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END

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2	50902-VE-SW-XX-SH-M-5601 - Piccadilly Station - Equipment & Valve Schedule	P1
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VITAL ENERGI UTILITIES LIMITED

Public Sector Decarbonisation Scheme (PSDS) Decarbonising Network Rail's Railway Infrastructure Manchester Piccadilly Station Stage 3 Multi-Disciplinary Report

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1. INTRODUCTION

As part of Network Rail's (NR) ambition to decarbonise, they have secured public sector decarbonisation scheme (PSDS) funding managed by Salix. Vital Energi are the delivery partner to NR for PSDS, and propose to supply and install 5 No. 150kW air source heat pump (ASHP) at one of their sites, Manchester Piccadilly Train Station (PS), within the grant funding. Vital Energi have prepared a Stage 3 design report to present the developed design, including removal and modifications to existing systems, proposed new equipment, services routes and future operation.

This report has been prepared to communicate the details of the Stage 3 developed design associated with the ASHP, any assumptions made and further works to be considered.

The existing plantroom locating gas boiler plant is located in the undercroft area under the station and the proposed location for the new ASHPs is the undercroft area adjacent to Sheffield Street.

This work builds upon the RIBA Stage 2 development undertaken as part of the pre-construction stage.

2. DESIGN CRITERIA

This section of the report references the basis of design taken forward from the Vital Energi concept design.

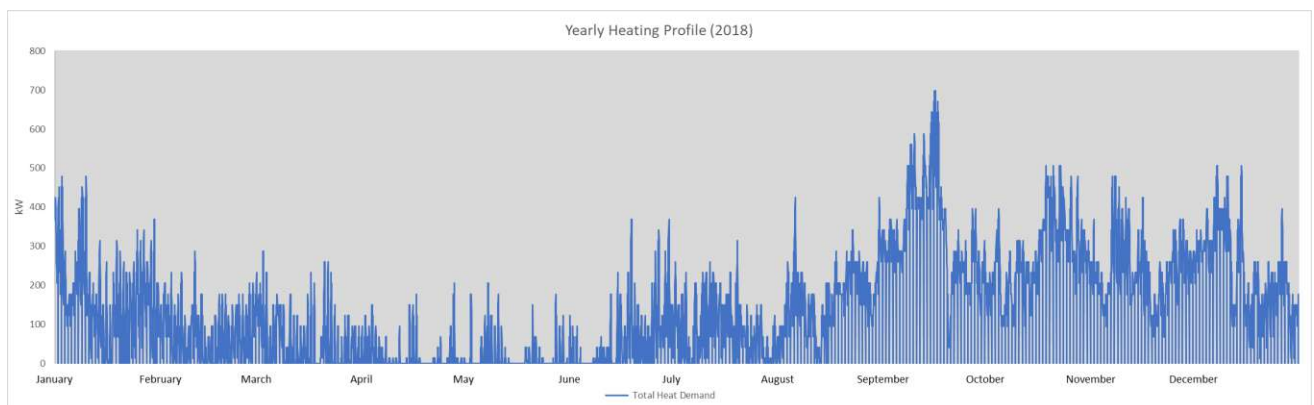


Figure 1 - Graph of 2018 Yearly Heating Demand

Figure 1 above utilises existing gas data to model the heating demands of PS, highlighting a peak demand of ~700kW between September/October and averaging ~500kW for the remainder of the year. There are two gas boilers currently located within the plantroom, however only one is operational. This boiler is able to meet the peak demand currently with a max output of 725kW. This assumes the existing system has been oversized or secondary connections have since installation been severed from the LTHW circuit. Vital Energi's proposal will be to install 750kW of ASHP, matching the current output of the boiler / modelled peak demand.

Vital propose 5 No. ASHP, with large levels of modulation between the units. Each unit can modulate down to 25%, providing a minimum output of 37.5kW. This increases the efficiency of the plant, especially during warmer months with small heating demand.

The number of units provides resilience for the system. If one ASHP were to become inoperable there would be four units remaining, providing an output of 600kW. Relating this back to figure 1, this would be sufficient to meet peak demand for the majority of the year.

The output of the ASHPs (750kW) is at -5°C external design conditions, proving the units are a resilient heat source and the heat output is not affected by extreme external design conditions.

3. INFORMATION ON EXISTING SYSTEMS

NR have provided information for the existing LTHW circuit / general services. Vital have utilised this and gathered further information on the existing systems via non-intrusive site surveys and engineering judgement to develop the RIBA Stage 3 design.

Vital Energi have now been instructed to develop the design to RIBA Stage 3, building upon the RIBA Stage 2 Design.

It has been assumed that the existing water quality in heating systems is in line with BSRIA guidelines for LTHW heating systems and that no hydraulic separation between existing LTHW circuits, new ASHPs and ancillaries is required. Upon approval of the stage 3 design, water samples will be taken to validate the assumption that existing water quality is in line with BSRIA guidelines. This information will be shared with NR to create a baseline on system water quality. This will need to be undertaken with sufficient lead in to inform the Stage 4 design.

Commissioning data for the existing systems has been made available by NR and it has been assumed that existing heating systems are currently in full working order and are fit for purpose and can be re-used. Upon approval of the stage 3 design, flowrates of existing systems will be taken to provide validation of the existing system performance prior to ASHP integration. This will need to be undertaken with sufficient lead in to inform the Stage 4 design. The commissioning data will be shared with NR once undertaken to create a baseline on the performance of the existing LTHW system.

At this time only one of the two gas boilers within the boiler room of PS is currently in operation, and the remaining operational boiler is demonstrating signs of failure due to nearing its end of life.

4. SECONDARY SIDE MODIFICATIONS

Vital Energi have undergone temperature data logging at PS to understand the system temperatures. Crucial to conclude whether it is suitable for integration of the ASHPs into the existing system. Heat pumps are more efficient at higher differential temperatures, with many unable to handle extremely narrow differential temperatures. The outcome of the logging showed that the system can perform at 80°C/70°C, see "50902-VE-PS-XX-TS-M-5606 P1 - Temperature Logging Technical Submittal" for further information. This 10°C ΔT is suitable for the ASHP integration and no secondary side modifications will be required.

Only the primary generation side of the system is currently within Vital Energi scope, however surveys have been carried out to determine the requirement for secondary side modifications on the existing system. These surveys suggest secondary side modifications are not to required.

The extent of the existing secondary systems is assumed to be as per “*Railtrack / Liang / Bailey Rail - Piccadilly Station MR08350 – Site Wide Heating and Cooling Distribution Schematic*” – Dated Aug 2002.

From the limited surveys undertaken the expectation is that the existing systems are constant volume with 3port diverting valves to AHUs / Air curtains and variable with differential pressure valves used for the Radiator circuits.

5. STAGE 3 DESIGN LEVEL OF DEVELOPMENT AND ASSOCIATED RISK

Upon approval of the stage 3 design, the ASHP scheme will be developed through the following RIBA design stages:

Stage 4 – Technical Design

Stage 5 – Manufacturing and Construction (Contractor Working Drawings).

The design currently sits at RIBA Stage 3 (Spatial Co-ordination). At Stage 3, there are elements of design and associated mechanical, electrical, builders work and other unforeseen items that cannot yet be detailed. These elements have been identified using engineering judgement and will be derisked through further surveys / general works.

From Stage 2 the following Key Project Risks have been identified:

1. Structural capacity of ground within undercroft ASHP compound. Intrusive surveys (Borehole drilling) and non-intrusive surveys (Ground Penetrating Radar Survey (GPRS)) are required to derisk.
2. Structural capacity of existing structure to fix new services (walls / slabs). Pull tests are required to derisk.
3. Asbestos in older buildings
4. Water quality and condition of existing pipework
5. Builders work routing for M&E services + Firestopping
6. Planning approvals – NR to advise what is required from Vital Energi
7. Work in operational buildings (24/7 NR control rooms)
8. Change of pressure regime to LTHW heating system due to increased pipework distribution. Risk of higher pressures causing existing aged systems (systems assumed to date from 1991) to leak.

Please refer to the Vital Energi Stage 3 Risk Register for proposed Risk Treatment Strategy and Mitigations in connection with the Stage 3 Proposal.

6. MECHANICAL AND ELECTRICAL SHUTDOWNS

The integration of ASHP's will require shutdowns of the existing heating and electrical systems.

It has been assumed that these can be done in agreement with NR and no temporary boilers / generators or out of hours working will be needed.

Further coordination with NR will be required to determine the programme for this work and agree when best to plan this disruption. This will determine the requirement for temporary boilers or if an alternative method is more practical. i.e., Out of hours working.

7. MEANS OF ACCESS

Strip Out / Construction.

It has been assumed that access for the removal of existing basement plant and installation of new can be undertaken using the existing street access from London Road, with pipework and equipment being manually handled / and or manoeuvred to / from plant areas using specialist equipment. Eg stair climbers / block and tackle etc.

If this is not possible, large equipment can be removed via the under croft leading to the large station car park in the arches / under croft, see figure 2.

These assumptions will need to be reviewed with specialist lifting / removal contractor.

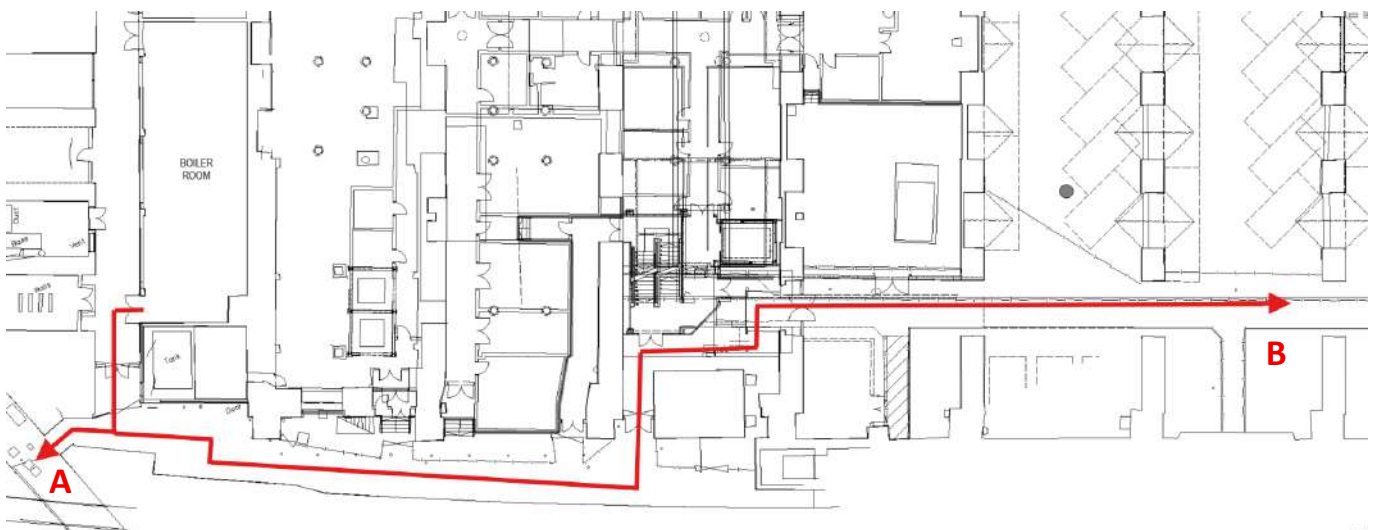


Figure 2: Boiler Room Equipment Access and Egress Routes; A – London Road & B – Station Car Park

The existing boiler flue removal within the boiler room will require work at height, as will the installation of new external M&E services from the boiler room to the ASHP compound.

Heat pump manufacturers

The proposed heat pump system for PS will consist of 5 No. 150kW Pure Thermal Atherm 80 300.2 ASHP's connected to the main Low temperature hot water (LTHW) system. These units are capable of offering an 80°C flow temperature in a single stage heat pump system.

Heat pump configuration

The schematic/general arrangement of the proposed heat pumps is provided in appended drawings "50902-VE-PS-XX-SC-M-5602" & "50902-VE-PS-XX-SC-M-5603".

Vital Energi propose to install the external ASHP'S in the under croft area of Piccadilly Station. The system utilises this heat source to feed multiple building services, including AHUs, Air curtains and VT Radiator Circuits.

See "Railtrack / Liang / Bailey Rail - Piccadilly Station MR08350 – Site Wide Heating and Cooling Distribution Schematic" – Dated Aug 2002 for assumed extent of secondary systems.

The LTHW heating circuit for the ASHPs incorporates thermal storage via two 8,000L buffer vessels (BV-A-01/BV-A-02) within the heat pump compound. This vessel prevents unwanted 'cycling' from the heat pump compressor and eliminates the impact of when a heat pump goes into defrost. This improves efficiency and increases the lifespan of the heat pump equipment. From these buffer vessels, LTHW is pumped directly into the main LTHW building circuit.

Under the PSDS funding it is a requirement that existing natural gas boilers are removed, as the heat pump in effect 'replaces' these heat generators. Both 725kW natural gas boilers are to be removed and replaced by the 5 No. 150kW ASHP system as part of these works.

Heat Pump Locations

The proposed plantroom and under croft general arrangements (GA's) are provided in appended drawings "50902-VE-PS-XX-DR-M-5603", "50902-VE-PS-XX-DR-M-5604" & "50902-VE-PS-XX-DR-M-5605".

The ASHP's/ 8,000L buffer vessels will be located in the under croft area below a car park adjacent to Sheffield Street. Due to the weight of the units, GPRS / borehole drilling will be required to aid the structural survey and conclude the size of the structural reinforcements required.

The pipework from the ASHP's will run through the arches and under croft of PS, fixed to the existing brickwork arches. Pull tests will be completed to determine the structural capacity of the arches and will be done prior to installation in order to ensure the arches have sufficient structural capacity.

The removal of the existing gas boilers in the plantroom has created space for the pressurisation unit, distribution pump skid, expansion / buffer vessel and side stream filter. The distribution pumps will be used to accommodate the existing system and the increased pressure losses through proposed equipment and pipework runs from the buffer vessels located in the heat pump compound. The DN125 pipework run from heat pump compound to boiler room is approximately 280m.

The buffer vessels, pumps and other associated equipment will be positioned to ensure that maintenance space and access routes are sufficiently maintained. It is known the existing signalling cable duct running through the undercroft is critical infrastructure and as such, must be maintainable at all times.

Pressurisation Equipment

The existing spill fill pressurisation unit and ancillary equipment will be removed as part of the works.

Due to the existing system being an atmospheric spill fill pressurisation system, it will be upgraded to a modern closed circuit. The addition of 16000 litres of buffer vessel and associated pipework will increase the system volume. The expansion within the system can be seen as 500-550L within the existing spill tank located within the plantroom. With this change in volume and operating temperatures, the existing system volume has been calculated as 17,000-18,000L. Incorporating the proposed design and calculated to BS EN 12828, the expansion vessel has been sized to 2000L, with 1530L of expansion.

The proposed pressurisation unit will have an integral degasser, degassing the LTHW and allowing for the removal of the existing vacuum degasser.

Accommodation For Future District Heating (DH) Connection (Funding Requirement)

Shown within the blue hatching in figure 4, Vital Energi have left an area of the existing boiler plantroom to accommodate for a future DH connection. This space has been sized from previous heat network projects designed and constructed by Vital Energi with the same peak load required for the future connection (~750kW).

Plausibility of Electric Boiler (Funding Requirement)

As part of the Salix funding requirements, an emitter study is required to determine whether the electric boiler is required in scope. This emitter study is not required due to the temperature logging that has taken place at PS. The system at PS runs at 80°C /70°C Flow/Return and our ASHPs are capable of the flow temperatures. As a result, the electric boiler is no longer required for temperature top up.

As Salix funding does not allow for resilience heating plant, the electric boiler is now removed from scope.

Buffer Vessel Sizing

Compressor Cycles

Utilising CIBSE Guide B1 section 1.5.5.2 "*Storage Systems*", the buffer vessels can be sized to ensure the heat pumps have sufficient time to prevent unwanted cycling of their compressors. It is good practice to accommodate for 4-6 cycles/hour, see below for the equation used (Figure 5).

1.5.5.2 Storage systems

The general principle is to determine the heat input rate required to heat up the storage volume within a specified time period (the recovery time). The heating load, Φ_{dhw} (W) imposed on the heat source is given by:

$$\Phi_{\text{dhw}} = M C_{\text{pw}} (\theta_{\text{ws}} - \theta_{\text{wl}}) / T_{\text{rec}} \quad (1.32)$$

where M is the mass of the stored water (kg), θ_{ws} is the design storage temperature (°C) and T_{rec} is the recovery time (s).

Figure 5 - Equation used to derive buffer vessel size requirement

The calculated buffer vessel sizing and compressor cycling times are shown below:

- ASHPs require 16,000L and the compressors will cycle for 15 minutes (4 cycles/hour) / 10,714L and the compressors will cycle for 10 minutes (6 cycles/hour).

Defrost

The Pure Thermal Atherm 80 300.2 have in built controllers which prevent more than two units going into defrost at one time. With this in mind, if two of the units is in defrost, it will leave 4 No. heat pumps and 450kW of capacity available to the LTHW system. This will therefore leave 300kW to be drawn from the buffer vessels and at 80/70 the buffer vessels can provide max flow temperature at peak load for 37 minutes. This is enough time for the units to go through defrost.

Mains Cold Water

The current mains cold water pipework within the boiler room plantroom will be reused and connected to the proposed pressurisation unit. A new water meter with a pulsed output will also be proposed to ensure the water input into the system is recorded.

Drainage

As an ASHP operates by cooling external air to extract heat, condensation is formed on the evaporator of the heat pump. This condensate shall fall into channels located in the concrete plinth below the ASHP's and run to existing drainage.

The ASHP's will also incorporate LTHW pressure safety relief valves for the protection of the systems and building occupants. These discharges will be terminated into a local rainwater drainage to ensure water is not discharged into areas prone to pooling which could freeze.

Any water discharged in a fault condition within the boiler room plantroom will fall to existing plantroom drainage.

Water Quality

The ASHPs will be connected directly onto the building's existing LTHW system. The heat pump manufacturer has confirmed the water quality requirements for their equipment, to ensure expected

performance and prevent corrosion. If the water quality requirements are not met, the warranty provided by the manufacturer is null and void. Therefore, it is important that the existing water quality is reviewed ahead of connection to the system. Initial water quality requirements are to meet BSRIA BG 29/BG 50 requirements.

Water quality samples should be taken from the LTHW system before connecting the heat pumps. Should the water quality not comply with the manufacturer requirements, a water quality specialist should be involved to address any issues. BSRIA BG 29 / BG 50 to have assumed to have been followed on the existing LTHW system. Should the water quality not be suitable for connection of new ASHP it will be the responsibility of NR to undertake appropriate remedial action.

To improve the water quality to the heat pump, and as good practice, an air and dirt separator will be added onto the common return pipe before the ASHP's to remove any unwanted material in the pipe.

Strip-Out Works

The existing plant that is no longer necessary/in working order must be removed prior to the new installation. Below is a list of items that are to be removed and replaced:

- 2 No. Gas Boilers
- 2 No. Gas boosters
- Existing Pressurisation unit / Spill tank
- Degassing Units
- Dosing Pot
- Side Stream Filter
- Distribution Pumps
- Heating Pipework
- Gas Pipework
- Flue pipework within plantroom from the existing boilers

For all strip-outs/relocations, see figure 6 / "50902-VE-PS-XX-DR-M-5601 P1 - Existing Boiler Room Strip-Out GA" & "50902-VE-PS-XX-SC-M-5601 P1 - Existing Boiler Room Strip-Out P&ID".

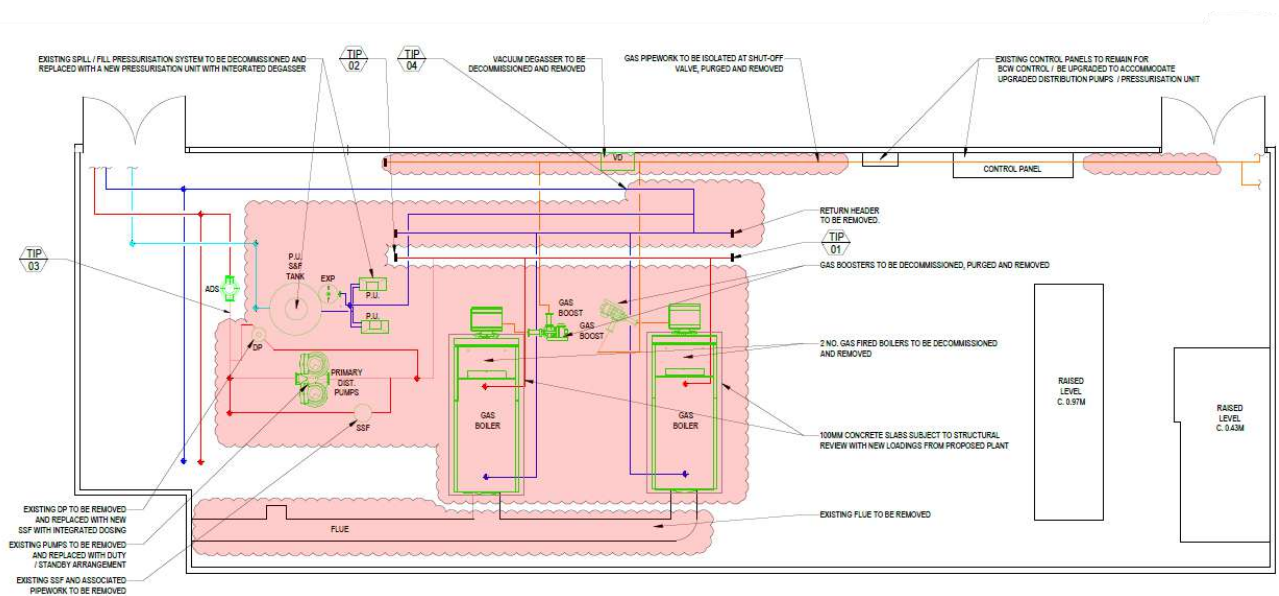


Figure 6 - Boiler Room Strip out GA

Ventilation

Existing Plantroom

The existing plantroom has natural ventilation louvres located on the wall of the plantroom and mechanical ventilation at high level. The louvres cover much of the wall and is assumed to provide sufficient ventilation for the existing gas fired boiler plant and natural gas pipework. These louvres are to remain to provide ventilation to dissipate standing losses from existing pipework / pumps.

ASHP Compound

Short circuiting is to be avoided, which is where cold air is expelled and recirculated into the ASHP in a constant loop. This causes the heat pump to go into a downward spiral and naturally damages efficiency drastically to a point it is inoperable. Vital are proposing ventilation hoods to be located on top of the ASHPs, guiding the cold air exerted from the ASHPs onto Sheffield Street.

BMS

The existing BMS Panel located in the AHU roof plantroom will be modified with hardware in connection with removed boilers and pumps removed. Hardware in connection with the retained plant, AHUs and the like will be retained.

A new BMS panel to control new WSHP, ASHP, Pumps, Pressurisation units and ancillaries is to be provided in the existing boiler room plantroom.

New panels are to be installed / existing panels modified are to be interfaced to operate as a complete Schneider single system.

Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) - General

The Dangerous Substances and Explosive Atmosphere Regulations are concerned with protection against risks from fire, explosion and similar events arising from dangerous substances used or present in the workplace. The regulations require that risks from dangerous substances are assessed, eliminated, or reduced. They contain specific requirements to be applied where an explosive atmosphere may be present and require the provision of arrangements to deal with accidents, emergencies etc. and provision of information, training, and use of dangerous substances. The regulations also require the identification of pipelines and containers containing hazardous substances. All gas systems except those in domestic parts of buildings fall within the scope of DSEAR. This requires that a risk assessment be completed for each premise to determine if any hazardous area exists and its extent.

In 2015, the regulation was amended to include all refrigeration, air conditioning and heat pump installations. Therefore, a DSEAR risk assessment must be carried out for the proposed heat pump installation.

Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) - Refrigerant

The DSEAR assessment will review items such as the refrigerant type and charge, any safety systems proposed/required, possible leak scenarios and existing energy centre ventilation provision. Recommendations from this assessment may include additional safety systems, such as gas detection and alarm equipment, or ventilation. This will be established at the detailed design stage and a report produced to inform detailed design and future access restrictions to roof as required.

Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) – Natural Gas

The existing gas main to the boilers will be capped off at the shut-off valve located in the plantroom and made safe. There are no current purge points to enable purging of the redundant pipeline, therefore further surveys are required to determine a safe method.

It is assumed that as the existing gas distribution route is safe and no additional measures are required. i.e. additional ventilation, gas alarms etc.

Frost Protection Strategy

The following frost protection measures will be included.

- Pump cycling via BMS.

ASHP Defrost Cycling

During colder weather the condensation that forms on the evaporator coil of the ASHP can freeze which can put unnecessary strain on the heat pump and leads to high inefficiency and eventually mechanical problems such as leaks in refrigerant lines due to expansion. To combat this, the ASHP's go into a defrost cycle which reverses the system so that the coil expels heat and in turn melts the frost build up.

This however means the ASHP is operating at a reduced output whilst it is in this mode, relying on the buffer vessel's thermal storage to match the required demand for a short period of time.

In regard to the proposed system, there will be two controllers. One controller will control 3 No. ASHPs and the other will control the remaining 2 No. ASHPs. These controllers avoid more than two units ASHPs going into a defrost cycle. This ensures that there will be at least 450kW of ASHP available at all times, providing support and slowing the depletion of the buffer vessels.

Once a unit goes into defrost, the system is prone to cold slugs that lower flow temperatures as a result of the reduced output. Three-port valves will be installed on the flow pipework to divert the flow back to the second buffer vessel, ensuring the flow temperature remains unaffected.

9. METERING

The following metering will satisfy the project requirements for M&V.

- ASHP heat outputs –
HM-A-01
HM-A-02
HM-A-03
HM-A-04
HM-A-05
HM-A-06
- ASHP electrical inputs

LVSWB-01 main incomer elec meter - 001
ASHP-A-01 elec meter - 101
ASHP-A-02 elec meter - 102
ASHP-A-03 elec meter - 103
ASHP-A-04 elec meter - 104
ASHP-A-05 elec meter - 105

The inclusion of Mechanical and Electrical metering is captured on the included M and E layouts/schematics.

10.ELECTRICAL

10.1 HV / LV Distribution

Following parasitic load calculations, it is envisaged that an additional maximum electrical load demand to service the new heat pump installation will be circa 570KVA. The stations current connection agreement import capacity is 2MVA which is being upgraded to 2.5MVA. From the half hourly data a maximum demand of circa 1458kVA. Therefore the new maximum demand will be circa 1929kVA.

Please refer to Appendix A for the Piccadilly Station Electrical Load Schedule - 50902-VE-PS-XX-SH-E-6201 and HV & LV Single Line Diagram 50902-VE-PS-XX-SC-E-6001 for further details.

The new heat pump installation will be supplied power, with the installation of a packaged substation located within the existing HV switchroom and adjacent LV switchroom, in the form of a close coupled high voltage ring main unit (RMU-04), aluminium wound 800kVA cast resin 6.6kv/415V transformer (TX-04) and 2000A 50kA rated form 4 type 6 IP31 LV switchboard (LVSWB-01).

The RMU break in location is between existing RMU-02 and RMU-03 on the train stations existing private wire HV network. Network rail will be carrying out the enabling works including the transfer of open points on the 2 no. existing RMU's in December 25, to allow the new substation installation in the following year. New HV cabling will connect the existing ring switches to the new packaged substation RMU all from above, utilising the existing localised HV cable ladders in the adjacent space.

The packaged substation will be located in an extended metal gated enclosure to separate the HV and LV sections of the equipment. The transformer access doors will be castell interlocked with the RMU and incoming sections of the LV switchboard, to prevent access to the transformer when in service/live.

The elec metered LV switchboard has a separate incoming section for a temporary generator connection, in the form of fascia mounted powerline connectors, so that heating equipment can remain in service for prolonged power outages on the DNO network,

The existing distribution boards within the LV switchroom and boiler plantroom both have spare capacity and are proposed for re-use for the additional lighting and small power circuits, pumps, pressurisation, side stream filter and BMS control panel power supplies. Final confirmation of switchboards, connections and configurations shall be detailed at the next design stage.

VE will undertake calculations and specification for switchboards, transformers, LV power systems and LV distribution inclusive of HV / LV cabling. Fault calculations and discrimination studies will be completed for the LV and HV network.

All power and connections are designed and installed in accordance with the latest amendment of BS7671:2018 IEE 18th edition wiring regulations.

Please refer to Appendix B for 50902-VE-PS-B1-DR-E-5001 Piccadilly Station Electrical Equipment Layout, 50902-VE-PS-XX-SH-E-6201 P3 PS Electrical Load Schedule, 50902-VE-PS-XX-SP-E-6201 P3 PS RMU, Transformer, LV Switchboard Specification and 50902-VE-PS-XX-SC-E-6001 Piccadilly Station HV & LV Single Line Diagram for further details.

10.2 Cable Containment

All required primary and secondary containment, associated accessories and support steelwork for a complete installation within the heat pump installation and boiler plantroom will be required, in the form of cable ladder and tray where required.

In order to provide a low impedance earth path throughout, suitable earth links placed at all joints are provided on all cable ladder and tray.

Please refer to Appendix B for 50902-VE-PS-00-DR-E-6101 P1 Piccadilly Station Containment Layout and 50902-VE-PS-00-DR-E-6102 P1 Piccadilly Station Site Wide Containment Layout for further details.

10.3 Small Power and Lighting

As part of the works, Vital Energi will supply, install, test, and commission all small power accessories including socket outlets, and isolators for the fixed equipment at the heat pump installation and boiler plantroom. Power supplies from the distribution boards will also serve BMS-CP-01 & BMS-CP-02, maintenance lighting circuits and mechanical plant. The power supply requirements will be 3 phase and neutral 400V @ 50Hz, with single phase and neutral 230V for the small equipment and panels, where possible the control voltages will be 24VAC.

The small power system shall generally comprise of the following elements as a minimum:

- IP65 13A maintenance switched socket outlets .
- Local power supplies IP66 rotary isolator switches to dedicated fixed equipment mounted as close as practicable to the cable entry of the item of equipment they feed.

All locations of main equipment are shown as indicated on the drawings, the exact location is to be confirmed when procurement of the equipment has been completed.

Lighting in the form of suspended high bay LED luminaires will be provided for maintenance lighting at the heat pump installation with dedicated spotlight emergency luminaires for the emergency lighting. The control of lighting including emergency lighting will be via standard switches/key switches local to the heat pump installation. The design will ensure that a minimum of 200 lux and 0.4 uniformity are achieved, for task areas of the heat pump installation complying with BS EN12464-1. Emergency lighting has been designed to meet 1 lux on the centre line of the escape routes and to allow safe egress from the heat pump compound, complying with BS 5266-1.

Please refer to Appendix B for 50902-VE-PS-00-DR-E-6201 P1 Piccadilly Station Small Power Layout, 50902-VE-PS-00-DR-E-6203 P1 Piccadilly Station Plantroom Small Power Layout, 50902-VE-PS-00-DR-E-6301 P1 Piccadilly Station Lighting Layout and 50902-VE-PS-XX-RP-E-6301 P1 Piccadilly Station Dialux Lighting Report for further details.

10.4 Earthing and Bonding

The existing earthing system in the HV substation will be utilised/extended for the new packaged plantroom installation, to a new LV earth bar mounted adjacent the new LV switchboard assembly.

Main protective bonding from the new earth bar will be installed to the following:

- Any extraneous metal
- Cable containment
- Metallic casing for all main equipment and plant
- Expansion Vessel frames
- Package substation metal fence
- Transformer and HV switchgear frames
- Heating flow and return pipework
- Building structure

Further detail and earthing and bonding schematic to follow in the next design stage.

10.5 Telecommunications / Data Installation

A comms data outlet on the stations comms network is required adjacent the BMS control panel BMS-CP-01 in the LV switchroom, to allow remote access to the BMS system and link to the BMS head end computer. A fibre optic link will be provided to enable full communication between the BMS control panel in the boiler plantroom.

Please refer to Appendix B for 50902-VE-PS-00-DR-E-6201 P1 Piccadilly Station Small Power Layout for further details.

10.6 Automatic Fire Detection

No applicable works

10.7 Gas Alarm Detection

The heat pump refrigerant gas alarm detection is integral to the heat pump assembly which will remove the heat pump from operation on a gas detection signal.

10.8 BMS Control System

A new building management system (BMS) will be installed in the existing LV switchroom via new control panel BMS-CP-01 and outstation BMS-CP-02 in the existing boiler plant room.

Complete with a front-end control and monitoring system. The system will allow for recording and reporting of the operation of the new heat pump installation. The BMS will also act as a server and allow remote access through a web client for remote monitoring.

The BMS will control and/or monitor the plant which includes but not limited to the following:

- Heat pumps
- Distribution Pumps
- Pressurisation Unit
- Side Stream Filter
- Heat pump shunt pumps
- Transformer high temp alarms
- LV switchboard for circuit protective device position feedback, electrical metering and battery tripping unit fault.

A BMS allows good control, monitoring and data acquisition providing a robust and secure total system solution. Items and devices that can be monitored include but are not limited to:

- Uninterruptible power supply system (UPS) for the BMS control circuit
- Pushbuttons and switches
- Programmable controllers
- I/O modules
- Operator interfaces
- Fault alert/alarms in the event of component malfunction.
- Alarm accept and reset from the BMS
- Data logger
- Development software packages
- Specialized hardware and software that support process control, motion control, and drive control
- View facility-wide operationally centric data
- Capture, store and retrieve critical operational data with operator notes
- View trend data in real-time from “live” data or historical sources
- Provide high system availability and data integrity
- Pre-emptive critical alarm notification of operations and maintenance staff via text or voice paging system (TBC if required at detail design stage)
- Produce operational and regulatory report on regular intervals
- Provide system-wide administration of security and log-on rights
- Increase system throughput

- Increase reliability
- Design flexibility
- System scalability

All systems offer local and remote (off site) communications ensuring that the maintenance teams are informed at the earliest instance of any warnings or faults in the system and prior to this having a detrimental impact on the end user, aiding maintenance and providing trending information.

All meters will have Modbus outputs for logging within the BMS. Where possible all electricity meters will have a Modbus connection to allow all information to be gathered from the device and viewed via the BMS.

The control system, monitoring and data recording for the new heat pump installation will need to be agreed in more detail with the client, this is to be confirmed at the next design stage.

Please refer to Appendix B for 50902-VE-PS-XX-SC-E-6802 P1 Piccadilly Station System Architecture Diagram, 50902-VE-PS-XX-SC-E-6801 P1 Piccadilly Station Undercroft Area Block Cable Diagram, 50902-VE-PS-XX-SC-E-6803 P1 Piccadilly Station Boiler Room Block Cable Diagram, 50902-VE-PS-XX-SH-E-6801 P1 Piccadilly Station Undercroft Area BMS Requirements Document & 50902-VE-PS-XX-SH-E-6802 P1 Piccadilly Station Boiler Room BMS Requirements Document for further details.

11.STRUCTURAL

Due to the structural limitations of the existing floor in the undercroft, concrete slabs will be required to support the external ASHPs. The size of these slabs will be subject to a Ground Penetrating Radar Survey (GPRS) and Bore Hole Drilling survey. These surveys will be completed at stage 4.

It has been assumed the existing boiler slabs have sufficient capacity to accommodate the 2,000L expansion vessel located in the boiler room plantroom. The current boilers weigh ~3,000kg, and the expansion vessel will weigh ~2,000kg.

12.BUILDERSWORK

Only penetrations through walls are expected. These are expected to be limited to holes up to 250mm diameter to accommodate insulated pipework / firestopping.

All required builderswork openings will be checked by Vital structural engineer.

13.FIRE STRATEGY

The fire strategy has been provided by Network Rail.

The current fire strategy states that all penetrations through internal and external walls, floors, ceilings and roofs will be fire stopped to achieve 60 minute fire rating.

The undercroft areas / heat pump compound where Vital's work is proposed will have a new fire strategy completed to incorporate the proposed design.

It has been assumed that the new heat pump compound doesn't compromise existing means of escape / travel distances although this will be validated by a fire engineer.

14.ACOUSTIC ASSESSMENT

RBA have carried out an acoustic assessment, modelling the impact of the increase in noise level in the area surrounding the heat pump compound. The nearest receptor is residential apartments located behind the car park adjacent to the compound to the north. RBA sample the surrounding sound levels during a 24 hour period to establish a baseline. This baseline (criterion) and prediction is as below.

Table 5 – Predicted Plant Noise Levels

Operating Period	Noise Level (dB) at NSR1	
	Prediction	Criterion
Daytime (07:00 – 23:00)	44	43
Night-time (23:00 – 07:00)	44	36

The summary is the proposal of an acoustic wall overlooking Sheffield street or further 8 dB(A) acoustic mitigation on the ASHPs themselves.

Refer to RBA acoustic report in appendix.

15.COLD PLUME ASSESSMENT

Vital Energi have tasked Redmore Environmental to complete a cold plume assessment at Piccadilly Station. As the ASHPs expel cold air, this must be analysed to prevent any disruption to the local atmosphere which can cause discomfort for local residents.

The assessment found that the ASHP's will have a minimum impact in the vicinity of the plant. The maximum temperature the cold plume will decrease the local ambient temperature is 1.73°C. Redmore Environmental concluded the magnitude of change would be "relatively small" and that the "effects are not considered to be significant", see section 3.4.1 of "10073 – Cold Plume Assessment".

Refer to Redmore Environmental report in appendix.

16.DSEAR ASSESSMENT

As referenced within section 8, a DSEAR assessment is required to model the potential dangers of the heat pumps discharging their refrigerant. Vital have gone to GEXCON to model this, the outcome of which highlights the ATEX zones as a result of the refrigerant discharge.

The conclusion to the Gexcon modelling is that as below

2.3 Hazardous Area Classification & Risk Assessment Summary

Area Name		Heat Pump Installation						
Equipment	Component	Zone Class	Zone Extent	Minimum ATEX Specification	Personnel Risk		Equipment Risk	
					Primary	Secondary	Primary	Secondary
Air-Source Heat Pumps	R290 Release - Flanges and Connections C010101	Zone 2 NE	Negligible extent [change secondary event to N/A]	N/A	E	N/A	E	N/A
Air-Source Heat Pumps	R290 Release - High Pressure Relief Valve C010102	Zone 1 + Zone 2	Zone 1: Extending 1m in all directions, forming a spherical area originating from the vent discharge point. Zone 2: Extending from the PRV discharge point, horizontally in all directions for 1m and down to the ground as well as along the floor for 9m in all directions.*	Zone 1: Ex II 2G IIA T2 Zone 2: Ex II 3G IIA T2	C(Lower)	N/A	C(Lower)	N/A

* This extent should be taken as indicative only, please see page 16 for HAC considerations

The summary highlights an ATEX 1 is required around the discharge pipework, and as the discharge pipework currently faces towards the ground, there is an ATEX zone 2 along the ground for 9m around the discharge point.

Vital are proposing a change to the refrigerant safety discharge pipework. The pipework will be modified to discharge the refrigerant vertically, preventing a zone 2 forming along the floor. Further information will be provided in a revised report in due course.

Refer to the current report in the appendix.

17. PLANNING SUBMISSION / LISTED BUILDING CONSIDERATIONS.

No planning submission has been made at this time. NR hold responsibility for planning applications and will generate the required planning deliverables from Vital Energi M&E submissions.

The date for planning submission and approval is as yet unknown.

18. COMMISSIONING

Following the installation of the proposed heat pump and associated equipment, and the removal of existing equipment / alterations to control systems, the LTHW systems will need to be flushed and commissioned in line with industry guidance.

The LTHW system will be commissioned in accordance with Vital Energi specification 'Y51 - Testing and Commissioning of Mechanical and Electrical Services'.

19. EQUIPMENT AND WORKMANSHIP SPECIFICATION

All work will be carried out in accordance with Vital Energi's standards.

No NR preferred manufacturers have been shared; it has therefore been assumed that the usual Vital Energi supply chain will be acceptable.

20. CLIENT REVIEW PROCESS

No requirement for a formal NR review and approval procedure has been shared.

Due to the project being submitted through “high street environment”, Vital can follow the RIBA stage process where each stage will be concluded with a stage report. These reports will require acceptance or acceptance with comments to move the stages forward.

It has been assumed that no client review and approval process is required, although Vital will share information with NR via email. No platform is planned to store documents and their statuses, currently Vital Energi maintain document registers which track the documents status

21. APPENDIX A – Mechanical Design Documentation

Appendix Register
50902-VE-PS-XX-DR-M-5601 P1 - Existing Boiler Room Strip-Out GA
50902-VE-PS-XX-DR-M-5603 P2 - Proposed Undercroft GA
50902-VE-PS-XX-DR-M-5604 P2 - Undercroft Proposed Pipework Route GA
50902-VE-PS-XX-DR-M-5605 P2 - Proposed Boiler Room GA
50902-VE-PS-XX-SC-M-5601 P1 - Existing Boiler Room Strip-Out P&ID
50902-VE-PS-XX-SC-M-5602 P1 - Proposed Boiler Room P&ID
50902-VE-PS-XX-SC-M-5603 P1 - Proposed Undercroft P&ID
50902-VE-SW-XX-SH-M-5601 P1 - Piccadilly Station - Equipment & Valve Schedule
Relevant Existing Information.
<i>Railtrack / Liang / Bailey Rail - Piccadilly Station MR08350 – Site Wide Heating and Cooling Distribution Schematic”– Dated Aug 2002</i>

22. APPENDIX B – Electrical Design Documentation

Appendix Register
50902-VE-PS-00-DR-E-5001 P4 - Piccadilly Station Electrical Equipment Layout
50902-VE-PS-00-DR-E-6101 P1 - Piccadilly Station Containment Layout
50902-VE-PS-00-DR-E-6102 P1 - Piccadilly Station Site Wide Containment Layout
50902-VE-PS-00-DR-E-6201 P1 - Piccadilly Station Small Power Layout
50902-VE-PS-00-DR-E-6202 P1 - Piccadilly HV RMU / Transformer Layout
50902-VE-PS-00-DR-E-6203 P1 - Piccadilly Station Plantroom Small Power Layout
50902-VE-PS-00-DR-E-6301 P1 - Piccadilly Station Lighting Layout
50902-VE-PS-XX-SC-E-6001 P6 - Piccadilly Station HV & LV Single Line Diagram
50902-VE-PS-XX-SC-E-6801 P1 - Piccadilly Station Block Cable Diagram
50902-VE-PS-XX-SC-E-6802 P1 - Piccadilly Station System Architecture Diagram
50902-VE-PS-XX-SC-E-6803 P1 - Piccadilly Station Boiler Room Block Cable Diagram
50902-VE-PS-XX-SH-E-6201 P3 - Piccadilly Station Electrical Load Schedule
50902-VE-PS-XX-RP-E-6301 P1 - Piccadilly Station Dialux Lighting Report
50902-VE-SW-XX-SP-E-6201 P3 - Piccadilly Station Close Coupled RMU, Transformer & LV Switchboard Specification
50902-VE-PS-XX-SC-E-6801 P1 - Piccadilly Station Undercroft Area Block Cable Diagram
50902-VE-PS-XX-SC-E-6802 P1 - Piccadilly Station System Architecture Diagram
50902-VE-PS-XX-SC-E-6803 P1 - Piccadilly Station Boiler Room Block Cable Diagram
50902-VE-PS-XX-SH-E-6801 P1 - Piccadilly Station Undercroft Area BMS Requirements Document
50902-VE-PS-XX-SH-E-6802 P1 - Piccadilly Station Boiler Room BMS Requirements Document

23.APPENDIX C – Acoustic Design Documentation

Appendix Register
14806.RP01.PNA.0.01122025.JMM – Manchester Piccadilly Station – Plant Noise Assessment

24. APPENDIX D – General Information

Appendix Register
50902 - Vital Energi Stage 3 Risk Register

25.APPENDIX E – Cold Plume Assessment Documentation

Appendix Register
10073r1 - Cold Plume Assessment - Manchester Piccadilly Station

26.APPENDIX F –DSEAR Assessment Documentation

Appendix Register
Gexcon-25-100940-RA1-Rev00 - Manchester Piccadilly Station Heat Pump DSEAR Assessment



MANCHESTER PICCADILLY STATION

Plant Noise Assessment

Reference: 14806.RP01.PNA.0

Prepared: 1 December 2025

Revision Number: 0

VITAL Energi
Century House
Roman Road
Blackburn
BB1 2LD

Plant Noise Assessment



MANCHESTER PICCADILLY STATION

Reference: 14806.RP01.PNA.0

Prepared: 1 December 2025

Revision	Comment	Date	Prepared By	Approved By
0	First issue of report	1 December 2025	James Melville	Andrew Heath

Terms of contract:

RBA Acoustics Ltd have prepared this report in accordance with our Scope of Work. RBA Acoustics Ltd shall not be responsible for any use of the report or its contents for any purpose other than that for which it was provided. Should the Client require the distribution of the report to other parties for information, the full report should be copied. No professional liability or warranty shall be extended to other parties by RBA Acoustics Ltd without written agreement from RBA Acoustics Ltd.

The recommendations within this report relate to acoustics performance only and will need to be integrated within the overall design by the lead designer to incorporate all other design disciplines such as fire, structural integrity, setting-out, etc. Similarly, any sketches appended to this report illustrate acoustic principles only and will need to be developed into full working drawings by the lead designer to incorporate all other design disciplines.



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APPENDIX B - INSTRUMENTATION

APPENDIX C - PLANT CALCULATIONS

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APPENDIX E - GRAPHS AND SITE PLANS

1. INTRODUCTION

It is proposed to locate new items of plant at Manchester Picadilly Station. As part of the planning application, Manchester City Council requires consideration be given to atmospheric noise emissions from the proposed equipment to the nearest noise-sensitive receptors.

RBA Acoustics have been commissioned to undertake measurements of the prevailing noise conditions at the site and to determine the atmospheric noise emission limits in accordance with Manchester City Council's requirements. This report presents the results of the noise measurements, associated criteria and provides the required assessment.

2. SITE DESCRIPTION

The site is shown in relation to its surroundings in the site plan in Figure 1 (Appendix E).

The proposed development site is a currently an unused compound located underneath Manchester Picadilly Station. To the north of the site is a multi-storey carpark and beyond that residential apartments associated with Home Apartments. To the southeast and west of the site is Manchester Picadilly Station and its associated sprawl.

3. ENVIRONMENTAL NOISE SURVEY

3.1 Survey Methodology

Monitoring of the prevailing background noise was undertaken over the following period:

- 09:30 19th November to 09:00 20th November 2025

As the survey was unattended it is not possible to comment with certainty regarding meteorological conditions throughout the entire survey period. However, based on observations during the site visits and weather reports for the area, conditions were generally considered suitable for obtaining representative noise measurements, being predominantly dry with little wind.

Measurements were made of the L_{A90} , L_{Amax} and L_{Aeq} noise levels over 15-minute sample periods. A summary of acoustic terminology is included in Appendix A.

3.2 Measurement Position

To determine the existing noise climate around the site measurements were undertaken at the following location:

- **Measurement Position 1 – Sheffield Street**

The microphone was attached to tripod approximately 1.4m from the ground. The microphone position was along the boundary fence of the compound away from any reflective surfaces. The noise climate consisted of road traffic noise associated with the surrounding road network as well as tram noise from the nearby tramway.

The measurement position is also illustrated on the site plan attached in Figure 1 (Appendix E).

3.3 Instrumentation

For information regarding the equipment used for the measurements please refer to Appendix B.

The sound level meter was calibrated both prior to and on completion of the survey with no significant calibration drift observed.

3.4 Survey Noise Levels

The noise levels measured are shown as time-histories on the attached Graphs 1-2 (Appendix E).

Selection of an appropriately representative background sound level is discussed in BS 4142:2014 *Methods for Rating and Assessing Industrial and Commercial Sound* as follows:

“In practice, there is no “single” background sound level as this is a fluctuating parameter. However, the background sound level used for the assessment should be representative of the period being assessed.

[...] A representative level should account for the range of background sound levels and should not automatically be assumed to be either the minimum or modal value.”

The typical background L_{A90} and the period averaged L_{Aeq} noise levels measured are summarised in Table 1.

Table 1 - Measured Baseline Noise Levels

Measurement Period	Measurement Position 1 (MP1)	
	Typical Background Noise Level $L_{A90,15min}$ (dB)	Period-Averaged Noise Level $L_{Aeq,T}$ (dB)
Daytime (07:00 – 23:00)	48	62
Night-time (23:00 – 07:00)	41	58

4. PLANT NOISE CRITERIA

The requirements of Manchester City Council's Environmental Health Department regarding new building services plant are understood to be as follows.

"Externally mounted ancillary plant, equipment and servicing shall be selected and/or acoustically treated in accordance with a scheme designed so as to achieve a rating level of 5dB (LAeq) below the typical background (LA90) level at the nearest noise sensitive location"

In line with the above requirements we would propose items of mechanical services be designed so that noise emissions from the plant do not exceed the following levels when assessed at the nearest noise sensitive location:

Table 2 – Plant Noise Limits at NSR

Assessment Period	Plant Noise Criteria to be achieved at 1m outside the window of the nearest Noise-Sensitive Receptor (NSR), L_{Aeq} (dB)
Daytime (07:00 – 23:00)	43
Night-time (23:00 – 07:00)	36

It should be noted that the above requirements are applied at the nearest residential adjacencies and alternative criteria should be incorporated if there are also commercial properties affected by the proposed plant installations.

5. PLANT NOISE ASSESSMENT

This assessment has been based on the information provided to RBA by VITAL Energi, the project M&E Consultants and is described in the following sections.

5.1 Proposed Plant Items

The following plant is proposed for the scheme:

Table 3 – Proposed Plant Items

Ref.	Manufacturer/Model/Duty	Plant Type
ASHP1-5	A-THERM80 300.2	Air Source Heat Pump

5.2 Plant Locations

All air source heat pumps will be located in a currently unused undercroft compound under Manchester Piccadilly Station overlooking Sheffield Street. The equipment positions are indicated on the site plan in Figure 2 in Appendix E.

5.3 Plant Noise Levels

Information regarding the noise levels of the proposed plant has been provided by the manufacturer of the units. The associated plant noise levels are detailed as follows:

Table 4 – Plant Noise Levels

Unit	Parameter	dBA
A-THERM80 300.2	Lp @ 1m	81

5.4 Noise-Sensitive Receptor (NSR)

Based on observations made on site we understand the nearest noise-sensitive receptors to the proposed plant to be as follows:

- **NSR1 – Home Apartments 35, 37 & 39 Chapeltown Street**
The nearest noise sensitive receptor to the plant location is considered to be 1st Floor south east facing windows associated with Home Apartments 35, 37 & 39 Chapeltown Street.

The receptor is shown in the site plan in Figure 1 in Appendix E.

5.5 Predicted Noise Levels at NSR

Our calculation method for predicting noise levels from the proposed external plant at the nearest noise-sensitive receptors, based on the information above, is summarised below.

- Source Term SPL / SWL
- Distance Attenuation
- Directivity
- Reflections
- Screening

Calculation sheets are attached for further information in Appendix C.

The results of the calculations indicate the following noise levels at the nearest affected residential windows:

Table 5 – Predicted Plant Noise Levels

Operating Period	Noise Level (dB) at NSR1	
	Prediction	Criterion
Daytime (07:00 – 23:00)	44	43
Night-time (23:00 – 07:00)	44	36

Noise from the proposed plant installations are above the criteria required by Manchester City Council

We therefore recommend the following mitigation measures be included in the design and installation.

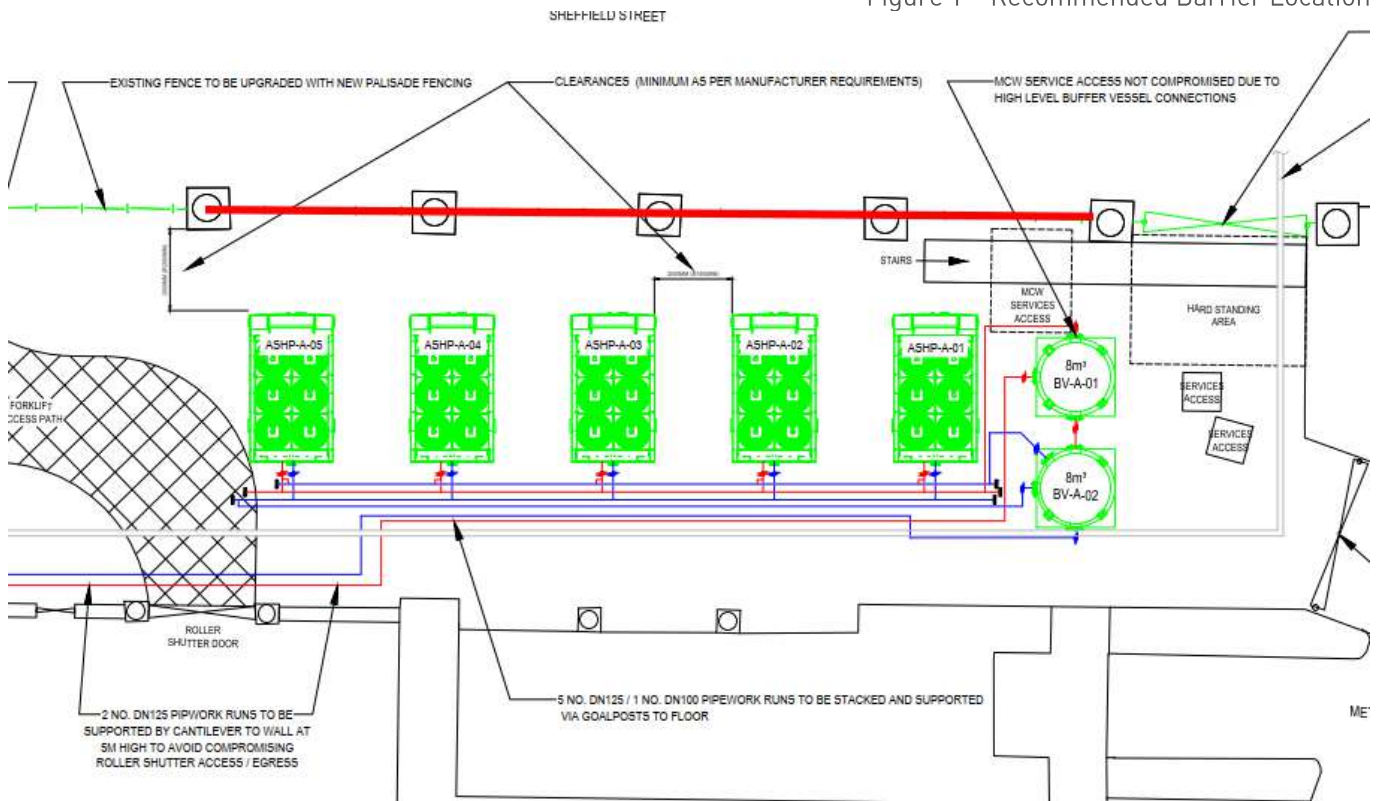
6. ACOUSTIC MITIGATION

There are two options that could be considered.

6.1 Option 1 – Solid Screen

Sufficient reductions would be achieved by a solid, impermeate barrier of 12kg/m² surface density, 3.5m in height, located along the compound boundary overlooking Sheffield Street as indicated in the below Figure 1.

Figure 1 – Recommended Barrier Location



With the above mitigation measures included, the resultant predicted noise levels are as follows:

Table 6 – Predicted Plant Noise Levels with Mitigation

Operating Period	Noise Level (dB) at NSR1	
	Prediction	Criterion
Daytime (07:00 – 23:00)	36	43
Night-time (23:00 – 07:00)	36	36

Noise from the proposed plant with the mitigation measures incorporated is within the Local Authority criteria.

6.2 Option 2 – Acoustic Enclosure

The Air Source Heat Pumps should be installed within an enclosure capable of achieving a minimum of 8dBA of attenuation.

With the above mitigation measures included, the resultant predicted noise levels are as follows:

Table 7 – Predicted Plant Noise Levels with Mitigation

Operating Period	Noise Level (dB) at NSR1	
	Prediction	Criterion
Daytime (07:00 – 23:00)	36	43
Night-time (23:00 – 07:00)	36	36

Noise from the proposed plant with the mitigation measures incorporated is within the Local Authority criteria.

7. VIBRATION CONTROL

In addition to the control of airborne noise transfer, it is also important to consider the transfer of noise as vibration to adjacent properties (as well as to any sensitive areas of the same building).

We would typically advise that ASHPs be isolated from the supporting structure by means of either steel spring isolators or rubber footings. For particularly sensitive locations, or when on lightweight structures the mounts should ideally be caged and be of the restrained type.

It is important the isolation is not “short-circuited” by associated pipework or conduits. To this end, any conduits should be looped and flexible connectors should be introduced between the condenser and any associated pipework. Pipework should be supported by brackets containing neoprene inserts.

8. CONCLUSION

RBA Acoustics have undertaken noise monitoring at Manchester Piccadilly Station. The measured noise levels are presented within this report. The resultant noise levels have been used to determine the required criteria for atmospheric noise emissions from the proposed plant installations.

The following options mitigation measures are proposed within this report:

- Solid barrier of 12kg/m² surface density, 3.5m in height, located along the compound boundary overlooking Sheffield Street
- OR
- An acoustic enclosure capable of achieving a minimum of 8dBA of attenuation

Provided the above mitigation measures are included in the design and installation, the results of the assessment indicate atmospheric noise emissions from the proposed plant are within the criteria required by Manchester City Council and, as such, can be considered acceptable in terms of noise.

Appendix A - Acoustic Terminology

A-weighting (e.g. dB(A))	A correction applied across the frequency bands to take into account the response of the human ear, and therefore considered to be more representative of the sound levels people hear.
DeciBel (dB)	Unit used for many different acoustic parameters. It is the logarithmic ratio of the level being assessed to a standard reference level.
L_{eq}	The level of a notional steady sound which, over a stated period of time, T , would have the same acoustic energy as the fluctuating noise measured over that period. Typically used to represent the average or ambient noise level.
$L_{Aeq,T}$	The A-weighted level of a notional steady sound which, over a stated period of time, T , would have the same acoustic energy as the fluctuating noise measured over that period. Typically used to represent the average or ambient noise level.
L_{An} (e.g. L_{A10} , L_{A90})	The sound level exceeded for n% of the time. E.g. L_{A10} is the A-weighted level exceeded for 10% of the time and as such can be used to represent a typical maximum level. Similarly, L_{A90} is the level exceeded for 90% of the measurement period, and is often used to describe the underlying background noise.
NR	Noise Rating – A single figure term to describe a measured noise level which considers the frequency content of the noise, generally used for internal noise level measurements (particularly mechanical services plant).

Appendix B - Instrumentation

The following equipment was used for the acoustic measurements.

Table B1 - Equipment Calibration Details				
Manufacturer	Model Type	Serial No.	Calibration	
			Certificate No.	Valid Until
Norsonic Type 1 Sound Level Meter	Nor140	1406969	UCRT25/2391	1 October 2027
Norsonic Pre Amplifier	1209	21204		
Norsonic ½" Microphone	1225	285599		
Norsonic Sound Calibrator	1251	34966	UCRT25/2381	1 October 2027

Appendix C - Plant Calculations

Table C1 - Example Calculation – ASHP1

Parameter	dBA
L_w	83
Screening	-5
Distance losses @ 113m	-41
Noise level at receiver	34

Appendix D - CDM Considerations

The Likelihood (L) the harm will occur can be assessed by applying an indicative score (from 1 to 5) as follows:

- 1 – Remote (almost never)
- 2 – Unlikely (occurs rarely)
- 3 – Possible (could occur, but uncommon)
- 4 – Likely (recurrent but not frequent)
- 5 – Very likely (occurs frequently)

The Severity of harm (S) can be assessed by applying an indicative score (from 1 to 5) as follows:

- 1 – Trivial (e.g. discomfort, slight bruising, self-help recovery)
- 2 – Minor (e.g. small cut, abrasion, basic first aid need)
- 3 – Moderate (e.g. strain, sprain, incapacitation for more than 3 days)
- 4 – Serious (e.g. fracture, hospitalisation for more than 24 hours, incapacitation for more than 4 weeks)
- 5 – Fatal (single or multiple)

The rating value is obtained by multiplying the two scores and is then used to determine the course of action.

Table D1- Risk Ratings

Rating Bands (Likelihood x Severity)		
Low Risk (1 – 8)	Medium Risk (9 -12)	High Risk (15 – 25)
May be ignored but ensure controls remain effective	Continue, but implement additional reasonable practicable controls where possible	Avoidance action is required; therefore alternative design solutions must be examined. Activity must not proceed until risks are reduced to a low or medium level

The following hazards pertinent to our design input have been identified and control measures suggested:

Table D2 – Risk Assessment

Hazard	Risk Of	At Risk	Rating			Control Measures	Controlled		
			L	S	R		L	S	R
Vibration Isolators	Injury to hands	Contractors	3	3	9	Care needs to be taken during adjustment. Follow manufacturers guidance	1	3	3

L: Likelihood S: Severity R: Rating

Appendix E - Graphs and Site Plans

Manchester Piccadilly Station

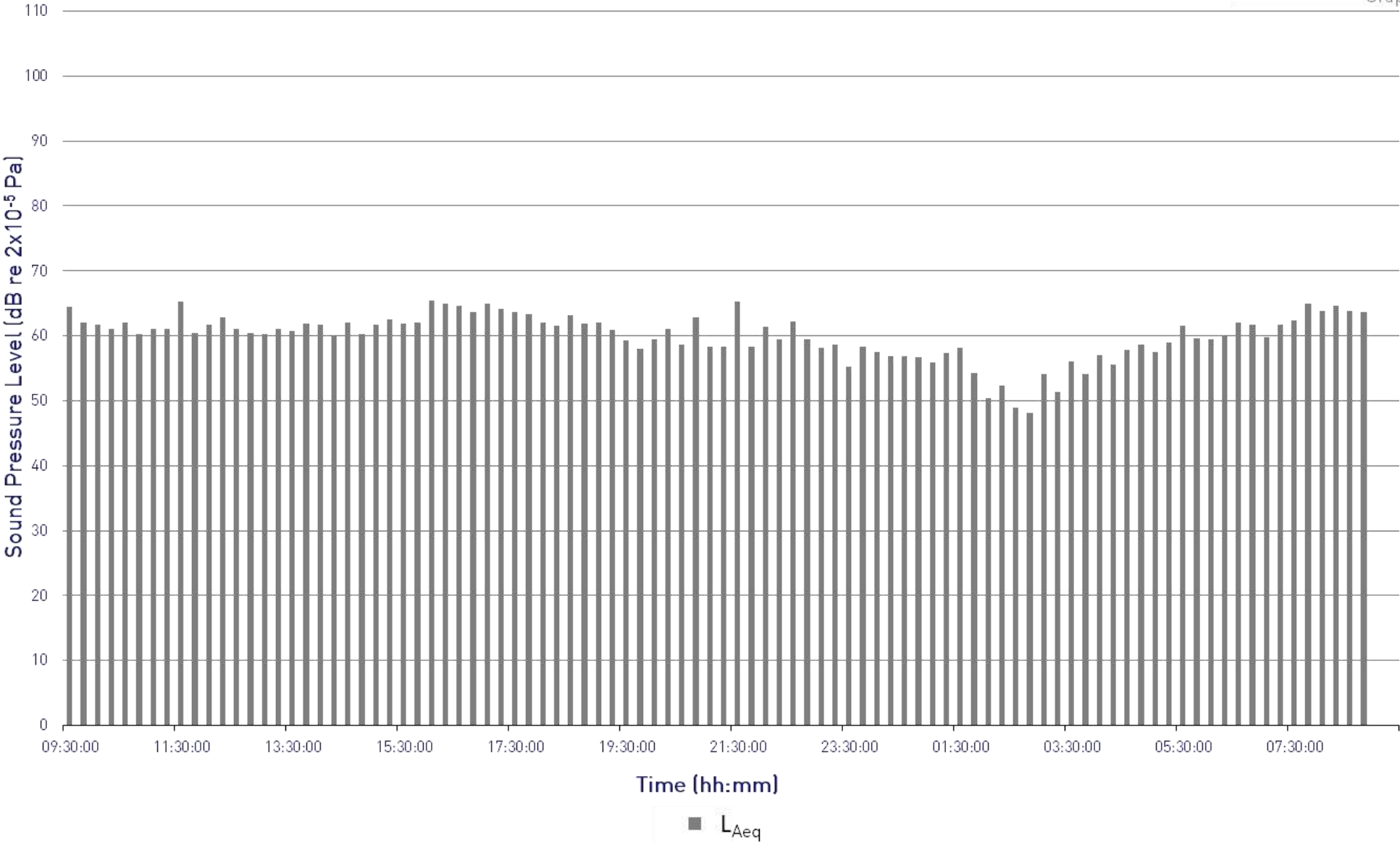
L_{Aeq} Time History

Measurement Position 1



Project: 14806

Graph 1



Manchester Piccadilly Station

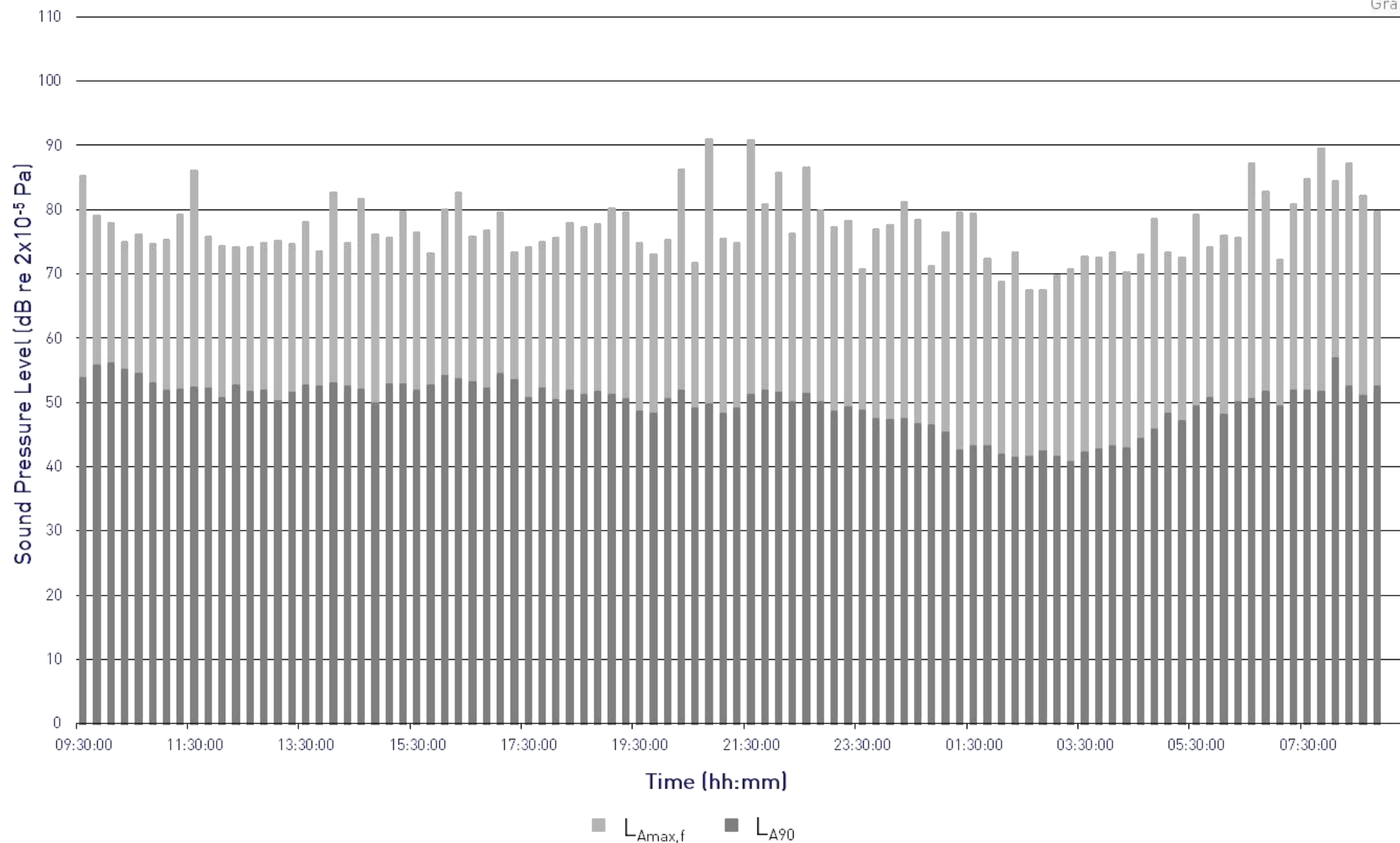
$L_{Amax,f}$ and L_{A90} Time History

Measurement Position 1



Project: 14806

Graph 2



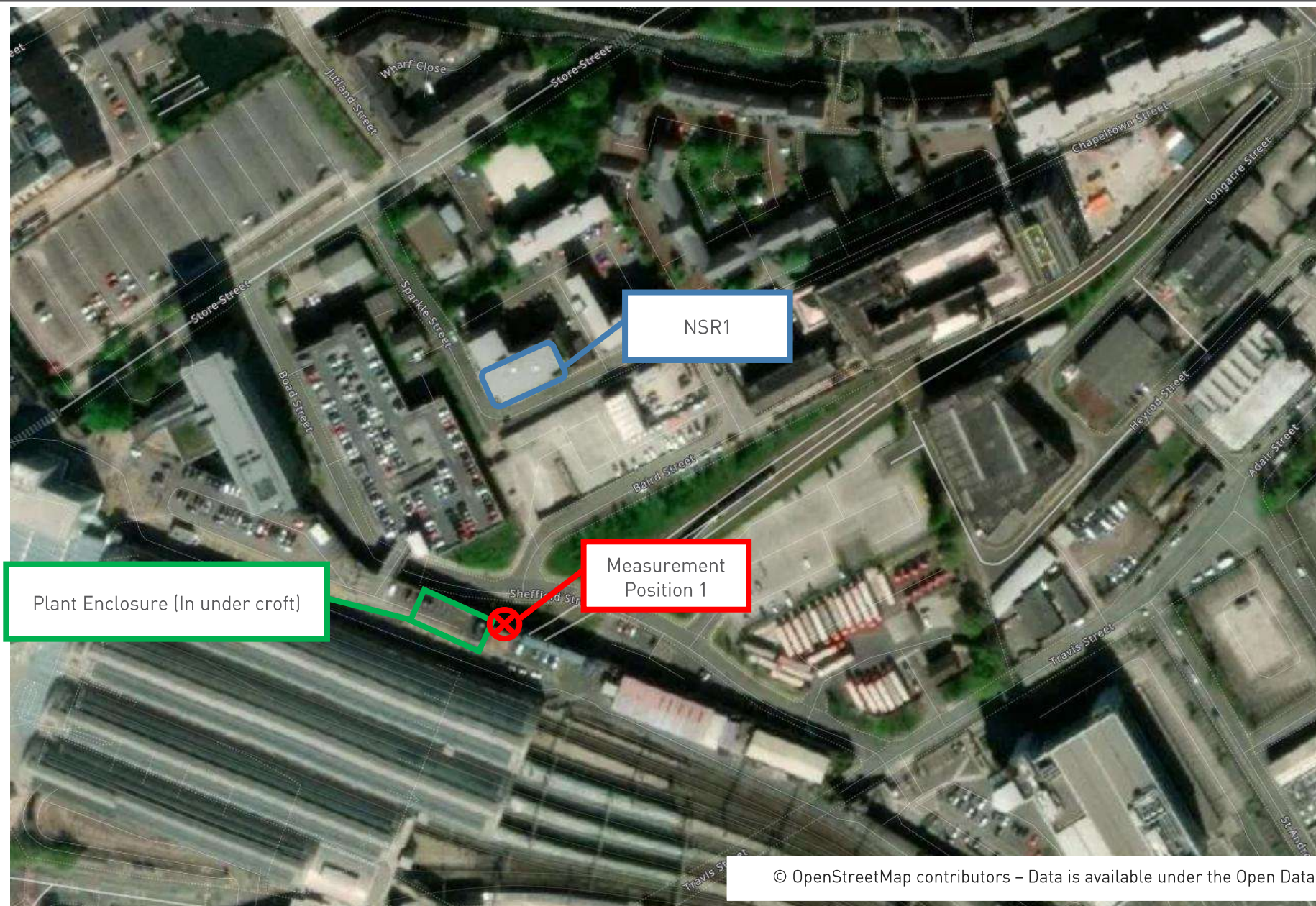


Figure 1 – Site Layout

Manchester Piccadilly Station

Project 14806

1 December 2025

Not to Scale



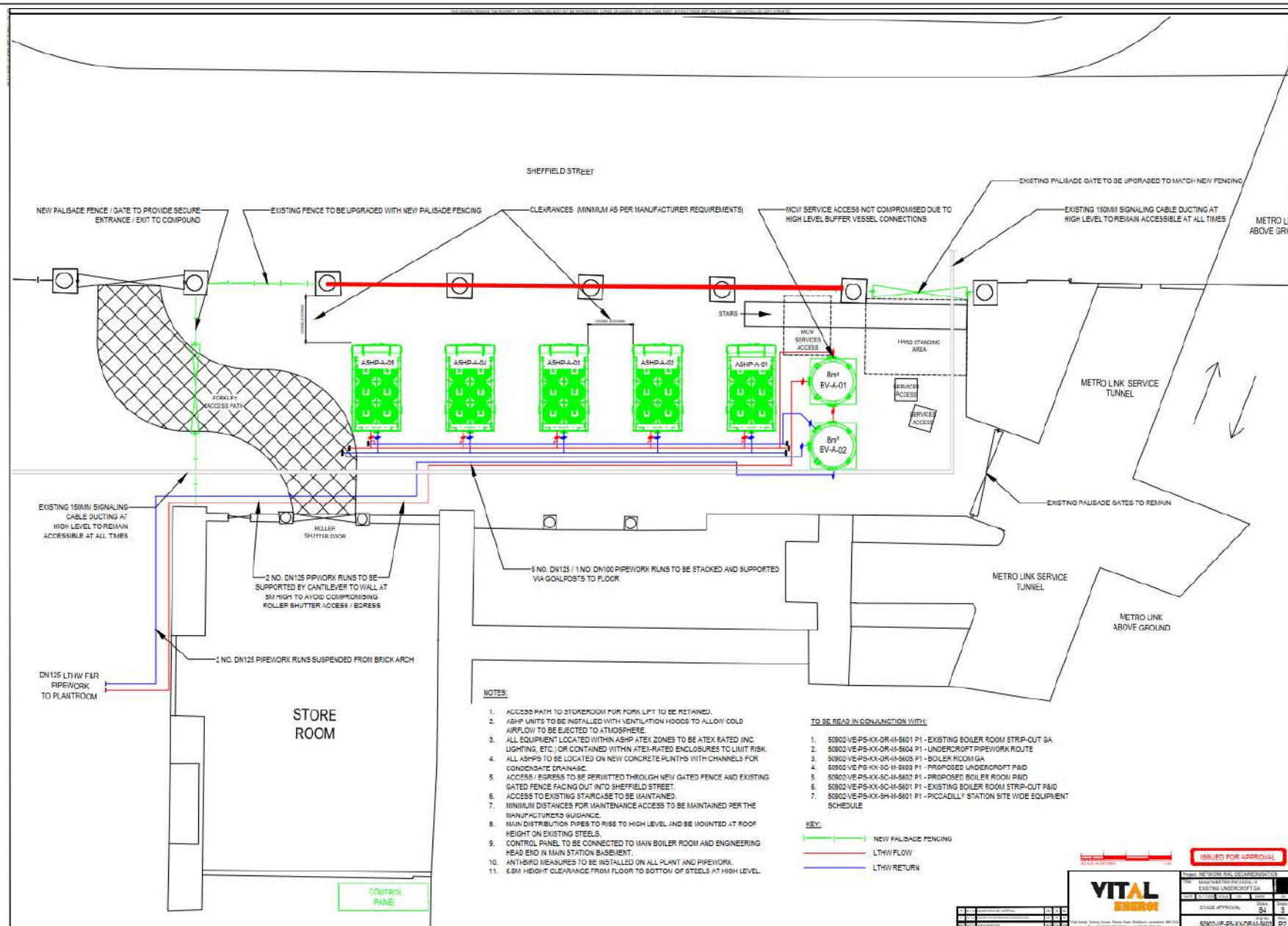


Figure 2 – Plant Layout

Manchester Piccadilly Station

Project 14806

1 December 2025

Not to Scale

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Cold Plume Assessment
Manchester Piccadilly Station

Client: Vital Energi Utilities Limited

Reference: 10073r1

Date: 25th November 2025



Report Issue

Report Title: Cold Plume Assessment - Manchester Piccadilly Station

Report Reference: 10073

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	1	2	3	4
Prepared by	Emily Pears-Ryding			
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This report has been prepared by Redmore Environmental Ltd in accordance with the agreed terms and conditions of appointment. Redmore Environmental Ltd cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.

Executive Summary

Redmore Environmental Ltd was commissioned by Vital Energi Utilities Limited to undertake a Cold Plume Assessment in support of a proposed Air Source Heat Pump system at Manchester Piccadilly Station.

Air released from the plant is 1.3°C colder than the ambient air at the point of emission. As such, there is concern regarding the impact of the cold plume on receptors within the vicinity of the site. A Cold Plume Assessment was therefore undertaken to quantify changes in temperature levels at sensitive locations and provide consideration of any variations in the context of ambient conditions.

Dispersion modelling was undertaken in order to quantify changes in temperature levels at receptors in the vicinity of the site. This utilised information on likely releases to represent cold plume behaviour within the atmosphere.

The results indicated the cold plume has the potential to lower temperatures at sensitive locations by up to 1.73°C. As the largest reductions resulted in temperature levels similar to existing ambient conditions and the magnitude of change was relatively small, effects were not considered to be significant.

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1.0 INTRODUCTION

1.1 Background

1.1.1 Redmore Environmental Ltd was commissioned by Vital Energi Utilities Limited to undertake a Cold Plume Assessment in support of a proposed Air Source Heat Pump (ASHP) system at Manchester Piccadilly Station.

1.1.2 Air released from the plant is 1.3°C colder than the ambient air at the point of emission. As such, there is concern regarding the impact of the cold air on receptors within the vicinity of the site. A Cold Plume Assessment was therefore undertaken to quantify changes in temperature levels at sensitive locations and provide consideration of any variations in the context of ambient conditions.

1.2 Site Location and Context

1.2.1 The site is located at Manchester Piccadilly Station, at National Grid Reference (NGR): 384924, 397880. Reference should be made to Figure 1 for a map of the site and surrounding area.

1.2.2 It is proposed to construct and operate five ASHPs each containing six fans. Cold air will be released via 30 fans venting horizontally onto Sheffield Street, adjacent to the site.

1.2.3 Air released from the plant is approximately 1.3°C colder than the ambient air at the point of emission. As such, there is concern regarding the impact of the cold plume on receptors within the vicinity of the site. A Cold Plume Assessment was therefore undertaken to quantify changes in temperature levels at sensitive locations and provide consideration of any variations in the context of ambient conditions. The results are provided in the following report.

2.0 METHODOLOGY

2.1 Introduction

- 2.1.1 Cold air released from the five ASHPs has the potential to reduce temperature levels at sensitive receptors. These have been quantified through dispersion modelling in accordance with the methodology outlined in the following Sections.

2.2 Dispersion Model

- 2.2.1 Dispersion modelling was undertaken using ADMS-6 (v6.0.2.5), which is developed by Cambridge Environmental Research Consultants (CERC) Ltd. ADMS-6 is a short-range dispersion modelling software package that simulates a wide range of buoyant and passive releases to atmosphere. It is a new generation model utilising boundary layer height and Monin-Obukhov length to describe the atmospheric boundary layer and a skewed Gaussian concentration distribution to calculate dispersion under convective conditions.
- 2.2.2 The model utilises hourly meteorological data to define conditions for plume, transport and diffusion. It estimates conditions for each source and receptor combination for each hour of input meteorology and calculates the predicted temperature at a specific position within the assessment domain over long and short-term periods.
- 2.2.3 It should be noted that predicted temperature output can only be calculated for one point source in ADMS-6. As such, the five ASHPs were modelled as a combined point source to allow suitable outputs to be generated and represent the maximum plume affected temperature reductions.

2.3 Modelling Scenarios

- 2.3.1 The plume affected temperature change was predicted at various heights for every hour of meteorological data considered in the assessment. Temperature reductions were subsequently determined by comparing the model output with ambient levels.

2.4 Sensitive Receptors

2.4.1 A desk-top study was undertaken in order to identify any sensitive receptor locations in the vicinity of the plant that required specific consideration during the assessment. These are summarised in Table 1. It should be noted that locations were modelled at multiple heights in order to reflect receptors on different building floors.

Table 1 Sensitive Receptor Locations

Receptor		Distance from ASHP (m)	Modelled Heights Above Ground Level (m)
R1	Sheffield Street	36.0	1.5, 9.4
R2	Sheffield Street	5.9	1.5, 9.4
R3	Station Car Park	20.1	1.5, 3.0, 6.1, 9.0, 11.9
R4	Station Car Park	27.5	1.5, 3.0, 6.1, 9.0, 11.9
R5	Sheffield Street	30.4	1.5, 9.4
R6	Ofsted	60.6	1.5, 4.7, 12.4, 18.5, 24.6, 30.7

2.4.2 Reference should be made to Figure 2 for a graphical representation of the sensitive receptor locations.

2.5 Process Conditions

2.5.1 A summary of the inputs used in the assessment is provided in Table 2. It should be noted that cold air released from each ASHP will be exhausted via six fans. The five ASHPs were represented by one point source in the model. As such, the values presented below are the total from all units.

Table 2 Process Conditions

Parameter	Unit	ASHP
Source height	m	2.28
Source diameter	m	50 ^(a)
Exhaust air temperature	°C	1.3 below ambient

Parameter	Unit	ASHP
Exhaust air flow rate	m ³ /s	197.3
Exhaust air flow rate (per fan)	m ³ /s	6.57
Exhaust air efflux velocity	m/s	0.1 ^(b)

Note: (a) Effective diameter reflective of the combined surface area of 30 fans.

(b) Efflux velocity modelled at 0.1m/s to represent horizontal release.

2.5.2 Reference should be made to Figure 2 for a map of the source location.

2.6 Building Effects

2.6.1 Analysis of the site location indicated several structures should be included within the model in order to take account of building effects on dispersion. Input geometries are shown in Table 3.

Table 3 Building Geometries

Building	NGR (m)		Height (m)	Length (m)	Width (m)	Angle (°)
	X	Y				
Station Car Park east	384922.4	397956.5	15.5	32.6	102.1	243.8
Station Car Park west	384898.1	397951.9	15.5	13.9	87.4	243.8
Network Rail Car Park	384941.8	397868.0	9.4	318.0	24.5	111.1
Network Rail Car Park	384846.4	397924.4	9.4	99.3	11.7	111.4
National Highways	384830.2	397957.3	38.9	27.4	24.6	244.7
Ofsted	384853.1	397962.7	38.9	19.3	68.7	244.7

2.6.2 Reference should be made to Figure 2 for a graphical representation of the building locations.

2.7 Meteorological Data

2.7.1 Meteorological data used in the assessment was taken from Manchester Airport meteorological station over the period 1st January 2022 to 31st December 2024 (inclusive). This observation station is located at NGR: 381792, 384116, which is approximately 14.1km

south-west of the site. It is anticipated that conditions would be reasonably similar over a distance of this magnitude. The data was therefore considered suitable for an assessment of this nature.

- 2.7.2 All meteorological files used in the assessment were provided by Atmospheric Dispersion Modelling Ltd, which is an established distributor of data within the UK.

2.8 Roughness Length

- 2.8.1 Roughness length (z_0) is a modelling parameter applied to allow consideration of surface height roughness elements. A z_0 of 1m was used within the model to describe the modelling extents. This value is considered appropriate for the morphology of the area and is suggested within ADMS-6 as being suitable for 'cities, woodland'.

- 2.8.2 A z_0 of 0.2m was used within the model to describe the meteorological site. This value is considered appropriate for the morphology of the area and is suggested within ADMS-6 as being suitable for 'agricultural areas (min)'.

2.9 Monin-Obukhov Length

- 2.9.1 The Monin-Obukhov length provides a measure of the stability of the atmosphere. A minimum Monin-Obukhov length of 30m was used within the model to describe both the modelling extents and meteorological site. This value is considered appropriate for the nature of both areas and is suggested within ADMS-6 as being suitable for 'cities and large towns'.

3.0 **ASSESSMENT**

3.1 **Introduction**

3.1.1 Dispersion modelling was undertaken with the inputs described in Section 2.0. The results are summarised in the following Sections.

3.2 **Results**

3.2.1 The maximum plume affected temperature reductions at sensitive receptors are shown in Table 4.

Table 4 Maximum Predicted Temperature Reductions

Receptor		Height (m)	Maximum Predicted Temperature Reduction (°C)		
			2022	2023	2024
R1	Sheffield Street	1.5	1.32	1.32	1.33
		9.4	0.01	0.01	0.01
R2	Sheffield Street	1.5	1.33	1.33	1.33
		9.4	0.00	0.00	0.00
R3	Station Car Park	1.5	1.33	1.33	1.32
		3.0	1.36	1.36	1.36
		6.1	1.58	1.58	1.58
		9.0	1.73	1.73	1.73
		11.9	0.00	0.00	0.00
R4	Station Car Park	1.5	1.32	1.33	1.33
		3.0	1.36	1.36	1.36
		6.1	1.58	1.58	1.58
		9.0	1.73	1.73	1.73
		11.9	0.00	0.00	0.00
R5	Sheffield Street	1.5	1.32	1.33	1.33

Receptor		Height (m)	Maximum Predicted Temperature Reduction (°C)		
			2022	2023	2024
		9.4	0.03	0.02	0.03
R6	Ofsted	1.5	1.32	1.33	1.32
		4.7	1.49	1.49	1.49
		12.4	0.00	0.00	0.01
		18.5	0.00	0.00	0.00
		24.6	0.00	0.00	0.00
		30.7	0.00	0.00	0.00

3.2.2 The meteorological data was reviewed in order to identify the atmospheric conditions that resulted in the largest temperature reductions at receptors. As shown in Table 4, this was predicted at a height of 9.0m. The results are summarised in Table 5.

Table 5 Atmospheric Conditions Resulting in the Largest Temperature Reductions

Year	Maximum Temperature Reduction (°C)	Ambient Temperature (°C)	Wind Speed (m/s)	Wind Direction (°)	Cloud Cover (Oktas)
2022	1.73	5	2.6	320	0
2023	1.73	5	2.6	160	0
2024	1.73	5	2.6	220	0

3.2.3 A review of the results indicated the following:

- The maximum plume affected temperature reduction at sensitive receptors ranged between 0.00°C and 1.73°C;
- The magnitude of change was greatest at R3 and R4 at a height of 9.0m. Temperatures quickly return to near ambient above this height, which would be expected given the building complexities in the immediate vicinity of the fans;
- The results for each year of meteorological data were similar; and,
- Relatively low wind speeds resulted in the largest temperature reductions. This is likely to result in higher impacts due to less mixing of the plume in the atmosphere.

3.2.4 It should be noted that the minimum and maximum ambient temperature recorded at Manchester Airport meteorological station for the utilised data sets of 2022 to 2024 was -10°C and 37°C, respectively. Similar conditions would be expected at the site. As shown in Table 5, maximum impacts occurred at an atmospheric temperature of 5°C, which are well within the ambient temperature range. As such, the operation of the plant is unlikely to lower temperatures at receptors to levels below those not already experienced at their respective locations. The presented temperature changes are also the maximum at each receptor from all data points in the meteorological file. As such, at all other times the temperature change would be lower than those shown in Table 4.

3.3 Influence of Assessment Approach on Findings

3.3.1 A number of assumptions were adopted during the completion of the assessment. These ensured worst case results for the following reasons:

- The modelling assumed the plant operates at full capacity throughout an entire year. However, the temperature reduction caused by the plume would be less than modelled during periods of reduced load. The maximum predicted temperature changes are therefore worst-case; and,
- The largest temperature reduction of 1.73°C was produced from one hour of meteorological data, within a total of 26,183 records. The change during all other conditions would be less. The presented results are therefore worst-case.

3.3.2 Based on the above factors, actual changes in temperature at sensitive receptors are likely to be lower than those predicted for the majority of the time.

3.4 Summary

3.4.1 The results indicated the cold plume has the potential to lower temperatures at sensitive locations by up to 1.73°C. The change during all other meteorological conditions would be less. As the largest reductions resulted in temperature levels similar to ambient conditions experienced by receptors and the magnitude of change was relatively small, effects are not considered to be significant.

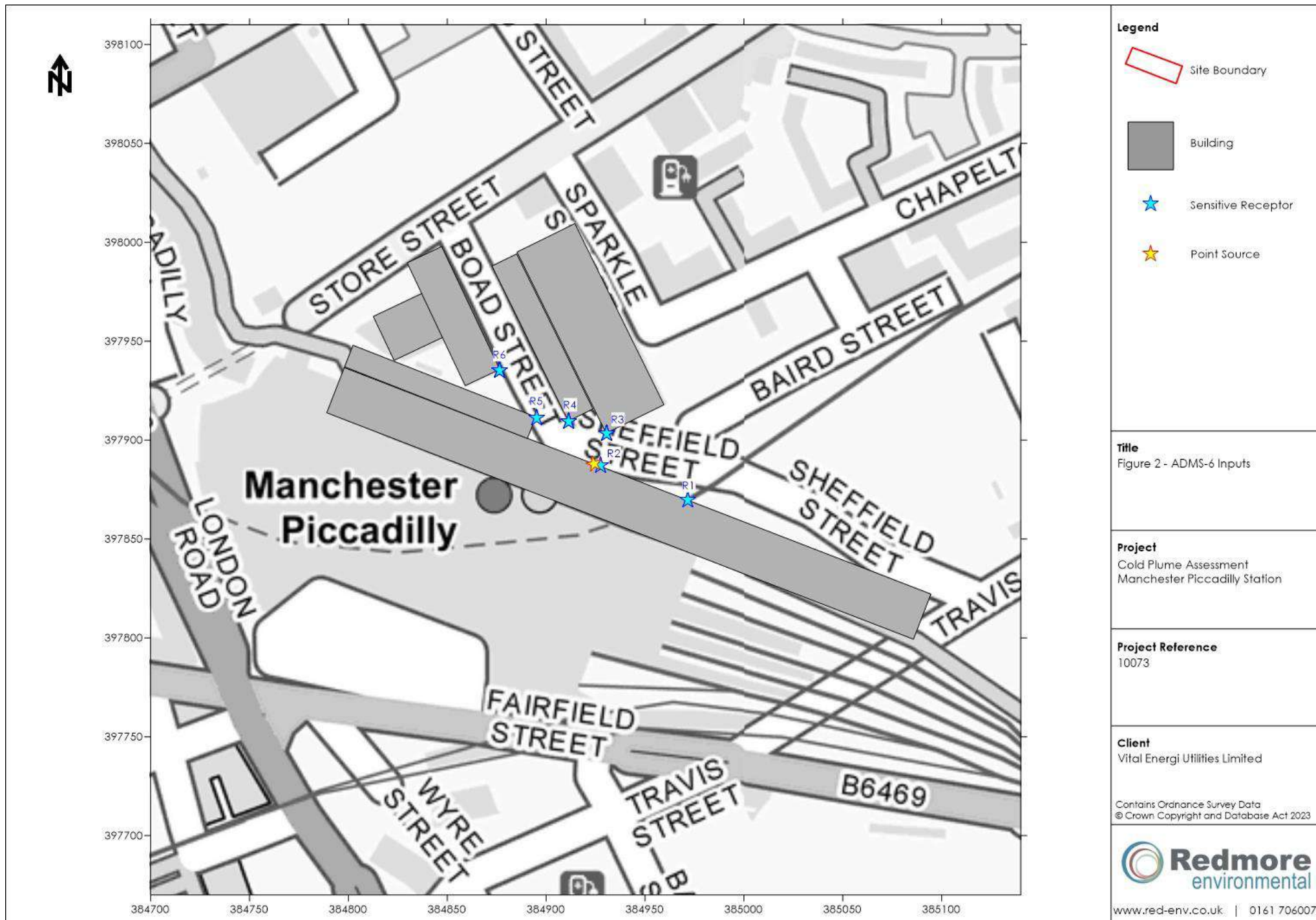
4.0 SUMMARY AND CONCLUSION

- 4.1.1 Redmore Environmental Ltd was commissioned by Vital Energi Utilities Limited to undertake a Cold Plume Assessment in support of a proposed ASHP system at Manchester Piccadilly Station.
- 4.1.2 Air released from the plant is 1.3°C colder than ambient at the point of emission. As such, there is concern regarding the impact of the cold plume on receptors within the vicinity of the site. A Cold Plume Assessment was therefore undertaken to quantify changes in temperature levels at sensitive locations and provide consideration of any variations in the context of ambient conditions.
- 4.1.3 Dispersion modelling was undertaken using ADMS-6 in order to quantify changes in temperature levels at receptors in the vicinity of the site. This utilised information on likely releases to represent cold plume behaviour within the atmosphere.
- 4.1.4 The results indicated the cold plume has the potential to lower temperatures at sensitive locations by up to 1.73°C. The change during all other conditions would be less. As the largest reductions resulted in temperature levels similar to ambient conditions experienced by receptors and the magnitude of change was relatively small, effects are not considered to be significant.

5.0 **ABBREVIATIONS**

ASHP	Air Source Heat Pump
CERC	Cambridge Environmental Research Consultants
NGR	National Grid Reference
Z ₀	Roughness length

Figures



Manchester Piccadilly Station Heat Pump DSEAR Assessment

DSEAR Assessment Report

Vital Energi

Manchester, United Kingdom

Client Contact	Callum Shaw
Project No.	100940
Revision	00
Date of Issue	25/11/2025
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DSEAR ASSESSMENT REPORT

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Revision History

Rev.	Date	Author	Checker	Approver	Notes
00	25/11/2025	Louise Rennard	Siddharth Dwivedi	Louise Black	First issue to client

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1 Assessment Overview

Gexcon UK Ltd (Gexcon) were contracted by Vital Energi to conduct a Hazardous Area Classification (HAC) and a risk assessment and to advise on suitable risk reduction measures in line with Regulation 7, Regulation 5 and Regulation 6, respectively, of the Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) for the heat pumps to be installed in the undercroft below a car park located in Manchester Piccadilly Station, United Kingdom.

This report details the key findings of the assessment for the heat pump installation based on the following equipment defined in the proposed scope of work:

- Heat Pump Installation including 6x Dethermina A-THERM80 Air Source Heat Pumps (ASHPs) utilising R-290 (propane)

2 Summary of Assessment

2.1 Summary of Risks Identified

The following table provides a summary of the risks identified during the assessment. A breakdown of each risk can be found in 'Appendix 1: Detailed Assessment' within this report. Full details of the risk calculation are provided in the methodology. Medium risks indicate that further risk reduction measures are required unless it can be demonstrated that the risks are As Low As Reasonably Practicable (ALARP). High risks indicate an unacceptable level of risk, immediate action must be taken to reduce these risks.

Table 1: Identified Risks

Grade	Risk Level	Description	Identified Risks
A	Very High	Intolerable - Risk reduction measures must be implemented immediately	0
B	High	Intolerable - Risk reduction measures must be implemented	0
C(Upper)	Medium (upper band)	Tolerable if ALARP – Further risk reduction must be considered, and all reasonably practicable measures implemented, risks in the upper band of tolerable if ALARP should be prioritised over those in the lower band.	0
C(Lower)	Medium (lower band)	Tolerable if ALARP – Further risk reduction must be considered, and all reasonably practicable measures implemented	2
D	Low	Broadly Acceptable – Further measures may be necessary to adhere to codes, standards and established good practice. Legal requirements must still be complied with.	0
E	Very Low	Broadly Acceptable – Further measures may be necessary to adhere to codes, standards and established good practice. Legal requirements must still be complied with.	2

2.2 Further Risk Reduction

Where a hazard has been identified, recommendations to support reducing the risk towards as low as reasonably practicable (ALARP) have been provided. These risk reduction measures are listed for each component in the report section 'Appendix 1: Detailed Assessment' and summarised in Section 2.4 below.

2.3 Hazardous Area Classification & Risk Assessment Summary

Area Name		Heat Pump Installation						
Equipment	Component	Zone Class	Zone Extent	Minimum ATEX Specification	Personnel Risk		Equipment Risk	
					Primary	Secondary	Primary	Secondary
Air-Source Heat Pumps	R290 Release - Flanges and Connections C010101	Zone 2 NE	Negligible extent [change secondary event to N/A]	N/A	E	N/A	E	N/A
Air-Source Heat Pumps	R290 Release - High Pressure Relief Valve C010102	Zone 1 + Zone 2	Zone 1: Extending 1m in all directions, forming a spherical area originating from the vent discharge point Zone 2: Extending from the PRV discharge point, horizontally in all directions for 1m and down to the ground as well as along the floor for 9 m in all directions.*	Zone 1: Ex II 2G IIA T2 Zone 2: Ex II 3G IIA T2	C(Lower)	N/A	C(Lower)	N/A

* This extent should be taken as indicative only, please see page 16 for HAC considerations

2.4 Recommendations Summary

Area Name		Heat Pump Installation			
Number	Equipment	Component	Hierarchy	Term	Recommendation
1	Air-Source Heat Pumps	R290 Release - Flanges and Connections C010101	Control of Release	SHOULD	It should be confirmed that the ASHP extraction ventilation exceeds the minimum requirements for high dilution (0.68 m/s - see Calculation 1).
2	Air-Source Heat Pumps	R290 Release - High Pressure Relief Valve C010102	Regulatory Compliance	SHOULD	The current arrangement for the PRV discharge significantly increases the risks associated with a release as it will result in a large low lying flammable cloud, where ignition sources are more likely to be present and there is potential for the release to enter the heat pump enclosures. The PRV must be rerouted to discharge vertically upwards to a safe unobstructed location away from personnel and ignition sources in order to safely dilute the release of flammable gas in accordance with EN 378-2:2016.
3	Air-Source Heat Pumps	R290 Release - High Pressure Relief Valve C010102	Good Practice Measure	SHOULD	The pressure relief valves should be routinely inspected and tested at suitable intervals in accordance with the manufacturer's guidance under a suitable Inspection and Maintenance Schedule.

Area Name			General Recommendations		
Number	Equipment	Component	Hierarchy	Term	Recommendation
4	-	-	Regulatory Compliance	MUST	The heat pump suppliers must demonstrate compliance with European Standard EN 378 (parts 1-4), i.e., by reference to the standard on the equipment's EU Declaration of Conformity (DoC), which is required for the CE marking. If the manufacturers/ suppliers cannot demonstrate this, consider performing a gap analysis.
5	-	-	Ignition Control	SHOULD	It should be verified that all ATEX equipment has been installed by a competent person (preferably part of a recognized accredited scheme, e.g. CompEx or IECEx) and in accordance with the manufacturer's instructions.
6	-	-	Ignition Control	SHOULD	An effective permit to work system should be used to control hot work, welding, etc.
7	-	-	Ignition Control	SHOULD	A specification for appropriate ATEX equipment to be located within hazardous zones should be provided to suppliers to ensure incorrect equipment is not installed in future. This applies to both non-electrical and electrical equipment.

Area Name				Additional Compliance Recommendations	
Number	Equipment	Component	Hierarchy	Term	Recommendation
8	-	-	Regulatory Compliance	MUST	ATEX equipment must be inspected and maintained in order to maintain its certification. A rolling inspection of equipment certified suitable for use within a hazardous zone should be compiled in accordance with EN 60079 Part 17 Inspection. Non-electrical equipment should be inspected and maintained in line with the manufacturer's instructions for safety, which should be provided in line with EN 80079-36.
9	-	-	Regulatory Compliance	MUST	A record of documentation demonstrating compliance with DSEAR must be kept and made available upon request of an enforcing officer, specifically the significant findings of the risk assessment listed in Regulation 5(4). An Explosion Protection Document (or equivalent document) is an effective way to demonstrate compliance.
10	-	-	Regulatory Compliance	MUST	Personnel must receive suitable and sufficient information, instruction and training in accordance with Regulation 9 of DSEAR.
11	-	-	Regulatory Compliance	MUST	The employer must ensure that appropriate work clothing which does not give rise to electrostatic discharges is provided for use in areas classified as hazardous in line with Regulation 7(5) of DSEAR.
12	-	-	Regulatory Compliance	MUST	All hazardous zones must be identified with Ex Signage in accordance with Regulation 7(3) of DSEAR.
13	-	-	Regulatory Compliance	MUST	Before a workplace containing hazardous areas is used for the first time, the overall explosion safety must be verified by a person competent in the field of explosion protection (as a result of experience, professional training, or both).
14	-	-	Regulatory Compliance	MUST	A periodic review of the DSEAR risk assessment must be scheduled in accordance with Regulation 5(3) of DSEAR.
15	-	-	Regulatory Compliance	MUST	There must be arrangements in place to deal with accidents, incidents and emergencies in accordance with the requirements of Regulation 8 of DSEAR.
16	-	-	Regulatory Compliance	MUST	The nature of the contents and any associated hazards of dangerous substances within containers and pipes must be clearly identifiable in line with Regulation 10 of DSEAR, if not already marked in accordance with the relevant legislation listed in Schedule 5 of DSEAR.
17	-	-	Regulatory Compliance	MUST	Where two or more employers share the same workplace where an explosive atmosphere may occur, the employer responsible for the workplace must co-ordinate the implementation of all the measures required by DSEAR to be taken to protect employees from the risk of the explosive atmosphere(s).

DSEAR ASSESSMENT REPORT

3 Appendix 1: Detailed Assessment

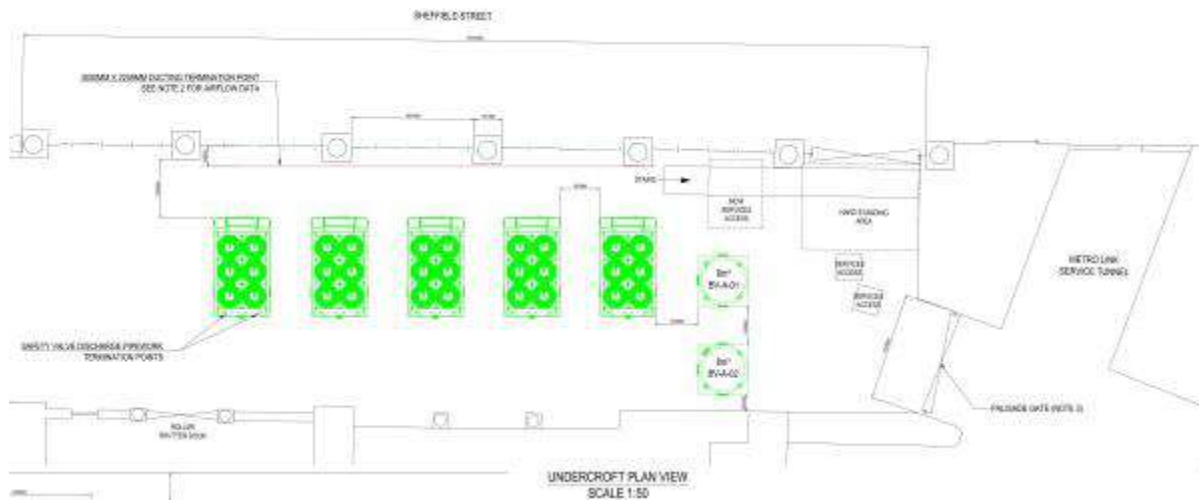
3.1 Summary of Material Properties

Hazardous Materials - Gases								
Material	Lower Explosion Limit	Upper Explosion Limit	Auto Ignition Temp.	Explosion Rate Constant	Flash Point	Maximum Explosion Pressure	Minimum Ignition Energy	Gas Group
	LEL %vol/vol	UEL %vol/vol	AIT degC	Kst bar m s-1	FP degC	Pmax barg	MIE mJ	-
R290 (propane)	2.2	9.5	468	-	gas	-	0.24	IIA
Compressor Oil	?	?	?	?	>200	?	?	?
Comments	Data obtained from the Installation & Operation Manual for the A-THERM80 unit and GESTIS							

3.2 Detailed Assessment Considerations

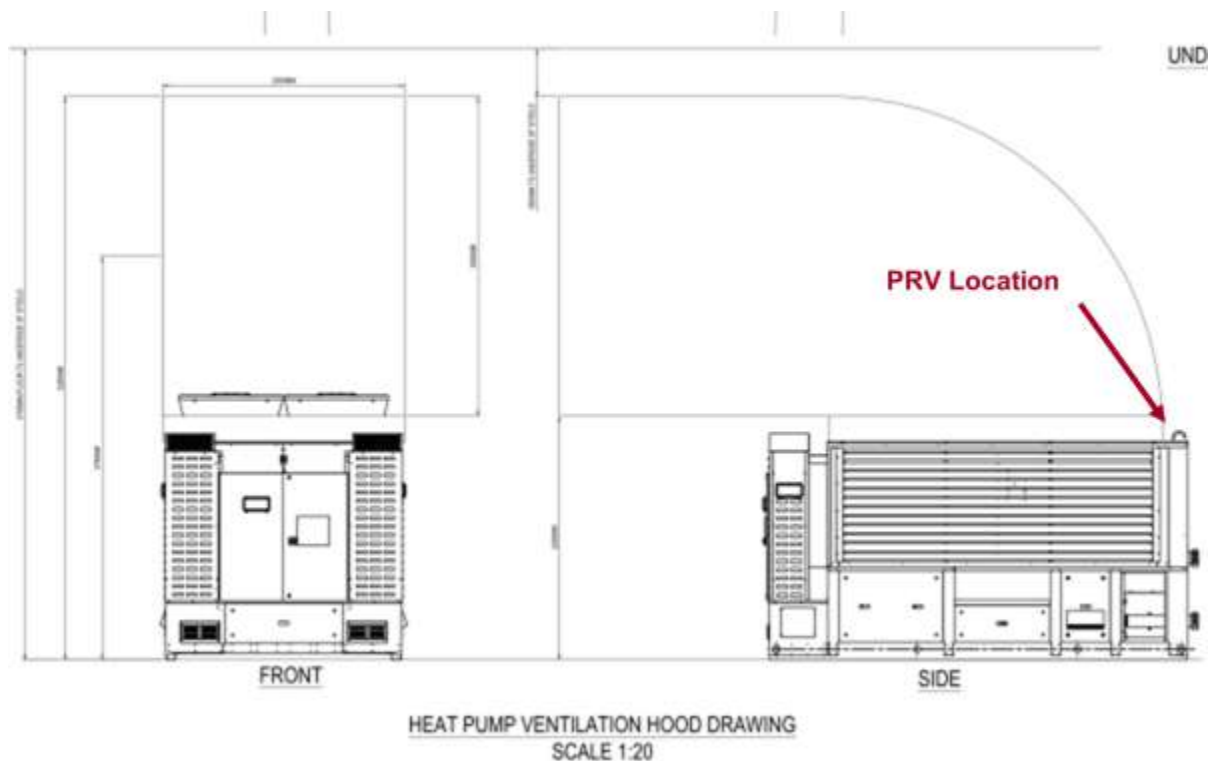
Area	Heat Pump Installation	Identifier	A01
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Area Description
The heat pump installation will be located in the undercroft of Manchester Piccadilly station. There will be 5x ASHP units located in the middle of the area and spaced 1,500 mm apart. The layout plan provided by Vital Energi detailed that ASHP airflow is to be diverted externally towards a pedestrianised street (Sheffield Street) via a diverter. The airflow provided will be approximately 130,750 - 142,100 m³/h depending on the external temperature. Within the undercroft, there will also be two 8m³ storage tanks of which the function is unknown at the time of the assessment. This installation is connected to the metro link service tunnel via a palisade security gate. The metro tunnel is said to provide ventilation into the rear of the ASHP units. Additional access into the heat pump installation area includes a set of stairs near the palisade security gate and a roller shutter door at the opposite end of the area. It is considered that personnel could be present within the installation area during normal operation



Equipment	Air-Source Heat Pumps	Identifier	E0101
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Equipment Description
<u>ASHPs</u> Each ASHP comprises of 3 sets of dual refrigerant circuits (i.e. 6 circuits per ASHP). The ASHPs are Dethermina A-THERM 80 300.2 heat pumps, each circuit containing 14 kg of R290 refrigerant (total inventory of 84 kg) with 1 semi hermetic reciprocating compressor with a compressor oil charge of 7 L each. The ASHPs use R290 as a refrigerant which is classified as a class A3 refrigerant: 'highly flammable low toxicity' according to EN 378-1 and ISO 817. The maximum operating pressure of the refrigerant on the compressor side is 36 barg. From this, an approximate maximum operating temperature has been obtained by using the ASHRAE handbook to give 87.5 °C. The heat pump and all associated equipment (i.e. sensor for leak monitoring equipment) are confined in an enclosure with dimensions 3,934 mm (w) x 2,110 mm (h) x 2,259 mm (d). These enclosures have louvres on longest adjacent walls which provide the enclosure with natural cross flow ventilation. Additionally, based on the notes in the equipment layout design, it has been assumed that the ASHP will be provided with mechanical ventilation which achieves airflow of approximately 130,750 - 142,100 m³/h. In the operational manual, the manufacturer has detailed various measures to reduce ignition likelihood in the event of a leak. This includes a refrigerant leak detector which is Category 2 ATEX rated and alarms at 10% of LEL. Additionally, the power supply to all utilities present in the unit is interrupted to avoid electrical sources of ignition. However, the ATEX fan continues extract the refrigerant within the compressor compartment. Both the gas detectors and ATEX-rated fans have a separate, dedicated power supply. The oil present in the compressor can be released at high pressure however in the event of a pressurised release of oil from the compressor such as a leak, the mist will coalesce upon contact with the inner walls of the enclosure, therefore, no hazardous areas have been considered for the release of compressor oils on the enclosure. <u>PRVs</u> The ASHPs will be equipped with two pressure relief valves (PRVs), the PRV on the low side and liquid receiver is a Castel 3061/2C model and the PRV on the compressor is a Castel 3065/4C model. The client confirmed the maximum design pressure rating of the unit is 40 barg, therefore, this has been assumed the lifting pressure of the compressor (high) PRV. There is only one discharge location, so it has been assumed the low and high PRVs discharge in the same location. This is on top of the unit, below the fans and facing downwards at a height of 2.332 m (i.e. the height of the ASHP, see figure below).



Hazardous Materials - Gases								
Material	LEL %vol/vol	UEL %vol/vol	AIT degC	Kg bar m s-1	FP degC	Pmax barg	MIE mJ	Gas Group
R290 (propane)	2.2	9.5	468	-	gas	-	0.24	IIA
Compressor Oil	?	?	?	?	>200	?	?	?
Comments	Data obtained from the Installation & Operation Manual for the A-THERM80 unit and GESTIS							

Component	R290 Release - Flanges and Connections	Identifier	C010101
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Hazardous Area Classification			
Zone Classification	Zone Extent	HAC Considerations	Minimum ATEX Specification
Zone 2 NE	Negligible extent	The hazardous area classification and zone extent for the ASHP compressor and the ASHP's refrigerant pipework's flanges and connections has been calculated according to the EN 60079-10-1 standard. The release grade is classed as secondary, where the mechanical ventilation is provided by the heat pump fans which is considered to be sufficient to produce "high" dilution with "good" availability using Table C.1 in EN 60079-10-1. A Zone 2 NE has been classified around the ASHP compressor and the ASHP'S refrigerant pipework's fittings, flanges and connection in accordance with the EN 60079-10-1:2021 standard. REF: CALC 1 in Appendix 2: Detailed Calculations.	N/A
Risk Assessment			
Event	Event Description	Personnel Risk	Equipment Risk
Primary	Flash Fire	E	E
Secondary	N/A	N/A	N/A
Ignition Assessment			
Ignition Source	Ignition Likelihood	Considerations	
Frictional Energy	Not Credible		
Hot Surfaces	Not Credible		
Flames & Hot Gases	Not Credible		
Electrical Apparatus	Not Credible		
Static Electricity	Rare	It is considered that the ASHP refrigerant pipework will be adequately equipotentially bonded and earthed to mitigate against ignition by static discharge.	
Exothermic Reactions	Not Credible		
Other	Not Credible		

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Consequence Assessment			
Event	Event Description	Personnel Consequence	Equipment Consequence
Primary	Flash Fire	Moderate injury, may require professional medical treatment and less than one month off work but no lasting effects.	Damage to process unit, no significant down time for the plant, minor business interruption
Secondary	N/A	N/A	N/A
Occupancy Assessment			
Event	Occupancy	Comments	
Primary	Restricted Access	It is considered that personnel are not likely to be present during normal operation as the refrigerant pipework is enclosed in the ASHP	
Secondary	N/A	N/A	
Mitigation Assessment			
Event	Mitigation Effectiveness	Comments	
Primary	Not Effective	None identified	
Secondary	N/A	N/A	
Recommendations			
Number	Hierarchy	Term	Recommendation
1	Control of Release	SHOULD	It should be confirmed that the ASHP extraction ventilation exceeds the minimum requirements for high dilution (0.68 m/s - see Calculation 1).

Component	R290 Release - High Pressure Relief Valve	Identifier	C010102
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Hazardous Area Classification			
Zone Classification	Zone Extent	HAC Considerations	Minimum ATEX Specification
Zone 1 + Zone 2	Zone 1: Extending 1m in all directions, forming a spherical area originating from the vent discharge point Zone 2: Extending from the PRV discharge point, horizontally in all directions for 1m and down to the ground as well as along the floor for 9 m in all directions.	As the both the high and low PRVs discharge is the same location only the high PRV has been assessed. The PRV discharge pipework is directed towards the ground. The maximum operating pressure of the compressor is 40 barg and the PRV orifice size is 6.5 mm. As the PRV is directed downwards, the zone extent of the release cannot be modelled using 2D tools (as per the standard Gexcon approach) as these tools cannot account for the effects of impingement. A high-pressure release will produce a high velocity jet of vapour which will lose velocity upon impingement with the ground and subsequently produce a diffusive cloud which spreads at low level. As propane is a dense gas, the vapour cloud is not subject to dilution provided through buoyancy effects, potentially resulting in a large low lying vapour cloud. The stated zone extent should therefore be taken as indicative only, also noting that the behaviour of a release of this nature is greatly affected by the surrounding environment. Reference is made to Figure D.1 within EN 60079-10-1:2021 for calculation of zone extents for a heavy gas release. Assuming with the release characteristic based on a release rate in the order of 0.8 m³/s (based assuming on a 10 second release of the inventory of a single circuit), a zone extent of 9 m would be is determined. A Zone 2 has been classified which extends from the PRV discharge point, horizontally in all directions for 1m and down to the ground as well as along the floor for 9 m in all directions. In addition, to capture any fugitive emissions that may occur, a Zone 1 of a nominal 1m radius is also placed around the end of the discharge point in accordance with the EI 15 guidance.	Zone 1: Ex II 2G IIA T2 Zone 2: Ex II 3G IIA T2

Risk Assessment			
Event	Event Description	Personnel Risk	Equipment Risk
Primary	Flash Fire	C(Lower)	C(Lower)
Secondary	N/A	N/A	N/A
Ignition Assessment			
Ignition Source	Ignition Likelihood	Considerations	
Frictional Energy	Occasional	It is expected that the ASHP extraction fans on adjacent units will be located within the hazardous zone extent and are Category 3 ATEX-rated.	
Hot Surfaces	Not Credible		
Flames & Hot Gases	Not Credible		
Electrical Apparatus	Occasional	The release could potentially enter the source container or adjacent containers. Equipment within containers is ATEX rated.	
Static Electricity	Occasional	It is assumed the equipment will be adequately equipotentially bonded and earthed to mitigate against ignition from static discharge. However, the ground level release could be ignited by personnel in the area.	
Exothermic Reactions	Not Credible		
Other	Not Credible		
Consequence Assessment			
Event	Event Description	Personnel Consequence	Equipment Consequence
Primary	Flash Fire	Major injury requiring professional medical treatment with more than one month off work and likely to result in long term effects.	Damage to process unit, no significant down time for the plant, minor business interruption
Secondary	N/A	N/A	N/A
Occupancy Assessment			
Event	Occupancy	Comments	
Primary	Unrestricted Access	It is considered that personnel could be present in the area during normal operation	
Secondary	N/A	N/A	
Mitigation Assessment			
Event	Mitigation Effectiveness	Comments	
Primary	Not Effective	None identified.	
Secondary	N/A	N/A	

DSEAR ASSESSMENT REPORT**17**

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Recommendations			
Number	Hierarchy	Term	Recommendation
2	Good Practice Measure	SHOULD	The pressure relief valves should be routinely inspected and tested at suitable intervals in accordance with the manufacturer's guidance under a suitable Inspection and Maintenance Schedule.
3	Regulatory Compliance	SHOULD	The current arrangement for the PRV discharge significantly increases the risks associated with a release as it will result in a large low lying flammable cloud, where ignition sources are more likely to be present and there is potential for the release to enter the heat pump enclosures. The PRV must be rerouted to discharge vertically upwards to a safe unobstructed location away from personnel and ignition sources in order to safely dilute the release of flammable gas in accordance with EN 378-2:2016.

3.3 Additional Recommendations

General Recommendations

The recommendations in this section apply to all areas of the facility.

Number	Hierarchy	Term	Recommendation
4	Regulatory Compliance	MUST	The heat pump suppliers must demonstrate compliance with European Standard EN 378 (parts 1-4), i.e., by reference to the standard on the equipment's EU Declaration of Conformity (DoC), which is required for the CE marking. If the manufacturers/ suppliers cannot demonstrate this, consider performing a gap analysis.
5	Ignition Control	SHOULD	It should be verified that all ATEX equipment has been installed by a competent person (preferably part of a recognized accredited scheme, e.g. CompEx or IECEx) and in accordance with the manufacturer's instructions.
6	Ignition Control	SHOULD	An effective permit to work system should be used to control hot work, welding, etc.
7	Ignition Control	SHOULD	A specification for appropriate ATEX equipment to be located within hazardous zones should be provided to suppliers to ensure incorrect equipment is not installed in future. This applies to both non-electrical and electrical equipment.

Additional DSEAR Compliance Activities

The recommendations in this section are required in order to comply with additional sections of the DSEAR regulations.

Number	Hierarchy	Term	Recommendation
8	Regulatory Compliance	MUST	ATEX equipment must be inspected and maintained in order to maintain its certification. A rolling inspection of equipment certified suitable for use within a hazardous zone should be compiled in accordance with EN 60079 Part 17 Inspection. Non-electrical equipment should be inspected and maintained in line with the manufacturer's instructions for safety, which should be provided in line with EN 80079-36.
9	Regulatory Compliance	MUST	A record of documentation demonstrating compliance with DSEAR must be kept and made available upon request of an enforcing officer, specifically the significant findings of the risk assessment listed in Regulation 5(4). An Explosion Protection Document (or equivalent document) is an effective way to demonstrate compliance.
10	Regulatory Compliance	MUST	Personnel must receive suitable and sufficient information, instruction and training in accordance with Regulation 9 of DSEAR.
11	Regulatory Compliance	MUST	The employer must ensure that appropriate work clothing which does not give rise to electrostatic discharges is provided for use in areas classified as hazardous in line with Regulation 7(5) of DSEAR.
12	Regulatory Compliance	MUST	All hazardous zones must be identified with Ex Signage in accordance with Regulation 7(3) of DSEAR.
13	Regulatory Compliance	MUST	Before a workplace containing hazardous areas is used for the first time, the overall explosion safety must be verified by a person competent in the field of explosion protection (as a result of experience, professional training, or both).
14	Regulatory Compliance	MUST	A periodic review of the DSEAR risk assessment must be scheduled in accordance with Regulation 5(3) of DSEAR.
15	Regulatory Compliance	MUST	There must be arrangements in place to deal with accidents, incidents and emergencies in accordance with the requirements of Regulation 8 of DSEAR.
16	Regulatory Compliance	MUST	The nature of the contents and any associated hazards of dangerous substances within containers and pipes must be clearly identifiable in line with Regulation 10 of DSEAR, if not already marked in accordance with the relevant legislation listed in Schedule 5 of DSEAR.
17	Regulatory Compliance	MUST	Where two or more employers share the same workplace where an explosive atmosphere may occur, the employer responsible for the workplace must co-ordinate the implementation of all the measures required by DSEAR to be taken to protect employees from the risk of the explosive atmosphere(s).

3.4 Bibliography

DSEAR Dangerous Substances and Explosive Atmospheres Regulation, (DSEAR) 2002 Statutory Instrument 2776

ATEX 137 Directive 1999/92/EC of the European Parliament and Council of 16 December 1999: On minimum requirements for improving the safety and health protection of workers at risk from explosive atmospheres

EN IEC 60079-10-1:2021, Explosive atmospheres. Classification of areas. Explosive gas atmospheres

ASHRAE Research, 2017 ASHRAE Handbook Fundamentals I-P Edition, Atlanta: ASHRAE Research, 2017.

EN 80079-20-1:2019, Explosive atmospheres Part 20-1: Material characteristics for gas and vapour classification Test methods and data

BS EN 378-1- 4:2016 - Refrigerating systems and heat pumps - Safety and environmental requirements

A-THERM80 dethermina, Installation & Operation Manual, Revision 5.0, 12/06/2025

Undercroft Plant Layout Sketch, 50902-VE-PS-XX-SK-M-5601, P1, 11/11/2025

Safety Valve 2065/4C, Castel Italian Technology, Product Details

4 Appendix 2: Detailed Calculations

Component	C010101	Identifier	CALC 1
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Detailed Calculations
The hazardous area classification and extent have been determined using the EN 60079-10-1:2021 standard. The calculation methodology in Annex B of the standard was followed. The following data inputs were used for the calculations in Annex B.7.2.3: • Release Pressure: 36 barg (gauge pressure) • Molar Mass: 44 kg kmol⁻¹ • Specific Heat Capacity: 8035 J kg⁻¹ K⁻¹ (obtained an estimate using ASHRAE) • The release was determined to be Choked (Sonic) • Co-efficient of discharge: 0.75 • Cross-section of opening through which fluid is released: 0.25 mm² • Compressibility factor: 1 • Universal Gas Constant: 8314 J mol⁻¹ K⁻¹ • Temperature: 360.5 K (obtained from ASHRAE at 30 barg) • Atmospheric Pressure: 101.325 kPa • Lower Flammability Limit (LFL): 1.7 % v/v (Obtained from EN 80079-20-1:2017) • The release characteristic was calculated to be 0.0435 m³ s⁻¹ No background calculations with respect to Section C.3.6.2 of EN 60079-10-1:2021 have been conducted as the ASHP has limited inventory (a total of 28 kg per unit) therefore a continuous release is not expected and the units are located outside. Using Graph C.1 – Chart for assessing degree of dilution: • Ventilation Velocity for Medium Dilution: 0.002 ms⁻¹ • Ventilation Velocity for High Dilution: 0.591 ms⁻¹ • The fans on top of the ASHP unit are assumed to achieve ventilation velocities within the ASHP enclosure which exceed the requirement for 'high' dilution • Good availability has been chosen as the ventilation is provided by the ATEX fans which run continuously and increase flow rate when refrigerant is detected. • The leak from connections and flanges is not expected during normal operation. The release grade is considered to be secondary Using Table D.1 and Figure D.1, Zones for grade of release and effectiveness of ventilation and chart for estimating hazardous distance respectively: • Secondary grade of release • Medium Dilution • Good Availability

- Heavy Gas release type

A Zone 2 NE has been classified around the ASHP compressor and the ASHP'S refrigerant pipework's fittings, flanges and connections.

5 Appendix 3: About Gexcon

Gexcon is a global leader in process safety software, safety consulting and testing services, and specialises in analysis of dispersion, explosion and fire related risk and consequences.

As of early 2021, Gexcon AS has been fully owned by Longship Fund II. Longship is a Norwegian private equity investor established by a group of experienced investment professionals in 2015. Gexcon were previously owned by Christian Michelsen Research (CMR), part of the NORCE organisation (Norwegian Research Centre AS) and have a strong history in research.

Gexcon is headquartered in Bergen, Norway, with 11 subsidiaries and branch offices across the globe.

Besides providing consultancy services within Gexcon's traditional core activities these offices host special competence in areas such as structural analysis, transformer explosions, and accident investigations. As of 2023, Gexcon has 170+ employees.

Since the start of Gexcon in 1987 the company name (anacronym for Global Explosion Consultants) has been synonymous with gas explosion safety assessments. Since 2000 we have performed more than 200 quantitative ventilation/dispersion/explosion studies using FLACS for clients all around the world in addition to numerous qualitative explosion risk analyses.

Gexcon is widely respected for its technical competence, quality, objectiveness, and professionalism of the work we conduct. It is a world leader in undertaking and delivering safety studies with a long experience of carrying out explosion risk assessments for operators, engineering contractors, and regulatory authorities globally. We will deploy these qualities to fully meet the objectives of this project. Gexcon seeks to ensure that our work applies the state of the art in analysis technology and knowledge of the important parameters and arrives at conclusions and makes practical recommendations that will be of benefit to both contractor and client.

6 Appendix 4: Detailed Methodology

6.1 Hazardous Area Classification

Hazardous area classification is essentially two steps. The first step is to identify the grade of release, which allows designation of the zone, and the second step is determining the extent of the zone. The grade of release refers to the likelihood that a flammable atmosphere may be present and are defined as follows:

- Continuous – Flammable atmosphere is present continuously or for long periods.
- Primary – Flammable atmosphere may occur periodically or occasionally during normal operation.
- Secondary - Flammable atmosphere is not expected to occur but if it does it will be infrequent and for short periods only.

Area Classification is affected by a number of factors, including operating conditions, type of equipment and the material under consideration. The surroundings may also affect both the zone designation and zone extents due to the impact on the dispersion of flammable gases / vapours / dust. Industry standards for hazardous area classification provide guidance on zoning which considers the effect of these influencing factors.

Gexcon's approach to area classification is based on the latest relevant industry standards and guidance for the material under consideration. There are four key standards:

- EN 60079-10-1: Used for area classification of flammable gases.
- EN 60079-10-2: Used for area classification of combustible dusts
- EI 15: Used for area classification of flammable and combustible liquids
- IGEM: Provide a suite of documents for area classification of natural gas, primarily IGEM UP/16 and IGEM SR/25

These standards provide general guidance on area classification for the material types, as well as having some specific guidance for certain materials (IGEM are specific to natural gas, EI 15 provides some specific guidance for certain materials such as LPG). In addition to these documents, a range of supporting standards, guidance documents and relevant industry research for specific materials, processes or equipment items are considered. The bibliography provides a list of frequently referenced standards.

Table 1: Likelihood of flammable atmospheres [2]

Zone	Definition
Zone 0	A place in which an explosive atmosphere consisting of a mixture with air of dangerous substances in the form of gas, vapour or mist is present continuously or for long periods or frequently.
Zone 1	A place in which an explosive atmosphere consisting of a mixture with air of dangerous substances in the form of gas, vapour or mist is likely to occur in normal operation occasionally.
Zone 2	A place in which an explosive atmosphere consisting of a mixture with air of dangerous substances in the form of gas, vapour or mist is not likely to occur in normal operation but, if it does occur, will persist for a short period only.
Zone 2 NE	A Zone 2 of Negligible Extent. If a flammable atmosphere does occur, it will be very small in volume and dissipate quickly.
Zone 20	An area in which there is either always, for long periods or often the presence of an explosive atmosphere in the form of a cloud of flammable dust.
Zone 21	An area in which during normal operation, it is likely that an explosive atmosphere in the form of a cloud of flammable dust exists.
Zone 22	An area in which an explosive atmosphere in the form of a cloud of flammable dust is unlikely to exist. If however an explosive atmosphere does occur, it will exist for a short period only.

6.2 Risk Assessment

The standard risk assessment undertaken as part of a DSEAR assessment is a semi-quantitative assessment. Gexcon adopt a modified version of a standard methodology referred to as SCRAM (Short-Cut Risk Assessment Methodology). The methodology involves categorising the likelihood and consequences of an incident in several broad Categories. Gexcon's methodology introduces additional considerations and applies literature-based frequencies and probabilities to reduce variation between assessment and to increase robustness. A key amendment is that the basic methodology does not explicitly apply probabilities or frequencies, with any parameter associated with likelihood assessed on a scale of 1 – 5, representing from 'very unlikely' to 'very likely' respectively. The Gexcon approach follows a LOPA style methodology in which probabilities are explicitly applied and also considers several additional factors, such as mitigation and occupancy.

The flow chart below outlines the approach that will be taken.

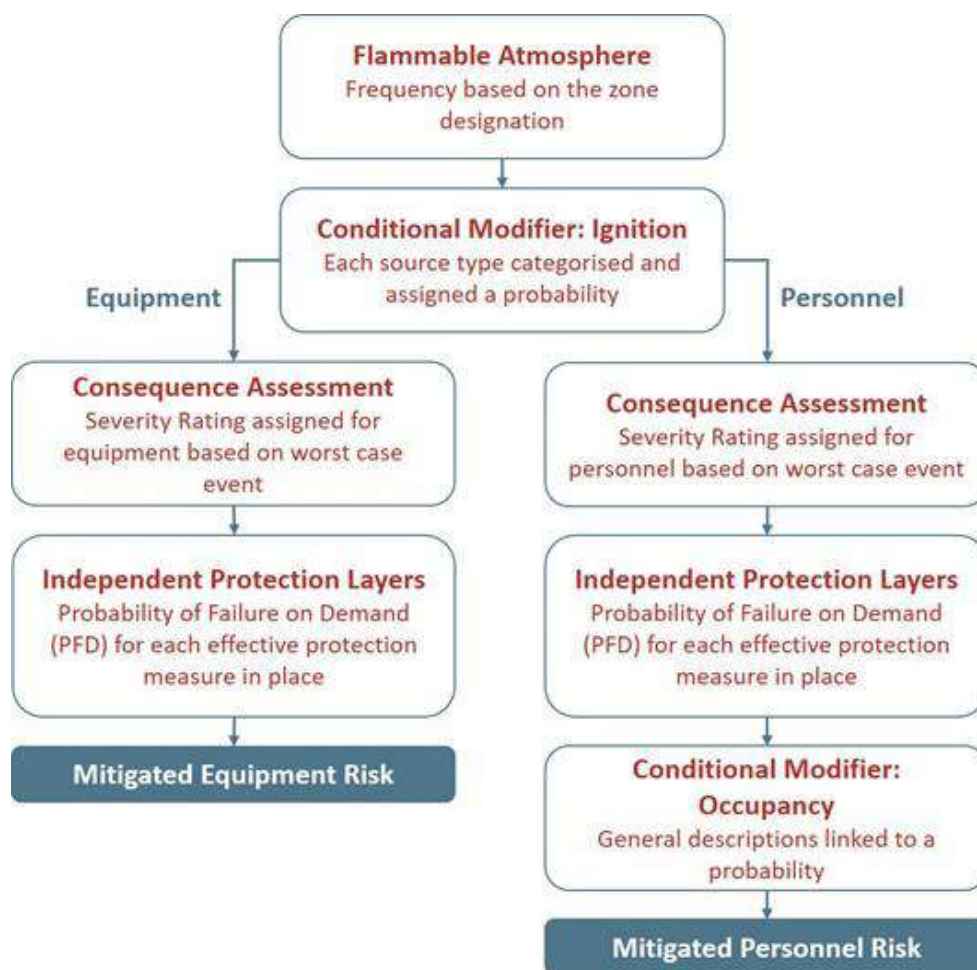


Figure 1 - SCRAM assessment process flow chart

Probability of an Event

The probability of an event occurring depends on the probability of an effective ignition source and the probability of having an explosive / flammable atmosphere. The probability of an explosion or fire will then be the product of these two probabilities.

The below matrix is used to derive the probability of an event from the probability of ignition and the probability of a flammable atmosphere.

Probability of Ignition	5	1	2	3	4	5
	4	1	2	3	3	4
	3	1	2	2	3	3
	2	1	1	2	2	2
	1	1	1	1	1	1
		1	2	3	4	5
	Probability of Flammable Atmosphere					

Flammable Atmosphere in the Process

Hazardous Area Classification has been undertaken using the guidance provided within relevant industry standards (i.e. EN-60079 / EI15 / IGEM) as described above. Each zone is characterized by the persistence of an explosive atmosphere, i.e. the proportion of time in the year when a flammable atmosphere may be expected, and from this the likelihood of the explosive atmosphere can be described.

Markowski [2] suggests that the frequency of explosive atmospheres may be assessed in terms of an approximation of the order of magnitude based on the release grades. This provides a frequency of a flammable atmosphere (per year) based on the zone designation.

Table 2: Likelihood of flammable atmospheres [2]

Zone	Description of Existence	
20 / 0	Will persist permanently or for a long period or frequently	Normal operation
21 / 1	Likely to occur in normal operation (occasionally)	Also, in the event of foreseeable faults
22 / 2	Unlikely (not expected in normal operation)	Possible in rarely occurring faults

Based on Gexcon experience, the frequencies suggested are considered lenient. As this is not a quantitative assessment methodology, and taking into account the points raised above, Gexcon have set frequency grades which are considered to better represent the definitions. These are shown in Table 3 below. An additional grade has been assigned which may be selected where the area has been designated as a zone 2 / 22 NE

Table 3: Frequencies for use in the Gexcon Methodology

Zone	Description of Existence	Category
0 / 20	A place in which an explosive gas / dust atmosphere is present continuously, for long periods or frequently	Continuous
1 / 21	A place in which an explosive gas / dust atmosphere is likely to occur in normal operation occasionally	Likely
2 / 22	Area in which an explosive gas / dust atmosphere is not likely to occur in normal operation but, if it does occur, will persist for a short period only	Not Likely
2 / 22 NE	Similar to Zone 2 / 22 but zone extension applies only within 500mm of source.	Negligible Extent
No Zone	A flammable atmosphere is not expected at all in normal operation	Non-hazardous

Note on designation of flammable atmospheres

Certain guidance documents suggest a persistence time associated with each zone in terms of number of hours present per year. It is considered that these values can be somewhat misleading for a non-continuous operation and result in incorrect zoning. For example, rail unloading may take place 2-3 times per week and whilst the rail car is being unloaded into the hopper, the hopper is filled with dust clouds. If this unloading operation takes around an hour to complete, a flammable atmosphere is present for 2-3 hours per week, a relatively insignificant amount of time, and therefore one might suggest a Zone 22.

However, whilst the operation is taking place, dust clouds are present continuously and therefore during this timeframe the hopper would be designated as a Zone 20 (or 21). The critical issue is that Category 3 equipment, installed due to a Zone 22 designation, is not appropriate for these periods when the hopper should in fact be designated as a Zone 20 or 21. Therefore, Gexcon's approach to zoning applies the corresponding zone for the period when the equipment is in operation. If necessary, a zone will also be designated for when equipment is not in operation (for example, if dust layers can remain after operation).

Conditional Modifiers

Conditional modifiers associated with ignition shall be applied only to initiating events associated with hazardous zones. It is assumed that a propagating event will not require an ignition source.

Similarly, the conditional modifier for occupancy will only apply to the frequency of an ignited event impacting personnel, the frequency of impact to equipment will be calculated separately.

Probability of Ignition Source

Gexcon's methodology for determining ignition probability involves assigning categories according to a description of the persistence of the ignition source, each with an associated likelihood. The overall probability of ignition is assigned based on the ignition source deemed to be the most effective to cause ignition.

Potential Ignition Sources

EN 1127-1 [6] provides a list of 13 ignition sources for consideration. Based on Gexcon experience, a number of these are extremely specific and do not apply to the vast majority of installations. The assessment methodology will prompt the assessor to consider the most common ignition sources individually and provide a statement with regards to these sources. The less common sources will be listed for consideration but will only be specifically mentioned if they are identified as present. Otherwise, the assessment will state that none of these 'other' source apply.

Table 5: Potential ignition sources

Source (as listed in EN 1127-1)	Type	Description
Hot Surfaces	Common	This source considers heated surfaces generated as part of the process. This does not include hot surfaces due to mechanical friction caused by equipment failure/poor maintenance (covered under mechanical equipment). This also does not include hot surfaces due to hot embers in processes involving dusts (covered by flames and hot gases). Hot surfaces may be present on the surface of reaction vessels containing hot liquids / gases for example, or within chute impact zones in solids handling processes.
Flames and hot gases (including hot particles)	Common	This source should also consider hot embers generated within solids handling processes and potential for smouldering material.
Mechanically generated sparks	Common	Mechanical equipment is an ignition risk within most processes. This source refers to ignition due to mechanical equipment and should also consider the potential for trapped objects generating sparks / frictional heat.
Electrical apparatus	Common	Electrical equipment is an ignition risk within most processes.

Source (as listed in EN 1127-1)	Type	Description
Stray electric currents, cathodic corrosion protection	Rare	Cathodic protection is not relevant for the majority of plant equipment. Stray electrical currents are possible from transformers for example, and would be considered in these assessments, however, this is not considered applicable to the majority of equipment. (Note arcing due to an electrical fault and static are covered separately)
Static electricity	Common	Static is a common source of ignition.
Lightning	Rare	The majority of the process equipment is within buildings or structures and all equipment and process building structures should always be earthed. Lightning strikes generally quite rare and therefore would only be considered in cases where lightning strikes are known to have occurred or equipment is not suitably protected from lightning strikes.
Radio frequency (RF), electromagnetic waves from 104 Hz to 3 x 10 ¹¹ Hz	Rare	This is not a common ignition source and would apply to a small number of sites and materials.
Electromagnetic waves from 3 x 10 ¹¹ Hz to 3 x 10 ¹⁵ Hz	Rare	This is not a common ignition source and would apply to a small number of sites and materials.
Ionizing radiation	Rare	This is a very site specific ignition source and is rarely seen.
Ultrasonic	Rare	This is a very site specific ignition source and is rarely seen.
Adiabatic compression and shock waves	Rare	This is a very site specific ignition source and is rarely seen.
Exothermic reactions, including self-ignition of dusts	Rare	Exothermic reactions would be process specific. Dust builds up around equipment leading to self-heating is somewhat more likely but been considered in the assessment of flames and hot gases.

Occupancy and Mitigation

A conditional modifier is assigned to account for the occupancy of the area, as well as the assumed effectiveness of any mitigation measures which relate to the events considered.

Risk Calculation

The risk calculation is based on the total frequency of an event impacting personnel / equipment (i.e. frequency of initiating event accounting for conditional modifiers) and the associated consequence. The combination of the frequency of the event and the associated consequences is compared against the risk criteria defined on a risk matrix. The risk matrix will be based on the HSE tolerability criteria [4] for individual risk. The overall risk associated with each item of equipment / location will be calculated, as well as the risk for each initiating event. This will demonstrate the significance of the effect of propagation in each location and the impact of propagation on the overall risk.

Individual Risk

It should be noted that a semi-quantitative assessment does not include all contributing factors that are required to determine the level of individual risk; however, it is considered that this approach is reasonable and conservative. Individual risk refers to the annual risk of death to which a specific individual is exposed. When the consequences of an event are assessed following the methodology outlined here, this is essentially a judgement of whether it is thought that the event would produce life threatening consequences and whether any one person on site may be in the vicinity at the time. In fact, this one person could be one out of 100 people who may be in the area. Therefore, the individual risk in this instance would be much less than the calculated event frequency.

Another factor that would greatly influence the individual risk is the calculation of occupancy. The approach taken for this methodology is a very simplified approach based primarily on whether access is possible and assuming that someone may be present if so. This is extremely simplified compared to a quantitative assessment, which considers detailed population data based on shift patterns, working hours and operator responsibility (i.e. in which areas are they likely to be present).

Based on the points raised above, using the tolerability criteria for individual risk could produce quite conservative conclusions. However, it should also be noted that the tolerability criteria from the HSE is based on the site risk, i.e. the individual risk from all possible hazardous events on site. Therefore, the individual risk from the site is essentially the sum of all events with the potential to impact that person. Again, there may only be a handful of events that could occur in the area in which the individual is present, however, as stated above, the semi-quantitative methodology does not consider occupancy in this level of detail.

Given the nature of the semi-quantitative assessment, in terms of the degree of engineering judgement involved and simplifications in the methodology discussed above, the use of individual risk tolerability criteria is considered to provide a conservative but suitable indication of the risk.

Note that the only alternative approach would be to consider societal (group) risk, however this is generally used in cases where a single incident could result in multiple fatalities. As DSEAR generally focuses on localised events, i.e. pin hole leaks and flammable atmospheres inside equipment, these events are rarely expected to give rise to multiple fatalities.

Tolerability Criteria

There is no legally set numerical requirement for the tolerability of risk of a potentially fatal accident, but it is expected to be as low as reasonably practicable (ALARP). The HSE publication 'Reducing Risks, Protecting People' (R2P2) [4] proposes a framework for assessing risk tolerability which is widely used in industry.

The HSE adopts a three-tier framework for risk tolerability – as shown in the figure below. The values for tolerability are set based on HSE experience and various industry fatality data, which is described in paragraphs 128 – 133 of R2P2 [4]. Under these guidelines, the upper limit of tolerability is a risk of death of $1.00\text{E-}03$ per year (1 in 1000 per year). This is considered a tolerable (provided it can be demonstrated that the risk is as low as reasonably practicable) level of risk to be accepted by any substantial category of workers for any large part of a working life. Above this value, the level of risk is considered intolerable, and action is needed to reduce the risk.

The guidance also suggests that the lower bound for individual risk, at which the level of risk is considered broadly acceptable, is considered to be a risk of death in the region of $1.00\text{E-}06$ per year (1 in 1 million per year). This individual risk value of $1.00\text{E-}06$ per year has therefore been selected to represent the boundary at which no further effort needs to be applied to reduce risk further.

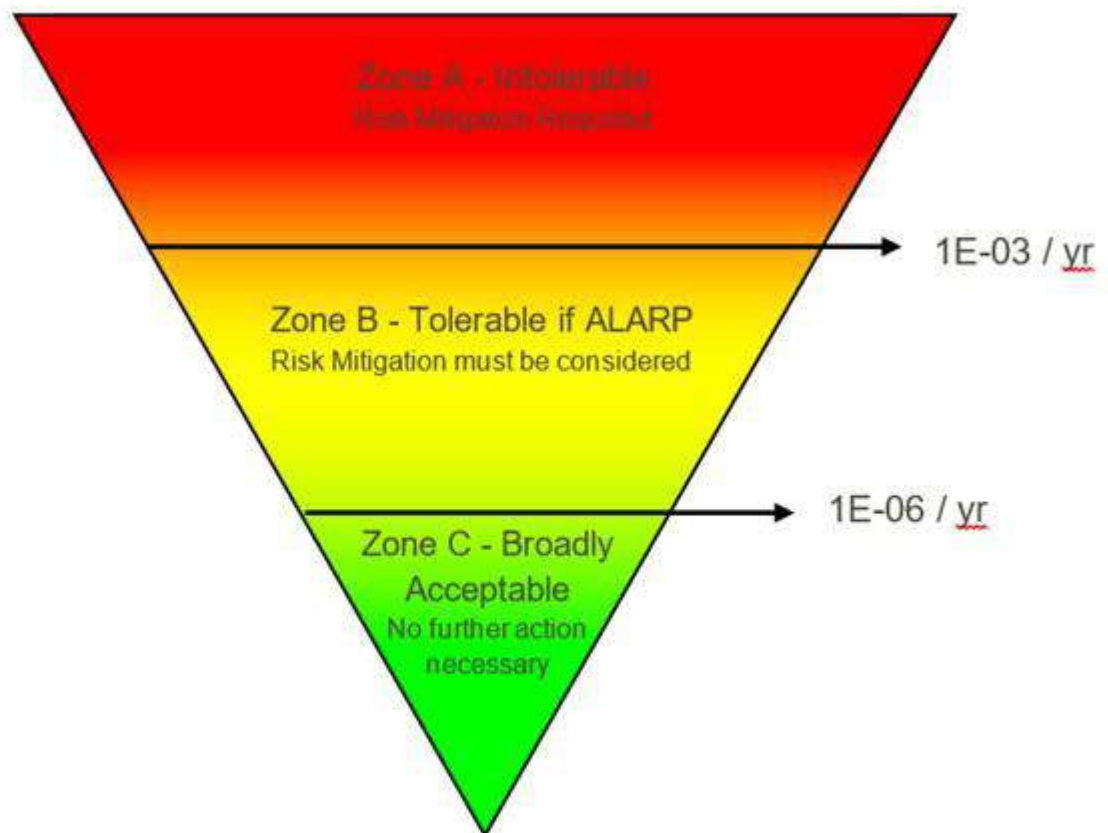


Figure 1: HSE ALARP Triangle

Risk Matrix

The risk matrix has been set as shown below. The tolerability limits applied within the matrix are based on the HSE criteria above but have been adjusted to account for the fact that the assessment is not a detailed quantitative risk analysis (limits have been reduced by an order or magnitude). The risk matrix aims to provide a conservative indication of risk.

Consequence	5	C	C	B	A	A
	4	D	C	C	B	A
	3	D	C	C	C	B
	2	E	D	C	C	C
	1	E	E	D	D	C
		1	2	3	4	5
	Frequency					

Table 7: Frequency bands

Grade	Description
1	Extremely Remote
2	Remote
3	Unlikely
4	Somewhat Likely
5	Likely

Table 8: Risk ranking

Grade	Risk Level	Description
A	Very High	Intolerable - Risk reduction measures must be implemented immediately
B	High	Intolerable - Risk reduction measures must be implemented
C(Upper)	Medium (upper band)	Tolerable if ALARP – Further risk reduction must be considered, and all reasonably practicable measures implemented, risks in the upper band of tolerable if ALARP should be prioritised over those in the lower band.
C(Lower)	Medium (lower band)	Tolerable if ALARP – Further risk reduction must be considered, and all reasonably practicable measures implemented
D	Low	Broadly Acceptable – Further measures may be necessary to adhere to codes, standards and established good practice. Legal requirements must still be complied with.
E	Very Low	Broadly Acceptable – Further measures may be necessary to adhere to codes, standards and established good practice. Legal requirements must still be complied with.

Consequence

As discussed earlier, to maintain consistency between the risk assessment undertaken as part of DSEAR compliance activities and other forms of risk analysis (e.g. LOPA/SIL, QRA, etc.), all consequences should be assessed as unmitigated. This means that the severity rating assumes that there are no controls or mitigation in place, i.e. worst case. However, it should also be highlighted that this does not mean that every event has the potential to result in catastrophic consequences, the area classification and zone extents must be considered to determine how severe the event could be. Consequences are assessed for personnel and equipment separately using the following categories.

Table 9: Severity grade for impact to personnel

Grade	Description
1	Minor injury (cuts/bruises), first aid only.
2	Moderate injury, may require professional medical treatment and less than one month off work but no lasting effects.
3	Major injury requiring professional medical treatment with more than one month off work and likely to result in long term effects.
4	Incident resulting in a single fatality. Multiple permanent injuries or irreversible health effects.
5	Multiple worker fatalities, incident affecting a large number of personnel.

Equipment consequences are generally assessed in terms of a monetary value with regards to cost of damage. This is often difficult to assess and can lead to inconsistency, this approach is also unsuitable for the subjective nature of the impact certain costs may have on a business. The categories proposed are therefore based on potential interruption to business and whether this is considered significant for the site under consideration.

Table 10: Severity grades for impact to equipment

Grade	Description
1	Minor damage to plant, no interruption to business or process.
2	Damage to process unit, no significant down time for the plant, minor business interruption
3	Process unit collapse and possible damage to corresponding units, requirement to shut down plant while repairs are undertaken, moderate business interruption.
4	Severe damage to plant and process unit, process stopped for foreseeable future while repairs are undertaken. Significant interruption to business, loss of a key process.
5	Widespread, extensive damage to process units and structure, unlikely to be operational for foreseeable future, potential threat to long term prospects / future of business.

6.3 Recommendation

Each recommendation is assigned a category which corresponds to the hierarchy presented in Regulation 6 of DSEAR, good practice or other regulatory requirements.

Table 11: Recommendation hierarchy

DSEAR Regulation	Category
6(2)	Elimination / Substitution
6(4)(a)	Inventory Reduction
6(4)(b),(c),(d),(e)	Control of Release
6(4)(f)(i)	Ignition Control
6(4)(f)(ii)	Avoid Adverse Conditions
6(4)(g)	Segregate Incompatible Substances
6(5)(a)	Reduce Occupancy
6(5)(b),(c),(d),(e)	Explosion / Fire Protection
6(5)(f)	PPE
N/A	Good Practice Measure
N/A	Regulatory Compliance

Specific terminology is used in the recommendations, consisting of keywords: Consider, Should and Must. The definition and explanation of each term is contained in the table below.

Table 12: Recommendation terminology¹¹¹

Term	Definition	Explanation
CONSIDER	Prescribes a requirement which, it is intended, will be complied with, unless after further review, deviation is considered to be acceptable.	This recommendation (or an equivalent) should be implemented to demonstrate that all reasonably practicable measures have been implemented in line with the ALARP principles. The suggested measure aligns with industry best practice or is expected to be a low-cost improvement. It is expected that the measure will be implemented unless it can be demonstrated that the cost outweighs the risk reduction benefit (e.g. Through cost-benefit analysis).

Term	Definition	Explanation
SHOULD	Prescribes a requirement which, it is intended, will be complied with fully in accordance with the principles of ALARP.	This recommendation aligns with industry good practice or is specified in a recognised standard or publication containing prescriptive requirements. Equivalent measures to achieve the same overall outcome could be implemented. Regulation 6 of DSEAR requires employers to implement measures in line with the principles of ALARP. Regulation 6(1) states that: Every employer shall ensure that risk is either eliminated or reduced so far as is reasonably practicable. These recommendations would provide the basis for demonstration of compliance with this Regulation and therefore a robust “Well Reasoned Argument” (WRA) would be required to justify any instance where the recommendation has not been implemented. This WRA would be the basis of defence in any subsequent accident investigation or legal proceedings, where the burden of proof is placed on the defendant.
MUST	Prescribes a requirement in law by Great Britain (GB) at the time of issue of this document which will be complied with fully and without deviation.	This recommendation must be implemented, as it is a requirement in law in Great Britain (GB) at the time of issue of this document. A “Well Reasoned Argument” will not be accepted as a defence in any subsequent accident investigation or legal proceedings.

6.4 References

- [1] The Energy Institute Model Code of Safe Practice Part 15, Area Classification for Installations Handling Flammable Fluids (4th Edition, June 2015)
- [2] A. S. Markowski, M. S. Mannan, A. Kotynia and H. Pawlak, "Application of fuzzy logic to explosion risk assessment," Journal of Loss Prevention in the Process Industries, vol. 24, no. 6, pp. 780-790, 2011.
- [3] Guidelines for Initiating Events and Independent Protection Layers in LOPA, AIChE CCPS 2015
- [4] Reducing Risks, Protecting People - R2P2, HSE, 2001
- [5] EN 1127-1:2019 Explosive Atmospheres – Explosion Prevention and Protection – Basic Concepts and Methodology



Risk Event	Risk Description	Owner	Cause and Consequences	Current Risk	Mitigation	Residual Risk
1	Planning Approval Rejection - Allerton Depot	VE/NR	Reistance to / refusal of planning applications relating to the installation of heat pumps. If declined, the heat pump scheme would not be installed.	Low	Early engagement with planning authority sought. Planners suggest minimal chance of resistance/rejection and to proceed with full planning application. No further action required. Plan for different low-carbon heat technologies in the event planning is refused (e.g. full IR).	Low
2	Heat Pump COPs	VE / NR	Heat pumps cannot achieve the desired electrical performance. Cost of heat would increase.	High	Completed a technology appraisal across a range of heat pump technologies to ensure suitable COPs can be demonstrated. Built-in design margin to be conservative regarding electrical performance. Constant monitoring and reviewing of COPs. Work to reduce and optimise systems (i.e. lowering temperatures) where possible/practical to increase heat pump efficiency.	Med
3	High Acoustic Levels	VE	Acoustics too high for surrounding receivers, planning conditions would not be met, heat pumps would not be allowed to operate.	High	Early engagement with acoustic specialists - surveys completed to understand acoustic mitigation requirements (e.g. acoustic fencing, enclosures, etc.). Selection of plant that are inherently low / ultra low noise. Location of plant away from any nearby (sensitive) receivers.	Med
4	Lack of Grid Capacity - Allerton	NR/VE	Insufficient grid supply would mean electrified heating plant could not operate. NR / Northern Trains want additional power in the near future to power new training facilities and a new fleet.	High	Early future requirements need to be provided by NR / NT. Early DNO engagement to review existing supply capacity and requirement for upgrades. An element of contingency is built into the programme to allow for upgrade works to be completed.	Med
5	Lack of Grid Capacity - Manchester Piccadilly	NR/VE	Insufficient grid supply would mean electrified heating plant could not operate.	High	Early DNO engagement to ensure sufficient capacity can be maintained. An element of contingency is built into cost and programme for any unforeseen works / delays.	Med
6	Delayed Delivery	VE	Supply chain delays cause delay to installation and overall completion of programme. Project delivery would be delayed / late.	Med	Early engagement with manufactuers to ensure plant availability. Options for early procurement put in place. Alternative sources researched. Contingency built into cost/programme for unforeseen delays.	Low
7	RICS Acrediation	VE	VE are currently working through the RICS acreditation process.	Low	VE have employed a specialist consultant to help guild us through the onboarding process.	Low
8	NR / Northern Trains Coordination & PTW Processes	VE / NR	Delays may occure due to coordination between VE install works and NR / NT daily operations.	High	Agreed programme of works, regular engagement with site asset managers, PTW prepared prior to day of works.	Med
9	UTX Crossing	VE / NR	These are none standard works for VE.	Med	VE will employ a specialist sub co or NR to design and install these works.	Low
10	Asbestos	NR	Both sites have asbestos identified.	High	VE to coordinate their desgin to avoid ACM's where possible. NR to remove or build compartmentation if asbestos not be avoided.	Low
11	Ground Risk	NR / VE	VE have to enter the ground to form foundations and cross the track at Piccadilly.	Low	VE have completed underground services surverys at Allerton. Plant foundations to be designed as shallow as possible.	Low
12	Pest Control	NR / VE	Personelle infection from vermin carrying disease or vermin droppings.	High	Pest control and speacialist cleaners to be employed to ensure workers are safe.	Low
13	Legionella Risk in DHW	NR / VE				

PROJECT:	Allerton Depot and Piccadilly Station
TITLE:	Piccadilly Station Site Wide Equipment Schedule
DOCUMENT NO:	50902-VE-PS-XX-SH-M-5601
PROJECT REF:	VCS0902
	50902-VE-PS-XX-SC-M-5602
SCHEMATIC:	50902-VE-PS-XX-SC-M-5603
STATUS:	ISSUED FOR APPROVAL
DESIGN STAGE:	STAGE 3

SYSTEM REFERENCES	
A	PRIMARY
B	SECONDARY
W	COLD WATER

NOTES:	
	Updated

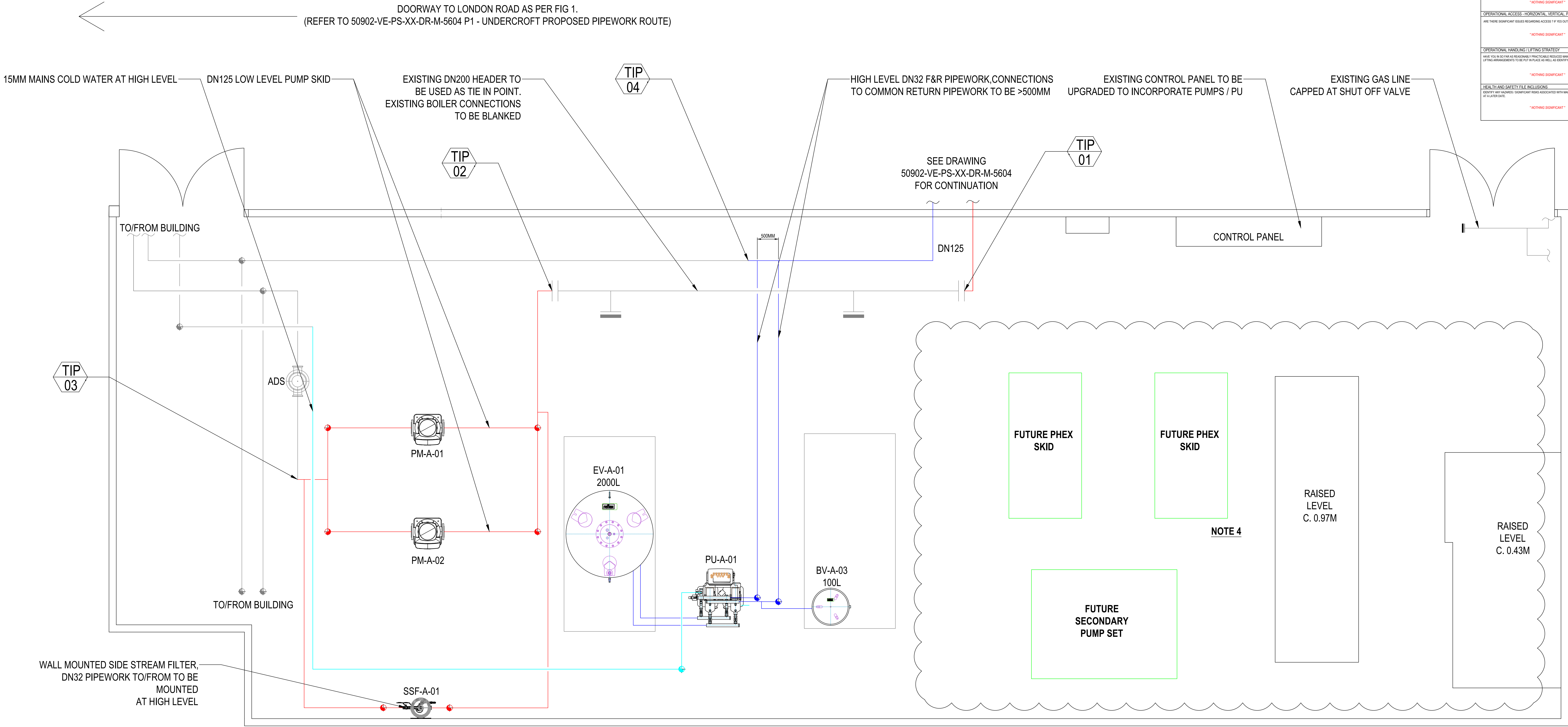
REV	DATE	Description	ENG	CKD	APP
P1	21.11.2025	ISSUED FOR APPROVAL	CSH	TW	BC



ISSUED FOR APPROVAL

MAJOR PLANT													
REF	TYPE	QTY	SYS	LOCATION	MANUFACTURER	MODEL	DESCRIPTION	CONNECTION SIZE	CONNECTION TYPE	PRESSURE RATING	TEMPERATURE RATING	kV	WEIGHT
ASHP-A-01	AIR SOURCE HEAT PUMP	1	A	UNDERCROFT COMPOUND	PURE THERMAL / DETHERMINA	ATHERM 80 300.2	R290 SINGLE STAGE HEAT PUMP, 150kW @ -5°C, 2259 x 3934 x 2500 (W X D X H) (mm), SOUND POWER LEVEL 89db(A)	4"	VICTAULIC	6 BAR	80°C	N/A	3972kg (WET)
ASHP-A-02	AIR SOURCE HEAT PUMP	1	A	UNDERCROFT COMPOUND	PURE THERMAL / DETHERMINA	ATHERM 80 300.2	R290 SINGLE STAGE HEAT PUMP, 150kW @ -5°C, 2259 x 3934 x 2500 (W X D X H) (mm), SOUND POWER LEVEL 89db(A)	4"	VICTAULIC	6 BAR	80°C	N/A	3972kg (WET)
ASHP-A-03	AIR SOURCE HEAT PUMP	1	A	UNDERCROFT COMPOUND	PURE THERMAL / DETHERMINA	ATHERM 80 300.2	R290 SINGLE STAGE HEAT PUMP, 150kW @ -5°C, 2259 x 3934 x 2500 (W X D X H) (mm), SOUND POWER LEVEL 89db(A)	4"	VICTAULIC	6 BAR	80°C	N/A	3972kg (WET)
ASHP-A-04	AIR SOURCE HEAT PUMP	1	A	UNDERCROFT COMPOUND	PURE THERMAL / DETHERMINA	ATHERM 80 300.2	R290 SINGLE STAGE HEAT PUMP, 150kW @ -5°C, 2259 x 3934 x 2500 (W X D X H) (mm), SOUND POWER LEVEL 89db(A)	4"	VICTAULIC	6 BAR	80°C	N/A	3972kg (WET)
ASHP-A-05	AIR SOURCE HEAT PUMP	1	A	UNDERCROFT COMPOUND	PURE THERMAL / DETHERMINA	ATHERM 80 300.2	R290 SINGLE STAGE HEAT PUMP, 150kW @ -5°C, 2259 x 3934 x 2500 (W X D X H) (mm), SOUND POWER LEVEL 89db(A)	4"	VICTAULIC	6 BAR	80°C	N/A	3972kg (WET)
HEAT METERS													
REF	TYPE	QTY	SYS	LOCATION	MANUFACTURER	MODEL	DESCRIPTION	CONNECTION SIZE	FLOW RATING	PRESSURE RATING	MAX TEMP RATING	FLOW REQUIRED	WEIGHT kg
HM-A-01	HEAT METER	1	A	ASHP-A-01 INLET	KAMSTRUP	ULTRAFLOW 54 + MULTICAL 603 suitable for 24vac Power Supply with Modbus Comms Card 65-5- CKCE -XXX	ULTRASONIC FLOW METER & CALCULATOR	DN50 x 270mm	QP15m3/h KV 40	PN16	130°C	12.9m3/h	10.1kg
HM-A-02	HEAT METER	1	A	ASHP-A-02 INLET	KAMSTRUP	ULTRAFLOW 54 + MULTICAL 603 suitable for 24vac Power Supply with Modbus Comms Card 65-5- CKCE -XXX	ULTRASONIC FLOW METER & CALCULATOR	DN50 x 270mm	QP15m3/h KV 40	PN16	130°C	12.9m3/h	10.1kg
HM-A-03	HEAT METER	1	A	ASHP-A-03 INLET	KAMSTRUP	ULTRAFLOW 54 + MULTICAL 603 suitable for 24vac Power Supply with Modbus Comms Card 65-5- CKCE -XXX	ULTRASONIC FLOW METER & CALCULATOR	DN50 x 270mm	QP15m3/h KV 40	PN16	130°C	12.9m3/h	10.1kg
HM-A-04	HEAT METER	1	A	ASHP-A-04 INLET	KAMSTRUP	ULTRAFLOW 54 + MULTICAL 603 suitable for 24vac Power Supply with Modbus Comms Card 65-5- CKCE -XXX	ULTRASONIC FLOW METER & CALCULATOR	DN50 x 270mm	QP15m3/h KV 40	PN16	130°C	12.9m3/h	10.1kg
HM-A-05	HEAT METER	1	A	ASHP-A-05 INLET	KAMSTRUP	ULTRAFLOW 54 + MULTICAL 603 suitable for 24vac Power Supply with Modbus Comms Card 65-5- CKCE -XXX	ULTRASONIC FLOW METER & CALCULATOR	DN50 x 270mm	QP15m3/h KV 40	PN16	130°C	12.9m3/h	10.1kg
HM-A-06	HEAT METER	1	A	DISTRIBUTION RETURN	KAMSTRUP	ULTRAFLOW 85 + MULTICAL 603 suitable for 24vac Power Supply with Modbus Comms Card 65-5- FBCM -XXX	ULTRASONIC FLOW METER & CALCULATOR	DN125 x 350mm	QP150m3/h KV 373	PN16	130°C	64.3m3/h	28.2kg
PUMPS													
REF	TYPE	QTY	SYS	LOCATION	MANUFACTURER	MODEL	DESCRIPTION	CONNECTION SIZE	CONNECTION TYPE	PRESSURE RATING	TEMPERATURE RATING	DUTY FLOW KG/S	WEIGHT kg
PM-A-01	DISTRIBUTION (DUTY)	1	A	BOILER ROOM	GRUNDFOS	TPE2 100-350 N-A-F-A-BQQENWB No. 93338868 C/W INERTIA BASES No. 99696463 & PRESSURE TRANSDUCERS No. 96611525	SINGLE STAGE, CLOSE COUPLED IN-LINE CENTRIFUGAL PUMP, BUILT-IN FREQ. CONVERTER 11kW, 3 X 380-500v, ETA PUMP +MOTOR+FREQ. CONVERTER 67.9%	DN100	FLANGED	PN16	120°C	17.86 @ 275KPa	167kg
PM-A-02	DISTRIBUTION (STANDBY)	1	A	BOILER ROOM	GRUNDFOS	TPE2 100-350 N-A-F-A-BQQENWB No. 93338868 C/W INERTIA BASES No. 99696463 & PRESSURE TRANSDUCERS No. 96611526	SINGLE STAGE, CLOSE COUPLED IN-LINE CENTRIFUGAL PUMP, BUILT-IN FREQ. CONVERTER 11kW, 3 X 380-500v, ETA PUMP +MOTOR+FREQ. CONVERTER 67.9%	DN100	FLANGED	PN16	120°C	17.86 @ 275KPa	167kg
VESSELS													
REF	TYPE	QTY	SYS	LOCATION	MANUFACTURER	MODEL	DESCRIPTION	CONNECTION SIZE	CONNECTION TYPE	PRESSURE RATING	MAX TEMP RATING	FLOW REQUIRED	WEIGHT kg
BV-A-01	BUFFER VESSEL	1	A	UNDERCROFT COMPOUND	HARTWELL	BESPOKE 8000L	8000L, DIAMETER 2050mm INCL. 150mm MINERAL WOOL INSULATION / 0.7mm ALUZINC CLADDING, HEIGHT 4200mm	SYSTEM INLET/OUTLET DN125 DRAIN 2" BSP	FLANGED	6 BAR	100°C	N/A	5000kg (DRY) ~13000kg (WET)
BV-A-02	BUFFER VESSEL	1	A	UNDERCROFT COMPOUND	HARTWELL	BESPOKE 8000L	8000L, DIAMETER 2050mm INCL. 150mm MINERAL WOOL INSULATION / 0.7mm ALUZINC CLADDING, HEIGHT 4200mm	SYSTEM INLET/OUTLET DN125 DRAIN 2" BSP	FLANGED	6 BAR	100°C	N/A	5000kg (DRY) ~13000kg (WET)
PRESSURISATION													
REF	TYPE	QTY	SYS	LOCATION	MANUFACTURER	MODEL	DESCRIPTION	CONNECTION SIZE	FLOW RATING	PRESSURE RATING	MAX TEMP RATING	FLOW REQUIRED	WEIGHT kg
PU-A-01	PRESSURISATION/DEGASSING UNIT	1	A	BASEMENT PLANTROOM	REFLEX	VARIOMAT CONTROL UNIT VS 2-2/60 SC (MODEL NO. 8911220) C/W PRIMARY VESSEL EXPANSION SET (MODEL NO. 6940400)	PRESSURISATION, DEGASSING AND MAKE-UP UNIT, INTEGRATED PUMPS, 704 x 921 x 825 (W X H X D) (mm), 2.2 kW, 230V / 50Hz, SOUND PRESSURE LEVEL 55dB(A), MAX P0 4.8 BAR	DEGASS LINE G 1 1/4" SYS CONNECTION G 1 1/4" VESSEL CONNECTION G 1 1/4" CWS CONNECTION RP 1/2"	N/A	10 BAR	90°C	N/A	61.1kg
EV-A-01	EXPANSION VESSEL	1	A	PU-A-01	REFLEX	Reflex VG 2000 GY 6b G1 (MODEL NO. 8601005)	2000L VESSEL, 1200mm DIA X 2587mm H	G 1"	N/A	6 BAR	70°C	N/A	400kg (DRY) ~2400kg (WET)
BV-A-03	BUFFER VESSEL	1	A	PU-A-01	REFLEX	Reflex N 100 (MODEL NO. 8216300) C/W BUFFER VESSEL LOCKSHIELD VALVE (MODEL NO. 7613100)	100L VESSEL, 512mm DIA X 669mm H	R 1"	N/A	6 BAR	120°C	N/A	118kg (DRY) ~1118kg (WET)
WATER TREATMENT / FILTRATION													
REF	TYPE	QTY	SYS	LOCATION	MANUFACTURER	MODEL	DESCRIPTION	CONNECTION SIZE	FLOW RATING	PRESSURE RATING	MAX TEMP RATING	FLOW REQUIRED	WEIGHT kg
SSF-A-01	SIDESTREAM FILTER	1	A	PUMP SIDE STREAM BYPASS	VEXO	X-POT 6 (PRODUCT CODE V-XPOTXPOT6) C/W X-POT 6 COMPLIANCE PACK (PRODUCT CODE V-XPOT6(CP)PACK) & X-POT 6 CONTRACTOR PACK (PRODUCT CODE V-XPOT6(CONT)PACK)	SIDE STREAM FILTER W/MAGNETIC FILTRATION, AIR AND DIRT SEPERATOR AND DOSING UNIT, 10L DOSING CAPACITY, 86,400L MAX SYSTEM VOLUME	1"	1 L/S	7 BAR	95°C	0.52L/S (45,000L SYS VOL/24HOURS)	21kg (DRY) 34kg(WET)
ADS-A-01	AIR AND DIRT SEPERATOR	1	A	UNDERCROFT	SPIROTECH	SpiroCombi -DN125 -Magnet -Flange MODEL NO. BC125FM	AIR AND DIRT SEPARATOR W/MAGNETIC FILTRATION, KVS 350.7	DN125 PN10	0-72m3/h	10 BAR	0-110°C	64.3m3/h	71kg (DRY) ~121kg (WET)
COLD WATER													
REF	TYPE	QTY	SYS	LOCATION	MANUFACTURER	MODEL	DESCRIPTION	CONNECTION SIZE	FLOW RATING	PRESSURE RATING	MAX TEMP RATING	FLOW REQUIRED	WEIGHT kg
BT-W-01	BREAK TANK	1	W	MCW LINE	REFLEX	REFLEX FILLCONTROL P (8813100)	BREAK TANK, 654 x 617 x 423 (W X H X D) (mm)	INLET/OUTLET 1/2"	N/A	8 BAR	30°C	N/A	28kg (DRY)
WM-W-01	WATER METER	1	W	MCW LINE	HONEYWELL	MID APPROVED WATER METER, V210, WITH PR6 OUTPUT METER	ROTARY PISTON VOLUMETRIC WATER METER, PR6 PULSES OUTPUT COMPATIBLE, MAX PRESSURE 16 BAR	15mm	MIN FLOW 6.25l/h	G 1 1/2"A	50°C	1l/s	0.9kg
WS-W-01	WATER SOFTENER	1	W	MCW LINE	REFLEX	FILLSOFT HOUSING FG II, BASIC VALVE FOR MAKEUP WATER TREATMENT (MODEL NO.9125661), 2 CATRIDGE CAPACITY, C/W 2 NO. FILLSOFT WATER SOFTENING RESIN CARTRIDGE FSP 6000 (MODEL NO. 6811800)	WATER SOFTENER	RP 1/2"	360l/h	8 BAR	40°C	N/A	3.6kg

HEALTH AND SAFETY INFORMATION
ALL WORKS SHALL BE CARRIED OUT BY COMPETENT PEOPLE. IN ADDITION TO THE HAZARDS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, THE DESIGNERS HAVE REVIEWED THE HAS RISKS AND DEVELOPED A DESIGNERS RISK ASSESSMENT. THE CONTRACTOR SHALL REFER TO THE CONSTRUCTION PHASE PLAN AND ADOPT THE HAS AND DESIGNERS RISK ASSESSMENT FINDINGS IN THE DEVELOPMENT OF THEIR RAMS, BEFORE UNDERTAKING ANY WORKS. PLEASE ALSO NOTE THE FOLLOWING ->
DIFFICULTY TO MANAGE THERE MAY BE COMMON RISKS BUT BE IN AVOIDANCE LOCATIONS, ES. SCAFFOLDING, DELIVERIES, PROXIMITY OF DUAL MAINS OR POWER LINES, WORKING IN CLOSE PROXIMITY TO THE PUBLIC ETC. "NOTHING SIGNIFICANT"
UNUSUAL THERE MAY BE COMMON RISKS OCCURRING IN USUAL CIRCUMSTANCES, THEY MIGHT ALSO BE UNUSUAL BECAUSE OF THE NATURE OF THE CONSTRUCTION METHOD OR SITE CONDITIONS, ES. UNSTABLE OR CONTAMINATED GROUND, ASBESTOS, LEAD PAINT, SILICA DUST ETC. "NOTHING SIGNIFICANT"
NOT LIKELY TO BE OBVIOUS TO A CONTRACTOR OR DESIGNER THE CONTRACTOR, AT THE PRESENT STAGE, AS WELL AS THE DESIGNER, COULD NOT BE AWARE OF SOME OF THE LESS OBVIOUS RISKS, ES. STRUCTURAL ISSUES ASSOCIATED WITH WORKING AROUND EXISTING FOUNDATIONS, FRAGILE ROOFS OR FRAGILE SURFACES ETC. "NOTHING SIGNIFICANT"
OPERATIONAL ACCESS - HORIZONTAL, VERTICAL, PEDESTRIAN, VEHICLE PLANT ARE THERE SIGNIFICANT ISSUES REGARDING ACCESS? IF YES, SET OUT BELOW OR REFER TO APPROPRIATE DOCUMENT ETC. "NOTHING SIGNIFICANT"
OPERATIONAL HANDLING / LIFTING STRATEGY HAVE YOU AS FAR AS REASONABLY PRACTICABLE REDUCED MANUAL LIFTING? IDENTIFY ANY ITEMS THAT MAY REQUIRE EXCESSIVE LIFTING ARRANGEMENTS TO BE PUT IN PLACE AS WELL AS IDENTIFY ANY UNUSUAL RISKS ASSOCIATED WITH HANDLING AND LIFTING. "NOTHING SIGNIFICANT"
HEALTH AND SAFETY FILE INCLUSIONS IDENTIFY ANY HAZARDS / SIGNIFICANT RISKS ASSOCIATED WITH MAINTENANCE OR REMOVAL / DEMOLITION OF THE CONTENTS OF THIS DRAWING AT A LATER DATE. "NOTHING SIGNIFICANT"



NOTES:

- BMS PANEL HAS CONNECTION TO CRITICAL MCW PUMPS - NOT TO BE ISOLATED - STRATEGY FOR CHANGE OVER TO BE AGREED WITH NETWORK RAIL.
- CURRENT LTHW QUALITY MUST MEET BSRIA BG29 & BG50 STANDARDS TO AVOID VOIDING ASHP WARRANTY / LOWERING EFFICIENCY, SEE 50902-VE-PS-XX-TS-M-XX01 - STAGE 3 REPORT TECHNICAL SUBMISSION FOR FURTHER INFORMATION .
- ALL EQUIPMENT MUST ENTER/LEAVE THROUGH DOOR INDICATED ON FIG 1, OPENING ONTO LONDON ROAD.
- SPACE IN PLANTROOM RESERVED TO ACCOMMODATE FUTURE HEAT SUBSTATION FOR DISTRICT HEATING CONNECTION.
- ALL PENETRATIONS THROUGH WALLS / CEILINGS / FLOORS TO PROVIDE 60 MINS FIRE RATING.
- DOORWAY 0.74M (W) X 2M (H) WITH THE POSSIBILITY OF WIDER IF TIMBER FRAME REMOVED OF 1.33M(W) X 2.67M (H)

TO BE READ IN CONJUNCTION WITH:

- 50902-VE-PS-XX-DR-M-5601 P1 - EXISTING BOILER ROOM STRIP-OUT GA
- 50902-VE-PS-XX-DR-M-5603 P1 - PROPOSED UNDERCROFT GA
- 50902-VE-PS-XX-DR-M-5604 P1 - UNDERCROFT PIPEWORK ROUTE
- 50902-VE-PS-XX-SC-M-5603 P1 - PROPOSED UNDERCROFT P&ID
- 50902-VE-PS-XX-SC-M-5601 P1 - EXISTING BOILER ROOM STRIP-OUT P&ID
- 50902-VE-PS-XX-SC-M-5602 P1 - PROPOSED BOILER ROOM P&ID
- 50902-VE-PS-XX-SH-M-5601 P1 - PICCADILLY STATION SITE WIDE EQUIPMENT SCHEDULE

KEY:

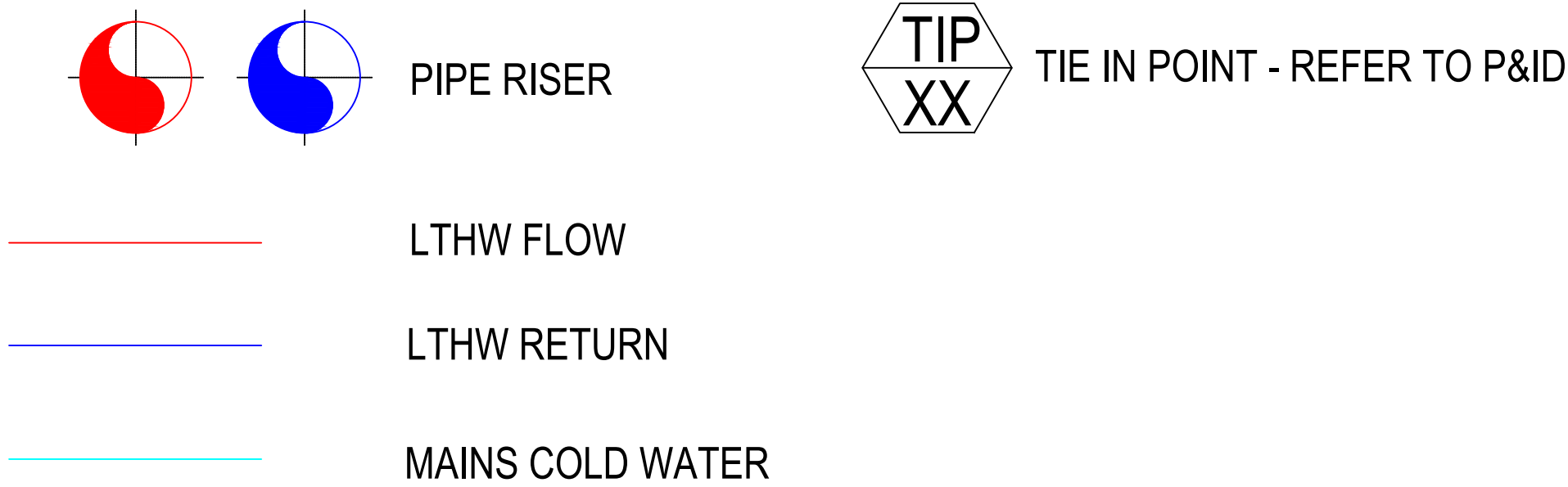


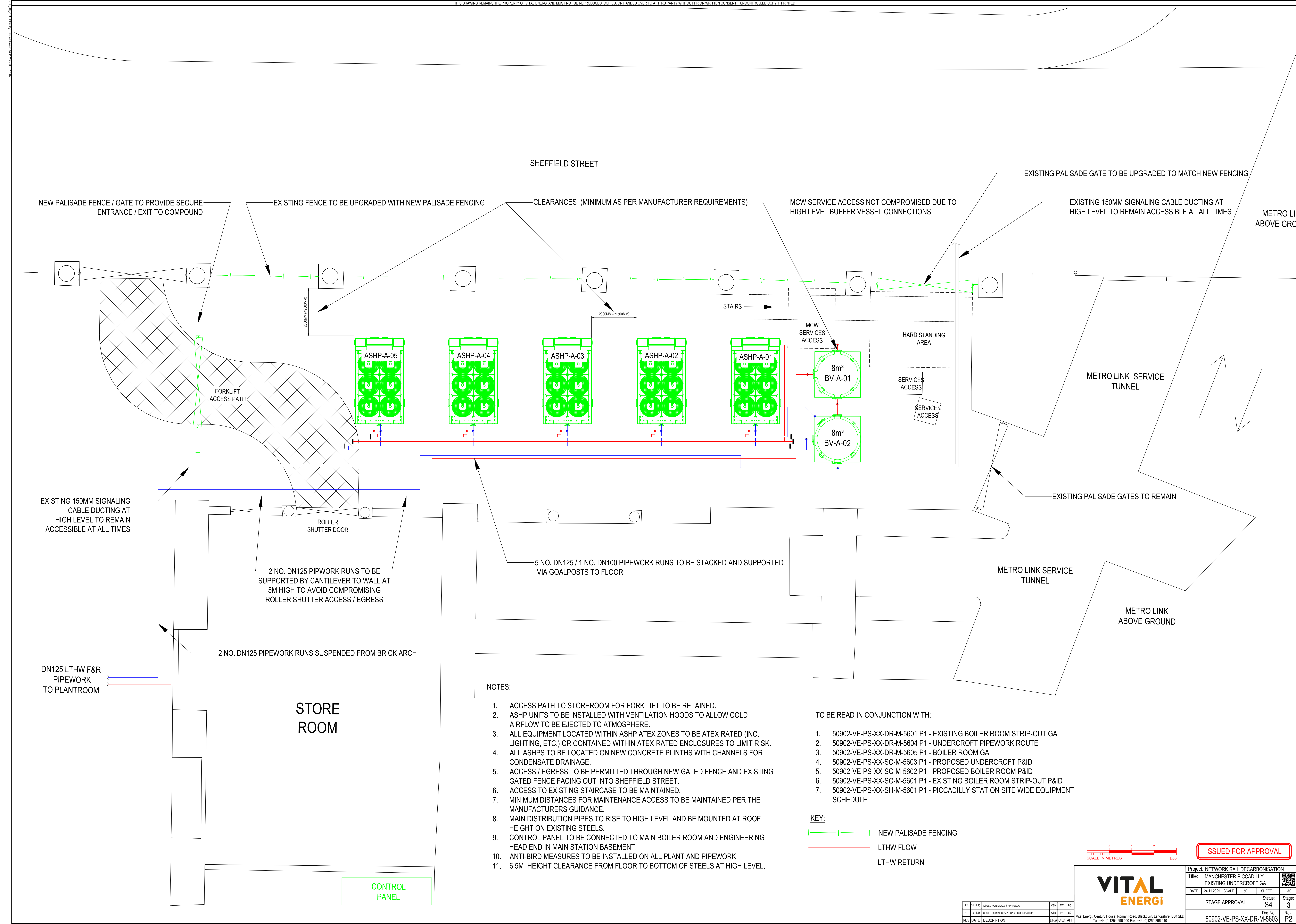
FIG 1 - REFER TO NOTE 6.

SCALE IN METRES

ISSUED FOR APPROVAL

REV	DATE	DESCRIPTION	DRW	CHKD	APP
P2	21.11.24	ISSUED FOR STAGE 3 APPROVAL	CSB	TW	BC
P1	13.11.24	ISSUED FOR INFORMATION / COORDINATION	CSB	TW	BC

VITAL ENERGI		Project: NETWORK RAIL DECARBONISATION	
Title: MANCHESTER PICCADILLY PROPOSED BOILER ROOM GA		Status: S4	
DATE: 21.11.2025		SHEET: 3	
SCALE: 1:20		Rev: P2	
Vital Energi, Century House, Roman Road, Blackburn, Lancashire, BB1 2LD		50902-VE-PS-XX-DR-M-5605	
Tel: +44 (0)1254 296 000 Fax: +44 (0)1254 296 040			



NOTES:

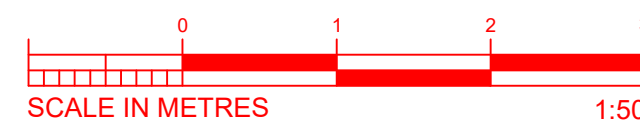
1. ACCESS PATH TO STOREROOM FOR FORK LIFT TO BE RETAINED.
2. ASHP UNITS TO BE INSTALLED WITH VENTILATION HOODS TO ALLOW COLD AIRFLOW TO BE EJECTED TO ATMOSPHERE.
3. ALL EQUIPMENT LOCATED WITHIN ASHP ATEX ZONES TO BE ATEX RATED (INC. LIGHTING, ETC.) OR CONTAINED WITHIN ATEX-RATED ENCLOSURES TO LIMIT RISK.
4. ALL ASHPs TO BE LOCATED ON NEW CONCRETE PLINTHS WITH CHANNELS FOR CONDENSATE DRAINAGE.
5. ACCESS / EGRESS TO BE PERMITTED THROUGH NEW GATED FENCE AND EXISTING GATED FENCE FACING OUT INTO SHEFFIELD STREET.
6. ACCESS TO EXISTING STAIRCASE TO BE MAINTAINED.
7. MINIMUM DISTANCES FOR MAINTENANCE ACCESS TO BE MAINTAINED PER THE MANUFACTURERS GUIDANCE.
8. MAIN DISTRIBUTION PIPES TO RISE TO HIGH LEVEL AND BE MOUNTED AT ROOF HEIGHT ON EXISTING STEELS.
9. CONTROL PANEL TO BE CONNECTED TO MAIN BOILER ROOM AND ENGINEERING HEAD END IN MAIN STATION BASEMENT.
10. ANTI-BIRD MEASURES TO BE INSTALLED ON ALL PLANT AND PIPEWORK.
11. 6.5M HEIGHT CLEARANCE FROM FLOOR TO BOTTOM OF STEELS AT HIGH LEVEL.

TO BE READ IN CONJUNCTION WITH:

1. 50902-VE-PS-XX-DR-M-5601 P1 - EXISTING BOILER ROOM STRIP-OUT GA
2. 50902-VE-PS-XX-DR-M-5604 P1 - UNDERCROFT PIPEWORK ROUTE
3. 50902-VE-PS-XX-DR-M-5605 P1 - BOILER ROOM GA
4. 50902-VE-PS-XX-SC-M-5603 P1 - PROPOSED UNDERCROFT P&ID
5. 50902-VE-PS-XX-SC-M-5602 P1 - PROPOSED BOILER ROOM P&ID
6. 50902-VE-PS-XX-SC-M-5601 P1 - EXISTING BOILER ROOM STRIP-OUT P&ID
7. 50902-VE-PS-XX-SH-M-5601 P1 - PICCADILLY STATION SITE WIDE EQUIPMENT SCHEDULE

KEY:

- NEW PALISADE FENCING
- LTHW FLOW
- LTHW RETURN



ISSUED FOR APPROVAL

VITAL ENERGI

Project: NETWORK RAIL DECARBONISATION

Title: MANCHESTER PICCADILLY EXISTING UNDERCROFT GA

DATE: 24.11.2025 SCALE: 1:50 SHEET: A0

STAGE APPROVAL Status: S4 Stage: 3

50902-VE-PS-XX-DR-M-5603 Drg-No: Rev: P2

REV DATE DESCRIPTION CDR TWR BC

P2 24.11.25 ISSUED FOR STAGE 3 APPROVAL CDR TWR BC

P1 13.11.25 ISSUED FOR INFORMATION / COORDINATION CDR TWR BC

Vital Energi, Century House, Roman Road, Blackburn, Lancashire, BB1 2LD

Tel: +44 (0)1254 296 000 Fax: +44 (0)1254 296 040

HEALTH AND SAFETY INFORMATION

ALL WORKS SHALL BE CARRIED OUT BY COMPETENT PEOPLE.
IN ADDITION TO THE HAZARDS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, THE DESIGNERS HAVE REVIEWED THE H&S RISKS AND DEVELOPED A DESIGNERS RISK ASSESSMENT. THE CONTRACTOR SHALL REFER TO THE CONSTRUCTION PHASE PLAN AND ADOPT THE H&S AND DESIGNERS RISK ASSESSMENT FINDINGS IN THE DEVELOPMENT OF THEIR RAMS, BEFORE UNDERTAKING ANY WORKS. PLEASE ALSO NOTE THE FOLLOWING :-

DIFFICULTY TO MANAGE

* NOTHING SIGNIFICANT *

* NOTHING SIGNIFICANT

UNUSUAL

THESE MAY BE COMMON RISKS OCCURRING IN UNUSUAL CIRCUMSTANCES. THEY MIGHT ALSO BE UNUSUAL BECAUSE OF THE NATURE OF THE CONSTRUCTION METHOD OR SITE CONDITIONS, EG. UNSTABLE OR CONTAMINATED GROUND, ASBESTOS, LEAD PAINT, SILICA DUST ETC.

* NOTHING SIGNIFICANT

NOT LIKELY TO BE OBVIOUS TO A CONTRACTOR OR DESIGNER

THE CONTRACTOR, AT THE PRICING STAGE, AS WELL AS DURING THE DESIGN CYCLE MAY NOT BE AWARE OF SOME OF THE LESS OBVIOUS RISKS E.G. STRUCTURAL ISSUES ASSOCIATED WITH WORKING AROUND EXISTING FOUNDATIONS, FRAGILE ROOFS OR FRAGILE SURFACES ETC.

* NOTHING SIGNIFICANT

OPERATIONAL ACCESS - HORIZONTAL, VERTICAL, PEDESTRIAN, VEHICLE / PLAN

ARE THERE SIGNIFICANT ISSUES REGARDING ACCESS? IF YES OUTLINE BELOW OR REFER TO APPROPRIATE DOCUMENT ETC.

* NOTHING SIGNIFICANT

OPERATIONAL HANDLING / LIFTING STRATEG

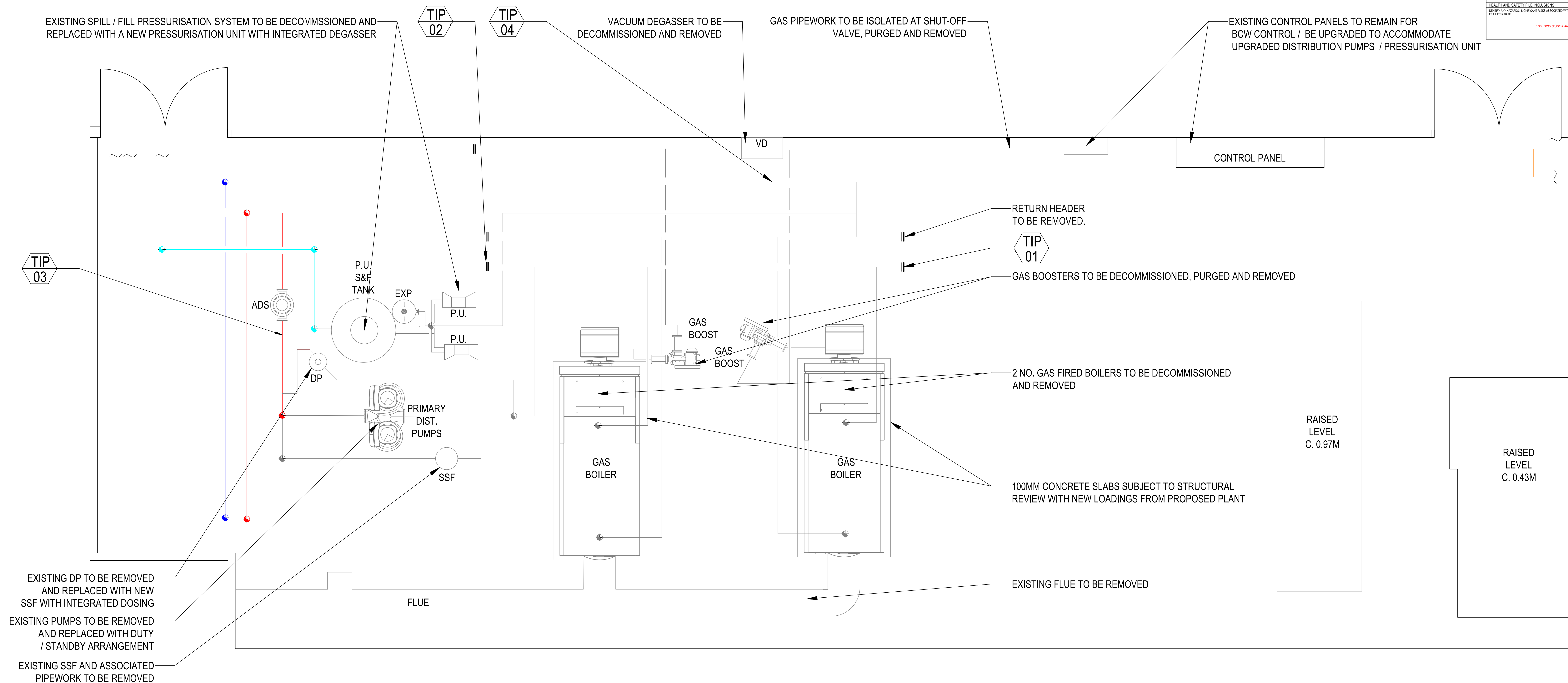
HAVE YOU IN SO FAR AS REASONABLY PRACTICABLE REDUCED MANUAL LIFTING? IDENTIFY ANY ITEMS THAT MAY REQUIRE EXCESSIVE LIFTING ARRANGEMENTS TO BE PUT IN PLACE AS WELL AS IDENTIFY ANY UNUSUAL RISKS ASSOCIATED WITH HANDLING AND LIFTING.

* NOTHING SIGNIFICANT

HEALTH AND SAFETY FILE INCLUSIONS

IDENTIFY ANY HAZARDS / SIGNIFICANT RISKS ASSOCIATED WITH MAINTENANCE OR REMOVAL / DEMOLITION OF THE CONTENTS OF THIS DRAWING AT A LATER DATE.

* NOTHING SIGNIFICANT



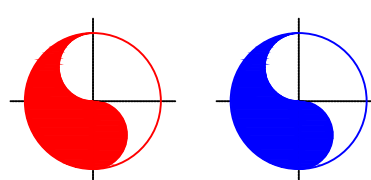
NOTES:

1. BMS PANEL HAS CONNECTION TO CRITICAL BCW PUMPS - NOT TO BE ISOLATED
2. CURRENT LTHW QUALITY MUST MEET ASHP STANDARDS TO AVOID VOIDING WARRANTY / LOWERING EFFICIENCY, SEE "50902-VE-PS-XX-TS-M-XX01 - STAGE 3 REPORT TECHNICAL SUBMISSION" FOR FURTHER INFORMATION .
3. ALL EQUIPMENT MUST ENTER/LEAVE THROUGH DOOR INDICATED ON FIG 1, OPENING ONTO LONDON ROAD.
4. PHASING OF STRIP OUT / CHANGEOVER TBA WITH NETWORK RAIL.
5. WATER QUALITY SAMPLES TO BE TAKEN PRIOR TO MODIFICATIONS.
6. EXISTING FLOW RATES TO BE RECORDED PRIOR TO MODIFICATIONS.
7. DOORWAY 0.74M (W) X 2M (H) WITH THE POSSIBILITY OF WIDER IF TIMBER FRAME REMOVED OF 1.33M(W) X 2.67M (H).

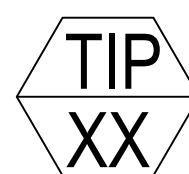
TO BE READ IN CONJUNCTION WITH:

1. 50902-VE-PS-XX-DR-M-5603 - PROPOSED UNDERCROFT GA
2. 50902-VE-PS-XX-DR-M-5604 - UNDERCROFT PIPEWORK ROUTE
3. 50902-VE-PS-XX-DR-M-5605 - PROPOSED BOILER ROOM GA
4. 50902-VE-PS-XX-SC-M-5601 - PROPOSED BOILER ROOM STRIP-OUT P&ID
5. 50902-VE-PS-XX-SC-M-5603 - PROPOSED UNDERCROFT P&ID
6. 50902-VE-PS-XX-SC-M-5602 - PROPOSED BOILER ROOM P&ID
7. 50902-VE-PS-XX-SH-M-5601 - PICCADILLY STATION SITE WIDE EQUIPMENT SCHEDULE

KEY:



PIPE RISER



TIE IN POINT - REFER TO P&ID

MAINS COLD WATER (MCW)

LOW TEMPERATURE HOT WATER (LTHW) FLOW

LOW TEMPERATURE HOT WATER (LTHW) RETURN

NATURAL GAS LINE



FIG 1 - REFER TO NOTE 7.



ISSUED FOR APPROVAL



Title: MANCHESTER PICCADILLY EXISTING

BOILER ROOM STRIP-OUT GA

DATE	04.12.2025	SCALE	1:20	SHEET
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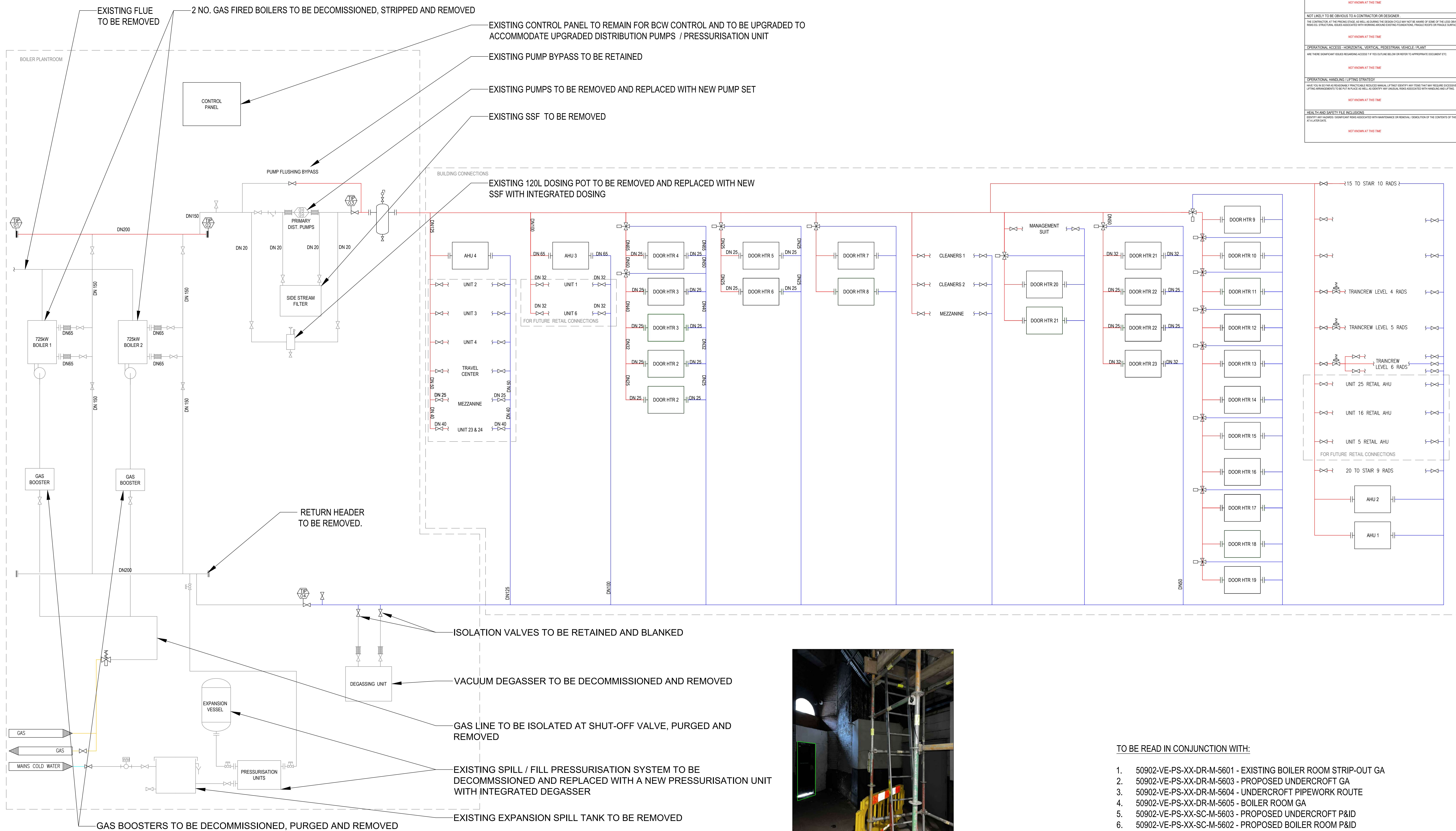
					Status:
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STAGE APPROVAL S4

Drq-No:

50902-VE-PS-XX-DR-M-5601

P2	04.12.25	ISSUED FOR STAGE 3 APPROVAL - UPDATED WITH NR LINE TYPES	CSH	TW	BC
P1	21.11.25	ISSUED FOR STAGE 3 APPROVAL	CSH	TW	BC
REV	DATE	DESCRIPTION	DRW	CKD	AP



NOTES:

1. BMS PANEL HAS CONNECTION TO CRITICAL BCW PUMPS - NOT TO BE ISOLATED
2. CURRENT LTHW QUALITY MUST MEET ASHP STANDARDS TO AVOID VOIDING WARRANTY / LOWERING EFFICIENCY, SEE "50902-VE-PS-XX-TS-M-XX01 - STAGE 3 REPORT TECHNICAL SUBMISSION" FOR FURTHER INFORMATION .
3. ALL EQUIPMENT MUST ENTER/LEAVE THROUGH DOOR INDICATED ON FIG 1, OPENING ONTO LONDON ROAD.
4. PHASING OF STRIP OUT / CHANGEOVER TBA WITH NETWORK RAIL.
5. WATER QUALITY SAMPLES TO BE TAKEN PRIOR TO MODIFICATIONS.
6. EXISTING FLOW RATES TO BE RECORDED PRIOR TO MODIFICATIONS.
7. DOORWAY 0.74M (W) X 2M (H) WITH THE POSSIBILITY OF WIDER IF TIMBER FRAME REMOVED OF 1.33M(W) X 2.67M (H).

KEY:

- | | |
|--|---|
| | MAINS COLD WATER (MCW) |
|  | LOW TEMPERATURE HOT WATER (LTHW) FLOW |
| | LOW TEMPERATURE HOT WATER (LTHW) RETURN |
| | NATURAL GAS LINE |
|  | REDUNDANT / TO BE REMOVED |
|  | TIE IN POINT |



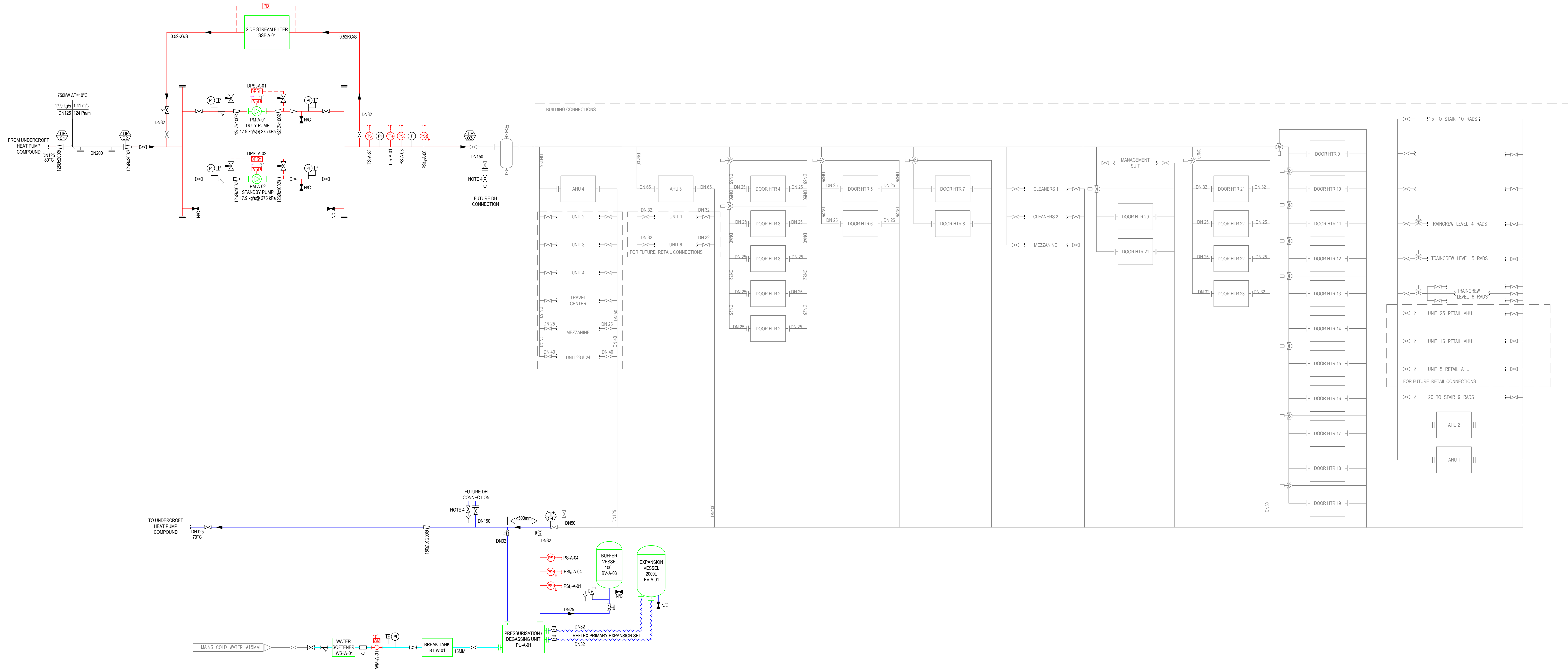
FIG 1 - SEE NOTE 7

TO BE READ IN CONJUNCTION WITH:

1. 50902-VE-PS-XX-DR-M-5601 - EXISTING BOILER ROOM STRIP-OUT GA
2. 50902-VE-PS-XX-DR-M-5603 - PROPOSED UNDERCROFT GA
3. 50902-VE-PS-XX-DR-M-5604 - UNDERCROFT PIPEWORK ROUTE
4. 50902-VE-PS-XX-DR-M-5605 - BOILER ROOM GA
5. 50902-VE-PS-XX-SC-M-5603 - PROPOSED UNDERCROFT P&ID
6. 50902-VE-PS-XX-SC-M-5602 - PROPOSED BOILER ROOM P&ID
7. 50902-VE-PS-XX-SH-M-5601 - PICCADILLY STATION SITE WIDE EQUIPMENT SCHEDULE

ISSUED FOR APPROVAL

HEALTH AND SAFETY INFORMATION
ALL WORKS SHALL BE CARRIED OUT BY COMPETENT PEOPLE. IN ADDITION TO THE HAZARDS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, THE DESIGNERS HAVE REVIEWED THE HAS RISKS AND DEVELOPED A DESIGNERS RISK ASSESSMENT. THE CONTRACTOR SHALL REFER TO THE CONSTRUCTION PHASE PLAN AND ADOPT THE HAS AND DESIGNERS RISK ASSESSMENT FINDINGS IN THE DEVELOPMENT OF THEIR RAS, BEFORE UNDERTAKING ANY WORKS. PLEASE ALSO NOTE THE FOLLOWING:-
DIFFICULTY TO HANDLE THESE MAY BE COMMON RISKS BUT BE IN AVOIDED LOCATIONS. EG. SCAFFOLDING, DELIVERIES, PROXIMITY OF GAS MAINS OR POWER LINES, WORKING IN CLOSE PROXIMITY TO THE PUBLIC ETC. NOT KNOWN AT THIS TIME
NOT LIKELY TO BE DRAVING TO A CONTRACTOR OR DESIGNER THE CONTRACTOR, AT THE RELEVANT STAGE, AS WELL AS ADOPTING THE DESIGNER'S RISK MAY NOT BE AWARE OF SOME OF THE LESS OBVIOUS RISKS EG. STRUCTURAL ISSUES ASSOCIATED WITH WORKING AROUND EXISTING FOUNDATIONS, FRAGILE ROOFS OR FRAGILE SURFACES ETC. NOT KNOWN AT THIS TIME
OPERATIONAL ACCESS - HORIZONTAL, VERTICAL, PEDESTRIAN, VEHICLE, PLANT ARE THERE SIGNIFICANT ISSUES REGARDING ACCESS? IF YES, OUTLINE BELOW OR REFER TO APPROPRIATE DOCUMENT ETC. NOT KNOWN AT THIS TIME
OPERATIONAL WORKERS' LIFTING STRATEGY HAVE YOU IN SO FAR AS REASONABLY PRACTICABLE REDUCED MANUAL LIFTING? IDENTIFY ANY ITEMS THAT MAY REQUIRE EXCESSIVE LIFTING ARRANGEMENTS TO BE PUT IN PLACE AS WELL AS IDENTIFY ANY UNUSUAL RISKS ASSOCIATED WITH HANDLING AND LIFTING. NOT KNOWN AT THIS TIME
HEALTH AND SAFETY FILE INCLUSIONS IDENTIFY ANY HAZARDOUS / SIGNIFICANT RISKS ASSOCIATED WITH MAINTENANCE OR REMOVAL / DEMOLITION OF THE CONTENTS OF THIS DRAWING AT A LATER DATE. NOT KNOWN AT THIS TIME



NOTES:

- ALL DRV'S / HEAT METERS TO BE INSTALLED IN A STRAIGHT PIPE WITH A MINIMUM 5 DIAMETERS UPSTREAM AND 3 DIAMETERS DOWNSTREAM.
- ALL SAFETY VALVES TO BE DISCHARGED TO EXTERNAL GULLEYS / EXISTING PLANTROOM DRAINAGE.
- CURRENT LTHW QUALITY MUST MEET ASHP STANDARDS TO AVOID VOIDING WARRANTY / LOWERING EFFICIENCY, SEE "50902-VE-PS-XX-TS-M-XX01 - STAGE 3 REPORT TECHNICAL SUBMISSION" FOR FURTHER INFORMATION .
- DN25 DRAIN VALVES TO BE PROPOSED TO ALLOW FOR REGULAR PURGING OF DEAD LEG.
- PHASING OF STRIP OUT / CHANGEOVER TBA WITH NETWORK RAIL.
- WATER QUALITY SAMPLES TO BE TAKEN PRIOR TO MODIFICATIONS.
- EXISTING FLOW RATES TO BE RECORDED PRIOR TO MODIFICATIONS.
- DOORWAY 0.74M (W) X 2M (H) WITH THE POSSIBILITY OF WIDER IF TIMBER FRAME REMOVED OF 1.33M(W) X 2.67M (H).

TO BE READ IN CONJUNCTION WITH:

- 50902-VE-PS-XX-DR-M-5601 P1 - EXISTING BOILER ROOM STRIP-OUT GA
- 50902-VE-PS-XX-DR-M-5603 P1 - PROPOSED UNDERCROFT GA
- 50902-VE-PS-XX-DR-M-5604 P1 - UNDERCROFT PIPEWORK ROUTE
- 50902-VE-PS-XX-DR-M-5605 P1 - BOILER ROOM GA
- 50902-VE-PS-XX-SC-M-5603 P1 - PROPOSED UNDERCROFT P&ID
- 50902-VE-PS-XX-SC-M-5601 P1 - EXISTING BOILER ROOM STRIP-OUT P&ID
- 50902-VE-PS-XX-SH-M-5601 P1 - PICCADILLY STATION SITE WIDE EQUIPMENT SCHEDULE

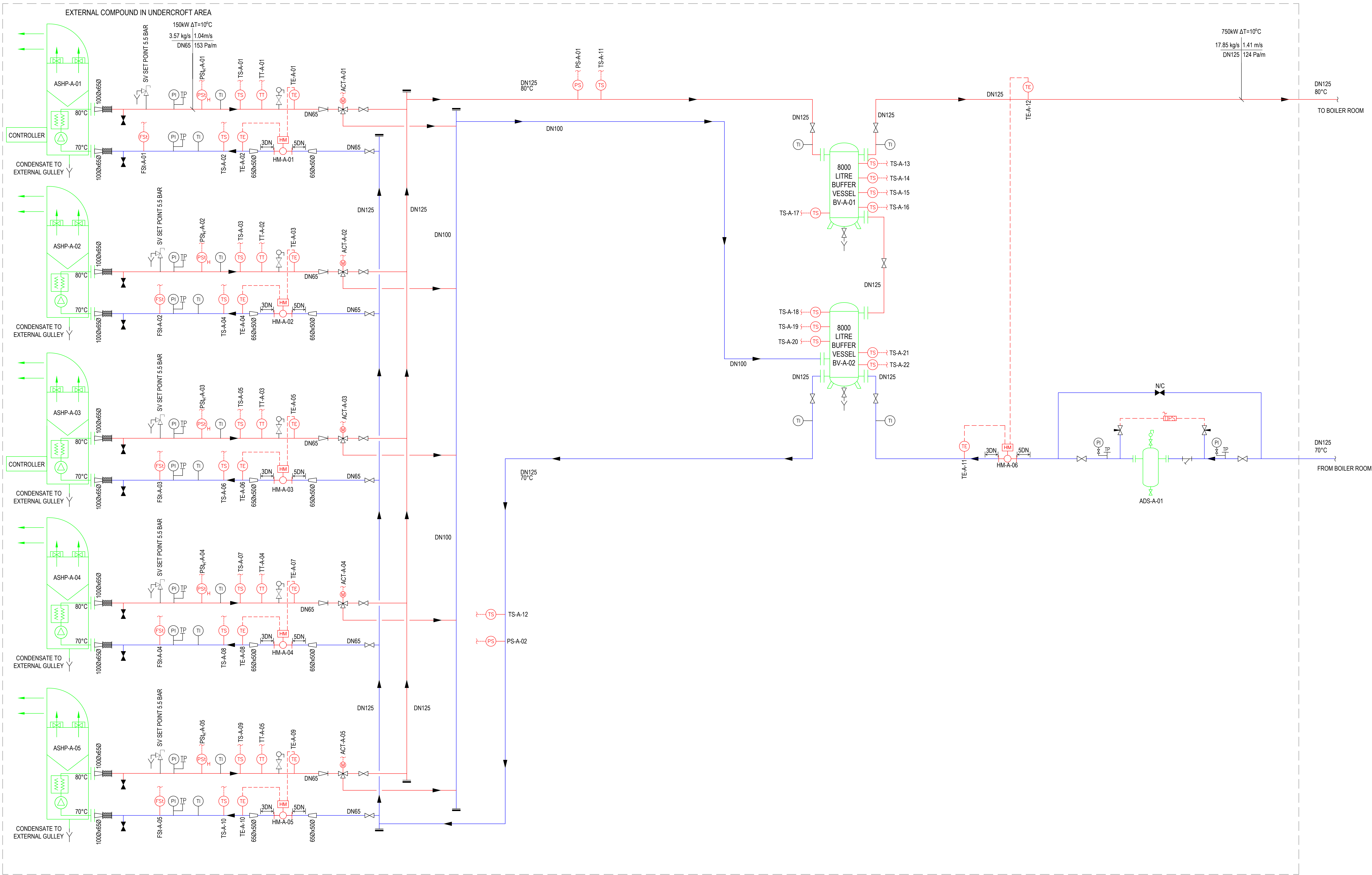
KEY:

- LTHW RETURN
- LTHW FLOW
- MAINS COLD WATER
- TIE IN POINT



FIG 1 - SEE NOTE 8

ISSUED FOR APPROVAL



HEALTH AND SAFETY INFORMATION	
ALL WORKS SHALL BE CARRIED OUT BY COMPETENT PEOPLE. IN ADDITION TO THE HAZARDS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, THE DESIGNERS HAVE REVIEWED THE HAS RISKS AND DEVELOPED A DESIGNERS RISK ASSESSMENT. THE CONTRACTOR SHALL REFER TO THE CONSTRUCTION PHASE PLAN AND ADOPT THE HAS AND DESIGNERS RISK ASSESSMENT FINDINGS IN THE DEVELOPMENT OF THEIR RISKS, BEFORE UNDERTAKING ANY WORKS. PLEASE ALSO NOTE THE FOLLOWING:-	
DIFFICULTY TO HANDLE THESE MAY BE COMMON RISKS BUT BE IN AVOIDED LOCATIONS, E.G. SCAFFOLDING, DELIVERIES, PROXIMITY OF GAS MAINS OR POWER LINES, WORKING IN CLOSE PROXIMITY TO THE PUBLIC ETC.	
NOT KNOWN AT THIS TIME	
THESE MAY BE COMMON RISKS OCCURRING IN USUAL CIRCUMSTANCES, THEY MIGHT ALSO BE UNUSUAL BECAUSE OF THE NATURE OF THE CONSTRUCTION METHOD OR SITE CONDITIONS, E.G. WORKING ON CONTAMINATED GROUND, ADJACENT LAND PLOTS, BLOCK OUT ETC.	
NOT KNOWN AT THIS TIME	
NOT LIKELY TO BE OBVIOUS TO A CONTRACTOR OR DESIGNER. THE CONTRACTOR, AT THE RELEVANT STAGE, SHOULD ASSESS THE DESIGN/DETAILS MAY NOT BE AWARE OF SOME OF THE LESS OBVIOUS RISKS E.G. STRUCTURAL ISSUES ASSOCIATED WITH WORKING AROUND EXISTING FOUNDATIONS, FRAGILE ROOFS OR FRAGILE SURFACES ETC.	
NOT KNOWN AT THIS TIME	
OPERATIONAL ACCESS - HORIZONTAL, VERTICAL, PROXIMITY, VEHICLE, PLANT ARE THERE SIGNIFICANT ISSUES REGARDING ACCESS? IF YES OUTLINE BELOW OR REFER TO APPROPRIATE DOCUMENT ETC.	
NOT KNOWN AT THIS TIME	
OPERATIONAL HAZARDS / LIFTING STRATEGY HAVE YOU IN SO FAR AS REASONABLY PRACTICABLE REDUCED MANUAL LIFTING? IDENTIFY ANY ITEMS THAT MAY REQUIRE EXCESSIVE LIFTING ARRANGEMENTS TO BE PUT IN PLACE AS WELL AS IDENTIFY ANY UNUSUAL RISKS ASSOCIATED WITH HANDLING AND LIFTING.	
NOT KNOWN AT THIS TIME	
HEALTH AND SAFETY FILE INCLUSIONS IDENTIFY ANY HAZARDS / SIGNIFICANT RISKS ASSOCIATED WITH MAINTENANCE OR REMOVAL / DEMOLITION OF THE CONTENTS OF THIS DRAWING AT A LATER DATE.	
NOT KNOWN AT THIS TIME	

TO BE READ IN CONJUNCTION WITH:

- 50902-VE-PS-XX-DR-M-5601 P1 - EXISTING BOILER ROOM STRIP-OUT GA
- 50902-VE-PS-XX-DR-M-5603 P1 - PROPOSED UNDERCROFT GA
- 50902-VE-PS-XX-DR-M-5604 P1 - UNDERCROFT PIPEWORK ROUTE
- 50902-VE-PS-XX-DR-M-5605 P1 - BOILER ROOM GA
- 50902-VE-PS-XX-SC-M-5602 P1 - PROPOSED BOILER ROOM P&ID
- 50902-VE-PS-XX-SC-M-5601 P1 - EXISTING BOILER ROOM STRIP-OUT P&ID
- 50902-VE-PS-XX-SH-M-5601 P1 - PICCADILLY STATION SITE WIDE EQUIPMENT SCHEDULE

KEY:

- LTHW RETURN
- LTHW FLOW
- TIP XX
TIE IN POINT

NOTES:

- CURRENT LTHW SHALL BE INLINE BSRIA BG29 / BG50 WHICH IS A MANUFACTURER REQUIREMENT TO ENSURE WARRANTY VALIDITY / EFFICIENCY.
- ALL HEAT PUMPS TO BE FITTED WITH VENTILATION HOOD OVER FANS WITH DUCTING TO PREVENT COLD AIR SHORT CIRCUITING WITHIN UNDERCROFT AREA.
- ALL DRV'S / HEAT METERS TO BE INSTALLED IN A STRAIGHT PIPE WITH A MINIMUM 5 DIAMETERS UPSTREAM AND 3 DIAMETERS DOWNSTREAM.
- WATER QUALITY SAMPLES TO BE TAKEN PRIOR TO MODIFICATIONS.
- EXISTING FLOW RATES TO BE RECORDED PRIOR TO MODIFICATIONS.

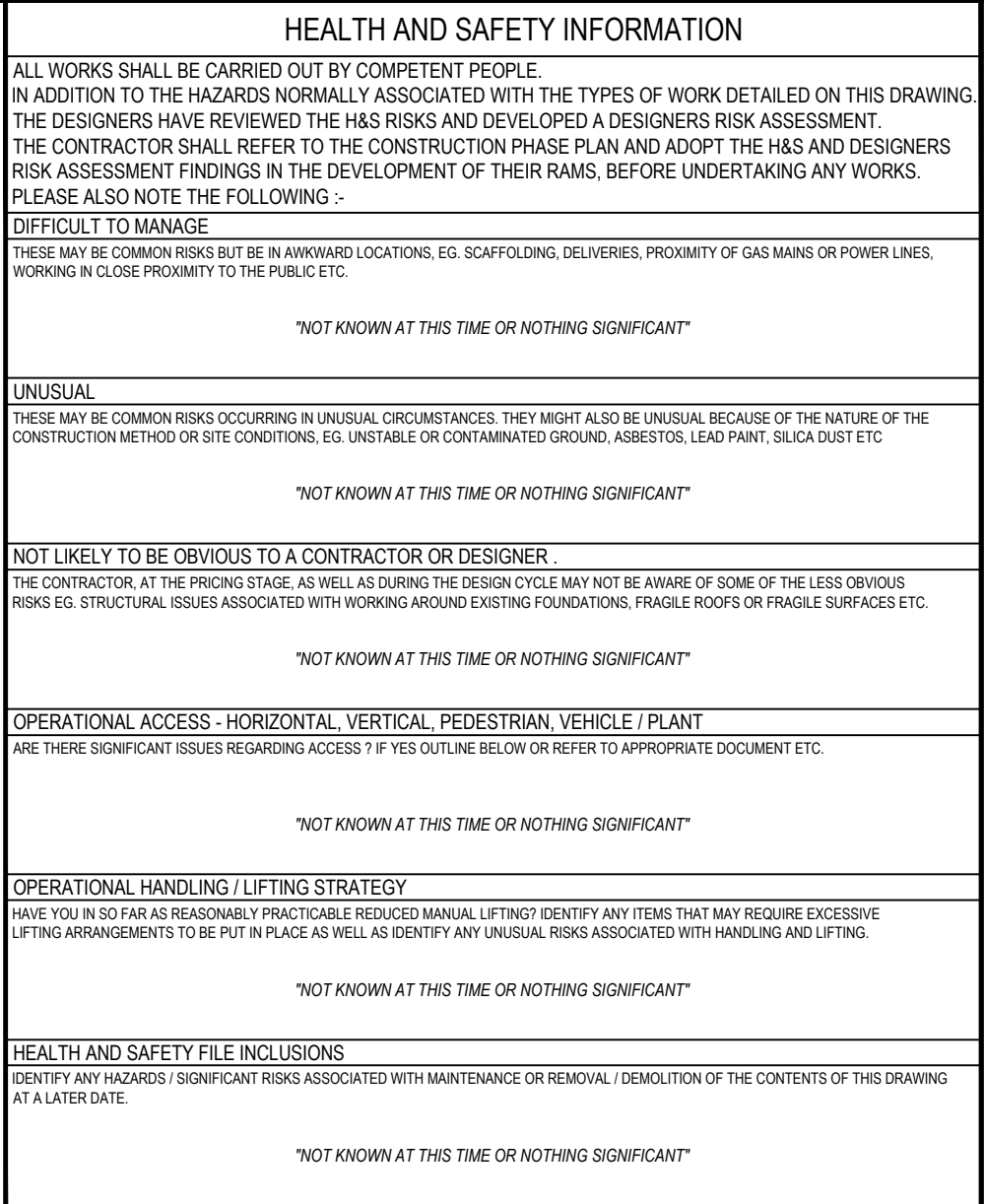
ISSUED FOR APPROVAL

VITAL ENERGI

Project: NETWORK RAIL DECARBONISATION			
Title: MANCHESTER PICCADILLY PROPOSED UNDERCROFT P&ID			
DATE	21/11/2025	SCALE	N.T.S.
SHEET	40	STATUS	S4
STAGE APPROVAL	3	Rev	P1
50902-VE-PS-XX-SC-M-5603			

P1	21/11/25	ISSUED FOR STAGE 3 APPROVAL	CSB	TW	BC
REV	DATE	DESCRIPTION	DRN	CHK	APP

Vital Energi, Century House, Roman Road, Blackburn, Lancashire, BB1 2LD
Tel: +44 (0)1254 296 000 Fax: +44 (0)1254 296 040



1. THE ELECTRICAL INSTALLATION WILL BE INSTALLED IN ACCORDANCE WITH THE CURRENT EDITION OF BS7671 (IET WIRING REGULATIONS)
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL AND STRUCTURAL DRAWINGS.

	ELECTRICAL DISTRIBUTION BOARD
	ELECTRICAL SWITCHGEAR / EQUIPMENT
	BMS CONTROL PANEL
	EARTH BAR

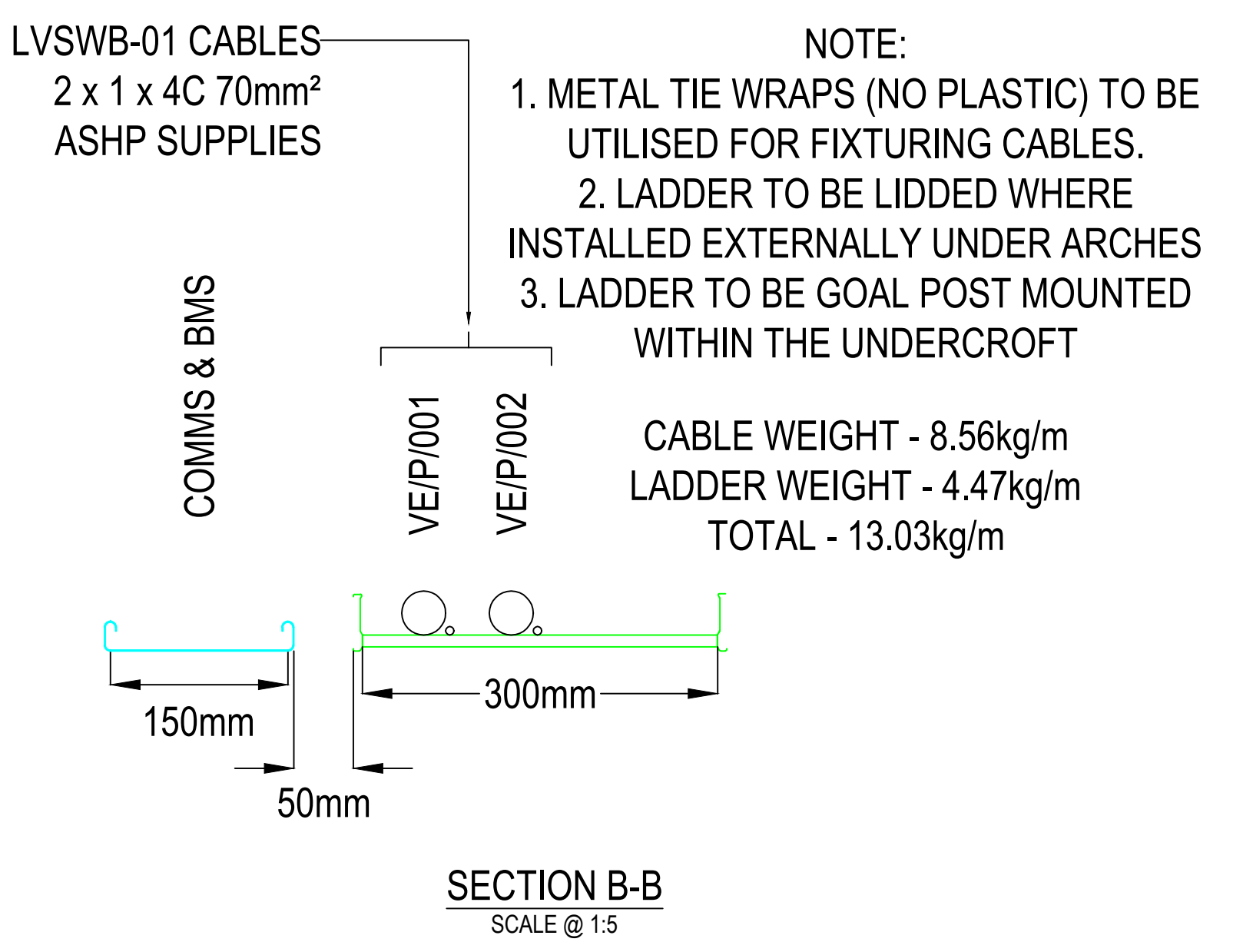
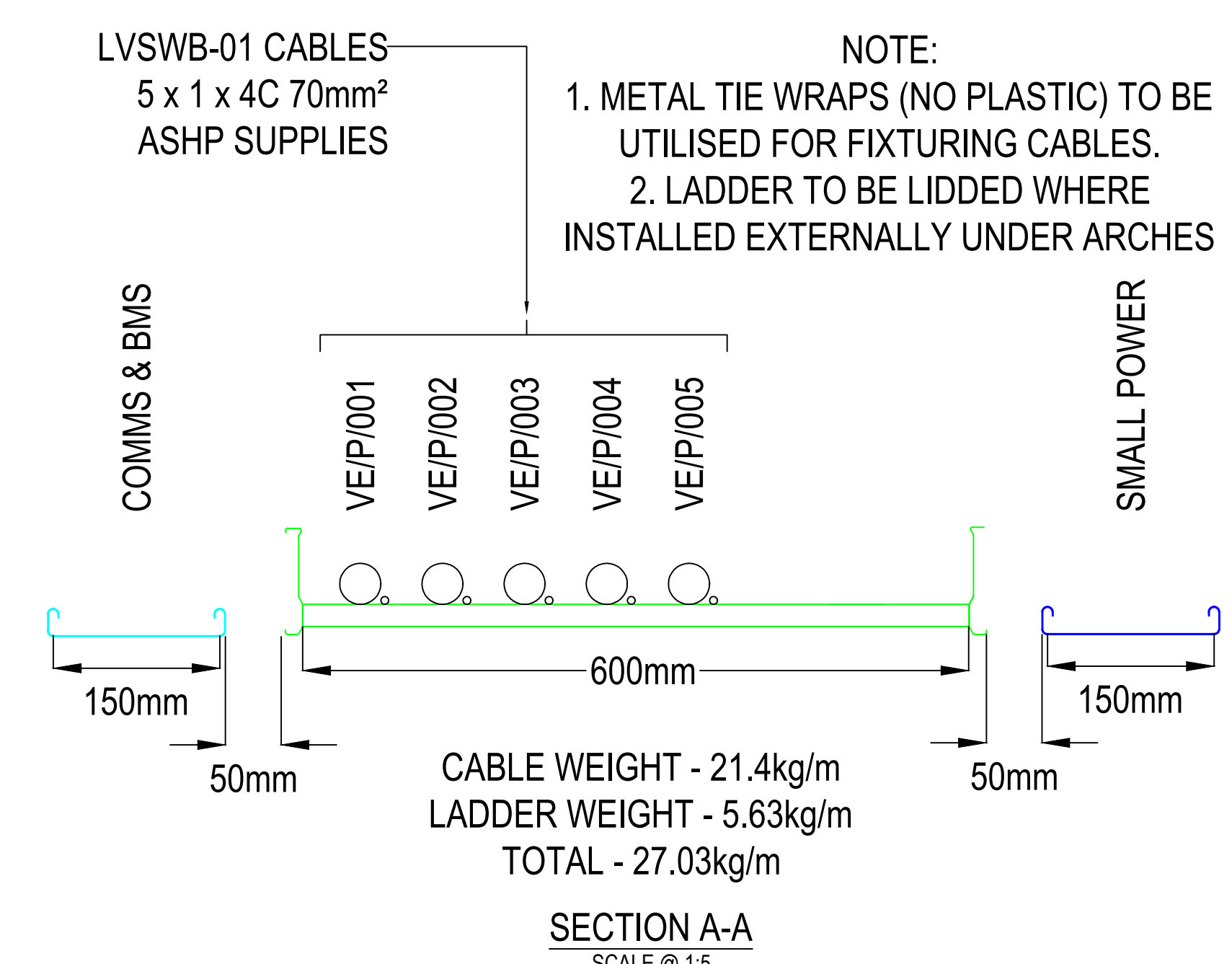
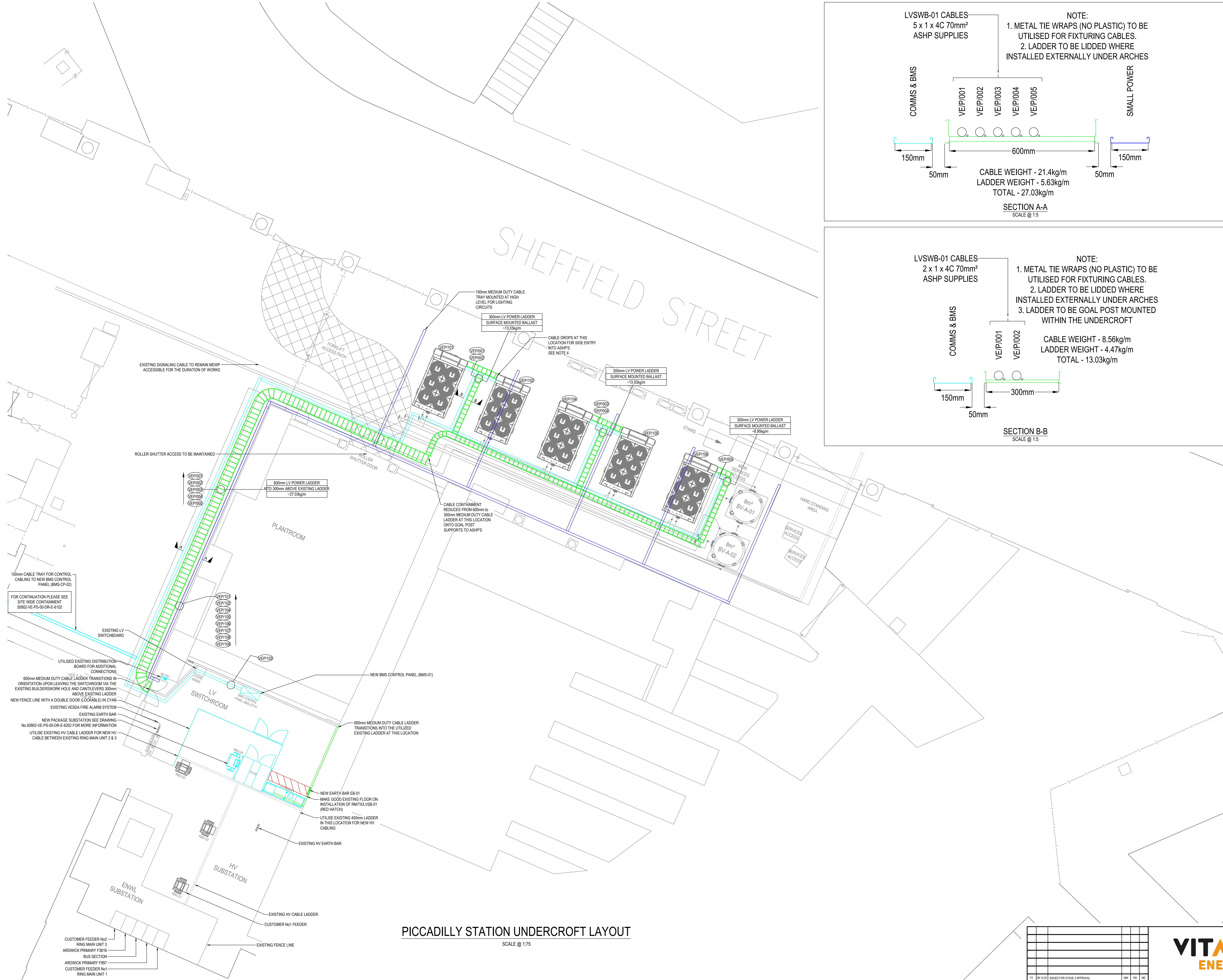
1. EXISTING HV CABLEING IS 300mm² 3C PICAS FROM RECORD INFORMATION, THIS SHALL BE CONFIRMED BEFORE THE HV CABLEING SELECTIONS ARE FINALISED AT NEXT DESIGN STAGE.
2. EXISTING HV RING PROTECTION CT's & CABLEING CURRENTLY UNKNOWN, THIS SHALL BE CONFIRMED BEFORE THE HV CABLEING SELECTIONS ARE FINALISED AT NEXT DESIGN STAGE.
3. SMALL POWER, LIGHTING, SECURITY, FIRE & GAS DETECTION REQUIREMENTS TO BE CONFIRMED AND IMPLEMENTED DURING STAGE 3 DESIGN.
4. MODEL FOR CLOSE COUPLED RMU / CAST RESIN TRANSFORMER AND LV SWITCHBOARD TBC.

50902-VE-PS-XX-SC-E-6001 AD HV & LV SINGLE LINE DIAGRAM



VITAL
ENERGi

Project: PICCADILLY STATION					
Title: PICCADILLY STATION ELECTRICAL EQUIPMENT LAYOUT					
DATE	24.07.2025	SCALE	1:100	SHEET	A1
Status: S4 STAGE APPROVAL					Stage: 3
Drg-No: 50902-VE-PS-B1-DR-E-5001					Rev: P4



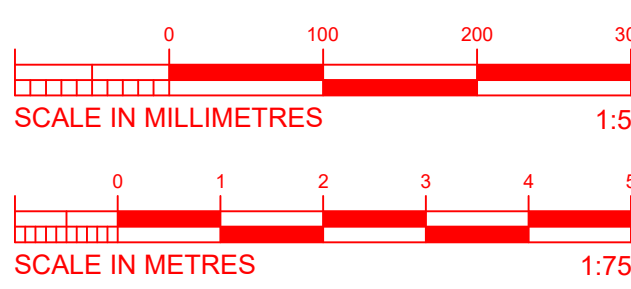
HEALTH AND SAFETY INFORMATION	
ALL WORKS SHALL BE CARRIED OUT BY COMPETENT PEOPLE. IN ADDITION TO THE HAZARDS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, THE DESIGNER HAS REVIEWED THE HAZARD AND DEVELOPED A DESIGNER'S RISK ASSESSMENT. THE CONTRACTOR SHALL REFER TO THE CONSTRUCTION PHASE PLAN AND ADOPT THE HAS AND DESIGNERS RISK ASSESSMENT FINDINGS IN THE DEVELOPMENT OF THEIR RISK, BEFORE UNDERTAKING ANY WORKS. PLEASE ALSO NOTE THE FOLLOWING ->	
DIFFICULT TO MANAGE THERE MAY BE COMMON RISKS THAT ARE IN AVOIDABLE LOCATIONS, E.G. SCAFFOLDING, DELIVERIES, PROXIMITY OF GAS MAINS OR POWER LINES, WARNING IN CLOSE PROXIMITY TO THE PUBLIC ETC. NOT KNOWN AT THIS TIME OR NOTHING SIGNIFICANT	
UNUSUAL THERE MAY BE COMMON RISKS OCCURRING IN UNUSUAL CIRCUMSTANCES. THEY WOULD ALSO BE DANGEROUS BECAUSE OF THE NATURE OF THE CONSTRUCTION METHOD OR SITE CONDITIONS, E.G. UNSTABLE OR CONFINED TO GROUND, ASBESTOS, LEAD PAINT, SILICA DUST ETC. PLEASE REFER TO THE OPERATIONAL SITE SPECIFIC ASBESTOS MANAGEMENT PLAN FOR MORE INFORMATION	
NOT LIKELY TO BE OBVIOUS TO A CONTRACTOR OR DESIGNER. THE CONTRACTOR, AT THE PROGRESS STAGE, AS WELL AS DURING THE DESIGN CYCLE, MAY NOT BE AWARE OF SOME OF THE LESS OBVIOUS RISKS, E.G. STRUCTURAL ISSUES ASSOCIATED WITH EXISTING FOUNDATION TYPING, FINAL SCOPE OF PAVEMENTS ETC. NOT KNOWN AT THIS TIME OR NOTHING SIGNIFICANT	
OPERATIONAL ACCESS - HORIZONTAL, VERTICAL, PEDESTRIAN, VEHICLE / PLANT ARE THERE SIGNIFICANT ISSUES REGARDING ACCESS? IF YES OUTLINE BELOW OR REFER TO APPROPRIATE DOCUMENT ETC. NOT KNOWN AT THIS TIME OR NOTHING SIGNIFICANT	
OPERATIONAL HANDLING / LIFTING STRATEGY WHAT YOU DO BY MEANS OF MANIPULATING OBJECTS, INCLUDING LIFTING, CARRYING, ANY OTHER TASKS THAT MAY BE REQUIRED DURING LIFTING ARRANGEMENTS TO BE PUT IN PLACE AS WELL AS IDENTIFY ANY UNUSUAL RISKS ASSOCIATED WITH HANDLING AND LIFTING. PROCEED WITH CAUTION DURING OPERATIONAL HANDLING MANOEUVRES AS THE UNDERCROFT IS A LISTED BUILDING	
HEALTH AND SAFETY FILE INCLUSIONS IDENTIFY ANY HAZARDS / DANGEROUS RISKS ASSOCIATED WITH MAINTENANCE OR PERSONAL / DESTRUCTION OF THE CONTENTS OF THIS DRAWING AT A LATER DATE. PLEASE REFER TO THE OPERATIONAL SITE SPECIFIC ASBESTOS MANAGEMENT PLAN FOR MORE INFORMATION	

- NOTES**
- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL AND STRUCTURAL DRAWINGS.
 - CONTAINMENT ROUTES AND HEIGHTS TO BE CO-ORDINATED WITH 3D LAYOUT DRAWINGS. FINAL POSITIONS ARE TO BE CO-ORDINATED AND AGREED ON SITE. HOWEVER IF ANY OF THE MAJOR ROUTES SHOWN ARE ALTERED, PLEASE CONTACT THE DESIGN DEPARTMENT TO CHECK ANY EFFECT ON THE CABLE SIZING CALCULATIONS. ALL INVERT LEVELS INDICATED ARE TO THE UNDERSIDE OF THE ASSOCIATED CONTAINMENT.
 - CONTROL AND LV CABLES INCLUDING ALL SECONDARY CONTAINMENT MUST BE SEGREGATED IN ACCORDANCE WITH BS7671, INCLUDING LATEST AMENDMENTS.
 - ALL LOCALISED SUPPORTS, TRAY AND TRUNKING DROPS AND SECONDARY CONTAINMENT TO PLANT AND EQUIPMENT TO BE AGREED ON SITE. NOT CURRENTLY SHOWN FOR CLARITY.
 - EVERY PIECE OF EQUIPMENT AND CONTROL GEAR SHALL BE LABELED CLEARLY BY MEANS OF ENGRAVED TRAFFIC/LABEL SCREW FIXED TO THE SURFACE.
 - ISOLATORS SERVING VARIOUS EQUIPMENT TO BE MOUNTED ONTO UNISTRUT FRAMEWORK LOCAL TO THE EQUIPMENT. ISOLATOR TO EQUIPMENT CONNECTION VIA COPEX.
 - ALL LADDER RACK, TRAY AND TRUNKING JOINTS SHALL BE LINKED ACROSS WITH EARTH STRAPS.

CONTAINMENT LEGEND:	
	MEDIUM DUTY CABLE LADDER FOR LV SUBMANS - SIZES AND MOUNTING HEIGHTS ON LAYOUT
	1 x 150mm GALVANISED STEEL MEDIUM DUTY CABLE TRAY FOR POWER MOUNTED AT 200mm AFFL
	LV MEDIUM DUTY GALVANISED STEEL PERFORATED TRAY MOUNTED AT 150mm AFFL - SIZES AND MOUNTING HEIGHT ON LAYOUT FOR BMS COMMS FIBRE AND BMS WIRING
	BMS CONTROL PANEL
	ELECTRICAL DISTRIBUTION BOARD
	ELECTRICAL SWITCHBOARD
	CABLE MARKERS
	SECTION ARROWS/DETAIL

- REFERENCE DOCUMENTS:**
- 50902-VE-PS-XX-SC-E-6001 PICCADILLY STATION HV & LV SINGLE LINE DIAGRAM
 - 50902-VE-PS-00-DR-E-6201 PICCADILLY STATION HV RMU TRANSFORMER LAYOUT
 - 50902-VE-PS-XX-SH-E-6202 PICCADILLY STATION LV CABLE CALCULATIONS
 - MANCHESTER PICCADILLY RAIL STATION - OPERATIONAL SITE SPECIFIC ASBESTOS MANAGEMENT PLAN

- HOLDS:**
- INVERT LEVELS OF CONTAINMENT TO BE ADDED AT STAGE 4
 - GOAL POST SUPPORTS TO BE ADDED AT STAGE 4



ISSUED FOR STAGE APPROVAL

PICCADILLY STATION UNDERCROFT LAYOUT
SCALE @ 1:75

Project: PICCADILLY STATION		Title: PICCADILLY STATION CONTAINMENT LAYOUT		Rev: P1	
Date: 08.12.2025	Scale: 1:75	Sheet: A0	Status: S4	Stage: 3	Rev: P1
STAGE APPROVAL		Status: S4		Stage: 3	
50902-VE-PS-00-DR-E-6101		Dr: No: 50902-VE-PS-00-DR-E-6101		Rev: P1	
P1 08.12.25 ISSUED FOR STAGE 3 APPROVAL		MR FM VE		Vital Energi, Century House, Roman Road, Blackburn, Lancashire, BB1 2LD	
REV DATE DESCRIPTION		DRN CHK APP		Tel: +44 (0)1254 296 000 Fax: +44 (0)1254 296 040	

HEALTH AND SAFETY INFORMATION	
ALL WORKS SHALL BE CARRIED OUT BY COMPETENT PEOPLE. IN ADDITION TO THE HAZARDS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, THE DESIGNERS HAVE REVIEWED THE HAS RISKS AND DEVELOPED A DESIGNERS RISK ASSESSMENT. THE CONTRACTOR SHALL REFER TO THE CONSTRUCTION PHASE PLAN AND ADOPT THE HAS AND DESIGNERS RISK ASSESSMENT FINDINGS IN THE DEVELOPMENT OF THEIR RAMS, BEFORE UNDERTAKING ANY WORKS. PLEASE ALSO NOTE THE FOLLOWING -	
DIFFICULT TO MANAGE THERE MAY BE COMMON RISKS BUT IF IN A PARTICULAR LOCATION, E.G. SCAFFOLDING, DELIVERIES, PROXIMITY OF GAS MAINS OR POWER LINES, WORKING IN CLOSE PROXIMITY TO THE PUBLIC ETC.	"NOT KNOWN AT THIS TIME OR NOTHING SIGNIFICANT"
UNUSUAL THERE MAY BE COMMON RISKS OCCURRING IN UNUSUAL CIRCUMSTANCES. THEY MIGHT ALSO BE UNUSUAL, BECAUSE OF THE NATURE OF THE CONSTRUCTION METHOD OR SITE CONDITIONS, E.G. UNSTABLE OR UNDEVELOPED GROUND, ASBESTOS, LEAD PAINT, BLACK EXIST ETC.	PLEASE REFER TO THE OPERATIONAL SITE SPECIFIC ASBESTOS MANAGEMENT PLAN FOR MORE INFORMATION
NOT LIKELY TO BE OBVIOUS TO A CONTRACTOR OR DESIGNER THE CONTRACTOR, AT THE PRELIMINARY STAGE, AS WELL AS DURING THE DESIGN/DETAILS MAY NOT BE AWARE OF SOME OF THE LESS OBVIOUS RISKS, E.G. STRUCTURAL ISSUES ASSOCIATED WITH WORKING AROUND EXISTING FOUNDATIONS, FRAGILE ROOFS OR FRAGILE SURFACES ETC.	"NOT KNOWN AT THIS TIME OR NOTHING SIGNIFICANT"
OPERATIONAL ACCESS, JORDITIONAL, VERTICAL, PROCESTRAN, VEHICLE IN JANT ARE THERE SIGNIFICANT ISSUES REGARDING ACCESS IF VES OUTLINE BELOW OR REFER TO APPROPRIATE DOCUMENT ETC.	"NOT KNOWN AT THIS TIME OR NOTHING SIGNIFICANT"
OPERATIONAL HANDLING/LIFTING STRATEGY HAVE YOU RISK ASSESSMENT/FRAGILE REDUCES MANUAL LIFTING? IDENTIFY ANY ITEMS THAT MAY REQUIRE EXCESSIVE LIFTING ARRANGEMENTS TO BE PUT IN PLACE AS WELL AS IDENTIFY ANY UNUSUAL RISKS ASSOCIATED WITH HANDLING AND LIFTING.	PROCEED WITH CAUTION DURING OPERATIONAL HANDLING MANEUVERED AT THE UNDERCROFT IF A LIFTED BUILDING
HEALTH AND SAFETY FILE INCLUSIONS IDENTIFY ANY HAZARDS / SIGNIFICANT RISKS ASSOCIATED WITH MAINTENANCE OR REMOVAL / DEMOLITION OF THE CONTENTS OF THIS DRAWING AT A LATER DATE.	PLEASE REFER TO THE OPERATIONAL SITE SPECIFIC ASBESTOS MANAGEMENT PLAN FOR MORE INFORMATION

NOTES:

- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL AND STRUCTURAL DRAWINGS.
- ALL WORK BY ELECTRICAL CONTRACTOR MUST COMPLY WITH BS7671 INCLUDING LATEST AMENDMENTS AND RELEVANT BUILDING REGULATIONS.
- THE MAIN TRUNKING CONTAINMENT TO BE UTILISED WHERE POSSIBLE. PLEASE REFER TO DRAWING 50927-VE-EC-00-DR-E-6101.
- ELEC BOILERS CABLE ENTRY FROM BELOW. ALLOW FOR CABLE LADDER DROP TO FINISHED FLOOR LEVEL.
- INTERCONNECTION CABLE (OUTDOOR - INDOOR) 4 CORE 2.5mm² HBBN-F BY ELECTRICAL SUB-CONTRACTOR. 3 INDOOR CASSETTES AT GROUND FLOOR PRESENTATION SPACE.

LEGEND:

- TWIN SWITCHED 230V SOCKET OUTLET AS MK METAL CLAD ALM SURFACE MOUNTED AT 450mm AFFL
- DISTRIBUTION BOARD
- BMS CONTROL PANEL
- SWITCHBOARD
- IP66 ROTARY ISOLATOR SWITCH
- EARTH BAR
- CAT 6 DATA OUTLET INSTALLED BY NETWORK RAIL COMMS TEAM R445 MODULE MOUNTING HEIGHT AS INDICATED. 2 DENOTES TWIN OUTLET.

REFERENCES:

- 50902-VE-PS-XX-SC-E-6001 PICCADILLY STATION HV & LV SINGLE LINE DIAGRAM
50902-VE-PS-XX-SH-E-6201 - ELECTRICAL LOAD SCHEDULE
50902-VE-PS-XX-SH-E-6202 PICCADILLY STATION LV CABLE CALCULATIONS

HOLDS:

- EQUIPMENT LOAD TBC ON PROCUREMENT OF PLANT
- LV CABLE SCHEDULE TO FOLLOW AT STAGE 4

ISOLATOR ID	EQUIPMENT	MOUNTING HEIGHT	SWITCHGEAR SOURCE
ISO-01	AIR SOURCE HEAT PUMP (ASHP-A-01) (VEP1001)	INTEGRATED TO EQUIPMENT	LVSWB-01
ISO-02	AIR SOURCE HEAT PUMP (ASHP-A-02) (VEP1002)	INTEGRATED TO EQUIPMENT	LVSWB-01
ISO-03	AIR SOURCE HEAT PUMP (ASHP-A-03) (VEP1003)	INTEGRATED TO EQUIPMENT	LVSWB-01
ISO-04	AIR SOURCE HEAT PUMP (ASHP-A-04) (VEP1004)	INTEGRATED TO EQUIPMENT	LVSWB-01
ISO-05	AIR SOURCE HEAT PUMP (ASHP-A-05) (VEP1005)	INTEGRATED TO EQUIPMENT	LVSWB-01
ISO-06	BMS CONTROL PANEL (BMS-CP-01) (VEP1103)	FRONT FACIA	DB ND501/2-L3

FUSE ID	EQUIPMENT	MOUNTING HEIGHT	SWITCHGEAR SOURCE
RAD-01	UNDER CROFT SOCKETS (VEP1108)	450mm AFFL TO CENTRE OF OUTLET	DB ND-501/4-L3



ISSUED FOR APPROVAL

PICCADILLY STATION SMALL POWER LAYOUT

SCALE @ 1:50



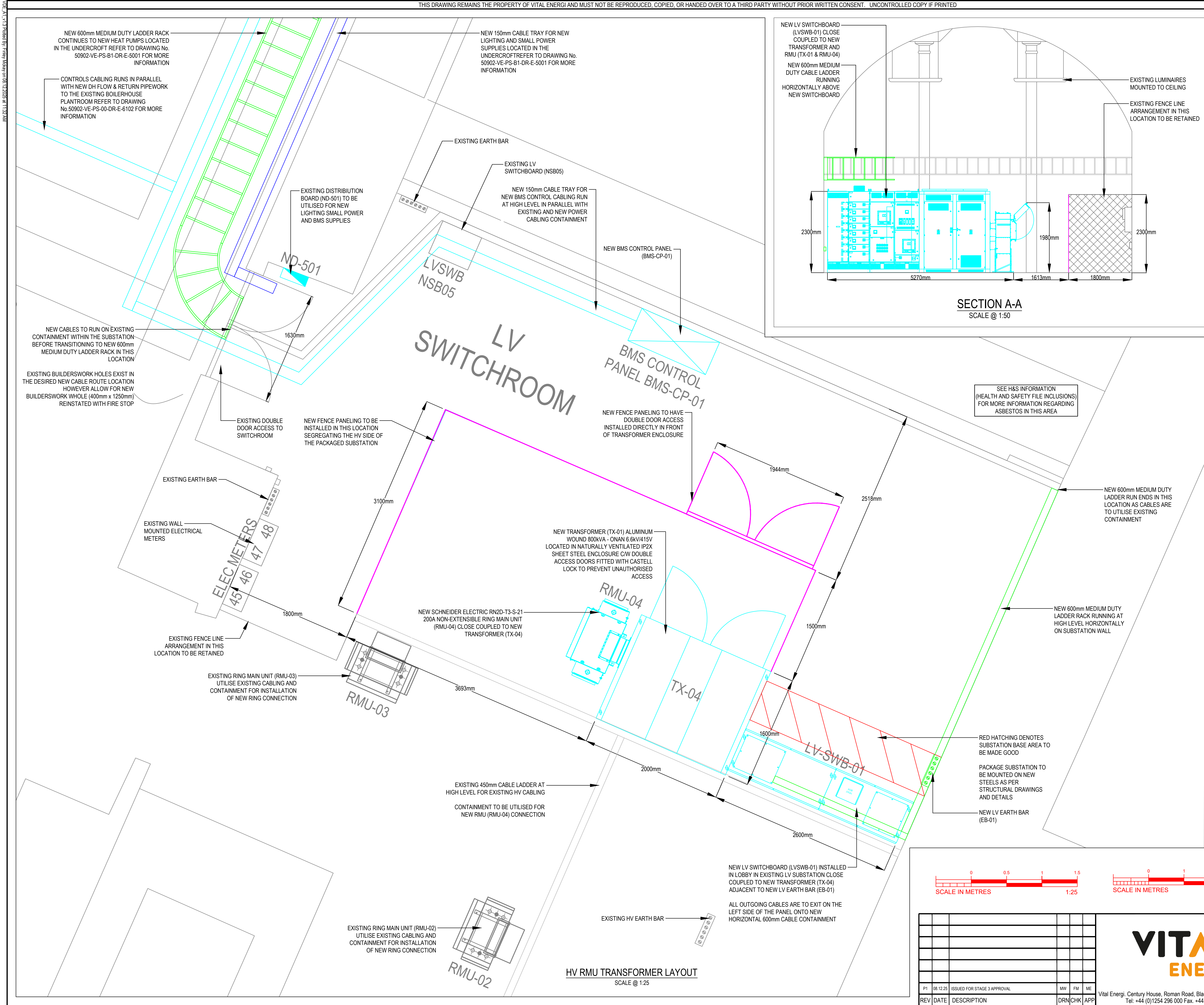
Project: ALLERTON DEPOT & PICCADILLY STATION			
Title: PICCADILLY STATION SMALL POWER LAYOUT			
DATE	08.12.2025	SCALE	1:50
SHEET			A0
STAGE APPROVAL		Status: S4	Stage: 3
50902-VE-PS-00-DR-E-6201		Rev: P1	

P1	08.12.25	ISSUED FOR STAGE 3 APPROVAL	MR	FM	VE
REV	DATE	DESCRIPTION	DRN	CHK	APP

Vital Energi, Century House, Roman Road, Blackburn, Lancashire, BB1 2LD
Tel: +44 (0)1254 296 000 Fax: +44 (0)1254 296 040

Doc: A1-1-3 Prepared By: Emily Harvey on 08/12/2025 at 11:37 AM

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HEALTH AND SAFETY INFORMATION

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DIFFICULT TO MANAGE

THESE MAY BE COMMON RISKS BUT BE IN AWARD LOCATIONS, EG. SCAFFOLDING, DELIVERIES, PROXIMITY OF GAS MAINS OR POWER LINES, WORKING IN CLOSE PROXIMITY TO THE PUBLIC ETC.

NOT KNOWN AT THIS TIME OR NOTHING SIGNIFICANT

UNUSUAL

THESE MAY BE COMMON RISKS OCCURRING IN UNUSUAL CIRCUMSTANCES. THEY MIGHT ALSO BE UNUSUAL BECAUSE OF THE NATURE OF THE CONSTRUCTION METHOD OR SITE CONDITIONS, EG. UNSTABLE OR CONTAMINATED GROUND, ASBESTOS, LEAD PAINT, SILICA DUST ETC.

NOT KNOWN AT THIS TIME OR NOTHING SIGNIFICANT

NOT LIKELY TO BE OBVIOUS TO A CONTRACTOR OR DESIGNER

THE CONTRACTOR, AT THE PRICING STAGE, AS WELL AS DURING THE DESIGN CYCLE MAY NOT BE AWARE OF SOME OF THE LESS OBVIOUS RISKS EG. STRUCTURAL ISSUES ASSOCIATED WITH WORKING AROUND EXISTING FOUNDATIONS, FRAGILE ROOFS OR FRAGILE SURFACES ETC.

NOT KNOWN AT THIS TIME OR NOTHING SIGNIFICANT

OPERATIONAL ACCESS - HORIZONTAL, VERTICAL, PEDESTRIAN, VEHICLE / PLANT

ARE THERE SIGNIFICANT ISSUES REGARDING ACCESS? IF YES OUTLINE BELOW OR REFER TO APPROPRIATE DOCUMENT ETC.

NOT KNOWN AT THIS TIME OR NOTHING SIGNIFICANT

OPERATIONAL HANDLING / LIFTING STRATEGY

HAVE YOU IN SO FAR AS REASONABLY PRACTICABLE REDUCED MANUAL LIFTING? IDENTIFY ANY ITEMS THAT MAY REQUIRE EXCESSIVE LIFTING ARRANGEMENTS TO BE PUT IN PLACE AS WELL AS IDENTIFY ANY UNUSUAL RISKS ASSOCIATED WITH HANDLING AND LIFTING.

NOT KNOWN AT THIS TIME OR NOTHING SIGNIFICANT

HEALTH AND SAFETY FILE INCLUSIONS

IDENTIFY ANY HAZARDS / SIGNIFICANT RISKS ASSOCIATED WITH MAINTENANCE OR REMOVAL / DEMOLITION OF THE CONTENTS OF THIS DRAWING AT A LATER DATE.

EXISTING ASBESTOS IS APPARENT WITHIN THE EXISTING SWITCHROOMS AND PLANTROOMS AS SUGGESTED FROM THE PROVIDED REPORTS. PROCEED WITH CAUTION AND IN LINE WITH THE CORRECT ASBESTOS REGULATIONS & LEGISLATION.

NOTES

- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL AND STRUCTURAL DRAWINGS.
- CABLES ENTERING HV SWITCHROOM TO BE SEALED TO STOP WATER INGRESS WITH A SUITABLE CABLE TRANSIT / FIRE STOPPING FOLLOWING CABLE INSTALLATION.
- CONTAINMENT ROUTES AND HEIGHTS TO BE CO-ORDINATED WITH 3D LAYOUT DRAWINGS, FINAL POSITIONS ARE TO BE COORDINATED AND AGREED ON SITE, HOWEVER IF ANY OF THE MAJOR ROUTES SHOWN ARE ALTERED PLEASE CONTACT THE DESIGN DEPARTMENT TO CHECK ANY EFFECT ON THE CABLE SIZING CALCULATIONS. ALL INVERT LEVELS INDICATED ARE TO THE UNDERSIDE OF THE ASSOCIATED CONTAINMENT.
- CONTROL AND LV CABLING INCLUDING ALL SECONDARY CONTAINMENT MUST BE SEGREGATED IN ACCORDANCE WITH BS7671, INCLUDING LATEST AMENDMENTS.
- ALL LOCALISED SUPPORTS, TRAY AND TRUNKING DROPS AND SECONDARY CONTAINMENT TO PLANT AND EQUIPMENT TO BE AGREED ON SITE.
- EVERY PIECE OF EQUIPMENT AND CONTROL GEAR SHALL BE LABELED CLEARLY BY MEANS OF ENGRAVED TRAFFOLITE LABEL, SCREW FIXED TO HE SURFACE.
- ALL LADDER RACK, TRAY AND TRUNKING JOINTS SHALL BE LINKED ACROSS WITH EARTH STRAPS.
- ALL TRUNKING TO MEET AN IP4X RATING IN ACCORDANCE WITH BS50085-1.

LEGEND:

- ELECTRICAL DISTRIBUTION BOARD
- ELECTRICAL BATTERY TRIPPING UNIT
- EARTH BAR
- MEDIUM DUTY CABLE LADDER FOR LV & HV CABLES
- 50mm FIRE ALARM BASKET
- NEW FENCING AND DOUBLE DOOR ACCESS

HOLDS

REFERENCE DOCUMENTS

50902-VE-PS-XX-SC-E-6001 PICCADILLY STATION HV & LV SINGLE LINE DIAGRAM

50902-VE-PS-00-DR-E-6101 PICCADILLY STATION CONTAINMENT LAYOUT

50902-VE-PS-00-DR-E-6102 PICCADILLY STATION SITE WIDE CONTAINMENT LAYOUT

50902-VE-PS-B1-DR-E-5001 PICCADILLY STATION ELECTRICAL EQUIPMENT LAYOUT

MANCHESTER PICCADILLY RAIL STATION - OPERATIONAL SITE SPECIFIC ASBESTOS MANAGEMENT PLAN

ISSUED FOR STAGE
APPROVAL

0 0.5 1 1.5
SCALE IN METRES 1:25

0 1 2 3
SCALE IN METRES 1:50

REV	DATE	DESCRIPTION	DRN	CHK	APP
P1	08.12.25	ISSUED FOR STAGE 3 APPROVAL			

**VITAL
ENERGI**

Vital Energi, Century House, Roman Road, Blackburn, Lancashire, BB1 2LD
Tel: +44 (0)1254 296 000 Fax: +44 (0)1254 296 040

Project: PICCADILLY STATION				
Title: PICCADILLY STATION HV RMU / TRANSFORMER LAYOUT				
DATE	08.12.2025	SCALE	1:25	SHEET
STAGE APPROVAL			Status: S4	Stage: 3
50902-VE-PS-B1-DR-E-6201			Dwg-No:	Rev: P1

HEALTH AND SAFETY INFORMATION

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NOT KNOWN AT THIS TIME OR NOTHING SIGNIFICANT -

UNUSUAL

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PLEASE REFER TO THE OPERATIONAL SITE SPECIFIC ASBESTOS MANAGEMENT PLAN FOR MORE INFORMATION

NOT LIKELY TO BE OBVIOUS TO A CONTRACTOR OR DESIGNER

THE CONTRACTOR, AT THE PROPOSED STAGE, AS WELL AS DURING THE DESIGN/CONSTRUCTION, MAY NOT BE AWARE OF SOME OF THE LESS OBVIOUS RISKS E.G. STRUCTURAL ISSUES ASSOCIATED WITH WORKING AROUND EXISTING FOUNDATIONS, FRAGILE ROOFS OR FRAGILE SURFACES ETC.

NOT KNOWN AT THIS TIME OR NOTHING SIGNIFICANT -

OPERATIONAL ACCESS, HORIZONTAL, VERTICAL, PEDESTRIAN, VEHICLE IN ANY

ARE THERE SIGNIFICANT ISSUES REGARDING ACCESS? IF YES, OUTLINE BELOW OR REFER TO APPROPRIATE DOCUMENT ETC.

NOT KNOWN AT THIS TIME OR NOTHING SIGNIFICANT -

OPERATIONAL HANDLING / LIFTING STRATEGY

HAVE YOUIN SUFFICENTLY FAR AS REASONABLY PRACTICABLE REDUCED MANUAL LIFTING? IDENTIFY ANY ITEMS THAT MAY REQUIRE EXCESSIVE LIFTING ARRANGEMENTS TO BE PUT IN PLACE AS WELL AS IDENTIFY ANY UNUSUAL RISKS ASSOCIATED WITH HANDLING AND LIFTING.

PROCEED WITH CAUTION DURING OPERATIONAL HANDLING
MANEUVERED AT THE JUNCTION OF 2 OR 3 LIFTED BUILDING

HEALTH AND SAFETY FILE INCLUSIONS

IDENTIFY ANY HAZARDS / SIGNIFICANT RISKS ASSOCIATED WITH MAINTENANCE OR REMOVAL / DEMOLITION OF THE CONTENTS OF THIS DRAWING AT A LATER DATE.

PLEASE REFER TO THE OPERATIONAL SITE SPECIFIC ASBESTOS MANAGEMENT PLAN FOR MORE INFORMATION

NOTES:

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2. ALL WORK BY ELECTRICAL CONTRACTOR MUST COMPLY WITH BS7671 INCLUDING LATEST AMENDMENTS AND RELEVANT BUILDING REGULATIONS.

LEGEND:

1 x 150mm GALVANISED STEEL MEDIUM DUTY CABLE TRAY FOR POWER MOUNTED AT XXmm AFFL
DISTRIBUTION BOARD
BMS CONTROL PANEL
IP66 ROTARY ISOLATOR SWITCH
EARTH BAR

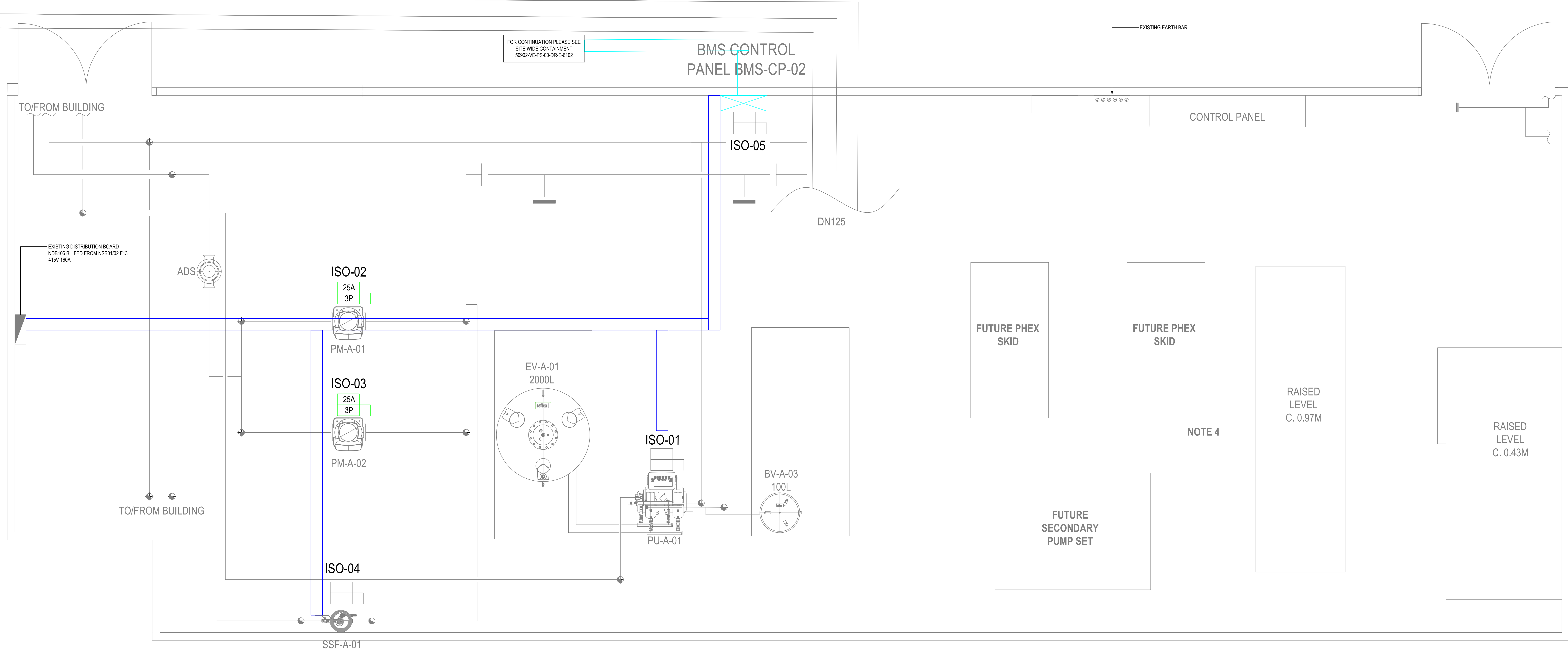
REFERENCES:

50902-VE-PS-XX-SC-E-6001 PICCADILLY STATION HV & LV SINGLE LINE DIAGRAM
50902-VE-PS-XX-SH-E-6201 ELECTRICAL LOAD SCHEDULE
50902-VE-PS-XX-SH-E-6202 PICCADILLY STATION LV CABLE CALCULATIONS
50902-VE-PS-00-DR-E-6102 PICCADILLY STATION SITE WIDE CONTAINMENT

HOLDS:

1. LV CABLE SCHEDULE TO BE ISSUED AT THE NEXT DESIGN STAGE

ISOLATOR ID	EQUIPMENT	MOUNTING HEIGHT	SWITCHGEAR SOURCE
ISO-01	PRESSURISATION UNIT (VEP201)	INTEGRATED TO EQUIPMENT	NDB1062-L2
ISO-02	PRIMARY CIRCULATION PUMP No.1 (VEP202)	ADJACENT TO EQUIPMENT	NDB1063-L1,L2,L3
ISO-03	PRIMARY CIRCULATION PUMP No.2 (VEP203)	ADJACENT TO EQUIPMENT	NDB1064-L1,L2,L3
ISO-04	SIDE STREAM FILTER No.1 (VEP204)	INTEGRATED TO EQUIPMENT	NDB1065-L2
ISO-05	BMS-CP-02 CONTROL PANEL (VEP205)	INTEGRATED TO EQUIPMENT	NDB1066-L1



ISSUED FOR APPROVAL

VITAL ENERGI

Vital Energi, Century House, Roman Road, Blackburn, Lancashire, BB1 2LD
Tel: +44 (0)1254 296 000 Fax: +44 (0)1254 296 040

Project: PICCADILLY STATION

Title: PLANTROOM SMALL POWER LAYOUT

DATE: 08.12.2025 SCALE: 1:50 SHEET: A0

STAGE APPROVAL Status: S4 Stage: 3

50902-VE-PS-00-DR-E-6203 Drg-No: Rev: P1

Rev: P1

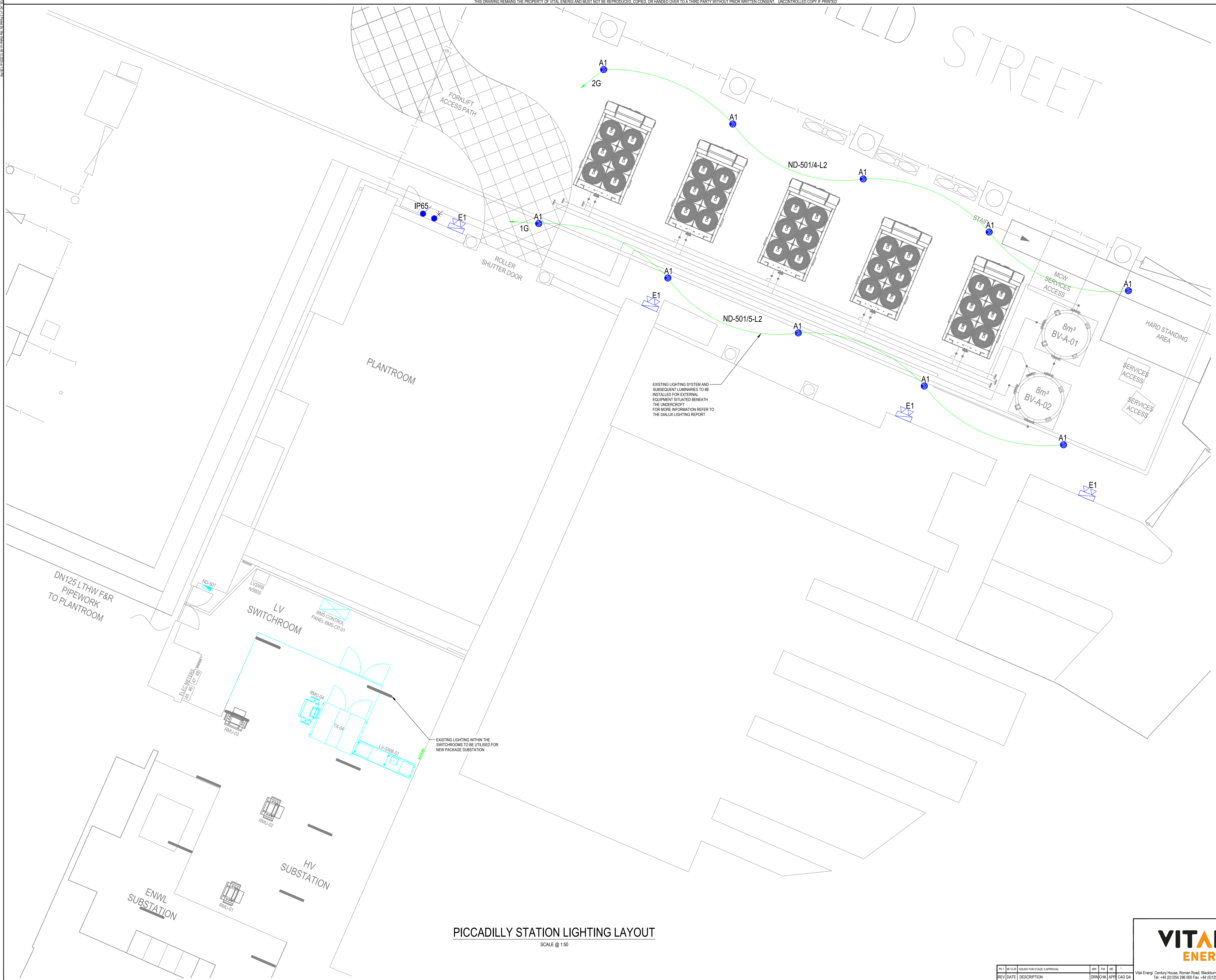
DATE: 08.12.2025

DESCRIPTION: ISSUED FOR STAGE 3 APPROVAL

MR: FM: KE: DRN: CHK: APP:

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HEALTH AND SAFETY INFORMATION

ALL WORKS SHALL BE CARRIED OUT BY COMPETENT PEOPLE.
IN ADDITION TO THE HAZARDS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, THE DESIGNERS HAVE REVIEWED THE HAS RISKS AND DEVELOPED A DESIGNERS RISK ASSESSMENT. THE CONTRACTOR SHALL REFER TO THE CONSTRUCTION PHASE PLAN AND ADOPT THE HAS AND DESIGNERS RISK ASSESSMENT PROVIDED IN THE DEVELOPMENT OF THEIR RAMP, BEFORE UNDERTAKING ANY WORKS. PLEASE ALSO NOTE THE FOLLOWING:-

DIFFICULTY TO MANAGE:
THESE MAY BE COMMON RISKS BUT BE IN AVOIDED LOCATIONS, E.G. SCATTERING, DELIVERIES, PROXIMITY OF GAS MAINS OR POWER LINES, WORKING IN CLOSE PROXIMITY TO THE PUBLICS.

"NOT KNOWN AT THIS TIME OR NOTHING SIGNIFICANT"

UNUSUAL:
THESE MAY BE COMMON RISKS OCCURRING IN UNUSUAL CIRCUMSTANCES. THEY WOULD ALSO BE UNUSUAL BECAUSE OF THE NATURE OF THE CONSTRUCTION METHOD OR SITE CONDITIONS, OR DURING OR CONTINUING TO OCCUR, SUBJECT TO LONG TERM, DELAY, ETC.

PLEASE REFER TO THE OPERATIONAL SITE SPECIFIC ASBESTOS MANAGEMENT PLAN FOR MORE INFORMATION

NOT LIKELY TO BE OBVIOUS TO A CONTRACTOR OR DESIGNER:
THE CONTRACTOR, AT THE PHASE STAGE, AS WELL AS DURING THE DESIGN PHASE MAY NOT BE AWARE OF SOME OF THE LESS OBVIOUS PHYSICAL, STRUCTURAL ISSUES ASSOCIATED WITH WORKING AROUND EXISTING FOUNDATIONS, PAVEMENTS, PEOPLE OR PAVEMENTS, ETC.

"NOT KNOWN AT THIS TIME OR NOTHING SIGNIFICANT"

OPERATIONAL ACCESS - HORIZONTAL, VERTICAL, PEDESTRIAN, VEHICLE, PLANT:
ARE THERE SIGNIFICANT ISSUES REGARDING ACCESS? IF YES, OUTLINE BELOW OR REFER TO APPROPRIATE DOCUMENT ETC.

"NOT KNOWN AT THIS TIME OR NOTHING SIGNIFICANT"

OPERATIONAL HANDLING / LIFTING STRATEGY:
HAVE YOU IN SO FAR AS READILY AVAILABLE PRACTICABLE RESOURCES, IDENTIFIED ANY ITEMS THAT MAY REQUIRE EXCESSIVE LIFTING ARRANGEMENTS TO BE USED? IF YES, OUTLINE BELOW OR REFER TO APPROPRIATE DOCUMENT ETC.

PROCEED WITH CAUTION DURING OPERATIONAL HANDLING MANOEUVRES AT THE UNDERCROFT IS A LISTED BUILDING

HEALTH AND SAFETY FILE INCLUSIONS:
IDENTIFY ANY HAZARDOUS / SIGNIFICANT RISKS ASSOCIATED WITH MAINTENANCE OR REMOVAL / DEMOLITION OF THE CONTENTS OF THIS DRAWING. IF A HAZARDING.

PLEASE REFER TO THE OPERATIONAL SITE SPECIFIC ASBESTOS MANAGEMENT PLAN FOR MORE INFORMATION

- NOTES**
- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL AND STRUCTURAL DRAWINGS.
 - ALL WORK BY ELECTRICAL CONTRACTOR MUST COMPLY WITH BS7671, INCLUDING LATEST AMENDMENTS AND RELEVANT BUILDING REGULATIONS.
 - EMERGENCY LIGHTING HAS BEEN PROVIDED IN ACCORDANCE WITH BS5266-1.
 - TEST FACILITY FOR THE EMERGENCY LIGHTING CIRCUIT TO BE VIA INDIVIDUAL KEYSWITCH, LOCATED ADJACENT TO THE LIGHT SWITCH.
 - ANY CHANGES TO LIGHT FITTING TYPE AND POSITION MUST BE AUTHORISED BY VITAL ENERGI'S DESIGN ENGINEER UNDERSIGNED ON THIS DRAWING.
 - FINAL CONNECTIONS TO LUMINAIRES TO BE CARRIED OUT IN HEAT RESISTANT FLEXIBLE CABLES.
 - ALL LIGHTING CONTAINMENT SUPPLIED BY ELECTRICAL SUB-CONTRACTOR. DRAWING 50902-VE-PS-00-DR-E-6101 FOR FURTHER DETAILS. LUMINAIRES WHERE INDICATED ARE SUSPENDED ON JACK CHAINS VIA SUITABLE IP65 JUNCTION BOXES AT EACH LUMINAIRE.
 - LIGHTING ILLUMINANCE LEVELS WITHIN ALL PARTS OF THE UNDERCROFT AND PLANTROOM DESIGNED TO BS EN 12464-1, BS EN 12464-2, BS 5266.

- LIGHTING & EMERGENCY LIGHTING LEGEND:**
- A1 A1 THORN HIPAK GEN 9653206 LED 10000 840 WB HF QCS IP65 56 BV SUSPENDED AT 4.7m ABOVE GROUND FLOOR LEVEL
 - LIGHT SWITCH MOUNTED AT 1200mm AFFL
 - G G DENOTES NO. OF GANGS
 - IP65 RATED
 - EMERGENCY LIGHTING KEY TESTING SWITCH MOUNTED AT 1200mm AFFL ADJACENT LIGHTING SWITCH
 - E1 EMERGENCY LED TWINSPOOT LUMINAIRE (3 HR NON-MAINTAINED) MOUNTED 4.8m ABOVE GROUND LEVEL IN UNOBSTRUCTED VIEW

REFERENCE DRAWINGS

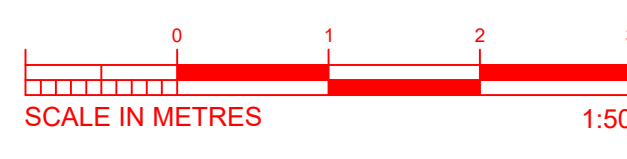
50902-VE-PS-XX-RP-E-6301 PICCADILLY STATION DIALUX LIGHTING REPORT

50902-VE-PS-00-DR-E-6101 PICCADILLY STATION CONTAINMENT LAYOUT

50902-VE-PS-XX-SH-E-6202 PICCADILLY STATION LV CABLE CALCULATIONS

HOLDS:

- LV CABLE SCHEDULE TO FOLLOW AT STAGE 4



ISSUED FOR STAGE APPROVAL

PICCADILLY STATION LIGHTING LAYOUT

SCALE @ 1:50

Vital Energi, Century House, Roman Road, Blackburn, Lancashire, BB1 2LD
Tel: +44 (0)1254 296 000 Fax: +44 (0)1254 296 040

Project: PICCADILLY STATION		
Title: PICCADILLY STATION LIGHTING LAYOUT		
DATE: 08.12.2025	SCALE: 1:50	
STATUS: S4	STAGE: 3	
STAGE APPROVAL		Rev: P1
50902-VE-PS-00-DR-E-6301		

PS 1	08.12.25	ISSUED FOR STAGE 3 APPROVAL	MM	PM	ME	*
REV	DATE	DESCRIPTION	DRN	CHK	APP	CAD QA

IEC 617 DEVICE NUMBERS AND FUNCTIONS FOR SWITCHGEAR APPARATUS	
DEVICE REFERENCES	DESCRIPTION
50	INSTANTANEOUS OVERCURRENT RELAY
51	AC TIME OVERCURRENT RELAY
64N	RESTRICTED EARTH FAULT
86	LOCKOUT RELAY
49A	TRANSFORMER THERMAL RELAY ALARM
49T	TRANSFORMER THERMAL RELAY TRIP
OTHER	
M1	SOCOMEK DIRIS A30 WITH MODBUS MODULE
M2	SOCOMEK DIRIS A20 METER WITH MODBUS MODULE
SEF	STANDBY EARTH FAULT

HEALTH AND SAFETY INFORMATION	
ALL WORKS SHALL BE CARRIED OUT BY COMPETENT PEOPLE. IN ADDITION TO THE HAZARDS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, THE DESIGNERS HAVE REVIEWED THE HAS RISKS AND DEVELOPED A DESIGNERS RISK ASSESSMENT. THE CONTRACTOR SHALL REFER TO THE CONSTRUCTION PHASE PLAN AND ADOPT THE HAS AND DESIGNERS RISK ASSESSMENT FINDINGS IN THE DEVELOPMENT OF THEIR RAMP, BEFORE UNDERTAKING ANY WORKS. PLEASE ALSO NOTE THE FOLLOWING: DIFFICULT TO HANDLE THERE MAY BE COMMON RISKS BUT BE IN AVOIDANCE LOCATIONS (E.G. SCAFFOLDING, DELIVERIES, PROXIMITY OF GAS MAINS OR POWER LINES, WORKING IN CLOSE PROXIMITY TO THE PUBLIC ETC.)	
NOT KNOWN AT THIS TIME OR NOTHING SIGNIFICANT	
UNUSUAL THERE MAY BE COMMON RISKS OCCURRING IN UNUSUAL CIRCUMSTANCES. THEY WOULD ALSO BE UNUSUAL BECAUSE OF THE NATURE OF THE CONSTRUCTION METHOD OR SITE CONDITIONS (E.G. UNSTABLE OR CONTAMINATED GROUND, ASBESTOS, LAC PAINT, SOLID OIL ETC.)	
NOT KNOWN AT THIS TIME OR NOTHING SIGNIFICANT	
NOT LIKELY TO BE OBVIOUS TO A CONTRACTOR OR DESIGNER THE CONTRACTOR, AT THE DESIGN STAGE, AS WELL AS DURING THE DESIGN CYCLE, MAY NOT BE AWARE OF SOME OF THE LESS OBVIOUS RISKS OR DIFFICULTY ASSOCIATED WITH WORKING AROUND EXISTING FOUNDATION, PAVEMENT ROOFS OR WALLS, ETC.	
NOT KNOWN AT THIS TIME OR NOTHING SIGNIFICANT	
OPERATIONAL ACCESS - HORIZONTAL, VERTICAL, PEDESTAL, VEHICLE, PLANT ARE THERE SWAMP GATE ISSUES REGARDING ACCESS TO THE SYSTEM DESIGN OR OTHERS TO APPROPRIATE DOCUMENT ETC.	
NOT KNOWN AT THIS TIME OR NOTHING SIGNIFICANT	
OPERATIONAL HANDLING (LIFTING STRATEGY) DOES THE LIFTING REQUIREMENT PRESENT A SIGNIFICANT RISK OF INJURY, IF NOT IDENTIFY ANY THOSE THAT MAY REQUIRE EXCESSIVE LIFTING ARRANGEMENTS TO BE PUT IN PLACE AS WELL AS IDENTIFY ANY UNUSUAL RISKS ASSOCIATED WITH HANDLING AND LIFTING.	
NOT KNOWN AT THIS TIME OR NOTHING SIGNIFICANT	
HEALTH AND SAFETY FILE INCLUSIONS IDENTIFY ANY HAZARDS / SWAMP GATE RISKS ASSOCIATED WITH MAINTENANCE OR REMOVAL / DESTRUCTION OF THE CONTENTS OF THIS DRAWING AT A LATER DATE.	
NOT KNOWN AT THIS TIME OR NOTHING SIGNIFICANT	

NOTES:

- THE ELECTRICAL INSTALLATION WILL BE INSTALLED IN ACCORDANCE WITH THE CURRENT EDITION OF BS7671 (IET WIRING REGULATIONS)
- THE SURGE PROTECTION DEVICES SHALL BE AS CLOSE AS POSSIBLE TO THE MAIN INCOMER CONNECTIONS AND INSTALLED IN ACCORDANCE WITH THE MANUFACTURERS RECOMMENDATIONS.
- THE LV SWITCHBOARD WILL BE FORM 4B TYPE 6, TOP ENTRY, TOP EXIT WITH FRONT ACCESS, COMPLETE WITH A MANUFACTURER ASSEMBLED PLINTE TO RAISE THE HEIGHT OF THE SWITCHBOARD BY 100mm. THE LV SWITCHROOM SLAB WILL ALSO BE RAISED BY A FURTHER 150mm AFFL WITHIN THE DOOR REVEAL.
- CAPABILITY FOR PADLOCKING ALL ISOLATING DEVICES IN THE OFF POSITION IS TO BE PROVIDED.
- THE GENERATOR MUST NOT RUN IN PARALLEL WITH THE UTILITY MAINS, THEREFORE SHORT OUTAGES WILL BE SEEN DURING THE MANUAL TRANSFER FROM MAINS TO GENERATION AND BACK TO MAINS.
- ALL 100A TO 630A MCCBS COMBINED WITH ELECTRONIC TRIPS (MICROLOGIC 2) ALL SUBMAIN CIRCUIT MCCBS COMBINED WITH ELECTRONIC TRIPS (MICROLOGIC 5)
- ALL MCCBS DEVICES SHALL BE FIXED PATTERN SWITCHGEAR. ALL ACB DEVICES SHALL BE WITHDRAWABLE.
- ALL SWITCHBOARD COMPARTMENTS TO BE FITTED OUT WITH PLUG IN BASES TO ENABLE EASE OF INSTALLATION FOR FUTURE DEVICES.

LEGEND:

- 6.6KV SYSTEM CABLE
- 6.6KV SYSTEM BUSBAR
- LV SYSTEM CABLE
- LV SYSTEM BUSBAR
- TRIPPING CABLE
- COMMS CABLE
- TRANSFORMER
- MOULDED CASE CIRCUIT BREAKER
- WITHDRAWABLE AIR CIRCUIT BREAKER
- CIRCUIT EARTH SELECTOR SWITCH
- ON LOAD ISOLATOR
- MINIATURE CIRCUIT BREAKER
- SURGE PROTECTION DEVICE
- 3 PHASE CURRENT TRANSFORMER
- MULTIFUNCTION POWER METER
- ISOLATOR
- SWITCHED FUSED CONNECTION UNIT AS MK METALCLAD MOUNTED ADJACENT EQUIPMENT/PANEL
- EMERGENCY STOP
- VARIABLE SPEED DRIVE CONTROLLED PUMP
- NEUTRAL EARTH LINK
- CASTELL KEY (FS TYPE) TRAPPED
- CASTELL KEY (FS TYPE) FREE

HOLDS:

- EXISTING HV CABLEING IS 300mm² PICAS FROM RECORD INFORMATION, THIS SHALL BE CONFIRMED BEFORE THE HV CABLEING SELECTIONS ARE FINALISED AT NEXT DESIGN STAGE.
- EXISTING HV RING PROTECTION CT's & SETTINGS CURRENTLY UNKNOWN, THIS SHALL BE CONFIRMED BEFORE THE HV CABLEING SELECTIONS ARE FINALISED AT NEXT DESIGN STAGE.
- TEMPORARY GENERATOR CONNECTION ON LVSB-01 OPTIONAL AT ADDITIONAL COST.
- CLEAR.
- ALL CABLE SIZES & EQUIPMENT LOADS TO BE CONFIRMED ON PROCUREMENT OF PLANT.

REFERENCES:

50902-VE-PS-00-DR-E-5001 PICCADILLY STATION ELECTRICAL EQUIPMENT LAYOUT
50902-VE-PS-XX-SH-E-5001 PICCADILLY STATION ELECTRICAL LOAD SCHEDULE

ISSUED FOR STAGE
APPROVAL

REV	DATE	DESCRIPTION	DRW	CHK	APP
PS	24.02.25	ISSUED FOR STAGE 3 APPROVAL	MW	FW	ME
PS	16.11.24	MODIFICATIONS TO RAILGAL & T10.04 RATINGE L100001 RATING AND OUTGOING RATINGE MODIFIED EXISTING ON CIRCUITS NOW INDICATED ISSUED FOR ENQUIRIES	MW	FW	SH
FW	13.11.24	MODIFICATIONS TO RAILGAL T10.04 L100001 AND DB-01 ISSUED FOR ENQUIRIES	MW	FW	SH
FW	09.10.24	ISSUED FOR INFORMATION & BMS-01 CONTROL PANELS ADDED	MW	FW	ME

VITAL ENERGI		Project: ALLERTON DEPOT & PICCADILLY STATION Title: PICCADILLY STATION HV & LV SINGLE LINE DIAGRAM	
DATE	24.07.2025	SCALE	N.T.S.
SHEET		STATUS	S4
STAGE	APPROVAL	STAGE	3
DRG No.	50902-VE-PS-XX-SC-E-6001	Rev.	P6

1. 50902-VE-PS-XX-SH-E-6801 - PICCADILLY STATION UNDERCROFT AREA BMS REQUIREMENTS DOCUMENT
2. 50902-VE-PS-XX-SC-E-6802 - PICCADILLY STATION SYSTEM ARCHITECTURE DIAGRAM
3. 50902-VE-PS-XX-SC-E-6803 - PICCADILLY STATION BOILER ROOM BLOCK CABLE DIAGRAM
4. 50902-VE-PS-XX-SC-E-6001 - PICCADILLY STATION HV & LV SINGLE LINE DIAGRAM
5. 50902-VE-SW-XX-SH-M-5601 - PICCADILLY STATION - EQUIPMENT & VALVE SCHEDULE
6. 50902-VE-PS-XX-SC-M-5603 - PROPOSED UNDERCROFT P&ID

1. FOR DETAILED I/O REQUIREMENTS, PLEASE REFER TO THE PICCADILLY STATION UNDERCROFT AREA BMS REQUIREMENTS DOCUMENT (50902-VE-PS-XX-SH-E-6801).

[illegible]

1. 50902-VE-PS-XX-SH-E-6801 - PICCADILLY STATION UNDERCROFT AREA BMS REQUIREMENTS DOCUMENT
2. 50902-VE-PS-XX-SC-E-6803 - PICCADILLY STATION BOILER ROOM BLOCK CABLE DIAGRAM
3. 50902-VE-PS-XX-SC-E-6001 - PICCADILLY STATION HV & LV SINGLE LINE DIAGRAM
4. 50902-VE-PS-XX-SC-M-5603 - PROPOSED UNDERCROFT P&ID
5. 50902-VE-PS-XX-SH-E-6801 - PICCADILLY STATION BOILER ROOM BMS REQUIREMENTS DOCUMENT
6. 50902-VE-PS-XX-SC-M-5602 - PROPOSED BOILER ROOM P&ID
7. 50902-VE-PS-XX-SC-E-6801 - PICCADILLY STATION UNDERCROFT AREA BLOCK CABLE DIAGRAM

	12F MULTIMODE FIBRE CABLE
	BELDEN 9841 / 9842 MODBUS CABLE
	BS5308 CONTROLS CABLE
	RJ45 CAT 6 UNSHIELDED 23 AWG IP20 PATCHCORD
	LV POWER CONNECTION (SEE LV SLD FOR DETAILS)



VE-A2_V1.3 Printed By: Osada Gbille on 05.12.2025 at 1:53 PM

REFERENCE DRAWINGS

- 1. 50902-VE-PS-XX-SH-E-6802 - PICCADILLY STATION BOILER ROOM BMS REQUIREMENTS DOCUMENT
- 2. 50902-VE-PS-XX-SC-E-6802 - PICCADILLY STATION SYSTEM ARCHITECTURE DIAGRAM
- 3. 50902-VE-PS-XX-SC-E-6801 - PICCADILLY STATION UNDERCROFT AREA BLOCK CABLE DIAGRAM
- 4. 50902-VE-PS-XX-SC-E-6001 - PICCADILLY STATION HV & LV SINGLE LINE DIAGRAM
- 5. 50902-VE-SW-XX-SH-M-5601 - PICCADILLY STATION - EQUIPMENT & VALVE SCHEDULE
- 6. 50902-VE-PS-XX-SC-M-5601 - EXISTING BOILER ROOM STRIP-OUT P&ID
- 7. 50902-VE-PS-XX-SC-M-5602 - PROPOSED BOILER ROOM P&ID

NOTES

- 1. FOR DETAILED I/O REQUIREMENTS, PLEASE REFER TO THE PICCADILLY STATION BOILER ROOM BMS REQUIREMENTS DOCUMENT (50902-VE-PS-XX-SH-E-6802).

LEGEND:

- WM

WATER METER
- TS

TEMPERATURE SENSOR
- TT+

HIGH LEVEL THERMOSTAT
- DPSi

DIFFERENTIAL PRESSURE SENSOR
- pst-

LOW PRESSURE SWITCH
- AI
- ANALOGUE INPUT

AO

pst+

HIGH PRESSURE SWITCH

PS

PRESSURE SENSOR

VSD

PUMP W/ VARIABLE SPEED DRIVE

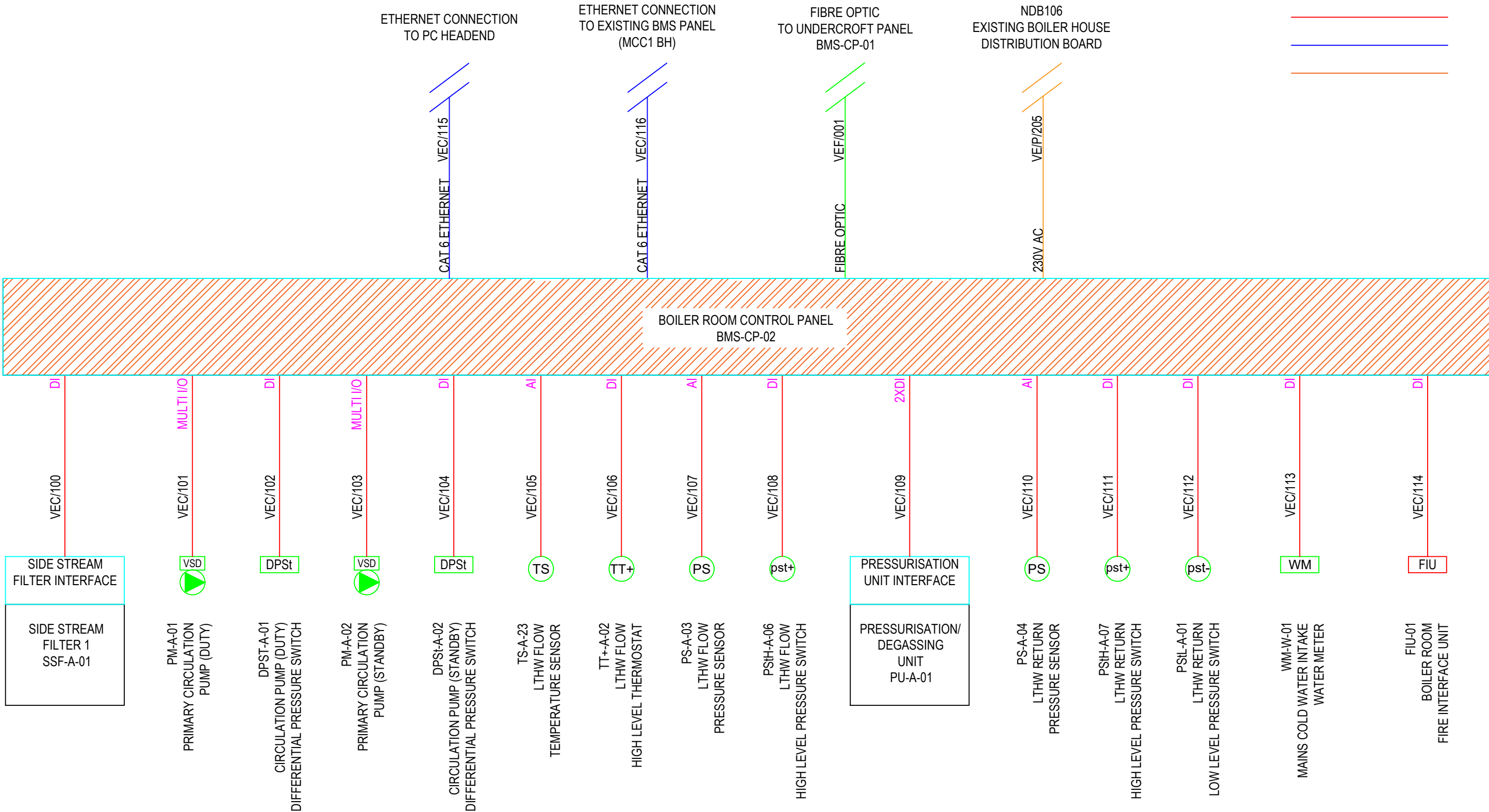
FIU

FIRE ALARM INTERFACE

DI

DO

12F MULTIMODE FIBRE CABLE
BS5308 CONTROLS CABLE
RJ45 CAT 6 UNSHIELDED 23 AWG IP20 PATCHCORD
LV POWER CONNECTION (SEE LV SLD FOR DETAILS)



ISSUED FOR STAGE
APPROVAL

						*	
						*	
						*	
						*	
						*	
						*	
P1	05.12.25	ISSUED FOR STAGE 3 APPROVAL		CG	JL	IA	*
REV	DATE	DESCRIPTION		DRN	CHK	APP	CAD QA



Vital Energi, Century House, Roman Road, Blackburn, Lancashire, BB1 2LD
Tel: +44 (0)1254 296 000 Fax: +44 (0)1254 296 040

Project: PICCADILLY STATION					
Title: BOILER ROOM PANEL BLOCK CABLE DIAGRAM					
DATE	05.12.25	SCALE	N.T.S	SHEET	A2
STAGE APPROVAL				Status: S4	Stage: 3
50902-VE-PS-XX-SC-E-6803					Drg-No: Rev: P1

Piccadilly Station Electrical Load Schedule

Piccadilly Station Specific Notes:

Associated Documents / Drawings:

- 50902-VE-PS-XX-SC-E-6001 Piccadilly Station HV & LV Single Line Diagram
- 50902-VE-PS-00-DR-E-5001 Piccadilly Station Electrical Equipment Layout

Project Details

Project Name:	Allerton Depot & Piccadilly Station	
Contract Number:	VC50902	
Document Number:	50902-VE-PS-XX-SH-E-6201	
Revision:	P3	
Revision Date:	08/12/2025	Vital Energi Century House Roman Road Blackburn Lancashire BB1 2LD T: +44 (0) 1254 296 000 www.vitalenergi.co.uk
Originator	Mia Walker	

Revision History									
Revision:	P1	Revised:	Chris Tickle	Checked:	Arthur Simpson	Approved:	Wam Akolwa	Date:	24.07.25
Internal Issue									
Revision:	P2	Revised:	Finley McKay	Checked:	Mohammed Bhada	Approved:	Matt Edwards	Date:	09.09.25
Issued for Information									
Revision:	P3	Revised:	Mia Walker	Checked:	Finley McKay	Approved:	Matt Edwards	Date:	08.12.25
Issued for Stage 3 approval									
Revision:		Revised:		Checked:		Approved:		Date:	
Revision:		Revised:		Checked:		Approved:		Date:	
Revision:		Revised:		Checked:		Approved:		Date:	
Revision:		Revised:		Checked:		Approved:		Date:	
Revision:		Revised		Approved		Approved		Date:	

Existing HV Network																																																																													
Plant Items	ID	Manufacturer	Model No.	Rated Power (kW)	Diversity	Rated Power inc. diversity (kW)	Power Factor	Full Load Current (A)	Load inc Diversity Current (A)	Phase	Cycles	Elect. Supply (V)	Notes																																																																
Existing Load				1386.000	1.000	1386.00	1.000	121.2	121.2	3	50Hz	6600	At HV. Maximum demand on existing incoming Elec Meter																																																																
Additional Transformer No.4 Load	TX-04	TBC		543.500	1.000	543.50	1.000	47.5	47.5	3	50Hz	6600	At HV																																																																
<table><tr><td></td><td></td><td></td><td></td><td>Rated Power (kW)</td><td>Full Load Current (A)</td><td>Rated Power inc. diversity (kW)</td><td>Load inc Diversity Current (A)</td></tr><tr><td colspan="4">Total Load</td><td>1929.500</td><td>168.787</td><td>1929.50</td><td>168.787</td></tr></table> <table><tr><td colspan="6">Total Diversified Power</td><td>1929.50</td><td>kW</td></tr><tr><td colspan="6">Total Diversified Current</td><td>168.79</td><td>A</td></tr><tr><td colspan="6">HV Network New Maximum Demand</td><td>1929.50</td><td>kVA</td></tr></table> Import Capacity increased from 2MVA to 2.5MVA																		Rated Power (kW)	Full Load Current (A)	Rated Power inc. diversity (kW)	Load inc Diversity Current (A)	Total Load				1929.500	168.787	1929.50	168.787	Total Diversified Power						1929.50	kW	Total Diversified Current						168.79	A	HV Network New Maximum Demand						1929.50	kVA																								
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HV Network New Maximum Demand						1929.50	kVA																																																																						
Main LV Switchboard - LVSWB-01																																																																													
Plant Items	ID	Manufacturer	Model No.	Rated Power (kW)	Diversity	Rated Power inc. diversity (kW)	Power Factor	Full Load Current (A)	Load inc Diversity Current (A)	Phase	Cycles	Elect. Supply (V)	Notes																																																																
Air Source Heat Pump No.1 (Duty)	ASHP-A-01	Pure Thermal	A-Therm80 300.2	108.700	1.000	108.70	0.980	160.1	160.1	3	50Hz	400	Load at worst case operating condition for design temp 80/70, includes 12kW shunt pump																																																																
Air Source Heat Pump No.2 (Duty)	ASHP-A-02	Pure Thermal	A-Therm80 300.2	108.700	1.000	108.70	0.980	160.1	160.1	3	50Hz	400	Load at worst case operating condition for design temp 80/70, includes 12kW shunt pump																																																																
Air Source Heat Pump No.3 (Duty)	ASHP-A-03	Pure Thermal	A-Therm80 300.2	108.700	1.000	108.70	0.980	160.1	160.1	3	50Hz	400	Load at worst case operating condition for design temp 80/70, includes 12kW shunt pump																																																																
Air Source Heat Pump No.4 (Duty)	ASHP-A-04	Pure Thermal	A-Therm80 300.2	108.700	1.000	108.70	0.980	160.1	160.1	3	50Hz	400	Load at worst case operating condition for design temp 80/70, includes 12kW shunt pump																																																																
Air Source Heat Pump No.5 (Duty)	ASHP-A-05	Pure Thermal	A-Therm80 300.2	108.700	1.000	108.70	0.980	160.1	160.1	3	50Hz	400	Load at worst case operating condition for design temp 80/70, includes 12kW shunt pump																																																																
<table><tr><td></td><td></td><td></td><td></td><td>Rated Power (kW)</td><td>Full Load Current (A)</td><td>Rated Power inc. diversity (kW)</td><td>Load inc Diversity Current (A)</td></tr><tr><td colspan="4">Total Load</td><td>543.500</td><td>800.484</td><td>543.50</td><td>800.484</td></tr></table> <table><tr><td colspan="6">Total Connected Load</td><td>543.50</td><td>kW</td></tr><tr><td colspan="6">Maximum Demand Current</td><td>800.48</td><td>A</td></tr><tr><td colspan="6">Total TX-04 Diversified Load</td><td>543.50</td><td>kW</td></tr><tr><td colspan="6">Total TX-04 Diversified Current</td><td>800.48</td><td>A</td></tr><tr><td colspan="6">Minimum Transformer Size</td><td>693.24</td><td>kVA</td></tr><tr><td colspan="6">Minimum Generator Size</td><td>924.32</td><td>kVA</td></tr></table> Inc. 80% load rating Inc. 60% step load standby rating																		Rated Power (kW)	Full Load Current (A)	Rated Power inc. diversity (kW)	Load inc Diversity Current (A)	Total Load				543.500	800.484	543.50	800.484	Total Connected Load						543.50	kW	Maximum Demand Current						800.48	A	Total TX-04 Diversified Load						543.50	kW	Total TX-04 Diversified Current						800.48	A	Minimum Transformer Size						693.24	kVA	Minimum Generator Size						924.32	kVA
				Rated Power (kW)	Full Load Current (A)	Rated Power inc. diversity (kW)	Load inc Diversity Current (A)																																																																						
Total Load				543.500	800.484	543.50	800.484																																																																						
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Minimum Transformer Size						693.24	kVA																																																																						
Minimum Generator Size						924.32	kVA																																																																						
TX-04 sized at 800kVA																																																																													
Existing LV Switchrom Lighting and Small Power Distribution Board DB-501																																																																													
Plant Items	ID	Manufacturer	Model No.	Rated Power (kW)	Diversity	Rated Power inc. diversity (kW)	Power Factor	Full Load Current (A)	Load inc Diversity Current (A)	Phase	Cycles	Elect. Supply (V)	Notes																																																																
Air Source Heat Pump No.1 230V supply	ASHP-A-01	Pure Thermal	A-Therm80 300.2	0.200	1.000	0.20	0.800	1.1	1.1	1	50Hz	230	Load tbc on procurement of plant																																																																
Air Source Heat Pump No.2 230V supply	ASHP-A-02	Pure Thermal	A-Therm80 300.2	0.200	1.000	0.20	0.800	1.1	1.1	1	50Hz	230	Load tbc on procurement of plant																																																																
BMS Control Panel 01	BMS-01	TBC		1.000	1.000	1.00	0.800	5.4	5.4	1	50Hz	230	Load tbc on procurement of plant																																																																
Air Source Heat Pump No.3 230V supply	ASHP-A-03	Pure Thermal	A-Therm80 300.2	0.200	1.000	0.20	0.800	1.1	1.1	1	50Hz	230	Load tbc on procurement of plant																																																																
Air Source Heat Pump No.4 230V supply	ASHP-A-04	Pure Thermal	A-Therm80 300.2	0.200	1.000	0.20	0.800	1.1	1.1	1	50Hz	230	Load tbc on procurement of plant																																																																
Air Source Heat Pump No.5 230V supply	ASHP-A-05	Pure Thermal	A-Therm80 300.2	0.200	1.000	0.20	0.800	1.1	1.1	1	50Hz	230	Load tbc on procurement of plant																																																																
Lighting Circuit 1	LTG-01	See Ltg Layout	See Ltg Layout	0.285	0.500	0.14	0.800	1.5	0.8	1	50Hz	230	Load tbc on procurement of plant																																																																
Small Power Circuit 1	RAD-01			1.500	0.500	0.75	0.800	8.2	4.1	1	50Hz	230																																																																	
Lighting Circuit 2	LTG-02	See Ltg Layout	See Ltg Layout	0.285	0.500	0.14	0.800	1.5	0.8	1	50Hz	230	Load tbc on procurement of plant																																																																
<table><tr><td></td><td></td><td></td><td></td><td>Rated Power (kW)</td><td>Full Load Current Per Phase (A)</td><td>Rated Power inc. diversity (kW)</td><td>Load Current Per Phase inc Diversity (A)</td></tr><tr><td colspan="4">Additional Distribution Board Load</td><td>4.070</td><td>7.373</td><td>3.04</td><td>16.495</td></tr></table>																		Rated Power (kW)	Full Load Current Per Phase (A)	Rated Power inc. diversity (kW)	Load Current Per Phase inc Diversity (A)	Additional Distribution Board Load				4.070	7.373	3.04	16.495																																																
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Additional Distribution Board Load				4.070	7.373	3.04	16.495																																																																						
Existing Boilerhouse Lighting and Small Power Distribution Board NDB106																																																																													
Plant Items	ID	Manufacturer	Model No.	Rated Power (kW)	Diversity	Rated Power inc. diversity (kW)	Power Factor	Full Load Current (A)	Load inc Diversity Current (A)	Phase	Cycles	Elect. Supply (V)	Notes																																																																
Pressurisation / Degassing Unit	PU-A-01	Reflex	Variomat VS 2-2/60 SC	2.200	0.800	1.76	0.900	10.6	8.5	1	50Hz	230	Load tbc on procurement of plant																																																																
Replacement Distribution Pump (Duty)	PM-A-01	Grundfos	TPE2 100-350 N-A-F-A-BQQENWB	12.000	1.000	12.00	0.900	19.2	19.2	3	50Hz	400	Load tbc on procurement of plant																																																																
Replacement Distribution Pump (Standby)	PM-A-01	Grundfos	TPE2 100-350 N-A-F-A-BQQENWB	12.000	0.000	0.00	0.900	19.2	0.0	3	50Hz	400	Load tbc on procurement of plant																																																																
Side Stream Filter No.1	SSF-A-01	Vexo	X-POT 6 V-XPOTXPOT6	0.300	0.800	0.24	0.950	1.4	1.1	1	50Hz	230	Load tbc on procurement of plant																																																																
BMS Control Panel 02 TBC	BMS-02	TBC		1.000	1.000	1.00	0.800	5.4	5.4	1	50Hz	230	Load tbc on procurement of plant																																																																
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Piccadilly Station - Undercroft Area BMS Requirements Document

Project Specific Notes:

Issued for stage 3

Associated Documents / Drawings:

50902-VE-PS-XX-SC-E-6001 - Piccadilly Station HV & LV Single Line Diagram
50902-VE-PS-XX-SC-M-5603 - Proposed Undercroft P&ID
50902-VE-PS-XX-SC-E-6801 - Piccadilly Station Undercroft Area Block Cable Diagram
50902-VE-PS-XX-SC-E-6802 - Piccadilly Station System Architecture Diagram
50902-VE-SW-XX-SH-M-5601 - Piccadilly Station - Equipment & Valve Schedule
50902-VE-PS-XX-SH-E-6802 - Piccadilly Station Boiler Room BMS Requirements Document

Project Details

Project Name:	Piccadilly Station
Contract Number:	VC50902
Document Number:	50902-VE-PS-XX-SH-E-6801
Revision:	P1
Revision Date:	05/12/2025
Originator	Csaba Grill



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Revision History									
Revision:	P1	Revised	Csaba Grill	Checked	Jon Linford	Approved	Ian Alty	Date:	05/12/2025
Issued For Stage 3 Approval									
Revision:		Revised		Checked		Approved		Date:	
Revision:		Revised		Checked		Approved		Date:	
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Piccadilly Station Undercroft Area - Cable Specifications & Notes

Cable / Installation Specifications:

- 1) All containment shall be installed as per the Vital Energi main containment drawings referenced on the front cover of this document.
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- 15) All power cabling (110V/230V/400V) shall be XLPE/LSOH/SWA/LSOH BS 6724 or equal and approved.
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- 17) Every piece of equipment and control gear shall be labelled clearly by means of an engraved traffolyte label, screw fixed to the surface of the equipment.
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- A. Supplied and Installed by VE - Wired and terminated by the controls contractor.
- B. Supplied by the controls contractor - pocket issued to Vital Energi for mechanical installation. Controls contractor cable, terminate and commission instrumentation device (e.g. temperature sensor, thermostat).
- C. Supplied by the controls contractor - Free issued to Vital Energi for mechanical installation. Controls contractor cable, terminate and commission (e.g. differential pressure sensor, pressure switch).
- D. Supplied, installed and cabled by controls contractor. (e.g. Thermal link, EM Stop button)
- E. Existing equipment - wired and terminated by the control contractor.
- F. Supplied by boiler manufacturer.
- G. Supplied and installed by others.
- H. Supplied and installed by fire alarm contractor.

Switch/Pushbutton Key:

LT - Lamp Test - Momentary Push button
HOA - Hand Mode, Off Mode, Auto Mode, - 3 Way Switch

LED (LAMP) Key:

H - Hand Mode - White
A - Auto Mode - White
F - Device Fault - Red
R - Device Running - Green
PP - Panel Power - White
PC - Panel Control Power - White

Notes:

Piccadilly Station - Undercroft Area BMS Requirements

50902-VE-PS-XX-SC-M-5603 Proposed Undercroft P&ID												
Reference No	Description	DI	DO	AI	AO	Communications		Switch/ Push Button	LED	Hard Wire Interlocks	Supply / Installation Requirement	Notes
						Type	Points					
System A - Undercroft ASHP System												
ASHP-A-01	Air Source Heat Pump 1 Control Panel	2	1			Modbus RTU	10	HOA	F,R	1	A	2 x DI - Unit Status, General Remote Alarm, DO - Remote ON/OFF, Modbus - Sequenced to ASHP - 2 & ASHP - 3
FSt-A-01	ASHP-A-01 Return Flow Switch	1									C	
PStH-A-01	ASHP-A-01 Flow High Pressure Switch	1								1	C	Interlocked with ASHP Enable
TS-A-01	ASHP-A-01 Flow Temperature Sensor			1							B	
TT+-A-01	ASHP-A-01 Flow Thermostat	1								1	B	Interlocked with ASHP Enable
TS-A-02	ASHP-A-01 Return Temperature Sensor			1							B	
HM-A-01	ASHP-A-01 Heat Meter 24V Supply											24VAC Power Supply
HM-A-01	ASHP-A-01 Heat Meter					Modbus RTU	5				A	Modbus - Instantaneous & cumulative energy kWh/ flow m³, flow/ return temperature
TE-A-01	ASHP-A-01 Flow Temperature Element (Connected to HM-A-01)											TE to be wired to the Heat meter input to enable temperature reading
TE-A-02	ASHP-A-01 Return Temperature Element (Connected to HM-A-01)											TE to be wired to the Heat meter input to enable temperature reading
ACT-A-01	ASHP-A-01 Flow 3-Way Control Valve Actuator 24V Supply											24VAC Power Supply
ACT-A-01	ASHP-A-01 Flow 3-Way Control Valve Actuator			1	1						A	AO - Modulation Signal, AI - Feedback Signal
ASHP-A-02	Air Source Heat Pump 2 Control Panel	2	1					HOA	F,R	1	A	2 x DI - Unit Status, General Remote Alarm, DO - Remote ON/OFF
FSt-A-02	ASHP-A-02 Return Flow Switch	1									C	
PStH-A-02	ASHP-A-02 Flow High Pressure Switch	1								1	C	Interlocked with ASHP Enable
TS-A-03	ASHP-A-02 Flow Temperature Sensor			1							B	
TT+-A-02	ASHP-A-02 Flow Thermostat	1								1	B	Interlocked with ASHP Enable
TS-A-04	ASHP-A-02 Return Temperature Sensor			1							B	
HM-A-02	ASHP-A-02 Heat Meter 24V Supply											24VAC Power Supply
HM-A-02	ASHP-A-02 Heat Meter					Modbus RTU	5				A	Modbus - Instantaneous & cumulative energy kWh/ flow m³, flow/ return temperature
TE-A-03	ASHP-A-02 Flow Temperature Element (Connected to HM-A-02)											TE to be wired to the Heat meter input to enable temperature reading
TE-A-04	ASHP-A-02 Return Temperature Element (Connected to HM-A-02)											TE to be wired to the Heat meter input to enable temperature reading
ACT-A-02	ASHP-A-02 Flow 3-Way Control Valve Actuator 24V Supply											24VAC Power Supply
ACT-A-02	ASHP-A-02 Flow 3-Way Control Valve Actuator			1	1						A	AO - Modulation Signal, AI - Feedback Signal
ASHP-A-03	Air Source Heat Pump 3 Control Panel	2	1					HOA	F,R	1	A	2 x DI - Unit Status, General Remote Alarm, DO - Remote ON/OFF
FSt-A-03	ASHP-A-03 Return Flow Switch	1									C	
PStH-A-03	ASHP-A-03 Flow High Pressure Switch	1								1	C	Interlocked with ASHP Enable
TS-A-05	ASHP-A-03 Flow Temperature Sensor			1							B	
TT+-A-03	ASHP-A-03 Flow Thermostat	1								1	B	Interlocked with ASHP Enable
TS-A-06	ASHP-A-03 Return Temperature Sensor			1							B	
HM-A-03	ASHP-A-03 Heat Meter 24V Supply											24VAC Power Supply
HM-A-03	ASHP-A-03 Heat Meter					Modbus RTU	5				A	Modbus - Instantaneous & cumulative energy kWh/ flow m³, flow/ return temperature
TE-A-05	ASHP-A-03 Flow Temperature Element (Connected to HM-A-03)											TE to be wired to the Heat meter input to enable temperature reading
TE-A-06	ASHP-A-03 Return Temperature Element (Connected to HM-A-03)											TE to be wired to the Heat meter input to enable temperature reading
ACT-A-03	ASHP-A-03 Flow 3-Way Control Valve Actuator 24V Supply											24VAC Power Supply
ACT-A-03	ASHP-A-03 Flow 3-Way Control Valve Actuator			1	1						A	AO - Modulation Signal, AI - Feedback Signal

ASHP-A-04	Air Source Heat Pump 3 Control Panel	2	1			Modbus RTU	10	HOA	F,R	1	A	2 x DI - Unit Status, General Remote Alarm, DO - Remote ON/OFF, Modbus - Sequenced to ASHP - 5
FSt-A-04	ASHP-A-04 Return Flow Switch	1									C	
PStH-A-04	ASHP-A-04 Flow High Pressure Switch	1								1	C	Interlocked with ASHP Enable
TS-A-07	ASHP-A-04 Flow Temperature Sensor			1							B	
TT+-A-04	ASHP-A-04 Flow Thermostat	1								1	B	Interlocked with ASHP Enable
TS-A-08	ASHP-A-04 Return Temperature Sensor			1							B	
HM-A-04	ASHP-A-04 Heat Meter 24V Supply											24VAC Power Supply
HM-A-04	ASHP-A-04 Heat Meter					Modbus RTU	5				A	Modbus - Instantaneous & cumulative energy kWh/ flow m³, flow/ return temperature
TE-A-07	ASHP-A-04 Flow Temperature Element (Connected to HM-A-04)											TE to be wired to the Heat meter input to enable temperature reading
TE-A-08	ASHP-A-04 Return Temperature Element (Connected to HM-A-04)											TE to be wired to the Heat meter input to enable temperature reading
ACT-A-04	ASHP-A-04 Flow 3-Way Control Valve Actuator 24V Supply											24VAC Power Supply
ACT-A-04	ASHP-A-04 Flow 3-Way Control Valve Actuator			1	1						A	AO - Modulation Signal, AI - Feedback Signal
ASHP-A-05	Air Source Heat Pump 3 Control Panel	2	1					HOA	F,R	1	A	2 x DI - Unit Status, General Remote Alarm, DO - Remote ON/OFF
FSt-A-05	ASHP-A-05 Return Flow Switch	1									C	
PStH-A-05	ASHP-A-05 Flow High Pressure Switch	1								1	C	Interlocked with ASHP Enable
TS-A-09	ASHP-A-05 Flow Temperature Sensor			1							B	
TT+-A-05	ASHP-A-05 Flow Thermostat	1								1	B	Interlocked with ASHP Enable
TS-A-10	ASHP-A-05 Return Temperature Sensor			1							B	
HM-A-05	ASHP-A-05 Heat Meter 24V Supply											24VAC Power Supply
HM-A-05	ASHP-A-05 Heat Meter					Modbus RTU	5				A	Modbus - Instantaneous & cumulative energy kWh/ flow m³, flow/ return temperature
TE-A-09	ASHP-A-05 Flow Temperature Element (Connected to HM-A-05)											TE to be wired to the Heat meter input to enable temperature reading
TE-A-10	ASHP-A-05 Return Temperature Element (Connected to HM-A-05)											TE to be wired to the Heat meter input to enable temperature reading
ACT-A-05	ASHP-A-05 Flow 3-Way Control Valve Actuator 24V Supply											24VAC Power Supply
ACT-A-05	ASHP-A-05 Flow 3-Way Control Valve Actuator			1	1						A	AO - Modulation Signal, AI - Feedback Signal
PS-A-01	Common Flow Pressure Sensor			1							B	
TS-A-11	Common Flow Temperature Sensor			1							B	
TS-A-12	Common Return Temperature Sensor			1							B	
PS-A-02	Common Return Pressure Sensor			1							B	
TS-A-13	Buffer Vessel BV-A-01 Temperature Sensor			1							B	
TS-A-14	Buffer Vessel BV-A-01 Temperature Sensor			1							B	
TS-A-15	Buffer Vessel BV-A-01 Temperature Sensor			1							B	
TS-A-16	Buffer Vessel BV-A-01 Temperature Sensor			1							B	
TS-A-17	Buffer Vessel BV-A-01 Temperature Sensor			1							B	
TS-A-18	Buffer Vessel BV-A-02 Temperature Sensor			1							B	
TS-A-19	Buffer Vessel BV-A-02 Temperature Sensor			1							B	
TS-A-20	Buffer Vessel BV-A-02 Temperature Sensor			1							B	
TS-A-21	Buffer Vessel BV-A-02 Temperature Sensor			1							B	
TS-A-22	Buffer Vessel BV-A-02 Temperature Sensor			1							B	
HM-A-06	Common Return Heat Meter 24V Supply											24VAC Power Supply
HM-A-06	Common Return Heat Meter					Modbus RTU	5				A	Modbus - Instantaneous & cumulative energy kWh/ flow m³, flow/ return temperature
TE-A-11	Common Return Temperature Element (Connected to HM-A-06)											TE to be wired to the Heat meter input to enable temperature reading
TE-A-12	Common Flow Temperature Element (Connected to HM-A-06)											TE to be wired to the Heat meter input to enable temperature reading
DPS-A-01	ADS-A-01 Differential Pressure Sensor			1							C	
Miscellaneous												
LVSWB-01	EC Main LV Close-Coupled Switchboard	6				Modbus RTU	45			1	A	6 x DI - SEF Relay Tripped, REF Relay Tripped, LVSB BTU Fault Status, 400V Surge Protection Activated, LV ACB Tripped Status, ACB Open/ Close Status Metering Modbus x 9
LV-EPO-01	Substation Room Emergency Power-Off Button	1								1	D	Emergency Power Off Button
TX-04	New Cast-Resin Transformer (Close-Coupled w/ LVSWB-01)	2						F			A	2 x DI - Winding Temperature Alarm, Temperature Monitor Fault
FIU-01	Substation Room Fire Alarm Interface Unit	1								1	H	Fire Alarm Activated
BMS-CP-01	Undercroft Area BMS Control Panel	3							PP/PC		D	3 x DI - 230 VAC Healthy, 24 VAC Healthy, UPS Healthy
Communications												
BMS-CP-02	Boiler Room BMS Panel Fibre Connection					Fibre Optic					A	Approx. 240m (TBC) of fibre optic cable connecting BMS-CP-01 and BMS-CP-02
	Distribution system	38	5	30	5		95			18		
	Total (Excluding Future I/O)	38	5	30	5							
	Grand Total (Including 20% Future I/O Wired to Terminals)	46	6	36	6							

Piccadilly Station - Boiler Room BMS Requirements

Project Specific Notes:

Issued for stage 3

Associated Documents / Drawings:

- 50902-VE-PS-XX-SC-M-5602 - Proposed Boiler Room P&ID
- 50902-VE-PS-XX-SH-E-6801 - Piccadilly Station Undercroft Area BMS Requirements Document
- 50902-VE-PS-XX-SC-E-6803 - Piccadilly Station Boiler Room Block Cable Diagram
- 50902-VE-PS-XX-SC-E-6802 - Piccadilly Station System Architecture Diagram
- 50902-VE-SW-XX-SH-M-5601 - Piccadilly Station - Equipment & Valve Schedule
- 50902-VE-PS-XX-SC-E-6001 - Piccadilly Station HV & LV Single Line Diagram

Project Details

Project Name:	Piccadilly Station
Contract Number:	VC50902
Document Number:	50902-VE-PS-XX-SH-E-6802
Revision:	P1
Revision Date:	05/12/2025
Originator	Csaba Grill



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Revision History									
Revision:	P1	Revised	Csaba Grill	Checked	Jon Linford	Approved	Ian Alty	Date:	05/12/2025
Issued for Stage 3 Approval									
Revision:		Revised		Checked		Approved		Date:	
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LED (LAMP) Key:

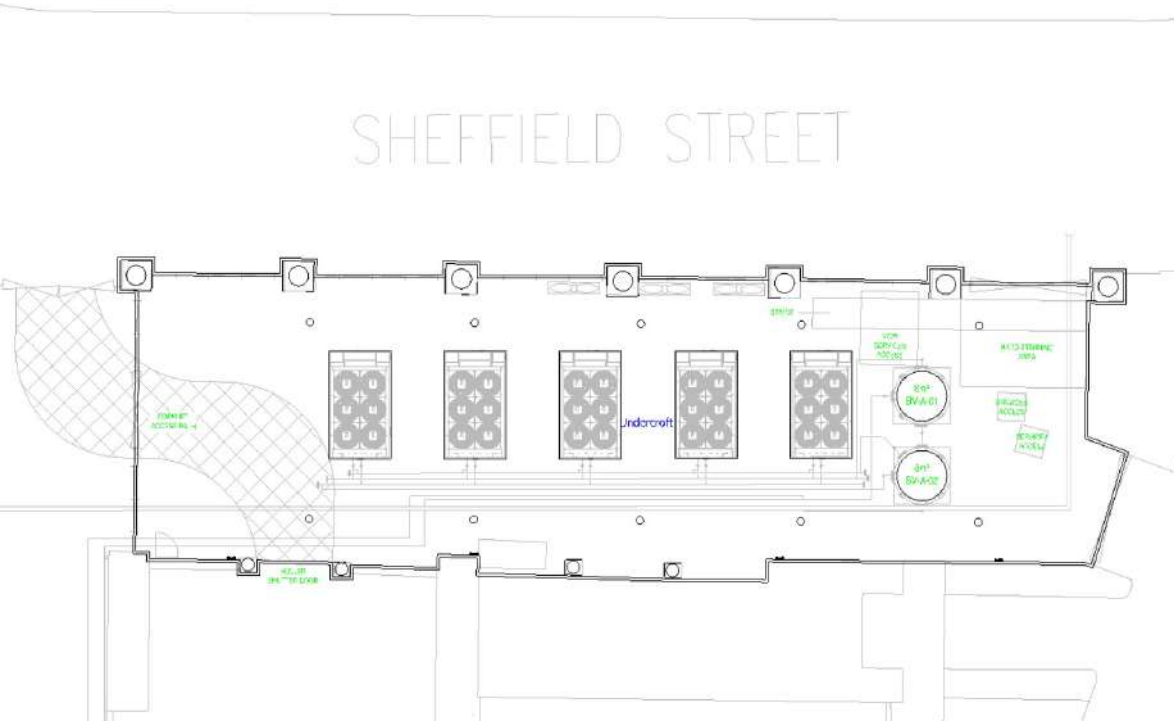
H - Hand Mode - White
A - Auto Mode - White
F - Device Fault - Red
R - Device Running - Green
PP - Panel Power - White
PC - Panel Control Power - White

Notes:

Piccadilly Station - Boiler Room BMS Requirements Document

50902-VE-PS-XX-SC-M-5602 Proposed Boiler Room P&ID

Reference No	Description	DI	DO	AI	AO	Communications		Switch/Push Button	LED	Hard Wire Interlock	Supply/ Installation Requirements	Notes
						Type	Points					
System A - Boiler Room System												
SSF-A-01	LTHW Flow Side Stream Filter	1									A	Common Fault
PM-A-01	PM-A-01 Primary Circulation Pump (Duty))	2	1	1	1			HOA	F/R	1	A	2 x DI - Running and Fault, DO - Enable, AO - Modulation, AI - Feedback
DPSt-A-01	Circulation Pump (Duty) Differential Pressure Switch	1									C	
PM-A-02	PM-A-02 Primary Circulation Pump (Standby)	2	1	1	1			HOA	F/R	1	A	2 x DI - Running and Fault, DO - Enable, AO - Modulation, AI - Feedback
DPSt-A-02	Circulation Pump (Standby) Differential Pressure Switch	1									C	
TS-A-23	LTHW Flow Temperature Sensor			1							B	
TT+-A-01	LTHW Flow High Level Thermostat	1								1	B	Interlocked with ASHP
PS-A-03	LTHW Flow Pressure Sensor			1							B	
PSH-A-06	LTHW Flow High Level Pressure Switch	1									C	
PU-A-01	Mains Cold Water Intake Pressurisation/ Degassing Unit	2							F		A	Pressure Fault/ Common Fault
PS-A-04	LTHW Return Pressure Sensor			1							B	
PSH-A-04	LTHW Return High Level Pressure Switch	1								1	C	Interlocked with pumps
PSIL-A-01	LTHW Return Low Level Pressure Switch	1								1	C	Interlocked with pumps
System W - Incoming Water System												
WM-W-01	Mains Cold Water Intake Water Meter	1									A	Pulsed Input
Peripheral												
FIU-01	Boiler Room Fire Alarm Interface Unit	1								1	H	Fire Alarm Activated
BMS-CP-02	Boiler Room BMS Panel Internal Connections	3						PP/PC				3 x DI - 230 VAC Healthy, 24 VAC Healthy, UPS Healthy
Communications												
BMS-CP-01	Undercroft Area BMS Control Panel Fibre Connection					Fibre Optic						Approx. 240m (TBC) of fibre optic cable connecting BMS-CP-01 and BMS-CP-02
PC	Ethernet connection to PC Headend					CAT 6 Ethernet						
MCC1-BH	Ethernet connection to existing Network Rail BMS panel					CAT 6 Ethernet						
	Distribution system	18	2	5	2		0			6		
	Total (Excluding Future I/O)	18	2	5	2							
	Grand Total (Including 20% Future I/O Wired to Terminals)	22	2	6	2							



50902-VE-PS-XX-RP-E-6301 Piccadilly Station Dialux Lighting Report

Object
Piccadilly Station Approach,
Greater Manchester,
M60 7RA

Editor
Issued by: Mia Walker
Checked by: Finley Mckay
Approved by: Matt Edwards

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Luminaire list

Φ_{total} 102396 lm	P_{total} 586.0 W	Luminous efficacy 174.7 lm/W	$\Phi_{\text{Emergency lighting}}$ 2396 lm	$P_{\text{Emergency lighting}}$ 16.0 W
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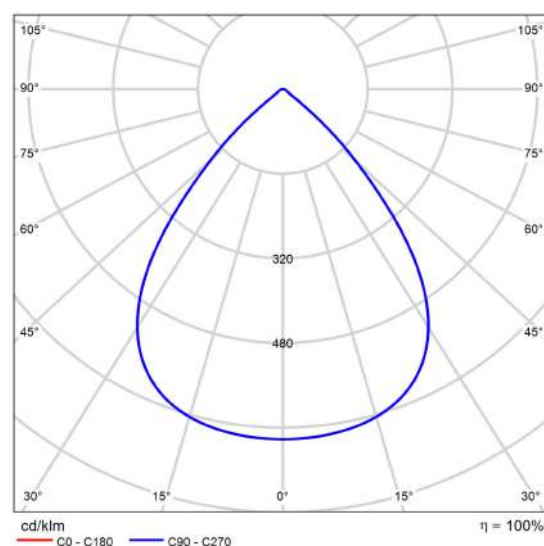
pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
10	Thorn Lighting	96636206	HIPAK G4 S LED10000-840 WB HF QC5 [STD]	57.0 W	10000 lm	175.4 lm/W
4	Thorn Lighting	96637113	VOYAGER TWINSPOOT MSW E3-NM WH [STD]	4.0 W	599 lm	149.8 lm/W
				 4.0 W	599 lm (100 %)	–

Product data sheet

Thorn Lighting - HIPAK G4 S LED10000-840 WB HF QC5 [STD]



Article No.	96636206
P	57.0 W
Φ_{Lamp}	10000 lm
$\Phi_{\text{Luminaire}}$	10000 lm
η	100.00 %
Luminous efficacy	175.4 lm/W
CCT	4000 K
CRI	80



Polar LDC

An IP65 single point suspension LED high bay luminaire with wide beam optic. Electronic, fixed output control gear, for 220-240V, 50/60Hz supply. Class I electrical. IK08. Housing: Die-cast aluminium. Lens/Diffuser: polycarbonate. Supplied with mounting hook. Equipped with 5 pole Quick Connect socket. Complete with 4000K LED.

ambient temperature: -30°C to +50°C

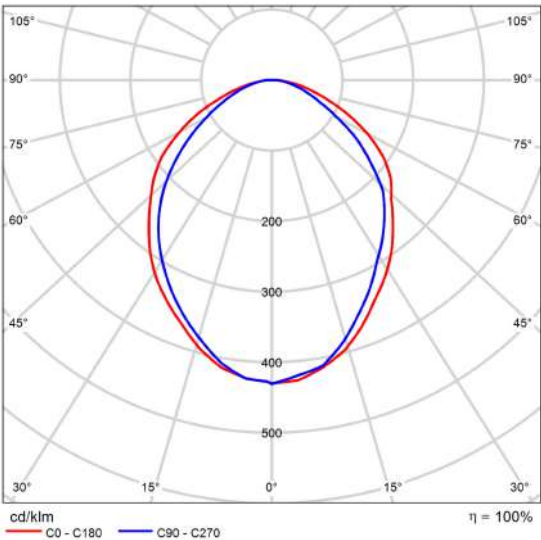
Dimensions: Ø280 x 170 mm
 Luminaire input power: 56.8 W
 Luminaire luminous flux: 10000 lm
 Luminaire efficacy: 176 lm/W
 Weight: 3.18 kg

Product data sheet

Thorn Lighting - VOYAGER TWINSPOUT MSW E3-NM WH [STD]



Article No.	96637113
P	4.0 W
P _{Emergency lighting}	4.0 W
Φ _{Lamp}	600 lm
Φ _{Luminaire}	599 lm
Φ _{Emergency lighting}	599 lm
η	99.84 %
Luminous efficacy	149.8 lm/W
CCT	3000 K
CRI	100
ELF	100 %



Polar LDC for Light emission 1 and 2

Durable light weight IP65 LED twin spotlight safety luminaire, turnable and tiltable LED light heads for optimum adaption for any application: self-contained luminaire, manual test, 3hr duration time; non-maintained mode; display of luminaire status via status LED; housing made of polycarbonate white; wall surface-mounted luminaire; Screw mounting of the cover; luminaire easy to install; Quick fit terminal block, wiring possible up to 2,5 mm²; suitable for indoor use; Units should be mounted at least 30° above line of sight; Maintenance free LiFePo4 battery pack, 24 hour recharge period; Power supply: 220/240 V AC; degree of protection: IP65, class of protection: Class II electrical; Dimensions: 87 x 280 x 300 mm; Luminaire input power: 3.2 W; weight: 1.25 kg

y	C0°	C90°	C0°- C360°
0°-180°	128.91	129.20	129.27
60°-90°	47.95	32.08	50.74

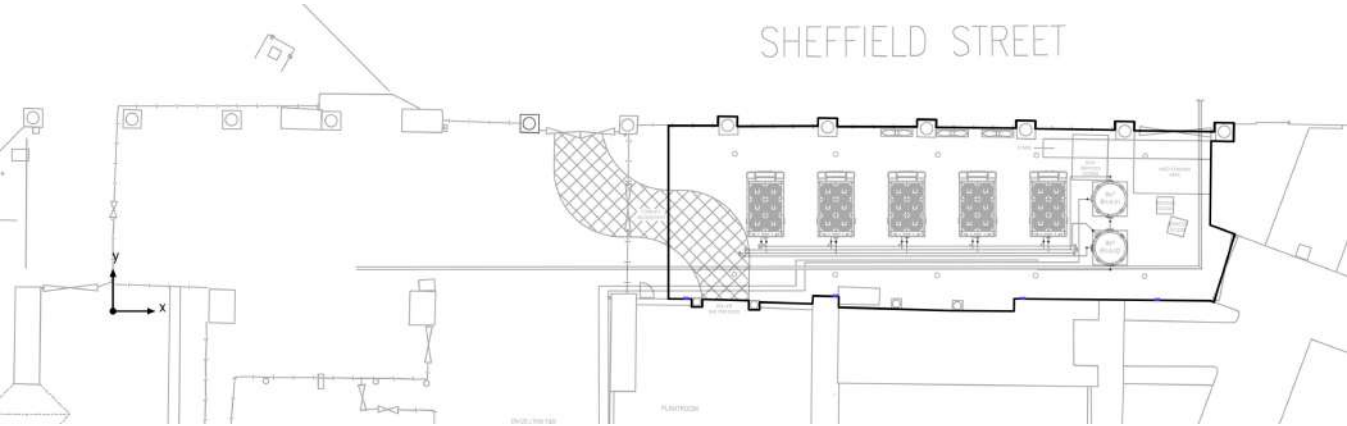
Product data sheet

Thorn Lighting - VOYAGER TWINSPOt MSW E3-NM WH [STD]

Glare valuation table for Light emission 1 and 2 [cd]

Piccadilly Station · Sheffield Street · Undercroft (Emergency light scene)

Summary



Ground area	343.44 m ²
Reflection factors	Ceiling: 70.0 %, Walls: 27.0 %, Floor: 21.5 %
Maintenance factor	0.80 (fixed)

Clearance height	5.200 m
Mounting height	4.800 m

Piccadilly Station · Sheffield Street · Undercroft (Emergency light scene)

Summary

Results

	Symbol	Calculated	Target	Check	Index
Space	Lighting power density	0.05 W/m ²	–		

Notes on planning:

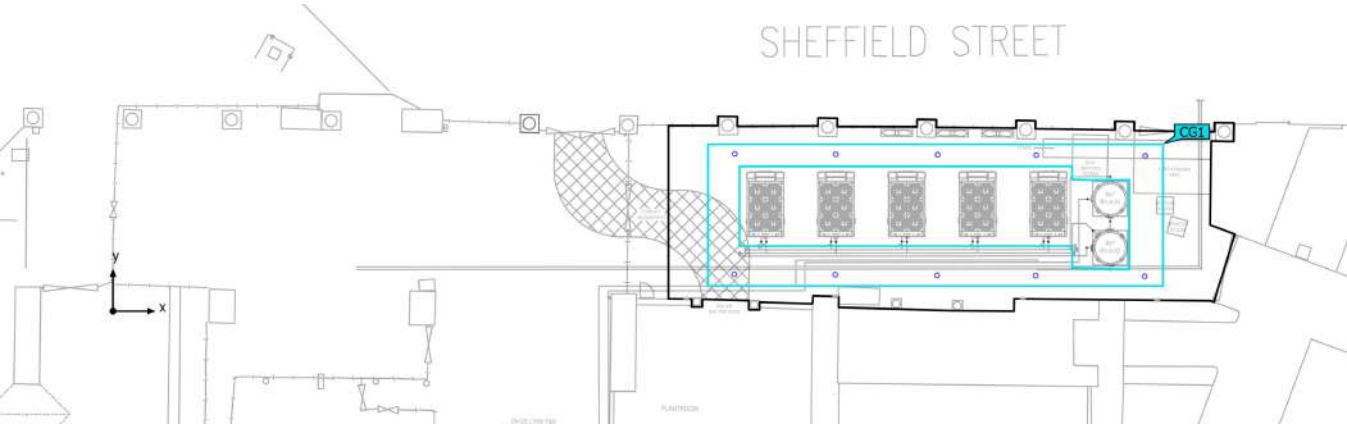
The emergency lighting scene was calculated with the first reflection and without taking into account the placed furniture.

Luminaire list

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
4	Thorn Lighting	96637113	VOYAGER TWINSPOt MSW E3-NM WH [STD]	4.0 W	599 lm	149.8 lm/W
				 4.0 W	599 lm (100 %)	–

Piccadilly Station · Sheffield Street · Undercroft (Light scene)

Summary



Ground area	343.44 m ²
Reflection factors	Ceiling: 70.0 %, Walls: 27.0 %, Floor: 21.5 %
Maintenance factor	0.80 (fixed)

Clearance height	5.200 m
Mounting height	4.700 m

Piccadilly Station · Sheffield Street · Undercroft (Light scene)

Summary

Results

	Symbol	Calculated	Target	Check	Index
Glare valuation ⁽¹⁾	R _{UG, max}	23	≤ 25	✓	
Energy estimation ⁽²⁾	Consumption	1283 kWh/a	max. 12050 kWh/a	✓	
Space	Lighting power density	1.66 W/m ²	–		

(1) Based on a rectangular space of 11.475 m x 33.649 m and SHR of 0.25.

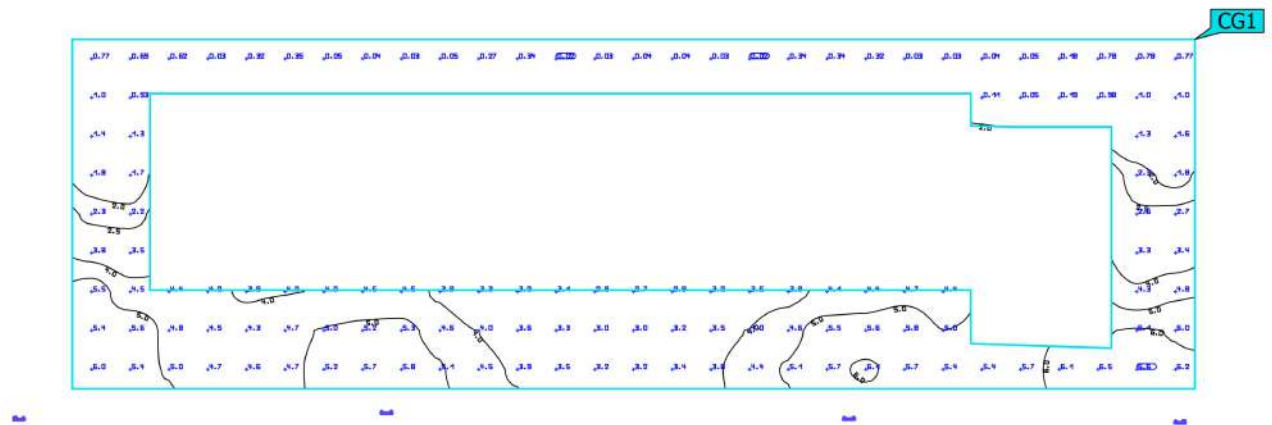
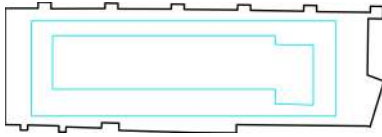
(2) Calculated using DIN:18599-4.

Utilisation profile: Industrial activities and crafts - Power stations (28.4 Side rooms, e.g. pump rooms, condenser rooms, switchboards)

Luminaire list

pcs.	Manufacturer	Article No.	Article name	R _{UG}	P	Φ	Luminous efficacy
10	Thorn Lighting	96636206	HIPAK G4 S LED10000-840 WB HF QC5 [STD]	23	57.0 W	10000 lm	175.4 lm/W

Piccadilly Station · Sheffield Street · Undercroft (Emergency light scene)

Calculation surface 1

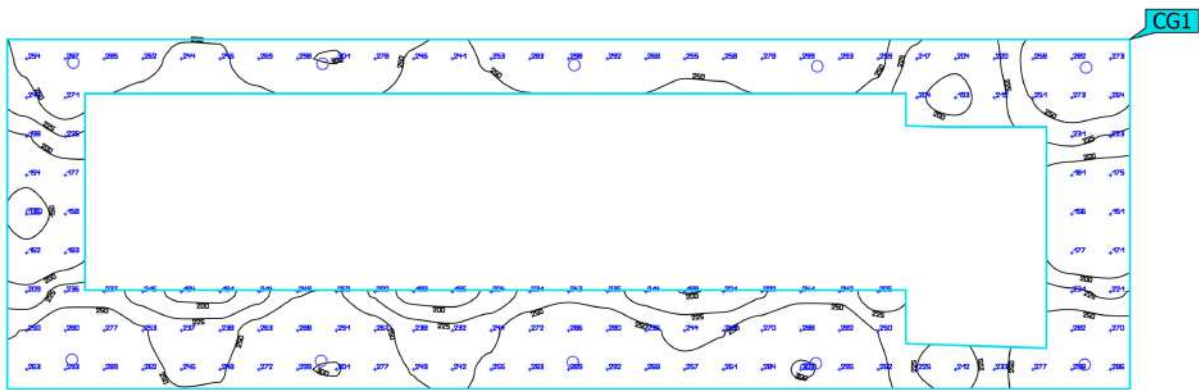
Properties	$\bar{E}$	E_{min}	E_{max}	$U_o (g_1)$	g_2	Index
Calculation surface 1	3.11 lx	0.022 lx	6.61 lx	0.007	0.003	CG1
Perpendicular illuminance						
Height: 0.100 m						

Notes on planning:

The emergency lighting scene was calculated with the first reflection and without taking into account the placed furniture.

Piccadilly Station · Sheffield Street · Undercroft (Light scene)

Calculation surface 1



Properties	$\bar{E}$	E_{min}	E_{max}	$U_o (g_1)$	g_2	Index
Calculation surface 1 Perpendicular illuminance Height: 0.100 m	245 lx	136 lx	302 lx	0.56	0.45	CG1

Utilisation profile: Industrial activities and crafts - Power stations (28.4 Side rooms, e.g. pump rooms, condenser rooms, switchboards)

Glossary

A

A	Formula symbol for a surface in the geometry
---	--

B

Background area	The background area borders the direct ambient area according to DIN EN 12464-1 and reaches up to the borders of the room. In larger rooms, the background area is at least 3 m wide. It is located horizontally at floor level.
-----------------	--

C

CCT	(Engl. correlated colour temperature) Body temperature of a thermal radiator which serves to describe its light colour. Unit: Kelvin [K]. The lesser the numerical value the redder; the greater the numerical value the bluer the light colour. The colour temperature of gas-discharge lamps and semi-conductors are termed "correlated colour temperature" in contrast to the colour temperature of thermal radiators. Allocation of the light colours to the colour temperature ranges acc. to EN 12464-1: Light colour - colour temperature [K] warm white (ww) < 3,300 K neutral white (nw) ≥ 3,300 – 5,300 K daylight white (dw) > 5,300 K
Clearance height	The designation for the distance between upper edge of the floor and bottom edge of the ceiling (in the completely furnished status of room).
Control group	A group of luminaires that are dimmed and controlled together. For each lighting scene, a control group provides its own dimming value. All luminaires within a control group share this dimming value. The control groups with their luminaires are automatically determined by DIALux on the basis of the created light scenes and their luminaire groups.
CRI	(Engl. colour rendering index) Designation for the colour rendering index of a luminaire or a lamp acc. to DIN 6169: 1976 or CIE 13.3: 1995. The general colour rendering index Ra (or CRI) is a dimensionless figure that describes the quality of a white light source in regards to its similarity with the remission spectra of defined 8 test colours (see DIN 6169 or CIE 1974) to a reference light source.

Glossary

D

Daylight autonomy	Describes what percentage of the daily working time the required illuminance is met by daylight. The nominal illuminance is used from the room profile, unlike described in EN 17037. The calculation is not done in the centre of the room but at the placed sensor measuring point. A room is considered sufficiently supplied with daylight if it achieves at least 50% daylight autonomy.
Daylight factor	Ratio of the illuminance achieved solely by daylight incidence at a point in the inside to the horizontal illuminance in the outer area under an unobstructed sky. Formula symbol: D (Engl. daylight factor) Unit: %
Daylight quotient effective area	A calculation surface within which the daylight quotient is calculated.

E

Energy evaluation	Based on an hourly calculation procedure for daylight in indoor spaces, considering the project geometry and any existing daylight control systems. Orientation and location of the project are also considered. The calculation uses the specified system power of the luminaires to determine the energy demand. A linear relationship between power and luminous flux in the dimmed state is assumed for daylight-controlled luminaires. Times of use and nominal illuminance are determined from the usage profiles of the spaces. Switched-on luminaires that are explicitly excluded from control also consider the specified times-of-use. The daylight control systems use a simplified control logic that closes them at an outdoor horizontal illuminance of 27,500lx. The calendar year 2022 is used as a reference only. It is not a simulation of this year. The reference year is only used to assign the days of the week to the calculated results. The changeover to summer time is not considered. The reference sky type used is the average sky described in CIE 110 without direct sunlight. The method was developed together with the Fraunhofer Institute for Building Physics and is available for review by the Joint Working Group 1 ISO TC 274 as an extension of the previous annual regression-based method.
Environmental zones	The assessment of intrusive light and light immission depends on the environment of the lighting installation. Depending on the standard, 4-6 different zones are defined, ranging from highly protected areas in natural settings to urban areas, commercial zones, and industrial zones.
Eta (η)	(light output ratio) The light output ratio describes what percentage of the luminous flux of a free radiating lamp (or LED module) is emitted by the luminaire when installed. Unit: %

Glossary

G

g_1	Often also U_o (Engl. overall uniformity) Designates the overall uniformity of the illuminance on a surface. It is the quotient from E_{min} to $\bar{E}$ and is required, for instance, in standards for illumination of workstations.
g_2	Actually it designates the "non-uniformity" of the illuminance on a surface. It is the quotient of E_{min} to E_{max} and is generally only relevant for certifying the emergency lighting acc. to EN 1838.

I

Illuminance	Describes the ratio of the luminous flux that strikes a certain surface to the size of this surface ($lm/m^2 = lx$). The illuminance is not tied to an object surface. It can be determined anywhere in space (inside or outside). The illuminance is not a product feature because it is a recipient value. Luxometers are used for measuring. Unit: Lux Abbreviation: lx Formula symbol: E
Illuminance, adaptive	For the determining of the middle adaptive illuminance on a surface, this is rastered "adaptively". In the area of large illuminance differences within the surface, the raster is subdivided finer; within lesser differences, a rougher classification is made.
Illuminance, horizontal	Illuminance that is calculated or measured on a horizontal (level) surface (this can be for example a table top or the floor). The horizontal illuminance is usually identified by the formula letter E_h .
Illuminance, perpendicular	Illuminance that is calculated or measured plumb-vertical to a surface. This needs to be taken into account for tilted surfaces. If the surface is horizontal or vertical, then there is no difference between the perpendicular and the horizontal or vertical illuminance.
Illuminance, vertical	Illuminance that is calculated or measured on a vertical surface (this can be for example the front of some shelves). The vertical illuminance is usually identified by the formula letter E_v .

K

k_s	The glare effect of a light source can be described by the glare metric k_s . It relates the solid angle of the glaring light source as seen from the point of immission, the ambient luminance, and the maximum allowable luminance.
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Glossary

L

LENI	(Engl. lighting energy numeric indicator) Lighting energy numeric indicator acc. to EN 15193 Unit: kWh/(m² * a)
LLMF	(Engl. lamp lumen maintenance factor)/acc. to CIE 97: 2005 Lamp flux maintenance factor that takes the luminous flux reduction into account of a luminaire or an LED module in the course of the operating time. The lamp flux maintenance factor is specified as a decimal digit and can have a maximum value of 1 (no luminous flux reduction existing).
LMF	(Engl. luminaire maintenance factor)/acc. to CIE 97: 2005 Luminaire maintenance factor that takes the soiling into account of the luminaire in the course of the operating time. The luminaire maintenance factor is specified as a decimal digit and can have a maximum value of 1 (no soiling existing).
LSF	(Engl. lamp survival factor)/acc. to CIE 97: 2005 Lamp survival factor that takes the total failure into account of a luminaire in the course of the operating time. The lamp survival factor is specified as a decimal digit and can have a maximum value of 1 (no failures existing within the time concerned or prompt replacement after the failure).
Luminance	Dimension for the "brightness impression" that the human eye has of a surface. The surface itself can emit light thereby or light striking it can be reflected (emitter value). It is the only photometric value that the human eye can perceive. Unit: Candela per square metre Abbreviation: cd/m² Formula symbol: L
Luminous efficacy	Ratio of the emitted luminous flux Φ [lm] to the absorbed electrical power P [W] Unit: lm/W. This ratio can be formed for the lamp or LED module (lamp or module light output), the lamp or module with control gear (system light output) and the complete luminaire (luminaire light output).
Luminous flux	Dimension for the total light output that is emitted from one light source in all directions. It is thus an "emitter value" that specifies the entire emitting output. The luminous flux of a light source can only be determined in a laboratory. A difference is made between the lamp or LED module luminous flux and the luminaire luminous flux. Unit: Lumen Abbreviation: lm Formula symbol: Φ

Glossary

Luminous intensity	Describes the intensity of the light in a certain direction (emitter value). The luminous intensity is a matter of the luminous flux Φ that is emitted in a certain spherical angle Ω. The radiation characteristics of a light source are presented graphically in a light distribution curve (LDC). The luminous intensity is an SI base unit. Unit: Candela Abbreviation: cd Formula symbol: I
M	
Maintenance factor	See MF
MF	(Engl. maintenance factor)/acc. to CIE 97: 2005 Maintenance factor as decimal number between 0 and 1 that describes the ratio of the new value of a photometric planning parameter (e.g. of the illuminance) to a maintenance value after a certain time. The maintenance factor takes into account the soiling of luminaires and rooms as well as the luminous flux reduction and the failure of light sources. The maintenance factor is taken into account either overall or determined in detail acc. to CIE 97: 2005 by the formula $RMF \times LMF \times LLMF \times LSF$.
O	
Obtrusive light/Light immission	To protect the nocturnal environment and minimize problems for humans, flora, and fauna, it is necessary to limit obtrusive light (also known as light pollution), which can cause serious physiological and ecological issues for individuals and the environment. Light immission refers to the disturbing influence of emitted light from artificial light sources.
Operating times	The assessment of obtrusive light and light immission depends on the operating times of the lighting installation. Depending on the standard, 1-3 different operating times are specified. In the absence of specific details, an operating time between 06:00 and 22:00 can be assumed.
P	
P	(Engl. power) Electric power consumption Unit: watt Abbreviation: W

Glossary

R

$R_{(UG)} \max$	Measure of the psychological glare in indoor spaces. In addition to the luminance of luminaires, the level of the $R_{(UG)}$ value also depends on the observer position, the viewing direction and the ambient luminance. The calculation is made according to the table method, see CIE 117. Among other things, EN 12464-1:2021 specifies maximum permissible $R_{(UG)}$- values $R_{(UGL)}$ for various indoor workplaces.
R_{DLO}	The ratio of the luminous flux emitted below the horizontal plane to the total lamp luminous flux of a luminaire or lighting installation in its operational position.
R_G	The glare directly caused by luminaires of an outdoor lighting installation is determined using the CIE Glare Rating (RG) method. To calculate this, the equivalent veiling luminance of the surroundings is needed. There are four options for determining this: • An exact calculation according to CIE 112, based on the scene area. • A simplified method according to EN 12464-2, based on the scene area. • Using a custom calculation area to determine the equivalent veiling luminance. • Specifying a fixed value for easy comparability.
R_{UF}	upward flux ratio The ratio of the luminous flux emitted directly or reflected above the horizontal plane to the luminous flux that cannot be avoided under ideal conditions to achieve the illuminance level on a deliberately illuminated area.
R_{UL}	upward light ratio The ratio of the luminous flux emitted above the horizontal plane to the luminous flux of a luminaire or lighting installation in its operational position. The luminaire efficiency is considered in this calculation.
R_{ULO}	upward light output ratio The ratio of the luminous flux emitted above the horizontal plane to the total lamp luminous flux of a luminaire or lighting installation in its operational position.
Reflection factor	The reflection factor of a surface describes how much of the striking light is reflected back. The reflection factor is defined by the colour of the surface.
RMF	(Engl. room maintenance factor)/acc. to CIE 97: 2005 Room maintenance factor that takes the soiling into account of the space encompassing surfaces in the course of the operating time. The room maintenance factor is specified as a decimal digit and can have a maximum value of 1 (no soiling existing).
$RUG \max$	(unified glare rating) Measure for the psychological glare effect in interiors. In addition to luminaire luminance, the RUG value also depends on the position of the observer, the viewing direction and the ambient luminance. Among other things, EN 12464-1 specifies maximum permissible RUG values for various indoor workplaces.

Glossary

RUG observer	Calculation point in the room, for the DIALux the RUG value is determined. The location and height of the calculation point should correspond to the typical observer position (position and eye level of the user).
S	
Surrounding area	The ambient area directly borders the area of the visual task and should be planned with a width of at least 0.5 m according to DIN EN 12464-1. It is at the same height as the area of the visual task.
V	
Visual task area	The area that is needed for carrying out the visual task in accordance with DIN EN 12464-1. The height corresponds with the height at which the visual task is executed.
W	
Wall zone	Circumferential area between working plane and walls which is not taken into account for the calculation.
Working plane	Virtual measuring or calculation surface at the height of the visual task that generally follows the room geometry. The working plane may also feature a wall zone.

VITAL ENERGI UTILITIES LIMITED

Piccadilly Station

Close Coupled RMU/Transformer/ LV Switchboard Specification

Document Reference: 50902-VE-PS-XX-SP-E-6201

Revision: P3

Issued By	Mia Walker	Building Services Engineering Apprentice	Date	04.12.2025
Checked By	Ben Hebden	Principal Engineer (Electrical)	Date	04.12.2025
Approved By	Matt Edwards	Associate Design Director (Electrical)	Date	04.12.2025

**Piccadilly Station
Close Coupled RMU/Transformer/LV
Switchboard Specification**

Table 1 – Revision History

Revision History						
Revision	Date	Page(s) Affected	Description	Produced By	Checked By	Approved By
P1	13.11.2025	All	Issued for enquiries	MW	BH	ME
P2	19.11.2025	All	TX-04 and LVSWB-01 ratings modified	MW	ME	BH
P3	04.12.2025	All	Issued for Stage 3 Approval	MW	BH	ME

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INTRODUCTION

This specification covers the design, manufacture, works testing, delivery to site, offloading, final positioning, assembly, testing and commissioning of a package substation. The package substation shall be of the type detailed within this document.

The site address is:

Piccadilly Station Approach,
Greater Manchester,
M60 7RA

The Vendor shall allow for offloading and final positioning onto prepared foundations of all component sections of the package substation.

If the any component of the package substation requires partial or full sectional splitting to enable delivery to site, the contractor shall allow for full reassembly on site, re-testing and certification.

The supplier shall allow for the client factory witness testing (FAT) and site acceptance testing (SAT) of the LV switchboard.

This specification will be read in conjunction with the documents and standards referenced in Table 3 and Table 4.

1 REFERENCE DOCUMENTS

Table 3 – Reference Documents

Reference	Description
50902-VE-PS-XX-SC-E-6001	Piccadilly Station HV & LV Single Line Diagram
50902-VE-PS-B1-DR-E-5001	Piccadilly Station Electrical Equipment Layout

2 SCOPE

The vendor shall provide design, manufacture, works testing, delivery, and erection onto prepared foundations, testing and pre-commissioning a package substation consisting of LV Switchboard, close coupled dry type transformer and close coupled HV ring main unit.

The switchboard manufacturer shall co-ordinate the design to provide a package substation with all required electrical, protection and control connections between individual components of the equipment.

The switchgear manufacturer shall also allow for the required ECS communications, 24Vdc battery tripping unit, interlocking, power factor correction, temporary generation connection section and associated bus wiring within each switchboard.

3 EXTENT OF EQUIPMENT AND SERVICES

3.1 Extent of Equipment

- LV switchgear as defined in this specification and the Single Line Diagrams. All ACB's and MCCB'S shall be from the same manufacturer.
- Dry type (AN) transformer as defined in this specification and the Single Line Diagram.
- IP21 transformer enclosure with electrical and mechanical interlocks.
- Busbar connection from the transformer LV terminals to the LV switchgear main incoming circuit breaker.
- One set of all specialist tools required for operation and maintenance of LV switchgear.
- One set of all necessary operating, lifting and removal devices as appropriate for the LV switchgear.
- Holding down bolts for all components of the package substation.
- Onsite re-assembly, testing and pre-commissioning of the package substation.
- One set (one hard copy, plus one electronic copy) of O&M manuals and certification.
- Integral DC supply and charger unit.
- HV Ring Main Unit
- Mimic markings shall be provided on the face LV and HV switchgear.
- Rubber mat for the full length of the front LV and HV switchgear.

3.2 Terminal Points

- Cable terminations and steel gland plates on the outgoing LV switchboard cable ways, including undrilled steel gland plates for cables (but exclusive of cable glands).
- Cable terminations and steel gland plates for the auxiliary cables, including undrilled steel gland plates for cables (but exclusive of cable glands).
- Cable terminations and non-ferrous gland plates on the Ring Main Unit ring switch cable boxes (but exclusive of cable glands).
- Powerlock temporary generator connection points.
- The transformer frame earthing terminals.
- The transformer enclosure earthing terminals.
- The LV Switchboard earthing terminals.
- The contact with the civils works of the foundation bolts.

4 NORMATIVE STANDARDS

Vital Energi have incorporated a ruling date for standards to be the first revision date of this document.

The equipment is to be designed, manufactured and tested in accordance with the following principal British Standards (or equivalent national standards) as applicable.

Table 4 – Normative Standards

Reference	Description
BS 7671	Requirements for Electrical Installations. IET Wiring Regulations.
BS EN 60255	Electrical relays
BS EN 60051	Direct acting indicating analogue Electrical measuring instruments and their accessory's.
BS EN IEC 60688	Electrical measuring transducers for converting AC electrical quantities to analogue and digital signals.
BS EN IEC 60947-2	Low-voltage switchgear and controlgear - Circuit-breakers
BS EN 61439	Specification for low voltage switchgear and control gear assembly's, part 1 & 2.
BS EN 60529	Specification for degrees of protection provided by enclosures (IP code).
BS EN IEC 61869-1	Instrumentation transformers
BS EN IEC 61869-2	Instrument transformers - Additional requirements for current transformers
BS EN IEC 61869-3	Instrument transformers - Additional requirements for inductive voltage transformers
BS EN IEC 61643-11	Low- voltage surge protective devices. Surge protective devices connected to low-voltage power systems. Requirements and test methods.
IEEE 1115	Sizing of Nickel cadmium batteries for stationary applications.
BS EN 13601	Specification for copper for electrical purposes
BS EN 60076-1	Power transformers - Part 1: General
BS EN 60076-11	Power transformers - Part 11: Dry-type transformers
BS 6231	Electric cables. Single core PVC insulated flexible cables of rated voltage 600/1000 V for switchgear and control gear wiring
BS EN 60255 Series	Measuring relays and protection equipment.
BS EN 61243-5	Live working. Voltage detectors. Voltage detecting systems (VDS)
BS EN 61869-2	Instrument transformers. Additional requirements for current transformers
BS EN 62271-1	High-voltage switchgear and control gear. Common specifications
BS EN 62271-206	High-voltage switchgear and control gear. Voltage presence indicating systems for rated voltages above 1 kV and up to and including 52kV.

Reference	Description
BS EN IEC 61936-1	Power installations exceeding 1 kV a.c. Common rules
BS EN IEC 62271-100	High-voltage switchgear and control gear. Alternating current circuit-breakers
BS EN IEC 62271-102	High-voltage switchgear and control gear. Alternating current disconnectors and earthing switches
BS EN IEC 62271-103	High-voltage switchgear and controlgear - Alternating current switches for rated voltages above 1 kV up to and including 52 kV
BS EN IEC 62271-200	High-voltage switchgear and control gear. AC metal-enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV
BS 6231	Electric cables. Single core PVC insulated flexible cables of rated voltage 600/1000 V for switchgear and control gear wiring
ESQCR	Electrical Safety, Quality and Continuity Regulations
-	Health and safety at work act
-	Construction (design and management) regulations
-	The Electricity at Work Act

5 TECHNICAL REQUIREMENTS

5.1 LV Switchboard LVSWB-01 Design Data

Table 5 – LV Switchboard LVSWB-01 Design Data

LV Switchboard LVSWB-01 Design Data	
Form of separation	Form 4b Type 6
Short circuit withstand/certification	50kA, 1 second / Declaration of conformity to the harmonised standard EN 61439-2 including normative documents.
Busbar type	Rectangular, hard drawn, high conductivity copper (bolted)
Busbar rating current	1250A
Nominal voltage	400V Three Phase / 230V Single Phase
Access	Front access
Intake Section	Provision to connect to 1250A busbar from close coupled transformer. 1250A 4P withdrawable 400Vac ACB device: Electronic trip unit c/w LSI function Schneider MTZ with micrologic 5 or equal & approved, • Shunt trip, • Auxiliary status contacts (2 sets - open/closed/tripped),

LV Switchboard LVSWB-01 Design Data	
	- Electrical & mechanical interlock with temporary generator connection section – Please refer to Sections 5.4 and 5.5. - Mechanical interlock with transformer enclosure – Please refer to Class X CT's and protection fuses Restricted earth fault Relay (64N) – GE MCAG14 or equal & approved c/w matching test block, Stand-by earth fault Relay (SEF) – GE Agile P14D or equal & approved c/w matching test block, Lockout relay (86) – GE MVAJ053 or equal & approved, Socomec Diris A30 meter or equal & approved c/w Modbus connectivity, CL 0.5 CT's and fuses as required, Neutral earth link c/w labelling, Type 1 & 2 surge protection device c/w status monitoring, Labelling in line with BS7671 requirements
Temporary Generator Connection Section	1250A 4P withdrawable 400Vac ACB device: Electronic trip unit c/w LSI function Schneider MTZ with micrologic 5 or equal & approved, - Auxiliary status contacts (2 sets - open/closed/tripped), - Electrical & mechanical interlock with intake section – Please Refer to Sections 5.4 and 5.5. 2 x 800A, 5 port Powerlock sequential mating boxes, mounted on the front face of the section. Socomec Diris A30 meter or equal & approved c/w Modbus connectivity, CL 0.5 CT's and fuses as required,
Outgoing Section/s	Outgoing feeder CPD's shall be Schneider NSX MCCB's with micrologic 2 tripping unit or equal & approved, All outgoing circuits shall be furnished with Socomec Diris A20 or equal & approved c/w Modbus connectivity, CL 0.5 CT's and fuses as required, Refer to single line diagram for quantity and required ratings
Incoming cable entry	Bus bar connection to transformer LV terminals.
Incoming Transformer cable gland plate	N/A
Outgoing cable exit	Top
Outgoing cable gland plate	3mm Steel
Switchboard Steelwork	Electrogalvanized, minimum 2mm thickness. Switchboard will come complete with an integral 100mm high steel plinth

LV Switchboard LVSWB-01 Design Data	
IP rating	IP31
Labels	Traffolyte/ Busbar mimic markings on front face of switchboard.
Paint finish	Manufacturer's standard

5.2 Transformer TX-04 Design Data

Table 6 – Transformer TX-04 Design Data

Transformer TX-04 Design Data	
Rated Power (S_R)	800kVA
Highest Voltage (U_m)	7,200V
HV Winding Rated Voltage (U_R)	6,600V
LV Winding Rated Voltage (U_R)	415V
Short Circuit Impedance (Z)	5% $\pm$ IEC Tolerances
Maximum Load Losses (P_k)	8,000W
Maximum No-Load Losses (P_o)	1,170W
Winding Connections	Dyn11
Insulating Medium	Dry-Type
Cooling Method	AN
Insulation Class	Class F (155°C)
Insulation Level – AC Withstand Voltage (RMS)	28kV
Insulation Level – Lightning Impulse Withstand Voltage	75kV
Climatic Class	C1
Environmental Class	E2
Fire Behaviour Class	F1
Enclosure	IP21 with Castel Interlock – Please Refer to Section 5.4.
Neutral Sizing	100% of Full Phase Rated Current
K Factor	1
Tappings	$\pm$ 5% in 2.5% steps
Frame Earth Terminals	2
Enclosure Earth Terminals	2
Transformer Monitoring	Winding Temperature Monitoring (PT100)

5.3 Ring Main Unit RMU-04 Design Data

Table 7 – Ring Main Unit RMU-04 Design Data

Ring Main Unit RMU-04 Design Data	
Switchgear Manufacturer	Schneider
Switchgear Part Number	RN2d-T3
Switchgear Description	Non-Extensible Ring Main Unit
Mounting	Freestanding
Left Hand Ring Switch Cable Access	From Above 3C 300mm ² Al
Right Hand Ring Switch Cable Access	From Above 3C 300mm ² Al
Circuit Breaker Cable Access	From Above
Voltage Rating	12kV
Fault Rating	21kA
Lightning Impulse withstand	95kV BIL
Power Frequency withstand	28kV
Internal Arc withstand	21kA for 1s (AF)
CB Protection Relay	VIP410A
VIP Additional test winding kit	Yes (Protection relay primary injection test point)
VDIS Indication	Yes
Tripped on Fault Contact	Yes
Low Gas Pressure Indication	Yes
Shunt Trip Coil	Yes
Provision for Left Hand Ring Switch Motorisation	Yes
Left Hand Ring Switch Motor Pack	No
Provision for Right Hand Ring Switch Motorisation	Yes
Right Hand Ring Switch Motor Pack	No
Provision for Circuit Breaker Motorisation	Yes
Circuit Breaker Motor Pack	No
Circuit Breaker Castel Interlock	Yes – Please Refer to Section 5.4.

5.4 Mechanical Interlocks

Mechanical interlock keys and mechanisms shall be selected from the Castell range and shall be compatible with FS type keys.

5.4.1 Transformer Access

Table 8 – Transformer Access Mechanical Interlocks

	Ring Main Unit Circuit Breaker	Low Voltage Intake ACB	Transformer Enclosure Door
Normal Operation	Closed, HV ₁ Key Trapped	Closed, LV ₁ Key Trapped	Locked Closed, HV ₁ & LV ₁ Keys Not Available
Transformer Access	Earth Selected, HV ₁ Key Free	Open, LV ₁ Key Free	Open, HV ₁ & LV ₁ Keys Trapped

5.4.2 Temporary Generator Connection

Table 9 – Temporary Generator Connection Mechanical Interlocks

	Low Voltage Intake ACB	Temporary Generator ACB
Normal Operation	Closed, LV ₂ Key Trapped	Locked Open, LV ₂ Key Not Available
Temporary Generator	Open, LV ₂ Key Free	Closed, LV ₂ Key Trapped

5.5 Electrical Interlocks

The LV switchboard shall incorporate electrical interlocks that prevent any open ACB's from closing whenever any other ACB is in the closed position.

Table 10 – LV Switchboard Electrical Interlocks

	Low Voltage Intake ACB	Temporary Generator ACB
Normal Operation	Closed, Electrical Interlock to Temporary Generator ACB Active	Open, Close Inhibited by Electrical Interlock.
Temporary Generator	Open, Close Inhibited by Electrical Interlock.	Closed, Electrical Interlock to Intake ACB Active

5.6 Normal Service Conditions

The equipment will be suitable for indoor use in a naturally ventilated environment given the following normal service conditions:

Table 11 – Normal Service Conditions

Normal Service Conditions	
Maximum Daily Temperature	40°C
Maximum Daily Average Temperature	35°C
Minimum Ambient Temperature	-5°C
Maximum Daily Average Relative Humidity	<95%
Altitude Above Sea Level	<1000m
Pollution Degree	2

6 LOW VOLTAGE SWITCHBOARD

6.1 Rated Characteristics

6.1.1 Rated insulation voltage

The completed switchgear assembly shall have a rated insulation voltage U_i : 1 000V.

6.1.2 Temperature rise

The cable terminals and equipment shall be suitably rated to allow cable operating temperatures of 90°C.

The temperature rise of terminals for external insulated connections shall be limited to 30°C for PVC insulated cable and 50°C for XLPE or EPR insulated cable. The temperature rise of other equipment comprising the switchboard shall not exceed those prescribed by BSEN 61439.

6.1.3 Rated frequency

The rated frequency shall be 50Hz.

6.1.4 Rated interrupting and peak making current

The rated symmetrical interrupting and peak making capacities of ACBs and other switching devices comprising the switchboard shall be a minimum of 50kA RMS and 110kA respectively.

These values shall also apply to equipment and connections (e.g. current transformers, busbars and riser connections located on the fixed portion that may be subject to the electromagnetic and thermal effects of short circuit currents.

6.1.5 Rated short time rating

The short time rating of the equipment will be a minimum of 50kA RMS for 1 second.

6.1.6 Rated asymmetrical interrupting current

The AC component shall be equal to that given in clause 6.1.4 above in respect of the symmetrical component.

6.1.7 Internal electrical supplies/ distribution

The following Distribution supplies are required for operation of equipment on the switchboards and shall be included as part of the construction:

- 24V dc nominal, negative pole earthed for control supplies, shunt trip and spring release coils.
- 230V ac +10% / -6%, 50Hz, neutral solidly earthed, for the operation of spring charging motors and anti-condensation heaters.

6.1.8 Surge Protection

The switchgear shall be installed within a building provided with a lightning protection system designed in accordance with BS EN 62305 and BS7671.

The incoming circuit to the switchgear shall be furnished with a surge protection device (SPD) complying with the requirements and tests of BS EN 61643-11. The SPD shall provide protection against both common mode and differential mode overvoltage's. The SPD shall be of the type providing type 1 enhanced protection, Connection Type 1 (CT 1) as detailed in BS7671, Chapter 53.

6.1.9 Painting

The manufacturer's standard specification for painting is acceptable, although details shall be submitted to Vital Energi for approval.

6.1.10 Packaging and shipping

The manufacturer's standard specification for packing and shipping is acceptable, although details shall be submitted to Vital Energi for approval. The equipment shall be suitably packed for transport by road.

6.2 Functional Equipment

6.2.1 General

Functional units of the same type and current rating shall be interchangeable. Where there is a difference, they will not be interchangeable.

All switching devices (ACBs, moulded case circuit breakers, fuse switches and isolating devices) comprising the switchboards and panelboards shall provide an isolating distance appropriate to their rated insulation voltage (U_i) in accordance with the requirements of and tests as provided for in BS EN 60947-2

6.2.2 Circuit breakers

Where specified the circuit protective devices shall meet the following specifications:

Air circuit breakers (ACBs)

ACBs shall be of the air break, withdrawable pattern, four poles as defined on the single line diagram. ACBs shall have trip free independent manual closing mechanisms equipped with manual spring charging.

ACB's shall be provided with adjustable long, short time and instantaneous overcurrent protection and earth fault protection. The instantaneous and earth fault features shall be capable of being disabled independently.

Moulded Case Circuit Breakers (MCCBs)

MCCBs shall not be used in place of an ACB for the protection and isolation of either incoming or feeder circuits unless specifically permitted by this specification and the single line diagram.

MCCBs shall have trip-free independent manual closing mechanisms equipped with either manual or motor spring charged operating mechanisms. Mechanisms of the latter type shall automatically re-charge the springs once the circuit breaker has closed. The use of under voltage release coils for control and protection purposes is not permitted unless prior permission to use such devices has been obtained from Vital Energi..

Any MCCB offered shall be rated for Category B duty as defined in BS EN IEC 60947-2. The rated service breaking capacity (I_{cs}) shall be equal to 100% of the rated ultimate breaking capacity (I_{cu}) for the maximum prospective short circuit fault current of the system. The energy let through under such conditions shall be provided by the manufacturer.

Each MCCB in a distribution system shall at all fault levels, up to and including the maximum, fully discriminate with both upstream and downstream protective devices.

MCCBs shall be provided with adjustable tripping devices arranged to provide overcurrent protection. Time delayed and instantaneous features shall be provided, with the facility to disable the instantaneous tripping feature and earth fault feature independently. All protective devices are to be provided with electronic trip units as per the Vital Energi protective device settings document issued with this specification.

Where an MCCB is used for isolation purposes, the interlocking requirements identified in this specification shall be provided. The MCCB when in the off position shall provide a safe isolating distance across the open contacts in accordance with BS EN IEC 60947-1.

The following mechanical indicators will be provided on all circuit breakers as appropriate:

- Circuit Breaker Open / Closed
- Circuit Breaker Tripped

800V AC Fuses

~~Where 800V AC fuses are provided at the LV switchboard for the string inverter AC circuits, the manufacturer will offer gRL/gS class NH fuse links and NH fuse bases meeting the requirements of BS EN / IEC 60269-4:2009 Low voltage fuses. (Supplementary requirements for fuse links for the protection of semiconductor devices.) These fuses are primarily selected for short circuit protection as overload protection is provided by the inverter.~~

~~The manufacturer will select the correct size fuse link and holder appropriate with inverter maximum continuous rating as detailed on the inverter manufacturers data sheets. Furthermore, the manufacturer will ensure thermal coordination of the NH fuse link and NH fuse holder (at maximum continuous current rating) such that the fuse link watts loss per phase cannot exceed the fuse base/holder watts loss per phase (typically 32W).~~

6.3 Method of construction

6.3.1 Internal separation

The internal separation of assemblies comprising the switchboard (e.g. busbar compartment, combination motor starter etc.) shall be to Form 4b, Type 6 to BS EN 61439-2.

6.3.2 Degree of protection

The degree of protection afforded to accidental contact and the ingress of dust and water to the external enclosure will be IP31 to IEC 60529.

6.3.3 Assemblies

The assemblies comprising the switchboard (ACBs, fuse switches and other devices) as defined in this specification shall together, form a flush fronted assembly.

6.3.4 Doors

Hinged doors shall open not less than 90 degrees. Movement shall be restricted to prevent damage or tension being applied to internal wiring. Provision shall be made to padlock the doors in a closed position. All indicators shall provide positive indication of the device position and be clearly visible when the doors are in the closed position. All doors and removable panels shall be installed with gaskets.

6.3.5 Enclosures

Enclosures shall ensure safe working conditions on the 'dead' side of any circuit isolating device with adjacent circuits live. Any live conductors or connections which would be exposed when withdrawable equipment is removed shall be protected by the automatic shutters giving a degree of protection to IP 20 minimum. The shutters shall be capable of being padlocked in position once equipment is withdrawn.

6.3.6 Withdrawable equipment

Withdrawable equipment which may cause injury to an operator whilst being withdrawn, therefore the limit of travel shall be fitted with positive restraint. Such restraint shall require deliberate manual manipulation before it is possible to remove the withdrawable part.

6.3.7 Interlocks

Interlocks shall be provided on the equipment, such that:

Access to non-withdrawable components shall be prevented by means of a defeatable interlock unless the circuit is disconnected.

Insertion or withdrawal of any component shall not be possible unless the circuit is disconnected.

It shall not be possible to operate any device using the operating handle whilst the circuit breaker way is open.

6.3.8 Terminations

Connections provided for auxiliary cables (e.g. those used for control, protection, indication, alarm circuits etc. and generally operating at extra low voltage) shall be marshalled via bus wires to compartments segregated from the main connections or otherwise arranged so that it is possible to work on or install these circuits without the need to access chambers containing main circuit connections, busbars or other connections or components which may be live during normal service conditions.

Terminals provided for the termination of auxiliary connections and cables both internal to the switchboard and within the marshalling sections shall be of the “retained screw type”, mounted on DIN rail and be fitted with unique cable reference numbers.

Terminals of the insulation displacement type or those that require specialist tools for termination purposes or those where the screw directly compresses the conductors are not acceptable.

6.3.9 Busbars

Busbars shall be rated as detailed in Section 5.1.

The main horizontal busbars shall have a constant cross section throughout their length and be rated for continuous operation corresponding to the rated incoming supply. Busbar systems shall preferably be assembled utilising electro-tin-plated copper.

Any neutral busbar shall have the same cross-sectional area and rating as the phase busbars.

Each tee-off busbar shall have a constant cross section and be fitted to the full length of the cubicle. The rating of the tee off busbar shall correspond to the sum of the rated current of the outgoing circuits and the maximum rated current of any future circuits it may supply.

Both horizontal and tee-off busbars shall be adequately braced to withstand the thermal and dynamic affects caused by short circuit current. Any insulation system used shall be capable of withstanding the temperature rise resulting from the flow of short circuit current for the short time rating of the switchgear.

Busbars shall be supported on non-hygroscopic insulators and identified with plastic identification spot labels (L1, L2, L3 and N). Busbar support spacing shall be designed to ensure no busbar deflection when experiencing the declared peak short circuit current rating. In any case, busbar supports shall be installed at no more than 1500mm centres.

In the case of withdrawable equipment, the segregation shall extend up to and including the fixed isolating contacts.

6.3.10 Cabling

Cable entry shall be from above, as indicated on the single diagram. Removable undrilled gland plates shall be provided for each cable access. Gland plates for single core cables shall be manufactured from non-magnetic metal. A means of earthing the cable gland (provided by others) to the gland plate other than that achieved by metal to metal contact shall be provided.

6.3.11 Earthing

The LV switchboard is intended for use on a system that is solidly earthed. The LV switchboard shall be provided with a full-length earth bar with cross sectional area rated for 50kA, 1 second short-circuit withstand current. Whenever possible, joints in the main earth bar will only occur at joints between cubicles separated for transportation purposes. Provision shall be made at each end of the main earth bar for connection to the plant earthing system.

The switchgear shall be provided with an external earth connection point suitable for connection of a lightning protection tape to be connected, the earth stud shall be connected directly to the chassis and the internal earth bar.

The transformer neutral-earth connection shall be made in the LV switchboard. The neutral-earth connection shall be provided by means of a fully rated, bolted link between neutral and earth busbars located as close as possible to the incoming transformer busbar connection.

The neutral earth link shall be clearly identified and read as follows:

“CAUTION – MAIN EARTH LINK FOR THE LV SWITCHBOARD MUST NOT BE LEFT DISCONNECTED”.

The tee-off earth bars shall have a cross section equal to the main earth bar and shall be located such that the cabling gland plates may easily be connected to it.

Control and instrument transformers shall be connected to the switchboard earth bars via a removable link.

It shall be possible to install any cabling without dismantling any earth bar.

Withdrawable components shall be connected to earth when they are connected to the main supply.

Such connections will be made prior to the main connection being established.

6.3.12 Current transformers

Current transformers shall be provided as appropriate and as required by the protection, instrumentation and metering schemes. Current transformers shall normally be located on the circuit side of any isolating device. Care shall be exercised regarding the location of CTs provided for

restricted earth fault protection where there is more than one incoming supply to the switchgear and four pole circuit breakers are employed. The manufacture shall design and supply all CTs associated with earth fault protection and locate them within the assembly.

6.3.13 Busbar Connected Voltage Transformers

One Busbar connected Voltage Transformer (VT) will be provided in accordance with the requirements indicated in this section. The VT type, accuracy and output will be as indicated on the single line diagram.

Busbar connected voltage transformers will be of the three phase three limb epoxy resin or similar design. Voltage transformers containing oil are not acceptable. The voltage transformer will provide a three phase secondary star connected winding.

The Voltage Transformers will be of the withdrawable type or alternatively a means of isolating the windings from the primary connections will be provided. Any high voltage connections that would be exposed once the VT is isolated will be provided with earthed metal shutters arranged to close automatically over main connections which may be live when equipment is withdrawn during maintenance or operational activities.

The earthing of the windings will be as follows:

The 'star' point of the primary winding will be earthed.

The 'star' point of the three phase secondary winding will be earthed

Fuses will be provided in the phase connections that are not earthed. Isolation links will be provided in earthed phase connections and in earthing connections to the star points of windings where these are earthed.

The voltage transformer ratio will be $(\text{Primary Line Voltage}/\sqrt{3})/(\text{110}/\sqrt{3})$, the output will be Cl. 1.0/3P.

The busbar connected voltage transformer will provide a reference voltage to the G99 Protection.

6.3.14 Protection and control

General

Protective relays shall be flush mounted within inner fascia on the fixed portion of the equipment. Relay test plugs and sockets shall be provided to facilitate testing of the relays, including secondary injection tests, without requiring the disturbance of wiring or connections.

Relays shall be provided with shorting links that are arranged to automatically short circuit current transformer secondary connections upon removal of the relay.

Isolation links shall be provided in the pilot wire and intertripping circuits of protective schemes utilising pilot wires or intertripping circuits.

Relay power supplies shall be sub-fused. The power supply wiring to the relays shall be the last connection on the circuit so that the watchdog supervises the entire circuit for supply failure or other faults.

6.3.15 Transformer

The transformer installation shall be protected by restricted earth fault, stand-by earth fault, LSI and thermal overload protection incorporated within the LV switchboard. In addition to tripping the low voltage circuit breaker, these relays shall send an intertripping signal to the HV CB within the Ring Main Unit.

6.3.16 Powerlock Sequential Mating Boxes

Powerlock sequential mating boxes shall have the characteristics detailed in Table 12.

Table 12 - Powerlock Sequential Mating Box Characteristics

Powerlock Sequential Mating Box Characteristics	
Current Rating	800A
Peak Short Circuit Current Withstand	75kA
Short Circuit Current Withstand	35.5kA for 1s
Rated Operating Voltage	1,000V AC
Degree of Protection	IP67
Voltage Withstand	2,000V AC

Powerlock sequential mating boxes shall have five connection ports.

Powerlock sequential mating boxes shall be populated with drain type connectors, suitable for accepting standard Veam single pole connectors.

Powerlock sequential mating boxes shall incorporate an integral shutter mechanism to control the connection sequence of leads, such that safety conductors are connected first and withdrawn last.

The integral shutter mechanism shall have a key operated locking system to prevent unauthorized use.

Powerlock sequential mating boxes shall be installed complete with an operational lid.

Drain type connection sockets shall be coloured as indicated below:

- Earth – Green
- Neutral – Blue
- L1 – Brown
- L2 – Black
- L3 - Grey

Gasket shall be installed between Powerlock sequential mating boxes and the switchboard to achieve the declared degree of protection.

6.3.17 Auxiliary and position switches

Auxiliary and position switches shall be provided in sufficient quantities consistent with the control, protection, interlocking and alarm and indication requirements of the project.

Auxiliary switches shall be positively driven by the main contact operating mechanism.

Auxiliary or position switches from each device (e.g. ACB) required for control, interlocking or remote indication shall be wired to the appropriate marshalling box. At least two normally open and two normally closed auxiliary switches along with one normally open and one normally closed position switches shall be provided for future use.

Where withdrawable type switchgear is used, the connection between the truck and fixed portion shall be by means of plugs and sockets, the male portion of the assembly being located on the truck.

The plugs and sockets shall preferably engage automatically as the main contacts are engaged. It shall not be possible to disengage the auxiliary plugs and sockets once the circuit breaker is closed.

The auxiliary and position switches shall be provided for two functions, the first is to permit system control. The second function is to provide remote and local system indication and monitoring. The systems shall be independent of each other such that the failure of one system does not impact upon operation of the other.

6.3.18 Indication and alarm

As a minimum, the following functions shall be provided for the main air circuit breakers. The list, as given, is not exhaustive and the equipment vendor shall co-operate with the purchaser to finalise the list.

Main ACB open / closed

In the case of control functions, the circuits shall be hardwired to a marshalling point(s) on the switchgear for connection to the appropriate system. In the case of system indication/monitoring facilities the equipment vendor shall wire the signals to the marshalling points located on the switchgear for direct connection to the ECS system. All control wiring within the control section shall be continuous and terminate at a suitable terminal block.

The following indications and alarms shall be provided for remote annunciation as a minimum (The list given is not exhaustive and the equipment vendor shall liaise with Vital Energi to finalise the list.)

- Transformer Incomer: In service, open, closed or tripped
- ~~➤ Bus coupler: In service, open, closed~~
- 1no. Restricted earth fault relay status
- 1no. Standby earth fault relay status
- Tripping battery: Fault or loss of supply & low volts
- Surge protective device status

Facilities shall be provided for padlocking or otherwise locking all isolating devices in the off position only. All control switches will be capable of being padlocked in the neutral position. Selector switches shall be capable of being padlocked in any selected position.

6.3.19 Labels

Each way shall be provided with a permanently fixed label indicating the voltage / current and its designation.

Each circuit shall be fitted with a permanently fixed label indicating circuit title. In the case of withdrawable equipment, the circuit title shall be fitted to both fixed and moving portions.

The manufacturer shall install busbar mimic marking on the front face of the switchgear.

The manufacturer shall provide on a separate plate located in easily visible location a plate containing the following information as a minimum:

- Manufacturer's name
- Year of manufacture
- Serial No.
- Rated voltage
- Rated current
- Rated symmetrical short circuit capacity
- IEC 61439-2

6.3.20 Warning notices

Warning notices to the manufacturer's standard shall be permanently fixed to covers whose removal may expose live conductors or equipment.

All warning notices shall comply with the requirements of BS7671.

Additional warning notices for the presence of dual power supplies shall be provided on the front of the switchgear. These notices shall detail the isolation point for all power supplies.

6.3.21 Anticondensation heaters

Thermostatically controlled anti-condensation heaters shall be provided throughout the switchgear, located to maintain an even temperature throughout the various equipment compartments.

6.3.22 Metering

Incoming and outgoing circuits shall be provided with multi-function metering which shall provide the following information as a minimum:

- Phase voltages
- Line voltages
- Phase currents
- kW
- kVA
- kVAr
- kWh
- kVArh
- Phase power factor
- THD_I
- THD_V
- Individual harmonic currents
- Frequency

All meters shall be fitted with an MODBUS RTU module and to be loop connected and terminated in a marshalling section in the control panel.

The manufacture shall supply meters pre commissioned and internally wired to suit the CT's and VT's fitted within the switchgear, the connections between the RMU and switchboards will be undertaken on site by the electrical contractor.

6.3.23 Modbus Communication

All equipment shall be capable of MODBUS communication which shall be picked up on the Vital Energi ECS.

6.3.24 Modbus Communication Wiring

All the devices installed on the switchgear that have Modbus RTU communication shall be daisy chained and wired to a set of terminals using RS485 cable, for external connection to the Vital Energi ECS system.

6.3.25 Tamper Contacts

All panel doors shall be fitted with tamper contacts to be monitored via the ECS. Tamper contacts shall be wired back to the marshalling section/s, ready for connection the ECS.

6.3.26 Temperature Sensors

High and low temperature sensors shall be fitted within the panel to provide internal temperature alarm signals for the ECS panel (temp high & temp low), the sensors shall be wired back to the marshalling section/s within each item of switchgear.

6.3.27 Tripping & Closing Battery and Charger Unit

General and duty

A stand-alone battery and charger unit having a nominal voltage output of 24V DC and suitable for operation from a 230V, single phase, AC supply shall be provided for each of the switchboard as part of this order.

The unit shall be internally mounted within the switchboard. The unit shall be provided with an undrilled removable gland plate suitable for receiving XLPE/SWA/LSZH cables. The battery capacity shall be determined in accordance with the requirements of IEEE 485 for the duty below.

The charger shall be rated to provide 80% recharge within 14hours and full charge in under 24 hours following a full rated discharge.

The charger unit shall be provided with a voltmeter indicating the output voltage, and status lamps indicating Mains On, Mains Fail and Charge Fail.

Batteries

The battery shall be capable of supporting the quiescent demand of the switchboard and ring main unit for a period of 24 hours in the absence of the supply from the charger, following which it shall be capable of performing 3 complete opening and closing cycles on each motor charged circuit breaker forming the switchboard and ring main unit.

The battery shall comprise vented Valve Regulated Lead Acid cells complete with intercell connectors located in a separate compartment to the charging unit. The battery shall be provided with a centre tap high resistance earth system. The system shall be arranged to provide an alarm in the event of an earth fault occurring on either pole. Five sets of DC output fuses shall be provided, arranged such that discrimination with the fuses located on the switchboard is achieved.

The battery shall be designed and rated to maintain a voltage window of 26.7V (Maximum float) and 21.6V (End of Discharge) when measured at the switchgear terminals. For the purposes of design, the cable voltage drop between the battery unit and the switchgear shall be taken to be 2.5% of nominal (24V) voltage.

Communication/Indication

Volt free contacts shall be provided for the following indications:

- Charger Fault
- Low Volts

Indication shall be wired back to the switchboard marshalling section/s, ready for connection to the ECS.

6.4 Testing & Commissioning

6.4.1 Type Test

Equipment shall be fully type tested in accordance with the relevant specifications referenced in Section 4 of this specification. Alternatively type test certificates may be submitted for approval for identical equipment in lieu of type testing. Any differences between the equipment type tested and that offered under this specification shall be identified by the equipment vendor.

6.4.2 Routine Test

Routine tests for each type or rating for the equipment offered will comply with the relevant standards as specified in Section 4 of this specification.

Additional factory routine tests will be carried out on the switchgear as follows: -

- Withstand / pressure test commensurate with the equipment rated voltage.

- Full functional test including operation of the circuit breaker including motorised operation.
- Functional operation of all auxiliary contacts
- Protection system including protection relay (O/C & E/F), CTs (Ratio & Polarity) and trip coil tests by primary and secondary injection testing as necessary.
- Instrumentation / Calibration tests (Inclusive of requirements of proceeding sub clauses)
- Protective relay primary injection tests (Inclusive of requirements of proceeding sub clauses)
- Testing and proving of protective relay configurations and logic

6.4.2.1 Routine tests for accuracy of measuring and protective current transformers

Measurement CTs and Protection CTs shall be tested for limits of ratio and phase displacement. The routine test for accuracy shall in principle be the same as the type test detailed in BS EN 61869-2 "Instrument transformers. Additional requirements for current transformers".

CT test results (for each CT) shall be submitted by the switchgear manufacturer complete with the following information:

- CT serial number
- Secondary winding Resistance test results corrected to 75°C
- Excitation curve data
- Table detailing current ratio error in % at % of rated current
- Table detailing phase displacement in minutes at % rated of rated current
- Ratio error graph.

6.4.2.2 Routine tests for accuracy of measuring and protective voltage transformers

Measurement VTs and Protection VTs shall be tested for limits of ratio and phase displacement. The routine test for accuracy will in principle be the same as the type test detailed in BS EN 61869-3 "Instrument transformers. Additional requirements for inductive voltage transformers".

VT test results shall be submitted by the switchgear manufacturer complete with the following information:

- VT serial number
- Table detailing voltage ratio error in % at % of rated current
- Table detailing phase displacement in minutes at % rated of rated current

6.4.3 Factory Acceptance Test

Factory Acceptance Tests (FAT) shall be carried out at the manufacturer's factory prior to delivery to determine the proper function of the equipment in accordance with the specification. Vital Energi (and the Clients representative) shall witness all tests and notice shall be given when the system or equipment is ready for inspection or test to enable the necessary arrangements for attending the test to be made.

The testing scope related to all switchgear panel shall cover:

- Visual inspection and check of dimensions.
- Test of the switchgear logic i.e., interlocking

The testing scope related to one switchgear panel shall cover:

- Mechanical operation test.
- Functionality test.
- Power frequency voltage withstand test of the main circuit
- Dielectric and insulation test on control and auxiliary circuit
- Measuring of the resistance of the main circuit
- Test of measure and protection circuit.

6.4.4 Site Acceptance Test

The vendor shall complete Site Acceptance Tests (SAT).

Site acceptance tests shall include tests in line with the manufacturer's installation recommendations including:

- BTU commissioning
- Torque settings
- Pressure test followed by insulation resistance
- Busbar Ductor test
- Primary injection test
- VT Ratio test
- Protection Relay test
- CT Mag Curves

Before the installation work, the vendor shall provide Vital Energi with a full and detailed method statement for the pre-commissioning, setting to work, commissioning, testing and handover procedures to be applied to the switchgear.

Site commissioning tests shall include primary & secondary injection tests to prove the following parts of the protection and metering system:

- The electronic circuit as a whole.
- The trip coil and the circuit breaker mechanical tripping mechanism.
- Protection relay pick-up check and operating time and curve check at final settings.

7 Transformer

7.1 General

The transformer provided shall be a dry type transformer with epoxy resin cast units suitable for indoor use.

The dry-type distribution transformer shall meet the requirements of BS EN 60076-11.

The life expectancy of the distribution transformer shall be not less than 30 years, and the choice of components and accessories shall not limit the life expectancy, providing operation is within the limits of BS EN 60076-1.

The distribution transformer shall be designed and manufactured to operate on a three-phase system with a nominal frequency of 50 Hz.

7.2 Rated Characteristics

The transformer rated characteristics shall be as detailed in Section 5.2.

7.3 Short Circuit Impedance

The distribution transformer short-circuit impedance shall be as detailed in Section 5.2.

7.4 Losses

The transformer load and no-load losses shall be no greater than the losses described in Section 5.2.

7.5 Winding Connections

The transformer winding connections shall be as detailed in Section 5.2.

7.6 Cooling

The dry-type distribution transformer cooling mode shall be treated as AN in accordance with BS EN 60076-11. Forced cooling shall not be required to achieve the rated power under the normal service conditions described in BS EN 60076-1.

7.7 Insulation Class

The transformer insulation class shall be as detailed in Section 5.2.

7.8 Insulation Level

The transformer AC withstand and lightning impulse withstand insulation levels shall be as detailed in Section 6.2.

7.9 Climatic Class

The transformer climatic class shall be as detailed in Section 5.2.

7.10 Environmental Class

The transformer environmental class shall be as detailed in Section 6.2.

7.11 Fire Class

The transformer fire class shall be as detailed in Section 6.2.

7.12 Enclosure

An enclosure shall be provided for the dry-type distribution transformer.

The enclosure shall provide the degree of protection detailed in Section 6.2.

The enclosure shall generally be constructed from steel sheets and shall be suitable for the connection of cable boxes, where applicable.

The enclosure shall allow access to the transformer and all associated fittings, terminals and tapping links for maintenance either through lift off lockable doors, hatches or covers removable with aid of tools.

The enclosure shall be removable without need for disconnection of bushings/terminals from the transformer.

7.13 Neutral Sizing

The transformer neutral shall be sized as detailed in Section 6.2.

7.14 Tappings

The transformer shall be provided with facility to tap the transformer ratio via use of bolted links.

Tappings shall be provided on the higher voltage winding for a variation of the no-load primary voltage as detailed Section 6.2.

7.15 Lifting

Lifting fittings shall be provided, to suit slings or shackles, of adequate design to facilitate lifting in a reasonably upright position.

Any appropriate pair of lifting fittings shall be capable of supporting (with a factor of safety of at least two) the weight of the transformer.

7.16 HV Termination

A cable box, of the manufacturers design shall be provided for HV cables.

The cable box shall not impede access to the transformer enclosure.

The transformer shall not interfere with the enclosure ventilation design.

7.17 LV Termination

The transformer shall be close coupled to the LV switchgear.

7.18 Earth Terminals

The transformer frame shall be provided with earth terminals as detailed in Section 6.2.

The transformer enclosure shall be provided with earth terminals as detailed in Section 6.2.

Earth connections shall be free of paint, corrosion and grease, and shall be adequately protected against corrosion for storage.

7.19 Transformer Monitoring

A transformer electronic winding temperature monitoring device shall be provided.

The electronic winding temperature monitoring device shall be mounted on the external side of the transformer enclosure.

The electronic winding temperature monitoring device shall monitor the transformer winding temperature using two platinum temperature sensors fitted into each winding.

The electronic winding temperature monitoring device shall display the temperature of all windings.

The electronic winding temperature monitoring device shall provide an alarm signal by means of a volt free contact, wired back to the LV switchboard marshalling section/s, when the temperature of any winding exceeds a user configurable threshold.

The electronic winding temperature monitoring device shall initiate a trip of the LV switchboard incoming ACB when the temperature of any winding exceeds a user configurable threshold.

7.20 Rating Plate

The Transformer shall be provided with a rating plate complying with section 8 of BS EN 60076-1.

A duplicate of the transformer rating plate shall be fitted to the transformer enclosure.

The rating plates shall be of durable non-corrodible metal and be securely fixed to the transformer and enclosure in a readily accessible position.

7.21 Type Test

Equipment shall be type tested in accordance with the relevant standards given in section 4 of this specification. Alternatively type test certificates may be submitted for approval for identical equipment in lieu of type testing. Any differences between the equipment type tested and that offered under this specification will be identified by the equipment vendor.

7.22 Routine Testing

Routine tests shall comply with the relevant standards as specified in Section 4 of this specification.

Additional routine tests shall be made on the completed transformer and be carried out as part of the Factory Acceptance Tests witnessed by the purchaser and their client. The transformer will be subjected routine tests as detailed in BS EN 60076-1 and BS EN 60076-11 i.e.:

- Measurement of Insulation Resistance (pre) - The Insulation resistance will be measured between the each of the windings and each of the windings and the enclosure before any other tests are completed.
- Measurement of winding resistance - At ambient temperature the winding resistance must be measured and recorded.
- Vector Group
- Measurement of voltage ratio and check of phase displacement – For bolted tap changers, operation shall be checked throughout the range during the voltage ratio tests.
- Measurement of no-load loss and current.
- Measurement of load loss and short circuit impedance.
- Applied voltage test - The test shall be carried using a separate source; the frequency of the test voltage shall be the same as the rated frequency of the Transformer under test. The minimum voltage applied to the high voltage winding shall be 28kV RMS. The minimum voltage applied to the low voltage winding shall be 3kV RMS.
- Induced overvoltage test - The minimum induced overvoltage test voltage shall have a value of 24kV RMS. A three-phase test is not required if the test configuration for the single-phase test is in accordance with BS EN 60076-3, figure 3. The induced overvoltage test shall ensure that as well as meeting the requirements of BS EN 60076 the voltage appearing between windings

including sections and turns thereof, terminals and connections of the phase under test, is at least twice the value that would occur during normal operation for any tapping position.

- Measurement of Insulation Resistance (post) - The Insulation resistance will be measured between the each of the windings and each of the windings and the tank following all other tests.

The Transformer manufacturer shall give two weeks' notice of tests prior to commencement. On satisfactory completion of the tests, and before the equipment is despatched, the Transformer manufacturer shall make test certificates available for approval.

7.23 Factory Acceptance Test

Factory acceptance testing, to determine the proper function of the assembly in accordance with the specification, shall be carried out at the manufacturer's factory prior to delivery to determine the proper function of the equipment in accordance with the specification. Vital Energi (and the Clients representative) will witness all tests and notice shall be given when the system or equipment is ready for inspection and test to enable the necessary arrangements for attending the test to be made.

The factory acceptance test FAT shall be conducted as per BS EN 60076-1 and BS EN BS EN 60076-11 standards. Test shall include the following in accordance with the latest version of the above referenced standards:

- Perform insulation resistance test winding to winding and each winding to ground.
- Applied voltage test
- Repeat insulation resistance test winding to winding and each winding to ground.
- Perform turns ratio tests at all tap positions
- Polarity and phase rotation
- No load loss
- Load loss and short circuit impedance
- Excitation
- Winding resistance

The following functional checks shall be included

- Tap change functionality
- Temperature sensing device, including test alarm and trip contacts.
- Mechanical interlock operability

The manufacturer shall provide certified test reports for each unit as part of the operations and maintenance manual.

7.24 Site Acceptance Tests

The site installer / electrical contractor shall provide Site Acceptance Tests (SAT).

Site acceptance tests will include tests in line with the manufacturer's installation recommendations.

8 Ring Main Unit

8.1 Rated Characteristics

The ring main unit rated characteristics shall be as detailed in Section 5.3.

The temperature rise of terminals for external insulated connections shall be limited to 30°C for PVC insulated cable and 50°C for XLPE or EPR insulated cable.

8.2 Auxiliary Supplies

Auxiliary supplies shall be provided from the LV switchboard integral battery and charger, the switchboard auxiliary equipment shall be 24Vdc for operation of shunt tripping coils, spring release coils and low energy closing mechanisms.

8.3 Surface Preparation and Coatings

Surface preparations shall comply with the requirements of ENA TS 98-1.

8.4 Shipping and Handling

The general provisions for the rules for transport, storage and erection are included in Clause 1.10 of ENA TS 41-36 and shall be applied to the shipping and handling of Vital Energi units.

8.5 Functional Equipment

8.5.1 General

The equipment shall be of the outdoor, non-extensible, metalclad, Sulphur Hexafluoride (SF6) insulated, fixed / demountable type, fabricated from a minimum of 2mm sheet steel.

The panels shall have an ingress protection of no less than IP54 with the main door shut and IP41 with the main door open.

The front shall include a clear mimic diagram which indicates the different functions. The position indicators shall give a true reflection of the position of the main contacts and shall be clearly visible to the operator

The lever operating direction shall be clearly indicated in the mimic diagram. The manufacturer's plate shall include the switchboard's main electrical characteristics.

8.5.2 Bus Bars

Busbars shall be manufactured from HDHC copper, with cast resin insulation, and shall have a continuous current rating of 630A throughout the switchboard.

Busbars shall be able to withstand the thermal and dynamic effects of the rated short circuit currents without damage or degradation.

8.5.3 Ring Switches

Ring switches shall be fixed pattern and shall be manufactured in accordance with the requirements of BS EN IEC 62271-103.

Ring switches shall consist of 630 amp fault making/load breaking, spring assisted switches

Ring switches shall be provided with an integral fault making/dead breaking earth switch.

Earth switches shall be mechanically interlocked to prevent the main and earth switch from being switched ON at the same time.

The selection of the main/earth switch lever on the facia, shall only be possible when either the main or earth switch is in the off position.

The main/earth switch leaver shall be provided with the facility to be secured using a 6mm hasp padlock in both the main and earth positions.

Ring switches shall be operated by a unidirectional handle, which once inserted requires a minimum of 3 seconds to remove and re-insert to perform the reverse operation.

8.5.4 Circuit Breaker

The circuit breaker shall be fixed pattern and shall be manufactured in accordance with the requirements of BS EN 62271-100.

The circuit breaker shall be capable of interrupting all types of load at any power factor for a current of magnitude between zero and its maximum continuous rating.

The circuit Breaker shall consist of 200 ampere, spring assisted, three position rotating arc type SF6 circuit breakers.

The circuit breaker shall be provided with an integral fault making/dead breaking earth switch.

Earth switches shall mechanically interlocked to prevent the main and earth switch from being switched ON at the same time.

Circuit breaker tripping shall be inhibited when in the Earth On position.

The selection of the main/earth switch lever on the facia, shall only be possible when either the main or earth switch is in the off position.

The main/earth switch leaver shall be provided with the facility to be secured using a 6mm hasp padlock in both the main and earth positions.

The manual operation of the circuit breaker shall not have an effect on the trip spring. This should only be discharged under a fault (electrical) trip, the following manual reset operation should recharge the trip spring and reset the circuit breaker mechanism in the main off position.

The circuit breaker shall be fitted with a mechanical flag which shall operate under a fault (electrical) trip occurring. The 'tripped' flag should change should be labelled normal and tripped indicating the status if the unit.

The unit shall also have the option to be fitted with a multi-tap shunt trip coil and auxiliary switch for remote tripping/indication of the circuit breaker.

Circuit breakers shall be operated by a unidirectional handle, which once inserted requires a minimum of 3 seconds to remove and re-insert to perform the reverse operation.

8.5.5 Degree of Protection

The degree of protection afforded by the equipment shall be as detailed in Section 5.3.

8.5.6 Auxiliary and Position Switches

Auxiliary switches shall preferably be positively driven by the main contact operating mechanism.

8.5.7 Padlocking Facilities

Padlocking facilities shall be provided to prevent danger and unauthorised interference with equipment when properly used. As a minimum the following devices shall be provided with padlocking facilities as appropriate to the type of switchgear offered:-

- Main/Earth Switch Leaver
- Main Operating Mechanism
- Switchgear Door
- LV Compartment
- Operating Handle
- Main Earth Bar Cover

8.5.8 Voltage Transformers

Voltage Transformers shall be of the air insulated, fixed, cast resin 3 x single phase type with a secondary voltage of 110V.

~~Voltage Transformers shall have a burden of 50VA and be of class 0.2.~~

~~Voltage transformers shall be easily removable for HV pressure testing via access from the front of the panel.~~

~~Voltage Transformers shall comply with the following local and international standard BS-EN 61869-3.~~

~~Voltage Transformers shall be fitted with a rating plate in accordance with BS-EN 61869-3.~~

~~Voltage Transformer secondary fuses shall be provided.~~

~~Voltage Transformer wiring shall be wired to terminals located in the LV Compartment.~~

8.5.9 Protection Current Transformers/Sensors

General

~~Circuit Current Transformers shall be located on the on the circuit side of feeder and incomer circuit breakers.~~

~~Current Transformers shall be rated for a continuous thermal current of 120% of the rated primary current.~~

~~Current transformers shall have a short time thermal current rating equal to the short time rating of the switchboard assembly.~~

~~Current Transformers shall have a dynamic current rating equal to the peak withstand (making) rating of the assembly.~~

~~Current Transformers shall comply with the requirements of BS-EN 61869-2.~~

~~Current Transformers shall be labelled individually and in accordance with BS-EN 61869-2. Duplicate labels shall be positioned in the LV compartment.~~

~~Current Transformer wiring shall be wired to terminals located in the LV compartment.~~

8.5.10 Time Limit Fuse Protection

~~Where the HV protection selected is Time Limit Fuses (TLF's), 100/50/5 Class X protection current transformers shall be provided.~~

8.5.11 Multifunction Relay Protection

Where the HV protection selected is multifunction relay, protection current sensing shall be provided by over moulded, high sensitivity dual wound sensors.

8.5.12 Labels

The equipment shall be supplied with a supplementary, durable and clearly legible nameplate containing the applicable information detailed in table 9 of BS EN 62271-1.

In addition, the nameplate shall display:

- Classification of mechanical operations.
- Classification of electrical endurance.

The equipment shall be supplied with removable traffolyte circuit identification labels at the front and rear of each compartment, which shall be fixed to the equipment via the use of screws.

The equipment shall be supplied with removable traffolyte equipment identification labels for power meters, test blocks and protection relays.

8.6 Type Tests

The equipment shall be subject to the following type tests specified in BS EN 62271.

- Dielectric tests.
- Radio interference voltage test.
- Circuit resistance test.
- Temperature rise tests.
- Short-time and peak withstand current test.
- Verification of protection.
- Tightness test.
- Electromagnetic compatibility test.
- Internal arc-withstand test.

All type test reports and certificates shall be provided to Vital Energi for approval.

8.7 Routine Tests

The equipment shall be subjected to the routine tests at the supplier's works. The tests shall ensure the reliability of the equipment and shall include the following.

- Mechanical operation test.
- Test of auxiliary electrical supplies.
- Dielectric test on the main circuit.
- Checking of partial discharge on a complete unit to the test levels quoted in ENA TS 41-18.
- Tests on auxiliary and control circuits.
- Measurement of the main circuit resistance.
- Tightness test.
- Design and visual checks.

Routine test records shall be provided to Vital Energi for approval.

8.8 Factory Acceptance Tests

The supplier shall invite Vital Energi to carry out factory acceptance tests at the suppliers works.

Invitations to attend factory acceptance tests shall not be sent until type test certificates and routine test records have been approved by Vital Energi.

Factory acceptance tests shall be a repeat of routine tests.

Snags identified during factory acceptance testing shall be recorded on a snagging schedule.

Following completion of site acceptance testing, the supplier shall issue Vital Energi with a signed copy of the factory acceptance test records and snagging schedule.

The equipment shall not be packaged for shipping until all snags have been closed out.

8.9 Site Acceptance Tests

The Switchgear Vendor shall provide with his tender a list of proposed site acceptance tests for Vital Energi's approval.