Plant and Equipment Systems Report

PROJECT ATLAS DATA CENTRE

Client:
Goodman Property Services (Aust) Pty Ltd

Revision:
A

Date:
17/04/2026

REPORT INFORMATION

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1 Preface

1.1 Executive Summary

The Plant and Equipment Systems Report has been prepared by LCI Consultants on behalf of Goodman property Services (Aust) Pty Ltd to accompany a State Significant Development Application (SSDA) for the construction and ongoing operation of a data centre facility and associated Offsite Enabling Infrastructure (OEI) at 10 Roberts Road, Eastern Creek within the Blacktown Local Government Area ("LGA"). The site is legally described as Lot 553 in Deposited Plan 1110447. This report has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) issued for the Project Atlas Data Centre (SSD - 101067971) date 16th January 2026.

This report concludes that the plant and services equipment proposed for the data centre development are suitable and warrants approval subject to the implementation of the following mitigation measures:

- Acoustic attenuation of generator engines and selected cooling equipment
- Limiting testing frequency of backup generation plant
- Justification of the selected cooling plant, after detailed assessment of available technologies

After implementing the mitigation measures outlined above, the remaining impacts are considered acceptable. As detailed in Section 3, backup power is essential for the proposed mission-critical facility. Section 3.1 explores alternative backup generation options, with the site to ultimately rely on diesel generators housed in acoustic-rated enclosures within a dedicated structure. Section 3.2 provides design considerations, including generator specifications, acoustic treatment, and fuel type. While the exact frequency and duration of testing are yet to be determined, offering a general overview of expected operational parameters.

Section 4 covers the chosen data hall cooling system, with a comprehensive assessment of current commercially available technologies, and justification for the final selection. The section further explores the placement of the mechanical plant, as well as measures proposed to mitigate the impact of heat rejection and noise on nearby properties, through Computational Fluid Dynamics (CFD) modelling and acoustic treatment.

2 Introduction

A State Significant Development Application (SSDA) has been prepared to support a data centre at 10 Roberts Road, Eastern Creek (the **site**) and associated offsite enabling infrastructure.

The proposal will include:

- Site preparation works including demolition, bulk excavation and removal of existing structures on the site, tree and vegetation clearing and bulk earthworks.
- Construction, fit-out and 24/7 operation of a Data Centre
- Offsite enabling infrastructure
- 2 Data Centre Buildings
  - Building 1 – 2 Levels + rooftop plant
  - Building 2 – 3 Levels + rooftop plant
- Ancillary office, EOT and amenity
- Provision of required utilities including:
  - diesel storage tanks
  - water tanks
  - substations on site
- Vehicle access for 20m articulated vehicles (semi-trailers)
- Associated landscaping and site servicing
- Installation of site services and drainage infrastructure

This Infrastructure Requirements & Utilities Report has been prepared by LCI Consultants on behalf of Goodman Property Services (Goodman Property Services (Aust) Pty Ltd, the **applicant**) to address the Secretary's Environmental Assessment Requirements (SEARs) and accompanying cover letter issued for the Project Atlas Data Centre (SSD- 101067971) dated 26 January 2026.
This report identifies and assesses the site utilities infrastructure requirements, the impacts on existing infrastructure and service providers, as well as the delivery and staging plan for the project.

2.1 The Site

The proposed Data Centre is located at 10 Roberts Road, Eastern Creek, legally referred to as Lot 553 DP1110447 with Offsite Enabling Infrastructure (OEI) proposed across Lot 21 DP1246626, Lot 20 DP1157491, and Lot 22 DP1246626 to connect to TransGrid's Sydney West Substation & Switchyard. The site is located on Country of the Dharug people within the local government area of Blacktown.

The Data Centre site has a land area of approximately 168,574m^2.

The site is identified as part of the Eastern Creek Precinct Stage 3 within the Western Sydney Employment Area. It is located approximately 35km of the Sydney Central Business District (CBD) and 5.1 km from Rooty Hill Train Station.

The site has a site area of approximately 17 hectares and is bounded by industrial development and has a primary frontage of 400m to Roberts Road. The existing site contains an industrial warehouse and surrounding hard-stand areas.

Surrounding land uses in the vicinity include:

- Northeast: A range of mixed-use industry & commercial buildings
- Southeast: Data Centre and substation
- South, southwest and west: land primarily owned and operated by Transgrid Sydney
- Northwest: Commercial industry and the Industrial Harvest cafe

The site is zoned IN1 General Industrial within Chapter 2 Western Sydney Employment Area of State environmental Planning Policy (Industry and Employment) 2021 (IESEPP). The proposal is permissible with development consent in the IN1 zone as per the State Environmental Planning Policy (Transport and Infrastructure) 2021 (TISEPP).

A summary of key features for the site and surrounding context is also summarised in the Table below:

Table 1: Summary of Key Features

Item	Description
Site Area	Data Centre – 168,574m^2
Ownership	Goodman
Legal Description	Data Centre - Lot 553 DP1110447 OEI - Lot 21 DP1246626, Lot 20 DP1157491, and Lot 22 DP1246626

An aerial photograph is provided for context, refer to Figure 2-1 below.

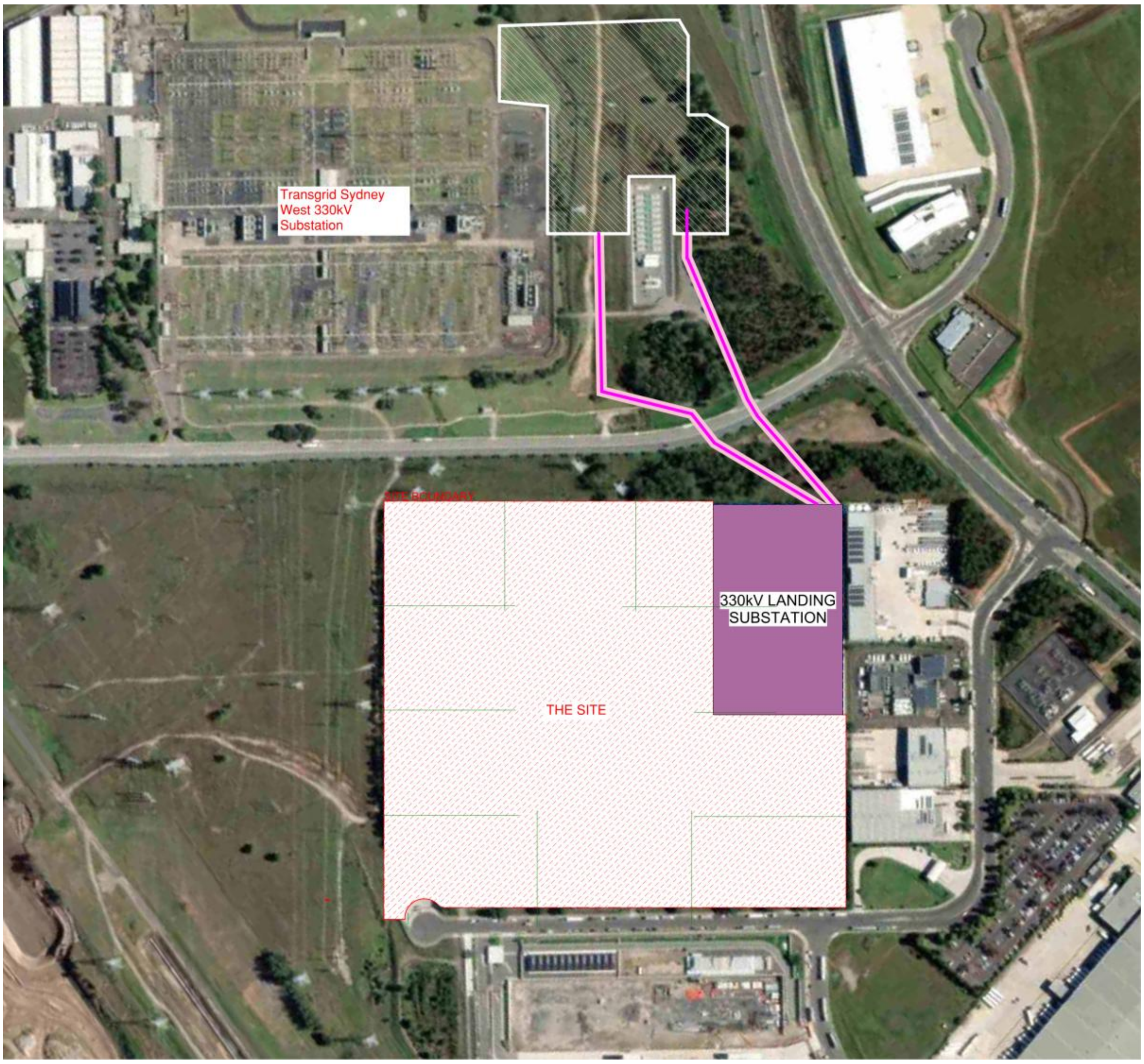

Figure 2-1: Site Plan (Source: Grimshaw Architects)

2.2 Project Details

The key components of the Project are listed in the following table.

Table 2: Project Details

Descriptor	Project Details
Project Area	The data centre development relates to Lot 553 in Deposited Plan 1110447 and comprises an area of approximately 168,574sqm.
Proposed Use	Data centre with ancillary office space.
Project Description	▪ Site preparation and bulk earthworks. ▪ Construction of two (2) three and two-storey data centre buildings, with a maximum height of 14.04 and 24.84 metres respectively, and a combined total gross floor area (GFA) of approximately 99,130 sqm including technical data halls, office and administrative areas, and ancillary circulation space.

	▪ Onsite parking of 150 parking spaces, comprising a total of 3 accessible parking spaces. ▪ Landscaping and associated public domain works. ▪ 249 generators for backup power. ▪ Extension and augmentation of physical infrastructure and utilities, as required including new on-site substation towards the East of the lot and water storage tanks integrated within the site footprint.
Total Gross Floor Area	99,130 sqm
Building Height	14.04 and 24.84 metres for Building 1 & 2 respectively
Data Halls	29 data Halls
Landscape Area	Refer to Landscape Report
Car Parking	150 car spaces including 3 DDA space
Bicycle Spaces	13 spaces (across both buildings)
Utilities	Provision of required utilities including: ▪ 249 x diesel generators ▪ 16 x water tanks for industrial water. ▪ 2 x above-ground water tank for fire water ▪ 330/33kV switching station
Power Consumption	500 MVA (site ultimate)
Operations and Management	The facility will be operated on a 24-hour, 7 day a week basis.
Existing Services and Infrastructure	The site is fully serviced; however, existing services and infrastructure will be extended, adapted and augmented to meet the demands of the project.

2.3 Purpose

The Plant and Equipment Systems Report has been prepared by LCI Consultants on behalf of Goodman Property Services (Goodman Property Services (Aust) Pty Ltd, the **applicant**) to accompany a detailed State Significant Development Application (**SSDA**) for a proposed data centre development at 10 Roberts Road, Eastern Creek (the **site**).

The Plant and Equipment Systems Report has been developed to support the SSDA to be submitted to NSW Department of Planning, Housing, and Infrastructure (NSW DPHI) and details the proposed backup power system requirements for the data centre, as well as the proposed cooling plant.

This report identifies and examines the proposed back-up power and cooling systems, detailing their scale, capacity, effects on neighbouring properties and projected testing protocols, while presenting a justification for their selection by an evaluation of possible alternative solutions. It aims to demonstrate the system's suitability and reliability for backup power and cooling to the proposed mission-critical facility.

2.4 Response to SEARS

This report has been prepared in response to the requirements contained within the Secretary’s Environmental Assessment Requirements (**SEARs**) dated 16 January 2026 issued for the SSDA (**SSD-101067971**). Specifically, this report has been prepared to respond to the SEARS requirement issued below:

Table 3: SEARs Compliance

Project SEAR SSD-101067971	Section of report
Plant and Equipment Systems	
➢ detailed justification for the chosen primary power supply, any on-site energy generation, storage and back-up power systems, including:	
• a comprehensive assessment of alternative commercially available technologies (e.g. solar power, large-scale batteries, hydrogen cells, etc.)	3.1.1,3.1.2
• a detailed description of how the proposed configuration will minimise emissions, avoid unnecessary over-provisioning, and reduce network constraints through demand management	3.1.2.1
• demonstration of a commitment to continual improvement with respect to the design of the back-up power system and its associated emissions	3.2.1,3.2.2,3.2.3
➢ a detailed overview of the proposed back-up power system (if chosen), including:	
• number and individual capacity of each power unit (in terms of megawatts and megajoules per second)	3.2.2
• maximum operating time during a power outage event	3.2.4
• details of the proposed testing regime for back-up power units, including:	3.2.4
○ all testing types (e.g. monthly, annual) and details of scheduled and unscheduled works that would require use of back-up power units (e.g. electrical infrastructure works),	
○ number of tests for each power unit per year,	
○ number of power units to be tested at any one time,	
○ testing duration for each power unit (including cool down),	
○ load during testing,	
○ time of the day testing will occur,	
○ maximum number of tests per day,	
○ total number of cumulative hours power units will be tested and operated per annum.	
○ testing procedure (including whether testing will be carried out individually or in clusters), frequency and duration (including confirmation and, if necessary, justification of the need to test during sensitive time periods)	
➢ a detailed justification for the chosen data hall cooling system, including:	
• a comprehensive assessment of alternative commercially available technologies (e.g. evaporative cooling, immersion cooling, direct-to-chip cooling, etc.)	4.1.,4.2
• demonstration of a commitment to continual improvement and consideration of retrofitting with respect to new and efficient data hall cooling systems	4.2
➢ demonstration the placement of mechanical plant and equipment has considered the impact of heat rejection on habitable rooms and communal open spaces, including those of nearby properties.	4.1.1,4.1.2,4.3

2.5 Stakeholder Engagement

Stakeholder consultations with Transgrid are ongoing. Refer to the SEARs Infrastructure Report for further details on stakeholder consultations.

2.6 Methodology

This section outlines the methodology used to identify the baseline and undertake the assessment of selection and potential impacts of the proposed backup power system on the surrounding area.

2.6.1 Study Area

The assessment area will be limited to the subject site (including site boundary) and the surrounding roads/buildings.

2.6.2 Method of Assessment

Backup Power

To address the project SEARs, Section 3 of this report has analysed the proposed electrical topology of the site and calculated the individual and aggregate backup power required for each building. The backup power sources have been identified through availability in the market, suitability for Data Centres of this scale, and viability for the proposed site. Through reference projects, vendor information and application of Australian design standards, the designs of the generator enclosures and fuel storage have been proposed.

Cooling Systems

To address the project SEARS, Section 4 of this report analyses the current commercially available technologies for cooling, with an assessment of the advantages and disadvantages of each viable system. A justification of the selected cooling system has been conducted through availability in the market, suitability for purpose and viability for the proposed site via in depth engineering assessments, such as CFD modelling, as well as acoustic and air quality considerations. Through reference projects, collaboration with vendors and application of Australian design standards, the designs of the cooling system have been proposed.

2.7 Existing Environment and Considerations

There are no backup power sources or major cooling plant at scale known to exist at the current site. While already located in an industrial zone, there are low density residential properties to the South which may be impacted by the proposed site while in construction and in operation.

The noise and emissions from the site Plant and Equipment Systems needs to be considered and mitigated through the design and operation of the site. While individual backup generation and cooling sources may produce limited pollution individually, the aggregate contribution of the site to the environment is of particular interest. These items are covered in other applicable reports.

3 Backup Power Requirement

The new development is proposed to be supplied via a new 330kV/33kV Substation. The power supply will be distributed throughout the site via the proponent's own underground electrical reticulation infrastructure. The new substation will be dedicated to the proposed site.

The data centre is a mission critical facility and therefore requires back up generation if there is an interruption to the primary utility supply. Each building will be provided with diesel-generators, uninterrupted power supply (UPS) and battery backup systems. The UPS and battery backup system are designed to maintain supply between loss of utility and changeover to the generator supply and are not intended to maintain the full load of the site for an extended period. For the purposes of this report, only the diesel-generators are considered as "Backup" power, the UPS and battery system are for energy storage and short-term supply only.

Provided the energy transmission system in the area is designed to highly reliability, the risk of interruption to the utility supplies is always a possibility. Furthermore, events that are out of the control of the utility, such as accidents, storms etc. also need to be considered. Any interruption without onsite Plant and Equipment Systems would be extremely damaging to the general community through disruption to the internet services facilitated by the data centre in the area.

3.1 Backup Power Selection

3.1.1 Selected Power Generation Technology

The Applicant has opted for diesel-generator sets for the backup power source for the proposed site. This is based on the most appropriate technology for a mission critical data centre and the market readiness for this technology in New South Wales. Alternatives have been considered for this site, but none are considered viable except for alternative fuel for the generator engines. All the backup generator sets See Section 4.2 below for further details.

3.1.2 Alternatives Considered

As part of the design development process, LCI has explored various alternatives to diesel fuel for delivering the essential standby power required to meet the development's redundancy needs. After evaluating the site's substantial electrical demand, the critical nature of redundancy, and the risks associated with power failure, the team determined that diesel generation offers the most suitable and justified solution.

Diesel generator systems represent a well-established and reliable technology, supported by extensive industry expertise and a strong track record of performance when properly maintained. In contrast, emerging alternatives with comparable energy capacity are still in early stages of development. Given the importance of uninterrupted operations throughout the project's lifespan, adopting these newer technologies would introduce unacceptable levels of risk.

3.1.2.1 Potentially Suitable for Deployment

The following table describes the backup supply technologies considered, rating its suitability for deployment for hyperscale data centres. The following technologies were recommended as potentially suitable for deployment as long duration backup supply in data centres:

- Lithium-ion batteries
- Diesel generators with renewable diesel (hydrotreated vegetable oil or HVO) as a fuel

- Open Cycle Gas Turbines (OCGT) or Reciprocating Engines with natural gas as a fuel
- Hydrogen Fuel Generators

Table 4: Backup Power Options Analysis

Technology	Description	Technology maturity	Suitability for Data Centres	Limitations for viability	Viability for the site
Lithium-ion Batteries	Lithium-ion batteries utilize an anode (negative electrode, usually made of graphite), a cathode (positive electrode, from a lithium metal oxide) and an electrolyte as a conductor.	**High** – due to their high energy density, lightweight design and relatively long cycle life, lithium-ion batteries are widely used in portable electronics, electric vehicles and other energy storage systems.	**Possibly suitable**: Advantages: • High power density • Declining costs Disadvantages: • Large physical footprint and Capex given the site backup requirements • Fire risk	Space Constraints: • Reduction in spatial requirements unlikely for this technology. • Capex costs: High due to the required capacity.	Due to the spatial requirements of lithium-ion batteries for the quantity of power generation required, coupled with fire-separation and safety requirements, it is not feasible to provide sufficient batteries in the event of an extended power failure to the site. Current lithium-ion battery provision to the site is to facilitate the switch between utility and backup power. Hence, this technology is **not viable** to be used as standalone backup power for the site.
HVO renewable diesel fuel	HVO fuel (Hydrotreated Vegetable Oil) is a renewable alternative to diesel made from vegetable oil, waste fats and other biological matter. Waste cooking oil, animal fats etc. are collected, with impurities removed during pre-treatment. The stock is then hydrotreated to remove oxygen and saturate the molecules. The final product is then refined to meet diesel standards.	**Moderate** – the HVO supply chain is still fairly localised, and dependent on availability of feedstock. There are no large scale HVO supply chain or support policies in Australia.	**Possibly suitable**: Advantages: • Biodiesel blends are compatible with existing diesel engines • Lower emissions than regular diesel. 100% renewable. Disadvantages: • Availability and supply chain	Availability of HVO is large quantities (available supply chain). There is a requirement of high volume of HVO diesel to be delivered to site for refills.	The site is proposed to use diesel generators, which shall utilize HVO fuel compatible engines, subject to availability and local supply chain, which is currently limited. Hence, this makes HVO currently fuel **moderately viable** but may become a viable option in the near future.
Natural Gas Fuel	Natural Gas can be used as a backup generation fuel via gas turbine generators.	**Moderate** - Natural Gas has a mature supply chain, with gas turbine generators used frequently in electric grids globally.	**Possibly suitable**: Advantages: • Proven technology, with fuel delivery via existing gas supply pipes Disadvantages: • Higher emission and noise criteria	• Environmental approvals, depending on exact technology, expected usage and noise. • Capacity from the existing gas pipeline,	**Not viable** – this technology requires additional space that what is currently available on site, due to additional cooling and ventilation requirements. Furthermore, the impact of a 450MW gas turbine on the local gas supply pipeline is significant and may trigger upgrade requirements.

			• Complex and specialized maintenance • High Capex • High cooling requirements	which may impact supply within the area	
Hydrogen Fuel	Hydrogen can be used as a backup generation fuel source, via hydrogen fuel cells.	Moderate – the current hydrogen supply chains are still immature, with progress improving with passing years. There are currently no data centres utilizing hydrogen fuel for backup generation at this scale.	Possibly suitable: Advantages: • Zero emissions • Long storage duration • Quire operation Disadvantages: • Supply chain issues • Large storage requirements, likely triggering major Hazard requirements	• Large spatial requirements due to hazardous hydrogen gas storage • Hydrogen supply chain limitations • Capex costs in line with alternate options	Not viable – this technology requires additional space that what is currently available on site, due to storage tank requirements. Furthermore, hydrogen supply pipeline would not be possible in the development timeframe. Safety considerations would have to also be considered, particular to neighbouring site regarding the storage of large quantities of hydrogen.

3.2 Backup Power Generators

3.2.1 Site Design

The containerised generator sets are located adjacent to the building they serve, split into 2 fuel farms per building. Building 1 generators are situated on the southern side of the building whilst building 2 generators are located on the northern side of the building of which both are in an external generator gantry (Figure 5-1). The site is proposed to include a total of 249 containerised diesel generators each with 990L day tanks within the enclosure and external dedicated double skinned above-ground diesel storage tanks with leak detection and a capacity of approximately 110kL located central to site.

The generators and the associated support and storage infrastructure will be constructed in a staged manner, with final capacity reached once all colocation spaces are in use. Fuel is proposed to be transferred from the dedicated storage tanks to the day tanks via a duty / standby pumping system with corresponding filtration units located within an enclosure on each respective fuel tank.

Figure 3-1: Location of proposed Generators (Blue)

3.2.2 Generator Design

The proposed site will use a total of 246 low voltage 2,800kWe and 3 x 1000kWe generators (a total of 249). This includes 91 generators for the North Building (Building 1) and 158 for the South Building (Building 2). These generators will only operate in the event of a mains utility failure to the respective electrical block or for testing purposes. These generators support a total ultimate load of 500MW.

3.2.2.1 Enclosure

To improve acoustics, safety, and general site delivery/readiness, all generators are proposed to be housed in prefabricated, acoustic-rated, enclosures with integrated day-tanks to store diesel locally. The container will include the following:

- Generator Engine Set.
- Local Fuel System, including pumps.

- Control and Power Panels.
- Acoustic attenuation for cold air intake, hot air discharge (for ventilation)
- Exhaust Gas Silencer & Flue

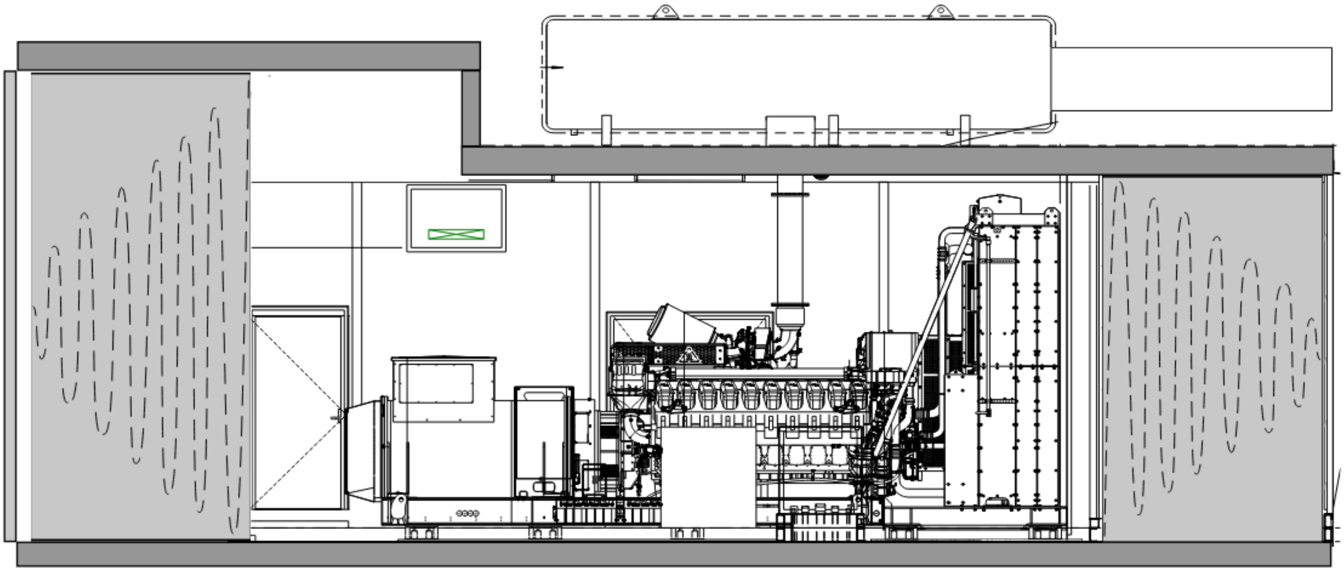

Figure 3-2: Typical Generator Enclosure

3.2.2.2 Acoustics

At this early stage, the final acoustic requirements are not known. Preliminary results and details on the noise modelling of the site shall be included in the acoustic report.

3.2.2.3 Emissions

For further details please refer to the Air Quality Impact Assessment Report by Northstar.

3.2.3 Fuel on Site

The generator engines on site will use diesel fuel to generate power. All of the generator enclosures will be located on external gantry structures where the generators are located on multiple levels (two rows of generators with a shared exhaust duct located in front of the generators). The generators are provided with fuel from a centralized bulk fuel storage and delivery system, located on ground level central to the site. The bulk fuel tanks will provide 24 hours of fuel for each generator and proposed to be designed to comply with AS 1940.

The following table provides the final storage requirements per building based on the proposed design. These proposed quantities are to be implemented in stages, depending on the utilisation of the colocation space. The final fuel capacity is anticipated to be reached once the site achieves full capacity.

Table 5: Final Fuel Storage per Building

Storage Area	Storage Type	Chemical	Class / Division	Quantity	Unit Capacity	Total Capacity
Building 1 Fuel Storage	Diesel Storage Tanks (Centralized System)	Diesel	C1	14	110,000L	1,104,000L

Building 2 Fuel Storage	Diesel Storage Tanks (Centralized System)	Diesel	C1	23	110,000L	2,063,700L
			Total Above Ground Diesel Quantity			**3,167,000L**

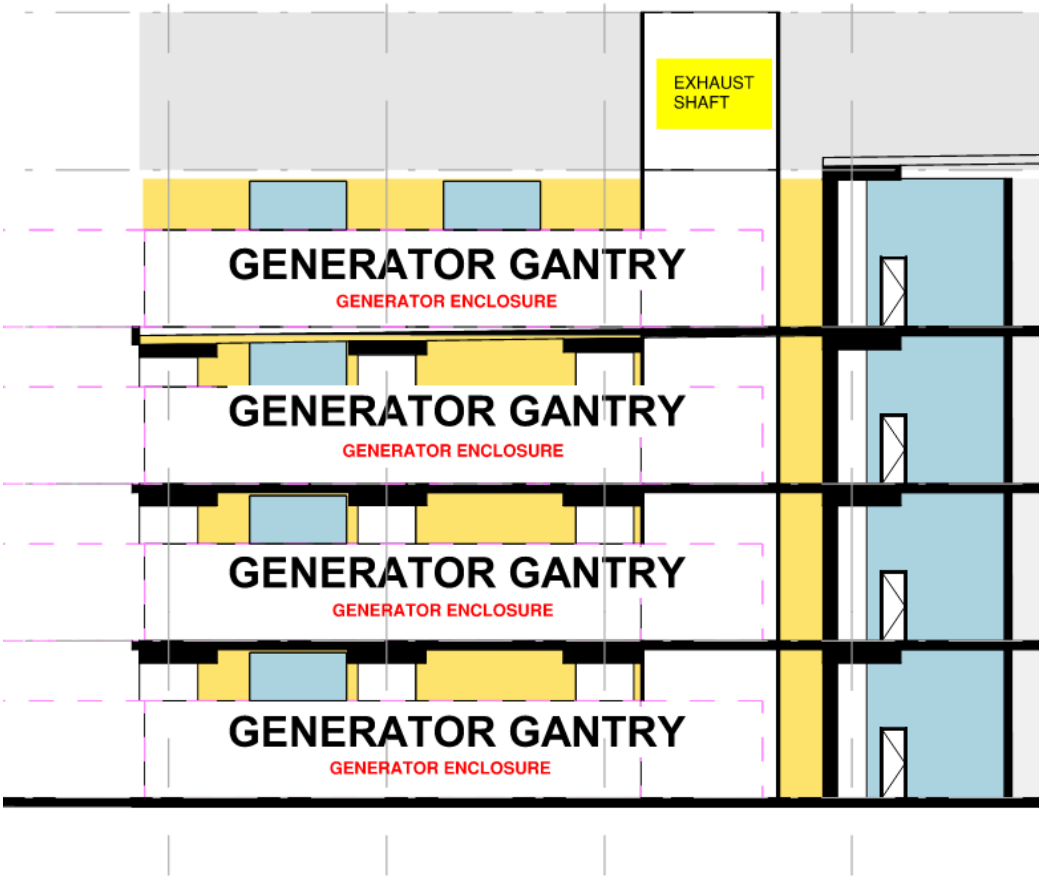

Figure 3-3: Quadruple Stacked Generator Gantry Section

3.2.3.1 Fuel Storage Requirements

The centralized bulk fuel storage is provided via on-ground storage tanks located central to the site, between the two Data Centre Buildings.

The tanks would be custom made, where the tank design is to suit the available space, with final dimensions subject to further detailed design.

3.2.3.2 AS 1940 Separation Distances

AS 1940 outlines separation distance requirements dependent on the size and type of tank. The design utilises 240-minute fire rated tanks, with a separation requirement of 600mm between each tank as per clause 5.7.6 (b) for above ground horizontally arranged tanks.

On site protected places are defined in Section 1.4.47 of AS1940 as: “*A building where people are employed within the property boundary, including offices, warehouses, manufacturing or processing areas, amenities and other dangerous goods stores where quantities exceed minor storage.*”

The data centre buildings would be considered protected places, with the following separation distances required from the bulk fuel tanks, as per Table 5.4 of AS 1940:

- For C1 Combustible liquids tanks >20kL and <40kL: 4.0 m

3.2.4 Testing Procedures

The Generators will each be tested to ensure they are functional in the event of a utility failure. Initially all generators as they are installed at the proposed site will undergo commission testing which involves several hours that the generator will run (this is anticipated to be conducted in stages, as backup generators are installed). After the generator(s) are installed and commissioned, regular testing will occur for all generators. For a breakdown of the proposed generator testing across the site, refer to **Error! Reference source not found.** below.

Table 6: Proposed Generator Testing Regime

Test Type	Qty. Site generators	Generators run per test	Run Time per year (mins)	Run Time per year (hours)
Annual (1 hour + 5 min. cooldown)	249	5*	4354	73
Six-monthly (30 min. + 5 min. cooldown)	249	5*	2344	39
Quarterly (30 min. + 5 min. cooldown)	249	5*	4687.32	78
			Total site (hours)	**190**

* Reduced to 4,3,2 & 1 as the Generators per block conclude testing

The site is divided into 5 x generator Testing blocks across the two (2) data centre buildings, with each Block provided with their dedicated permanently installed load bank. The quantity of generators in each block is as follows:

Building 1: Block 1 = 37, Block 2 = 54, Building 2: Block 3 = 43, Block 4 = 48, Block 5 = 67, Total = 249.

Hence, 5 generators are concurrently tested ONLY until the generators in the smallest block (Block A) are completed. The no. of concurrent tests then reduces to FOUR (4) for blocks 2-5 until the generators in the next smallest block (block 3) are completed. This reduces to 3, 2 and then single tests until all the generator testing is completed.

In summary, 37 x 5 = 185 generators are tested 5 concurrently, then 6 x 4 = 24 generators are tested 4 concurrently, then 5 x 3 = 15 generators are tested 3 concurrently, then 6 x 2 = 12 generators are tested 2 concurrently and finally the remaining 13 generators are tested one by one. (185 + 24 + 15 + 12 + 13 = 249)

Refer to the below breakdown of the proposed generator testing regime:

- **Annual Testing:** (185 x 65min) + (24 x 65min) + (15 x 65min) + (12 x 65min) + (13 x 65min) = 72.561 hours

- **Six-Monthly Testing:** (185 x 35min) + (24 x 35min) + (15 x 35min) + (12 x 35min) + (13 x 35min) = 39.061 hours

- **Quarterly Testing (conducted x 2 a year):** (185 x 35min) + (24 x 35min) + (15 x 35min) + (12 x 35min) + (13 x 35min) = 39.061 x 2 = 78.122 hours
- **Total**: 72.561 + 39.061 + 78.122 = 189.744 **~ 190 hours**

Generators are tested by connection to a load bank (equipment that utilizes electric power for testing purposes). It is assumed at this stage that five generators (two per building 1, and three per building 2) would be tested at any one time, with each building (Building 1 & 2) provided with two (2) and three (3) permanent load banks respectively at any given time. Tests are to be conducted concurrently to reduce the overall testing duration.

4 Mechanical Cooling Systems

4.1 Overview

The cooling system has been designed specifically to meet the client's requirements for the Data Centre. The Data Centre application is for high-density IT power, which is primarily used for high-power-density AI Data Centres.

Direct-to-chip (DTC) liquid cooling supplemented by air cooling was selected for its targeted efficiency on high-heat-flux chips, ease of integration with existing air infrastructure, and scalability for 12MW halls, outperforming alternatives in retrofit-friendly Sydney data centres. An alternative technology considered is immersive cooling (single/two-phase), which achieves superior uniformity/density yet demands high upfront costs, fluid management complexity, and full rack submersion, disrupting maintenance. DTC technology advantages include lower leak risks than full liquid and modular deployment without tanks/structural changes.

4.1.1 Cooling Solution

The cooling solution is based on hybrid dry coolers in combination with refrigeration equipment used for water temperature trimming when needed. An alternative technology to hybrid dry coolers is open-type cooling towers, which offer low capex/PUE but consumes larger amount of water and represent legionella risks (AS/NZS 3666).

The system represents the most energy-efficient cooling solution for the high-power density Data Centre and will achieve an annual average PUE (Power Usage Effectiveness) of 1.25 across both buildings (BLD1 and BLD2).

The annual average water utilisation effectiveness (WUE) is 1.47 across both buildings.

Mechanical System components are sized and selected in alignment with the electrical line-up and design topology/redundancy requirements.

4.1.2 Data Halls

Each Data Hall is provided with dedicated cooling systems. Liquid-to-air cooling ratio is 90/40.

There is a total of 16N Fan Wall Units (FWUs) serving each Data Hall in BLD1 and 14N FWUs serving each Data Hall in BLD2 in an (N+4) redundancy configuration. Each FWU has a capacity of 337 kW (BLD1) and 385 kW (BLD2). Air flow rate is designed at 75l/s/kW IT. FWUs are provided by dual fed ups backed power supply.

There is a total of 10N (Cooling Distribution Units (CDUs) serving each Data Hall in BLD1, 18N CDUs serving each Data Hall in BLD2 in an (N+2) redundancy configuration. Each CDU has a capacity of 1085 kW. TCS (Technology Cooling System) flow rate is 1.5LPM per kW. CDUs are provided by dual fed ups backed power supply.

The Central Cooling Plant is arranged in an (N+2) redundancy of cooling blocks.

4.2 Proposed Cooling System for the Project

A summary overview of the mechanical central plant equipment (hybrid dry coolers (HDC), water cooled chillers (WCC), and air-cooled chillers (ACC) is presented below:

The cooling systems utilise hybrid dry coolers for primary heat rejection, paired with air-cooled chiller trim featuring adiabatic pads for Building 1 (120 MW IT across 10 halls at 12 MW each, 26-36°C CHW temperature split) and water-cooled chiller trim for Building 2 (180 MW IT across 15 halls + 48 IT MW across 4 halls, 30-40°C CHW temperature split). Building 1 includes a 3.8 MW hybrid dry cooler, 1.5 MW air-cooled chiller trim, 10 HDC units, and

10 ACC in N+2 arrangement: Building 2 features 4.6 MW and 3.1 MW hybrid units, 12 HDC, and 4.1MW and 2.7MW WCC also in N+2.

The proposed cooling plant utilises hybrid dry coolers for primary heat rejection, paired with air-cooled chiller trim featuring adiabatic pads for Building 1 and water-cooled chiller trim for Building 2.

Hybrid dry coolers from a few vendors were selected for their improved energy efficiency, enhanced with group control logic, compact footprint, low noise and spatial efficiency, enabling constructability with phased installation, for architect integration, and low lifecycle costs via reduced maintenance access needs.

Placement of mechanical plant prioritises minimal impact on habitable rooms, communal spaces, and nearby properties, validated by CFD modelling to direct heat rejection plumes away from sensitive areas, ensuring no adverse thermal effects. This aligns with contractor sequencing (pre-cladding installs, short leads), builder risk mitigation (N+2) redundancy, vibration isolation per AS 2670.2), and architect aesthetics (screened enclosures). The hybrid design supports future retrofits through modular HDC scalability for emerging technologies, with no open towers to avoid plume/legionella risks per AS/NZS 3666.

The cooling systems are continuously monitored for failure and performance. Maintenance is undertaken on each Fan Wall Unit separately. As N+2 minimum redundancy is provided, the loss of two (2) units does not affect the cooling function.

In the event of a power failure, the cooling is restored within 12 to 20 seconds, i.e. the time taken for the generators to operate. 5 minutes of thermal storage is provided for generator start-up time and chiller ramp-up time. 24 hours of water storage is provided for the heat rejection plant in the event of mains water failure.

A full-time technical team is on site, continually monitoring the operation of the cooling systems. A comprehensive regular testing and maintenance programme is performed monthly on the cooling systems to ensure their continuous operation. Due to the critical nature of the facility and reliance upon cooling systems for the Data processing, maintenance is especially important.

4.2.1 Cooling System Analysis and Comparison

For project ATLAS, selecting a direct-to-chip (DTC) architecture with internal CDUs, paired with a Hybrid Dry Cooler (HDC) solution for both buildings—supported by an adiabatic air-cooled chiller (ACC) trim in Building 1 and a water-cooled chiller (WCC) in Building 2—provides a balanced, forward-looking cooling strategy. This configuration outperforms the other options in energy efficiency (PUE), water consumption (WUE), acoustic performance and readiness for future changes.

External Plant Strategy selected:

- Building 1: Hybrid Dry Cooler + Adiabatic Air-Cooled Chiller (trim)
- Building 2: Hybrid Dry Cooler + Water-Cooled Chiller

The combination of Adiabatic ACC, WCC and HDC technologies provides a resilient and scalable cooling architecture that maintains high energy performance across a wide range of ambient and load conditions, while also enabling delivery of lower cooling-water supply temperatures where required to meet specific customer or IT-equipment thermal specifications. With the DTC approach inside the data halls, a significant portion of the heat load is handled through liquid cooling—substantially reducing fan and air-side energy usage and enabling warmer coolant temperatures. The HDC system can operate in economiser mode when the ambient conditions are favourable.

Building 1 – HDC +Adiabatic ACC (trim)
Pairing an HDC with an Adiabatic ACC trim system supports a low-water and low-energy -usage solution. Under cooler ambient conditions, the HDC can operate in free-cooling mode, further reducing energy and water consumption while maintaining effective thermal performance.

Building 2 – HDC + WCC
Combining an HDC with a WCC offers strong peak and annual energy performance for higher-density operations, while using water more selectively than open cooling-tower systems. This approach delivers an efficient, high-capacity solution that remains aligned with specific customer requirements for a wide range of operating conditions.

Several cooling system options were reviewed as part of the concept design for the project and Table 7 below summarises all the options for the project whilst also considering future proofing the development to provide continual improvement to provided cooling system.

Table 7: Comparison of Cooling Options

Cooling Option	Analysis of Cooling Option	Future Proofing
Option 1. Hybrid Dry Cooler + Water Cooled Chiller (Trim) + FWU	- Average peak and annualised PUE - High peak, higher annual water usage than air - Moderate acoustic emission; quieter than air	Can be adopted for high supply air temperatures, compressorless cooling and LTC
Option 2. Hybrid Dry Cooler + Air-Cooled Chiller (Trim) + FWU	- Higher PUE than water-cooled trim, less efficient air-cooled at peak - Lower WUE than HDC + WCC - High acoustic emission than HDC and WCC	'Can be adopted for high supply air temperatures, compressorless cooling and LTC
Option 3. Hybrid Dry Cooler + Water Cooled Chiller + FWU	- Lower PUE than air-cooled trim, strong full and part load efficiency - High WUE condenser water system + HDC increases water consumption - Moderate acoustic emission; quieter than air	'Can be adopted for high supply air temperatures, compressorless (free) cooling and LTC
Option 4. Air-Cooled Chiller + FWU	- High PUE, least efficient at peak and annually than HDC + WCC/ACC - Very low WUE, attractive for strict water limits - Large roof spatial requirements - Highest acoustic emissions, major acoustic treatment required	Can be adopted for high supply air temperatures and LTC
Option 5. Hybrid Dry Cooler + Water Cooled Chiller (Trim) + CDU + FWU	- Improved PUE, DTC allows for a more efficient system - High WUE condenser water system + HDC increases water consumption - Higher complexity -Moderate acoustic emission from central roof plant; quieter than air - Less acoustic emission in the data hall compared to 100% air cooled by FWUs	Can be adopted for high supply air temperatures, compressorless (free) cooling
Option 6. Hybrid Dry Cooler + Air Cooled Chiller (Trim) + CDU + FWU	- PUE lower than pure air-cooled but higher than water-cooled CDU system - Lower WUE - Moderate / High noise emission from the central roof	Can be adopted for high supply air temperatures, compressorless (free) cooling

	plant - Less acoustic emission in the data hall compared to 100% air cooled by FWUs	
Option 7. Hybrid Dry Cooler + Water Cooled Chiller + CDU + FWU	- Low PUE, ideal for dense IT loads; efficient water-cooled plant with DTC - Higher WUE than air-cooled systems - Higher complexity - Lower acoustic emissions external / internal than air-cooled systems	Can be adopted for high supply air temperatures, compressorless (free) cooling
Option 8. Air-Cooled Chiller + CDU + FWU	- Similar to option 4, higher PUE than water-cooled systems but lower than full FWU system. - Very low WUE compared to water-cooled systems - High dBA acoustic emission due to a large field of ACCs - Less acoustic emission in the data hall compared to 100% air cooled by FWUs.	Can be adopted for high supply air temperatures
Option 9. Hybrid Dry Cooler +Adiabatic Air-Cooled Chiller +CDU + FWU	- Higher PUE than water-cooled systems but lower than ACC system. - Lower WUE compared to water-cooled systems - High dBA acoustic emission due to a large field of ACCs - Large roof spatial requirements.	Can be adopted for high supply air temperatures

4.2.2 Estimated Water and Energy Demand

The table below shows the relative estimated water and energy demand for the site associated with the mechanical cooling system.

Table 8: Estimated Water and Energy Demand

Mechanical Energy and Water Demand		
Total Annualised Water Demand	4,472,195	kL/year
Total Annualised Energy l Demand	498,809	MWh/year

4.2.3 Future Proofing Mechanical Cooling System

The mechanical services have been designed to be adaptable to future IT cooling technologies as they evolve. The current system accommodates existing cooling technologies, providing an efficient balance between water and energy use for data hall cooling. Sufficient flexibility has been incorporated to allow the system to respond to both current and future cooling requirements

Adaptive Cooling Capabilities

The cooling systems have been designed with adaptability to support evolving IT cooling technologies and a wide range of operating conditions. Adaptive cooling strategies include the following:

- Water-side system flexibility, incorporating multiple operating modes, including:
    - Chilled-water coil operation using chiller compressors

  - Partial and full free cooling operation
  - Hybrid dry coolers
  - Adiabatic air-cooled free-cooling chillers
  - DX cooling (CRAC units), where applicable
- Provision for future conversion to a hybrid dry-cooling central plant, should cooling supply temperature requirements increase. In this scenario, the chiller plant can be decommissioned and removed.
- Design accommodation for a range of IT heat densities, supporting both current and future rack power profiles.
- Capability to operate across a range of supply and return water temperatures, including:
  - Increased plant ΔT capability
  - Coil oversizing of approximately 10–20%, allowing operation at higher water temperatures in the future without loss of cooling capacity
- Full adaptability for liquid cooling solutions, supporting liquid-cooled IT loads of up to 100%, including:
  - Direct-to-Chip (DTC) cooling
  - Rear Door Heat Exchangers (RDHx)
  - Immersion cooling pods
- Provision for future expansion of DTC liquid cooling, as rack densities and IT technologies evolve.
- Expansion of DTC Liquid Cooling

Expansion of DTC Liquid Cooling – Implementation Approach

- Mechanical infrastructure provisions
  - Allowances are incorporated within the mechanical infrastructure to support expansion of Direct-to-Chip (DTC) liquid cooling systems.
  - Dedicated white space is reserved within the mechanical galleries to accommodate additional Cooling Distribution Units (CDUs), enabling future expansion to support higher-density rack deployments.
- Operating strategies
  - Progressive increases in DTC coolant supply temperatures will be implemented as IT hardware capabilities evolve.
  - Increased coolant temperatures will reduce chiller lift, improve overall system efficiency, and increase the proportion of operating hours served by hybrid coolers in dry mode.

RDHx Implementation approach

- Utilise available spare capacity within the chilled water or secondary coolant loops to accommodate incremental RDHx loads as rack densities increase.
- Establish one or more dedicated RDHx supply/return headers off the existing secondary circuit, with isolation valves and balancing valves per branch for future bays.
- Use CDUs for hydraulic separation for higher supply temperature to RDHx than to CRAH.
- Stage the deployment of the RDHx to target potential new high-density pods whilst leaving the rest of the hall on the conventional cooling.

Immersion Cooling Pods Implementation approach

- Provision of zones with adequate structural floor loading to accommodate immersion cooling tanks, including the weight of the tanks, dielectric fluid, and associated equipment.
- Mechanical infrastructure provisions to support immersion and liquid cooling systems, including allowance for distribution pipework, plant interfaces, and future expansion.
- Provision for increasing DTC coolant supply temperatures over time, enabling improved system efficiency, reduced chiller lift, and greater utilisation of non-mechanical cooling modes.

4.3 Location of Mechanical Plant

The placement of the mechanical plant has been analysed by Acoustic Engineer and has considered the noise impacts to any sensitive receptors around or proximity to the site. Computational Fluid Dynamics (CFD) modelling has also been undertaken to ensure the cooling system operates at its highest efficiency with minimum noise impact. Both acoustic and CFD analysis have been considered to ensure that there are no adverse impacts to nearby properties.

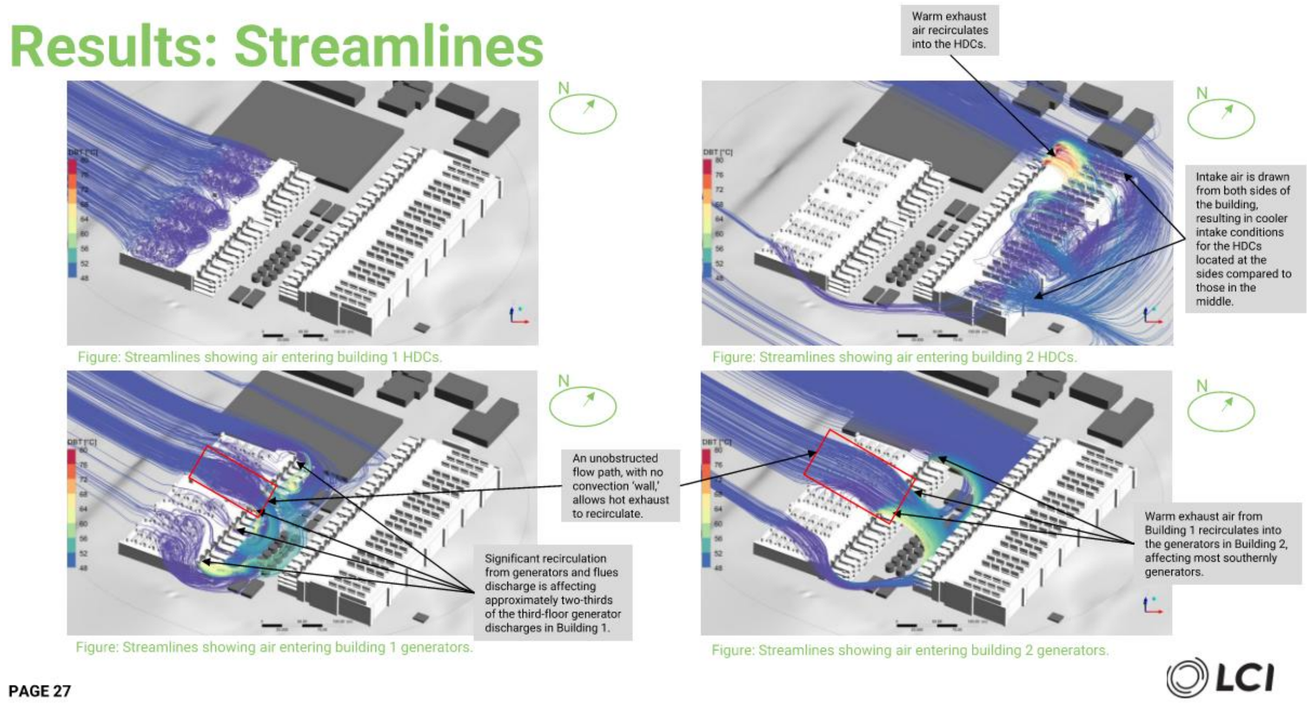

Figure 4-1: Typical CFD Modelling result

5 Conclusion

This report has provided an overview of the proposed diesel backup power system which will support the 500MVA of load through low-voltage generators. These generators will be tested at commissioning for several hours each, and subsequently once every few months for several hours at a time. Housing these generators inside acoustic-rated enclosures will mitigate risks of excessive noise pollution in the area. Limiting testing to the frequency mentioned within this report will reduce overall emissions and fuel usage at the site.

While other technologies have been considered for Plant and Equipment Systems, none are suitable for this site due to multiple constraints. The primary challenges include limited market availability, insufficient infrastructure to support increased electrical demands, and restricted on-site space, which makes alternative solutions impractical for addressing medium-term utility power outages.

The cooling system selected for the project has considered a balanced approach for both power usage effectiveness (PUE) and water usage effectiveness (WUE) whilst also factoring other multiple environmental considerations to meet the ESD targets as well as customer requirements for the high-density datacentre cooling solutions.

The Plant and Equipment Systems system has been proposed to offer the most practical and effective solution for the proposed site. This ensures that the state-significant development can begin delivering services promptly, while minimizing disruption to the surrounding community and environment.

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