the installation. All power meters are connected to the EMS.

SECTION 3.3.6: Power Accessories

6 Brindabella Business Park has been provided with general power outlets as detailed on the accompanying As Installed Drawings. RCD protection has been provided by way of combination RCD protected circuit breakers for single phase circuits and three phase outlets with integral RCD protection.

All general power complies with AS3000: Electrical Installations.

All outlets, sub circuit cabling and isolators are as shown on the accompanying As Installed Drawings.

SECTION 3.3.7: General Lighting

6 Brindabella Business Park has been provided with general lighting as follows:

Symbol	Description	Manufacturer	Model Number
A1	**Model Name:** Vertex Air **Type:** Recessed LED Luminaire **Wattage:** 28W **Lumen output:** 4125Lm **IP Rating:** IP20 **Colour Temperature:** 4000K, CRI 90+	Eagle Lighting Australia	EL-VERA-2111-000

	Fitting Colour: Standard White **Dimensions:** W300mm x L1500mm **Control:** DALI Dimmable		
A2	**Model Name:** Vertex Air **Type:** Recessed LED Luminaire **Wattage:** 14W **Lumen output:** 1750Lm **IP Rating:** IP44 **Colour Temperature:** 4000K, CRI 90+ **Fitting Colour:** white powdercoat finish **Dimensions:** W300mm x L600mm **Control:** DALI Dimmable	Eagle Lighting Australia	EL-VERA-2101-000
B1	**Model Name:** Quick Fit LED **Type:** Quick Fit LED, Surface Mounted Batten Luminaire **Wattage:** 52W **Lumen output:** 6200Lm **IP Rating:** IP20 **Colour Temperature:** 4000K, CRI 80+ **Fitting Colour:** White powdercoat finish **Dimensions:** W120mm x L1525mm **Control:** DALI Dimmable	Australume	QF64003L

B2	**Model Name:** Quick Fit LED **Type:** Quick Fit LED, Surface Mounted Batten Luminaire **Wattage:** 20W **Lumen output:** 2500Lm **IP Rating:** IP20 **Colour Temperature:** 4000K, CRI 80+ **Fitting Colour:** White powdercoat finish **Dimensions:** W120mm x L665mm **Control:** DALI Dimmable	Australume	QF25001L
C1	**Model Name:** Hero Wide Beam **Type:** Surface mounted Low Bay Wide Beam Luminaire, flat glass **Wattage:** 87W **Lumen output:** 12068Lm **IP Rating:** IP66 **Colour Temperature:** 4000K, CRI 80+ **Fitting Colour:** Black powdercoat finish **Dimensions:** W307mm x L498mmH90mm **Control:** DALI Dimmable	Fagerhult	31501-461
C2	**Model Name:** Medium Downlight **Type:** Surface Mounted Can LED Medium Downlight **Wattage:** 13W **Lumen output:** 1116Lm	Unios Apex	N/A

	IP Rating: IP65 **Colour Temperature:** 4000K, CRI 90+ **Fitting Colour:** Black powdercoat finish **Dimensions:** D105mm **Control:** DALI Dimmable		
C3	**Model Name:** Medium Downlight **Type:** Surface Mounted Can LED Downlight **Wattage:** 15W **Lumen output:** 1338Lm/m **IP Rating:** IP65 **Colour Temperature:** 4000K, CRI 90+ **Fitting Colour:** Black finish **Dimensions:** D105mm **Control:** DALI Dimmable	Unios Apex	N/A
D1	**Model Name:** PLEIAD G3 COMFORT **Type:** Recessed mounting downlight reflector **Wattage:** 250 **Lumen output:** 1590Lm **IP Rating:** IP20 **Colour Temperature:** 4000K, CRI 80+ **Fitting Colour:** Specular Reflector **Dimensions:** Dia183mm x H139mm **Control:** DALI Dimmable	Eagle Lighting Australia	EL-77937-0

D2	**Model Name:** Medium Downlight **Type:** Surface Mounted Can LED Medium Downlight **Wattage:** 10W **Lumen output:** 926Lm **IP Rating:** IP65 **Colour Temperature:** 4000K, CRI 90+ **Fitting Colour:** Black powdercoat finish **Dimensions:** W50mm x H90mm **Control:** DALI Dimmable	Unios Apex	N/A
D3	**Model Name:** Laser Blade **Type:** 10 - cell Recessed luminaire - LED - Warm white, with 10 optical elements with LED lamps - fixed optics.048° BA **Wattage:** 24.5W **Lumen output:** 1850Lm **IP Rating:** IP20 **Colour Temperature:** 3000K, CRI 95 **Fitting Colour:** Black powdercoat finish **Dimensions: L**281mmx44mmx54mm **Control:** DALI Dimmable	iGuzzini	MQ83.01
D4	**Model Name:** Medium Downlight **Type:** Surface Mounted Can LED Medium Downlight **Wattage:** 10W	Unios Apex	N/A

	Lumen output: 926Lm **IP Rating:** IP65 **Colour Temperature:** 4000K, CRI 90+ **Fitting Colour:** Black powdercoat finish **Dimensions:** W50mm x H90mm **Control:** DALI Dimmable		
D5	**Model Name:** Medium Downlight **Type:** Surface Mounted Can LED Medium Downlight **Wattage:** 10W **Lumen output:** 926Lm **IP Rating:** IP65 **Colour Temperature:** 4000K, CRI 90+ **Fitting Colour:** Black powdercoat finish **Dimensions:** W50mm x H90mm **Control:** DALI Dimmable	Unios Apex	N/A
D6	**Model Name:** Laser Blade **Type:** 10 - cell Recessed luminaire - LED - Warm white, with 10 optical elements with LED lamps - fixed optics.048° BA **Wattage:** 24.5W **Lumen output:** 1850Lm **IP Rating:** IP20 **Colour Temperature:** 3000K, CRI 95 **Fitting Colour:** Black powdercoat finish	iGuzzini	MQ83.01

	Dimensions: L281mmx44mmx54mm **Control:** DALI Dimmable		
G1	**Model Name:** VFL520 LED-12 S-70 **Type:** Street and Area Lighting (Post Top). 6 M tapered octagonal column with dorr, baseplate and vertical spigot **Wattage:** 24W **Lumen output:** 1500Lm **IP Rating:** IP66 **Colour Temperature:** 4000K, CRI 90+ **Fitting Colour:** Black **Dimensions:** 6.0m x **Control:** Driver	WE-EF	108-1491
G2	**Model Name:** 2 x VFL520 LED-12 S-70 **Type:** Street and Area Lighting (Post Top). 6 M tapered octagonal column with dorr, baseplate and vertical spigot **Wattage:** 24W **Lumen output:** 1500Lm **IP Rating:** IP66 **Colour Temperature:** 4000K, CRI 90+ **Fitting Colour:** Black	WE-EF	108-1491

	Dimensions: 6.0m x **Control:** Driver		
G3	**Model Name:** VFL530 LED-12 R-65 **Type:** Street and Area Lighting (Post Top). 6 M tapered octagonal column with dorr, baseplate and vertical spigot **Wattage:** 24W **Lumen output:** 2482Lm **IP Rating:** IP66 **Colour Temperature:** 4000K, CRI 90+ **Fitting Colour:** Black **Dimensions:** 6.0m x **Control:** Driver	WE-EF	108-1151
S1	**Model Name:** Gecko Projectors LED **Type:** Flood Light **Wattage:** 12W **Lumen output:** 1650Lm **IP Rating:** IP20 **Colour Temperature:** 4000K, CRI 80+ **Fitting Colour:** Black powdercoat finish **Dimensions:** Dia149mm **Control:** DALI Dimmable	Gecko	
S2	**Model Name:** Gecko Projectors LED **Type:** Flood Light	Gecko	N/A

	Wattage: 12W **Lumen output:** 1650Lm **IP Rating:** IP20 **Colour Temperature:** 4000K, CRI 80+ **Fitting Colour:** Black powdercoat finish **Dimensions:** Dia149mm **Control:** DALI Dimmable		
R1.5000.A	**Model Name:** IGuzzini Rings **Type:** Suspended Ring Luminaire, Flood 42° fitted with 3 groups of 3xQI98.04 Downlights units **Wattage:** 8W per unit, 72 W total **Lumen output:** 584lm **IP Rating:** IP20 **Colour Temperature:** 3000K, CRI 90+ **Fitting Colour:** Black **Dimensions:** Ring Dia mm **Control:** DALI Dimmable	iGuzzini	QI98.04Black
R2.2000.A	**Model Name:** IGuzzini Rings **Type:** Suspended Ring Luminaire, Flood 42° fitted with 2 groups of 3xQI98.04 Downlights units **Wattage:** 8W per unit, 48W total **Lumen output:** 584lm **IP Rating:** IP20 **Colour Temperature:** 3000K, CRI 90+	iGuzzini	QI98.04Black

	Fitting Colour: Black **Dimensions:** Ring Dia mm **Control:** DALI Dimmable		
R3.4000.A	**Model Name:** IGuzzini Rings **Type:** Suspended Ring Luminaire, Flood 42° fitted with 3 groups of 3xQI98.04 QI98.04 Downlights units **Wattage:** 8W per unit, 72W total **Lumen output:** 584lm **IP Rating:** IP20 **Colour Temperature:** 3000K, CRI 90+ **Fitting Colour:** Black **Dimensions:** Ring Dia mm **Control:** DALI Dimmable	iGuzzini	QI98.04Black
R4.3000.A	**Model Name:** IGuzzini Rings **Type:** Suspended Ring Luminaire, Flood 42° fitted with 4 groups of 3xQI98.04 QI98.04 Downlights units **Wattage:** 8W per unit, 96W total **Lumen output:** 584lm **IP Rating:** IP20 **Colour Temperature:** 3000K, CRI 90+ **Fitting Colour:** Black **Dimensions:** Ring Dia mm **Control:** DALI Dimmable	iGuzzini	QI98.04Black

R5.2000.A	**Model Name:** IGuzzini Rings **Type:** Suspended Ring Luminaire, Flood 42° fitted with 2 groups of 3xQI98.04 QI98.04 Downlights units **Wattage:** 8W per unit, 48W total **Lumen output:** 584lm **IP Rating:** IP20 **Colour Temperature:** 3000K, CRI 90+ **Fitting Colour:** Black **Dimensions:** Ring Dia mm **Control:** DALI Dimmable	iGuzzini	QI98.04Black
R6.2000.B	**Model Name:** IGuzzini Rings **Type:** Suspended Ring Luminaire, Flood 42° fitted with 3 groups of 3xQI98.04 QI98.04 Downlights units **Wattage:** 8W per unit, 72W total **Lumen output:** 584lm **IP Rating:** IP20 **Colour Temperature:** 3000K, CRI 90+ **Fitting Colour:** Black **Dimensions:** Ring Dia mm **Control:** DALI Dimmable	iGuzzini	QI98.04Black
R7.2000.B	**Model Name:** IGuzzini Rings **Type:** Suspended Ring Luminaire, Flood 42° fitted with 2 groups of 3xQI98.04 QI98.04 Downlights units	iGuzzini	QI98.04Black

	Wattage: 8W per unit, 48W total **Lumen output:** 584lm **IP Rating:** IP20 **Colour Temperature:** 3000K, CRI 90+ **Fitting Colour:** Black **Dimensions:** Ring Dia mm **Control:** DALI Dimmable		
R8.1600.B	**Model Name:** IGuzzini Rings **Type:** Suspended Ring Luminaire, Flood 42° fitted with 2 groups of 3xQI98.04 QI98.04 Downlights units **Wattage:** 8W per unit, 48W total **Lumen output:** 584lm **IP Rating:** IP20 **Colour Temperature:** 3000K, CRI 90+ **Fitting Colour:** Black **Dimensions:** Ring Dia mm **Control:** DALI Dimmable	iGuzzini	QI98.04Black
R9.4000.B	**Model Name:** IGuzzini Rings **Type:** Suspended Ring Luminaire, Flood 42° fitted with 3 groups of 3xQI98.04 QI98.04 Downlights units **Wattage:** 8W per unit, 72W total **Lumen output:** 584lm **IP Rating:** IP20	iGuzzini	QI98.04Black

	Colour Temperature: 3000K, CRI 90+ **Fitting Colour:** Black **Dimensions:** Ring Dia mm **Control:** DALI Dimmable		
R10.3000.B	**Model Name:** IGuzzini Rings **Type:** Suspended Ring Luminaire, Flood 42° fitted with 3 groups of 3xQI98.04 QI98.04 Downlights units **Wattage:** 8W per unit, 72W total **Lumen output:** 584lm **IP Rating:** IP20 **Colour Temperature:** 3000K, CRI 90+ **Fitting Colour:** Black **Dimensions:** Ring Dia mm **Control:** DALI Dimmable	iGuzzini	QI98.04Black
W1	**Model Name:** VLS420 LED-6 A-60 **Type:** Wall Fitting **Wattage:** 18W **Lumen output:** **IP Rating:** IP66 **Colour Temperature:** 4000K, CRI 90+, IK07 **Fitting Colour:** Black **Dimensions:** 6.0m x **Control:** ECG (non Dimmable)	WE-EF	131-9853

Each lighting circuit is controlled via wall mounted switch and PIR motions sensors located within each respective zone.

External lighting is provided with a time clock / switch.

The lighting systems comply with the requirements of AS 1680 Interior and Workplace Lighting.

SECTION 3.3.8: Exit and Emergency Lighting Systems

6 Brindabella Business Park has been provided with an exit and emergency system consisting of self contained, non maintained light fittings complete with removable sealed batteries suitable for minimum 2-hours operation.

The complete emergency and exit lighting system is connected to an automatic computerised monitoring and testing system.

The light fittings are summarised below:

Symbol	Description	Manufacturer	Model Number
	**Type:** Ceiling Recessed, Circular **Operating Mode:** Non-maintained **Wattage:** 2x3W LED **IP Rating:** IP20 **Battery:** L10 Lithium Battery Pack **Classification:** C0:D50 C90:D50 **Fitting Colour:** White **Dimensions:** 85mm Cut Out, 95mm Diameter	TBC	TBC

	**Type:** Surface Mounted, High Performance **Operating Mode:** Non-maintained **Wattage:** 2x3W LED **IP Rating:** IP66/67 **Battery:** L10 Lithium Battery Pack **Fitting Colour:** White **Classification:** C0:D40 C90:D40	TBC	TBC
	**Type:** Quick Fit LED, Surface Mounted Batten Luminaire with Emergency Pack **Wattage:** 52W **Lumen output:** 6200Lm **IP Rating:** IP20 **Colour Temperature:** 4000K, CRI 80+ **Fitting Colour:** White powdercoat finish **Dimensions:** W120mm x L1525mm **Control:** DALI Dimmable	Australume	QF64003L
	**Type:** Quick Fit LED, Surface Mounted Batten Luminaire with Emergency Pack **Wattage:** 20W **Lumen output:** 2500Lm **IP Rating:** IP20 **Colour Temperature:** 4000K, CRI 80+ **Fitting Colour:** White powdercoat finish **Dimensions:** W120mm x L665mm	Australume	QF25001L

	Control: DALI Dimmable		
	**Model Name:** XTA 1.5 Square **Type:** Linear, Surface mounted with Emergency Pack **Wattage:** 20W/m **Lumen output:** 1890Lm/m **IP Rating:** IP20 **Colour Temperature:** 4000K, CRI 90+ **Fitting Colour:** White powdercoat finish **Dimensions:** 0mm Wide x 46mm Highx1120mm **Control:** DALI Dimmable	Xero Lighting	XTA 1.5
	**Model Name:** LP Ultrablade Pro Exit **Type:** Surface Mounted, Pictograph ‘Running Man’ **Operating Mode:** Maintained **Wattage:** 3.5W LED **IP Rating:** IP20 **Battery:** Lithium Iron Phosphate Battery (3.2V, 1100mAh) **Classification:** C0:E6.3 C90:E6.3 **Fitting Colour:** White	TBC	TBC

	**Model Name:** LP Weatherproof Exit **Type:** Surface Mounted, Pictograph 'Running Man' with Direction Arrows as required **Operating Mode:** Maintained **Wattage:** 2.7W LED **IP Rating:** IP20 **Battery:** Lithium Iron Phosphate Battery (3.2V, 1500mAh) **Classification:** C0:E2 C90:E2 **Fitting Colour:** White	TBC	TBC
	**Model Name:** LP Weatherproof Exit **Type:** Surface Mounted, Pictograph 'Running Man' with Direction Arrows as required **Operating Mode:** Maintained **Wattage:** 2.7W LED **IP Rating:** IP20 **Battery:** Lithium Iron Phosphate Battery (3.2V, 1500mAh) **Classification:** C0:E2 C90:E2 **Fitting Colour:** White	TBC	TBC

The emergency lighting systems comply with the requirements of AS 2293 Emergency Escape Lighting and Exit Signs for Buildings.

SECTION 3.3.9: Building Services Network & Communications Systems

6 Brindabella Business Park has been provided with a Building Services Network integrating the communication and management of the PEMS, DALI lighting, BMS, Fire Alarm system, UPS and Security systems.

The building services network (BSN) has been provided by *Airmaster.*

Communications Cabinets

The communication cabinets are provided for the data and telecommunications within each building as follows:

North Building

Reference	Location	Dimensions
Basement	MDF / DAS Room floor mounted	42RU 800mm(w) x 1200mm (d)
CSB	Wall Mounted in the Main Switch Room	12RU 600mm(w) x 550mm (d)
Ground	Mounted within Nth BSN riser	12RU 600mm(w) x 550mm (d)
Level 1	Mounted within Nth BSN riser	12RU 600mm(w) x 550mm (d)
Level 2	Mounted within Nth BSN riser	12RU 600mm(w) x 550mm (d)
Level 3	Mounted within Nth BSN riser	12RU 600mm(w) x 550mm (d)
Level 4	Mounted within Nth BSN riser	12RU 600mm(w) x 550mm (d)
Level 5	Mounted within Nth BSN riser	12RU 600mm(w) x 550mm (d)
Plant RM	Wall mounted in Nth Plant Room	12RU 600mm(w) x 550mm (d)

South Building

Reference	Location	Dimensions
Ground	Mounted within Sth BSN riser	12RU 600mm(w) x 550mm (d)
Level 1	Mounted within Sth BSN riser	12RU 600mm(w) x 550mm (d)
Level 2	Mounted within Sth BSN riser	12RU 600mm(w) x 550mm (d)
Level 3	Mounted within Sth BSN riser	12RU 600mm(w) x 550mm (d)
Level 4	Mounted within Sth BSN riser	12RU 600mm(w) x 550mm (d)
Level 5	Mounted within Sth BSN riser	12RU 600mm(w) x 550mm (d)
Plant RM	Wall mounted in Sth Plant Room	12RU 600mm(w) x 550mm (d)

The Basement communications cabinet is 45RU, floor mounted with a front hinged door. All other communications cabinets are 12RU wall mounted with a front hinged door.

All communications cabling and hardware is CAT6A.

All communications outlets are RJ45 type terminations.

Patch panels have been installed within each communications cabinet for connection and termination of each field installed data connection point and outlet.

Uninterruptible Power Supply (UPS)

6 Brindabella Business Park has been provided with a *APC* UPS system, providing 30 minutes continued electric power without interruption upon failure or deterioration of the normal power supply as follows:

Nett rating: 6kVA

Battery capacity: 8.7 minutes at half full load capacity, 2.5 minutes at full load capacity

Supply: 1 phase / 240V / 50Hz input and output.

SECTION 2.13: Security Systems

6 Brindabella Business Park has been provided with a self controlled security system comprising central supervisory system for monitoring and control, access control system including intrusion detection, intercom & CCTV systems, controllers, expanders, door reed switches, motion detectors, duress buttons, emergency break glass, egress buttons, door locking, transfer devices and all associated wiring and conduit.

Security System Control Panel

The control panel provides programming of all access control functions, with a built in memory which allows recall and display of all transactions. The status of each area is displayed on the control panel.

In the event of an alarm the following operation will take place:

Initiate audible/visual alarm on panel.

Initiate external audible/visual alarm if required.

Initiate external audible/visual alarm if required.

Transmit alarm to control station.

A Mute, Reset and Time Delay buttons are provided on the control panel with the following functionality:

Mute Button: Provide facility to silence audible alarm while retaining visual indication until alarm is cleared and device is reset.

Reset: Private Code activated facility.

Time Delay: Provide adjustable time delay (30 sec to 3 mins) on motion alarm signals in sectors. Entry and exit sector intruder alarms on path to control panel can be delayed.

In the event of a general Fire Alarm, a High Level alarm is sent to the security system, which unlocks all nominated doors.

Access Control

The access control system controls and monitors doors utilising access keys, key pads, key readers, door locks, and door monitoring switches. In the event of a power failure, the system is provided with battery back-up for 6 hours.

Entry to the building, outside normal working hours when the building is secured and only available to persons who are holders of authorised access keys.

Exit from the building is available at all times, including at controlled access points, by push-button control, local movement detector or by operation of internal door handles.

Entry via access controlled door is available to key holders only at entry points authorised to the particular keys. Entry points are individually assigned to keys.

Access controlled doors remain unlocked for an adjustable period initially set at 30 seconds. On expiry of selected time, doors will relock.

Intercom System

Intercom systems have been provided throughout the site and are connected to the main access control system.

Duress Button

Duress Buttons are located throughout the site. Buttons activate a signal on the main security control panel alerting authorised personnel of required assistance. The notification is not announced.

Emergency Break Glass

Emergency break glass buttons have been installed throughout the site. Occupants can activate an emergency by manually pressing down on the break glass window. A signal is sent to the main security control panel upon activation of any emergency break glass.

Upon receipt of the emergency signal via the main security control panel an alarm will be activated requiring manual disarming prior to switching OFF.

Equipment Specifications

Manufacture/ Supplier	Model	Description
Gallagher	C300100	Controller 6000
Gallagher	C300182	8H Communication Module
Gallagher	C200105	Dual Cabinet - with Power Supply (8A), Cool Gray
Gallagher	C300688	HBUS 16 In 16 Out Board Communication extension
Gallagher	C300480	T15 Multi Tech Card Reader, Black
Jackfuse	PP8PTC	Power Port 8PTC - Self Healing Power Distribution Module for Access Control
Lockwood	PD-102001-000	Lockwood ES2000-1 Electric Strike, 850kg, Monitored, PTL/PTO, 12V DC (SCEC)
FSH	FSH-FEM5700M	Electromagnetic Lock Standard Mag, 580kg, Single Monitored LP/LSS/DSS, Surface Mount, 12/24V DC (SCEC)
FSH	FSH-FEM5700DM	Electromagnetic Lock Standard Mag, 580kg, Double Monitored LP/LSS/DSS, Surface Mount, 12/24V DC (SCEC)
CSD	CSD-1200	12V 7.0Ah Sealed Lead Acid Battery
Sprint	SPRL22MUSHROOM	GREEN High Impact 22mm IP67 Mushroom Button & Stainless

		Steel Switch Plate
X2	X2-EXIT-021	Emergency Door Release, X2 Door Exit Resettable - Green, DPDT, Plug on Screw terminals
CSD	CSD-2000	Heavy Duty Roller Shutter door Reed switch
Aritech	1076C-N	Recessed Steel Door Contact w/Wire Leads, 3/4" Diameter, SPDT, 3/8" Gap Size, Single Pole-Double Throw, White
Avigilon	AV-NVR4X-STD-48TB-AU	Avigilon 48 TB (64 TB Raw) NVR4X Standard Video Recorder with Microsoft Windows 10 Enterprise Embedded and Avigilon Control Center
Avigilon	AV-2.0C-H5SL-BO1-IR	Avigilon 2.0 MP, WDR, LightCatcher, Day/Night, Indoor/Outdoor Bullet Camera, 3.1-8.4mm f/1.6, Integrated IR
Avigilon	AV-2.0C-H5SL-DO1-IR	Avigilon 2.0 MP, WDR, LightCatcher, Day/Night, Outdoor Dome Camera , 3.1-8.4mm f/1.6, Integrated IR
Avigilon	AV-3.0C-H4M-D1-IR	Avigilon 3.0 MP, WDR, LightCatcher, Day/Night, Indoor Dome Camera, 2.8mm f/1.4, IR

SECTION 3.3.10: CCTV Surveillance System

6 Brindabella Business Park has been provided with a digital Closed Circuit Television System (CCTV) with *Avigilon* H5A. The system equipment is rack mounted in main communications cabinet and comprises the following:

High Definition (1080P) Colour IP CCTV cameras to specified locations on the perimeter of the building.

Category 6 Class E communications cabling to all camera locations.

Computer based network video recording system (NVR) c/w backup storage.

NVR to be configured to operate all cameras.

Workstation to decode and display video streams.

“KVM” device consisting of LCD screen and keyboard interface.

Power over Ethernet (PoE) switches.

UPS providing back-up based on final system design.

Cabinet equipment including patch panels, cable management and all accessories.

TCP/IP interface to local area network to allow network access for viewing purposes.

Network software to allow viewing access to system on site and from a remote connection.

Software, programming, commissioning and testing to the proprietor’s requirements.

SECTION 2.15: Distributed Antenna System

6 Brindabella Business Park has been provided with a distributed antenna system (DAS) providing a consistent mobile service/signal throughout the site.

The system has a passive DAS technology for all current mobile technologies within 700, 800, 900, 2100, 2300 and 2600 MHz bands.

The system comprises the radio base equipment from the three major carriers located in the DAS Room connected to the distributed antenna system throughout the North and South buildings.

The equipment installed is summarised as follows:

Type	Description	Manufacturer / Model	Quantity
Antenna	Antenna Omni, SISO, 4.3-10 Female Pigtail, 617-6000 MHz	Galtronics PEAR GI0801-06971i	108
Load	Commscope	T-10-UW-43-M-i6	7
Cable	Cellflex - ⅞" Low-Loss Foam Dielectric Coaxial Cable	RFS/LCF78-50JA	-
Cable	Cellflex - 1/2" Low-Loss Foam Coaxial Cable	RFS/LCF-12-50J	-
Tail	0.5M ⅜ inch Flex RF tail 4.3-10 STR M/4.3-10 STR M	RFS/4M4MS38-0050PM	240
Tail	2.0M ½ inch Flex 4.3-10 STR M 4.3-10 STR M	Amphenol/T-AFK576-3 2M	122
Tail	4.0M ½ inch Flex 4.3-10 STR M 4.3-10 STR M	Amphenol/T-AFK576-3 4M	6
Connector	4.3-10 Female connector for ⅞" RF Coax	JMA/UXP-4F-78	292
Connector	4.3-10 Female connector for ½" RF Coax	JMA/UXP-4F-12	8
Splitter	4.8 db, DIR Couple, 698-3,800, 4.3-10	Innovatel/IN-MCPE-MD7038B - 5-155	38
Splitter	6 db, DIR Couple, 698-3,800, 4.3-10	Innovatel/IN-MCPE-MD7038B -6-155	2
Splitter	8 db, DIR Couple, 698-3,800, 4.3-10	Innovatel/IN-MCPE-MD7038B -8-155	15

Splitter	10 db, DIR Couple, 698-3,800, 4.3-10	Innovatel/IN-MCPE-MD7038B-10-155	4
Splitter	13 db, DIR Couple, 698-3,800, 4.3-10	Innovatel/IN-MCPE-MD7038B-13-155	6
Splitter	15 db, DIR Couple, 698-3,800, 4.3-10	Innovatel/IN-MCPE-MD7038B-15-155	1
Splitter	Multiband Network Combiner 4X4 Hybrid High Power, 4.3-10	Innovatel/IN-MCPE-MD7038B-155	2
Splitter	2 Way Wilkinson Splitter, 698-3800, 4.3-10	Innovatel/IN-SP2-W-638-MD	34

Refer to the accompanying As Installed Drawings for wiring diagrams and layout of the Distributed Antenna System.

SECTION 3.3.11: Free-to-air Television

6 Brindabella Business Park has been provided with Free-to-Air ‘Freeview’ television via a roof mounted antenna, wall mounted outlets, coax cabling and auxiliary equipment.

Outlet locations as shown on the accompanying As Installed Drawings.

SECTION 4: TRANSPORT FACILITIES

SECTION 4.1: Public Transport

Transport Canberra and QCity provide bus services within the Airport Precinct as follows:

ACTION bus route 3 is a regular service between Brindabella Business Park and the Canberra Airport terminal through to the City interchange, Belconnen interchange, Cohen St interchange to Spence Terminus, seven days a week including public holidays.

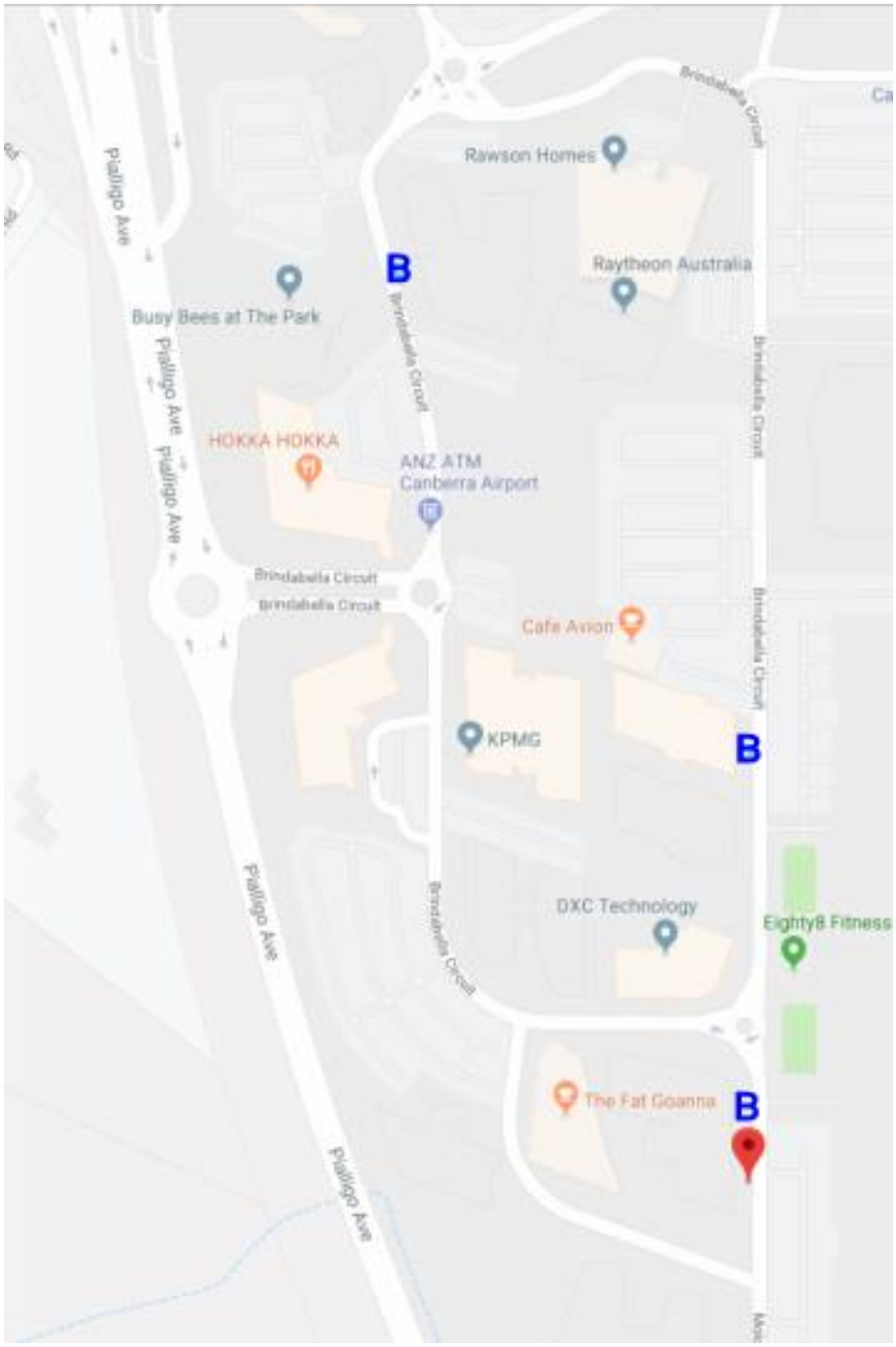
ACTION bus route 54 is a regular service between Majura Park and the City Interchange, via Campbell Park and the War Memorial, seven days a week including public holidays.

Qcity Transit bus route 834 is a service that operates Monday to Friday between Brindabella Business Park, Majura Park and the Queanbeyan interchange.

For public transport services within the ACT, please refer to ACTION's website www.action.act.gov.au for full details of timetables, maps and fares.

For public transport services to Queanbeyan, please refer to QCity website www.qcitytransit.com.au for full details of timetables, maps and fares.

Please see below for the closest bus stop location and the bus route from the Brindabella Business Park to Russell and the City Interchange;


Rawson Homes
Raytheon Australia
Busy Bees at The Park
HOKKA HOKKA
ANZ ATM
Canberra Airport
Brindabella Circuit
Cafe Avion
KPMG
DXC Technology
Eighty8 Fitness
The Fat Goanna
Pialligo Ave

SECTION 4.2: Car Parking

There is a single level basement carpark for approximately 98 cars located within the North building.

More car parking is available within the Brindabella Business Park with the main car park located parallel with the Airport runway. Restricted parking is available at 3, 5 & 7 Molonglo with 1 hour parking available in the external car park and selected tenant parking available in the undercover car park at 3, 5 & 7 Molonglo.

All other parking is pay parking. Daily parking fees can be paid at the parking machines located within the car park areas, and all other passes can be brought prior from the Airport. Business Park tenants can purchase daily tickets, money value cards (for irregular but frequent use), weekly tickets, top-up cards, and passes for monthly or longer. Parking fees are as follows:

Parking Pass	Per Day	Cost
Annual	$6.87	$1,650
6 Monthly	$7.70	$925
3 Monthly	$7.90	$475
Monthly	$8.25	$165
Weekly	$9.10	$45.50
Daily	$10.50	$10.50

SECTION 4.3: Visitor Car Parking

Where provided visitor parking is for the use of visitors and is not for use by staff. Visitor parking is restricted to either 60 or 120 minutes, as indicated by signage. Permits are not valid in visitor car-parks.

Please note that there are no free parking areas within Brindabella Business Park and Fairbairn and all car-parks in these precincts are regularly patrolled by Airport Parking Staff who can issue Parking Infringement Notices to any vehicle that contravenes parking instructions.

Parking is not permitted overnight.

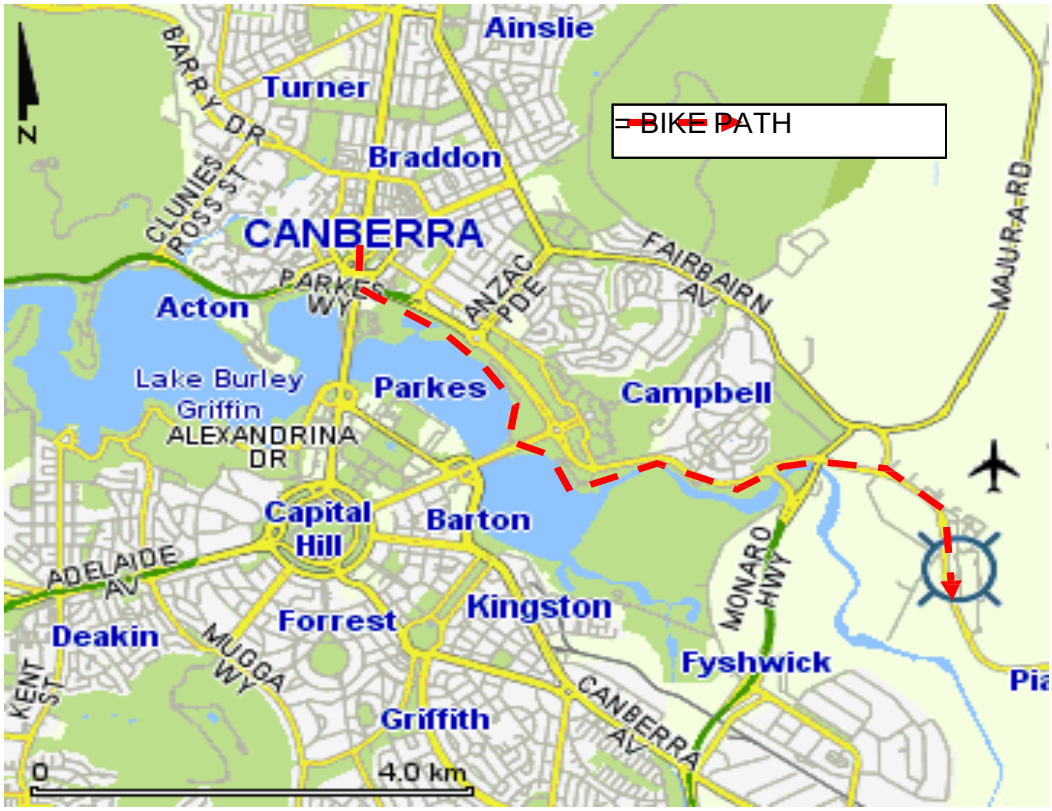
Refer to the following website for more details: www.airportbusinessparks.com.au/parking/

SECTION 4.4: Cycling

6 Brindabella Circuit has secure bike parking areas located on the Ground Floor comprising of a total of 103 bike parking slots and 48 visitor bike parking slots. There is a bike repair shop adjacent to the parking area. There are also bicycle parking stations across the Brindabella Business Park which allow for easy access to all buildings within the park.

End of trip facilities including bottle filling stations, showers and locker facilities are located on the Ground Floor of the buildings. To apply for a secure locker please contact Home Affairs Property.

The following map shows the best bike route from Civic to the Brindabella Business Park. This route is approximately 12 Kilometres and uses the bike paths around the lake it takes between 15 and 25 minutes.



SECTION 4.5: Private Vehicle Alternatives

Canberra International Airport supports reducing the number or size of vehicles used on the roads. Small cars and motorcycles typically are more fuel efficient than larger vehicles, and as such the Canberra International Airport has provided designated small parking spaces within parking areas and specific motorcycle parking areas. Large vehicles parked in the marked small vehicle spaces will be ticketed by the parking police.

Initiatives such as carpooling are recommended and supported. We recommend that the tenant set up such initiatives.

SECTION 5: MATERIALS & WASTE POLICY

Separation of waste streams, recycling of resources and reducing operational waste going to landfill is important in maintaining the Green Star rating.

Operational waste is separated into the following waste streams:

- Wastepaper
- Recycling
- General (landfill) waste
- Shredder waste
- Cardboard boxes
- Sanitary waste
- Sharps
- Medical waste

Two designated waste and recycling rooms have been provided externally to the main buildings which can be easily accessed at all times for recycled waste storage and sorting.

Canberra International Airport is committed to monitoring waste produced by all tenants, and report back on how well materials are separated for recycling. There is currently an informal competition between a number of tenants within the Brindabella Business Park to earn the title of most successful recycler.

SECTION 5.1: Recycling

To assist you with achieving recycling targets, the following is a brief summary of what can be recycled;

- All Paper and Lightweight Cardboard
- Glass Containers
- Milk and Juice Cartons
- Plastics 1, 2, 3; and

- Aluminium and Steel Cans

Please ensure all items that contained food products are rinsed before placing in recycling bins. It is recommended that the tenant provide separate bins for co-mingled waste (recyclable waste) and general waste. Tenants are not required to transport or empty recycling waste bins, as these bins will be emptied by the cleaners daily.

SECTION 5.2: Waste Removal

Waste removal and cleaning services are provided by TBC. The following table details the services provided and the frequency of each service:

Function	Frequency
Rubbish: • Empty wastepaper, recycling and garbage bins to hoppers/trash packs • Replace bin liners	• Daily • As Required
Carpeted Floors: • Remove loose paper and other rubbish • Spot vacuum all areas • Full vacuum to include edges and corners • Spot clean carpet stains	• Daily • Daily • Weekly • As Required
Resilient Floors: • Dust mop, wash and buff foyers • Wash vinyl, tiled and rubber floor surfaces • Spray buff vinyl floor surfaces and remove scuff marks • Apply polish (all resilient floor surfaces)	• Daily • Daily • Weekly • As Required
Toilets and Washrooms: • Clean and disinfect pans, seats, lids, urinals, taps, chrome fittings, pipes, doors, door handles, mirrors, basins, showers, vanity tops, etc. • Wash floors • Spot clean walls and partitions • Clean glass doors in foyer • Clean ground floor glass	• Daily • Daily • Weekly • Weekly • Weekly
Other Specific Work Included: • Sweep stairs and passageways • Sweep building surrounds and balconies • Sweep tenant exclusive-use car parks	• Weekly • Weekly • Weekly
Additional Work: • External window cleaning • Internal Window cleaning • Pressure cleaning – all buildings • Wash and degrease car parks • Clean plant room, electrical switch rooms/ utility rooms/ fire hydrant cupboards • Cleaning of Tenant showers	• 6 monthly • 6 monthly • As required • 6 monthly • Monthly • Daily

SECTION 6: CONTACT LIST

SECTION 6.1: Maintenance and Call Outs

We encourage you to inform Capital Airport Group if you experience or become aware of any aspects of repair, maintenance or lift service in the building or within the Business Park. To assist us with the efficient management of the repair we would appreciate the following information being provided;

Description and location of the repair or fault, and

Contact name and number of the person relating to the repair or fault.

SECTION 6.2: Contact Details (Monday – Friday)

Joe Lomas (Property Manager) Ph: (02) 6275 2222

SECTION 7: REFERENCES & FURTHER INFORMATION

To understand Green Star and how you can help the Capital Airport Group continue building environmentally friendly please feel free to visit the following web sites;

Energy Rating

www.energyrating.gov.au

Good Environmental Choice Australia

www.aela.org.au

Ecospecifier

www.ecospecifier.org

Green Building Council of Australia

www.gbca.org.au

Living Future Institute of Australia

www.living-future.org.au

Canberra Airport

www.canberraairport.com.au

SECTION 8: APPENDIX A

- Atelier 10 Green Star Appraisal Rev 4
- BMCS Functional Description

Green Star Design & As Built v1.2 — **APPRAISAL Rev 4**

1275 Brindabela 6 — **GS-5737DA** — **Monday, 21 June 2021**

Achievability — Four Star 45 to 59 points — Five Star 60 to 74 points — Six Star 75 or more points

67.6 Hi	41 No	109 Possible

Projected Points

Hi	No	Possible	Management			Explanation	Responsible Party	CAG BG Clause
13	1	14						
1		1	Green Star Accredited Professional	1.1	Accredited Professional	Green Star Accredited Professional active in all stages of project.	A10	
Y	-	-	Commissioning and Tuning	2.0	Environmental Performance Targets	Establish and documented project evironmental performance targets	A10	
1		1		2.1	Services and Maintainability Review	Perform comprehensive design review of services, maintainability, etc	Project Team	
1		1		2.2	Building Commissioning	Comprehensively pre-commission and commission nominated building systems	Commissioning Provider	CAG BG Clause 4.7
1		1		2.3	Building Systems Tuning	Commit to perform building systems tuning for no less than one year after occupancy	Commissioning Provider / Owner	
1		1		2.4	Independent Commissioning Agent	Engage independent Commissioning Agent to oversee commissioning process	Commissioning Provider	CAG BG Clause 4.7
2		2	Adaptation and Resilience	3.1	Climate Adaptation Plan	A project specific climate adaptation plan has been developed in accordance with a recognized standard	Project Team	
1		1	Building Information	4.1	Building Information	Make current building user information is available to all relevant stakeholders	Project Team	
1		1	Commitment to Performance	5.1	Environmental Building Reporting	Commit to reporting building environmental performance metrics over two years;	Owner	
	1	1		5.2	End of Life Waste Management	Commit to measurably reducing construction waste building upgrades and tenant end of Building	Owner	
Y	-	-	Metering and Monitoring	6.0	Metering Strategy	Provide water and energy meters for all major end users or uses	A10 / Services Engineer	ESD p11.2 Ene
1		1		6.1	Monitoring Strategy	Provide monitoring strategy to capture and process metered energy and water use	A10 / Services Engineer	BMS p10
Y	-	-	Construction Environmental Management	7.0	Environmental Management Plan	Comprehensive Environmental Management Plan in place for construction	Contractor	
1		1		7.1	Formalised Environmental Management System	Environmental Management System from EMP used through all stages of design and construction	Contractor	
1		1		7.2	High Quality Staff Support	Staff support practices are in place that; promote positive mental and phyisical health and knowledge of sustainable practices	Owner	
1		1	Operational Waste	8.1	Waste in Operations	Provide facilities to collect, process, and store multiple waste streams	Owner / Waste Auditor	p8

Hi	No	Possible	Indoor Environment Quality			Explanation	Responsible Party	CAG BG Clause
13	4	17						
1		1	Quality of Indoor Air	9.1	Ventilation System Attributes	Outdoor pollutants mitigated; ventilation system designed for cleaning + maintenance; ventilation system cleaned prior to use	Mech Eng.	Ventilation p11 Air Filtration
2		2		9.2	Provision of Outside Air	Provide 50-100% additional outdoor air, or maintain CO2 levels at 800-700 PPM. Natural ventilation spaces must comply with AS1668.2 for 2 pts	Mech Eng.	Ventilation p11
1		1		9.3	Exhaust or Elimination of Pollutants	Direct exhaust kitchens, photocopier areas, other pollution point source zones	Mech Eng.	Ventilation p11
1		1	Acoustic Comfort	10.0	Internal Noise Levels	Internal ambient noise levels, including outside and building systems sources, are suitable for activities	Acoustic	Acoustics p13
1		1		10.1	Reverberation	Reverberation levels meet AS/NZ 2107:200 Reverberation Time tables	Acoustic	
	1	1		10.2	Acoustic Separation	Reduce crosstalk between nominated spaces to weighted sound reduction index (Rw) of 45	Acoustic	
Y	-	-	Lighting Comfort	11.0	Minimum Lighting Comfort	Flicker free and high color rendition lighting	A10 / Services Engineer	Lighting p14
1		1		11.1	General Illuminance and Glare Reduction	Lighting levels and quality comply with best practice; glare is eliminated	A10 / Services Engineer	Lighting p14
	1	1		11.2	Surface Illuminance	Improve lighting uniformity through fixture type and surface properties	A10 / Services Engineer	
1		1		11.3	Localised control	Occupants provided individual control of lighting	A10 / Services Engineer	Lighting p14
Y	-	-	Visual Comfort	12.0	Glare Reduction	Fixed shares or blinds minimize direct sunlight into building	Architect / A10	p7
1	1	2		12.1	Daylight	40% / 60% of nominated area receives high daylight levels during 80% of day	Architect / A10	
1		1		12.2	Views	Direct line of sight to high quality internal or external views	Architect / A10	
1		1	Reduced Exposure to Pollutants	13.1	Paints, adhesives, sealants and carpets	Internally applied products meet stipulated VOC limits	Architect / Contractor	Internal p6/ CAG Building
1		1		13.2	Engineered wood products	95% of products meet stipulated formaldehyde limits	Architect / Contractor	Internal p6
			Thermal Comfort	14.1.2A	Thermal Comfort - Mechanical Prescriptive	Set points, modulation and zone sizes within set range. Façade performance within set range (<SHGC 0.3, <U3.0)		Thermal Zoning p12
1		1		14.1.2B	Thermal Comfort - Mechanical Performance	For 95% of nominated space, 98% of year, achieve 80% Acceptability in ASHRAE 55, OR PMV between +1 and -1; OR NatHERS 7 Star		
	1	1		14.2	Advanced Thermal Comfort	For 95% of nominated space, 98% of year, achieve 90% Acceptability in ASHRAE 55, OR PMV between +0.5 and -0.5; OR NatHERS 8 Star	A10 / Services Engineer	External Design p3

Hi	No	Possible	Energy			Explanation	Responsible Party	
7.6	14.4	22						
Y	-	-	Greenhouse Gas Emissions	15D.0	Conditional Requirement: NABERS Pathway	Meet DTS energy efficiency requirements -- OR -- NABERS Energy Commitment Agreement for a minimum of 4.5 Stars.	Project Team	
6.6	13.4	20		15D.1	NABERS Energy Commitment Agreement Pathway	Reduction of greenhouse gas emissions compared to NABERS 5-star baseline Building. 4pts = 20% ghg reduction. 'Use Green Star - Interiors Greenhouse Gas Emissions Calculator	Project Team	Environmental p1
	-	-		15E.0	Conditional Requirement: Reference Building Pathway		A10 additional	
		-		15E.1	Comparison to a Reference Building Pathway	Net zero emissions for 20pts		
			Peak Electricity Demand Reduction	16A	Prescriptive Pathway - On-site Energy Generation		A10 additional	
1	1	2		16B	Performance Pathway - Reference Building	20%=1pt, 30%=2pts		

Hi	No	Poss-ible	Transport			Explanation	Responsible Party	CAG BG Clause
5	5	10						
	3	10		17A.1	Travel Emissions Calculator	Reduce parking, make walkable, support transit, support active modes of transportation	Transport Consultant	
1	2	3	Sustainable Transport	17B.1	Access by Public Transport	Accessibility of the site by public transport. The points score is determined by completing the *Access by Public Transport Calculator*	A10	
1		1		17B.2	Reduced Car Parking Provision	Reducing number of car parks from allowable in planning provision	Project Team	
1		1		17B.3	Low Emission Vehicle Infrastructure	parking spaces and/or dedicated infrastructure is provided to support the uptake of low-emission vehicles	Project Team	CAG BG clause 4.9
1		1		17B.4	Active Transport Facilities	Bicycle parking and associated facilities are provided to a proportion of regular occupants and visitors	Project Team	
1		1		17B.5	Walkable Neighbourhoods	Walk Score of at least 80 as determined by the website www.walkscore.com. OR the project is located so that at least eight (8) amenities are within 400m of the project.	A10	

Hi	No	Poss-ible	Water			Explanation	Responsible Party	CAG BG Clause
5	7	12						
	6	12		18A	Reference Building Model	12pts requires 100% potable water produced on site	A10 additional	
1		1	Potable Water	18B.1	Sanitary Fixture Efficiency	Taps, Urinals, Toilets and Showers are within 1 star of WELS rated 6, 6, 5 and 3 stars respectively	Project Team	p8
	1	1		18B.2	Rainwater Reuse	Rainwater tank is installed to collect and reuse rainwater at a ratio of 10 L/m2	Project Team	
2		2		18B.3	Heat Rejection	2pts where no potable water is used for heat rejection	Project Team	
1		1		18B.4	Landscape Irrigation	Drip irrigation with moisture sensor override is installed, or where no potable water is used for irrigation	Project Team	
1		1		18B.5	Fire System Test Water	Test system does not expell water, or stores 80% of routine test water for reuse onsite	Project Team	

Hi	No	Poss-ible	Materials			Explanation	Responsible Party	CAG BG Clause
10	4	14						
4	1	6	Life Cycle Impacts	19.A.1	Comparative Life Cycle Assessment	Reduce building material and product environmental impacts across a range of categories through LCA or proscriptive pathways	LCA Practitioner	
2		4		19.A.2	Additional Life Cycle Impact Reporting	Report environmental impacts across five additional categories	LCA Practitioner	
		3		19B.1	Concrete	Portland cement content is reduced by 20% 1pt, or 40% 2pts. Water reduction 0.5pts, Aggregates reduction 0.5pts		
		1		19B.2	Steel	5% reduction in steel use compared to reference building		
		4		19B.3	Building Reuse	2pts Façade reuse - 80% by area 2pts Structure reuse - 60% by mass		
		3		19B.4	Structural Timber	3pts for 90% of building structure is timber		
1		1	Responsible Building Materials	20.1	Structural and Reinforcing Steel	60% of steel (by mass) from responsible manufacturers	Contractor	
1		1		20.2	Timber	95% of timber (by cost) from sustainable sources	Contractor	
1		1		20.3	Cables, pipes, floors and blinds	90% (by cost) of cables, pipes, floors, blinds either PVC free or meet Best Practice Guidelines	Contractor	
	3	3	Sustainable Products	21.1	Sustainable Products	3, 6, 9% products are recycled, reused, third-party certified, come with EPDs, or through stewardship programs	Contractor	
		-	Construction and Demolition Waste	22A	Fixed Benchmark	<10 kg/m2 = 1pts, <15 kg/m2 = 0.5pts,	Contractor	
1		1		22B	Percentage Benchmark	at least 90% of the waste generated during construction and demolition has been diverted from landfill	Contractor	

Hi	No	Poss-ible	Land Use & Ecology			Explanation	Responsible Party	CAG BG Clause
2	3	5						
-		-	**Ecological Value**	23.0	Endangered, Threatened or Vulnerable Species	demonstrate that no endangered or vulnerable species, or ecological communities were present on the site	A10 review	
	3	3		23.1	Ecological Value	the ecological value of the site is improved by the project	A10 review	
Y		-	**Sustainable Sites**	24.0	Conditional Requirement **Mandatory Requirement**	project site did not contain prime agricultural land, wetland, or impact 'Matters of National Significance'	A10 review	
1		1		24.1	Reuse of Land	75% of the site was previously developed land at the date of site purchase or, for previously owned land		
		n/a		24.2	Contamination and Hazardous Materials	the site, or an existing building, was previously contaminated and the site has been remediated		
1		1	**Heat Island Effect**	25.1	Heat Island Effect Reduction	75% of the total project site area comprises elements that reduce the impact of the heat island effect	A10 review	

Hi	No	Poss-ible	Emissions			Explanation	Responsible Party	CAG BG Clause
2	3	5						
	1	1	**Stormwater**	26.1	Stormwater Peak Discharge	Post-development peak ARI event discharge does not exceed the pre-development peak ARI event discharge.	A10	CAG BG clause 4.11
	1	1		26.2	Stormwater Pollution Targets	All stormwater discharged from site meets specified pollution reduction targets	A10	CAG BG clause 4.11
Y	-	-	**Light Pollution**	27.0	Light Pollution to Neighbouring Properties	Outdoor lighting complies with AS 4282:1997	A10	
1		1		27.1	Light Pollution to Night Sky	Minmize upward light OR Minimize light tresspass skyward and across project boundary	A10	CAG BG clause 4.11
1		1	**Microbial Control**	28.1	Microbial Control	Building is naturally ventilated and comfort conditioned OR building heat rejection systems include control measures for Legionella		
	1	1	**Refrigerant Impacts**	29.1	Refrigerant Impacts	Minimize environmental impacts of refrigerants by chosing low ODP and GWP refrgerants and implementing leak detection measures	WGE	Plant Configuration p13

Hi	No	Poss-ible	Innovation			Explanation	Responsible Party	CAG BG Clause
10	0	10						
2		2	**Innovative Technology or Process**	30.A	Onsite Renewable Energy	Renewable Energy Contribution from onsite energy generation (including shared renewable services): 5% 1pt. 10% 2pts.	Owner	
	1	1	**Market Transformation**	30.B	Soft Landings Framework	Building is designed, built, commissioned and tuned by adopting a 'Soft Landings' approach		
	1	1			Sustainable Sourcing of Aggregates	All concrete aggregates used have a chain of custody, or come from a responsible source		
	1	1			Warm Shell to Cold Shell	A specific Cold Shell strategy has been implemented or scope has changed from Warm Shell to Cold Shell following tenant engagement		
1	1	2	**Improving on Green Star Benchmarks**	30.C	Building Airtightness	1pt - Achieve 'normal' practice outcome of 7m3/(hr.m2) at 50Pa 2pts - Achieve a best practice airtightness outcome of 3m3/(hr.m2) at 50Pa	Contractor	
1		1			Ultra Low VOCs	Ultra-low VOC paints are to be used for over 50% of paint products (by volume) having a maximum TVOC content of 5g/L	Architect	
	2	2			Stormwater Pollution Reduction	All stormwater discharged from site meets the advanced pollution reduction targets		
1		1			Sustainable Transport:	No New Car Parks on Site	A10	
	1		**Innovation Challenge**	30.D	Powered by Renewables	100% Green Power		
	1	1			Local Procurement	Procure local labour, or materials, or both (2pts) with a strategy that increases rates of local procurement. Project team must set a benchmark 'business as usual' reference case, and demonstrate a significant improvement on this.		
	1	1			Community Benefits	Provide publicly accessible amenities such as: Open space, roof terrace, wifi, workspace.		
	1	1			Culture, Heritage, and Identity	Demonstrate best practice conservation refurbishment and public access to buildings listed on the Burra Charter		
	1	1			Financial Transparency	Anonymously disclose material and consulting costs of pursuing Green Star certification for GBCA annual reporting		
	1	1			Occupant Engagement	1 point is awarded where the Applicant carries out a pre and post occupancy survey.		
	1	2			Reconciliation Action Plan	Contractor must use this project in a central role for their new or ongoing/current RAP outcomes.		
1		1	**Global Sustainability**	30.E	WELL core parts pursued:	M09. Enhanced Access to Nature	A10	
1		1			WELL feature parts pursued:	W04. Enhanced Water Quality	A10	
1		1			WELL feature parts pursued:	W08. Handwashing	A10	
1		1			WELL feature parts pursued:	X07. Pesticide Use	A10	
1		1			WELL feature parts pursued:	V09. Exterior Active Design	A10	

CONTROL & ELECTRIC

Building Automation | Mechanical Electrical | Switchboards | Service PTY LTD
ACN 135 853 780

FUNCTIONAL SPECIFICATION

SIEMENS

BUILDING MANAGEMENT SYSTEM

For

Building 6
Brindabella Circuit

Prepared By

Control and Electric P\L
Units 16&17, 105 Newcastle Street
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Incorporating comments 02/02/2022

Revision History

Rev	Date	Initials	Comments	Status
A	25/06/2021	KM	For Comment	For Comment
B	31/08/2021	KM	For Approval	For Approval
C	2/02/2022	KM	Incorporating Comments	Incorporating Comments
D	22/03/2022	KM	Incorporating Comments	Incorporating Comments

Client Approval

This document has been written based on the specification and drawings for this project. It may include clarifications received from the consultant, where detail was not clear or missing from the specification, or where the specified BMS control or interface requirements were modified or changed.

This document is our interpretation of the specification in terms of the described BMS control and interface requirements, and describes in detail the strategies and functionality which will be programmed in the BMS control system for this project.

It is therefore important that this document is approved and agreed upon by all stake holders now before we start the final programming of the BMS. Changes made at a later date may incur additional costs.

Table of Contents

1 INTRODUCTION AND ABBREVIATIONS

1.1 Introduction

The following functional specification covers the operation of the building management system associated with the Building 6 Brindabella Circuit.

The BMS system controls &/or monitors the following equipment:

- Primary air-cooled thermal plant providing reverse cycle heating and cooling
- Secondary Chilled Water System (CHW)
- Secondary Heating Hot Water System (HHW)
- Secondary Tenant Supplementary Chilled Water System (CHW)
- Air Handling Units (AHUs)
- Variable Air Volume (VAV) boxes
- Fan Coil Units (FCUs)
- Return Air Fans (RAFs)
- Toilet Exhaust Fans (TEFs) incorporating Tenant Toilet Exhaust provisions
- Smoke Exhaust Fans (SEFs)
- Stairwell Pressurisation Fans (SPFs)
- Tenant General Exhaust Fans (GEFs)
- Tenant Outside Air Fans (OAFs)
- Retail Kitchen Exhaust fans (KEFs)
- Miscellaneous Ventilation Fans

1.2 Abbreviations

ABBREVIATIONS	DESCRIPTION	COMMENTS
ALN	Automation Level Network	Trunk system between PXCM
BACnet	Building Automation & Control Network	Communication Protocol
BMS	Building Management System	Apogee
BSN	Building Services Network	Interconnection of cont/Server
DDC	Direct Digital Controls	Field controllers
DXR	Digital VAV/FCU Controller	Field controllers
FLN	Floor Level Network	Network system
MMI	Man-Machine Interface	e.g. Computer, Printer
PPCL	Powers Process Control Language	Database
PTM	Point Termination Module	Field wiring connection point
PXC	Programmable Controller	DDC controller
PXCM	Modular Building Controller	DDC controller
SSTO	Start/Stop Time Optimisation	Software Program
TCP/IP	Transmission Control Protocol / Internet Protocol	Communication Protocol

The flexible architecture of the APOGEE BMS program can be customized to monitor and control one or several buildings on the one front-end computer. Any building can be linked to another building via a ALN (Automation Level Network). Any other buildings that require control and or monitoring can be linked at any stage via the ALN.

1.3 Mechanical Contractor – Design and Construct

CCS Group

19 Dalby Street

Fyshwick, ACT 2609

Phone: (02) 6203 2444

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1.4 System Design

Outside Design Conditions

- Weather Data: Canberra AMO
- Cooling Peak Load Temperature Non-Critical (Comfort) AIRAH-D09: 34.3°C DB/ 19.6°C WB
- Heating Peak Load Temperature Non-Critical (Comfort) AIRAH-D09: -2.2°C DB 80%RH
- Load Profile: Commercial Building (Offices & Retail)
- Hours of Operation: 8am-5pm provide economical after-hours operation on sections of each floor not exceeding 600m2.

Indoor Design Conditions

Area	Comments
Cooling/Heating	Air Source Heat Recovery Chiller, Reversible Heat pumps located in the Central Services Building
Open Plan Office	Dedicated AHUs within plantrooms serving each floor based on Zones with VAV & Reheat. FCUs in GF for offices and retail
Public Amenities	This area is served by dedicated FCU.
Kitchen / Kitchenette	Individual FCUs, with outdoor air ducted from the façade using louvres. Dedicated exhaust. No humidity controls. Provision of Outside Air (OA) end-capped and kitchen exhaust ductwork for tenant connection (by others)
Communication Room	Concealed FCU, with OA ducted from a common riser. No humidity controls.
Car Park	Dedicated Car Park Exhaust provided within the basement. Only required in the North Building.
Air Quality	Air quality is a very important aspect of occupancy well-being. All air conditioning systems shall be provided with pre and final filtration in accordance with the Australian Standards.

	CO2 control to 700 ppm max and measured at each temperature sensor location in office spaces. Outside Air of 12.1 Lts/sec High Efficiency F7 filtration

2 DESCRIPTION OF THE BUILDING MANAGEMENT SYSTEM

2.1 2.1 Principles of PXC Modular Operation

A PXC Modular gathers information about the environment of your facility and about the equipment it monitors and controls. The PXCM, receives updated information, stores information, executes control programs, handles operator commands and requests, and makes control management decisions. At the same time, the PXCM also translates decisions into actions and allows the operator to observe those actions; the operator can also override and modify the decisions made by the PXCM**.**

2.1.1 Gathering and Processing Field Inputs

The PXCM samples its field inputs, or points, for information approximately once every second and stores numerical representations of these values. Next, any points, which require additional handling, are checked, such as making a log entry in a point history file or notifying an operator of an alarm condition. The PXCM then takes the required action; that is, it adds current information to the history file or sends an alarm message to the proper location.

2.1.2 Executing Control Programs

The PXCM continuously executes a user-defined set of instructions called the control program. This program uses the most recent point values and the most recent clock time. The control program performs the following functions:

- Evaluates control strategies
- Uses an internal calendar and time clock for time based functions.
- Updates point values and commands field points according to the program results.
- Send alarms, messages, or reports to proper terminal locations as needed.

Example: Consider the following specifications for fan control:

During the day a fan turns ON if the room temperature rises above 27°C and turns OFF when the temperature drops below 23°C. Between 5:00pm and 7:00am the fan is turned OFF. If the temperature rises to 29°C, then the PXCM sends and alarm message to an alarm printer. You can meet this specification by doing the following:

- Connect a room temperature sensor/transmitter and fan starter to the PXCM.
- Define the room temperature sensor with a high alarm limit of 29 °C and the fan points in the PXCM database.
- Write a short control program, which defines your control strategy.
- Enable the execution for that portion of the control program.

To perform this control strategy, the PXCM executes the control program. It samples an electronic bead type, current or voltage signal representing the room temperature and updates the value associated with that temperature in its memory. If the temperature rises to 29°C then the PXCM sends an alarm message to the printer. It checks the current time once per second. If the time is after 5:00pm the control program checks the current value of the temperature and sends the appropriate ON or OFF command to the fan starter. As the command to start the fan is issued, the PXCM updates the value of the starter point in its memory to reflect the current state of the fan.

2.1.3 Processing Operator Commands

A user issues commands or requests to the PXCM using an operator terminal and the operator interface program that resides in the PXCM. The operation that a user can perform depends on their account privileges.

Access levels are the privileges that users are granted to objects i.e. Graphics Programs and Points. There are four access levels: No access, Read only, Command and Command and Edit. Each of these

levels can be assigned to field panel functions. When a user is assigned No access to an object, the related prompts are not displayed in the menus when that user is logged on.

The following access levels are available for object.

No Access – User cannot see the function

Read Only – User can only view the value or status of objects.

Command – Users can command the value or status of objects, as well as view.

Command/Edit – Users can add, delete, command, modify and view objects.

The access level determines the extent a user can use an application or function. For example, if a user command access to point editing, then only the functionality needed to command a point is available. The user would not have the prompts available to add, modify or delete a point definition.

2.1.4 Peer to Peer Networking

Up to 100 nodes per trunk and up to 4 trunks per Insight can be connected and can communicate by means of a Protocol 2 (P2) peer to peer network or BACnet IP. Information can be shared and accessed across the network from any PXCM by means of a communication link. This link is known as the Automation level network (ALN) trunk system. The ALN trunk system can be a physical wire, dedicated telephone lines, Fibre Optic cable or a dial up telephone lines. The trunk system provides connections within building or between buildings for multiple field panels and operator workstation.

More than one operator can access the network at a time. For example, as one operator accesses the system, another operator can access the system.

When an operator issues a command over the network, the PXCM at which the operator issued the command validates the command, determines where the command is to go, and passes the command to the destination over the network. A command issued by the operator at the PXCM located in any part of the building is sent by means of the communication trunk to the PXCM located in any other part of the building for the purpose of controlling the main air-handling unit of the building.

2.2 Installed Hardware

The following field panels are installed on this project:

Node	Type	Location	Serves
BRIN.6BN.NODE10	PXC Modular	Main CHW Plant – L6	Chiller Set 01,02 & 03 Secondary CHW & HHW system
BRIN.6BN.NODE11	PXC Modular	MSSB-N-L3	North Centre Zones
BRIN.6BN.NODE12	PXC Modular	MSSB-N-L3	North Perimeter Zones
BRIN.6BN.NODE13	PXC Compact	MSSB-N-B	Basement Equipment
BRIN.6BS.NODE14	PXC Modular	MSSB-S-L3	South Centre Zones
BRIN.6BS.NODE15	PXC Modular	MSSB-S-L3	South Perimeter Zones

2.2.1 BacNET PXC Modular with TX-I/O

2.2.1.1 Description

The Modular PXC Modular Controller is a high performance, modular DDC supervisory field panel. The field panel operates stand-alone or networked to perform monitoring functions without relying on a higher-level processor.

PXC Modular functionality includes the following:

- Modular TX-I/O hardware components to match equipment to initial monitoring requirements while providing for future expansion.
- With the addition of TX-I/O modules and a TX-I/O Power Supply on a self-forming bus, the PXC Modular can directly control up to 500 points.
- Modular, snap-in design simplifies installation and servicing.
- Integration platform for communications and interoperability with other systems and devices.
- Custom program sequences to match equipment control applications.
- Comprehensive alarm management, historical data trend collection, operator control and monitoring functions.
- Support for peer-to-peer communications over Industry standard 10/100 Base-T TCP/IP networks.
- Local operator interface that incorporates advanced audit trails to track operator actions made at the PXC Modular panel.

TX-I/O is a line of I/O modules with associated power and communication modules for use within the APOGEE system. TX-I/O products include eight types of I/O modules, modular TX-I/O Power Supplies, Bus Connection Modules, and Bus Interface Modules.

TX-I/O Modules provide I/O points for APOGEE based upon TX-I/O Technology. TX-I/O Technology provides flexibility of point types, tremendous flexibility of signal types and support for manual operation. There are eight types of TX-I/O modules:

- 8 point DI module (TXM1.8D)
- 16 point DI module (TXM1.16D)
- 6 point DO with Relay module (TXM1.6R)
- 6 point DO with Relay and Manual Override module (TXM1.6R-M)
- 8 point Universal module (TXM1.8U)
- 8 point Universal with local override/identification device (LOID) module (TXM1.8U-ML)
- 8 point Super Universal module (TXM1.8X)
- 8 point Super Universal with LOID module (TXM1.8X-ML)

The self-forming TX-I/O bus transmits power as well as communication signals. The TX-I/O bus can be extended a maximum of 50 meters.

Hot-swappable electronic components allow powered electronics to be disconnected and even replaced without removing terminal wiring or disturbing the self-forming bus.
The removable label holder allows for customized point labels.
LEDs provide status indication and diagnostic information for the I/O module, as well as for each point on the module.

All TX-I/O modules are also:

- DIN rail mounted
- High density (point count to physical dimensions)
- Hardware addressed with address keys
- Separable into terminal base and plug-in I/O module electronics for:

− Improved installation workflow, allowing field wiring to be terminated prior to installation of electronics.

2.2.2 BACnet DXR2 Compact Room Automation Station

2.2.2.1 Description

BACnet Compact Room Automation Stations (DXR2) operate stand-alone or connected to a BACnet MSTP (Master Slave Token Passing) or Ethernet Floor Level Network (FLN) to perform complex HVAC control, monitoring and energy management functions. A DXR2 can be loaded with an array of control applications specific to the HVAC industry. The control application selected is dependent upon the hardware platform selected and the terminal application requirements i.e., Variable Air Volume (VAV) control, Fan Coil Unit (FCU) control, Electric Duct Heater (EDH) control etc.

BACnet Compact Room Automation Stations are available in several hardware platforms to support different control applications. Units are available with differing numbers of on-board I/O, as well as with and without built in velocity measurement (for VAV applications).

A BACnet MSTP or Ethernet FLN connection not only allows for global commanding but allows the DXR2's control variables to be monitored at the field panel for graphical and alarming purposes.

3 Point Database

3.1.1 Overview

This section presents a description of the PXCM point database including point definition information, dynamic point information, point database structure, point addresses, and slopes and intercepts.

Most tasks, which the PXCM performs, involve either collecting measurements and other data from field hardware points or commanding them. Other tasks require communication and calculations within the control programs using store information. Operators also need a practical method of commanding and examining points. With the PXCM, operators use the commands and menu-driven prompts of the operator interface. The information that the PXCM needs on all points whether it is associated with the field hardware or is store information is called the *point database.*

Supplying the PXCM with logical points and information about the points creates the point database. There are two basic classifications of point information that make up the point database: information used to define points and information, which is updated or set during operation of the system.

3.1.2 Logical Points

The operator and the control program to reference physical or virtual points for commanding or monitoring purposes use logical points. Logical points handle alarming, totalisation, conversion of field inputs and outputs to engineering units, and so on.

3.1.2.1 Physical Points

Physical points are determined by the hardware that is connected to the PXCM. They each have a unique eight character point address that precisely defines the location of the hardware termination in the system by its network, field panel number, field device, and point termination number. The four types of physical points are as follows:

- Analogue Input (AI) points which receive/monitor variable signals.
- Analogue Output (AO) points which generates variable signals.
- Digital input (DI) points which receive/monitor two states (ON/OFF) signals. Pulse counting points are digital inputs, which count pulses from an input signal.
- Digital Output (DO) points which generates two states (ON/OFF) signals.

3.1.2.2 Virtual Points

Virtual points are identical to physical points in structure; however, they do not correspond to actual hardware terminations. Their point addresses specify “imaginary” terminations. Operators or the control programs to hold or store information use virtual points.

3.1.3 Point Definition Information

The information used to define a point in the point database is called *point definition information.* This information describes the characteristics of a point and changes only if you edit the database. The following information describes the various types of information you may be required to supply about a point when you define it in the point database.

3.1.3.1 Point Name/Point System Name

The point name and point system names are the labels that identify a particular point in the database. The point system name permanently identifies the point in the database, and cannot be modified. The point name can be modified after the point is defined in the database, and can be customised when needed.

Having two names provides the ability to customise the database without affecting the control of the system. PPCL programs (which exclusively use the point system name) remain unchanged if the point is changed.

Naming conventions allow you to use 1 to 30 characters for either name. Valid characters include the following: A-Z, a-z, 0-9, spaces ( ), periods (.), commas (,), dashes (-), underlines (_) and apostrophes (‘).

3.1.3.2 Point Naming Convention

The following point naming convention is incorporated in this project:

North Building

Point system name:

6B-N.L3.AHUC.CHWV

Site	**6 B**RINDABELLA – **N**orth Building
Location	**L3**
Equipment	**A**ir **H**andling **U**nit **C**
Variable	**CH**ILLED **W**ATER **V**ALVE

DXR2 Sub Point system name:

6B-N.VV-N-1-01:ROOM TEMP

Site	**6 B**RINDABELLA – **N**orth Building
Type	**V**A**V**
Location	**N**orth Side
Level	Level **1**
Equipment No	VAV No **01**
Sub Point	**ROOM TEMP**

South Building

Point system name:

6B-S.L3.AHUC.CHWV

Site	**6 B**RINDABELLA – **S**outh Building
Location	**L3**
Equipment	**A**ir **H**andling **U**nit **C**
Variable	**CH**ILLED **W**ATER **V**ALVE

DXR2 Sub Point system name:

6B-S.VV-N-1-01:ROOM TEMP

Site	**6 B**RINDABELLA – **S**outh Building
Type	**V**A**V**
Location	**N**orth Side
Level	Level **1**
Equipment No	VAV No **01**
Sub Point	**ROOM TEMP**

3.1.3.3 Point Types

There are 12 types of logical points. Each point type requires you to supply a specific set of information about it in the point database.

Logical Analogue Input (LAI). An LAI point provides one analogue input point. You can use this point type to process input signals from sensors such as temperature sensors, flow sensors, pressure sensors, and so on.

Logical Analogue Output (LAO). An LAO point provides one commandable analogue output point. You can use this point type to process output signals to devices such as valve actuators, damper motors, and so on.

Logical Enumerated (LENUM). A LENUM point provides multiple numeric values. Each value is associated with a state text entry. You can use this point to store operational values for an SSTO application.

Logical Digital Input (LDI). An LDI point type monitors one latched digital input. You can use this point to monitor the status of door contacts, fan proofs, smoke detectors, low temperature detectors, flow switches, damper end switches, limit switches, and so on.

Logical Digital Output (LDO). An LDO point provides one commandable latched or pulsed digital output for two states (ON/OFF) control. You can use this point type to provide output signals to switches for lighting, occupancy indication, and so on. LDO points can also be used to store ON/OFF values.

Logical Fast/Slow/Stop Latched (LFSSL). An LFSSL point provides two commandable latched digital outputs (FAST/SLOW and STOP) and optional monitoring of one latched digital input. You can use this point type for control of two speed latched motor starters with optional proof indication.

Logical Fast/Slow/Stop Pulsed (LFSSP). An LFSSP point provides three commandable, pulsed digital outputs (FAST/SLOW/STOP) and optional monitoring of one latched digital input. You can use this point type for ON/OFF and automatic control of latched motor starters with proof indication.

Logical On/Off/Auto Latched (LOOAL). An LOOAL point provides two commandable latched digital outputs (ON/OFF and AUTO) and optional monitoring of one latched digital input. You can use this point type for ON/OFF and automatic control of latched motor starters with proof indication.

Logical On/Off/Auto Pulsed (LOOAP). An LOOAP point provides two commandable pulsed digital outputs (ON and OFF), one commandable latched output (AUTO), and one latched digital input for proof. You can use this point type for ON/OFF and automatic control of pulsed motor starters with proof indication.

Logical Pulse Accumulator Input (LPACI). An LPACI point counts pulses for one digital input. You can use an LPACI point to count the number of pulses from an input, such as a meter, and to totalise the values from the meter, such as kilowatt-hours. You can use this point type for flow meters, power meters, and so on.

Logical Two State Latched (L2SL). An L2SL point provides one commandable latched digital output (ON/OFF) and optional monitoring of one latched digital input for proof. You can use this point type for control of devices such as latched motor starters with proof indication, such as fans or pumps.

Logical Two State Pulsed (L2SP). An L2SP point provides two commandable pulsed digital outputs (ON/OFF), and optional monitoring of one latched digital input for proof. You can use this point type for control of pulsed (push button) motor starters with proof indication, such as fans or pumps.

3.1.3.4 Point Description

The point description for a logical point is a string of 0 to 12 alphanumeric characters or blank spaces. Point descriptors help you to identify points when they are displayed at an operator's terminal or in reports. The system or the operator to request displays or to command points does not use point descriptors. Therefore, point descriptors need not be unique and they may even be left blank. Examples of point descriptors are as follows:

Point Name	Point Description
LC_CHW_CHILLER1_LWT	CHW LEAVING TEMP
LC_CHW_CHILLER1_STS	CHILLER1 STATUS

3.1.3.5 Alarm Information

The alarm option of a point applies to all logical point types. You can specify whether or not you want the point to be alarmable. When you specify that a point is alarmable, then the system may request additional information such as the values of the high alarm limit to define the conditions under which the point is put into or taken out of alarm. These conditions vary with point type and the individual point requirements. You also have the option of determining where the alarms will be displayed or printed.

3.1.3.6 Point Address

The point address applies to all logical point types. The point address is a unique eight-digit number that defines exact location of the point. As a rule no two point addresses are the same. A point address contains the following four parts, each of which tells the PXCM/RBC something about the point.

Field panel – The field panel identifies where the point resides. Field panel numbers can range from 1 through 100.

FLN trunk number. The FLN number identifies if the point resides in a FLN device. For points terminated within the PXCM/RBC, the FLN number must always be 0. For points residing in a FLN device, the trunk number identifies the FLN trunk on which the FLN device resides. Acceptable FLN trunk values are 1, 2 or 3.

Drop – The number from 000 to 255 that identifies the point termination module (PTM) or an FLN in which the point resides. If the point resides in a field panel, the Drop number is the number on the address key on the PTM. If the point resides on a FLN device, the Drop number is the FLN device number.

Point. Each point terminated in an PXCM/RBC has a unique point number associated with it. The point number is determined by the type of Point Termination Module it terminates in and the number on the address key that is inserted into the module. Modules may have up to four physical points each, so every module takes up four addresses. Modules are addressed by inserting the address key. The address keys are numbered 1 to 74 descriptions of point termination modules and placement of the address key.

3.1.3.7 Totalise Information

All logical point types except LPACI and LENUM points may be totalised. Totalising a point allows the system to keep track of information about the point such as run time for fans and pumps, total volume from a flow rate sensor, degree days, and so on. Point information may be totalised in hours, minutes or seconds.

3.1.3.8 Engineering Units

Engineering units are units of measurement associated with the value of logical analogue (LAO and LAI) and logical pulse accumulator (LPACI) points. Engineering units are expressed in English units or SI units.

3.1.3.9 Slope and Intercept Constants

Slope and intercept constants are numeric factors that are used to convert the digital units that the PXM uses into the appropriate engineering units that are meaningful to the user. Slope and intercept constants are necessary for analogue points and are determined by the type of field input and output that is represented by the physical point. When adding an analogue point to the database, the operator interface program at your terminal prompts you for the slope and the intercept constants for the point.

Slope and intercept constants for physical points. Physical points, field inputs and outputs are represented in engineering units such as pressure, amperage, voltage, temperature, and others.

3.1.3.10 Sensor Types

Sensor types apply to all physical LAI points. These points must be defined in the point database as receiving input that is either current (4 to 20 mA), voltage (0 to 10 Vdc), Thermistor, or L-type (a sensor that is terminated on a FLN device).

3.1.3.11 COV Limit

The Change-of-value (COV) limit applies to LAI, LAO, and LPACI points. This specifies the amount of change a point can experience before the system reports the change.

3.1.3.12 Initial Value

Initial value applies to LAO and LPACI points. The initial value of a point is the value of the point when it is first entered into the point database until it is commanded or receives a COV. The initial value is a numeric value that can be negative, positive, a decimal, or an integer.

3.1.3.13 English, SI Units

English, SI Units applies to LENUM points. The prompt for English, SI Units allows you to specify if the system should display units in English units or SI units.

3.1.3.14 Normally Closed

Normally closed applies to LDI points and to the proof portion of LFSSL, LFSSP, LOOAL, LOOAP, L2SL, and L2SP points. This information allows you to specify if the contacts that are associated with the point are open or closed in the de-energised state. An input of Y (Yes) indicates that the contacts are open in the de-energised state.

3.1.3.15 Gain

Gain defines the gain of the application for LPACI points. The value you set for gain applies to the number of engineering units represented by each pulse count. Gain can be a numeric value from 0.001 to 5000.0.

3.1.3.16 Count Both Edges

Count both edges apply to LPACI points. If an LPACI point is specified to have both pulse edges counted, it is the same as doubling the gain and dividing the COV limit in half; that is, one ON/OFF pulse counts as two inputs.

3.1.3.17 Invert Value

Invert value applies to LDO, LFSSL, LOOAL, LOOAP and L2SL points. Invert value allows you to reverse the energise and de-energise commands when the command is applied to the output point.

3.1.3.18 Proof

Proof applies to LFSSL, LFSSP, LOOAL, LOOAP, L2SL and L2SP points. Proof specifies a DI proof point that is to be monitored. If you select proof, you can also specify a proof delay and whether the contacts that are associated with the point are open or closed in the de-energised state. A proof delay sets the amount of time (in seconds) that the system waits before checking a proof. Using a proof delay prevents nuisance alarms. Valid entries are from 0 to 32,766 seconds.

3.1.4 Dynamic Point Information

Dynamic point information is information in the database that is continuously updated or changed during the operation of the system. Dynamic point information is not part of the data you enter when first defining a point in the database. Dynamic point information includes the following:

- Current value
- Point condition
- Command priority
- Alarm priority
- Digitised value
- Totalised value

3.1.4.1 Current Value

The current value of a logical point is displayed in units that are meaningful to the user. For LAI, LOA, and LPACI point types, the current value is displayed in engineering units. For other point types, the value is the last commanded or sensed state of the point. For example, the current value of an LDO point type may be displayed as ON or OFF. Output point values may be commanded by the operator or by the control program. Input point values or states are determined by changes sensed in the field hardware and transmitted to the PXM or assigned by the control program.

3.1.4.2 Point Condition

The condition of a logical point may be normal or non-normal.

3.1.4.3 Command Priority

The priority of a logical point is set by the last successful source of command to a point. Commands have rankings in terms of where they originate. The command can originate from an operator or from the control program. Most control program statements do not command points above priority NONE. Special control program statements command points at EMER and PDL priorities. A point can only be commanded again by a source that is of equal or greater value than its current priority. All operator (OPER) commands are of the same priority. Command priorities, in order from highest to lowest are as follows:

• Operator (OPER).	Originates from any operator command.
• Smoke Control (SMOKE).	Used for smoke control applications.
• Emergency (EMER).	Originates from control program emergency commands.
• Peak Demand Limiting (PDL).	Originates from control program Peak Demand Limiting commands.
• None (NONE).	Point is not under priority control.

3.1.4.4 Alarm Priority

The alarm priority of a logical point ranks the severity of the alarm from the lowest priority (1) to the highest priority (6).

3.1.4.5 Digitised Value

The digitised value of a logical point is an integer value used by the Open Processor to determine logical value, state, and the condition of logical points. Each logical point has a digitised value for each physical and virtual point associated with it.

3.1.4.6 Totalised Value

The totalised value of a logical point applies to all logical point types except LPACI points. This value is a sum of information about a point such as run time total volume, degree days, and so on. Point values may be totalised in hours or minutes.

4 Primary Thermal Plant

4.1 Thermal Plant overview

The primary thermal plant is an all-electric system utilising air-cooled reverse cycle chillers to provide both heating and cooling inclusive of tenant supplementary cooling. The primary plant consists of 3 air-cooled machines of the 4-pipe type that can deliver cooling and heating simultaneously or in isolation. Each machine incorporates integrated primary water pumps and delivers CHW at supply/return temperatures of 7.0/12.0℃ and HHW at supply/return temperatures of 45.0/40.0℃. Each Chiller has cooling capacity approximately 700 kW and a heating capacity of approximately 540 kW. The thermal plant and pumps are located on Level 6 of the North building and the plant serves both the North and South buildings. Supply and return pipes are both reticulated to and from the South building at high level through the roof structure over the plaza area between the two buildings. The field valves are of 2-way PICV type throughout the hydraulic system.

4.1.1 Thermal Plant Active BASE Initial Sequence

The primary chilled water circuit includes a lead/lag/lag chiller with associated pump configuration. The chiller system are automatically rotated every 24 hours, prior to plant start-up. Run hours of each chiller systems is logged by the BMS by totalising the compressor status (HLI dependant). The chiller system with the minimum run hours will be set as the lead system, the chiller system with the second lowest run hours lag chiller system and the chiller system with the max run hours will be the 2nd lag chiller system. The BMS will attempt to maintain an even hour's runtime for each chiller system.

If the lead chiller system presents an unavailable condition the lead chiller system will stop and made unavailable and the lag chiller system will be called to run. Every time there is a sequence change in the system the lead/lag/lag sequence will be reset as per the above logic to maintain the even run hours.

When the faulted chiller system unavailable condition has been rectified the BMS will then reselect the lead chiller system with the lowest run hours and resume normal operation.

The initial chiller system sequence will be set to 123 on the first cooling call.

4.1.2 Thermal Plant Heating and Cooling System Look Up Table

The primary chilled water circuit includes a lead / lag/ lag chiller system with associated pump configuration.

If there are no unavailable conditions present in the system as stated above, then the active sequence will be set to the base sequence (run hours). If an unavailable condition occurs the active sequence will take priority for setting the system sequence as per the below table. Once all unavailable conditions are reset then the active sequence will be set to the base sequence once again.

The active sequence is determined by the above availability conditions in a lookup table scenario below. The logic is as follows:

Chiller Normal Look Up Table:

0 = Normal/ 1 = Fault

	Fault	Software BMS Graphic Maint.	Pump Alarm	VSD Fault	VSD OFF	Heating Chiller System Avail.	Chiller Sys. Clg. Avail.	Chiller Sys. Avail
Chiller Fault	**1**	**0**	**-**	**-**	**-**	**UNAVAIL**	**UNAVAIL**	**UNAVAIL**
Chiller Maint	**0**	**1**	**-**	**-**	**-**	**UNAVAIL**	**UNAVAIL**	**UNAVAIL**
Chiller Fault & Maint	**1**	**1**	**-**	**-**	**-**	**UNAVAIL**	**UNAVAIL**	**UNAVAIL**
Chiller Normal	**0**	**0**	**0**	**0**	**0**	**AVAIL**	**AVAIL**	**AVAIL**
Cooling Pump Alarm	**-**	**0**	**1**	**0**	**0**	**AVAIL**	**UNAVAIL**	**HEATING ONLY (2nd LAG)**
Cooling Pump Maint	**-**	**1**	**0**	**0**	**1**	**AVAIL**	**UNAVAIL**	**HEATING ONLY (2nd LAG)**
Cooling Pump VSD Fault	**-**	**0**	**0**	**1**	**0**	**AVAIL**	**UNAVAIL**	**HEATING ONLY (2nd LAG)**
Clg Pump Normal	**-**	**0**	**0**	**0**	**0**	**AVAIL**	**AVAIL**	**AVAIL**
Heating Pump Alarm	**-**	**0**	**1**	**0**	**0**	**UNAVAIL**	**AVAIL**	**COOLING ONLY (2nd LAG)**
Heating Pump Maint	**-**	**1**	**0**	**0**	**1**	**UNAVAIL**	**AVAIL**	**COOLING ONLY (2nd LAG)**
Heating Pump VSD Fault	**-**	**0**	**0**	**1**	**0**	**UNAVAIL**	**AVAIL**	**COOLING ONLY (2nd LAG)**
Htg Pmp Normal	**-**	**0**	**0**	**0**	**0**	**AVAIL**	**AVAIL**	**AVAIL**

4.1.3 Thermal Plant Heating and Cooling System Active Sequence Matrix

On an initial start on a cooling / heating call of the plant if the system active sequence set by the base sequence is 123 then chiller 1 system will be activated in the same mode as the call. When the opposite system call i.e., heating mode is activated then the heating system of the already active chiller will also be enabled.

System Sequence Look Up Table:

Act Seq	CH1 Heat	CH1 Cool	CH2 Heat	CH2 Cool	CH3 Heat	CH3 Cool
123	**Lead**	**Lead**	**Lag**	**Lag**	**2nd Lag**	**2nd Lag**
132	**Lead**	**Lead**	**2nd Lag**	**2nd Lag**	**Lag**	**Lag**
213	**Lag**	**Lag**	**Lead**	**Lead**	**2nd Lag**	**2nd Lag**
231	**2nd Lag**	**2nd Lag**	**Lead**	**Lead**	**Lag**	**Lag**
312	**Lag**	**Lag**	**2nd Lag**	**2nd Lag**	**Lead**	**Lead**
321	**2nd Lag**	**2nd Lag**	**Lag**	**Lag**	**Lead**	**Lead**

Notes:

- Complete and periodical rotation occurs every 24 hours to even out the number of hours of each chiller sets. For instance, if initial sequence is 123, after 24 hours, the new sequence will be 231 if Chiller set 2 is the next one with the least number of hours compared to Chiller set 3.
- An induced rotation will occur if part of or the complete chiller set is in fault. For instance, if active sequence is 123 and chiller set 2 cooling pump is faulty, the Chiller set 2 will go to the 2nd lag position irrespective of its running hours, so sequence will change to 132.

5 Chilled Water (CHW) System

5.1 Overview

The CHW is a primary/secondary pumping system with two secondary circuits. The secondary system is decoupled from the primary loop via a thermal buffer tank with primary flow and temperature conditions monitored by a “production” thermal energy meter and temperature sensors in the primary loop.

There are two secondary CHW circuits serving the North and South buildings, fed from a single pump set. The pump set consists of three pumps, each fitted with a variable speed drive. Each of the base building pumps is sized for 33% duty to provide 66% redundancy such that the three pumps operate in a lead/lag arrangement. Pumps operating in parallel shall run at a common shaft speed.

5.2 CHW Plant System Equipment

The primary CHW plant consists of the following equipment:

1. Three (3) Aermec 4-pipe Air Cooled Chillers of model NRP-2606-A-4-PH-RG
2. Three (3) ABB Variable Speed Dedicated Primary Chilled Water Pumps.
3. Three (3) ABB Variable Speed Dedicated Secondary Chilled Water Pumps
4. Associated System Pipe work, Isolation, Balance & Control Valves.
5. Buffer tanks – 3500L
6. Five (5) Sitrans/UH50 Energy meter

The Chillers are nominated as follows:

1. CH-01 – Chiller 1 (Cooling – 707 kW)
2. CH-02 – Chiller 2 (Cooling – 707 kW)
3. CH-03 – Chiller 3 (Cooling – 707 kW)

The Primary Pumps are nominated as follows:

1. PCHWP-1 – Primary Chilled Water Pumps – Chiller 1 – 33.61 L/s
2. PCHWP-2 – Primary Chilled Water Pumps – Chiller 2 – 33.61 L/s
3. PCHWP-3 – Primary Chilled Water Pumps – Chiller 3 – 33.61 L/s

The secondary pumps are nominated as follows:

1. SCHWP-1 – Secondary Chilled Water Pump 1 – 38.14 L/s
2. SCHWP-2 – Secondary Chilled Water Pump 2 – 38.14 L/s
3. SCHWP-3 – Secondary Chilled Water Pump 3 – 38.14 L/s

The Energy meters are nominated as follows:

1. EM-CHW-01 - CHW PRODUCTION ENERGY METER
2. N-EM-CHW-2: CHW circuit of North Building
3. S-EM-CHW-3: CHW circuit of South Building
4. N-EM-CHW-4: N-FCU-G.1, N-FCU-G.2, N-FCU-G.3 & N-AHU-L
5. S-EM-CHW-5: S-FCU-G.1, S-FCU-G.2 & S-AHU-L

5.3 CHW Primary System Control Strategies

5.3.1 CHW Primary System Call Enable / Disable

The primary system is enabled when any secondary CHW becomes active from a genuine field cooling call. The primary system is disabled when the cooling call is no longer present. A cooling call is generated when ***ANY*** of the following conditions are active: -

- A Cooling Call is Active from ***ANY*** AHU Cooling Valves in North and South Building.
- A Cooling Call is Active from ***ANY*** FCU Cooling Valves in North and South Building.
- A Manual Cooling call is Active from the BMS for the associated Secondary CHW.

An Equipment Cooling Call is determined by the following conditions: -

- **Enable / Active** - Associated CHW Valve is open greater than 80% for 10 Minutes.
- **Disable / Inactive** - Associated CHW Valve is closed less than 10% for 10 Minutes.

Note: The Thermal plant is prevented from operating in cooling mode if the ambient temperature is below a pre-set but adjustable value (initially 15℃) unless already running in cooling mode or called to run by a Tenant Supplementary Cooling call.

5.3.2 CHW Primary System Availability

The chillers and CHW pumps are monitored continuously for availability within the chiller system selection strategy. The BMS monitors various parameters to assess the chiller and CHW pump availability. These parameters are as follows:

- Chiller Fault – This is a fault contact taken directly from the chillers' internal control system (LL contact) and from the Chiller controllers (HLI)
- Chiller Maintenance Switch – This is a Software Auto / Off switch located within the BMS graphics that can be used to put the chiller in/out of service. This is not a manual operation switch. Auto = Chiller controlled by BMS subject to other factors, OFF = Chiller taken out of service by BMS.
- Primary CHW Pump Fault & Alarm – Refer to section 5.4.1
- Primary CHW Pump VSD Auto / Off / Man Software Switch – The BMS will monitor the VSD Auto / Off Man keypad control via a HLI. Should the BMS detect an "auto condition" then the Pump is controlled by the BMS subject to other factors, Should the BMS detect an "Off or Manual Condition" then the pump is taken out of service. An "Off" condition is determined when the VSD is place into Off on the local keypad or Manual and the chiller differential pressure (DP) is less than the minimum chiller DP, or the pump is turned off at the switchboard Auto / Off switch.
- If the chiller software maintenance switch is MAINTENANCE, or the chiller has faulted, then the chiller system is deemed to be unavailable.

- If the chiller maintenance switch is in AUTO, and the chiller is in a normal condition, then the chiller is deemed to be available.

These alarm conditions are displayed within the Alarm Status application on the BMS PC Workstation. Some critical alarms are remotely notified to a specific list of recipients associated to alarm groups

5.3.3 Primary CHW plant staging

The quantity of Chillers and CHW pumps that are required to satisfy the system requirements are based on various parameters. These parameters are used to calculate what is known as the staging control, the BMS uses a stage counter that is incremented up or decremented down according to rising / falling load within the system. The stage counter has a range of 0 through to 3. On initial call for cooling from the system stage counter is set to one (1).

System Cooling Call staging will be as follows.

- Stage 0 - No operation – System shutdown
- Stage 1 - Operation of Lead Chiller and associated pumps
- Stage 2 - Operation of Lead and Lag Chiller and associated pumps
- Stage 3 – All three (3) Chillers

5.3.3.1 Primary CHW plant Stage Up

A Stage Up condition is determined by continuously checking for a rising load condition, when ***any*** of the selected Stage Up parameters are activated and this condition exists for the duration of the stage up time delay, the chilled water stage is incremented up by one. These Stage Up parameters can be included or excluded from the stage up routine by means of an operator check box on the graphic available to users with the necessary credentials. A 'Manual Stage' point is also provided on each CHW graphic to allow the operator to manually set / override the stage number to the required value.

The stage up parameters are as follows:

1. Calculated reverse flow in the de-coupler line:
   Difference in primary and secondary flows measured by the thermal energy flow meters
   OR
2. Secondary CHW supply temperature more than 2℃ (adj.) above set point.

   OR

3. Field Thermal Load is greater than the Stage Up Chiller Capacity Set Point once the time delay (adj.) has expired:

   - ✓ Stage Up 1 to 2 Capacity set point = 707 kW x 90% = ***636 kW***
   - ✓ Stage Up 2 to 3 Capacity set point = 636 kW x 2 = ***1272 kW***

   AND

1. The Stage Up Timer is above the Stage Up Time Delay Set point
   - ✓ Stage Up Time Delay Set point 600 sec (adj)

5.3.3.2 Primary CHW plant Stage Down

A Stage Down is determined by continuously checking for a falling load condition when ***all*** the selected Stage Down parameters are activated and this condition exists for the duration of the Stage Down time delay, the chilled water stage is incremented down by one. These Stage Down parameters can be included or excluded from the Stage Down routine by means of an operator check box on the graphic available to users with the necessary credentials.

The Stage Down parameters are as follows:

1. Field Thermal Load is less than the Stage Down Chiller Capacity Set Point once the time delay has expired:
   - ✓ Stage Down 2 to 1 Capacity Set point = 707 kW x 60% = ***424 kW***
   - ✓ Stage Down 3 to 2 Capacity Set point = 424 kW x 2 = ***848 kW***

   AND

2. The Stage Down Timer is above the Stage Down Time Delay Set point
   - ✓ Stage Down Time Delay Set point 600 sec (adj)

5.3.4 Chiller Enable/ Disable

When the chiller is required to run, the following sequence occurs;

- The associated Primary CHW pump is enabled, and the system verifies the Primary CHW pump operation via a combination of the motor torque status and actual CHW flow through the DPS across the evaporator as measured. If flow is not verified the CHW pump is disabled, locked out in software and the lag chiller system start-up sequence is commenced. The specific chiller will become unavailable and the chiller controller will output specific alarms to reflect the actual fault condition.
- Once the flow is verified, and the chillers' dedicated flow switch status in on, the chiller will be enabled, start-up and temperature / safety control functionality of the chiller is carried out by the chiller integral control system.

When the chiller is no longer required to run, the following sequence occurs;

- The chiller is disabled, shutdown and temperature / safety control functionality of the chiller is carried out by the chiller integral control system.
- A pump run-on delay timer is started to allow for the dedicated pump to run-on to allow the chiller to perform the correct shutdown sequences.
- Upon completion of the delay timer the running chilled water pump is disabled.

Pump Run-On Time Delay (adj.) 5 Minutes

5.3.5 Chiller Monitoring

The BMS provides a combination of low level monitoring and high level monitoring of various conditions within each chiller. The low level points are used in the chilled water plant control logic, whilst the high level points are for monitoring. The monitored conditions are as follows;

5.3.5.1 Low Level Monitoring

- Chiller Fault, this is a VFC condition generated by the chiller integral controls.
- Chiller Status, this is a VFC that is closed when the chiller is operational & is generated by the chiller's integral controls.
- Chiller CHW and HHW flow temp
- Chiller Hot side and Cold side DP

5.3.5.2 High Level Monitoring

The BMS monitors the chillers via a BacNET MS/TP high level interface. The BMS will monitor various points such as but not limited to Kilowatt Hours, Amps, Run Hours, Chiller Start/Stop, Oil Pressure, Suction/Discharge Pressure, Operating Mode, Fault Condition, temp reset etc…

5.4 PCHW Pump Operation – Variable Flow Primary

On receipt of the run command, the primary pump on the cold side are enabled when a cooling call has been activated.

Once enabled, the water pump modulates to maintain the required water pressure across the evaporator or condenser. This is achieved via the modulation of the VSD on each pump. Each DPS is wired directly to the pump VSD and an internal algorithm will modulate the speed of the pump using a PID loop. Typically the primary flow should match the secondary flow plus a buffer of around 10%.

In addition to the above, the variable speed drive is connected to the BACnet MS/TP network for high level control & monitoring. All points are available for display on the BMS graphics. The BMS monitors various conditions of each pump via the HLI including but not limited to the following:

- Run Status – derived at VSD from Motor Torque
- Fault Status – VSD internal Fault
- Motor Frequency
- Motor Current
- Motor Torque
- KWH

5.4.1 PCHW Pump Alarm Logic

The PCHW pump fault logic is derived from the following:

If the pump is commanded to start and the PCHW pump status input is not received within the pump fail alarm time delay, then a "pump fail alarm" is generated. The status input is wired to the VSD and set to monitor the motor torque. An 'On' status is enabled when the motor torque rises above the value required to achieve the minimum flow of the associated chiller. This alarm is registered at the BMS PC Workstation and the pump is held in an unavailable condition in order to prevent unnecessary cycling, this requires an operator keystroke via the graphics application to clear the fault. The fault will have the option to be remotely notified to a list of recipients.

Pump Fail Alarm Time Delay Set Point (adj.) = 2 Minutes

5.4.2 PCHW System Flow Control

The positive/negative flow is determined by difference in primary and secondary flows.

The Total CHW secondary flow will be the sum of thermal energy meters N-EM-CHW-2 and S-EM-CHW-3 while the CHW primary flow will be EM-CHW-01.

The CHW flow control routine is configured to maintain a minimal additional flow in the primary loop over the secondary loop of about 10% (adj). Magnetic thermal flow meters are installed in each secondary flow loop and the total secondary flow is calculated. The secondary CHW pumps will modulate to maintain the required DP set point in the associated secondary loops. The CHW flow set point in the primary loop (secondary total + 10%) will be reset in a linear fashion to maintain a positive flow direction in the primary loop and thereby maintaining only the necessary primary flow required. The system will not drive the CHW flow below the minimum or above the maximum design flow set points for each chiller. If the chiller is at maximum design water flow and there is still a negative flow direction in the balance line, an additional machine will be started. This strategy makes the most efficient use of the chiller & pump combination as good energy savings are realised at both the chiller and the CHW pump.

- Chiller 1 Minimum Flow Set Point 23.5 L/s
- Chiller 1 Maximum Flow Set Point 33.6 L/s
- Chiller 2 Minimum Flow Set Point 23.5 L/s
- Chiller 2 Maximum Flow Set Point 33.6 L/s
- Chiller 3 Minimum Flow Set Point 23.5 L/s
- Chiller 3 Maximum Flow Set Point 33.6 L/s

5.4.3 PCHW Supply Temperature Reset

During periods of light load and temperate ambient conditions (i.e., during the shoulder seasons as determined by valve position), the design minimum CHW temperature may not be required to achieve the cooling requirement of the building. As such, it is advantageous to reset the desired set point of the CHW system and in doing so, energy consumption can be minimised through the plant operation.

The BMS will monitor all active CHW valve positions and reset the chilled water temperature set point up or down to keep the most opened CHW valve position between 75% – 90%. The CHW temperature reset control is initially configured as the second stage reset for the CHW system. The CHW temperature set point reset control will only be executed if the secondary CHW DP set points have been reset to the minimum allowable DP. A selection button is provided on the BMS CHW graphics to select the preferred reset order – SCHW Pressure or PCHW Temp. The CHW temperature set point will be set at minimum for system start up. Each AHU and FCU can be removed from the CHW Temp / Differential reset control strategy by means of a check box on the associated equipment graphic.

- Minimum CHW Temperature Set Point (adj.) 7°C
- Maximum CHW Temperature Set Point (adj.) 12°C

Set Point for temperature set point reset to be adjusted up

- Max CHW Valve Position < 90% open

Set Point for temperature set point reset to be adjusted down

- Max CHW Valve Position > 75% open
-

Time delay between all CHW temperature set point changes

- Sample Time Delay 5 Minutes

CHW temperature set point reset rate of change

- Rate of Change 0.2 °C

5.5 SCHW System Control Strategies

5.5.1 SCHW Pumps Duty / Standby Changeover

The secondary CHW pumps (1 lead, 2 lags) are automatically rotated every 7 days during a 'system off' period so as not to affect the operation of the chiller. The run hours of each pump is logged by the BMS. The BMS attempts an even hour runtime for each pump.

If the lead pump is deemed to be 'unavailable' as described in section 5.5.3, then the sequence program enables the 1st lag pump to be the lead pump. Once the 'unavailable' pump is reset and deemed to be 'available', the sequence program retain it as the 1st lag or 2nd lag depending on the run hours of the other pump.

5.5.2 SCHW Pump Operation

On receipt of the run command, the lead secondary CHW pump is enabled. Once enabled the lead pump will modulate to maintain the associated system DP. This is achieved via the modulation of the variable speed drive (VSD) on each pump. The DPS is wired to the BMS controller and is located on Level 6. The BMS controller will modulate the speed of the pump using a PID algorithm to maintain the DP at the required set point as determined during commissioning.

- North Building SCHW Diff. Pressure Set Point (adj.) Variable xx to xx kPa
- South Building SCHW Diff. Pressure Set Point (adj.) Variable xx to xx kPa

Under periods of high demand, more flow is required in the secondary system that can be provided efficiently by a single pump. During these times, the 1st lag and the 2nd lag will be enabled to supplement the lead pump. The pumps have been sized so that the three of them are required to deliver full flow. The BMS will modulate all the enabled pumps to maintain the required system DP set point. The staging on /off of the lag pumps are determined by the CHW flow. These have been set according to the efficiency curves of the pumps as per the following: -

- Building SCHW Lag Pump(s) - On Set Point xx Hz & Off Set Point xx Hz

In addition to the above, the variable speed drives are connected to the BACnet MS/TP network for high level control & monitoring. All points are available for display on the insight graphics. The BMS monitors various conditions of each pump via the HLI including but not limited to the following:

- Run Status
- Fault Status
- Motor Frequency
- Motor Current
- Motor Torque
- KWH

5.5.3 SCHW Pump Alarm Logic

The SCHW pump fault logic is derived from the following:

If the pump is commanded to start and the SCHW pump status input is not received within the pump fail alarm time delay, then a “pump fail alarm” is generated. The status input is wired to the VSD and set to monitor the motor torque. An ‘On’ status is enabled when the motor torque rises above the value required to achieve the minimum flow at the minimum motor speed. This alarm is registered at the BMS PC Workstation, and the pump is held in an unavailable condition in order to prevent unnecessary cycling, this requires an operator keystroke via the graphics application to clear the fault. The fault has also the option to be remotely notified to a list of recipients.

Pump Fail Alarm Time Delay Set Point (adj.) 2 Minutes

The system comprises of 3 pumps where the 1st lag will take the place of the lead pump and the 2nd lag can also take over in the event of two pump failures.

5.5.4 SCHW System Differential Pressure Reset Operation

The secondary CHW system DP control is designed to vary the DP set point to allow the system to operate at the lowest allowable DP whilst maintaining the required CHW flow rate at the CHW valves. The BMS will monitor all the selected active CHW valve positions and reset the DP up or down to keep the most opened CHW valve position between 75% – 90%. This operation will allow the secondary CHW pumps to operate at a reduced frequency resulting in a reduction in energy consumption.

The CHW DP set point will be set at maximum for system start up. A time delay of 10 minutes will apply at start up to allow the system to settle before any set points can be adjusted.

- North Building SCHW Diff. Pressure Set Point (adj.) Variable xx to xx kPa
- South Building SCHW Diff. Pressure Set Point (adj.) Variable xx to xx kPa

Time delay between all chilled water differential pressure set point changes

- Sample Time Delay (adj.) 5 Minutes

Chilled water differential pressure set point reset rate of change

- Rate of Change (adj.) 5.0 kPa

5.6 CHW Fire Shutdown

All CHW plant will be shut down in a sequenced manner from system cooling calls during a general fire (GFR) shutdown. All BMS alarm processing is inhibited during this shutdown. This is a software function in order to allow the chiller and all associated equipment to be shutdown correctly. This alarm condition is displayed within the Alarm Status application on the BMS PC Workstations.

5.7 CHW Valve Exercise Routine

A valve exercise control routine is configured to open all CHW valves in the building to allow for the correct circulation of chemical treatment. Every seven (7) days, each CHW valve is driven open for a period of one (1) hour and the associated secondary pumps enabled. The exercise routine will occur during normal operation of the plant at a time that the space comfort will not be too affected. The routine time will be set-up by the operator as this particular time will be different depending on the (winter/summer) season.

- Valve Exercise Routine Time Monday (Adj.) - 12:00pam (Adj.)

During the valve exercise routine, the associated CHW secondary pump is set to run at full flow to move debris, etc..

6 HEATING WATER (HHW) SYSTEM

6.1 Overview

The HHW system is a primary/secondary pumping system with two secondary circuits. The secondary system is decoupled from the primary loop via a thermal buffer tank with primary flow and temperature conditions monitored by a “production” thermal energy meter and temperature sensors in the primary loop.

There are two secondary HHW circuits serving the North and South buildings, fed from a single pump set. The pump set consists of three pumps, each fitted with a variable speed drive. Each of the base building pumps is sized for 33% duty to provide 66% redundancy such that the three pumps operate in a lead/lag arrangement. Pumps operating in parallel shall run at a common shaft speed.

6.2 HHW Plant System Equipment

The primary HHW plant consists of the following equipment:

1. Three (3) Aermec 4-pipe Air Cooled Chillers of model NRP-2606-A-4-PH-RG
2. Three (3) ABB Variable Speed Dedicated Primary Hot Water Pumps.
3. Three (3) ABB Variable Speed Dedicated Secondary Hot Water Pumps
4. Associated System Pipe work, Isolation, Balance & Control Valves.
5. Buffer tanks – 3500L
6. Six (6) Sitrans/UH50 Energy meter

The Chillers are nominated as follows:

1. CH-01 – Chiller 1 (Heating – 540 kW)
2. CH-02 – Chiller 2 (Heating – 540 kW)
3. CH-03 – Chiller 3 (Heating – 540 kW)

The Primary Pumps are nominated as follows:

1. PHHWP-1 – Primary Hot Water Pumps – Chiller 1 – 26.10 L/s
2. PHHWP-2 – Primary Hot Water Pumps – Chiller 2 – 26.10 L/s
3. PHHWP-3 – Primary Hot Water Pumps – Chiller 3 – 26.10 L/s

The secondary pumps are nominated as follows:

1. SHHWP-1 – Secondary Chilled Water Pump 1 – 11.0 L/s
2. SHHWP-2 – Secondary Chilled Water Pump 2 – 11.0 L/s
3. SHHWP-3 – Secondary Chilled Water Pump 3 – 11.0 L/s

The Energy meters are nominated as follows:

1. EM-HHW-01 - HHW PRODUCTION ENERGY METER
2. N-EM-HHW-2: HHW circuit of North Building – 13.6 L/s
3. S-EM-HHW-3: HHW circuit of South Building – 15.1 L/s
4. N-EM-HHW-4:N-FCU-G.1, N-FCU-G.2, N-FCU-G.3, N-VAV-G2.2, N-FCU-G-EOT & N-AHU-L
5. S-EM-HHW-5: S-FCU-G.1, S-FCU-G.2, S-VAV-G-2.1, S-VAV-G-2.2 & S-AHU-L
6. N-EM-HHW-6: N-FCU-G-EOT

6.3 HHW Primary System Control Strategies

6.3.1 HHW Primary System Call Enable / Disable

The primary system is enabled when any secondary hot water system becomes active from a genuine field heating call. The Primary system is disabled when the heating call is no longer present. A heating call is generated when ***ANY*** of the following conditions are active: -

- A Heating Call is Active from ***ANY*** Air Handing Unit Heating Valves in North and South Building.
- A Heating Call is Active from ***ANY*** Fan Coil Unit Heating Valves in North and South Building
- A Manual Heating call is Active from the BMCS for the associated Secondary Hot Water System.

An Equipment Heating Call is determined by the following conditions: -

- **Enable / Active** - Associated HHW Valve is open greater than 80% for 10 Minutes.
- **Disable / Inactive** - Associated HHW Valve is closed less than 10% for 10 Minutes.

Note: The Thermal plant is prevented from operating in heating mode if the ambient temperature is above a pre-set but adjustable value (initially 21℃) unless already running in heating mode.

6.3.2 HHW Primary System Availability

The chillers and chilled water pumps are monitored continuously for availability within the chiller system selection strategy. The BMS monitors various parameters to assess the chiller and chilled water pump availability. These parameters are as follows:

- Chiller Fault – This is a fault contact taken directly from the chillers' internal control system.
- Chiller Maintenance Switch – This is a Software Auto / Off switch located within the BMS graphics that can be used to put the chiller in/out of service. This is not a manual operation switch. Auto = Chiller controlled by BMS subject to other factors, OFF = Chiller taken out of service by BMS.
- Primary HHW Pump Fault & Alarm – Refer to section 6.4.1
- Primary HHW Pump VSD Auto / Off / Man Software Switch – The BMS will monitor the VSD Auto / Off Man keypad control via a HLI. Should the BMS detect an "auto condition" then the Pump is controlled by the BMS subject to other factors, Should the BMS detect an "Off or Manual Condition" then the pump is taken out of service. An "Off" condition is determined when the VSD is place into Off on the local keypad or Manual and the chiller DP is less than the minimum chiller DP, or the pump is turned off at the switchboard Auto / Off switch.
- If the chiller software maintenance switch is MAINTENANCE, or the chiller has faulted, then the chiller system is deemed to be unavailable.
- If the chiller maintenance switch is in AUTO, and the chiller is in a normal condition, then the chiller is deemed to be available.

These alarm conditions are displayed within the Alarm Status application on the BMS PC Workstation.

6.3.3 Primary HHW plant staging

The quantity of chiller and HHW pumps that are required to satisfy the system requirements are based on various parameters. These parameters are used to calculate what is known as the staging control, the BMS uses a stage counter that is incremented up or decremented down according to rising / falling load within the system. The stage counter has a range of 0 through to 3. On initial call for heating from the system stage counter is set to one (1).

System Heating Call staging will be as follows.

- Stage 0 - No operation – System shutdown
- Stage 1 - Operation of Lead Chiller and associated pumps
- Stage 2 - Operation of Lead and 1st Lag Chiller and associated pumps
- Stage 3 – All three (3) Chillers

6.3.3.1 Primary HHW plant Stage Up

A Stage Up condition is determined by continuously checking for a rising load condition, when ***any*** of the selected Stage Up parameters are activated and this condition exists for the duration of the Stage Up time delay, the HHW stage is incremented up by one. These Stage Up parameters can be included or excluded from the stage up routine by means of an operator check box on the graphic available to users with the necessary credentials. A 'Manual Stage' point is also provided on each HHW graphic to allow the operator to manually set / override the stage number to the required value.

The Stage Up parameters are as follows:

4. Calculated reverse flow in the de-coupler line:
   Difference in primary and secondary flows measured by the thermal energy flow meters
   OR
5. Secondary HHW supply temperature more than 2℃ (adj.) below set point.

   OR

6. Field Thermal Load is greater than the Stage Up Chiller Capacity Set Point once the time delay (adj.) has expired:

   - ✓ Stage Up 1 to 2 Capacity set point = 540 kW x 90% = ***486 kW***
   - ✓ Stage Up 2 to 3 Capacity set point = 486 kW x 2 = ***972 kW***

   AND

7. The Stage Up Timer is above the Stage Up Time Delay Set point
   - ✓ Stage Up Time Delay Set point 600 sec (adj)

6.3.3.2 Primary HHW plant Stage Down

A Stage Down is determined by continuously checking for a falling load condition when ***all*** the selected Stage Down parameters are activated and this condition exists for the duration of the Stage Down time delay, the chilled water stage is incremented down by one. These Stage Down parameters can be included or excluded from the Stage Down routine by means of an operator check box on the graphic available to users with the necessary credentials.

The Stage Down parameters are as follows:

2. Field Thermal Load is less than the Stage Down Chiller Capacity Set Point once the time delay has expired:
   - ✓ Stage Down 2 to 1 Capacity Set point = 540 kW x 60% = ***324 kW***
   - ✓ Stage Down 3 to 2 Capacity Set point = 324 kW x 2 = ***648 kW***

   AND

8. The Stage Down Timer is above the Stage Down Time Delay Set point
   - ✓ Stage Down Time Delay Set point 600 sec (adj)

6.3.4 Chiller Enable/ Disable

When the chiller is required to run, the following sequence occurs;

- The associated Primary HHW pump is enabled, and the system verifies the Primary HHW pump operation via a combination of the motor torque status and actual HHW flow through the DPS across the condenser is measured. If flow is not verified the HHW pump is disabled, locked out in software and the lag chiller system start-up sequence is commenced. The specific chiller will become unavailable and the chiller controller will output specific alarms to reflect the actual fault condition.
- Once the flow is verified, and the chillers' dedicated flow switch status in on, the chiller will be enabled, start-up and temperature / safety control functionality of the chiller is carried out by the chiller integral control system.

When the chiller is no longer required to run, the following sequence occurs;

- The chiller is disabled, shutdown and temperature / safety control functionality of the chiller is carried out by the chiller integral control system.
- A pump run-on delay timer is started to allow for the dedicated pump to run-on to allow the chiller to perform the correct shutdown sequences.
- Upon completion of the delay timer the running HHW pump is disabled.

Pump Run-On Time Delay (adj.) 5 Minutes

6.3.5 Chiller Monitoring

The BMS provides a combination of low level monitoring and high level monitoring of various conditions within each chiller. The low level points are used in the chilled water plant control logic, whilst the high level points are for monitoring. The monitored conditions are as follows;

6.3.5.1 Low Level Monitoring

- Chiller Fault, this is a VFC condition generated by the chiller integral controls.
- Chiller Status, this is a VFC that is closed when the chiller is operational & is generated by the chiller's integral controls.
- Chiller HHW and HHW flow temp

- Chiller Hot side and Cold side DP

6.3.5.2 High Level Monitoring

The BMS monitors the chillers via a BacNET MS/TP high level interface. The BMS will monitor various points such as but not limited to Kilowatt Hours, Amps, Run Hours, Chiller Start/Stop, Oil Pressure, Suction/Discharge Pressure, Operating Mode, Fault Condition, temp reset etc…

6.4 PHHW Pump Operation – Variable Flow Primary

On receipt of the run command, the primary pump on the HOT side are enabled when a heating call has been activated.

Once enabled, the water pump modulates to maintain the required water pressure across the evaporator or condenser. This is achieved via the modulation of the VSD on each pump. Each DPS is wired directly to the pump VSD and an internal algorithm will modulate the speed of the pump using a PID loop. Typically the primary flow should match the secondary flow plus a buffer of around 10%.

In addition to the above, the variable speed drive is connected to the BACnet MS/TP network for high level control & monitoring. All points are available for display on the BMS graphics. The BMS monitors various conditions of each pump via the HLI including but not limited to the following:

- Run Status – derived at VSD from Motor Torque
- Fault Status – VSD internal Fault
- Motor Frequency
- Motor Current
- Motor Torque
- KWH

6.4.1 PHHW Pump Alarm Logic

The PHHW pump fault logic is derived from the following:

If the pump is commanded to start and the PHHW pump status input is not received within the pump fail alarm time delay, then a “pump fail alarm” is generated. The status input is wired to the VSD and set to monitor the motor torque. An ‘On’ status is enabled when the motor torque rises above the value required to achieve the minimum flow of the associated chiller. This alarm is registered at the BMS PC Workstation and the pump is held in an unavailable condition in order to prevent unnecessary cycling, this requires an operator keystroke via the graphics application to clear the fault. The fault will have the option to be remotely notified to a list of recipients.

Pump Fail Alarm Time Delay Set Point (adj.) = 2 Minutes

6.4.2 PHHW System Flow Control

The positive/negative flow is determined by difference in primary and secondary flows.

The total HHW secondary flow will be the sum of thermal energy meters N-EM-HHW-2 and S-EM-HHW-3 while the HHW primary flow will be EM-HHW-01.

The HHW flow control routine is configured to maintain a minimal additional flow in the primary loop over the secondary loop of about 10% (adj). Magnetic thermal flow meters are installed in each secondary flow loop and the total secondary flow is calculated. The secondary HHW pumps will modulate to maintain the required DP set point in the associated secondary loops. The HHW flow set point in the primary loop (secondary total + 10%) will be reset in a linear fashion to maintain a positive flow direction in the primary loop and thereby maintaining only the necessary primary flow required. The system will not drive the HHW flow below the minimum or above the maximum design flow set points for each chiller. If the chiller is at maximum design water flow and there is still a negative flow direction in the balance line, an

additional machine will be started. This strategy makes the most efficient use of the chiller & pump combination as good energy savings are realised at both the chiller and the chilled water pump.

- Chiller 1 Minimum Flow Set Point 18.25 L/s
- Chiller 1 Maximum Flow Set Point 26.10 L/s
- Chiller 2 Minimum Flow Set Point 18.25 L/s
- Chiller 2 Maximum Flow Set Point 26.10 L/s
- Chiller 3 Minimum Flow Set Point 18.25 L/s
- Chiller 3 Maximum Flow Set Point 26.10 L/s

6.4.3 PHHW Supply Temperature Reset

During periods of light load and temperate ambient conditions (i.e., during the shoulder seasons as determined by valve position), the design minimum HHW temperature may not be required to achieve the heating requirement of the building. As such, it is advantageous to reset the desired set point of the HHW system and in doing so, energy consumption can be minimised through the plant operation.

The BMS will monitor all active HHW valve positions and reset the HHW temperature set point up or down to keep the most opened hot water valve position between 75% – 90%. The hot water temperature reset control is initially configured as the second stage reset for the HHW system. The HHW temperature set point reset control will only be executed if the secondary HHW differential pressure set points have been reset to the minimum allowable DP. A selection button is provided on the BMS HHW graphics to select the preferred reset order – SHHW Pressure or PHHW Temp. The hot water temperature set point will be set at minimum for system start up. Each AHU and FCU can be removed from the HHW Temp / Differential reset control strategy by means of a check box on the associated equipment graphic.

- Minimum HHW Temperature Set Point (adj.) 40°C
- Maximum HHW Temperature Set Point (adj.) 45°C

Set Point for temperature set point reset to be adjusted up

- Max Hot Water Valve Position < 90% open

Set Point for temperature set point reset to be adjusted down

- Max Hot Water Valve Position > 75% open

Time delay between all chilled water temperature set point changes

- Sample Time Delay 5 Minutes

Hot water temperature set point reset rate of change

- Rate of Change 0.2 °C

6.5 SHHW System Control Strategies

6.5.1 SHHW Pumps Duty / Standby Changeover

The secondary HHW pumps (1 lead, 2 lag) are automatically rotated every 7 days during a 'system off' period so as not to affect the operation of the chiller. The run hours of each pump is logged by the BMS. The BMS attempts an even hour runtime for each pump.

If the lead pump is deemed to be 'unavailable' as described in section 6.5.3, then the sequence program enables the 1st lag pump to be the lead pump. Once the 'unavailable' pump is reset and deemed to be 'available', the sequence program retain it as the 1st lag or 2nd lag depending on the run hours of the other pump.

6.5.2 SHHW Pump Operation

On receipt of the run command, the lead secondary hot water pump is enabled. Once enabled the lead pump will modulate to maintain the associated system DP. This is achieved via the modulation of the variable speed drive (VSD) on each pump. The DPS is wired to the BMS controller and is located on Level 6. The BMS controller will modulate the speed of the pump using a PID algorithm to maintain the DP at the required set point as determined during commissioning.

- North Building SHHW Diff. Pressure Set Point (adj.) Variable xx to xx kPa
- South Building SHHW Diff. Pressure Set Point (adj.) Variable xx to xx kPa

Under periods of high demand, more flow is required in the secondary system that can be provided efficiently by a single pump. During these times, the 1st lag and maybe the 2nd lag will be enabled to supplement the lead pump. The pumps have been sized so that the three of them are required to deliver full flow. The BMS will modulate all the enabled pumps to maintain the required system DP set point. The staging on /off of the lag pumps are determined by the HHW flow. These have been set according to the efficiency curves of the pumps as per the following: -

- North Building SHHW Lag Pump(s) – On Set Point xx Hz & Off Set Point xx Hz
- South Building SHHW Lag Pump(s) - On Set Point xx Hz & Off Set Point xx Hz

In addition to the above, the variable speed drives are connected to the BACnet MS/TP network for high level control & monitoring. All points are available for display on the insight graphics. The BMS monitors various conditions of each pump via the HLI including but not limited to the following:

- Run Status
- Fault Status
- Motor Frequency
- Motor Current
- Motor Torque
- KWH

6.5.3 SHHW Pump Alarm Logic

The SHHW pump fault logic is derived from the following:

If the pump is commanded to start and the SHHW pump status input is not received within the pump fail alarm time delay, then a “pump fail alarm” is generated. The status input is wired to the VSD and set to monitor the motor torque. An ‘On’ status is enabled when the motor torque rises above the value required to achieve the minimum flow at the minimum motor speed. This alarm is registered at the BMS PC Workstation, and the pump is held in an unavailable condition to prevent unnecessary cycling, this requires an operator keystroke via the graphics application to clear the fault. The fault has also the option to be remotely notified to a list of recipients.

Pump Fail Alarm Time Delay Set Point (adj.) 2 Minutes

The system comprises of 3 pumps where the 1st lag will take the place of the lead pump and the 2nd lag can also take over in the event of two pump failures.

6.5.4 SHHW System Differential Pressure Reset Operation

The secondary HHW system DP control is designed to vary the DP set point to allow the system to operate at the lowest allowable DP whilst maintaining the required HHW flow rate at the HHW valves. The BMS will monitor all the selected active HHW valve positions and reset the DP up or down to keep the most opened HHW valve position between 75% – 90%. This operation will allow the secondary HHW pumps to operate at a reduced frequency resulting in a reduction in energy consumption.

The HHW DP set point will be set at maximum for system start up. A time delay of 10 minutes will apply at start up to allow the system to settle before any set points can be adjusted.

- North Building SHHW Diff. Pressure Set Point (adj.) Variable xx to xx kPa
- South Building SHHW Diff. Pressure Set Point (adj.) Variable xx to xx kPa

Time delay between all chilled water differential pressure set point changes

- Sample Time Delay (adj.) 5 Minutes

Chilled water differential pressure set point reset rate of change

- Rate of Change (adj.) 5.0 kPa

6.6 HHW Fire Shutdown

All HHW plant will be shut down in a sequenced manner from system heating calls during a general fire (GFR) shutdown. All BMS alarm processing is inhibited during this shutdown. This is a software function in order to allow the chiller and all associated equipment to be shutdown correctly. This alarm condition is displayed within the Alarm Status application on the BMS PC Workstations.

6.7 HHW Valve Exercise Routine

A valve exercise control routine is configured to open all HHW valves in the building to allow for the correct circulation of chemical treatment. Every seven (7) days, each HHW valve is driven open for a period of one (1) hour and the associated secondary pumps enabled. The exercise routine will occur

during normal operation of the plant at a time that the space comfort will not be too affected. The routine time will be set-up by the operator as this time will be different depending on the (winter/summer) season.

- Valve Exercise Routine Time Monday (Adj.) - 12:00am (Adj.)

During the valve exercise routine, the associated HHW secondary pump is set to run at full flow to move debris, etc...

7 VAV AIR HANDLING UNITS

7.1 Control Operation VAV AHU

7.1.1 Overview

There are eight (8) AHUs providing conditioned air to the VAVs around the building. These AHU's are listed as follows: -

- North Building: N-AHU-N serving the VAVs in the north side of the building.
- North Building: N-AHU-C serving the VAVs in the centre zone part of the building.
- North Building: N-AHU-W serving the VAVs in the west side of the building.
- South Building: S-AHU-N serving the VAVs in the north side of the building.
- South Building: S-AHU-C serving the VAVs in the centre zone part of the building.
- South Building: S-AHU-W serving the VAVs in the west side of the building.

Each AHU is furnished with CHW Cooling & HHW Heating coils, economy dampers & filter assemblies. All Perimeter zone VAV's operate in cooling and heating mode with HHW reheat capacity. Each Centre Zone VAV operate with cooling and heating via the primary air system except for the L5 Centre Zone VAVs which have HHW reheat capacity.
Each floor (L1-L5) will be supplied from 3 AHUs where each will supply to the corresponding North, West and Centre VAVs.

Each floor (L1-L5) return air path is fitted with a RAF. The RAF controls to a floor pressure sensor. The speed control of the RAF will aim to maintain a slight positive pressure per floor. The location of the pickup probe of the floor pressure sensor will be in such a way to give the most realistic floor pressure reading and compensate for the air interchange between floors caused by the Atrium.

7.2 Description of VAV AHU Supply Air Control Strategies

7.2.1 VAV AHU Enable (Typical)

The units are started and stopped automatically by one of the following:

- Zone by Zone Programmable time schedule.
- Optimum Start/Stop.
- After-hours Operation.
- Night Purge Operation.
- BMS Manual Start/Stop

7.2.1.1 Programmable Time Schedule (Typical)

The time schedules for each floor zone will be structured so that each AHU will be enabled independently. The floor zone independent time schedules will be configured to operate to suit the associated floor zone requirements.

Each AHU will be initiated by a call sequence from each of the floor zone time schedules when required to start.

A calendar will be available for programming events such as Public Holidays and will provide a global control for the specified period of the event.

The standard occupied hours for the building will be 8am to 5pm from Monday to Friday except for designated public holidays. The actual start time may be adjusted due to the optimum Start/Stop algorithm, refer to the following section regarding this control.

Initial Optimal Start Time: 1 hour (adj.)

Once each of the zone / tenant requirements are known the functional description will be update with all the individual time schedules.

7.2.1.2 Optimum Start/Stop (Typical)

Start/Stop Time Optimisation (SSTO) logic is used to control start/stop operation of the units. As per the Programmable Time Schedule above, each thermal zone has an independent SSTO algorithm. Based on the optimization parameters, SSTO calculates the latest possible time a zone can start and/or if the equipment heating/cooling can be stopped prior to an occupancy end, or if the unit shall operate after-hours to maintain the unoccupied temperature set-points.

In the event that zones are started or stopped too early or too late, the SSTO logic remembers the errors and adjusts the controllers to avoid starting or stopping equipment too early or late.

In order to determine the optimum time to start or stop the air conditioning plant, SSTO takes the following into account:

- Inside air temperature
- Outside air temperature
- Heating and cooling set points
- Occupancy start and stop times (programmable time schedule)
- Start time limitations (earliest start time - initially set to 120 min for Mon & 60 mins Tue - Fri)
- Stop time limitation (earliest stop time - initially set to 60 minutes).

The average temps of the SSTO zones as well as its status is trended and can be used to determine if the temp is achieved within the 120 minutes.

Evening run-down will be initiated from the optimum stop function, in this mode the DDC will determine whether to stop heating or cooling. Upon its decision the DDC will then close the required valves (cooling or heating) during the remaining occupancy period. At the end of the occupancy period the DDC will have closed the valves. This function will not operate if the AHUs are operating in the after-hours mode.

Depending on the conditions, the program assumes one of four modes.

- Warm up mode for start-up if the average zone temperature is below the heating set-point and the outside air temp is below 15ºC.
- Cool down mode for start-up if the average zone temperature is above the cooling set-point plus 1.0 ºC and the outside air temp is above 22ºC.
- Stop heating mode for shut down if the average zone temperature is less than 1ºC below the heating set-point and the outside air temp is above a pre-set value.
- Stop cooling mode for shut down if the average zone temperature is less than 1ºC above the cooling set-point.

During the morning warm up cycle the outdoor air and relief air dampers will close, return air damper will open, and the economy cycle will be inhibited. During the morning cool down cycle, the AHU CHW valves will be prevented from operating and the outside air and relief dampers will modulate to maintain the desired supply air temperature set point.

7.2.1.3 After-hours Operation (Typical)

After-hours operation shall be on a floor by floor zone basis and may be initiated via one or a combination of the following methods: -

- After Hours push button within the space.
- BMS Time Schedule Override.

After-hours operation of each zone is trended for management reporting purposes and system operators will be able to access the historical data via the reporting applications on the BMS PC Workstation. This historical data can be configured into daily, monthly and year to date totals per after-hours zone. The AH operation once activated will be maintained for one (1) hour. If more time required, the AH operation will need to be re-initiated.

7.2.1.4 Night Purge Operation (Typical)

The control system is configured to perform a night purge operation which will allow the AHU plant to operate in a full economy cycle mode with no mechanical cooling / heating taking place.

This will only occur if the following conditions are met:

- The outside air temperature is above 13ºC and is below 21ºC with an enthalpy less than 48 kJ/kg.
- The AHU is not in an occupancy or after-hours mode.
- The average zone temperature is above 26ºC.

Initially the Night Purge function will be disabled but once enabled the purge mode will operate until the average space temperature is below 24ºC. If any of the units SSTO, occupancy or after-hours modes are enabled the purge mode will be disabled.

7.2.1.5 BMS Manual Start/Stop (Typical)

The control system is configured to allow the operator to manually override the occupancy status of each AHU from the associated graphics pages on the BMS PC Workstation. During a BMS Manual Start/Stop, the plant will operation normally. The AHU will continue to run until the operator places the BMS Manual Start/Stop into “Auto” mode.

- “Manual” mode = BMS Manual Override Active.
- “Auto” mode = BMS Manual Override Inactive.

7.2.2 VAV AHU Supply & Return Air Floor Damper (Typical)

Each floor is generally provided with supply air from 3 AHUs – perimeter & centre. Further each floor has a dedicated RAF with an isolation damper which provides the airside system return airpath. As such there is an isolation damper for each supply and return air duct on each floor. Whenever a floor zone becomes occupied, by optimal start, time schedule or afterhours call, the associated floor dampers are driven open. When a thermal zone is non – active the floor supply and return isolation dampers will close. These dampers are supplied with spring return damper actuators for fail-safe operation during fire operation to the position required by the fire matrix.

7.2.3 VAV AHU Supply Air Fan Operation (Typical)

As mentioned, the AHU is enabled / disabled based on a call from each of the floor thermal zones. Once the AHU fan is enabled a PID loop within the VSD will attempt to maintain the required system static duct pressure at the pre-determined set-point as defined by the static pressure reset routine. The VSD will be connected to the FLN network for high level control & monitoring.

The SAF start/stop, fault & run status will be provided from the high-level interface. A low frequency limit is configured into each VSD to prevent damage to the motor of each unit. VSD motor torque will be used to provide a physical status for the unit.

7.2.4 VAV AHU Floor Max Damper Calculation (Typical)

The BMS will calculate the max damper for the purpose of AHU static pressure reset. The algorithm will only execute VAVs that is active via time schedule or after hours. This algorithm will operate for all active VAVs associated with each AHU system. The design intent is to only calculate the active VAVs damper positions via time schedule and after hours and therefore the AHU will control to the active demand for static pressure control and supply air temperature reset.

7.2.5 VAV AHU Static Pressure Reset Control

As mentioned in the previous paragraph, a reset algorithm will be programmed in an attempt to match the fan usage with the actual airflow demands from the associated VAV Zone Damper terminals. This algorithm will work in the following way:

For start-up, the initial static pressure setpoint is set midway between the maximum and minimum static pressure setpoint (commissioned value).

Once the fan has started and the start timer has elapsed, the algorithm will then reset the set point based on the 3 most open active VAV terminal (control terminal) based on the following. The algorithm will also allow the identification of the VAV boxes that are too demanding (rogue zones) so that they could be ignored and excluded from the maximum VAV damper calculation.

- If the control terminal damper position is > 90% the static pressure set point will be increased by the static gain increment.
- If the control terminal damper position is < 80% the static pressure set point will be decreased by the static gain increment.
- If the control terminal damper position is > 80% and less than 90% the static pressure set point will be held at its current value.

Static Gain Value (adj.) 5 Pa.

The static pressure set points have been commissioned to the following values: -

- N-AHU-N Static Pressure Set Point Min - TBA Pa, Max - TBA Pa
- N-AHU-C Static Pressure Set Point Min - TBA Pa, Max - TBA Pa
- N-AHU-W Static Pressure Set Point Min - TBA Pa, Max - TBA Pa
- N-AHU-L Static Pressure Set Point Min - TBA Pa, Max –TBA Pa
- S-AHU-N Static Pressure Set Point Min - TBA Pa, Max - TBA Pa
- S-AHU-C Static Pressure Set Point Min - TBA Pa, Max - TBA Pa
- S-AHU-W Static Pressure Set Point Min - TBA Pa, Max - TBA Pa
- S-AHU-L Static Pressure Set Point Min - TBA Pa, Max –TBA Pa

7.2.6 VAV AHU Supply Air Fan Alarm (Typical)

A Fan Failed Alarm will be raised if the Supply Fan is commanded ON and the Fan Status is OFF (determined by the pressure switch) after a time delay (adj.).

The alarm will be inhibited whenever the Fan is OFF or the condition is TRUE. This alarm condition will be displayed within the Alarm Status application on the BMS PC Workstation.

Fan Fail Alarm Time Delay (adj.) 300 sec.

7.2.7 VAV AHU Mixing Chamber Pressure Control (Typical)

Each AHU has a mixed air plenum air pressure sensor installed in the mixing chamber to control the operation of the AHU return air damper and maintain the minimum outside air intake. As the speed of the AHU changes in reaction to the changing zone conditions, the air pressure within the mixed air chambers vary. The return air damper will respond to the increase in negative pressure by opening the return damper further to maintain the correct outside air quantity. The minimum outside air damper position set point value is increased as the maximum return air CO2 value rises above the 700ppm setpoint to allow additional outside air to ventilate the space. The return air dampers are controlled using a PI action to maintain the mixed air pressure set point value and the floor return air fan is controlled using a PI action to maintain the floor pressure set point at a neutral value (slightly positive – 5Pa).

The mixed air pressure set points have been commissioned to the following values: -

- N-AHU-N Mixed Air Pressure Set Point Min - TBA Pa, Max - TBA Pa
- N-AHU-C Mixed Air Pressure Set Point Min - TBA Pa, Max - TBA Pa
- N-AHU-W Mixed Air Pressure Set Point Min - TBA Pa, Max - TBA Pa
- N-AHU-L Mixed Air Pressure Set Point Min - TBA Pa, Max –TBA Pa
- S-AHU-N Mixed Air Pressure Set Point Min - TBA Pa, Max - TBA Pa
- S-AHU-C Mixed Air Pressure Set Point Min - TBA Pa, Max - TBA Pa
- S-AHU-W Mixed Air Pressure Set Point Min - TBA Pa, Max - TBA Pa
- S-AHU-L Mixed Air Pressure Set Point Min - TBA Pa, Max –TBA Pa

7.3 VAV Return / Relief Air Fan Control (Typical)

7.3.1 VAV AHU Return Air Overview

Each floor has a RAF and an isolation damper. The RAF and isolation damper will only operate when the corresponding floor is active, and the zone AHU's have started.

Once the floor becomes active, the isolation damper will open. The RAF Speed will be controlled to maintain a positive floor pressure.

Floor Pressure Set Point: 5 Pa (.adj.)

A DPS is installed on the floor which measures the air pressure with reference to the ambient / neutral pressure.

7.3.2 VAV AHU Return Air Fan Enable (Typical)

The RAF will be enabled when:

- The floor is occupied.

  AND

- The isolation damper is opened.

7.3.3 VAV AHU Return Air Fan Monitoring (Typical)

The RAF start/stop, fault & run status will be provided from the high-level interface. A low frequency limit is configured into each VSD to prevent damage to the motor of each unit. VSD motor torque will be used to provide a physical status for the unit.

7.3.4 VAV AHU Return / Relief Air Fan Alarms (Typical)

A Fan Failed Alarm is raised if the RAF is commanded ON and the respective Fan Status Software point is OFF after a time delay (adj.). The alarm is inhibited whenever the Fan is OFF or the condition is TRUE.

Fan Fail Alarm Time Delay (adj.) 60 sec.

This alarm condition is displayed within the Alarm Status application on all BMS PC Workstations.

7.3.5 VAV AHU Return Air Fan Speed Control (Typical)

Each floor will have a dedicated RAF used to establish a neutral (slightly positive pressure – 5Pa) pressure. Each floor will be equipped with a floor pressure sensor wired directly to the VSD who will regulate the speed of the fan through a PI loop as per the pressure reading.

7.3.6 VAV AHU CO2 Control

Each AHU provides outside air via dedicated OA dampers that draw from the plant room. This unit incorporates motorised OA, return air & common relief air dampers (economy cycle dampers). The RAFs, return air dampers, relief air fans & relief air dampers are also incorporated into the control strategy for return/relief air. Each AHU has 1 damper for minimum OA and 1 damper for economy cycle.

Under normal operating modes, the damper for economy cycle will modulate from fully closed to the required position to achieve economy cooling operation. During non-economy operation, the damper for economy cycle will close completely leaving the damper for minimum OA at its commissioned position for minimum air quantity . The minimum required OA damper position is scheduled against the associated Maximum Return Air Carbon Dioxide (CO2) sensor. As the maximum CO2 levels within the return air rises, the minimum OA damper position required is increased as per the following values: -

- Space CO2 < 700 PPM - Minimum Outside Air set to minimum in L/s Position
- Space CO2 >= 700 PPM– Minimum Outside Air set to maximum in L/s Position %

When the ventilation system is not operational all motorised dampers will be modulated to fully closed.

7.3.7 VAV AHU Cooling Mode Control (Typical)

Each AHU provides cooling based on a control algorithm that calculates the required SA temperature set point in response to the average occupied deviation from set point of the associated perimeter zone VAV terminals or interior zone damper controls. The mode of the AHU is determined by the average occupied deviation from set point. If the deviation above the cooling deviation set point and the minimum VAV heating demand is less than the Heating Change Set Point, the AHU will be in a cooling mode.

Room Cooling Temperature Set Point (adj.) 22.5ºC

Minimum Cooling Supply Air Temperature See table below

Maximum Cooling Supply Air Temperature 22.0°C

An adaptive algorithm is then used to modulate the chilled water valve, the economy dampers, or a combination of both devices to achieve the required supply air temperature set point.

North Building		South Building	
AHU	**Min. Cooling SA Temp.**	**AHU**	**Min. Cooling SA Temp.**
N-AHU-N	12.0 °C	S-AHU-N	11.5 °C
N-AHU-W	12.0 °C	S-AHU-W	11.5 °C
N-AHU-C	10.5 °C	S-AHU-C	11.0 °C

7.3.8 VAV AHU Outside Air Economy Cooling Control (Typical)

When the OA enthalpy is less than the RA enthalpy & the OA temperature is less than 22.0°C & there is a cooling call, the economy cycle dampers will be modulated from 0-100% as the initial source of cooling in line with the adaptive cooling loop. When the OA enthalpy is greater than the RA enthalpy or the OA temperature is greater than 22.0°C or less than 10.0 °C , the economy cycle will be disabled, and the OA dampers positioned to achieve the minimum OA requirements.

This concept will provide a first stage approach to cooling should the OA conditions be favourable and will be achieved by modulating open the OA dampers and modulating closed the RA dampers to maintain the desired room temperature efficiently.

7.3.9 VAV AHU Heating Mode Control (Typical)

Each AHU provides heating based on a control algorithm that calculates the required SA temperature set point in response to the average occupied deviation from set point of the associated perimeter zone VAV terminals or interior zone damper controls. The mode of the AHU is determined by the average occupied deviation from set point. If the deviation is below the heating deviation set point and the maximum VAV cooling demand is less than the Cooling Change Set Point, the AHU will be in a heating mode.

Room Heating Temperature Set Point (adj.) 22.5ºC

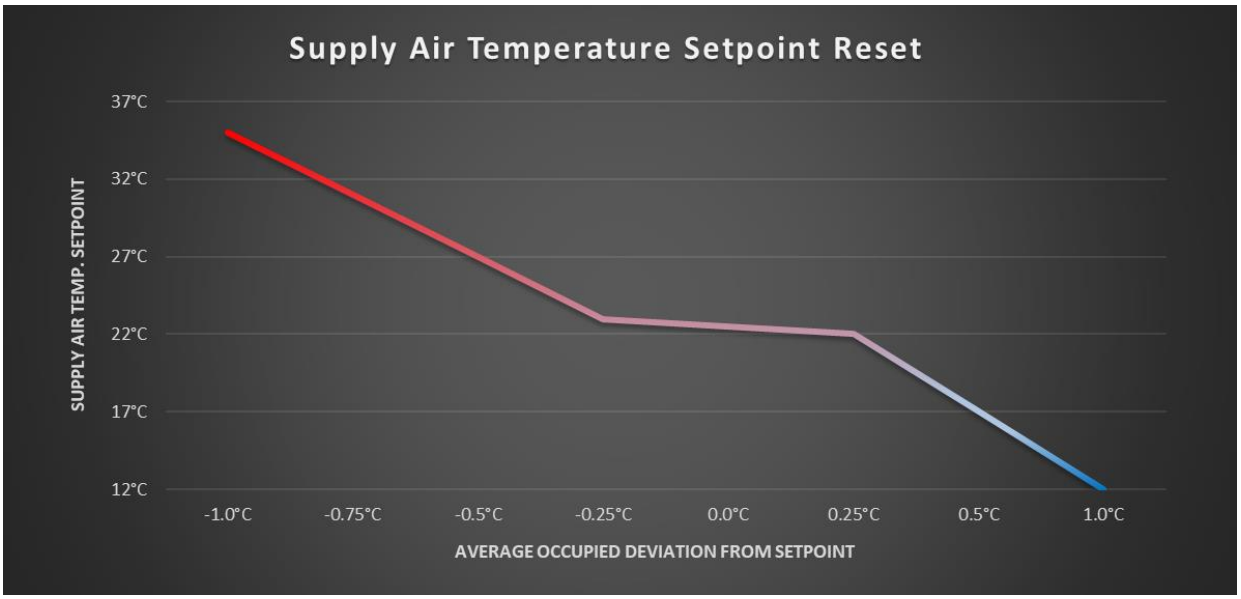
Minimum Heating Supply Air Temperature 23.0°C

Maximum Heating Supply Air Temperature See table below

North Building		South Building	
AHU	**Max. Heating SA Temp.**	**AHU**	**Max. Heating SA Temp.**
N-AHU-N	30.5 °C	S-AHU-N	30.5 °C
N-AHU-W	31.5 °C	S-AHU-W	30.5 °C
N-AHU-C	26.0 °C	S-AHU-C	27.5 °C

An adaptive algorithm is then used to modulate the heating water valve, to achieve the required SA temperature set point.

The following graph demonstrates the relationship between the average deviation from setpoint of the top-3 critical VAVs and the supply air temperature setpoint value.



7.3.10 VAV AHU Room Temperature Alarm (Typical)

Should the room temperature exceed the alarm temperature set point values for the Alarm Time Delay period, an alarm shall be raised to alert the maintenance staff. The room temperature alarms are inhibited from operation for 30 minutes after plant start-up and during shutdown.

Room Temperature Set Point: 22.5°C

Room Temperature Low Alarm Set Point: SP - 3°C (adj)

Room Temperature High Alarm Set Point: SP + 3ºC (adj.)

Room Temperature Alarm Time Delay (adj.) 15 Mins.

This alarm condition is displayed within the Alarm Status application on the BMS PC Workstations.

7.3.11 VAV AHU Dirty Filter Alarm (Typical)

The combined DP of the AHU bag & panel filters in monitored by the BMS. A dirty filter condition will be determined as per the filter manufacturer data, that will be used to trigger an alarm condition at the BMS.

AHU Filter Alarm Time Delay (adj.) 15 Mins.

- N-AHU-N Mixed Air Filter Pressure Set Point 165 Pa
- N-AHU-C Mixed Air Filter Pressure Set Point 165 Pa
- N-AHU-W Mixed Air Filter Pressure Set Point 165 Pa
- N-AHU-L Mixed Air Filter Pressure Set Point 165 Pa
- S-AHU-N Mixed Air Filter Pressure Set Point 165 Pa
- S-AHU-C Mixed Air Filter Pressure Set Point 165 Pa
- S-AHU-W Mixed Air Filter Pressure Set Point 165 Pa
- S-AHU-L Mixed Air Filter Pressure Set Point 165 Pa

7.3.12 VAV AHU Monitoring (Typical)

The BMS provides monitoring only of various conditions, as stated this is for monitoring purposes only and is intended to assist system operators in diagnosing plant performance. The monitored conditions are as follows;

- SA temperature (ºC), the temperature of the air leaving the AHU.
- Static pressure of the air downstream of the AHU.
- RA temperature (ºC), the temperature of the air in the return duct from the space.
- RA relative humidity (%RH), the %RH of the air in the return duct from the space.
- CHW Coil Air Off Temperature (°C) of the AHU.
- Dirty Filter Sensor, DP across the filters to indicate a dirty filter condition.
- Mixed Air Plenum Pressure, the pressure inside the mixed air plenum relative to the plantroom.
- RAF VSD Fault, direct hardware fault of AHU & RAF Variable Speed Drives.
- ARAF VSD Status, running status of RAF Variable Speed Drives, enabled from torque settings in VSD configuration.
- Temperature alarm in Cooling mode (temperature remaining above setpoint for more than an adjustable period)
- Temperature alarm in Heating mode (temperature remaining below setpoint for more than an adjustable period)

7.3.13 VAV AHU Fire Control (Typical)

All AHUs are controlled with hardwired FIP interlocks to control the individual air handlers based on the required fire mode operation. The fire mode operation will take precedence over any other control operation.

In fire mode the system shuts down MVCDs & VAV remain in current position and motorised spring returned smoke dampers to return to their fire mode position (closed).

This alarm condition is displayed within the Alarm Status application on all BMS PC Workstations.

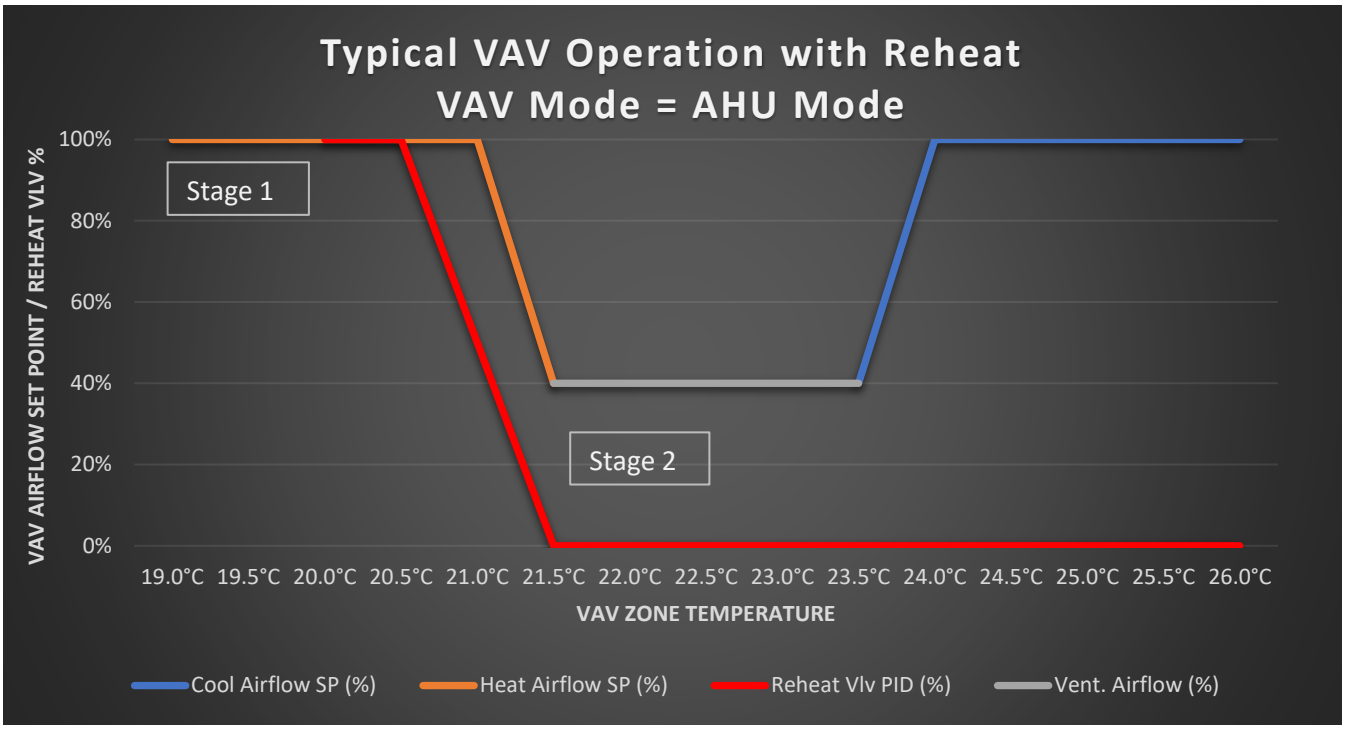
7.3.14 Perimeter & Internal Zone Variable Air Volume Unit Control

An application specific Direct Digital Controller (DDC), referred to as an Actuator Terminal Equipment Controller (DXR) VAV terminal is mounted within the ceiling space of each zone. Each VAV can be removed from the AHU control group by deselecting it via a check box on the associated graphics page. Once deselected, the VAV is removed from the AHU control group and will not contribute to the AVG, MIN & MAX zone temperatures, cooling or heating calls or damper position for static duct pressure reset. The VAV will continue to operate to serve the space based on the local zone conditions. DXRs will be sent into day mode via the network once it is determined that the zone is in an occupied condition ***AND*** the VAV has been selected as Active within the control group. Once in day mode the VAV will control temperature to a cooling temperature set point of 24.0°C, and a heating temperature set point of 21.0°C. The cooling / heating mode of the VAV is determined from the associated AHU control as detailed in sections 7.3.7 & 7.3.9. A room temperature sensor senses the local space temperature. The VAV terminal is supplied and fitted with an averaging velocity sensor of the Pitot tube type supplied by the VAV terminal Manufacturer. A DPS senses air velocity (therefore a calculated air volume) through the terminal. For a given space temperature, the DXR maintains constant air velocity by modulating the damper motor.

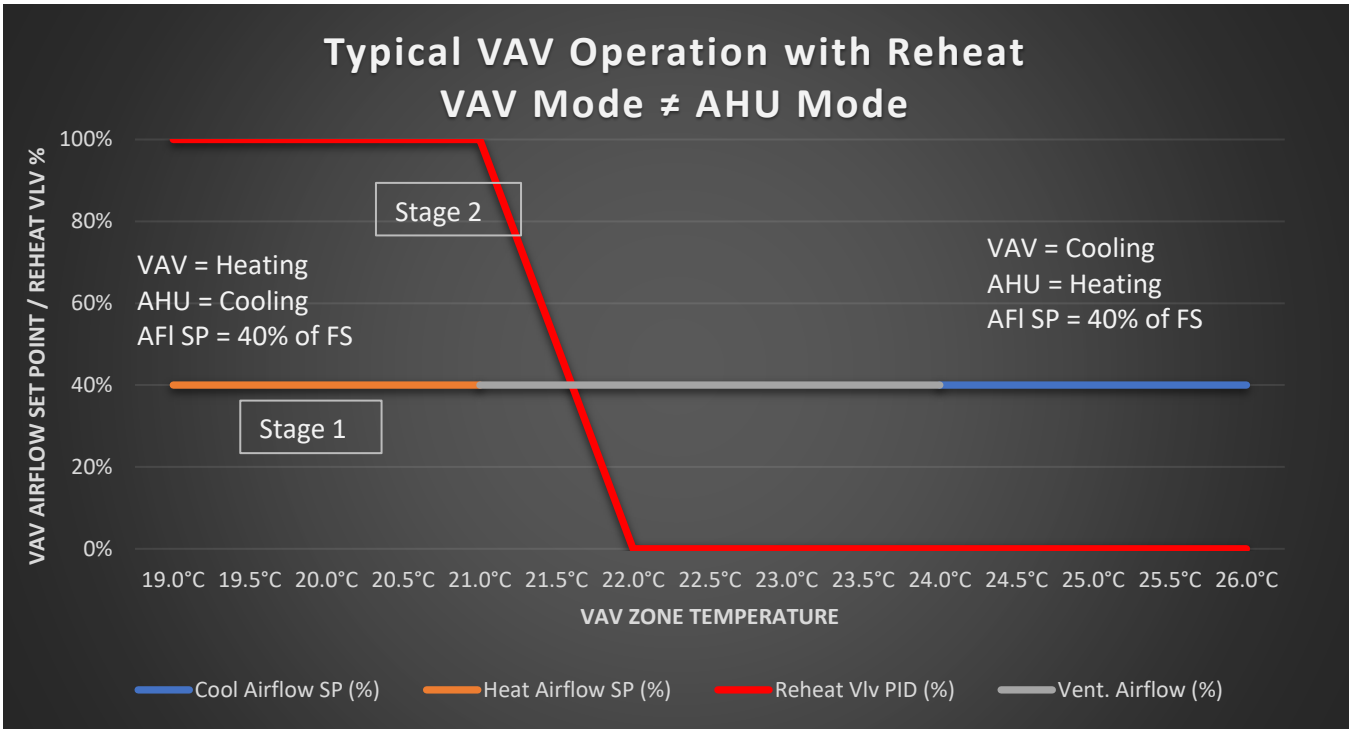
During Cooling Mode, the zone VAV will control the SA damper to maintain the required airflow into the zone using pressure independent modulation based on maintaining the zone cooling temperature Set point. If the zone requires heating (when the AHU is in the cooling mode) then the zone VAV will control the SA damper to maintain a minimum airflow into the zone and the associated reheat valve (perimeter VAV boxes only) will modulate open, when ***not*** in warmup mode, based on maintaining the zone heating temperature set point. If the AHU is in the heating mode, the VAV will be set to the heating mode and the SA damper is controlled to modulate the air into the zone. Once the room temperature rises above the heating set point, the VAV will maintain the minimum heating airflow volume.

- Perimeter VAV Zone Temp Cooling Set point (adj.) 24.0ºC (22.5°C + 1.5°C db)
- Perimeter VAV Zone Temp Heating Set point (adj.) 21.0ºC (22.5°C – 1.5°C db)

The following table demonstrates graphically the cooling & heating operation of each perimeter zone VAV in both buildings



Notes: In the control sequence in Heating mode, the damper will regulate first to satisfy the heating setpoint as a first stage before the Reheat Valve starts modulating as the second stage of Heating



7.4 Common Air Plenum

7.4.1 Common Air Plenum Overview

The mechanical set-up has a common air plenum where each floor RAF rejects the air from the floors. The common air plenum has a DPS on L3 which will monitor the difference in pressure between the plenum and the atmospheric pressure. In the event that the plenum is too positively pressured, the AHU spill air dampers located on roof will open in a staged fashion to bring down the DP to a defined range.

7.4.2 Common Air Plenum Relief Pressure Control

The pressure in the common air plenum will vary depending on the amount of air from the floor RAF being spilled and the degree of opening of the RA dampers of each AHUs. The pressure in the plenum will be constantly monitored with a DPS located on L3. A slightly positive pressure of around 5Pa (adj.) will need to be present at any moment. The spill air dampers will be regulated as per lookup table below. A PI loop having as control variable the DPS signal and setpoint of 5Pa (adj.) will produce an output (controlled variable) that we will define as the demand.

PI Loop output (Demand)	***Spill Air Damper 1***	***Spill Air Damper 2***	***Spill Air Damper 3***
0 → 33%	Regulates 0→ 100%	Closed	Closed
33% → 66%	Fully open	Regulates 0→ 100%	Closed
66% → 100%	Fully open	Fully open	Regulates 0→ 100%
100% (maintained)	Fully open	Fully open	Fully open

If the pressure sensor reading goes above a certain threshold, an alarm will go to the BMS after a certain delay to give time to the spill air dampers to reduce the pressure in plenum first.

Pressure Sensor Alarm	(135% of commissioning value) PA
Delay before alarm is activated	15 minutes

8 VENTILATION SYSTEMS

8.1 Control Operation – Ventilation System

8.1.1 Overview

Various ventilation systems are situated throughout the building to assist in the ventilation strategies required for this building. These are nominated as follows:

- ✓ Return Fans N-RAF-1.1 to 5.1 & S-RAF-1.1 to 5.1
- ✓ Toilet Exhaust System N-TEF-R.1 and S-TEF-R.1
- ✓ Smoke Exhaust Fans N-SEF-R.1 to R.6 & S-SEF-R.1 to R.6
- ✓ General Exhaust Fans N-GEF-R.1 and S-GEF-R.1
- ✓ Kitchen Exhaust Fan N-KEF-R.1 and S-KEF-R.1
- ✓ Stairwell Pressurisation Fans N-SPF-R.1 & N-SPF-R.2 – (refer to section 10.4)
- ✓ Tenant Outside Air Fan N-OAF-R.1 & S-OAF-R.1
- ✓ Basement & GFlr Exhaust Fans N-EAF-B.1, N-EAF-B.2, N-EAF-G.1, N-EAF-G.3 & N-EAF-EOT
- ✓ Car Park Exhaust Fans N-CPEF-B.1
- ✓ Basement Outside Air Fan N-OAF-G.1

8.2 Toilet Exhaust System - N-TEF-R.1 & S-TEF-R.1

8.2.1 Toilet Exhaust Fan Enable (Typical)

The toilet exhaust fans are started and stopped automatically by one of the following:

- Programmable time schedule.
- BMS Manual Start/Stop.
- Unit / System Interlock.
- AH call

8.2.2 Programmable Time Schedule (Typical)

TEFs serving general or common areas shall be controlled by the BMS on a time schedule basis. In addition, any after-hours operation shall also initiate the associated toilet exhaust system; opening the associated damper and adjusting the speed of the fan through a PID loop having as control variable the static duct pressure sensor reading.

8.2.3 BMS Manual Start/Stop (Typical)

The control system is configured to allow the operator to manually override the BMS control of each toilet exhaust fan from the associated graphics pages on the BMS PC Workstation. During a BMS Manual Start/Stop, the plant will operation normally. The TEF will continue to run until the operator places the BMS Manual Start/Stop into “Auto” mode.

- “Manual” mode = BMS Manual Override Active.
- “Auto” mode = BMS Manual Override Inactive.

8.2.4 Unit / System Interlock (Typical)

TEF associated with specific areas shall be interlocked to operate with the associated mechanical ventilation systems. For example, TEFs shall operate whenever the AHU is operational or whenever the room is deemed to be occupied as sensed from the associated lighting system.

8.2.5 Toilet Exhaust Fan Status Alarm

A Fan Failed Alarm is raised if the Supply Fan is commanded ON and the Fan status switch is OFF after a time delay (adj.). The alarm is inhibited whenever the Fan is OFF or the condition is TRUE. In the event of the fan status fault, the lag unit shall be enabled and the lead unit locked out until reset by the operator at the BMS workstation.

Fan Fail Alarm Time Delay (adj.) 60 sec.

This alarm condition is displayed within the Alarm Status application on the BMS PC Workstations.

8.3 Smoke Exhaust Fans - N-SEF-R.1 to R.6 & S-SEF-R.1 to R.6

8.3.1 Smoke Exhaust Fan Enable (Typical)

The SEFs are started and stopped automatically by the following:

- Fire Control System.

8.3.2 Fire Control System (Typical)

All SEFs are hardwired to be controlled by the building fire control panel. When required, the fire panel will initiate a call to start the associated smoke exhaust fan. The BMS will monitor the operation of the fan only. There is no control function for the BMS.

8.3.3 Smoke Exhaust Fan Status Alarm

A Fan Failed Alarm is raised if the Exhaust Fan is commanded ON and the Fan status switch is OFF after a time delay (adj.). The alarm is inhibited whenever the Fan is OFF or the condition is TRUE. In the event of the fan status fault, the lag unit shall be enabled and the lead unit locked out until reset by the operator at the BMS workstation.

Fan Fail Alarm Time Delay (adj.) 60 sec.

This alarm condition is displayed within the Alarm Status application on the BMS PC Workstations.

8.4 General Exhaust Fans - N-GEF-R.1 & S-GEF-R.1

8.4.1 General Exhaust Fan Enable (Typical)

The GEFs are started and stopped automatically by one of the following:

- Programmable time schedule.
- BMS Manual Start/Stop.
- Unit / System Interlock.
- AH call

8.4.2 Programmable Time Schedule (Typical)

GEFs serving general or common areas shall be controlled by the BMS on a time schedule basis. In addition, any after-hours operation shall also initiate the associated General Exhaust system; opening the associated damper and adjusting the speed of the fan through a PID loop having as control variable the static duct pressure sensor reading.

8.4.3 BMS Manual Start/Stop (Typical)

The control system is configured to allow the operator to manually override the BMS control of each GEF from the associated graphics pages on the BMS PC Workstation. During a BMS Manual Start/Stop, the plant will operation normally. The GEF will continue to run until the operator places the BMS Manual Start/Stop into “Auto” mode.

- “Manual” mode = BMS Manual Override Active.
- “Auto” mode = BMS Manual Override Inactive.

8.4.4 Unit / System Interlock (Typical)

GEFs associated with specific areas shall be interlocked to operate with the associated mechanical ventilation systems. For example, some areas as a part of a temperature control strategy for these rooms are commanded to come on as required by the BMS control routine.

8.4.5 General Exhaust Fan Status Alarm

A Fan Failed Alarm is raised if the Supply Fan is commanded ON and the Fan status switch is OFF after a time delay (adj.). The alarm is inhibited whenever the Fan is OFF or the condition is TRUE. In the event of the fan status fault, the lag unit shall be enabled and the lead unit locked out until reset by the operator at the BMS workstation.

Fan Fail Alarm Time Delay (adj.) 60 sec.

This alarm condition is displayed within the Alarm Status application on the BMS PC Workstations.

8.5 Kitchen Exhaust Fans - N-KEF-R.1 & S-KEF-R.1

8.5.1 Kitchen Exhaust Fan Enable (Typical)

The KEF (N-KEF-R.1) in North building is started and stopped automatically by one of the following:

- Local on/off switch within the Kitchen

Once the local on/off switch is enabled within the kitchen, the KEF will run at a fixed speed.

KEF speed (adj.) TBC %

The KEF (S-KEF-R.1) in South building is split into 3 tenancies. Each tenant can start or stop the KEF by the following:

- Local on/off switch within the tenant Kitchen

In the event that one (1) local switch is ON, KEF speed will be set to TBC Hz
In the event that two (2) local switches are ON, KEF speed will be set to TBC Hz
In the event that three (3) local switches are ON, KEF speed will be set to TBC Hz

8.5.2 Kitchen Exhaust Fan Alarms

A Fan Failed Alarm will be raised if the Supply Fan is commanded ON and the Fan Status is OFF after a time delay (adj.). The alarm will be inhibited whenever the Fan is OFF or the condition is TRUE.
This alarm condition will be displayed within the Alarm Status application on the Insight PC Workstation.

- Fan Fail Alarm Time Delay (adj.) 120 sec.

8.6 Tennant Outside Air Intake - N-OAF-R.1 & S-OAF-R.1

8.6.1 Tennant Outside Air Fan Enable

The OAFs are started and stopped automatically by one of the following:

- Programmable time schedule.
- BMS Manual Start/Stop.
- Unit / System Interlock.
- AH call

8.6.2 Programmable Time Schedule (Typical)

OAFs serving general or common areas shall be controlled by the BMS on a time schedule basis. In addition, any after-hours operation of the common areas shall also initiate the associated Outside Air system, opening the associated floor damper and adjusting the speed of the fan through a PID loop having as control variable the static duct pressure sensor reading.

8.6.3 BMS Manual Start/Stop (Typical)

The control system is configured to allow the operator to manually override the BMS control of each OAF from the associated graphics pages on the BMS PC Workstation. During a BMS Manual Start/Stop, the plant will operation normally. The OAF will continue to run until the operator places the BMS Manual Start/Stop into “Auto” mode.

- “Manual” mode = BMS Manual Override Active.
- “Auto” mode = BMS Manual Override Inactive.

8.6.4 Unit / System Interlock (Typical)

OAFs associated with specific areas shall be interlocked to operate with the associated mechanical ventilation systems. For example, some areas as a part of a temperature control strategy for these rooms are commanded to come on as required by the BMS control routine.

8.6.5 General Exhaust Fan Status Alarm

A Fan Failed Alarm is raised if the Supply Fan is commanded ON and the Fan status switch is OFF after a time delay (adj.). The alarm is inhibited whenever the Fan is OFF or the condition is TRUE. In the event of the fan status fault, the lag unit shall be enabled, and the lead unit locked out until reset by the operator at the BMS workstation.

Fan Fail Alarm Time Delay (adj.) 60 sec.

This alarm condition is displayed within the Alarm Status application on the BMS PC Workstations.

8.7 Basement Exhaust Air Fans - N-EAF-B.1, N-EAF-B.2, N-EAF-G.1 & N-EAF-G.3

8.7.1 Basement Exhaust Air Fan Schedule

The Basement has four (4) exhaust air fans extracting air in various areas as per the schedule listed below:

- ✓ N-EAF-B.1 (VSD) – Store & Main Switch
- ✓ N-EAF-B.2 (DOL) – Grease Trap
- ✓ N-EAF-G.1 (DOL) – COMMS. BSN & Security
- ✓ N-EAF-G.3 (DOL) – EOT

8.7.2 Basement Exhaust Air Fan Enable

The EAFs are started and stopped automatically by one of the following:

- Programmable time schedule.
- BMS Manual Start/Stop.

8.7.3 Programmable Time Schedule (Typical)

EAFs serving general or common areas shall be controlled by the BMS on a time schedule basis depending on the area in which air is being extracted. All Basement EAFs runs 24/7 (time scheduler won't have any 'OFF' time).

N-EAF-B.2, N-EAF-G.1, N-EAF-G.3, N-EAF-EOT are DOL type of fans and will run after receiving it's 'ON' signal from the BMS. The EOT fan has an isolation damper that will need to be opened before the fan starts, that is as soon as the scheduler is ON.

N-EAF-B.1 is equipped with a VSD, and its speed will be fixed & commanded by the BMS.

8.7.4 BMS Manual Start/Stop (Typical)

The control system is configured to allow the operator to manually override the BMS control of each EAF from the associated graphics pages on the BMS PC Workstation. During a BMS Manual Start/Stop, the plant will operation normally. The EAF will continue to run until the operator places the BMS Manual Start/Stop into "Auto" mode.

- "Manual" mode = BMS Manual Override Active.
- "Auto" mode = BMS Manual Override Inactive.

8.7.5 General Exhaust Fan Status Alarm

A Fan Failed Alarm is raised if the Fan is commanded ON and the Fan status switch is OFF after a time delay (adj.). The alarm is inhibited whenever the Fan is OFF, or the condition is TRUE. In the event of the fan status fault, the lag unit shall be enabled, and the lead unit locked out until reset by the operator at the BMS workstation.

Fan Fail Alarm Time Delay (adj.) 60 sec.

This alarm condition is displayed within the Alarm Status application on the BMS PC Workstations.

8.8 Car Park Exhaust Fan – CPEF-B.1

8.8.1 Car Park Exhaust Air Fan Enable

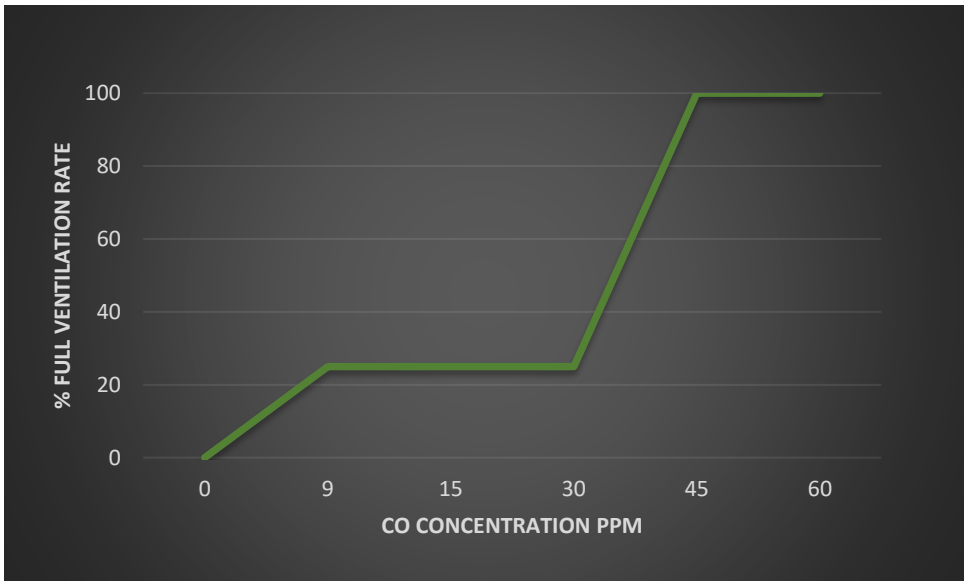
The fan is enabled and disabled by the following:

- ✓ Carbon Monoxide Monitoring

8.8.2 Car Park Exhaust Air Fan Operation

The Car Park Exhaust Fan is controlled by the BMS via CO (Carbon Monoxide) monitoring. The fan will run at a minimum speed when the timed average hi-select CO concentration rises above the minimum exposure limit (15% of 60 ppm). For un-attended car parks, the maximum exposure limit is configured as 60 ppm.

Once the fan is enabled the BMS will modulate the exhaust air fan VSD to maintain the required system timed average hi-select CO level at the pre-determined set points. At minimum airflow, the VSD will be supplying 25% of the total airflow volume. When the timed averaged hi-select CO reading ranges between 50% and 80% of the CO exposure limits (currently detailed as 60ppm), the fan will be ramped proportionally from 25% to 100% speed. The designed air flow range for the car park is xx L/s – xx L/s.



The VSD will be connected to the BMS for high level control & monitoring. The fan status & fault will be provided by the high-level interface to the VSD.

During a fire alarm the Car Park Exhaust Fan shall be interlocked with the fire panel and driven to full speed to destruction. All alarms shall be disregarded.

8.8.3 Car Park Exhaust Air Fan Alarm

A fan failed alarm is raised if the Exhaust fan is commanded ON and the software fan status proof switch is OFF after a time delay (adj.). The alarm is inhibited whenever the fan is OFF, or the condition is TRUE.

Fan Fail Alarm Time Delay (adj.) 60 sec.

8.8.4 Car Park Exhaust Air Fan Fire Operation

During a fire alarm, the Car Park Exhaust Fan will be driven to 100% speed. All BMS control is overridden during a fire alarm and the Exhaust Fan will run to destruction should this event persist. The fan will run continuously until the FFCP sends a stop signal & only then will the fan stop. The fan will revert to automatic operation when all fire signals have been reset. The FFCP will receive a status signal from the MSB to indicate true running status of the Fan.

8.9 Basement Outside Air Intake - N-OAF-G.1

8.9.1 Basement Exhaust Air Fan Enable & Operation

The Basement OAF is started and stopped automatically by one of the following:

- Programmable time schedule.
- BMS Manual Start/Stop.

On receiving the 'ON' signal the BMS will open the isolation damper as well as the Lift Lobby and Store 2 damper before starting the fan. The fan speed will be regulated by a PID loop in built in the BMS program were the PID loop control variable would be the static duct pressure.

Static duct pressure setpoint (adj.) TBC Pa.

8.9.2 Programmable Time Schedule (Typical)

OAF serving store 2, Lift Lobby, Store 1, South BSN, COMMS. BSN & Security and finally DAS room shall be controlled by the BMS on a time schedule basis. Since the Basement OAF runs 24/7 the time scheduler won't have any 'OFF' time.

8.9.3 BMS Manual Start/Stop (Typical)

The control system is configured to allow the operator to manually override the BMS control of each EAF from the associated graphics pages on the BMS PC Workstation. During a BMS Manual Start/Stop, the plant will operation normally. The EAF will continue to run until the operator places the BMS Manual Start/Stop into "Auto" mode.

- "Manual" mode = BMS Manual Override Active.
- "Auto" mode = BMS Manual Override Inactive.

8.9.4 Fan Status Alarm

A Fan Failed Alarm is raised if the Fan is commanded ON and the Fan status switch is OFF after a time delay (adj.). The alarm is inhibited whenever the Fan is OFF, or the condition is TRUE. In the event of the fan status fault, the lag unit shall be enabled, and the lead unit locked out until reset by the operator at the BMS workstation.

Fan Fail Alarm Time Delay (adj.) 60 sec.

This alarm condition is displayed within the Alarm Status application on the BMS PC Workstations.

8.10 Fire Mode

8.10.1 Fire Shutdown

All ventilation systems (Excluding the Smoke Exhaust) are shut down via hard wired interlocks in accordance with the fire matrix. This is performed within the mechanical switchboards from a general fire (GFR) shutdown wired by the fire contractor.

This signal is mimicked by the BMS and plant shutdown and sequentially restarted once the general fire alarm has been cleared. All BMS alarm processing is inhibited during this shutdown.

The general fire alarm condition is displayed within the Alarm Status application on the BMS PC Workstations.

9 FAN COIL UNITS – TYPICAL OPERATION

9.1 Control Operation – Fan Coil Units

9.1.1 Overview

FCUs provide cooled or heated air to either a section of the building (Ground Floor) or pre-conditioned air to certain VAVs. Each FCUs is controlled by low-level by the floor sub-panel attached to the modular main panel on L3.

The Fan Coil Units for the North Building are as follows:

- N-FCU-G.1 supplies chilled and heated air to N-VAV-G1.1 & N-VAV-G1.2
- N-FCU-G.2 supplies chilled and heated air to N-VAV-G2.1 & N-VAV-G2.2
- N-FCU-G.3 supplies chilled and heated air to Ground Floor (commercial section)
- N-FCU-EOT supplies heated air to EOT-F and EOT-M

The Fan Coil Units for the South Building are as follows:

- S-FCU-G.1 supplies chilled and heated air to S-VAV-G1.1 & S-VAV-G1.2 (commercial section)
- S-FCU-G.2 supplies chilled and heated air to S-VAV-G2.1 & S-VAV-G2.2 (commercial section)
- S-FCU-G.3 supplies chilled and heated air to S-VAV-G3.1, S-VAV-G3.2 & S-VAV-G3.3
- S-FCU-G.4 supplies chilled and heated air to Ground Floor.

Each FCU is furnished with CHW Cooling & / or HHW Heating coils, RA and/or OA dampers & filter assemblies to the exception of N-FCU-EOT which has a Heating coil only.

9.2 Description of Fan Coil Unit Control Strategies

9.2.1 FCU Enable

The units are started and stopped automatically by one of the following:

- Programmable time schedule.
- Optimum Start/Stop.
- After-hours Operation.
- BMS Manual Start/Stop

9.2.1.1 Programmable Time Schedule (Typical)

The time Schedules for each FCU will be structured so that each FCU will be enabled independently. The FCU independent time schedules will be configured to operate to suit the associated zone requirements.

A Common Schedule will be available for programming events such as Public Holidays and will provide a global control for the specified period of the event.

The standard occupied hours for the building will be 8am-5pm hours Monday to Friday except for designated public holidays. The actual start time may be adjusted due to the optimum Start/Stop algorithm, refer to the following section regarding this control. However, each FCU can have its own schedule.

- N-FCU-G.1 xx am to xx pm
- N-FCU-G.2 xx am to xx pm
- N-FCU-G.3 xx am to xx pm
- N-FCU-EOT xx am to xx pm
- S-FCU-G.1 xx am to xx pm
- S-FCU-G.2 xx am to xx pm
- S-FCU-G.3 xx am to xx pm
- S-FCU-G.4 xx am to xx pm

9.2.1.2 BMS Manual Start/Stop (Typical)

The control system is configured to allow the operator to manually override the occupancy status of each AHU from the associated graphics pages on the BMS PC Workstation. During a BMS Manual Start/Stop, the plant will operate normally. The FCU will continue to run until the operator places the BMS Manual Start/Stop into “Auto” mode.

- “Manual” mode = BMS Manual Override Active.
- “Auto” mode = BMS Manual Override Inactive.

9.2.2 FCU Supply Air Fan Operation (FCU N-FCU-G1, G2 & S-FCU-G1, G2 and G3)

On receipt of the run command, the control system responds by energising the respective SAF run relay. The static pressure sensor installed at the supply duct will monitor the static pressure which will vary as the VAV dampers open and closes. In event of low demand, the VAV damper will close and the SAF speed will go down to meet the commissioned static pressure setpoint as defined by the static pressure reset routine. The contrary will happen when the VAV damper opens in high demand.

9.2.2.1 FCU Static Pressure Setpoint Reset

A reset algorithm will be programmed to match the fan usage with the actual airflow demands from the associated VAV Zone Damper terminals. This algorithm will work in the following way:

For start-up, the initial static pressure setpoint is set midway between the maximum and minimum static pressure setpoint (commissioned value).

Once the fan has started and the start timer has elapsed, the algorithm will then reset the set point based on the most open active VAV terminal (control terminal) based on the following:

- If the control terminal damper position is > 90% the static pressure set point will be increased by the static gain increment.
- If the control terminal damper position is < 80% the static pressure set point will be decreased by the static gain increment.
- If the control terminal damper position is > 80% and less than 90% the static pressure set point will be held at its current value.

Static Gain Value (adj.) 5 Pa.

The static pressure set points have been commissioned to the following values: -

- N-FCU-G1 Static Pressure Set Point Min - TBA Pa, Max - TBA Pa
- N-FCU-G2 Static Pressure Set Point Min - TBA Pa, Max - TBA Pa
- S-FCU-G1 Static Pressure Set Point Min - TBA Pa, Max - TBA Pa
- S-FCU-G2 Static Pressure Set Point Min - TBA Pa, Max –TBA Pa

- S-FCU-G3 Static Pressure Set Point Min - TBA Pa, Max - TBA Pa

9.2.3 FCU Supply Air Fan Operation (FCU N-FCU-G3, EOT & S-FCU-G4)

As mentioned, the FCU is enabled / disabled based on various conditions i.e., Time Schedule, After-hours & others. Once the FCU fan is enabled a PID loop within the BMS controller will modulate the 0-10VDC output to the associated AHU EC motor to maintain the required system supply air temperature at the pre-determined set-point. The operating status of the supply fan is confirmed by means of a current switch to measure the EC motor current and provide a status input to the BMS.

9.2.4 FCU Supply Air Fan Alarm

A Fan Failed Alarm is raised if the Supply Fan is commanded ON and the Fan DP switch is OFF after a time delay (adj.). The alarm is inhibited whenever the FAN is OFF or the condition is TRUE.

Fan Fail Alarm Time Delay (adj.) 60 sec.

This alarm condition is displayed within the Alarm Status application on the Insight PC Workstations.

9.2.5 FCU Cooling Mode Control (FCU N-FCU-G1, G2 & S-FCU-G1, G2 and G3)

Each FCU provides cooling based on a control algorithm that calculates the required SA set point in response to the average occupied deviation from set point of the associated perimeter zone VAV terminals or interior zone damper controls. The mode of the FCU is determined by the average occupied deviation from set point. If the deviation above the cooling deviation set point and the minimum VAV heating demand is less than the Heating Change Set Point, the FCU will be in a cooling mode.

Room Cooling Temperature Upper limit 24.0℃

Minimum Cooling Supply Air Temperature see table below

Maximum Cooling Supply Air Temperature 22.0°C

Building Temp setpoint 22.5°C ± 1.5°C

North Building		South Building	
FCU	**Min. Cooling SA Temp.**	**FCU**	**Min. Cooling SA Temp.**
N-FCU-G1	XX °C	S-FCU-G1	XX °C
N-FCU-G2	XX °C	S-FCU-G2	XX °C
		S-FCU-G3	XX °C

9.2.6 FCU Heating Mode Control (FCU N-FCU-G1, G2 & S-FCU-G1, G2 and G3)

Each FCU provides heating based on a control algorithm that calculates the required SA temperature set point in response to the average occupied deviation from set point of the associated perimeter zone VAV terminals or interior zone damper controls. The mode of the FCU is determined by the average occupied deviation from set point. If the deviation is below the heating deviation set point and the maximum VAV cooling demand is less than the Cooling Change Set Point, the FCU will be in a heating mode.

Room Heating Temperature limit 21.0 ºC

Minimum Heating Supply Air Temperature 23.0°C

Maximum Heating Supply Air Temperature	see table below
Building Temp setpoint	22.5°C ± 1.5°C

North Building		South Building	
FCU	**Max. Heating SAT**	**FCU**	**Max. Heating SAT**
N-FCU-G1	XX °C	S-FCU-G1	XX °C
N-FCU-G2	XX °C	S-FCU-G2	XX °C
		S-FCU-G3	XX °C

An adaptive algorithm is then used to modulate the heating water valve, to achieve the required SAT set point.

9.2.7 FCU Outside Air Control, Outside Air Damper and Return Air Damper

Each FCUs are equipped with a RA damper as well as an OA damper. The controls will rely on the space CO2 (max value of the Top 3 max sensors) to determine the need for fresh air. In normal operation, the CO2 level would be around 700ppm implying that only minimum OA is required and maximum air recirculation.

As CO2 level rises, the volume of fresh air required will rise implying that the OA damper opens, and the RA damper starts closing. In other words, the OA damper and RA damper will complement each other.

9.2.8 FCU Cooling Mode Control (FCU N-FCU-G3 & S-FCU-G4)

Each FCU provides cooling based on a control algorithm that calculates the required supply air temperature set point in response to the deviation from set point of the associated room temperature.

This algorithm is only executed if the relevant SAF status (proof) is ON, if the proof is OFF then the output is held at zero.

The PID loop algorithm produces a control signal connected to the CHW Valve to maintain the required SAT.

Room Cooling Temperature Set Point (adj.)	24.0°C
Minimum Cooling Supply Air Temperature (N-FCU-G3)	xx°C (based on coil design)
Minimum Cooling Supply Air Temperature (S-FCU-G4)	xx°C (based on coil design)
Maximum Cooling Supply Air Temperature	24.0°C
Building Temp setpoint	22.5°C

9.2.9 FCU Heating Mode Control (FCU N-FCU-G3, EOT & S-FCU-G4)

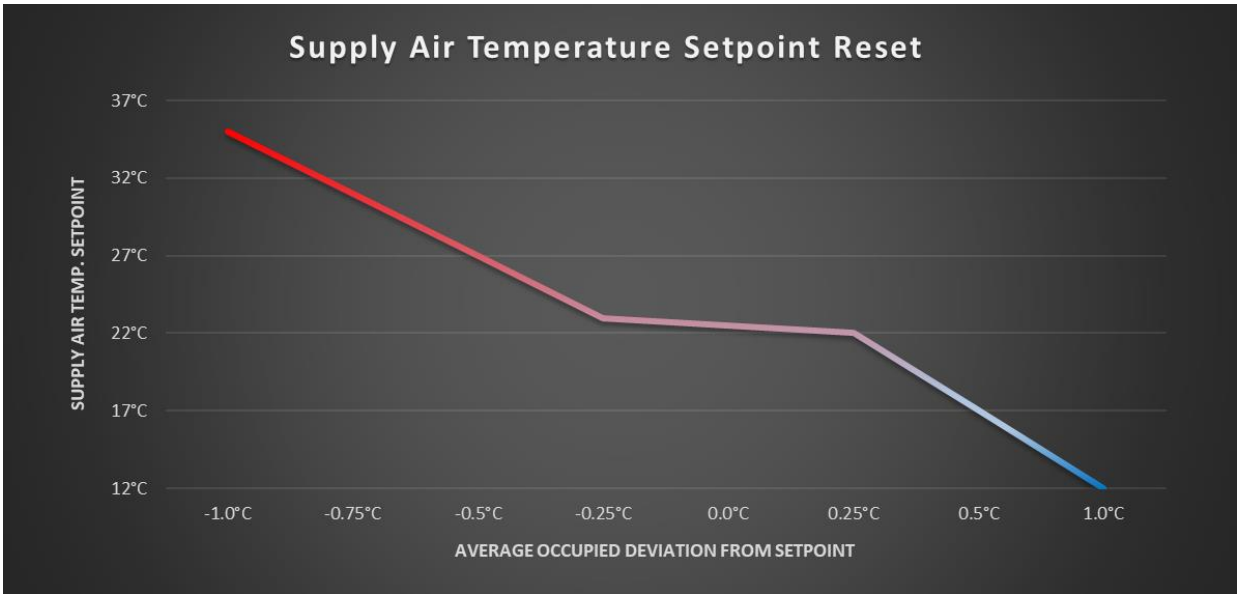
Each FCU provides heating based on a control algorithm that calculates the required supply air temperature set point in response to the deviation from set point of the associated room temperature.

This algorithm is only executed if the relevant SAF status (proof) is ON, if the proof is OFF then the output is held at zero.

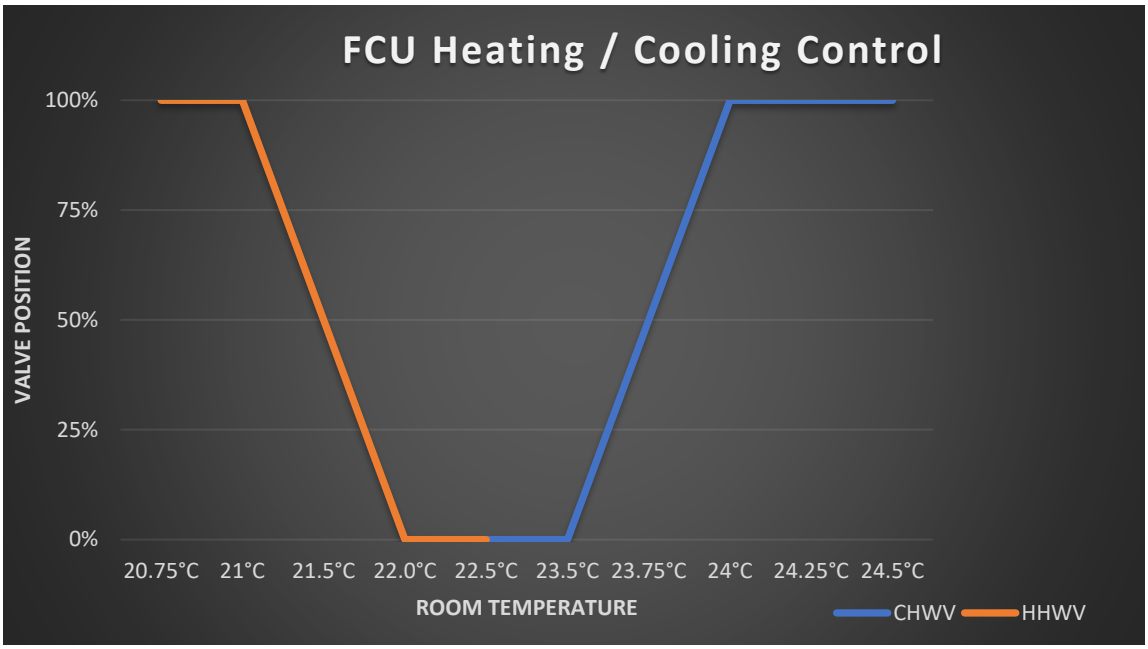
The PID loop algorithm produces a control signal connected to the CHW Valve to maintain the required SAT.

Room Heating Temperature Set Point (adj.)	24.0°C
Minimum Heating Supply Air Temperature	21.5°C
Maximum Heating Supply Air Temperature (N-FCU-G3)	xx°C (based on coil design)
Maximum Heating Supply Air Temperature (N-FCU-EOT	xx°C (based on coil design)
Maximum Heating Supply Air Temperature (S-FCU-G4)	xx°C (based on coil design)
Building Temp setpoint	22.5°C

The following graph demonstrates the relationship between the expected room temperature and the supply air temperature set point value.



The following graph represents the expected operation of a typical fan coil unit.



9.2.10 FCU Dirty Filter Alarm (Typical)

A DP switch is used to monitor the status of the panel filters in each FCU. A dirty filter condition will be determined during commissioning by blocking 50% of the filter area with the FCU running. The pressure switch is set to this value and used to trigger an alarm condition at the BMS.

FCU Filter Alarm Time Delay (adj.) 15 Mins.

This alarm condition is displayed within the Alarm Status application on the BMS PC Workstations.

9.2.11 FCU Monitoring (Typical)

The BMS provides monitoring only of various conditions, as stated this is for monitoring purposes only and is intended to assist system operators in diagnosing plant performance. The monitored conditions are as follows;

- SA temperature (°C), the temperature of the air leaving the FCU.
- Dirty Filter Switch, DP across the filters to indicate a dirty filter condition.
- FCU Fan Status, DP switch to confirm fan operation.
- VAV FCUs have DP sensors to monitor static duct pressure.

9.2.12 FCU Fire Shutdown (Typical)

All FCU's are wired with a general fire (GFR) shutdown hardwired interlock, which stops these units when the fire mode is activated. All BMS control is disabled and alarm processing is inhibited during this shutdown.

This alarm condition is displayed within the Alarm Status application on all BMS PC Workstations.

10 Miscellaneous

10.1 Electrical Meters

The BMS monitors the Electrical services via a Modbus high level interface connection to each multifunction power meter located in associated services switchboards. These meters are displayed on the electrical monitoring graphics pages, the energy consumption points (kW & kWh) for energy consumption purposes and are trended for the energy reporting strategies. Refer to the EMS documentation regarding energy reporting.

Equipment	Switchboard	Meter Type
CH-01	MSSB-N-L6-GEN	DIRIS A40
CH-02	MSSB-N-L6-GEN	DIRIS A40
CH-03	MSSB-N-L6	DIRIS A40

The BMS monitors each of the electrical energy meters via Modbus RTU/RS485 High Level Interface Communications Network. The following data points are available for each meter via the HLI;

- Total Active Power – kW
- Total Reactive Power – kVAr
- Total Apparent Power – kVA
- Total Active Energy – kWh
- Total Reactive Energy – kVArh
- Total Apparent Energy - kVAh
- Frequency - Hz
- Total Power Factor
- Current Phase A – Amps
- Current Phase B – Amps
- Current Phase C – Amps
- Current Neutral – Amps
- Voltage Phase A – Volts
- Voltage Phase B – Volts
- Voltage Phase C – Volts
- Voltage Phase A-B – Volts
- Voltage Phase B-C – Volts
- Voltage Phase A-C – Volts

10.2 Fire Fan Control Panel/ FIP

10.3 Smoke Management System

There are several SEFs in the North and South Building located on the Roof. They are listed as:

North Building

1. N-SEF-R.1 – Smoke Exhaust Fan 1 – Fire Control Only
2. N-SEF-R.2 – Smoke Exhaust Fan 2 – Fire Control Only
3. N-SEF-R.3 – Smoke Exhaust Fan 3 – Fire Control Only
4. N-SEF-R.4 – Smoke Exhaust Fan 4 – Fire Control Only

5. N-SEF-R.5 – Smoke Exhaust Fan 5 – Fire Control Only
6. N-SEF-R.6 – Smoke Exhaust Fan 6 – Fire Control Only

South Building

1. S-SEF-R.1 – Smoke Exhaust Fan 1 – Fire Control Only
2. S-SEF-R.2 – Smoke Exhaust Fan 2 – Fire Control Only
3. S-SEF-R.3 – Smoke Exhaust Fan 3 – Fire Control Only
4. S-SEF-R.4 – Smoke Exhaust Fan 4 – Fire Control Only
5. S-SEF-R.5 – Smoke Exhaust Fan 5 – Fire Control Only
6. S-SEF-R.6 – Smoke Exhaust Fan 6 – Fire Control Only

10.3.1 Smoke Exhaust Fan Enable (Typical)

The SEFs are started and stopped automatically by the following:

- Fire Control System.

10.3.2 Fire Control System (Typical)

All SEFs are hardwired to be controlled by the building fire control panel. When required, the fire panel will initiate a call to start the associated SEF. The BMS will monitor the operation of the fan only during fire operation.

10.3.3 Smoke Exhaust Fan

Smoke Exhaust Fan will be activated if there is a fire through the FIP and the MSSB where the VSD will go into fire mode and ramp-up to a commissioned speed.

North Building

1. N-SEF-R.1 – Smoke Exhaust Fan 1 Speed setpoint- TBA Hz
2. N-SEF-R.2 – Smoke Exhaust Fan 2 Speed setpoint- TBA Hz
3. N-SEF-R.3 – Smoke Exhaust Fan 3 Speed setpoint- TBA Hz
4. N-SEF-R.4 – Smoke Exhaust Fan 4 Speed setpoint- TBA Hz
5. N-SEF-R.5 – Smoke Exhaust Fan 5 Speed setpoint- TBA Hz
6. N-SEF-R.6 – Smoke Exhaust Fan 6 Speed setpoint- TBA Hz

South Building

1. S-SEF-R.1 – Smoke Exhaust Fan 1 Speed setpoint- TBA Hz
2. S-SEF-R.2 – Smoke Exhaust Fan 2 Speed setpoint- TBA Hz
3. S-SEF-R.3 – Smoke Exhaust Fan 3 Speed setpoint- TBA Hz
4. S-SEF-R.4 – Smoke Exhaust Fan 4 Speed setpoint- TBA Hz
5. S-SEF-R.5 – Smoke Exhaust Fan 5 Speed setpoint- TBA Hz
6. S-SEF-R.6 – Smoke Exhaust Fan 6 Speed setpoint- TBA Hz

10.3.4 Smoke Exhaust Fan Alarm & Monitoring (Typical)

The BMS will communicate through HLI with the VSD and will monitor the following points and produce an alarm if it is reported by the VSD. This alarm condition is displayed within the Alarm Status application on the BMS PC Workstations.

Points Monitored:

- ✓ Enable
- ✓ Status
- ✓ Speed
- ✓ Stairwell Pressure
- ✓ Current, Voltage, Power & Energy

10.4 Stairwell Pressurisation System

There are several SPFs located on the roof of Building A and Building B. These fans only operate during a fire alarm to pressurise the stairwells to prevent the influx of smoke and are listed as follows: -

North Building

1. N-SPF-R.1 – North Building Staircase N1 – Stairwell Pressurisation Fan- Fire Control only
2. N-SPF-R.2 – North Building Staircase N2 – Stairwell Pressurisation Fan- Fire Control only

South Building

1. S-SPF-R.1 – South Building Staircase N1 – Stairwell Pressurisation Fan- Fire Control only
2. S-SPF-R.2 – South Building Staircase N2 – Stairwell Pressurisation Fan- Fire Control only

10.4.1 Stairwell Pressurisation Fan Enable (Typical)

The SPFs are started and stopped automatically by the following:

- Fire Control System.

10.4.2 Fire Control System (Typical)

All SPFs are hardwired to be controlled by the building fire control panel. When required, the fire panel will initiate a call to start the associated stairwell pressurisation fan. The BMS will monitor the operation of the fan only during fire operation.

10.4.3 Stairwell Pressurisation Fan VSD Operation (Typical)

SPFs are provided with a pressure sensor that is located on the lower portion of the stairwell, usually 2/3rd of the length away from the fan. The VSD will modulate the fan speed to maintain a minimum of 20Pa and maximum of 50Pa pressure differential between the stairwell shaft and occupied space of the building

North Building

1. N-SPF-R.1 – North BLDG Staircase N1 – Stairwell Press. Fan pressure setpoint – TBA Pa
2. N-SPF-R.2 – North BLDG Staircase N2 – Stairwell Press. Fan pressure setpoint – TBA Pa

South Building

1. S-SPF-R.1 – South BLDG Staircase N1 – Stairwell Press. Fan pressure setpoint – TBA Pa
2. S-SPF-R.2 – South BLDG Staircase N2 – Stairwell Press. Fan pressure setpoint – TBA Pa

10.4.4 Stairwell Pressurisation Fan Alarm & Monitoring (Typical)

The BMS will communicate through HLI with the VSD and will monitor the following points and produce an alarm if it is reported by the VSD. This alarm condition is displayed within the Alarm Status application on the BMS PC Workstations.

Points Monitored:

- ✓ Enable

- ✓ Status
- ✓ Speed
- ✓ Stairwell Pressure
- ✓ Current, Voltage, Power & Energy

10.5 Mains Electricity Failure Mode (Generator)

10.5.1 Electrical Equipment Monitoring

TBC

10.6 Hydraulics

10.6.1 Water Meters

The BMS monitors numerous water meters throughout the North and South Building. These are a low-level interface to the BMS via a pulsed volt free contact from each water meter. This includes the following points:

Name	Reference No.	Size
North Building		
Ground floor Café Avion	CWM-N-1	25
Ground floor Commercial tenancy	CWM-N-2	25
L1 tenancy	CWM-N-3	25
L2 tenancy	CWM-N-4	25
L3 tenancy	CWM-N-5	25
L4 tenancy	CWM-N-6	25
L5 tenancy	CWM-N-7	25
L5 hot water supply	CWM-N-8	40
L6 mech supply	CWM-N-9	TBA
L6 mech supply	CWM-N-10	TBA
Main Hydraulic water meter	CVM-N-11	TBA
South building		
Ground floor Commercial tenancy	CWM-S-1	25
Ground floor Commercial tenancy	CWM-S-2	25
Ground floor Commercial tenancy	CWM-S-3	25
Ground floor Commercial tenancy	CWM-S-4	25
Ground floor Commercial tenancy	CWM-S-5	25

L1 tenancy	CWM-S-6	25
L2 tenancy	CWM-S-7	25
L3 tenancy	CWM-S-8	25
L4 tenancy	CWM-S-9	25
L5 tenancy	CWM-S-10	25
L5 hot water supply	CWM-S-11	40

10.6.2 Domestic Hot Water System

The BMS monitors the faut and run statuses of the Domestic Hot water pumps. This is a low-level interface to the BMS via a volt free contact from the DHW control panels. This includes the following points: -

- North Building – L5 DHW pump (PS-N-1) Status feedback
- North Building – L5 DHW pump (PS-N-1) Fault feedback
- South Building – L5 DHW pump (PS-S-1) Status feedback
- South Building – L5 DHW pump (PS-S-1) Fault feedback

10.6.3 Sewer Pumping Station

The BMS monitors the faut and run statuses of the sewer pumps. This is a low-level interface to the BMS via a volt free contact from the local sewer pump control panels. This includes the following points: -

- North Building – Basement sewer pump (PS-N-2) Status feedback
- North Building – Basement sewer pump (PS-N-2) Fault feedback

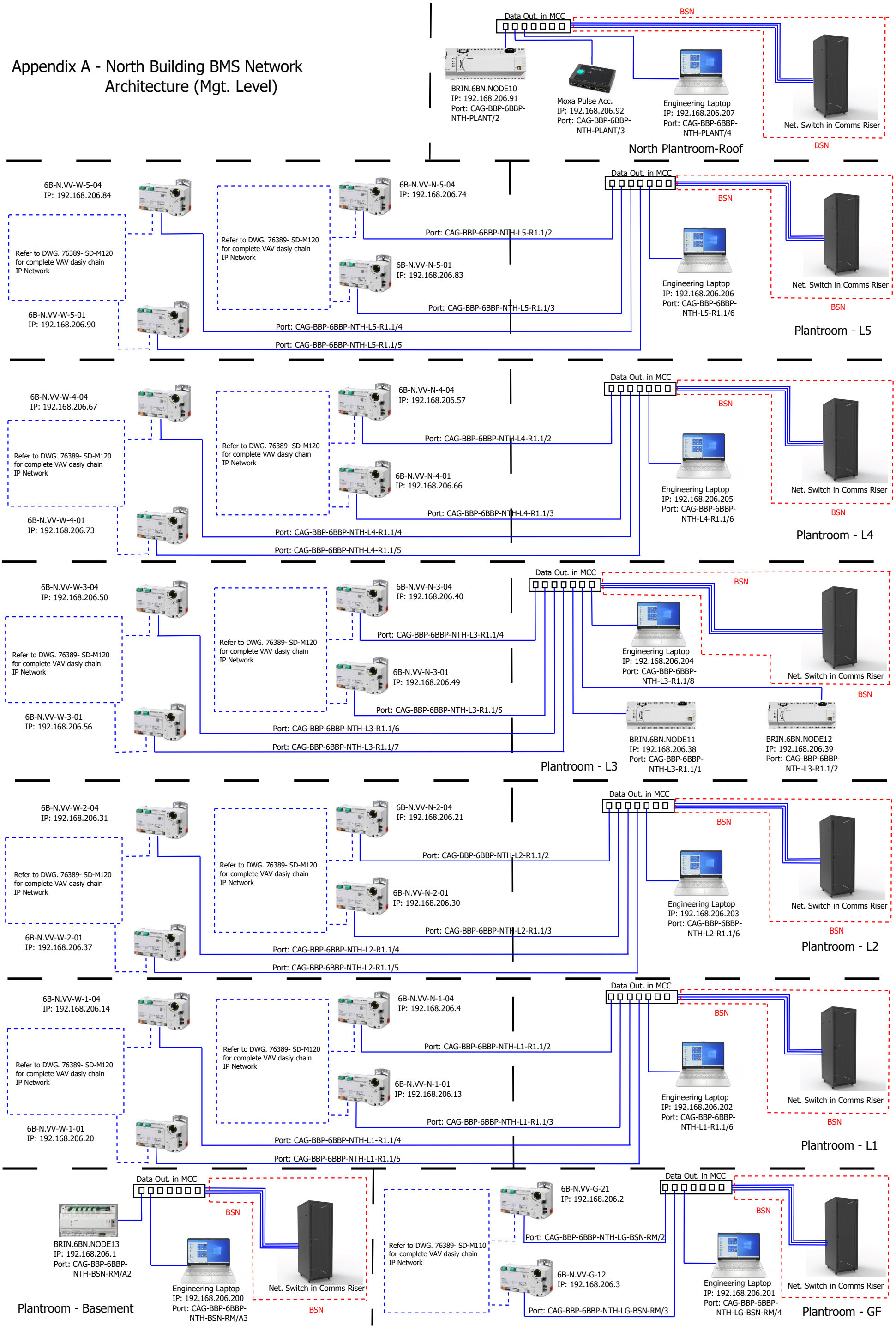
10.6.4 Stormwater Management

The BMS monitors the faut and run statuses of the stormwater pumps. This is a low-level interface to the BMS via a volt free contact from the stormwater control panels. This includes the following points: -

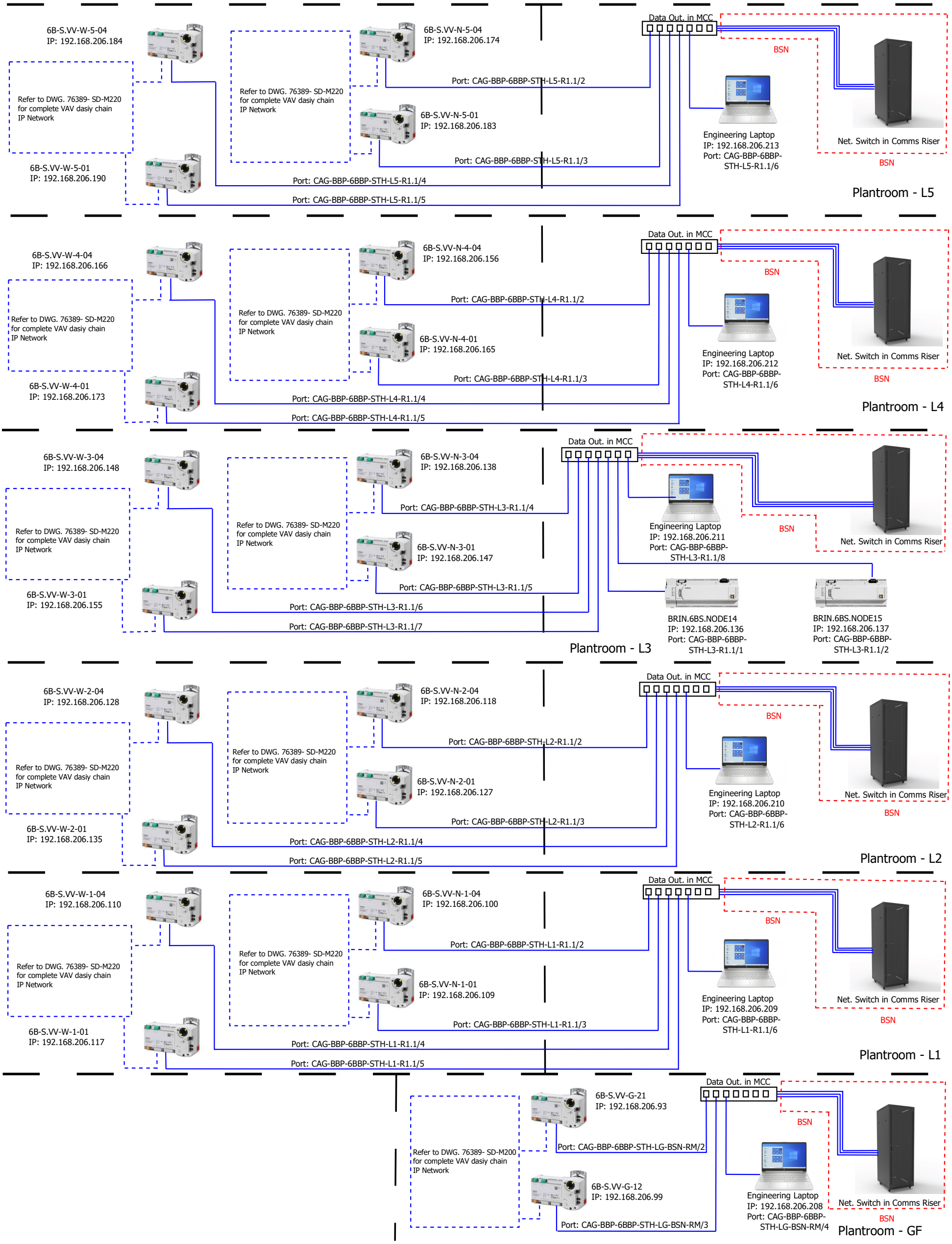
- North Building – Basement stormwater pump (PS-N-3) Status feedback
- North Building – Basement stormwater pump (PS-N-3) Fault feedback

11 Appendix

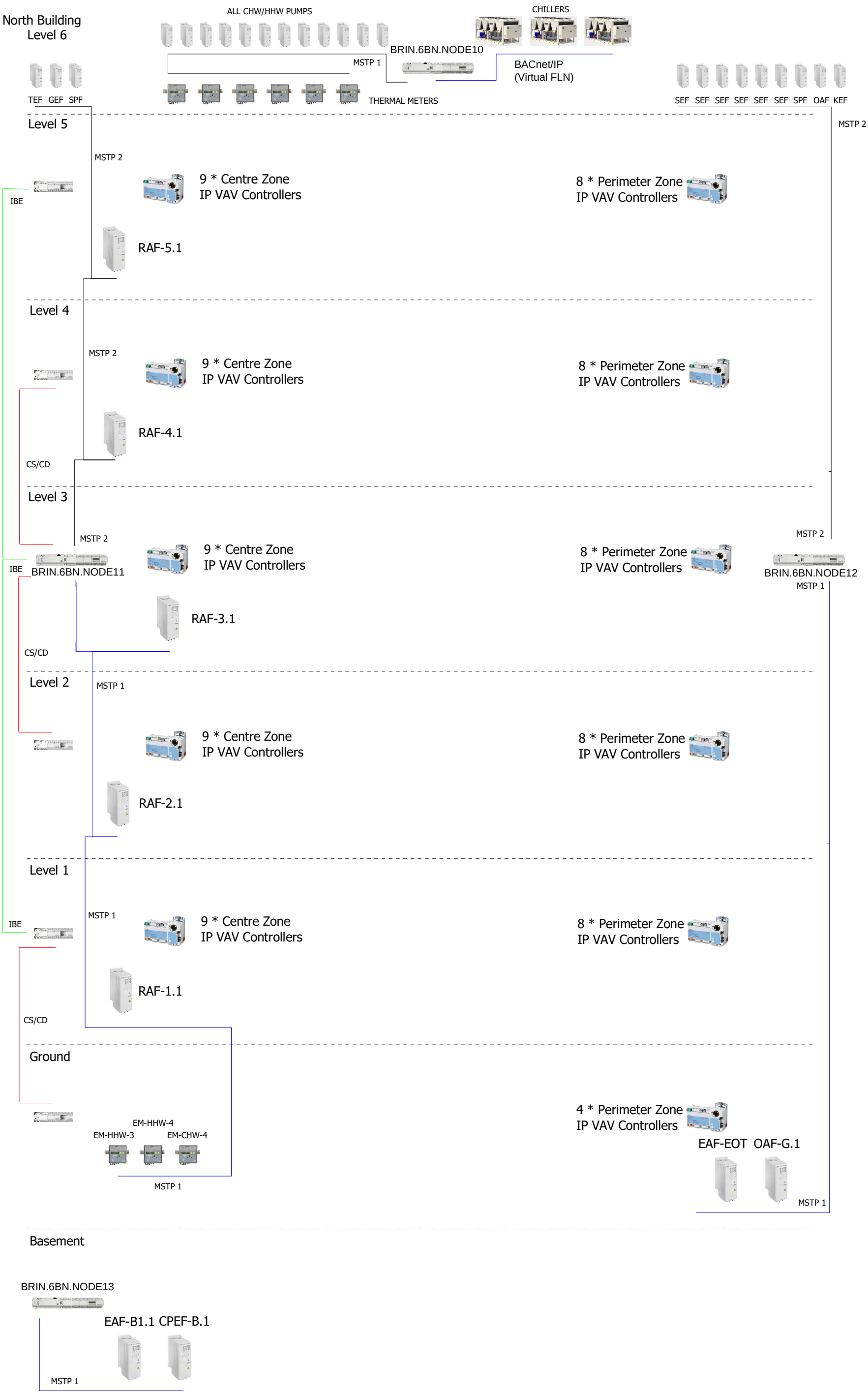
Appendix A - North Building BMS Network Architecture (Mgt. Level)



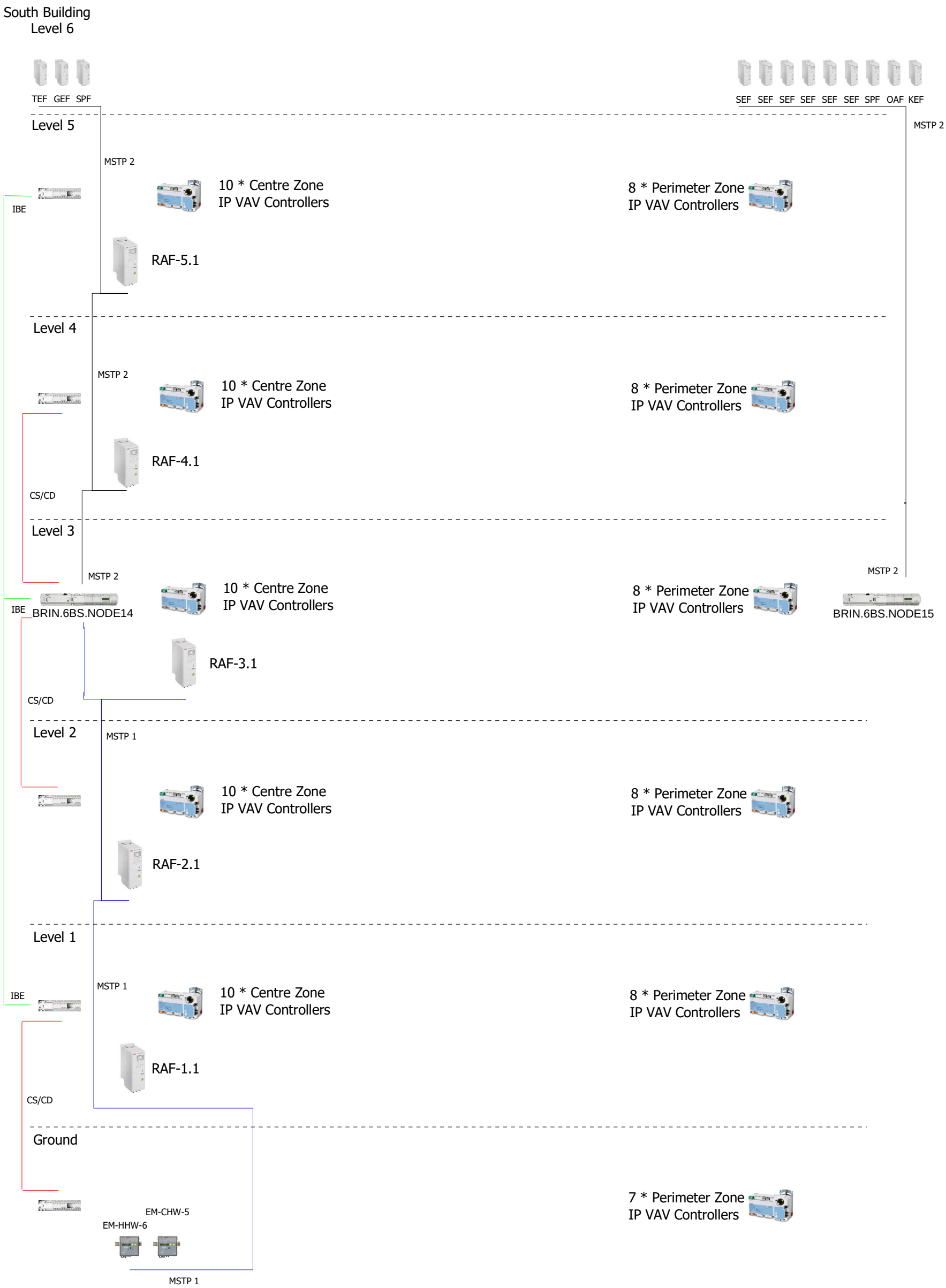
Appendix B - South Building BMS Network Architecture (Mgt. Level)



Appendix C - North Building BMS Network Architecture (Automation Level)



Appendix D - South Building BMS Network Architecture (Automation Level)



Building 6 Brindabella Circuit IP NETWORK PORT LOCATIONS									
LOCATION	*DEVICES - Type*	*DEVICES - Name*	*MANUFACTURER*	*Allocated Switch Port*	*IP ADDRESS*	*SUBNET MASK*	*GATEWAY*	*PROTOCOL/S*	*IP PORTS*
MSSB-N-L6	PXC MODULAR	BRIN.6BN.NODE10	SIEMENS	CAG-BBP-6BBP-NTH-PLANT/2	192.168.206.91	255.255.255.0	192.168.206.254	BACnet IP over Ethernet, Telnet	21,23,80,443,502,47808
	MOXA PULSE ACCUMULATOR - ioLogix E1210		MOXA	CAG-BBP-6BBP-NTH-PLANT/3	192.168.206.92	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	CHILLER 01 Pco Web controller		Carel		192.168.206.218	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	CHILLER 02 Pco Web controller		Carel		192.168.206.219	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	CHILLER 03 Pco Web controller		Carel		192.168.206.220	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	CHILLER Aernet Web Controller		Aermec		192.168.206.221	255.255.255.1	192.168.206.255	BACnet IP over Ethernet	21,23,80,443,502,47808
	Intesis box -INBACMBM6000000 (600 points)		Intesis		192.168.206.204	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
Mechanical Plantroom Level 5 Control Panel	DXR 2 VAV CONTROLLER (First VAV in group 1)	6B-N.VV-N-5-04	SIEMENS	CAG-BBP-6BBP-NTH-L5-R1.1/2	192.168.206.74	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-5-01	SIEMENS		192.168.206.75	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-5-02	SIEMENS		192.168.206.76	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-5-03	SIEMENS		192.168.206.77	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-5-04	SIEMENS		192.168.206.78	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-5-05	SIEMENS		192.168.206.79	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-5-06	SIEMENS		192.168.206.80	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-N-5-03	SIEMENS		192.168.206.81	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-N-5-02	SIEMENS		192.168.206.82	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (Last VAV in group 1)	6B-N.VV-N-5-01	SIEMENS	CAG-BBP-6BBP-NTH-L5-R1.1/3	192.168.206.83	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (First VAV in group 2)	6B-N.VV-W-5-04	SIEMENS	CAG-BBP-6BBP-NTH-L5-R1.1/4	192.168.206.84	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-W-5-03	SIEMENS		192.168.206.85	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-W-5-02	SIEMENS		192.168.206.86	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-5-09	SIEMENS		192.168.206.87	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-5-08	SIEMENS		192.168.206.88	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-5-07	SIEMENS		192.168.206.89	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (Last VAV in group 2)	6B-N.VV-W-5-01	SIEMENS	CAG-BBP-6BBP-NTH-L5-R1.1/5	192.168.206.90	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	BMS COMMISSIONING LAPTOP			CAG-BBP-6BBP-NTH-L5-R1.1/6	192.168.206.206	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
Mechanical Plantroom Level 4 Control Panel	DXR 2 VAV CONTROLLER (First VAV in group 1)	6B-N.VV-N-4-04	SIEMENS	CAG-BBP-6BBP-NTH-L4-R1.1/2	192.168.206.57	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-4-01	SIEMENS		192.168.206.58	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-4-02	SIEMENS		192.168.206.59	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-4-03	SIEMENS		192.168.206.60	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-4-04	SIEMENS		192.168.206.61	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-4-05	SIEMENS		192.168.206.62	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-4-06	SIEMENS		192.168.206.63	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-N-4-03	SIEMENS		192.168.206.64	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-N-4-02	SIEMENS		192.168.206.65	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (Last VAV in group 1)	6B-N.VV-N-4-01	SIEMENS	CAG-BBP-6BBP-NTH-L4-R1.1/3	192.168.206.66	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (First VAV in group 2)	6B-N.VV-W-4-04	SIEMENS	CAG-BBP-6BBP-NTH-L4-R1.1/4	192.168.206.67	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-W-4-03	SIEMENS		192.168.206.68	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-W-4-02	SIEMENS		192.168.206.69	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-4-09	SIEMENS		192.168.206.70	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-4-08	SIEMENS		192.168.206.71	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-4-07	SIEMENS		192.168.206.72	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (Last VAV in group 2)	6B-N.VV-W-4-01	SIEMENS	CAG-BBP-6BBP-NTH-L4-R1.1/5	192.168.206.73	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	BMS COMMISSIONING LAPTOP			CAG-BBP-6BBP-NTH-L4-R1.1/6	192.168.206.205	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
Mechanical Plantroom MSSB-N-L3	PXC MODULAR - PXC100.E96.A	BRIN.6BN.NODE11	SIEMENS	CAG-BBP-6BBP-NTH-L3-R1.1/2	192.168.206.38	255.255.255.0	192.168.206.254	BACnet IP over Ethernet, Telnet	21,23,80,443,502,47808
	PXC MODULAR - PXC00.E96.A	BRIN.6BN.NODE12	SIEMENS	CAG-BBP-6BBP-NTH-L3-R1.1/3	192.168.206.39	255.255.255.0	192.168.206.254	BACnet IP over Ethernet, Telnet	21,23,80,443,502,47808
	Intesis box -INBACMBM6000000 (600 points)		INTESIS	CAG-BBP-6BBP-NTH-L3-R1.1/8	192.168.206.204	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (First VAV in group 1)	6B-N.VV-N-3-04	SIEMENS	CAG-BBP-6BBP-NTH-L3-R1.1/4	192.168.206.40	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-3-01	SIEMENS		192.168.206.41	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-3-02	SIEMENS		192.168.206.42	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-3-03	SIEMENS		192.168.206.43	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-3-04	SIEMENS		192.168.206.44	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-3-05	SIEMENS		192.168.206.45	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-3-06	SIEMENS		192.168.206.46	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-N-3-03	SIEMENS		192.168.206.47	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-N-3-02	SIEMENS		192.168.206.48	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (Last VAV in group 1)	6B-N.VV-N-3-01	SIEMENS	CAG-BBP-6BBP-NTH-L3-R1.1/5	192.168.206.49	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (First VAV in group 2)	6B-N.VV-W-3-04	SIEMENS	CAG-BBP-6BBP-NTH-L3-R1.1/6	192.168.206.50	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-W-3-03	SIEMENS		192.168.206.51	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-W-3-02	SIEMENS		192.168.206.52	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-3-09	SIEMENS		192.168.206.53	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-3-08	SIEMENS		192.168.206.54	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-3-07	SIEMENS		192.168.206.55	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (Last VAV in group 2)	6B-N.VV-W-3-01	SIEMENS	CAG-BBP-6BBP-NTH-L3-R1.1/7	192.168.206.56	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
Mechanical Plantroom Level 2 Control Panel	DXR 2 VAV CONTROLLER (First VAV in group 1)	6B-N.VV-N-2-04	SIEMENS	CAG-BBP-6BBP-NTH-L2-R1.1/2	192.168.206.21	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-2-01	SIEMENS		192.168.206.22	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-2-02	SIEMENS		192.168.206.23	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-2-03	SIEMENS		192.168.206.24	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-2-04	SIEMENS		192.168.206.25	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-2-05	SIEMENS		192.168.206.26	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-2-06	SIEMENS		192.168.206.27	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-N-2-03	SIEMENS		192.168.206.28	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-N-2-02	SIEMENS		192.168.206.29	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (Last VAV in group 1)	6B-N.VV-N-2-01	SIEMENS	CAG-BBP-6BBP-NTH-L2-R1.1/3	192.168.206.30	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (First VAV in group 2)	6B-N.VV-W-2-04	SIEMENS	CAG-BBP-6BBP-NTH-L2-R1.1/4	192.168.206.31	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-W-2-03	SIEMENS		192.168.206.32	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-W-2-02	SIEMENS		192.168.206.33	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-2-09	SIEMENS		192.168.206.34	255.255.255.0	192.168.206.254		21,23,80,443,502,47808

	DXR 2 VAV CONTROLLER	6B-N.VV-C-2-08	SIEMENS		192.168.206.35	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-2-07	SIEMENS		192.168.206.36	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (Last VAV in group 2)	6B-N.VV-W-2-01	SIEMENS	CAG-BBP-6BBP-NTH-L2-R1.1/5	192.168.206.37	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	BMS COMMISSIONING LAPTOP			CAG-BBP-6BBP-NTH-L2-R1.1/6	192.168.206.203	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
Mechanical Plantroom Level 1 Control Panel	DXR 2 VAV CONTROLLER (First VAV in group 1)	6B-N.VV-N-1-04	SIEMENS	CAG-BBP-6BBP-NTH-L1-R1.1/2	192.168.206.4	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-1-01	SIEMENS		192.168.206.5	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-1-02	SIEMENS		192.168.206.6	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-1-03	SIEMENS		192.168.206.7	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-1-04	SIEMENS		192.168.206.8	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-1-05	SIEMENS		192.168.206.9	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-1-06	SIEMENS		192.168.206.10	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-N-1-03	SIEMENS		192.168.206.11	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-N-1-02	SIEMENS		192.168.206.12	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (Last VAV in group 1)	6B-N.VV-N-1-01	SIEMENS	CAG-BBP-6BBP-NTH-L1-R1.1/3	192.168.206.13	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (First VAV in group 2)	6B-N.VV-W-1-04	SIEMENS	CAG-BBP-6BBP-NTH-L1-R1.1/4	192.168.206.14	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-W-1-03	SIEMENS		192.168.206.15	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-W-1-02	SIEMENS		192.168.206.16	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-1-09	SIEMENS		192.168.206.17	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-1-08	SIEMENS		192.168.206.18	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-C-1-07	SIEMENS		192.168.206.19	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (Last VAV in group 2)	6B-N.VV-W-1-01	SIEMENS	CAG-BBP-6BBP-NTH-L1-R1.1/5	192.168.206.20	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	BMS COMMISSIONING LAPTOP			CAG-BBP-6BBP-NTH-L1-R1.1/6	192.168.206.202	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
Mechanical Plantroom MSSB-N-G	DXR 2 VAV CONTROLLER (First VAV in group 1)	6B-N.VV-G-21	SIEMENS	CAG-BBP-6BBP-NTH-LG-BSN-RM/2	192.168.206.2	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-G-22	SIEMENS		192.168.206.214	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-N.VV-G-11	SIEMENS		192.168.206.215	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (Last VAV in group 1)	6B-N.VV-G-12	SIEMENS	CAG-BBP-6BBP-NTH-LG-BSN-RM/3	192.168.206.3	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	BMS COMMISSIONING LAPTOP			CAG-BBP-6BBP-NTH-LG-BSN-RM/4	192.168.206.201	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
Mechanical Plantroom MSSB-N-B	PXC COMPACT - PXC36	BRIN.6BN.NODE13	SIEMENS	CAG-BBP-6BBP-NTH-BSN-RM/A2	192.168.206.1	255.255.255.0	192.168.206.254	BACnet IP over Ethernet, Telnet	21,23,80,443,502,47808
	BMS COMMISSIONING LAPTOP			CAG-BBP-6BBP-NTH-BSN-RM/A3	192.168.206.200	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
South Building									
Mechanical Plantroom Level 5 Control Panel	DXR 2 VAV CONTROLLER (First VAV in group 1)	6B-S.VV-N-5-04	SIEMENS	CAG-BBP-6BBP-STH-L5-R1.1/2	192.168.206.174	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-5-01	SIEMENS		192.168.206.175		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-5-02	SIEMENS		192.168.206.176		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-5-03	SIEMENS		192.168.206.177		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-5-04	SIEMENS		192.168.206.178		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-5-05	SIEMENS		192.168.206.179		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-5-06	SIEMENS		192.168.206.180		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-N-5-03	SIEMENS		192.168.206.181		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-N-5-02	SIEMENS		192.168.206.182		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (Last VAV in group 1)	6B-S.VV-N-5-01	SIEMENS	CAG-BBP-6BBP-STH-L5-R1.1/3	192.168.206.183	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (First VAV in group 2)	6B-S.VV-W-5-04	SIEMENS	CAG-BBP-6BBP-STH-L5-R1.1/4	192.168.206.184	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-5-10	SIEMENS		192.168.206.185		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-W-5-03	SIEMENS		192.168.206.186		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-W-5-02	SIEMENS		192.168.206.187		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-5-09	SIEMENS		192.168.206.188		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-5-08	SIEMENS		192.168.206.189		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-5-07	SIEMENS		192.168.206.190		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (Last VAV in group 2)	6B-S.VV-W-5-01	SIEMENS	CAG-BBP-6BBP-STH-L5-R1.1/5	192.168.206.191	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	BMS COMMISSIONING LAPTOP			CAG-BBP-6BBP-STH-L5-R1.1/6	192.168.206.213	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
Mechanical Plantroom Level 4 Control Panel	DXR 2 VAV CONTROLLER (First VAV in group 1)	6B-S.VV-N-4-04	SIEMENS	CAG-BBP-6BBP-STH-L4-R1.1/2	192.168.206.156	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-4-01	SIEMENS		192.168.206.157		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-4-02	SIEMENS		192.168.206.158		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-4-03	SIEMENS		192.168.206.159		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-4-04	SIEMENS		192.168.206.160		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-4-05	SIEMENS		192.168.206.161		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-4-06	SIEMENS		192.168.206.162		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-N-4-03	SIEMENS		192.168.206.163				21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-N-4-02	SIEMENS		192.168.206.164				21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (Last VAV in group 1)	6B-S.VV-N-4-01	SIEMENS	CAG-BBP-6BBP-STH-L4-R1.1/3	192.168.206.165	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (First VAV in group 2)	6B-S.VV-W-4-04	SIEMENS	CAG-BBP-6BBP-STH-L4-R1.1/4	192.168.206.166	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-4-10	SIEMENS		192.168.206.167		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-W-4-03	SIEMENS		192.168.206.168		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-W-4-02	SIEMENS		192.168.206.169		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-4-09	SIEMENS		192.168.206.170		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-4-08	SIEMENS		192.168.206.171		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-4-07	SIEMENS		192.168.206.172		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (Last VAV in group 2)	6B-S.VV-W-4-01	SIEMENS	CAG-BBP-6BBP-STH-L4-R1.1/5	192.168.206.173	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	BMS COMMISSIONING LAPTOP			CAG-BBP-6BBP-STH-L4-R1.1/6	192.168.206.212	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
Mechanical Plantroom MSSB-S-L3	PXC MODULAR - PXC100.E96.A	BRIN.6BS.NODE14	SIEMENS	CAG-BBP-6BBP-STH-L3-R1.1/2	192.168.206.136	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	PXC MODULAR - PXC00.E96.A	BRIN.6BS.NODE15	SIEMENS	CAG-BBP-6BBP-STH-L3-R1.1/3	192.168.206.137	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	MOXA PULSE ACCUMULATOR - ioLogix E2212		MOXA	CAG-BBP-6BBP-STH-L3-R1.1/8	192.168.206.211	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (First VAV in group 1)	6B-S.VV-N-3-04	SIEMENS	CAG-BBP-6BBP-STH-L3-R1.1/4	192.168.206.138	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-3-01	SIEMENS		192.168.206.139		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-3-02	SIEMENS		192.168.206.140		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-3-03	SIEMENS		192.168.206.141		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-3-04	SIEMENS		192.168.206.142		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-3-05	SIEMENS		192.168.206.143		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-3-06	SIEMENS		192.168.206.144		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-N-3-03	SIEMENS		192.168.206.145		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-N-3-02	SIEMENS		192.168.206.146		192.168.206.254		21,23,80,443,502,47808

	DXR 2 VAV CONTROLLER (Last VAV in group 1)	6B-S.VV-N-3-01	SIEMENS	CAG-BBP-6BBP-STH-L3-R1.1/5	192.168.206.147	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (First VAV in group 2)	6B-S.VV-W-3-04	SIEMENS	CAG-BBP-6BBP-STH-L3-R1.1/6	192.168.206.148	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-3-10	SIEMENS		192.168.206.149		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-W-3-03	SIEMENS		192.168.206.150		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-W-3-02	SIEMENS		192.168.206.151		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-3-09	SIEMENS		192.168.206.152		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-3-08	SIEMENS		192.168.206.153		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-3-07	SIEMENS		192.168.206.154		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (Last VAV in group 2)	6B-S.VV-W-3-01	SIEMENS	CAG-BBP-6BBP-STH-L3-R1.1/7	192.168.206.155	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
Mechanical Plantroom Level 2 Control Panel	DXR 2 VAV CONTROLLER (First VAV in group 1)	6B-S.VV-N-2-04	SIEMENS	CAG-BBP-6BBP-STH-L2-R1.1/2	192.168.206.118	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-2-01	SIEMENS		192.168.206.119		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-2-02	SIEMENS		192.168.206.120		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-2-03	SIEMENS		192.168.206.121		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-2-04	SIEMENS		192.168.206.122		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-2-05	SIEMENS		192.168.206.123		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-2-06	SIEMENS		192.168.206.124		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-N-2-03	SIEMENS		192.168.206.125		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-N-2-02	SIEMENS		192.168.206.126		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (Last VAV in group 1)	6B-S.VV-N-2-01	SIEMENS	CAG-BBP-6BBP-STH-L2-R1.1/3	192.168.206.127	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (First VAV in group 2)	6B-S.VV-W-2-04	SIEMENS	CAG-BBP-6BBP-STH-L2-R1.1/4	192.168.206.128	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-2-10	SIEMENS		192.168.206.129		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-W-2-03	SIEMENS		192.168.206.130		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-W-2-02	SIEMENS		192.168.206.131		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-2-09	SIEMENS		192.168.206.132		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-2-08	SIEMENS		192.168.206.133		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-2-07	SIEMENS		192.168.206.134		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (Last VAV in group 2)	6B-S.VV-W-2-01	SIEMENS	CAG-BBP-6BBP-STH-L2-R1.1/5	192.168.206.135	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	BMS COMMISSIONING LAPTOP			CAG-BBP-6BBP-STH-L2-R1.1/6	192.168.206.210	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
Mechanical Plantroom Level 1 Control Panel	DXR 2 VAV CONTROLLER (First VAV in group 1)	6B-S.VV-N-1-04	SIEMENS	CAG-BBP-6BBP-STH-L1-R1.1/2	192.168.206.100	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-1-01	SIEMENS		192.168.206.101		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-1-02	SIEMENS		192.168.206.102		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-1-03	SIEMENS		192.168.206.103		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-1-04	SIEMENS		192.168.206.104		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-1-05	SIEMENS		192.168.206.105		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-1-06	SIEMENS		192.168.206.106		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-N-1-03	SIEMENS		192.168.206.107		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-N-1-02	SIEMENS		192.168.206.108		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (Last VAV in group 1)	6B-S.VV-N-1-01	SIEMENS	CAG-BBP-6BBP-STH-L1-R1.1/3	192.168.206.109	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (First VAV in group 2)	6B-S.VV-W-1-04	SIEMENS	CAG-BBP-6BBP-STH-L1-R1.1/4	192.168.206.110	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-1-10	SIEMENS		192.168.206.111		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-W-1-03	SIEMENS		192.168.206.112		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-W-1-02	SIEMENS		192.168.206.113		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-1-09	SIEMENS		192.168.206.114		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-1-08	SIEMENS		192.168.206.115		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-C-1-07	SIEMENS		192.168.206.116		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (Last VAV in group 2)	6B-S.VV-W-1-01	SIEMENS	CAG-BBP-6BBP-STH-L1-R1.1/5	192.168.206.117	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	BMS COMMISSIONING LAPTOP			CAG-BBP-6BBP-STH-L1-R1.1/6	192.168.206.209	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
Mechanical Plantroom MSSB-S-G	DXR 2 VAV CONTROLLER (First VAV in group 1)	6B-S.VV-G-21	SIEMENS	CAG-BBP-6BBP-STH-LG-BSN-RM/A2	192.168.206.93	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-G-22	SIEMENS		192.168.206.94		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-G-12	SIEMENS		192.168.206.95		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-G-11	SIEMENS		192.168.206.96		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-G-31	SIEMENS		192.168.206.97		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER	6B-S.VV-G-32	SIEMENS		192.168.206.98		192.168.206.254		21,23,80,443,502,47808
	DXR 2 VAV CONTROLLER (Last VAV in group 1)	6B-S.VV-G-33	SIEMENS	CAG-BBP-6BBP-STH-LG-BSN-RM/A3	192.168.206.99	255.255.255.0	192.168.206.254	BACnet IP over Ethernet	21,23,80,443,502,47808
	BMS COMMISSIONING LAPTOP			CAG-BBP-6BBP-STH-LG-BSN-RM/A4	192.168.206.208	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
Common									
Generator Enclosure - CSB	BMS COMMISSIONING LAPTOP				192.168.206.216	255.255.255.0	192.168.206.254		21,23,80,443,502,47808
	MOXA Converter (MODBUS --> BACnet/IP)		MOXA		192.168.206.217	255.255.255.0	192.168.206.254		21,23,80,443,502,47808