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Southbank Place Development Energy Centre

MCPD Environmental Permit Application Supporting Document

Braeburn Estates Management Company Limited

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Quality information

Prepared by	Checked by	Verified by	Approved by
			
Aakanksha Sinha Senior Consultant	Helen Watson Associate Director	Mark Webb Technical Director	Mark Webb Technical Director

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1	29 Nov 2019	Initial Draft		Mark Webb	Technical Director
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Prepared for:

Braeburn Estates Management Company Limited

Prepared by:

Aakanksha Sinha
Senior Consultant
T: +441133012442
E: aakanksha.sinha@aecom.com

AECOM Infrastructure & Environment UK Limited
5th Floor, 2 City Walk
Leeds LS11 9AR
United Kingdom

T: +44 (0)113 391 6800
aecom.com

Table of Contents

Tables

1. Non-Technical Summary

This document presents the supporting information to an application for an Environmental Permit for the operation of a Medium Combustion Plant in the form of a gas-fired Combined Heat and Power (CHP) plant operated by Braeburn Estates Management Company Limited ("BEMC") at the new Southbank Place development in London.

The Southbank Place development incorporates eight residential and commercial buildings and includes an Energy Centre composed of a gas fired CHP plant and fourteen gas fired boilers for supplying heat and electricity to the development. The Energy Centre is located within the basement levels shared between the eight buildings, with the stacks for both the CHP plant and the boiler systems located on the roof level of a single building (Building 1), located at 8 Casson Square, London, SE1 7GU.

The net thermal input to the CHP plant is 2.05MWth with an output capacity of approximately 0.85MW electrical (MWe) and 0.9MW as heat. The CHP plant represents both a "Medium Combustion Plant" and a "Specified Generator" as it produces both heat and electricity, as defined in Schedules 25A and 25B of the Environmental Permitting (England and Wales) Regulations 2016 (as amended). As a specified generator, the CHP plant falls under Tranche B of the Environmental Permitting regime as a new plant.

The boiler plant comprises a total of fourteen (14) UltraGas 1000 boilers, each of which has a net rated thermal input of 943kW. Due to the thermal input of each boiler unit being <1MW, the boiler systems are outside the scope of the Medium Combustion Plant Directive (MCPD), and therefore do not require an Environmental Permit to operate. This position has been confirmed by the Environment Agency (EA) in the pre-application advice (Appendix B).

The primary purpose of the CHP plant is to supply power to the development, with any additional power needs (over and above that supplied by the Energy Centre) being provided by the National Grid. Although the CHP plant will have the capability to supply electricity to the National Electrical Transmission System (NTS), the likelihood of this is anticipated to be limited to when the CHP generates excess electricity. A formal export agreement will be obtained from NTS to determine when the site exports to the NTS. Considering the size of the CHP plant, and its primary objective of supplying to the Southbank Place development, the amount of electricity exported to the NTS by the CHP plant is expected to be minimal.

The CHP plant is an ENER-G 850 250NOx L33 (2.05MWth input (net)) engine. The CHP plant has its own emission stack to air, designated as Release Point A1. An air quality assessment including air dispersion modelling for the CHP plant, based on the guidance provided by the EA, has been undertaken by AECOM and is included in Appendix E. This assessment demonstrates that significant environmental impacts are not predicted for human health receptors as a result of the operation of the CHP plant. The modelling assessed the impact of pollutants emitted from the CHP plant namely oxides of nitrogen (NO_x as NO_2).

Due to the site setting, the impact of the emissions from the CHP plant were assessed at both off- and on-site human health receptor locations, including consideration to the varying receptor heights. There are no ecological receptors within the appropriate screening distance. Although the boiler plant operation itself is outside the scope of MCPD, the emissions from the boiler plant have been taken into account within the atmospheric dispersion modelling assessment so as to assess the cumulative air quality impacts associated with the emissions from the Energy Centre, in line with EA advice.

The modelling report has shown that the maximum off-site and on-site modelled NO_2 ground level concentration is <1% of the long-term National Air Quality Strategy (NAQS) objective and is therefore not significant. The short-term process contribution at the worst-case human health receptor is situated on-site, with the process contribution being <10% of the relevant NAQS, and therefore considered to be insignificant.

The site will develop an Environmental Management System (EMS) prior to commencement of operations.

2. Introduction

This document supports the application submitted by Braeburn Estates Management Company Limited ("BEMC") under the Environmental Permitting (England and Wales) Regulations 2016 (as amended) ("the EPR Regulations"), for an Environmental Permit to operate the CHP plant within the Energy Centre of the Southbank Place development, in Central London (the 'site'). The site is located at 8 Casson Square, London, SE1 7GU.

Figure 1 (Appendix A) shows the site's location (TQ 30875 80020).

The application has been prepared for one gas-fired CHP engine, producing approximately 854kW electrical output and 931kW heat output with a net thermal input of 2.05MWth to provide power and heating for the mixed-use development.

The thermal input of the CHP plant is more than or equal to 1MW and less than 50MW, therefore the plant falls under the requirements of both Schedule 25A "Medium Combustion Plants: Medium Combustion Plant Directive" and Schedule 25B "Specified Generators" of the Environmental Permitting (England and Wales) Regulations 2016 (as amended) ("EP Regulations"), being a medium combustion plant (and a generator) which is used for the purpose of generating both heat and electricity.

The EA "Specified Generator Tranche B Screening Tool" has been completed for the plant and determined that, on the basis of human health receptors, a bespoke Environmental Permit application is required. The output generated by the tool is provided in Appendix C.

As required by Annex II of the MCPD, the sector of activity of the medium combustion plant or the facility in which it is applied (or NACE code) is D35.1.10 - Production of Electricity.

The CHP plant is expected to commence operations in February 2020.

2.1 Proposed Operations

The Southbank Place development is a new mixed-use development in London and includes an Energy Centre for providing for the electrical and heating requirements of the new development.

The Energy Centre is composed of:

- A 2.05MWth (thermal input) Combined Heat and Power (CHP) unit, and
- 14 gas fired boilers (<1MWth each).

The fourteen (14) gas-fired boilers within the Energy Centre to provide additional heating to the development, which operate on an "on demand" basis. These boilers have been installed as 7 pairs of boilers with each individual paired set discharging to a single exhaust flue. As the 14 individual boilers each have a net thermal input of 943kW, the EA has confirmed that they are outside the scope of the Medium Combustion Plant Directive (MCPD) and therefore do not require a Permit to operate (see Pre-Application Advice in Appendix B). The details of the arrangement of the boilers has been included in this document to allow a complete description of the Energy Centre and their emissions to air have been included in the atmospheric dispersion modelling assessment so as to assess the cumulative air quality impacts associated with the emissions from the Energy Centre.

The CHP operates as the lead heating source for the development, with the gas boilers operating in a cascading arrangement to provide additional heat according to demand. Under the EP Regulations, only the CHP plant is considered to comprise a medium combustion plant as well as Tranche B specified generator, and therefore requires an Environmental Permit to operate.

This Permit Application is therefore solely focussed on the CHP plant.

The specified generator is a gas-fired CHP reciprocating engine - ENER·G 850 250NOX L33. The reported average efficiency of the engine is approximately 78% and therefore the rated thermal input of the specified generator is in the region of 2.05 MW. It is anticipated that testing of the actual efficiency (and therefore determination of the actual thermal input) would be carried out during commissioning,

planned for January 2020, and therefore this can be confirmed once complete. The CHP plant is expected to be in operation from February 2020.

The CHP plant is situated within a mixed use (residential and commercial) area and is therefore within close proximity to a number of sensitive human health receptors. The CHP plant is a standard package plant and is located within a dedicated area in the -1 Basement level, within the common basement area for the eight buildings within the development.

Based on the nature of the CHP plant, the maximum number of operational hours per year is expected to be 4,200, at loads of between 80 and 100%. The plant is operated remotely via a Building Management System (BMS) connected to the main BMS for the development, to ensure optimum operations. The daily CHP plant operation would be limited to between 06.00 – 18.00 via the BMS[1]. The environmental impact assessment of the emissions from the CHP plant has been carried out assuming continuous operation (24 hours), for the short-term impacts.

There is a single stack for the CHP plant (Release Point A1), located within Building 1 (see Figure 2, Appendix A) and extending to the building roof, discharging at a height of 109.5m. The main emissions to air from the stack would be:

- Oxides of nitrogen (NO_x) comprising nitric oxide (NO) and nitrogen dioxide (NO_2); created by the chemical combination of atmospheric oxygen and nitrogen within the high temperature combustion zone; and
- Carbon monoxide (CO).

Due to the inherent nature of the gas fuel, there would not be any significant emissions of sulphur dioxide or particulates.

The CHP plant would be maintained to ensure optimum thermal and electrical efficiency and to minimise emissions generation. Extractive monitoring of the emissions is proposed to be carried out at least every three years, in compliance with Annex III of the MCPD.

The site layout, including the site boundary, is shown in Figure 2 (Appendix A).

This application covers the following proposed activities for an Environmental Permit for the energy centre.

Table 2-1: Schedule 25B Listed Activities

Activity Reference	Schedule 25	Description of Activity
A1	Schedule 25A – A combustion plant with a rated thermal input equal to or greater than 1MW and less than 50MW. Schedule 25B – A generator with a rated thermal input more than or equal to 1MW and less than 50MW.	Combustion of natural gas in a medium combustion plant (and "Specified Generator") with a rated thermal input <50MWth to produce both thermal and electrical output.

[1] BMS Description of Operations: CHP & Thermal Storage, Sauter Automation Limited, 2017

4. Operating Techniques

4.1 Technical Standards

The key requirements of the MCPD are the limits placed on the emissions to air from combustion plants and the associated periodic monitoring and reporting of the emissions. The CHP plant will be compliant with the emissions and monitoring requirements of the Medium Combustion Plant Directive (MCPD) and will be operated in accordance with the applicable Sector Guidance, namely:

- Develop a management system: Environmental Permits'[2]; and
- Control and monitor emissions for your environmental permit[3];
- Specified generator: comply with permit conditions[4];
- Specified generators: dispersion modelling assessment[5]; and
- M5 – Monitoring of Stack Gas Emissions from Medium Combustion Plant and Specified Generators[6].

4.2 Process Description

4.2.1 Power Plant

The primary purpose of the CHP plant is to supply the energy needs of the development, with occasional top-ups provided by the National Electricity Transmission System (NTS). Although the CHP plant has the capability to export electricity to the NTS, this would not be the primary purpose of the plant and as such the scale of export to the NTS from the CHP plant is expected to be limited to when the CHP generates excess electricity. A formal export agreement will be obtained from NTS to determine when the site exports to the NTS. Considering the size of the CHP plant, and its primary objective of supplying to the Southbank Place development, the amount of electricity exported to the NTS by the CHP plant is expected to be minimal.

The CHP plant comprises a single ENER·G 850 250NOX reciprocating engine with Selective Catalytic Reduction (SCR) system. The power inputs and outputs of the engine are shown in Table 4-1.

Table 4-1: Details of the CHP Unit

Engine Type	No. of Engines	Power Output		Thermal Input (MW_{th})
		Electrical Output (MW_e)	Heat Output (MWth)	
ENER-G 850 250NOX(1)	1	0.850	0.900	2.05

Notes:

(1) Nominal outputs. Maximum electrical output of the CHP plant will be 0.854 kWe whilst maximum thermal output will be 0.931 kW. Please see Technical datasheet for the CHP plant in Appendix D.

[2] Develop a management system: Environmental Permits, EA, Published: 1 February 2016, Last updated: 14 January 2019, available at: https://www.gov.uk/guidance/develop-a-management-system-environmental-permits, accessed on 26/11/2019

[3] Control and monitor emissions for your environmental permit, EA, Published 1 February 2016, Last updated 8 November 2018, available at: https://www.gov.uk/guidance/control-and-monitor-emissions-for-your-environmental-permit, accessed on 26/11/2019

[4]Specified generator: comply with permit conditions, EA, Natural Resources Wales, Department for Environment, Food & Rural Affairs, and Welsh Government, Published: 15 July 2019, available at: https://www.gov.uk/guidance/specified-generator-comply-with-permit-conditions, accessed 26/11/2019

[5] Specified generators: dispersion modelling assessment, EA and Natural Resources Wales, Published: 15 July 2019, Last updated: 4 October 2019, available at: https://www.gov.uk/guidance/specified-generators-dispersion-modelling-assessment, accessed on: 26/11/2019

[6] Technical Guidance Note Monitoring M5 – Monitoring of Stack Gas Emissions from Medium Combustion Plants and Specified Generators, Version 1, EA, September 2018

When operational, the CHP plant would be run synchronised in parallel with the NTS supply, with the balance of the whole site demand being met from the NTS. In the event of an electrical supply failure or fault occurring on the incoming supply the CHP system would fully disengage/ isolate itself before finally shutting down in a safe manner. Upon restoration of the supply, the CHP plant would automatically restart and be re-synchronised with the mains and continue to operate in parallel with the incoming supply from the NTS. Figure 2 (Appendix A) shows the layout of the site whilst Figure 3 shows the layout of the CHP plant room.

Small power plants comprising reciprocating engines are more efficient than gas turbine based plants in situations where considerable load variations are possible, and are considered cost-efficient solutions for intermittent top-up of electricity supplies. In order to maintain satisfactory efficiency of such plants, smaller engines with the capability of quick start-up and shutdown are necessary, such that individual engines can be run at optimum loading and hence optimum efficiency. The technology selected for use as the CHP plant is therefore considered to represent BAT for the intended purpose.

Cooling is to be provided by a bank of air-cooled radiators.

4.2.2 Process Control System

The CHP plant is designed to operate as a 'stand-alone' package with automatic control that requires minimal or no supervision. The Energy Centre is designed to operate to match the heat demand of the Southbank Place development with the CHP being the primary unit supported by the bank of boilers (see Section 2.1), with the load on these units fluctuating to match the demand. As the CHP plant operation is dependent on the heat demand of the Southbank Place development, the electrical generation will also fluctuate, however, this will not be linked to the electrical demand of the Southbank Place development. It is therefore anticipated that most of the time the electricity will be used within the development, but there may also be occasional periods where an excess of electricity is generated which will be exported to the NTS. Appropriate agreements will be in place to limit the periods of export to the NTS by the CHP plant.

The day to day running of the CHP plant will occur remotely, with the plant being capable of both starting and operating from a remote station via appropriate communications links to facilitate remote operation, monitoring and control. The CHP plant will be controlled via a patented Distributed Intellect Remote Monitoring System (DIRMS) developed by the technology supplier, called 'Gkontrol'. The system stores and allows access to all required information on essential plant equipment parameters. The DIRMS unit is connected to a Central Maintenance Computer by a modem using a dedicated communications link.

A full BMS interface is provided to receive enable/ disable signals and monitor the status of the CHP plant system. This interface is linked to the Main BMS for the development. The control system will also control circulating pumps, fans and valves for the heating circuit within the CHP plantroom and ancillary plant.

The control system includes, but is not limited to, the following:

- Stop and start the engine at predetermined times and/ or to match building loads;
- Modulate the engine output when running to match the heat demand;
- Monitor performance of the engine and shed load or shut down if required;
- Revert to predetermined safe conditions on any failure or parameter excursion;
- Connect and disconnect the generator from the building electrical distribution system; and
- Disconnect the unit from the NTS.

The design philosophy of the control system is to provide the maximum possible level of automation for all systems installed at the site and the plant will, in general, operate automatically during normal operation.

4.3 Management Systems

The site will operate under an Environmental Management System (EMS), based on the requirements of ISO14001:2015. This EMS will be developed and implemented prior to commencement of operations, currently planned for February 2020. The EMS will be made available to the EA upon request.

In summary, the management system will identify systems and procedures that minimise the risk of pollution and harm to human health which may arise from the operation, maintenance, accidents, incidents and non-conformances at the site. It will also detail the provisions for recording and reporting the number of operational hours for the CHP plant.

The management system and procedures will be applicable to all staff, contractors and visitors. The management system will be developed to enable compliance with the Environmental Permit and other legislative requirements for the protection of the environment and human health.

Written procedures clearly describing responsibilities, actions and communication channels will be available for operational personnel dealing with emergencies.

Internal reviews of the management system (or relevant parts therein) will be undertaken at least on an annual basis or in the event of a change in operations/ site processes.

Internal audits will be undertaken to ensure compliance with the management system, relevant legal requirements, environmental and management performance and to identify preventative/ corrective actions to minimise the risk of breach/ non-compliance. The findings of such reviews and audits will be communicated to all staff and relevant external contractors and, where appropriate, improvement works/ corrective actions shall be implemented. All internal reviews, audits, amendments to the management system and improvement measures implemented will be recorded for reference and inspection purposes.

4.4 General Maintenance

The operator has a service and maintenance contract in place with a service provider approved by the Original Equipment Manufacturer (OEM).

In addition, a computerised maintenance management system will be in place to implement an appropriate automated system for scheduling and recording plant maintenance work and for reporting events and associated corrective actions. All plant and equipment on site are incorporated within a BMS, enabling the system to flag any fault with plant and equipment on site so the maintenance provider can action it. As such all plant, equipment, and infrastructure will be inspected regularly. Any issues identified during the inspections will be actioned following the inspection.

Routine maintenance would be undertaken regularly with major maintenance events undertaken periodically. Any materials required for maintenance works at the site would be brought to site by the maintenance contractor and removed for appropriate treatment and/ or disposal off-site on completion of works. No materials, including chemicals, required for maintenance works are stored on site.

4.5 Raw Materials

The use of hazardous materials within the site has been eliminated by design where possible, and minimised where it is not practical to eliminate them. Small quantities of hazardous materials, including chemicals, are stored on site. The site will have two 1,200 litre tanks for storing clean and waste oil, and a tank (approximately 1,000 litres) for storing urea for use in the SCR system. All tanks will be appropriately bunded and will be stored inside the building with no drains in the storage areas to be prevent escape of the substances and prevent pollution events.

Any materials required for maintenance works will be brought on site by the maintenance contractors and removed following completion of works.

4.6 Waste

Minor quantities of waste may be generated from maintenance works, which would be stored in a dedicated storage area. The waste storage area has appropriate signage to mark containers of hazardous and non-hazardous waste, including the 1,200-litre capacity tank storing waste oil.

All waste produced on site would be managed appropriately in line with the waste hierarchy and the Waste Framework Directive.

4.7 Energy Efficiency

According to article 2(1) of Schedule 24 of the EP Regulations, all applications for new environmental permits for relevant electricity generating installations, including medium combustion plant and specified generators, having a net rated thermal input exceeding 20MW, need to provide a cost-benefit analysis which assesses the cost and benefits of providing for the operation of the installation as a high-efficiency cogeneration installation.

With a net thermal input of approximately 2MW, the CHP plant is exempt from compliance with the requirements of Schedule 24 of the EP Regulations.

5. Emissions to Air

In compliance with the Specified Generator requirements, there would be no persistent emission of "dark smoke" from the CHP plant stack.

The Medium Combustion Plant/ Specified Generator comprises one CHP unit, housed within a dedicated plantroom within the shared basement of the eight buildings, as shown in Figure 3 (see Appendix A). The CHP plant exhaust flue is routed to the roof of Building 1, where it releases at a height of approximately 109.5m above ground level. The emission point is referenced to as A1 and is shown in Figure 2 (Appendix A).

Emissions of nitrogen oxides (NO_x) are controlled by the internal combustion control system integral to the engines' set-up, with lean-burn technology. In addition, Selective Catalytic Reduction (SCR) equipment is installed as secondary abatement to the CHP plant. The combination of primary and secondary control measures will enable the specified generator emission limit value for NO_x of 95mg/Nm^3 to be achieved. The technology supplier has provided a performance guarantee for NO_x emissions from the CHP plant, of 15mg/Nm^3 (at 15% O_2) when SCR is used, which has been taken into consideration in the dispersion modelling to assess the impact of the emissions from the CHP plant.

There is no emission limit value specified for CO within the MCPD, however, in line with MCPD requirements CO emissions from the CHP plant will be monitored periodically.

5.1 Flue Stacks

During operation there would be emissions from the Specified Generator stack. The details of the point source emissions parameters are shown in Table 5-1.

Table 5-1: Emission Parameters and Pollutant Emission Rates

Parameter		A1 CHP Plant Specified Generator
Stack height (m above ground level)		109.5
Stack diameter (m)		0.4
Average efflux velocity (m/s)		11.7
Volumetric flow (Nm^3/s)[1]		0.94
Volumetric flow at stack exit parameters (Am^3/s)		1.5
Average stack exit conditions	Temp (°C)	120
	Moisture (%)	7.4
Assumed maximum operating hours / year for assessment purposes		4,200
Oxides of nitrogen (NO_x) ELV (mg/Nm^3)[2]		40 mg/Nm^3 @ 5% O_2 (Approx. 15 mg/Nm^3 @ 15% O_2)
Oxides of nitrogen (NO_x) emission rate (g/s)		0.05

[1] Normalised to 0ºC, dry gas, 15% O_2

[2] Approximate NOx concentrations at 15% O_2 are presented to allow for direct comparison to the applicable ELV. Emissions from the Southbank Place Energy Centre CHP unit are significantly lower than the ELV.

6. Monitoring

6.1 Emissions to Air

There is one Release Point to air (A1) associated with the CHP plant.

Due to the individual thermal input of the engine being greater than 1MW and less than or equal to 20MW, the monitoring requirements of the MCPD apply to the emissions from the site. This requires that extractive monitoring is carried out every three years in the first instance. The first measurements will be carried out within four months of the grant of the Environmental Permit, or of the date of the start of the operation, whichever is the latest.

The extractive monitoring will be carried out by MCERTs accredited contractors in line with applicable EA technical guidance.

The Environmental Permit is expected to specify the emission limits and applicable analytical requirements for emissions monitoring. It is recognised there is no emission limit value for CO within MCPD, however there is still the requirement to monitor for it.

Table 6-1: Proposed Emissions and Monitoring (for insertion into permit)

Release Points	Parameter	Limit (mg/Nm^3)	Reference Period	Monitoring Frequency	Monitoring Standard or Method
A1	Oxides of Nitrogen (NO and NO_2 expressed as NO_2)	95[(a)]	Average over the sampling period	Every 3 years (at least)	BS EN 14792
	Carbon monoxide	N/A			BS EN 15058

Notes:

(a) 95 mg/m^3 @ 15% O_2 equates to 250 mg/Nm^3 @ 5% O_2.

(b) The MCPD does not specify any emission limit values for CO emissions.

(c) As the CHP engine will operate on natural gas there are no applicable emission limits set out in the MCPD for SO_2 or dust.

8. Environmental Risk Assessment (Impact Assessment)

8.1 Introduction

This section discusses the potential impact on sensitive receptors and the surrounding area and shows how the emissions from the CHP plant have been assessed. Guidance contained in the Environment Agency's - Air emissions risk assessment for your environmental permit[7], has been used to scope and assess the emissions from the site.

An initial Screening Risk Assessment has been carried out, the results of which indicated that detailed dispersion modelling was required. An air quality assessment, including detailed air dispersion modelling for the CHP plant to ensure that there are no predicted significant effects on sensitive receptors, was undertaken by AECOM. This Air Quality Assessment report is included in Appendix E.

8.2 Site Location and Sensitive Receptors

8.2.1 Human Receptors

The CHP plant lies within the borough of Lambeth, Central London, in a largely commercial and residential area. The building housing the CHP plant itself represents the closest residential receptors, and 46 receptor locations onsite, at different heights corresponding approximately to relevant building floor levels, have been identified in the air quality assessment (Appendix E).

In addition, 16 additional air quality sensitive receptors off-site have been identified.

The London Borough of Lambeth has declared an Air Quality Management Area (AQMA) for the whole of the borough, for the exceedance of the hourly and annual mean nitrogen dioxide objective, and also the daily and annual mean particulate matter (PM_{10}) objective.

Details of the location of the receptors are included within the dispersion modelling report (Figures 2 – 4, Appendix E). Due to the nature of the site, multiple receptor within the same building location were included within the assessment; a full list of human health receptors is presented in Table 8-1.

Table 8-1: Human Receptors in the Vicinity of the Site

Receptor	Receptor Identification	Receptor Location	X Co-ordinate	Y Co-ordinate
E01	The Tower Building	Off-site	530943.6	180026.7
E02	Elizabeth House	Off-site	530935.2	180005.9
E03	Elizabeth House	Off-site	530916.4	179972.6
E04	Elizabeth House	Off-site	530897.4	179941.7
E05	Elizabeth House	Off-site	530858.4	179872.2
E06	Waterloo Station	Off-site	530974.3	179969.2
E07	Waterloo Station	Off-site	530930.1	179905.3
E08	BFI IMAX	Off-site	530996.3	180110.0
E09	The Whitehouse	Off-site	530915.8	180122.3
E10	Conway Hall	Off-site	531039.9	180171.7
E11	Franklin Wilkins Building	Off-site	531016.9	180201.8
E12	James Clerk Maxwell Building	Off-site	531079.0	180128.2
E13	St Johns Church	Off-site	531118.6	180083.0

[7] Air emissions risk assessment for your environmental permit, Environment Agency and Defra, Published 1 February 2016 Last updated 2 August 2016, available at https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit , accessed on 25/11/2019

Receptor	Receptor Identification	Receptor Location	X Co-ordinate	Y Co-ordinate
E14	75 York Road	Off-site	530843.9	179821.0
E15	County Hall	Off-site	530795.8	179876.5
E16	Riverside Building/County Hall	Off-site	530722.3	179895.3
P01	8 Casson Square	On-site	530874.7	180017.1
P02	8 Casson Square	On-site	530896.2	180010.0
P03	8 Casson Square	On-site	530866.1	180031.5
P04	8 Casson Square	On-site	530912.4	180015.9
P05	8 Casson Square	On-site	530880.6	180039.3
P06	8 Casson Square	On-site	530902.7	180032.1
P07	1 Casson Square	On-site	530906.2	180044.5
P08	1 Casson Square	On-site	530898.3	180061.8
P09	1 Casson Square	On-site	530915.9	180069.7
P10	1 Casson Square	On-site	530923.6	180053.2
P11	30 Casson Square	On-site	530867.1	180065.9
P12	30 Casson Square	On-site	530885.2	180074.7
P13	30 Casson Square	On-site	530859.7	180083.3
P14	30 Casson Square	On-site	530875.8	180091.7
P15	The Belvedere	On-site	530831.0	180038.4
P16	The Belvedere	On-site	530841.8	180070.8
P17	The Belvedere	On-site	530807.6	180044.4
P18	The Belvedere	On-site	530817.8	180077.3
P19	2 Southbank Place	On-site	530872.2	180004.0
P20	2 Southbank Place	On-site	530847.4	180012.1
P21	2 Southbank Place	On-site	530891.7	179978.3
P22	2 Southbank Place	On-site	530827.7	179997.9
P23	2 Southbank Place	On-site	530864.5	179970.0
P24	2 Southbank Place	On-site	530834.9	179979.6
P25	Shell Centre	On-site	530816.9	180014.5
P26	Shell Centre	On-site	530807.6	180024.7
P27	Shell Centre	On-site	530810.1	179981.5
P28	Shell Centre	On-site	530786.3	180005.0
P29	Shell Centre	On-site	530788.3	179974.3
P30	1 Southbank Place	On-site	530862.2	179960.9
P31	1 Southbank Place	On-site	530832.6	179970.7
P32	1 Southbank Place	On-site	530856.8	179941.9
P33	1 Southbank Place	On-site	530826.8	179951.6
P34	1 Southbank Place	On-site	530853.7	179933.0
P35	1 Southbank Place	On-site	530823.3	179942.9
P36	1 Southbank Place	On-site	530846.9	179918.3

Receptor	Receptor Identification	Receptor Location	X Co-ordinate	Y Co-ordinate
P37	1 Southbank Place	On-site	530818.5	179927.6
P38	1 Southbank Place	On-site	530844.3	179912.4
P39	1 Southbank Place	On-site	530815.2	179921.7
P40	1 Southbank Place	On-site	530834.4	179892.3
P41	1 Southbank Place	On-site	530806.9	179901.1
P42	Belvedere Gardens	On-site	530791.7	179960.8
P43	Belvedere Gardens	On-site	530798.3	179949.6
P44	Belvedere Gardens	On-site	530789.0	179930.1
P45	Belvedere Gardens	On-site	530774.6	179908.9
P46	Belvedere Gardens	On-site	530796.5	179936.1

8.2.2 Sensitive Environmental Habitats

EA guidance requires that the effects of stack emissions on designated ecological sites be assessed where they fall within set distances of the source. There are no nationally designated sites within 2km of the site and no European designated sites within 5km (for a natural gas fired plant). Therefore, no ecological sites have been taken in to consideration within the impact assessment.

8.3 Impact Assessment Emissions to Air

Guidance from the EA[8] provides staged screening criteria to inform the level of detail that an air quality assessment is required to cover. The guidance advises that during the first stage, if both of the following criteria are met in respect of the predicted Process Contributions (PCs) of any substance, then no further assessment is required:

- PC <1% of the long-term environmental standard; and
- PC <10% of the short-term environmental standard.

If these first screening criteria are not met, then further assessment is required to determine the impact of the Predicted Environmental Concentration (PEC). The PEC is the sum of the PC and the concentration of the substance already present in the environment.

During normal operation there would be emissions from the CHP plant as well as the boilers. As per the EA's advice, the on-site gas-fired boilers have been included within the model, however these have been considered to contribute towards background pollutant concentrations. For the purposes of the assessment, the boilers have conservatively been assumed to operate at full load throughout the year (which is considered to be a significant over-estimate).

The height of the CHP plant stack is 109.5m, with the building height being 103.3m. Due to the setting of the CHP plant, the varying heights of the receptors in the vicinity of the emission point have been taken in to consideration in the assessment.

The emissions from the CHP used for the assessment are shown in Table 5-1.

The predicted annual mean PC NO_2 concentrations at all modelled off-site and on-site receptors are below 1% of the environmental standard of 40 µg/m^3. In accordance with the EA screening criteria, these insignificant long-term PCs from the CHP unit do not require any further assessment.

The maximum predicted 1-hour 99.79th percentile NO_2 PC off-site is 0.6 µg/m^3 which occurs at Receptor E16 (County Hall) at 1.5m above ground level and is 2.6 µg/m^3 on-site which occurs at Receptor P07

[8] Air emissions risk assessment for your environmental permit, EA, Published 1 February 2016, Last updated 2 August 2016, available at: https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit, accessed on: 25/11/2019

on the 33rd storey of the 1 Casson Square building, 109.2 m above ground level. The predicted short-term PC NO_2 concentrations at all modelled receptors are below 10% of the NAQS objective of 200 µg/m^3, at both on and off-site receptors. In accordance with the EA screening criteria, these insignificant PCs from the CHP unit do not require any further assessment.

Therefore, both long-term and short-term impacts of the NO_x emissions from the Centre CHP plant are screened out as insignificant.

A summary of the outputs from the dispersion modelling provided in Appendix E are presented in Table 6-2.

Table 8-2: H1 Screening Predicted Ground Level Concentrations – Human Receptors (Worst Case)

Pollutant	NAQS (µg/m^3)		Background + Gas Boilers Note 1 (µg/m^3)	Stage 1 Screening		
	Long Term	Short Term		PC (µg/m^3)	PC as % of NAQS	Insignificant?
NO_2 off-site (long term)	40	-	40.9	<0.1	0.24	Yes
NO_2 on-site (long term)	40	-	42.6	0.35	0.82	Yes
NO_2 off-site (short term)	-	200	82.8	0.6	0.3	Yes
NO_2 on-site (short term)	-	200	90.6	2.6	1.3	Yes

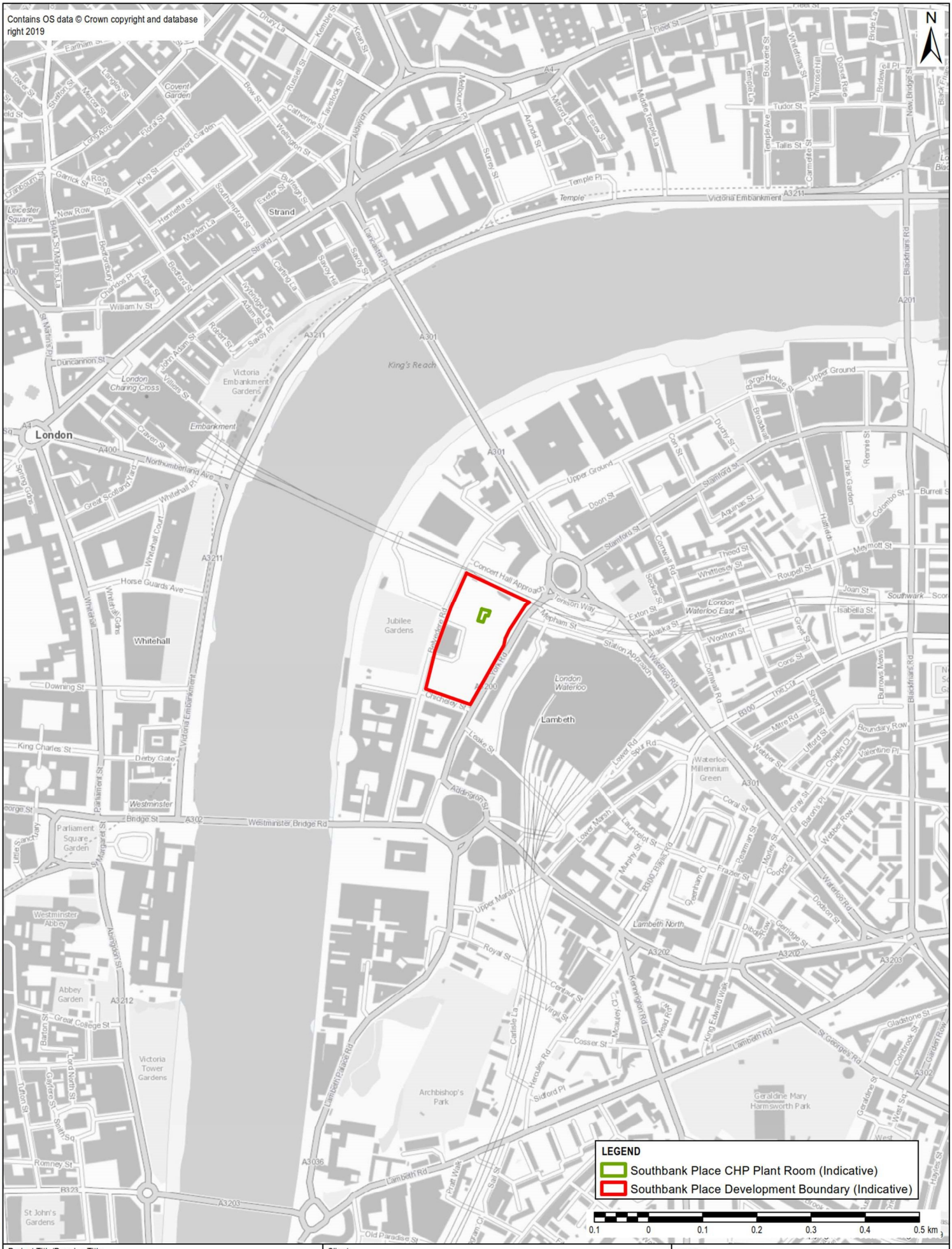
Notes:

(1) On-site receptors have been modelled at multiple heights to ensure that the full extent of any impact from the energy centre is assessed, however, only the maximum PC at each receptor location is presented with the corresponding height at which this occurs presented in the height column.

Appendices

Appendix A – Figures

- Figure 1 – Site Location Plan
- Figure 2 – Site Layout Plan
- Figure 3 – Figure Number 102INF-6200-26026 - Basement -1 INF CHP Plantroom Layout



Project Title/Drawing Title

SOUTHBANK PLACE ENERGY CENTRE
FIGURE 1: SITE LOCATION PLAN

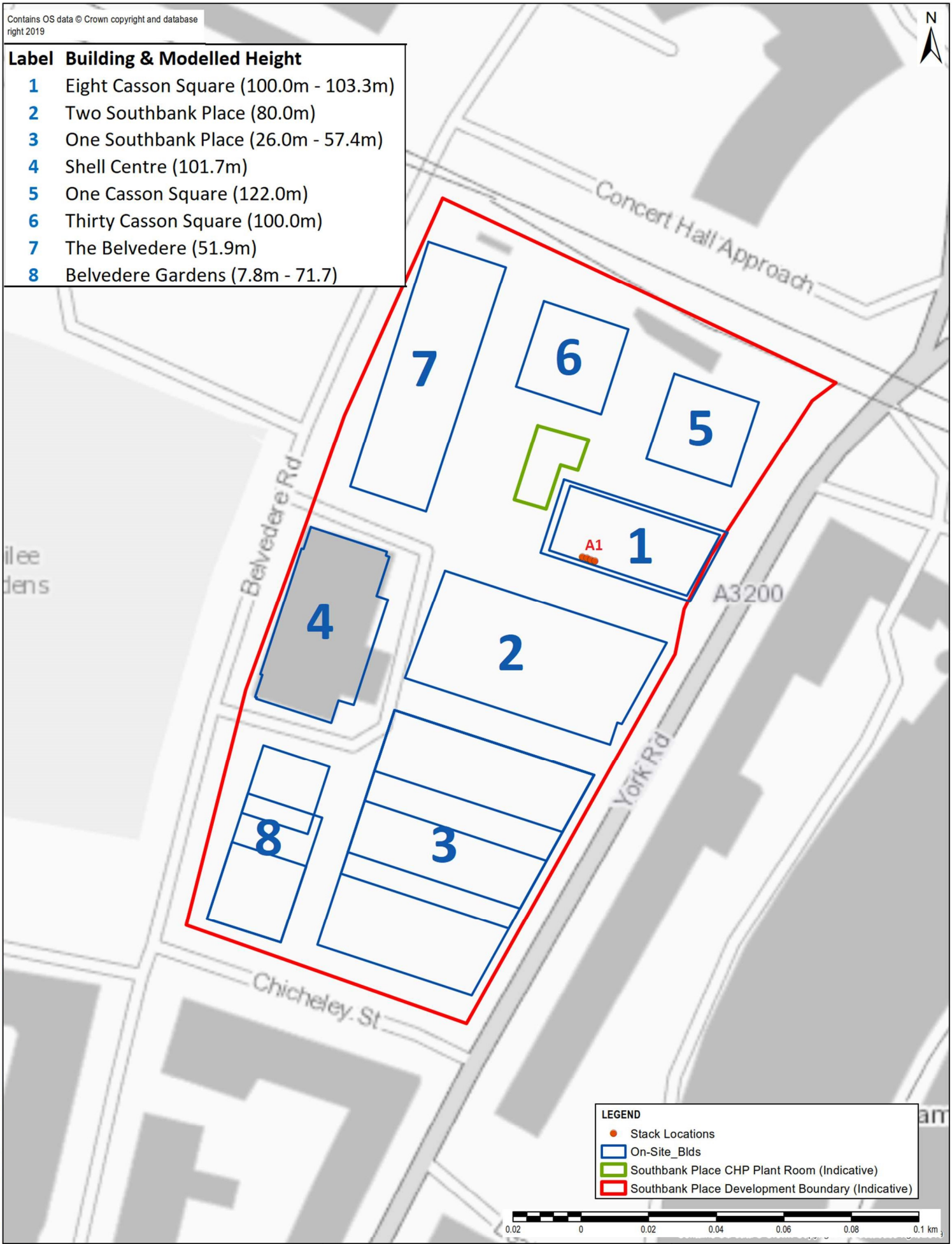
Client: BRAEBURN ESTATES DEV. (INF.) LTD

Drawn	Checked	Approved
BR	PF	GC
Date	**Scale @ A3**	**Purpose of Issue**
26/11/2019	1:6,293	Report
Drawing Number		**Rev**
60302608		0

AECOM
Sunley House
4 Bedford Park
Croydon, CR0 2AP
T: +44 (0)20 8639 3500
www.aecom.com

File Name:\\ukcrd1fp001.eu.aecomnet.com\UKCRD1FP001-V1\E\projects\general\Air Quality\Projects\Southbank Place - MCPD\8 GIS\Setup.mxd

Label	Building & Modelled Height
1	Eight Casson Square (100.0m - 103.3m)
2	Two Southbank Place (80.0m)
3	One Southbank Place (26.0m - 57.4m)
4	Shell Centre (101.7m)
5	One Casson Square (122.0m)
6	Thirty Casson Square (100.0m)
7	The Belvedere (51.9m)
8	Belvedere Gardens (7.8m - 71.7)



File Name:\\ukcrd1fp001.eu.aecomnet.com\UKCRD1FP001-V1\Eprojects\general\Air Quality\Projects\Southbank Place - MCPD\8 GIS\Setup.mxd

Project Title/Drawing Title

SOUTHBANK PLACE ENERGY CENTRE
FIGURE 2: SITE LAYOUT PLAN

Client: BRAEBURN ESTATES DEV. (INF.) LTD

Drawn	Checked	Approved
BR	PF	GC
Date	Scale @ A3	Purpose of Issue
26/11/2019	1:1,007	Report
Drawing Number		Rev
60302608		0

AECOM
Sunley House
4 Bedford Park
Croydon, CR0 2AP
T: +44 (0)20 8639 3500
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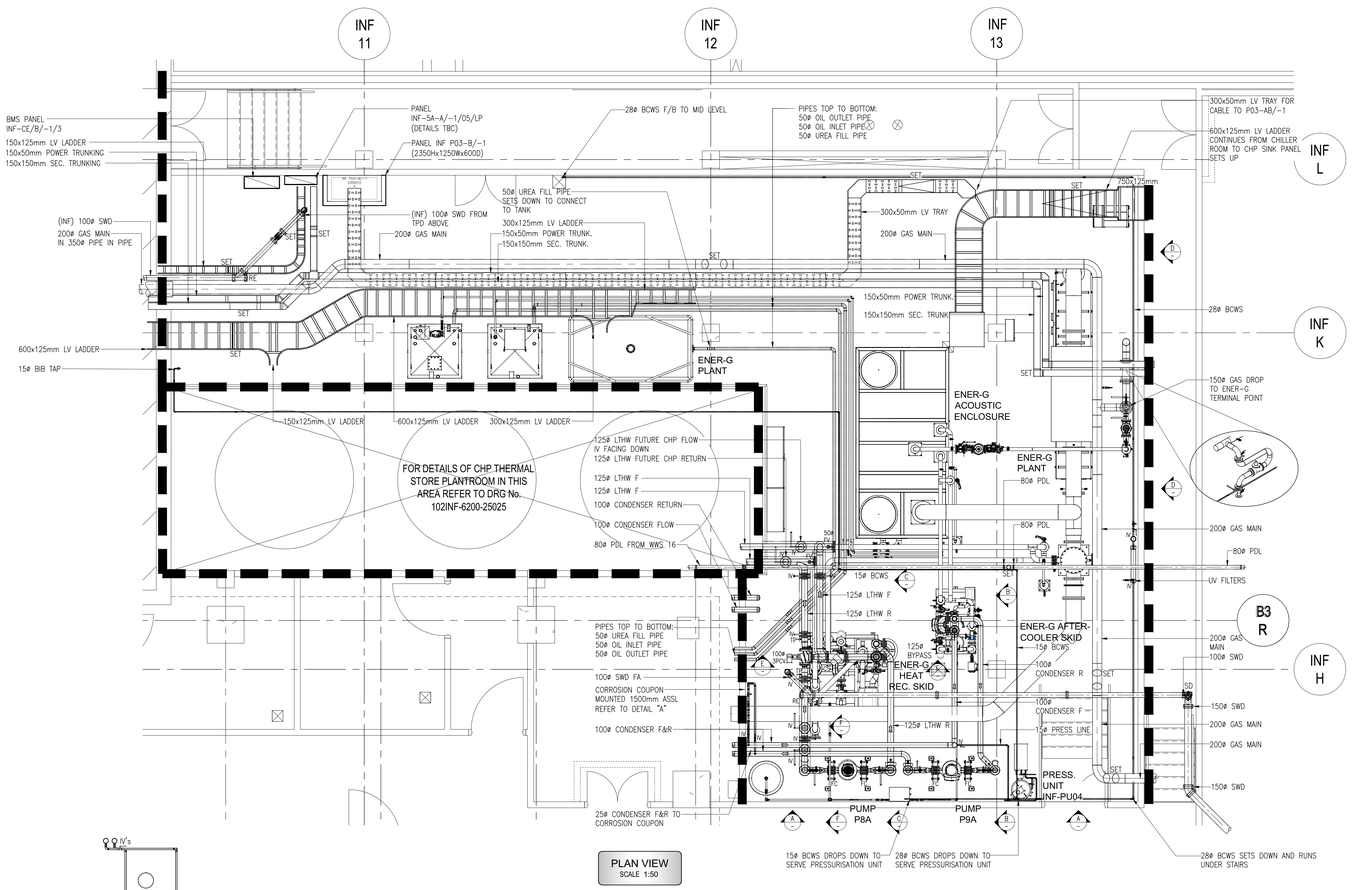
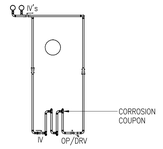
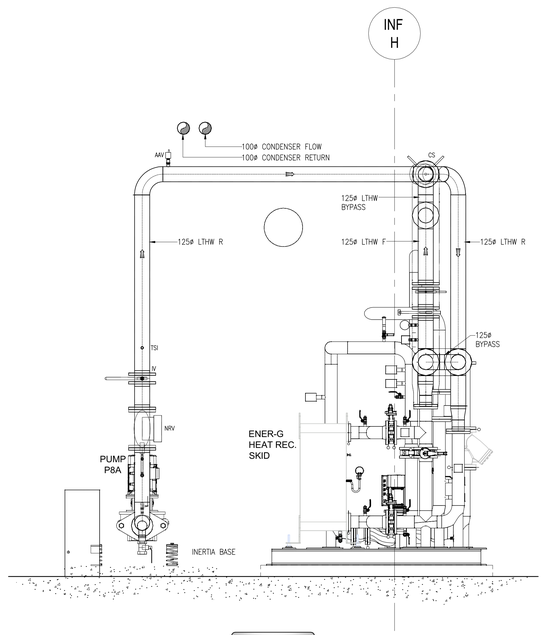


PLAN VIEW
SCALE 1:50



DETAIL "A"
SCALE 1:50

SECTION 'B-B'
SCALE 1:20



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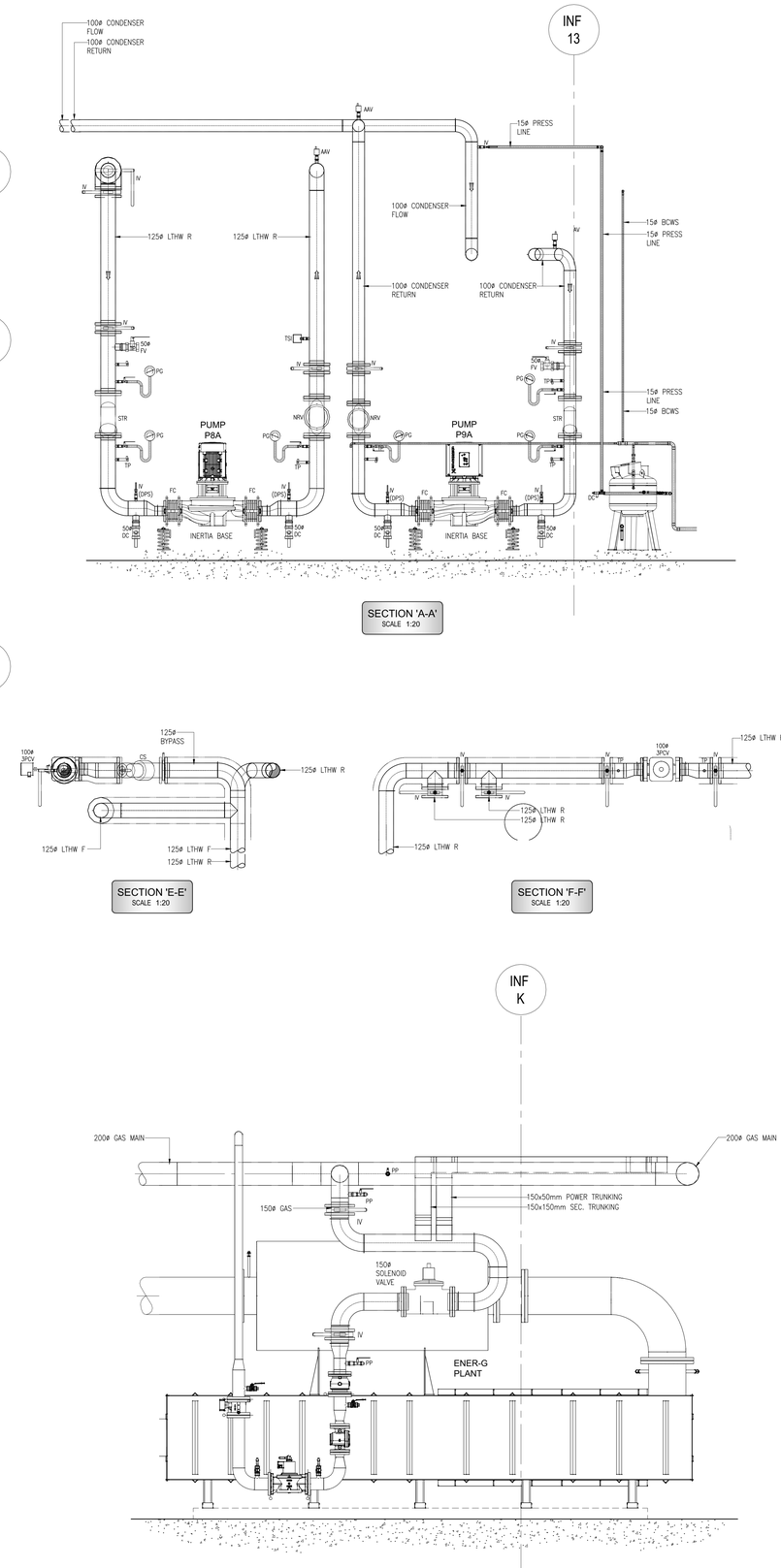

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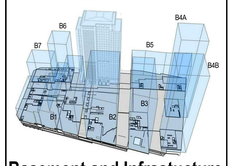
SCALE 1:20

SECTION 'A-A'
SCALE 1:20

SECTION 'E-E'
SCALE 1:20

SECTION 'F-F'
SCALE 1:20

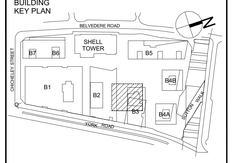
PROJECT
Southbank Place



Basement and Infrastucture

EMPLOYER:
Braeburn Estates Developments (Infrastructure) Limited

BUILDING KEY PLAN



READ IN CONJUNCTION WITH DRAWING No 102INF-6200-29005

NO.	REASON FOR ISSUE	DRN	CHK'D	DATE
AB	AS BUILT	MOB	LC	30 AUG'19
02	CORROSION COUPON AND CHP OIL FILL PIPEWORK ADDED. GAS SOLENOID VALVE RELOCATED. 600mm LV LADDER AND 300mm TRAY ADDED TO FEED RELEVANT PANELS RE-ISSUED FOR CONSTRUCTION	RJH	AM	24 SEP '18
01	PDL & SWD SERVICES ADDED ISSUED FOR CONSTRUCTION	PT	AM	26 FEB '18
00	ISSUED FOR APPROVAL	PT	AM	11 DEC '17

REVISIONS

DRAWING STATUS

AS BUILT

Nothing contained or implied in giving A-C status relieves the Trade Contractor of the responsibilities under the trade contract.

ALL DIMENSIONS ARE SHOWN IN METRIC.

CONSULTANTS

Masterplan Architects	**Squire and Partners** 77 Wicklow Street London WC1X 9JY
Executive Architects	**Adamson Associates** 401 Wellington St. W. Toronto M5V 1E7
Structural Engineers	**WSP** WSP House 70 Chancery Lane London WC2A 1AF
Infrastructure Commercial and Utility MEP	**AECOM** Mid City Place 71 High Holborn London WC1V 6QS
Residential MEP	**Hoare Lea** Western Transit Shed 12-13 Stable Street London N1C 4AB

DRAWING CREATED BY:

NG Bailey

3rd Floor, Angel Building, Islington, London EC1V 4AD.
Tel: 020 7843 0200 Fax: 020 7843 0201

DRAWING TITLE

BASEMENT -1
INF CHP PLANTROOM
LAYOUT

SCALE @ A0	DRAWN	CHECKED	DATE
1:50/1:20	PT	AM	16 NOV '17

GRAPHIC SCALE 0 1 2 3 4 5m

PROJECT NO.
30613

DRAWING ROOT	DRAWING NO.
3D	102INF-6200-26026

LOCATION	REVISION
102INF	AB

Appendix B – Pre-Application Advice Received from the EA

Ms Aakanksha Sinha
Braeburn Estates Management Company Ltd
30th Floor
One Canada Square
Canary Wharf
London
E14 5AB

Our Ref: EPR/UP3700BV/A001
Date: 01 October 2019

Dear Ms Sinha

Pre application checks – Basic service

I am pleased to provide you with your basic level of pre application advice for Southbank Place Development as requested.

As part of this service we have provided you with the following information:

Application Reference(s) number(s)	EPR/UP3700BV/A001
Habitats screening	Screening not undertaken at this stage as requested by the applicant.
Baseline fee required	The application charge for a medium combustion plant/specified generator bespoke application applied to your permitted activity will be: **Where modelling is required (complex bespoke)** Table 1.10- Combustion and Power: Ref: 1.10.2 Medium combustion plant site – requires dispersion modelling. Permit application: £6,550. **Where modelling is not required (simple bespoke)**

	Table 1.10 – Combustion and Power: Ref 1.10.3 Medium combustion plant site – does not require dispersion modelling. Permit application: £2028. For complex bespoke applications, if there is a SAC, SPA, Ramsar, SSSI site or MCZ within the screening distance, you will need to pay an additional fee for the assessment of the impact on habitats. Table 1.19 – Charges for plans and assessments: Ref 1.19.2 Habitats assessment - £779. **Further guidance can be found here:** https://www.gov.uk/government/publications/environmental-permitting-charging-scheme
Forms required to be submitted	You can apply for a permit for new medium combustion plant and specified generators using our digital application process here: - https://www.gov.uk/guidance/medium-combustion-plant-apply-for-an-environmental-permit#apply-for-a-bespoke-permit Alternatively, provide a fully completed version of Forms A, B2.5 and F1. If sections are not applicable to your permit please indicate this rather than leaving a section blank. - https://www.gov.uk/government/publications/application-for-an-environmental-permit-part-a-about-you - https://www.gov.uk/government/publications/application-for-an-environmental-permit-part-b25-new-bespoke-medium-combustion-plant-and-specified-generator-permit - https://www.gov.uk/government/publications/application-for-an-environmental-permit-part-f1-opra-charges-declarations
Additional documents required	Follow the link https://www.gov.uk/government/collections/medium-combustion-plant-and-specified-generator-regulations for relevant guidance on the Medium Combustion Plant Directive and Specified Generator Regulations. The page and related attached documents will offer you guidance on how to apply for a permit. Generally, you will need the following: Non-Technical Summary: You need to send us a simple explanation of what the activities are. This should include a summary of your operations, a summary of the key technical standards and control measures arising from your risk assessment.

	Environmental Risk Assessment: You should carry out an assessment of the emissions to air using the Tranche B generator tool: https://www.gov.uk/government/publications/specified-generator-tranche-b-screening-tool Depending on the outcome of the screening tool, you may be required to undertake detailed modelling of the emissions to air. You need to assess the risk of emissions to air using the methodology in this guidance which is specific to specified generators: https://www.gov.uk/guidance/specified-generators-dispersion-modelling-assessment General guidance for carrying out detailed air dispersion modelling should also be taken in to account: https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit Your modelling report needs to follow this guidance https://www.gov.uk/guidance/environmental-permitting-air-dispersion-modelling-reports You should provide the air modelling data files in support of any modelling that is undertaken with your application. Energy Efficiency Directive: Permit applications for new, or substantially refurbished, medium combustion plant or specified generators with a total thermal input of 20 MW thermal or more must also meet the requirements of Schedule 24 of the Environmental Permitting Regulations which implement the relevant requirements of the Energy Efficiency Directive (2012/27/EU). If this is relevant to your facility, then you need to provide a report demonstrating how Article 14 of the Energy Efficiency Directive has been considered.
Additional information	We can confirm that, based on the information you provided, the CHP will require permitting under Schedules 25A (MCP) and 25B (specified generators) of the Environmental Permitting Regulations 2018. This is assuming the date of first operation is after 20/12/2018. The 943 kWth boilers are out of scope of the Medium Combustion Plant Directive – only plant which are 1 MWth or more are in scope. The boilers therefore do not need to be permitted. However their

	emissions should be accounted for in the background of any air dispersion modelling that is submitted in support of a permit application for the CHP.

The advice given is based on the information you have provided, and does not constitute a formal response or decision of the Environment Agency with regard to future permit applications. Any views or opinions expressed are without prejudice to the Environment Agency's formal consideration of any application. Please note that any application is subject to a full technical check during duly making and determination, and additional information may be required based on your detailed submission and site specific requirements.

When you are ready to submit your application please quote the above reference number.

Your completed application can be sent via email to psc@environment-agency.gov.uk

Or by post to
Permitting Support Centre
Quadrant 2
99 Parkway Avenue
Sheffield
S9 4WF

A complete application must contain the following information:

Declaration	Please ensure the declaration section is completed by each relevant person. For a limited company, this must be a director/company secretary as listed on Companies House.
Payment	Please note your application will not be processed until we receive the full payment.

If you decide you would prefer our enhanced service (this service requires a fee) please visit GOV.UK where you can complete an online referral form.

We look forward to working with you on this project.

If you have any questions please find my contact details below.

Yours faithfully,

Kirstie Lythgo
Permitting Officer
Kirstie.lythgo@environment-agency.gov.uk

Appendix C - Specified Generator Screening Tool

Accompanying Excel spreadsheet.

Appendix D – CHP Engine Technical Datasheet

CANARY WHARF
CONTRACTORS

TRADE CONTRACTORS SUBMITTAL RECORD (TSR)

Project Number: 102INF	**Trade Contractor: NG Bailey Limited**	**Package Number: 6200**
Asite Document Number:102INF-6200-TI078	**Rev:00**	**Date Submitted:02-MAY-2017**
Description of changes / Reasons for this issue **First Issue/For Approval**		
Document Title: CHP Unit		
Document Type: Technical Information		

Lead Consultant Comments:	**Consultant Comments:**
Q&E Manager's Comments:	**Project & Package Manager's Comments**

102INF-6200-TI078

Index

102INF-6200-TI078

TECHNICAL DESCRIPTION

E850 250NOx Natural Gas:

849kW$_e$ (cosφ = 1.0)

400V 50Hz

UNIT & EXTERNAL CONTAINER SPECIFICATION

ENER-G Combined Power Limited
ENER-G House
Daniel Adamson Road
Manchester
M50 1DT
United Kingdom

T: +44 (0) 161 745 7450
F: +44 (0) 161 745 7457
E: chp@energ.co.uk
W: www.energ.co.uk

TABLE OF CONTENTS

1 ENER-G 850 250NOX TECHNICAL DESCRIPTION

1.1 PERFORMANCE

The ENER-G 850 250NOx Combined Heat and Power (CHP) unit is powered by an MTU gas fired spark ignition, 4-stroke engine which is coupled to a synchronous generator rated at 400V/3ph/50Hz.

The engine has been configured to run on Natural Gas with a nominal calorific value of 10 kWh/Nm³ and a Methane number of 80.

Parameter	Unit	NO_x mg/Nm³
Electrical output at generator terminals (cos φ = 1.0)	kW_e	849
Electrical output at generator terminals (cos φ = 0.95)	kW_e	847
Hot Water output (inc jacket, oil cooler and 1st Stage AC)	kW_{th}	1005
Exhaust Gas Heat output (cooled to 120°C)	kW_{th}	494
Exhaust Gas Heat output (cooled to 180°C)	kW_{th}	404
Total fuel input (net), Low Heat Value (LHV)	kW	2130
Total fuel input (gross), High Heat Value (HHV)	kW	2356
Efficiency (based on LHV) (cos φ = 1.0)	%	87.1
Efficiency (based on HHV) (cos φ = 1.0)	%	78.7

Ratings Definition

All ratings are standard service fuel stop power for continuous duty as per ISO 3046. Operation outside of the below given data will result in a power reduction or even operation that is not permitted.

- Intake air temperature 25°C
- Barometric pressure 1000 mbar
- Relative Humidity 30%
- Methane Number 80
- LHV of natural gas 10 kWh/Nm³

The equipment is designed as standard for parallel operation with the national electricity grids. Where a unit is operated in Island mode ENER-G Combined Power Ltd recommends that the maximum connected load is limited to 80% of the maximum continuous output rating (assuming the site power factor is no lower than 0.9).

This allows the unit to operate conservatively within its continuous rating lowering the risk of overloading the equipment. This guideline percentage may be varied depending on the level of

sophistication of the electrical load control (shedding) and the risk of overloading the equipment. Please contact the ECPL technical department for more details.

Compliance

ECPL CHP gas systems have been designed with reference to the following IGE Regulations:

- IGE/UP/1(Ed. 2) Strength Testing & Purging of Industrial & Commercial Gas Installations;
- IGE/UP/2 Installation Pipework, Boosters and Compressors on Industrial and Commercial Premises;
- IGE/UP/3 Gas Fuelled Spark Ignition and Dual Fuel Engines;
- IGE/UP/4(Ed.2) Commissioning of Gas Fired Plant on Industrial and Commercial Premises.

Notes

Acceptable fuel quality and conditions are defined in the original engine manufacturers fuel specification which is available on request.

Plant performance data in this specification is subject to the original tolerances set by the engine manufacturer. In general these are +/-3% on power output, +/-5% on fuel input and +/-8% on heat output. This CHP unit description is intended as a general specification for the CHP unit and specific site requirements may change this specification. The gross calorific value of the natural gas is assumed to be 1.106 times greater than the net calorific value of the gas. Electrical output is stated at the generator terminals.

The NO_x figures quoted are based on the dry exhaust stream with 5% O_2 content.

1.2 UNIT CONSTRUCTION

The CHP unit is an integrated package that offers an efficient and environmentally friendly way of providing heat and electricity simultaneously. The ENER-G 850 250NOx comprises of a:

- Gas engine;
- Synchronous generator;
- Jacket water and oil cooler heat recovery within container;
- Exhaust Gas Heat Exchanger (EGHE) mounted on container roof (if applicable);
- Dedicated control room incorporating control, protection and monitoring systems;
- Weatherised acoustic container.

The unit is primarily designed to operate as a 'stand-alone' package with automatic control that requires minimal or no supervision. In some cases, manual intervention or supervision can be advantageous.

1.2.1 ENGINE

The equipment prime mover is an MTU generator set with Series 4000 spark ignition, lean-burn gas engine featuring the latest developments in genset technology.

The foundation for the reliability and long service life of generator sets is the series 4000 engine with its proven main components, with originate from the Series 4000 diesel version, designed for maximum performance in different fields of applications.

The gas engine consist of lean-burn technology, modern ignition electronics with individual cylinder ignition timing control and automatic control for ignition energy adjustment, anti-knock control as well as rapid-response mixture and load control ensure efficient and safe operation with maximum prime energy exploitation.

The genset consists of the engine and flange-mounted alternator (SAE 00 housing) and are connected via a torsionally resilient coupling and resiliently mounted to a rigid, welded steel base frame. The electrical lube oil pump and a set of solenoid values are mounted to the genset base frame to allow for oil changes and automatic oil refilling.

Engine Data

• Engine type	Reciprocating gas engine
• Combustion cycle	4 Stroke Spark Ignition
• Number of cylinders	V8 configuration
• Normal synchronous speed	1500 rpm
• Aspiration	Turbocharged
• Aftercooler	Yes
• Combustion air flow	3616 Nm^3/h

Basic Engine Information

The engine is made up of a monobloc grey cast crankcase with inspection ports, flywheels housing SAE 00, flywheel oil pan. The engine crankcase is fitted out with a forged crankshaft and forged connecting rods with four-valve, individual cylinder heads with “Rotocap” rotators. The pistons are light-metal solid-skirt pistons with oil cooling duct, piston cooling via oil spray nozzles.

Mixture Formation

- Air intake via dry-type engine-mounted air filter;
- Venturi type air-gas mixer with gas supply via electronically controlled gas metering valve.

Turbocharging / Aftercooler

- Turbocharging for gas-air mixture compression;
- Two stage mixture cooling and throttles between mixture cooler and intake manifold.

Exhaust System

- Dry-type, insulated exhaust manifolds in the engine Vee with a common vertical exhaust outlet.

Lube Oil System

- Lube oil circulation pump with safety valve for forced-feed lubrication and piston cooling;
- Engine mounted heat exchanger;
- Lube oil filter with replaceable filter elements;
- Engine-mounted device for automatic oil level control;
- Oil dipstick;
- Connections for oil filling and oil discharge;
- Closed crankcase venting system with oil separator connected to mixture piping in front for turbocharger.

To ensure continuous operation of the CHP unit the engine sump oil level is kept at the optimum running level by a ‘top-up’ system. This consists of an integrated oil level switch housed underneath the engine. The tank has an oil level sender to prevent the unit running with an empty oil tank. To further protect the engine a pressure transducer is fitted to the engine oil gallery.

As an option we can provide external to the container package two oil tanks; a clean oil tanks and a waste oil tank. The clean oil tank will supply oil to the engine and the waste oil tank will hold used oil for collection and safe disposal off-site.

Starting System

Maintenance-free batteries encased within the engine bay provide the supply required to power the 24V DC, 2-pole starter motor(s), which is mounted on the flywheel housing. An automatic charger, fed from the main electrical system, maintains battery charge.

Factory Testing

The genset would be tested as standard in accordance with the original genset manufacturers standard test procedures. Any non-standard testing to be discussed by specific request with our technical department.

1.2.2 GENERATOR

Like the engines, the generators employed are optimised for maximum efficiency and incorporate such crucial features as best shock load acceptance, stable control behavior and high sustained short-circuit current.

This ENER-G CHP has a 400V 50Hz synchronous generator that is connected for normal co-generation operation as star-wound with the star point isolated. These meet the requirements of BS EN 60034 and the relevant section of other international standards such as BS5000, VDE 0530, NEMA MG1-32, IEC60034, CSA C22.2-100, AS1359. They are wound to 2/3 pitch which eliminate triple harmonics and is found to be the optimum design for trouble free supply of non-linear loads. A fully connected damper winding reduces oscillations during parallel operation.

Generator output is selected to reduce winding temperature, optimise efficiency and stabilise voltage, particularly in island mode. Other benefits include flexibility in acceptance of thyristor or other non-linear loadings such as IT equipment, low energy lighting etc. The generator has the following specifications:

Generator Data

• Type	Synchronous
• Generator KVA	1175kVA
• Voltage	400V
• Full Load Current per Phase (cos φ = 0.95)	1287A
• Synchronous speed	1500rpm
• Frequency	50Hz
• Temperature rise rating	Class H
• Protection Class	IP23
• Efficiency (cos φ = 1.0)	96.5%

1.2.3 HEAT RECOVERY

The complete heat recovery system is isolated from the clients Low Temperature Hot Water (LTHW) circuit by a plate heat exchanger housed within the container. This provides protection against varying quality circulating water. Insulation of the primary water pipe work and heat exchangers maximises heat recovery and minimises the amount of heat lost into the CHP container.

Four different heat recovery variations are available with the ENER-G 850 250NOx:

- Option 1 Engine and exhaust heat recovery to LTHW;

Engine Heat Recovery

The closed primary water circuit recovers heat from the engine jacket, oil cooler and the high temperature aftercooler. A thermostatic valve controls the temperature of the primary cooling system. This valve manages the warm up and cool down process of the engine avoiding any thermal shocks.

The primary heat recovery system comprises of the following components:

- Electrical primary water circulation pump (two pumps if Option 1 only);
- High pressure safety valve;
- Flexible connections to the engine;
- Binder test points;
- Thermostatic control valve;
- Primary/secondary plate heat exchanger (PHE);
- Thermal expansion vessels (one for main circuit, one for aftercooler circuit);
- Filling and draining facility;
- Automatic air venting;
- Water temperature sensors for measuring and protection.

The system is filled with a minimum 30% concentration of anti-freeze coolant for frost protection down to –10°C.

A stainless steel flexible connects the engine exhaust manifold to the outer flange of the container. If required with Option 1, the EGHE can be mounted locally on top of the container. The exhaust gases are cooled to approximately 120°C, which is above the condensation point of the exhaust gases. The EGHE has an over-capacity of 7% to allow for fouling.

Standard secondary water pumps are generally fitted as optional loose equipment and will accommodate a minimum external pressure drop beyond the CHP unit itself at the design flow rates. For external pressure drops greater than this, please refer to the technical department for up-rated selections.

1.2.5 CONTAINER

The genset container comprises of a steel frame with sound insulated panels and access panel doors designed to achieve an average sound pressure level of **75db(A) at 1m** in free field conditions. A low noise variant of 65db(A) at 1m in free field conditions is also available.

Ventilation air is drawn through a sound attenuator in the air inlet and blown through the container by internally mounted fans. The air intake and outlet arrangement utilises sound attenuators to achieve the design noise level. Combustion air is drawn from the container through a dedicated filter mounted on the engine.

Products are designed for full load operation at temperatures between a minimum of -10°C to a maximum of 35°C ambient. A cold climate option is available down to -30°C on request.

The container package is designed for mounting on a suitably sized concrete platform and the engine room has an integrated oil bund to contain oil spillage and has no floor penetrations.

Two doors provide ease of access into the engine-room. The end housing has been designed to be removed for removal of the engine generator set. 250kg (certificated) lifting beams are fitted above each cylinder bank to aid overhauls (beam trolley and chain blocks are not included).

Standard paint finish colour can be specified to suit client requirements.

Container Specification

- The container is divided into a separate switchgear section and generator section;
- Underfloor lining to achieve noise levels required (65dBA at 1m option);
- The switchgear section would have a single access door, floor mounting pads and also a cable exit aperture;
- A forced ventilation system ventilate the container via acoustically treated supply air fans complete with motor guards;
- The internal acoustic lining will be fitted with resin bonded mineral fibre and faced with a pre-galvanised perforated steel sheeting having an open area;
- All areas will be bunded to protect against oil spillage;
- All access doors are provided with stainless steel fasteners and door stays;
- A ventilation fan is provided within the control room section also;
- Fire, heat and gas detection systems are fitted as standard within the engine compartment;
- Lighting and small power is provided within the container and control room sections.

Ventilation and Combustion Air Data

- Maximum ambient temperature 35°C
- Ventilation air volume flow rate 4.17m^3/s
- Combustion air volume flow rate 3616m^3/h

Separate container layout drawings are available for space planning purposes on request.

1.2.6 HEAT REJECTION

The standard package includes for a separately mounted dual coiled heat rejection radiator. One coil is dedicated to the heat rejection from the 2nd stage of the aftercooler and the second coil is dedicated to the hot water heat recovery from the jacket of the engine.

An exhaust gas bypass would be rejecting any surplus exhaust gas heat in the case of Option 1 heat recovery option being selected.

Two noise options are available; the standard option provides for an average of 75dBA at 1m free field while the low noise option can deliver an average of 65dBA at 1m free field.

Please refer to separate container layout drawings for space planning requirements.

1.3 CONTROL AND PROTECTION

The CHP is controlled and protected by ***Gk***ontrol the successor to the ENER-G CPL patented Distributed Intellect Remote Monitoring System (DIRMS). ***Gk***ontrol starts the engine, synchronises the CHP to the mains electricity supply and controls the power output once on line. It monitors over 70 operating parameters continuously to protect the unit thermally, mechanically and electrically by continually monitoring over 70 operating parameters and stores these readings in its own memory at regular intervals. The unit is connected to a Central Maintenance Computer by modem using a dedicated communications link.

The CHP produces 3-phase electricity that is connected in parallel to the mains supply. There is a dedicated protection relay that satisfies the typical G59/2 recommendations. G59/2 provides detailed advice on suitable protection for small-scale parallel generation with the point of common connection at LV.

The ENER-G control panel meets the basic requirements of G59/2 but further protection may be requested to meet the requirements of the connection offered by the DNO. These connection arrangements have to be approved by the local electricity authorities (DNO).

1.3.1 ELECTRICAL SYSTEMS

The external container type CHP units have two electrical systems; the CHP ancillary system and the generator system.

The CHP ancillary system includes the CHP power panel, CHP control panel and container electrical system. The container electrical system contains the lighting with lights in the engine bay and in the control room; the portable equipment sockets in the engine bay and in the control room and the fire and gas alarm system. Between them the CHP power and control panel control all the ventilation fans, cooling water circulation pumps, engine systems, control equipment, and component items such as switches, starter batteries and ignition system. The CHP control panel includes a single mains socket, panel illumination lamp and a mains live warning indicator on the panel back plate. The electrical systems are designed and tested in accordance with the latest IET wiring regulations.

ENER-G CHPs have 400V 50Hz synchronous generators that are connected for normal co-generation operation as star-wound with the star point isolated. These meet the requirements of BS EN 60034 and the relevant section of other international standards such as BS5000, VDE 0530, NEMA MG1-32, IEC60034, CSA C22.2-100, AS1359. They are wound to 2/3 pitch which eliminate triple harmonics and is found to be the optimum design for trouble free supply of non-linear loads. A fully connected damper winding reduces oscillations during parallel operation.

The generator comes complete with automatic power factor controller and voltage regulator +/-5% adjustment; winding temperature monitoring and is IP23 rated.

This arrangement allows:

- 3 phase balanced load supply for normal operation
- Correction of the power factor of the site for normal operation

The generator is connected to the load through the synchronising air circuit breaker (ACB) and protection and control

1.3.2 CHP GENERATOR PANEL

This panel houses the main synchronising air circuit breaker (ACB), current transformers and voltage measuring equipment.

The ACB is controlled by the dedicated micro-processor based control system **G*k***ontrol within the CHP Control panel to ensure automatic, correct, safe and accurate synchronisation. Electrical protection is provided through an integrated protection module fitted to the ACB which gives over current and short circuit protection to the generator connection onto the utility.

Electrical connection to the generator output is done through an external, weather proof cable box fitted to the side of the CHP container where solid copper busbars are located to enable client connections.

CHP Power panel

This panel houses the switchgear for the majority of the CHP 400V equipment. This equipment includes but is not limited to ventilation fans, cooling water circulation pumps, battery chargers, variable speed drives

CHP Control panel

There is a **G*k***ontrol local display and a number of switches and indicators on the control panel door. These provide control interface functions and visual indication of the condition of the unit. They include:

- Modem
- Data memory
- Volt free contacts for BMS interface
- Panel Power On Indicator
- E Stop Push Button
- System reset button
- **G*k***ontrol diagnostic port
- Panel Isolator Switch
- **G*k***ontrol local display

The local display screen provides the following data when accessed:

- Instantaneous power output per phase and total (kW)
- Cumulative total power (kWh)
- Voltage per phase (V)
- Current per phase (V)
- Power factor per phase
- Exhaust system temperatures (C)

- Cooling system water/oil temperatures (C)
- Generator winding temperatures (C)
- Gas, water and oil system pressures (Bar)
- Machine status
- Machine time
- Time of last synchronization
- And many other parameters

1.3.3 EMERGENCY STOP SYSTEM

Emergency stop push buttons are mounted on the control panel door and within the engine bay; provision is made for the connection of external dual circuit emergency stop buttons. These feed into an industry standard emergency stop relay that stops the engine when operated, but does not disconnect the main electrical supplies.

The push button latches in after operation and must be twisted to release. The reason for the emergency stop must be investigated before the emergency stop button is released and system reset push button is pressed

1.3.4 CONTROL AND PROTECTION SYSTEM

G*k*ontrol, working through the CHP Control panel, controls:

- Start up
- Synchronising the engine/generator to the mains supply
- Load governing
- Power factor control
- Tripping (or stopping) the unit
- Automatic start after trip

1.3.5 G*K*ONTROL™ SYSTEM

G*k*ontrol governs engine speed to synchronise the generator AC voltage to the mains AC voltage. When synchronised, **G*k***ontrol adjusts the governor to change the engine output torque to the required power output (provided values of monitored parameters such as engine water temperature are within limits). In the event of unit disconnection or shut down due to either an internal or external fault **G*k***ontrol will automatically re-start the unit when the fault has cleared, if the fault that caused the unit to stop has not occurred more than the set limit for the current operating cycle.

G*k*ontrol controls generator operation as follows:

- Engine governing
- Generator synchronisation to the mains
- Fault detection
- Engine and generator protection and control
- Performance data logging

- Communication with a Central Maintenance Computer
- Electrical or thermal output control including export protection

G*k*ontrol has five electronic modules. These are:

- The **G*k***ontrol Main Processor: This unit has a microprocessor, memory, counters and opto-isolated interfaces for control and communications purposes. The board handles all the control actions, measurement interpretation and communications;
- The **G*k***ontrol Power Interface: This unit receives and conditions all the voltage and current inputs from the system and presents them to the **G*k***ontrol Main Processor;
- The **G*k***ontrol Analogue Input Module: This unit receives and conditions temperature and pressure inputs from the system and presents them to the **G*k***ontrol Main Processor;
- The **G*k***ontrol Thermocouple Module: This unit receives and conditions temperature inputs from the system and presents them to the **G*k***ontrol Main Processor;
- The **G*k***ontrol Keyboard and Display: This unit provides an operator interface with **G*k***ontrol.

1.4 PRODUCT OPTIONS

A number of additional product options are available for the unit. These include:

- Upgraded noise attenuation to reduce noise to an average of 65dB(A) at 1m in free field;
- Cold climate variant for operation down to -30°C;
- Secondary Water Pump;
- Flame Arrester;
- Gas and heat metering;
- Gas booster;
- Heat rejection equipment / controls (roof mounted options available);
- Power export control panel;
- Heat and gas metering;
- Modbus Interface Card;
- Catalytic converter for lower CO emissions (<300mg/Nm^3 from <1000mg/Nm^3);
- Generator only (no heat recovery);
- Anti-vibration support platforms for special applications;
- 'Island mode' operation;
- Direct High Voltage generation;
- Waste heat or combination boilers for steam generation;
- Medium Temperature Hot Water (MTHW) applications;
- CHP absorption chiller packages.

Product options are defined and offered by specific reference and specified to meet specific client requirements.

1.5 DESIGN AND CONSTRUCTION STANDARDS

ENER-G Combined Power CHP units will carry the CE mark and are designed and constructed with reference to the following requirements:

- G59/2 Electricity Councils Chief Engineers Regulations
- IGE/UP/1 Strength testing and purging of industrial and commercial gas Installations
- IGE/UP/2 Gas installation pipe work, boosters and compressors on industrial and commercial premises
- IGE/UP/3 Gas fuelled spark ignition and dual fuel engines
- IGE/UP/4 Commissioning of gas fired plant on industrial and commercial premises
- 72/23/EEC The Low Voltage Directive
- 2004/108/EC Electromagnetic Compatibility
- 2006/42/EC Machinery Safety Directive
- 17th Edition IEE Regulations
- EN 60034 General requirements for rotating electrical machines
- ISO 3046/1 Reciprocating internal combustion engines – Performance
- ISO 14314 Reciprocal internal combustion engines — Recoil starting equipment — General safety requirements
- EN 12601 Reciprocating internal combustion engine driven generating sets — Safety
- ISO 11102-1 Reciprocating internal combustion engines — Handle starting equipment — Part 1: Safety requirements and tests
- EN 60204-1 Safety of machinery; Electrical equipment of machines - Part 1: General requirements
- EN 61000-6-2 Electromagnetic compatibility (EMC) - Part 6-2: Generic standards; Immunity for industrial environments
- EN 61000-6-4 Electromagnetic compatibility (EMC) - Part 6-4: Generic standards; Emission standard for industrial environments (IEC 61000-6-4: 1997, modified)
- EN ISO 12100 Safety of machinery - general principles for design. Risk assessment and risk reduction.

2 CONTACT DETAILS

ENER-G Combined Power Limited

ENER-G House

Daniel Adamson Road

Manchester

M50 1DT

United Kingdom

T: +44 (0) 161 745 7450

F: +44 (0) 161 745 7457

E: chp@energ.co.uk

W: www.energ.co.uk

Technical Datasheet

E850 250NOx L33 Natural Gas CHP Unit

Energy Balance and Load Data at Power Factor 1		Units	100%	75%	50%
Electrical Output	(+/-3%)	kW	854	640	427
Electrical Efficiency (Net)	(+/-5%)	%	41.6%	40.3%	38.2%
Heat Output	(+/-10%)	kW	931	733	530
Thermal Efficiency (Net)	(+/-8%)	%	45.3%	46.1%	47.4%
Fuel Input (Net / Gross)*	(+/-5%)	kW	2053 / 2271	1588 / 1756	1116 / 1234
Total Efficiency (Net)	(+/-8%)	%	86.9%	86.5%	85.7%
Heat Output from Jacket Water	(+/-8%)	kW	462	341	236
Heat Output from Exhaust Gas @ Outlet Temp.	(+/-8%)	kW	469	392	294
Aftercooler Heat Output	(+/-8%)	kW	51	41	30
Radiated Heat Output	(+/-8%)	kW	37	28	20
Combustion Air Flow (30 C, 100 kPa, 30% RH)	(+/-5%)	m^3/h	3937	2968	2032
Fuel Mass Flow (ρ = 0.75kg/Nm³)	(+/-5%)	kg/h	154.0	119.1	83.7
Fuel Volume Flow (LHV = 10kWh/Nm³)	(+/-5%)	Nm3/h	205.3	158.8	111.6
Exhaust Mass Flow (Wet)	(+/-5%)	kg/h	4737	3574	2449
Exhaust Volume Flow @ Outlet Temp.	(+/-5%)	m^3/h	5276	3981	2728

*Natural gas Net and Gross fuel input figures are based on 36MJ/Nm3 and 39.8MJ/Nm3 respectively. The Gross figure is used when establishing UK fuel costs. Net figures are provided for ease of performance comparison with other technologies.

Engine Details

Manufacturer	MTU
Model	AoE 8V4000L33
Fuel Type	Natural Gas
Min. Methane Number	80
Cylinders	8
Aspiration	Turbocharged
Speed rpm	1500
Aftercooler	Yes

Hot Water Details

Max. Water In/Out Temp.	°C	78/89°C
Max. Water Flow Rate*	l/s	20.83
Max. Glycol Content	%	30
Connection Size	mm	100
Flange Type		PN16
Pressure Loss**	kPa	TBC
Max. Test Pressure	Bar	9.75

* Assuming Cp = 4.2 kJ/kg·K and ρ = 968.55 kg/m³

** Pressure loss figures stated are at max. water flow rate. Internal unit only.

Exhaust Details

Connection Size	mm	450
Flange Type		PN10
Outlet Temp.	°C	120
Allowable Backpressure	Pa	TBC
Allowable Backpressure with Catalyst	Pa	TBC

Ventilation Details

Connection Size	mm	TBC
Ventilation Rate***	m^3/s	5.37
Max. Air Inlet Temp.	°C	35
Max. Air Outlet Temp.	°C	50
Enclosure Pressure Drop	Pa	TBC

*** Vent rate is stated at max. air outlet temp, 100kPa

Aftercooler Details

Max. Water Inlet Temp.	°C	40
Water Flow Rate	l/s	6.11
Connection Size	mm	65
Flange Type		PN16
Pressure Loss	kPa	70
Max. Test Pressure	Bar	6
Ethylene Glycol Content	%	40

Generator Details

Manufacturer		Stamford
Model		PE734C-312
Type		Synchronous
Rating	kVA	1445
Voltage	V	400
Phase	Ph	3
Frequency	Hz	50
Protection Class		IP23
Rated Power Factor	PF	0.8
Xd Dir. Axis Synchronous		2.76
X'd Dir. Axis Transient		0.17
X"d Dir. Axis Sub-Transient		0.12
T" Sub-Transient Time Const.		0.01
T'do O.C Field Time Const.		2.23
CHP Protection Device	A/Ph	TBC
Indicative Client Protection Device	A/Ph	TBC
Current Per Phase @ 0.8PF	A	1528
Current Per Phase @ 0.95PF	A	1296
Efficiency @ 0.8PF	%	96.2%
Efficiency @ 0.95PF	%	96.9%
Indicative Main Cable Size [a] †	mm^2	TBC
Indicative Earth Cable Size [b] †	mm^2	TBC

[a] 4-Core XLPE/SWA/PVC to BS5467, Max 50 meters.

[b] 1-Core 6491B to BS7211, Max 50 meters.

† Sizes and lengths based on IET 17TH Edition BS7671, Installation method 31.

Fuel Details

Connection Size	mm	80
Flange Type		PN16
Min/Max. Supply Pressure	mbar	120/300

Emissions @ 5% O2

NOx	mg/Nm^3	250
CO	mg/Nm^3	1000
NOx (With Catalyst)	mg/Nm^3	N/A
CO (With Catalyst)	mg/Nm^3	TBC

Weight Details

Enclosure (Dry) STD/PREM.	See Sales Drawing
Container (Dry) STD/PREM.	See Sales Drawing

Noise Data

Enclosure SPL @ 1m SN/LN	dB(A)	70/65
Container SPL @ 1m SN/LN	dB(A)	75/65

NB: Output figures are based on operation at ISO 3046 conditions with the exception of exhaust output, which is quoted to 120°C, figures are stated from manufacturer's declared performance figures subject to the manufacturer's tolerances and subject to change without notice. Values for de-rated units are estimates only. Energy balance data assumes perfect combustion. All information detailed is for guidance only and is subject to change without notice due to our commitment to continuous improvement - all values should be confirmed with ENER-G Combined Power Ltd on a project specific basis.

T: +44 161 745 7450
F: +44 161 745 7457
www.energ.co.uk

ENER-G House
Daniel Adamson Road, Salford
Manchester, M50 1DT, UK

T19sch – Schedule of Combined heat and Power

Supply, install and commission the CHP equipment and heat rejection plant selected by the CHP manufacturer matched to the intercooler heat rejection. CHP plant to be a standalone integral system comprising the main elements as scheduled below.

Prime Mover		**CHP Trade Contractors Confirmed Figures**
Type	Reciprocating engine	Reciprocating engine - 8V4000L33
Fuel type	Natural gas (UK)	Natural gas (UK)
Fuel Consumption at maximum output (kW) Gross CV basis		2271 (HHV) 2053 (LHV)
Fuel supply pressure		120/130 mbar (min/max)
Minimum Methane Number		80
Generator		
Type	Synchronous	Synchronous
Rated output power (kVA)		1445
Rated active power (kW) after parasitic loads are subtracted	850 kW nominal	854
Electrical Output (kW) at 75% Part Load		640
Electrical Output (kW) at 50% minimum Part Load		427
Rated power factor	0.85	0.8 – 0.95
Rated reactive power (kVAR)		125 @0.85 PF
Generator Output	415V/3ph/50Hz	415V/3ph/50Hz
Performance class to BS ISO 8528		ISO 8528-5: Performance class depends on load steps, refer to DK-LS-0024
Thermal classification to BS EN 60085		Insulation class / temperature rise class H / F
Inverter / Rectifier		
Operating Mode		NA
Electrical Control Gear		
Grid connected or Island Mode	Grid Connected	Grid Connected (Parallel)
Heat Recovery System		
Type / Details		Full Heat Recovery (Jacket water, Oil & EGHE)
Heat Output (kW)	900 kW nominal	931
Heat Output (kW) at 75% Part Load		733
Heat Output (kW) at minimum Part Load		530
Hot Water Flow Temperature	90 ^{0}C	90
Hot Water Return Temperature	70 ^{0}C	50-78 deg C (VSD SWP-by others)
Intercooler Heat Rejection Plant (If required)		
Type / Details	Dry Air Coolers	Adiabatic DAC
Heat Rejection (kW)		51 (LT)
Air entering conditions	35 ^{0}C 50% RH	35 degC 30% RH
Hot Water flow and return Temperatures		38/36degC (Radiator)

T19sch – Schedule of Combined heat and Power

Site Conditions		
Max ambient temp	35 ^{0}C 50% RH	35 degC 30% RH
Min ambient Temp	-10 ^{0}C 100% RH	-10 ^{0}C 100% RH
Emissions		
Acoustic limitations	To meet criteria in Sandy Brown Acoustics Report	Noted
Waste Gases NOx limitation	40 mg/Nm3	40 mg/Nm3 via SCR 250mg/Nm³ at engine outlet

T19sch – Schedule of Combined heat and Power

Enclosure Details		
Finishes		Smooth
Limiting Dimensions		TBC
IP Rating	Internal	Internal
Exhaust System		
Flue gas temperature	Above condensing temperature	444 degC After T/C 120 degC after EGHE
Hot flue gas volume		5276m3/h @ 120 deg C +-5%
Hot gas velocity in flue	Min 7.5 m/s	As required to achieve back pressure
Maximum outer surface temperature of flue	^{0}C	Surface temp Control is 55 deg C
Flue height above ground level		By others
Exhaust gas silencer details		16" NB MASI+FPS3
Integration with BMS	Provide BMS interface	Yes.

Notes:

1. The CHP Trade Contractor shall fill in their confirmed plant outputs as part of the tender return
2. Where the CHP Trade Contractor is providing a full package they shall include for any parasitic loads within their plant when stating generator outputs
3. The above data shall be used in assessing tenders on a ife cycle basis
4. The completion of the contract shall only be achieved when the above data has been verified by testing on site after commissioning.

Signed: Mr Minesh Patel

Position: Business Development Manager

For and on behalf of: ENER-G Combined Power Limited, Edison House, 2 Daniel Adamson Road, Manchester, M50 1DT. Registered in England No: 1874716

Date: 23th March 2017

Individually signed continuation sheets to be provided if required.

SCOPE LEGEND

BY OTHERS

SUPPLY & INSTALL BY ENER-G.

SUPPLY ONLY ENDS

SIGNALS TO CHP CONTROL PANEL INCL. TANK LEVEL

POWER SUPPLY

FIRE, MIX TREATED WATER CORROSION INHIBITOR & BIOCIDE

CONTROL PANEL

HEAT REJECTION CONTROLS

AFTERCOOLER SKID

CHP VENTILATION AIR OUTLET BY OTHERS (3.64 M³/S) *** DIA. AIR DUCT

CHP VENTILATION AIR INLET BY OTHERS (4.63 M³/S) *** DIA. AIR DUCT

VENT AIR EXTRACT FAN (CONTROLLED BY FREQUENCY INVERTER)

ATTENUATOR

ACOUSTIC ENCLOSURE OUTLINE (75 dBA AT 1M)

UREA STORAGE TANK

UREA DAY TANK

CONTROLS AND SIGNALS FROM ENER-G.

UREA FILL POINT CABINET

51 kW+5%

65 N/S

0-24V CONTROL SIGNAL FROM ENER-G. PANEL

DN80

40% ETH. GLYCOL

QUICK FILL

15 N/S

3.64 M³/S

GAS LEAK DETECTOR

COMBUSTION AIR 0.99 M³/S

FIRE/SMOKE DETECTOR

4.63 M³/S TOTAL

ENCLOSURE AMBIENT TEMP.

GENSET

AFTERCOOLER 51 kW+5% NOMINAL

JACKET HEAT 462 kW+5%

JACKET WATER PRE HEATER

24 V CONTROL PANEL

AUX POWER PANEL

ACB PANEL

10 x PIPE DIA. STRAIGHT

GAS PROVING SYSTEM

40 N/S

77.1°C MAX.

SET PRESSURE 3.0 bar

EXHAUST GAS MONITORING POINT

6 OD

DN15

DN20 _ DN15

77°C

90°C

MIXING TUBE

COMBINED PRIMARY / SECONDARY SILENCER & SCRUBBER

EGHE 469 kW

DN15 VENT

EXHAUST DUCTING FROM THIS POINT BY OTHERS

95°C

88°C

86°C

Ø150

CONTROLS AND SIGNALS FROM ENER-G PANEL.

WASTE LUBRICATION OIL STORAGE TANK

CLEAN LUBRICATION OIL STORAGE TANK

FILL POINT CABINET

EMPTY DIRTY OIL

FILL CLEAN OIL

SIGNALS TO CHP CONTROL PANEL

EXPANSION VESSEL E-02

EXPANSION VESSEL E-01

PRESSURISATION SYSTEM U-01

CONTROL PANEL

TO DRAIN

POWER SUPPLY

HEAT RECOVERY SKID

HEAT METER

0-24V CONTROL SIGNAL FROM ENDS TO RUN PUMP

THERMAL STORE 1

THERMAL STORE 2

THERMAL STORE 3

CONTROL FROM BMS

FOR TENDERING PURPOSES ONLY

REV	DATE	DESCRIPTION	DRN	CHK	APP

1. NO DIMENSIONS ARE TO BE SCALED FROM THIS DRAWING
2. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS ON SITE

ENER-G COMBINED POWER LIMITED
ENER-G HOUSE, DANIEL ADAMSON ROAD,
SALFORD, MANCHESTER, M50 1DT, U.K.
TEL: 0161 745 7450
FAX: 0161 745 7457
WEB: WWW.ENERG.CO.UK

CLIENT	UNIT No.
	ECP-14431

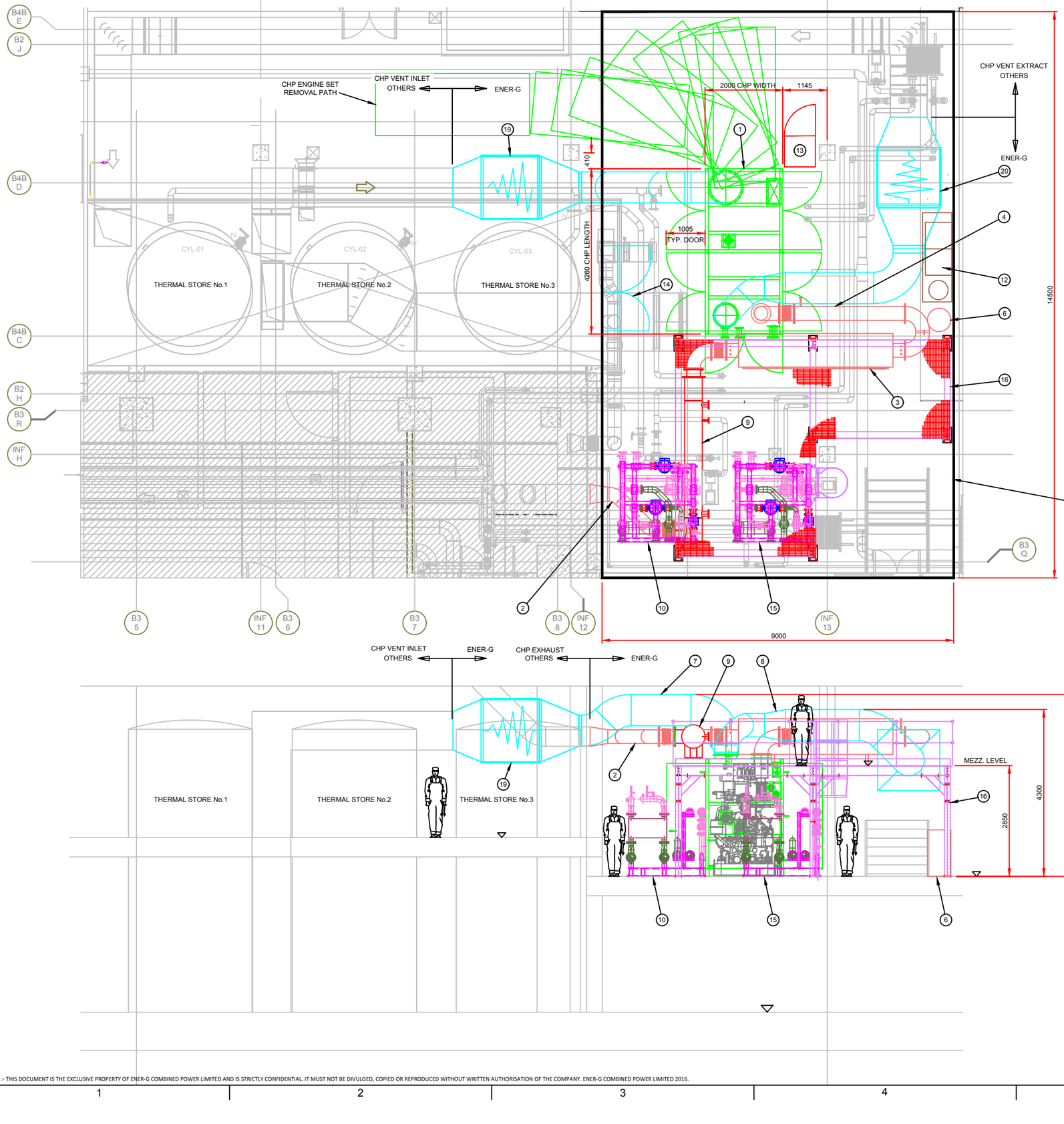
PROJECT: SHELL SOUTH BANK

DRAWING TITLE: SCHEMATIC DIAGRAM

DRAWING No.	SHEET No	REV
9999-M-0126	1 of 1	P6

DATE	SCALE	SHEET SIZE
19.11.14	N.T.S	A1

DRAWN BY	CHECKED	APPROVED
NG		



EQUIPMENT DESCRIPTION TABLE					
REF.	DESCRIPTION	REF/DRG No.	SUPPLIER	QTY	APPROX WEIGHT
1.	CHP ENCLOSURE - 850kWe		ENER-G	1	
2.	EXHAUST DUCT DN500	UP TO TIE-IN POINT	ENER-G	1	
3.	SCR NOX BUSTER REACTOR/SILENCER		ENER-G	1	
4.	SCR MIXING DUCT		ENER-G	1	
5.	SCR UREA STORAGE TANK	(NOT SHOWN)	ENER-G	1	
6.	SCR UREA DAY TANK		ENER-G	1	
7.	CHP VENTILATION INLET DUCT DN800	FROM TIE-IN POINT	ENER-G	1	
8.	CHP VENTILATION OUTLET DUCT DN800	UP TO TIE-IN POINT	ENER-G	1	
9.	EXHAUST GAS HEAT EXCHANGER		ENER-G	1	
10.	HEAT RECOVERY SKID		ENER-G	1	
11.	HEAT REJECTION RADIATOR (ROOF MOUNTED)	(NOT SHOWN)	ENER-G	1	
12.	PRESSURISATION UNIT		ENER-G	1	
13.	CHP POWER PANEL		ENER-G	1	
14.	CHP CONTROL PANEL		ENER-G	1	
15.	AFTERCOOLER SKID		ENER-G	1	
16.	SCR & EGHE MEZZANINE ACCESS PLATFORM		ENER-G	1	
17.	CLEAN LUBRICATING OIL STORAGE TANK	(NOT SHOWN)	ENER-G	1	
18.	WASTE LUBRICATING OIL TANK	(NOT SHOWN)	ENER-G	1	
19.	CHP VENTILATION INLET ATTENUATOR		ENER-G	1	
20.	CHP VENTILATION EXTRACT ATTENUATOR		ENER-G	1	

REFERENCE DRAWINGS.
9999-M-0126 MECHANICAL SCHEMATIC DIAGRAM

CHP PLANTROOM PLAN DETAILS TAKEN FROM AECOM MEP SERVICES LAYOUT (ZONE D) SHEET 1 DRG No 23263 REV 03

REV	DATE	DESCRIPTION	DRN	CHK	APP

1. NO DIMENSIONS ARE TO BE SCALED FROM THIS DRAWING
2. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS ON SITE

ENER-G COMBINED POWER LIMITED
ENER-G HOUSE, DANIEL ADAMSON ROAD,
SALFORD, MANCHESTER, M50 1DT, U.K.
TEL: 0161 745 7450
FAX: 0161 745 7457
WEB: WWW.ENERG.CO.UK

CLIENT:

UNIT No.: ECP-14431

PROJECT: SHELL SOUTH BANK

DRAWING TITLE: CHP PLANT LAYOUT

DRAWING No.	SHEET No	REV
9999-M-0400	1 of 1	P1

DATE	SCALE	SHEET SIZE
09.02.17	1:50 @A1	A1

DRAWN BY	CHECKED	APPROVED
CD		

T:\01 Enquiries\100-ECP-14184 -ECP-14431 - Shell Southbank Place, London\04 Design\01 Drawings\02 Drawings\Work In Progress\9999-M-0400-P1 CHP Plantroom Layout.dwg | 13/02/2017 10:07:34, DWG To PDF.pc3

SCR for the internal enclosures for the E850 CHP, for information only to meet meet 40mg/Nm3 @5%O2 (**9ppm NOx @ 5% O2).** Option 1: ENER-G 850 L33

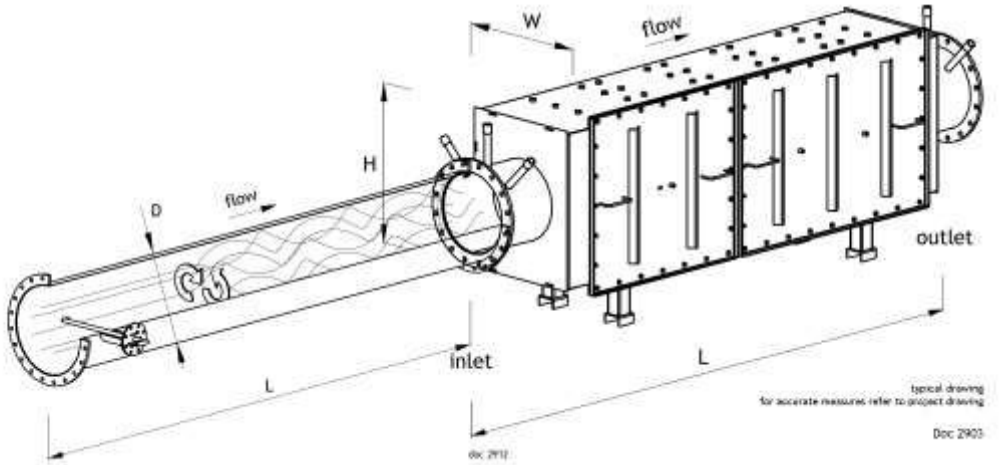
SCR (1 per CHP).

5. Tech Data / Dimensions / Consumables

5.1 Dimension MTU 8V 854 kW

Reactor			
Length	L=	3330	mm
Height	H=	920	mm
Width	W=	870	mm

Mixing duct			
Diameter	D=	350	mm
Length	L=	2850	mm



5.2 Consumables MTU 8V 854 kW

Urea (AdBlue) 32.5 w/w solution	1.0	l/h
Electrical Power 230 V / 50 Hz	1	kWh/h
Compressed air for injection	2	Nm3/h

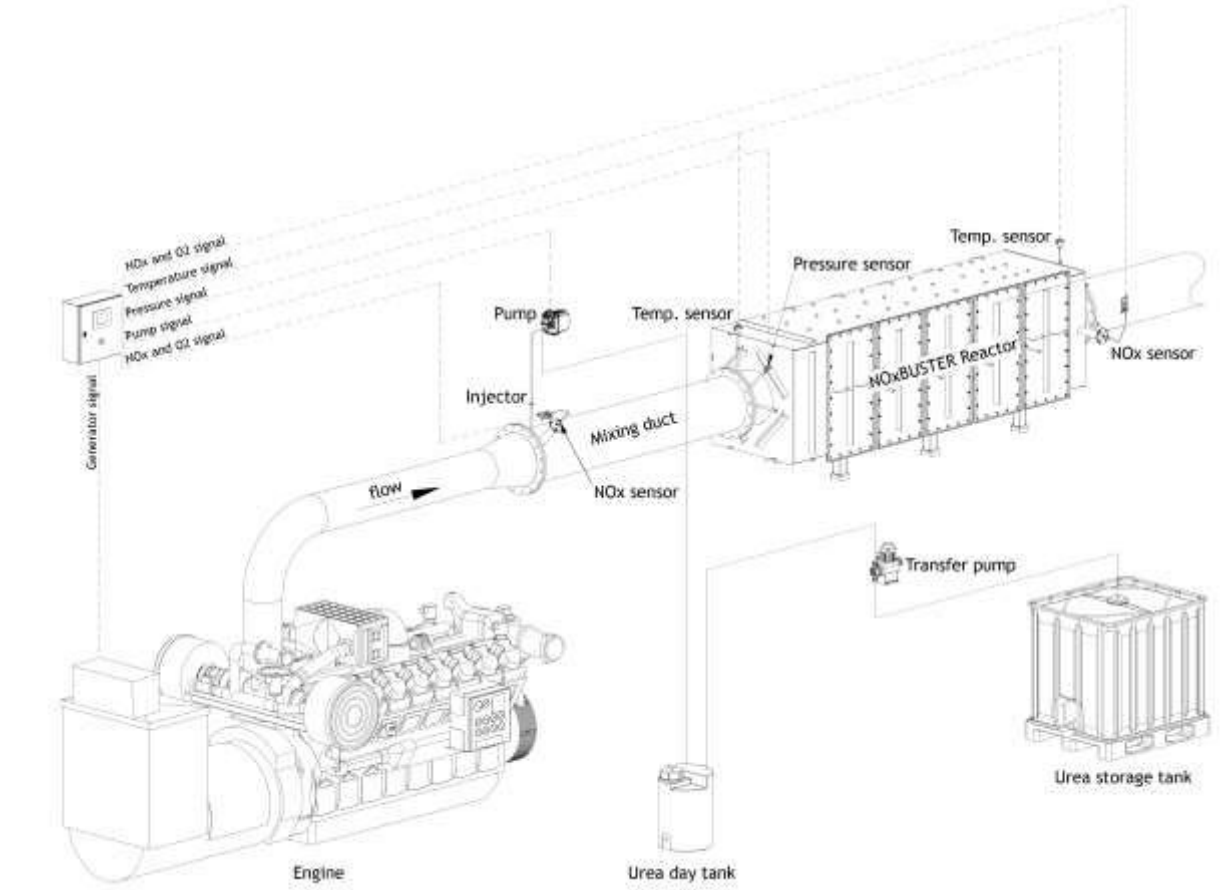
5.3 Back pressure MTU 8V 854 kW

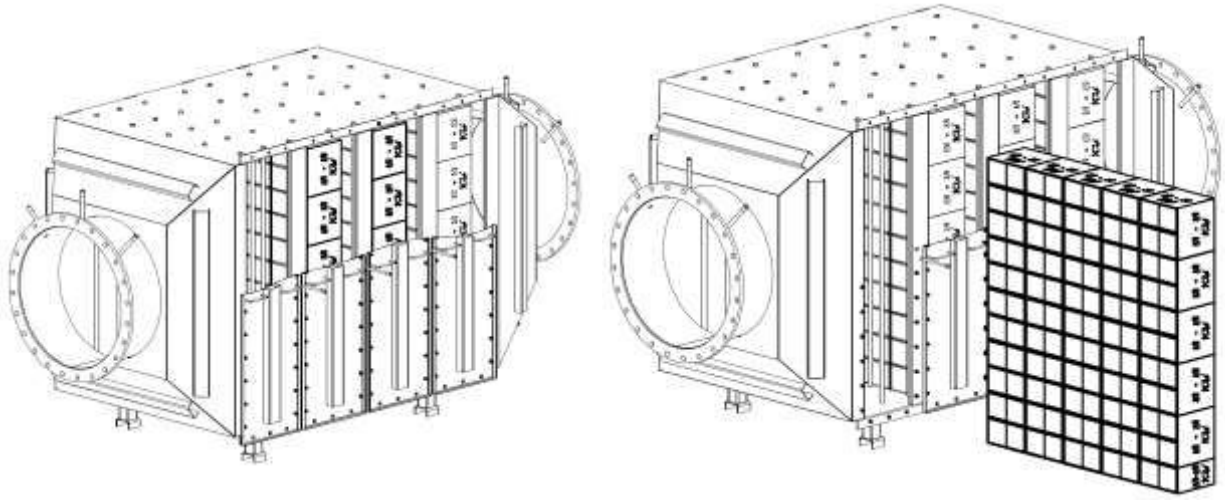
NOxBUSTER™ System, flange to flange, calculated value	17	mbar

6. Warranty values MTU 8V 854 kW

Nitrogen oxide	NOx <	9	ppm@5%O_2
Carbon monoxide	CO <	na	mg/Nm^3@5%O_2
Hydrocarbon	HC <	na	mg/Nm^3@5%O_2

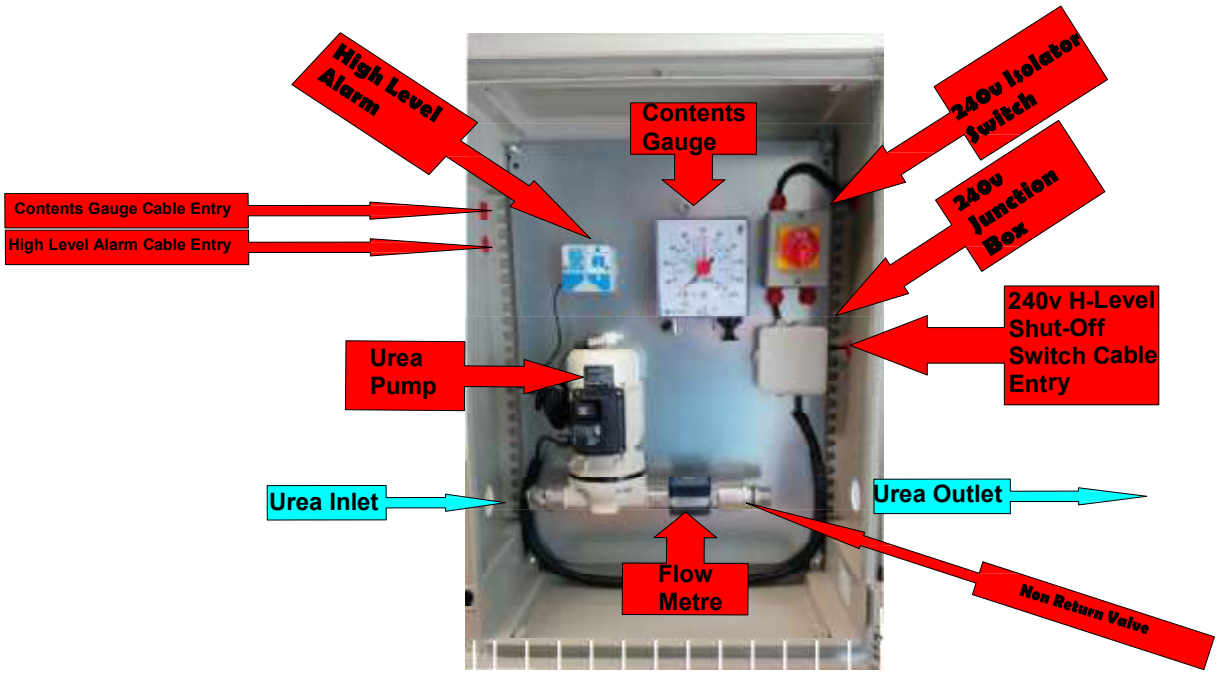
Typical set-up for SCR with gas engine.





SCR Remote fill point system

SYSTEM OVERVIEW & PARTS



INSTALLATION AND OPERATION

A suitable mounting bracket should be obtained from your local distributor or Agriemach Ltd in order for the system to be securely mounted for operation. All systems arrive with wall mounting brackets as standard.

DO NOT CONNECT TO A POWER SOURCE UNTIL ALL CHECKS HAVE BEEN CARRIED OUT

Suction/Delivery Hose

1. Use appropriate pipe connections and thread sealant to connect the hose.

2. Hose used should be at least as large as 1inch BSP. Any hose smaller than this will create a restriction and impact on performance.

3. When installing the hose, try to avoid bends where possible. Where a bend is unavoidable, it should be of the largest possible radius.

4. Use only AdBlue™ specific hose suitable for the transfer of AdBlue™ liquid.

Start-up/Operation

The following procedure outlines the most important steps involved in system operation. Any deviations from this procedure should be based on good engineering practice and site operating experience or practices.

1. Due to transportation and installation restrictions, the Tank Level Alarm, Contents Level Sensor, High Level Shut-off Switch and Hoses are not connected. Please read pages **11 to 18** to understand the installation procedure.

2. Ensure the Suction and Delivery hoses are connected, sealed and secure.

3. Ensure that the check valve and strainer is correctly installed on the suction hose.

4. The pump must not run for longer than 20 minutes before being shut off to cool. Over heating or running dry will damage the pump. It is recommended to leave the pump for 20 minutes to cool – this will be reduced during colder weather conditions. ***(WARNING: Maximum Pump Run Time is 20 minutes)***

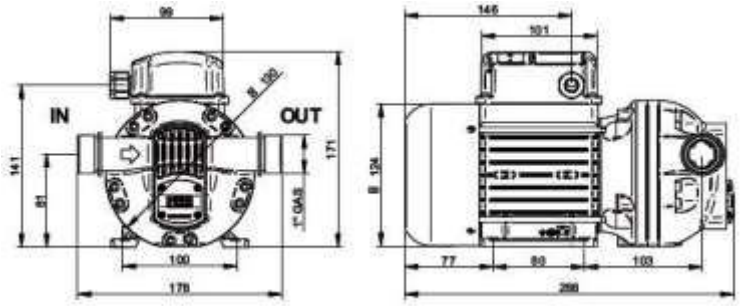
5. Ensure that the Suction line is fully submerged in AdBlue™ and the delivery line is securely connect to the bulk tank. *(Please note that the system has a maximum Suction lift of 3 metres)*

6. Connect the system to a suitable power source. *(Please ensure only qualified personnel with suitable electrical expertise carry this out)*

7. The system is self-priming and should require no assistance with this, providing the earlier steps have been carried out correctly and the Suction hose is not blocked in any way.

8. If the system has not filled with AdBlue™ within 7 seconds, please switch the pump off, assuming there is a problem. This will be seen through the flow meter.

PUMP DATA



L OPERATING CONDITIONS

L1 ENVIRONMENTAL CONDITIONS

TEMPERATURE	min. +23 °F / max +104 °F min. -5 °C / max +40 °C
RELATIVE HUMIDITY	max. 90%
LIGHTING	The environment must conform to directive 89/654/EEC on work environments. In case of non-EU countries, refer to directive EN ISO 12100-2 § 4.8.6.

ATTENTION ***The temperature limits shown apply to the pump components and must be respected to avoid possible damage or malfunction.***

L2 ELECTRICAL POWER SUPPLY

NOTE The pump must be powered by AC single-phase line, the nominal values of which are indicated on the table in the paragraph "G - ELECTRICAL DATA".
The maximum acceptable variations from the electrical parameters are:
Voltage: +/- 5% of the nominal value
Frequency: +/- 2% of the nominal value

ATTENTION ***Power supply from lines with values that do not fall within the indicated limits could cause damage to the electrical components.***

L3 DUTY CYCLE

NOTE The pumps have been designed for intermittent use and a 20-minute duty cycle under conditions of maximum back pressure.

ATTENTION ***Functioning under by-pass conditions is only allowed for short periods of time (max. 3 minutes).***

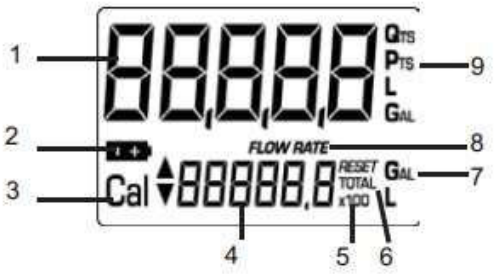
L4 PERMITTED AND NON-PERMITTED FLUIDS

FLUIDS PERMITTED	- AUS32 (DEF, AD-Blue); - WATER - LIQUID FOOD PRODUCTS	
FLUIDS NON-PERMITTED AND RELATED DANGERS	- DIESEL FUEL - PETROL - INFLAMMABLE LIQUIDS - CORROSIVE CHEMICAL PRODUCTS - SOLVENTS - LIQUIDS WITH VISCOSITY >20 cst	- OXIDATION OF PUMP - FIRE - EXPLOSION - CORROSION AND INJURY TO PERSONS - DAMAGE TO GASKET SEALS - MOTOR OVERLOAD

FLOW METER DATA

A4 LCD display

The "LCD" of the METER features two numerical registers and various indications displayed to the user only when the applicable function so requires.



Key:

1. Partial register (5 figures with moving comma FROM 0.1 to 99999) indicating the volume dispensed since the reset button was last pressed;
2. Indication of battery charge;
3. Indication of calibration mode;
4. Totals register (6 figures with moving comma FROM 0.1 to 999999), that can indicate two types of Total:
   - 4.1. General Total that cannot be reset (TOTAL)
   - 4.2. Resettable total (Reset TOTAL)
5. Indication of total multiplication factor (x10 / x100)
6. Indication of type of total, (TOTAL / Reset TOTAL);
7. Indication of unit of measurement of Totals: L=Litres Gal=Gallons
8. Indication of Flow Rate mode
9. Indication of unit of measurement of Partial: Qts=Quarts
   Pts=Pints
   L=Litres
   Gal=Gallons

A5 User Buttons

The k24 features two buttons (reset and cal) which individually perform two main functions and, together, other secondary functions.

The main functions performed are:

- For the reset key, resetting the partial register and resettable total (reset total)
- For the cal key, entering instrument calibration mode.

Used together, the two keys permit entering configuration mode, useful for changing the units of measurements and calibration factor.

H TECHNICAL SPECIFICATIONS

Measurement system		TURBINE
Resolution (nominal)	Hi Flow	0.010 lit/pulse
	Low Flow	0.005 lit/pulse
Flow Rate (Range)	K24 COL. BLACK Flow-rates:	5 ÷ 120 (Litres/minute) FOR DIESEL FUEL, WATER,.
	K24 COL. BEIGE Flow-rates	5 ÷ 100 (Litres/minute) FOR WATER/ UREA SOLUTION..
Operating pressure (Max)		10 (Bar) 145 (psi)
Bursting pressure (Min)		40 (Bar)
Storage temperature (Range)		-20 ÷ + 70 (°C)
Storage humidity (Max)		95 (% RU)
Operating temperature (Range)		-10 ÷ + 50 (°C)
Flow resistance		0.30 Bar at 100 lit/min.
Viscosity (Range)		2 ÷ 5.35 cSt
Accuracy		±1% after calibration within 10÷90 (litres/min) 2,65÷23,8 (gallons/ min) range
Reproducibility (Typical)		±0,3 (%)
Screen		Liquid crystals LCD. Featuring: - 5-figure partial - 6-figure Reset Total plus x10 / x100 6-figure non reset Total plus x10 / x100
Power Supply		2x1.5 V alkaline batteries size AAA
Battery life		18 ÷ 36 months
Weight		0.25 Kg (included batteries)
Protection		IP65

HIGH LEVEL ALARM DATA

IMPORTANT WARNING NOTES

1. The Hytek high level alarm MUST NOT be used to monitor petrol or other flammable liquids.
2. It is designed for use with Adblue®.
3. It must not be sited adjacent to a petrol dispenser or in any other hazardous zone.
4. Installation of this equipment should be carried out by a qualified fuel installation engineer.
5. The installation must conform to all relevant electrical and local authority regulations and standards

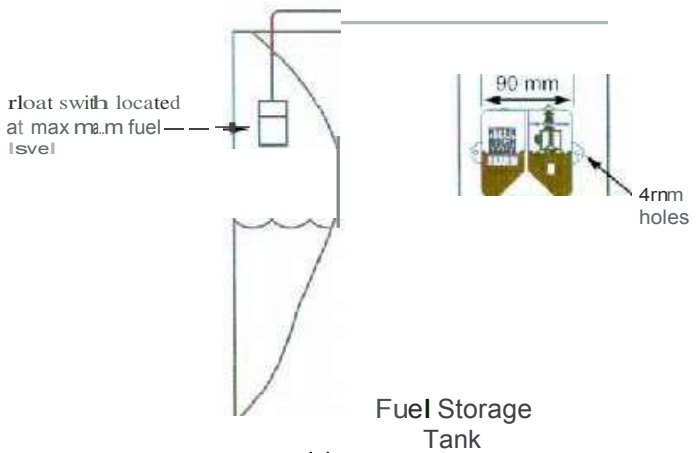
PRODUCT DESCRIPTION

The system consists of a weighted float switch that is connected, with a 5 metre fuel resistant cable, to the weatherproof High-level alarm box containing the visual and audible alarms.
The Hytek high-level alarm is designed to provide visual and audible alarms whenever a predetermined level, in an Adblue® storage tank, is reached.

INSTALLATION

1. Using the mounting lugs provided, fix the High-level alarm box in the position required using the supplied screws. Ensure that the light and green button are located at the top.
2. Feed the float switch through a hole/port in the top of the Adblue® storage tank. For steel tanks the brass cap will thread onto a 1 W' tank fitting. For plastic tanks the plate is secured using self-tapping screws.
3. Position the float switch so it will be activated when the Adblue® level in the tank reaches the required maximum height and secure in position using the gland on the cap/plate.
4. Remove the Hytek high-level alarm box cover (2 screws on the front) and connect the battery connector to the battery.
s. Press green button on top of Hytek high-level alarm box. Ensure a series of short beeps can be heard and the light flashes. Replace cover and screw down firmly.

INSTALLATION DIAGRAM



OPERATION

The Hytek high-level alarm will operate when the float switch is activated by a rising liquid level in the Adblue® storage tank. The alarm will sound as a rising beep every 2.5 seconds and the light will flash simultaneously.

To silence the alarm, press the green button. The light will continue to flash until the liquid level in the tank drops below the level of the float switch.

The battery will power the Hytek high-level alarm for 72 hours in full alarm mode with both the sounder and light activated. Low battery power is indicated by a short beep every 25 seconds.

When the battery is low and the Hytek high-level alarm is activated. The alarm will sound as a rising beep every 5 seconds to conserve power.

The light will flash every 25 seconds in normal operation (not in alarm mode) to indicate that the Hytek high-level alarm is operating correctly.

FAULT INDICATION

If the float switch is disconnected or the cable has been severed the Hytek high level alarm will emit a short beep every 5 seconds.
The light and sounder can be tested at any time by pressing the green button once. If the Hytek high-level alarm is functioning correctly a short series of beeps will sound and the light will flash.

CONTENTS GAUGE DATA

Capillary Installation(see Figs. 2,3 and 4)

The capillary tubing can be ¼" PVC or ¼% O.D. copper.

Install capillary tubing with fall towards the tank avoiding sharp bends and kinks in the capillary tubing. In the event of the instrument being mounted below the tank top level the installation of a Condensate Trap may be necessary in installations where there is a possibility of condensate forming within the capillary tubing.

When connecting the capillary tubing to the gauge proceed to assemble all connection parts in accordance with the illustration as shown in Fig.3 and tighten properly.

Where PVC tubing is used the ferrule provided should be pushed into the end of the PVC tubing to prevent the end from being closed by the compression fitting. Where PVC tubing is used the Tank Adaptor and the Balance Chamber (weight) are normally readily assembled and the Tank Adaptor needs only to be screwed into the top of the tank with a sufficient length of PVC tubing allowed for the distance between bottom and top inside the tank. The Balance Chamber (weight) will ensure that the PVC tubing is always kept at the bottom of the tank for accurate tank contents measurement.

Where ¼" O.D. copper capillary tubing is used it must be ensured that the capillary tubing is passed through the Tank Adaptor in a straight line to within approximately 10 - 20 mm of the bottom of the tank. In cases where the tank height exceeds 1200 mm (4") it is recommended that a protective pipe is installed around the copper capillary tubing to ensure that the copper tubing always remains within 10 - 20 mm of the tank bottom despite any possible turbulence of the liquid.

In order to simplify the obtaining of an accurate distance between the tank bottom and the end of the capillary tubing a stand-pipe end piece SEP can be supplied (see Fig.4).

Instrument Adjustment(see Fig.1)

If your instrument has been calibrated in gallons,litres or other specific units to your requirement in our Works Department then it is only necessary for you to check that the pointer is in fact on the zero mark with the capillary tubing disconnected. If this is not the case then the zero correction screw No.7 (see Fig.1) should be turned to bring the pointer to the zero mark. Then the capillary tubing is reconnected airtight and the installation will be ready for operation.

In the event of the basic universal instrument with 0 - 100% scale being supplied then the enclosed Index Table should be consulted. This gives on the left-hand vertical side the tank height in mm and on the top horizontal line the specific gravity of the liquid to be measured. By establishing the tank height in mm and the specific gravity of the liquid an Index Figure can be found on the Index Table (e.g 4' deep tank = 1200 mm, filled with heating oil 35 seconds specific gravity 0.84 = Index figure 1.20).

This index figure which has been obtained should then be set on the Index scale on the instrument (No.6 on Fig.1) by removing the glass of the unit and using the Index Adjustment Screw (No.5 on Fig.1) By turning the zero correction screw (No.7 on Fig.1) the pointer is now brought to the zero mark and the instrument is now fully adjusted for the tank in question.

A slide-in scale calibrated in gallons,litres or other units may now,if required, be placed over the basic 0 - 100% scale and the front glass is then carefully replaced.

Operation

Pull out pump carefully to the stop and release. This action should be repeated until the maximum reading is obtained on the dial, i.e. the instrument will not show a higher reading. It is essential that the pump of this instrument is operated every time before a reading is obtained.

Do not operate the pump during the tank filling process.

Fault Finding

1. Pointer hardly moves off the zero mark when pump is operated or does not maintain the tank contents reading for a sufficiently long period of time = leaking capillary lines, capillar/connections at gauge or condensate trap is leaking - check installation and eliminate leak.
2. Pointer goes beyond the 100% mark on the scale or pump does not return to its stop = blocked capillary line or capillary connections or condensate trap full - eliminate blockage or empty condensate trap.
3. Incorrect tank contents indication = instrument has been wrongly adjusted - check instrument setting against Index Table (tank height/specific gravity of liquid) and also ensure that zero correction is properly carried out.

Flg. 1

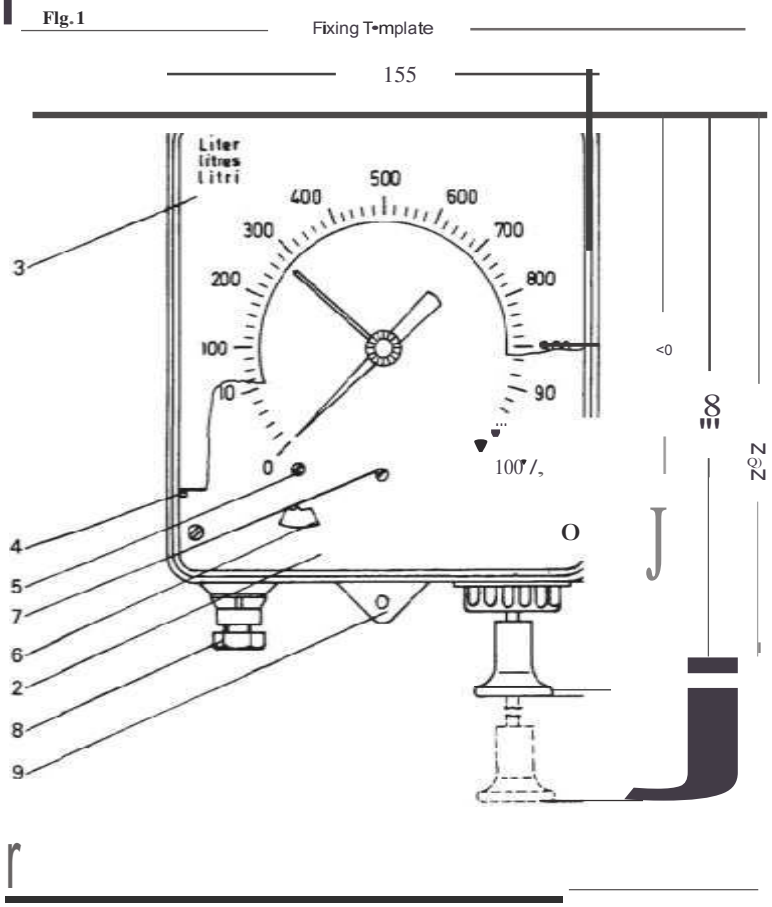


Fig. 1

1 Slot for removal of front glass
2 Basic dial
3 Slide-in scale
4 location lug
5 Index edjustment screw
6 Index scale
7 Zero correction
8 Capillary connection union
9 Fixing lug

Fig.2

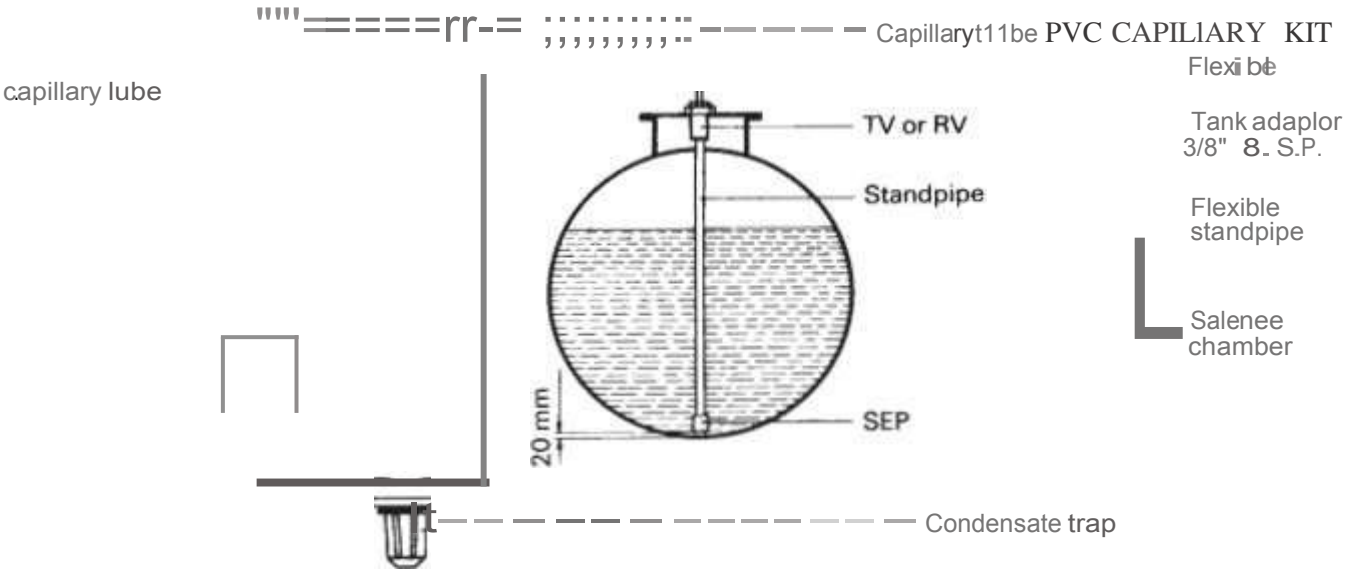


Fig.3

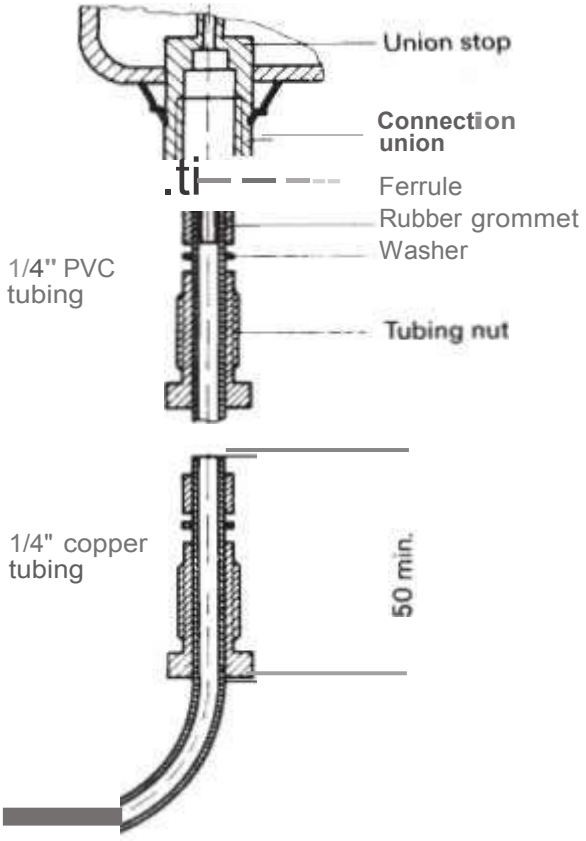


Fig.4

TV – tank adaptor

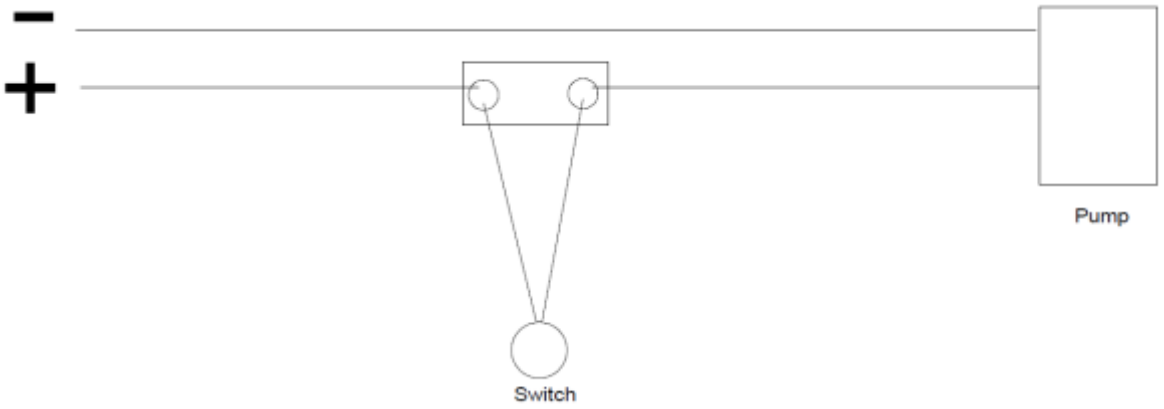
RV – tube connector

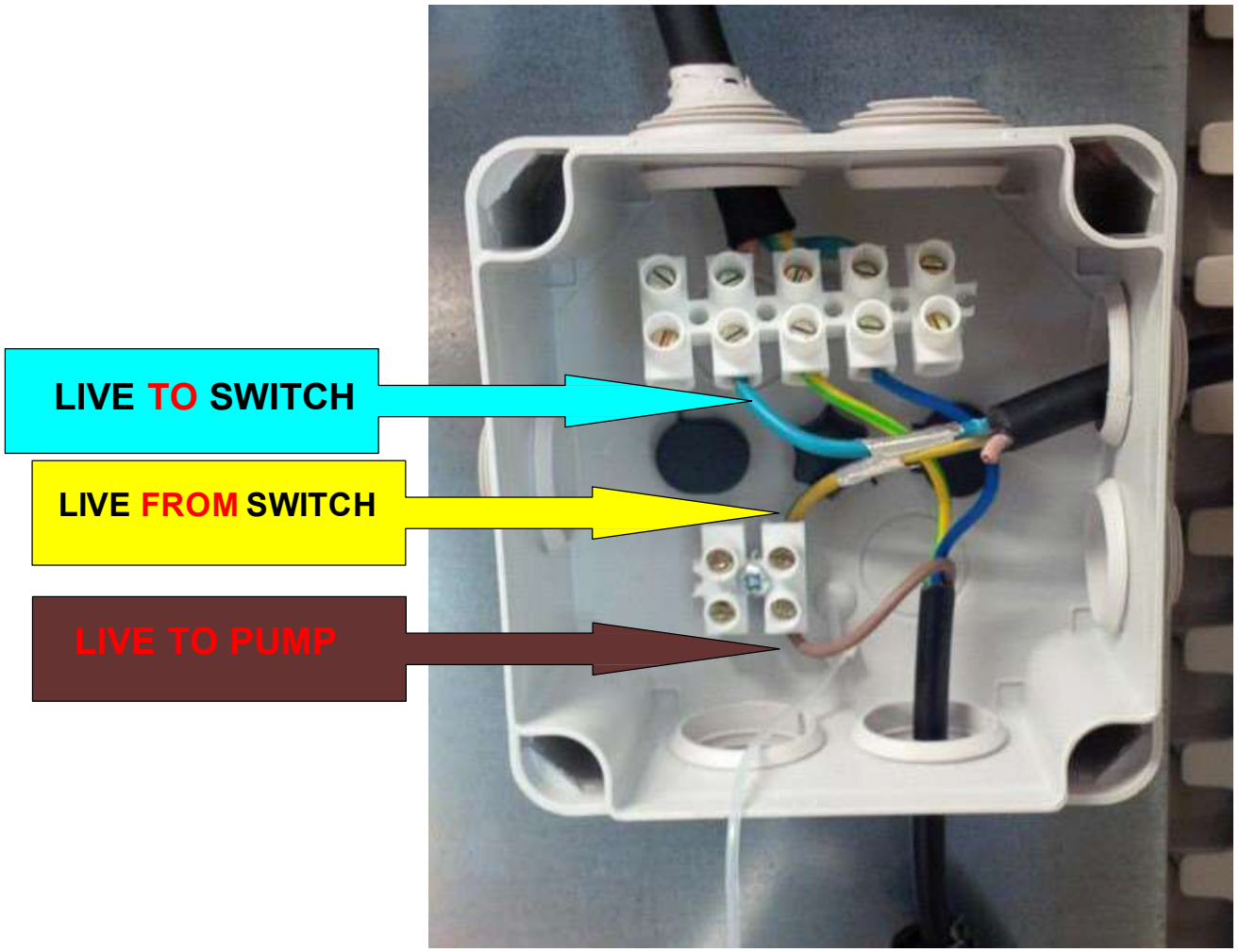
SEP- standpipe endpiece

Index-Table

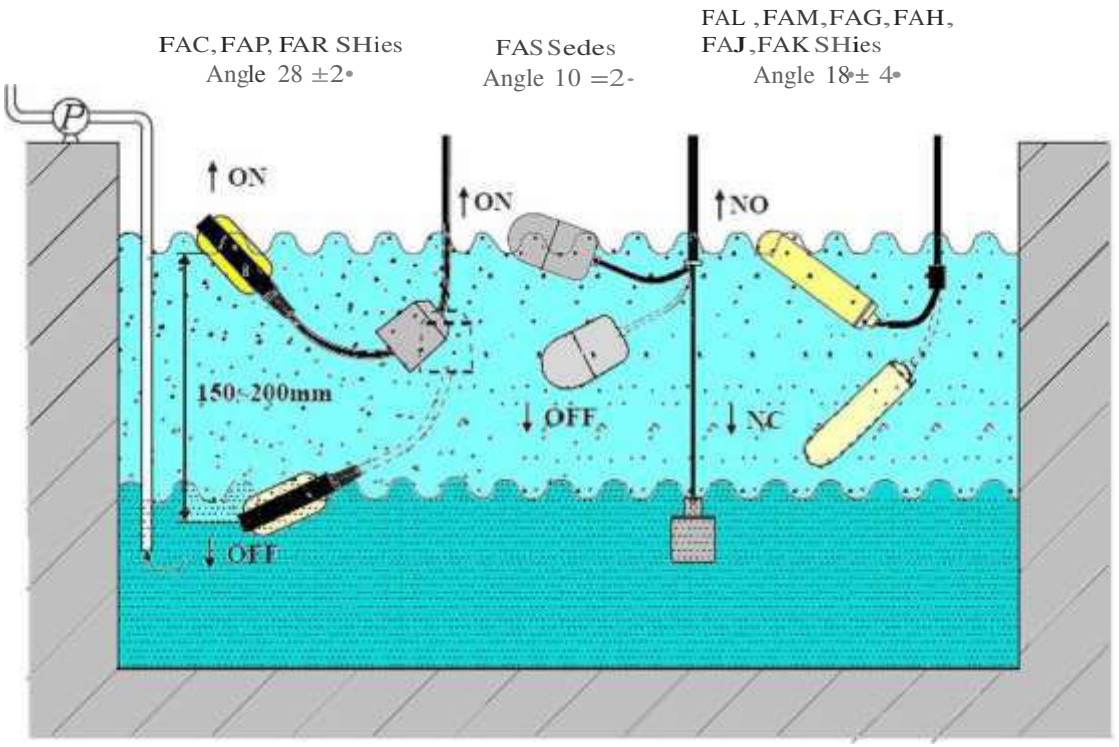
Tank height in mm	Specific Gravity															
	0,70	0,72	0,74	0,76	0,78	0,80	0,82	0,84	0,86	088	0,90	0,92	0,94	0,96	0,98	1.00
600	0,50	0,51	0,53	0,54	0,56	0,57	0.59	0,60	0,61	0,63	0,64	0,66	0,67	0,69	0,70	0.71
660	0,54	0,56	0,57	0,59	0,60	0.62	0,63	0,65	0,67	0,68	0,70	0,71	0,73	0,74	0,76	0.77
700	0,58	0,60	0,62	0,63	0,65	0.66	0,68	0.70	0,72	0.73	0.75	0,77	0,78	0,80	0,82	0,83
750	0,63	0.64	0,66	0,68	0,70	0,71	0,73	0,75	0.77	0,79	0,80	0,82	0,84	0.86	0,88	0,89
800	0,67	0,59	0,71	0,72	0,74	0,76	0,78	0,80	0.82	0,84	0,86	0,88	0,90	0,91	0.93	0,95
850	0,71	0,73	0,75	0,77	0,79	0,81	0,83	0,85	0,87	0,89	0,91	0.93	0,95	0,97	0,99	1,01
900	0,75	0,77	0,79	0,81	0,84	0,86	0,88	0,90	0.92	0,94	0,96	0,99	1,01	1,03	1,05	1,07
950	0.79	0,81	0,84	'1,86	0,88	0.91	0,93	0,95	0,97	1,00	1,02	1,04	1,06	1,08	1'11	1.13
1000	0,83	0,86	0,88	0,90	0,93	0,95	0,98	1,00	1.02	1.05	1,07	1,10	1,12	1'14	1,17	1,19
1100	0,92	0,94	0,97	1,00	1,02	1,05	1,07	1,10	1.13	1,15	1,18	1,20	1,23	1.26	1.28	1,31
1200	1,00	1,03	1,06	1,08	1'11	1,14	1'17	1,20	1,23	1,26	1,29	1,31	1,34	1,37	1.40	1,43
1250	1,04	1,07	1.10	1'13	1,16	1,19	1,22	1,25	1,28	1,31	1,34	1.37	1.40	1,43	1,46	1,50
1300	1,08	1'11	1'14	1,18	1,21	1,24	1,27	1,30	1,33	1.36	1,39	1.42	1.45	1.48	1,52	1,55
1400	1,17	1.20	1,23	1.27	1,30	1,33	1,37	1.40	1.43	1.47	1,50	1.53	1.57	1.60	1,63	1.65
1500	1.25	1.28	1.32	1.36	1.39	1,43	1.46	1,50	1,54	1,57	1,60	1,64	1,68	1,71	1.75	1.79
1600	1,33	1.37	1,41	1.45	1.48	1,52	1,56	1,60	1,64	1,67	1,70	1.75	1,80	1,83	1,85	1,90
1700	1.42	1.46	1,50	1,54	1,58	1,62	1,65	1,70	1,75	1.78	1,82	1,85	1,90	1,95	1,98	2,00
1800	1,50	1,54	1,59	1,63	1,67	1.70	1.75	1,80	1,85	1,89	1,93	1,95	2,00	2,05	2,10	2,15
1900	1.58	1,63	1,67	1,72	1.75	1,80	1,85	1,90	1,95	2,00	2.08	2,12	2,10	2,15	2,20	2.25
2000	1,67	1.70	1,75	1.80	1.85	1,90	1.95	2,00	2.05	2,10	2.15	2,20	2.25	2,30	2.35	2.40
2100	1,75	1,80	1,85	1,90	1,95	2,00	2,05	2,10	2.15	2.20	2,25	2,30	2,35	2.40	2.45	2,50
2200	1.85	1,90	1,95	2,00	2,05	2,10	2,15	2,20	2.25	2,30	2,35	2,40	2,45	2.50	2.55	2,60
2300	1,95	2,00	2,05	2,10	2,15	2,20	2,25	2,30	2.35	2.40	2.45	2,50	2,55	2.60	2,65	2,70
2400	2,00	2,05	2.10	2,15	2,.£0	2,30	2,35	2,40	2,45	2.50	2,55	2,€0	2,70	2.76	*2,80*	*2.85*
2500	2.10	2.15	2.20	2.25	2.30	2.40	2.45	2.50	2.55	2.60	2.70	2.75	2.80	2.85	2.90	3.00
2600	2.20	2,25	2,30	2,35	2,40	2,50	2,55	2.60	2,65	2.70	2,80	2,85	2,90	2,95	3,00	3,10
2700	2,25	2,30	2.40	2.45	2.50	2.55	2,65	2,70	2,75	2,85	2,90	2.95	3.00	3,10	3,15	3,20
2800	2,35	2.40	2.45	2,55	2.60	2,65	2,75	2,80	2.85	2.95	3,00	3,10	3,15	3,20	3,25	3,35
2900	2.45	2,50	2,55	2,130	2,70	2.75	2.85	2.90	2,95	3,05	3,10	3,20	3,25	3,30	3 40	3.45
3000	2,50	2,55	2.65	2.70	2,80	2,85	2.95	3,00	3,05	3,15	3,20	3.30	3.35	3.45	3.50	3.55
3100	2,60	2,65	2.75	2,80	2,90	2,95	3.05	3,10	3,20	3,25	3,30	3.40	3,50	3.55	3,60	3,70
3200	2.65	2.75	2.80	2.90	2.95	3.05	3,15	3,20	3,30	3.35	3.45	3,50	3,60	3.65	3.75	3,80
3300	2.75	2,85	2,90	3,00	3,05	3,15	3,20	3,30	3,40	3,45	3,55	3,60	3,70	3,80	3,85	3,95
3400	2,85	2.90	3.00	3.10	3,15	3,25	3,30	3,40	3,50	3,55	3,65	3,70	3,80	3.90	3,95	
3500	2,90	3.00	3,10	3,20	3,25	3.30	3.40	3.50	*6,60*	3.65	3,75	3.85	3,90	4,00		
3600	3,00	3,10	3,15	3,25	3,35	3.45	3,50	3,60	3.70	3,75	3.85	3,95				
3700	3,10	3.20	3.25	3.35	3.45	3,50	3,60	3.70	3,80	3.90	4,00					
3ro<l	3,20	3,30	3,35	3.45	3,55	3.60	3.70	3,80	3.90	4,00						
3900	3.25	3,35	3,45	3,55	3,60	3,70	3,80	3,90	4,00							
4000	3,35	3.45	3,50	3,60	3.70	3,80	3,90	4,00								

HIGH LEVEL SHUTDOWN SWITCH DATA

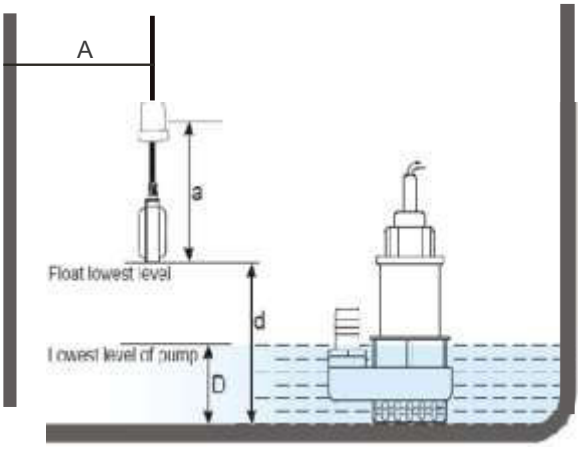


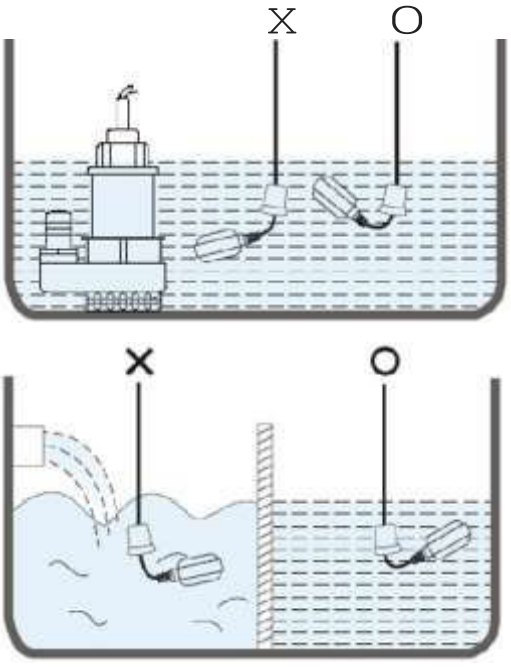


Working Principle



Installation Tips





ROUTINE MAINTENANCE

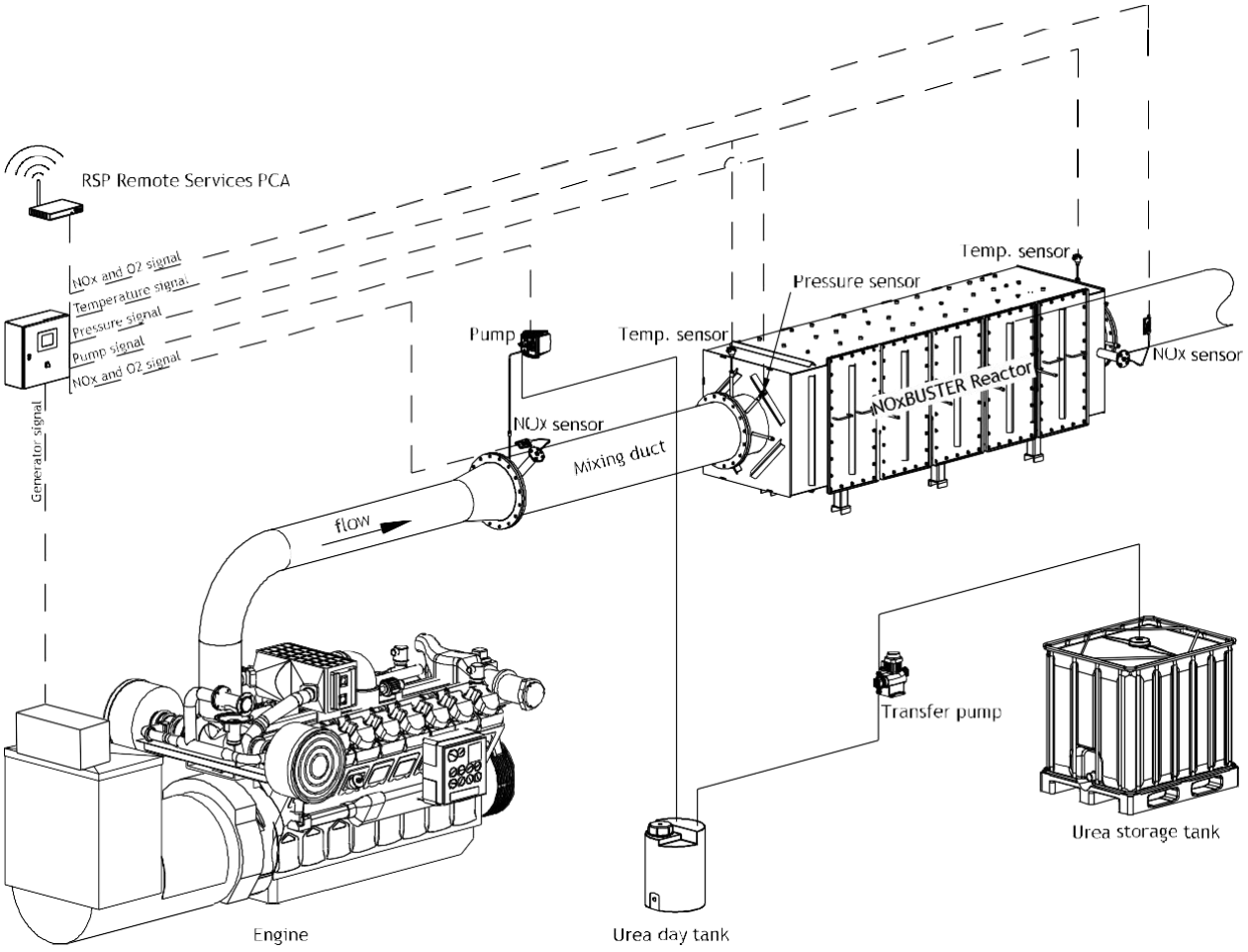
Routine maintenance and servicing are essential to ensure that the pump and all associated equipment give many years of trouble free operation.

The main factors in determining if overhaul is required are continual fault shutdown due to flow reduction or very loud operation.

Use only Agriemach Ltd original parts. Agriemach Ltd takes no responsibility for the use of parts other than those manufactured and supplied by us or your local distributor. The use of substitutes may result in poor system performance or an accident causing physical damage or injury to personnel.

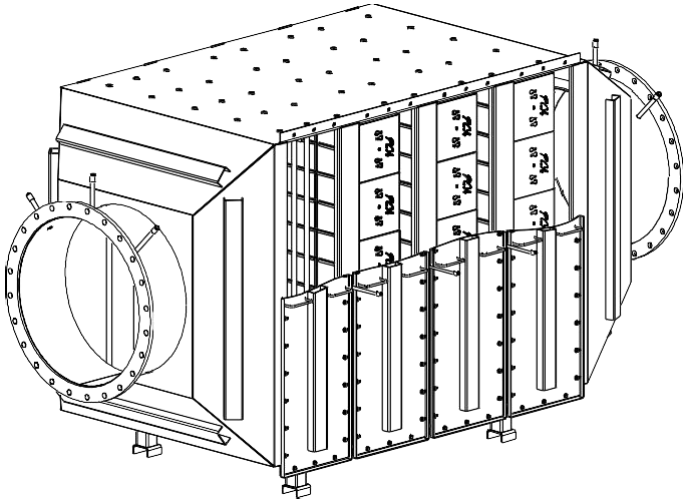
DATE OF SERVICE	WORK CARRIED OUT	COMMENTS

Southbank Place - SCR System Summary ENER-G 850 CHP with Combined SCR & Silencer.



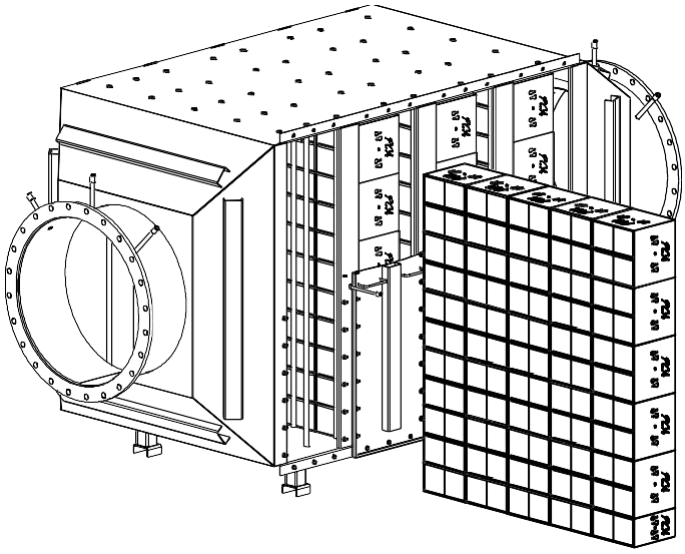
Highest Quality SCR Catalyst Material

We offer best available catalytic material, especially selected by us to perform under design conditions.



Future needs

Spare layers for future additional catalyst insert.



Engine Data

Engine:	MTU 8V 4000 L33 - 400V	
No:	1 Off	
Fuel:	Natural Gas	
Electrical Output:	854	kWe
Load:	100	%
Exhaust Flow rate ,wet:	3662	Nm3/h
Exhaust Flow rate ,dry:	3395	Nm3/h
Exhaust Gas Mass Flow ,wet:	4737	kg/h
Exhaust gas temperature:	444	° C at full load
Operating limit:	444 -508 ° C	

Inlet concentrations	
Nox stated as NO2 (Dry 5% O2):	<250
CO (dry 5% O2):	<1000
HCHO (Dry 5% O2):	-
VOC (Dry 5% O2):	-

Engine sound level

Engine sound level [21] (1 meter distance, free field)					
Frequency	Hz	**63**	**125**	**250**	**500**
Sound pressure level	dB	75.9	85.8	87.5	90.8
Frequency	Hz	**1000**	**2000**	**4000**	**8000**
Sound pressure level	dB	86.5	86.2	91.6	95.9
	Lin dB	99.2			
Sum of pressure levels	dB A	98.1			
Sound power level	dB A	117.2			
Undampened exhaust noise [21] (1 meter distance to outlet within 90°, free field)					
Frequency	Hz	**63**	**125**	**250**	**500**
Sound pressure level	dB	101.1	117.9	109.3	103.9
Frequency	Hz	**1000**	**2000**	**4000**	**8000**
Sound pressure level	dB	96.0	94.2	90.4	85.1
	Lin dB	118.7			
Sum of pressure levels	dB A	106.0			
Sound power level	dB A	118.2			

Fuel Data

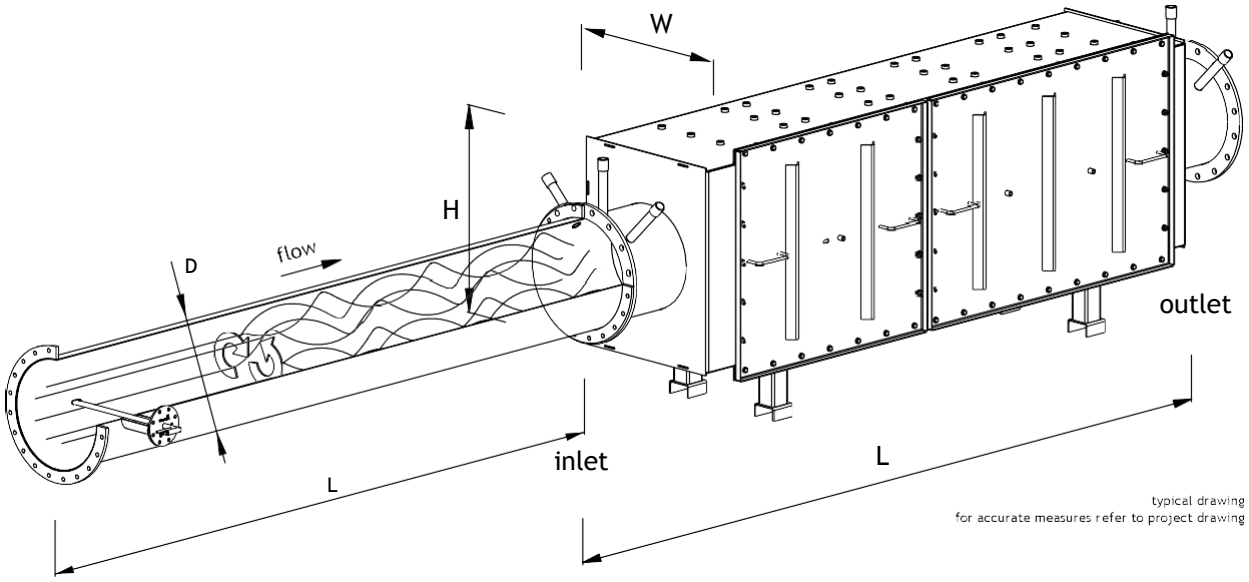
Natural gas

Tech Data / Dimensions / Consumables

Dimension

Reactor			
Length	L=	4’600	mm
Height	H=	920	mm
Width	W=	870	mm

Mixing duct			
Diameter	D=	350	mm
Length	L=	2’850	mm



Consumables

Urea (AdBlue) 32.5 w/w solution	1.1	l/h
Electrical Power 230 V / 50 Hz	1	kWh/h
Compressed air for injection	2	Nm3/h

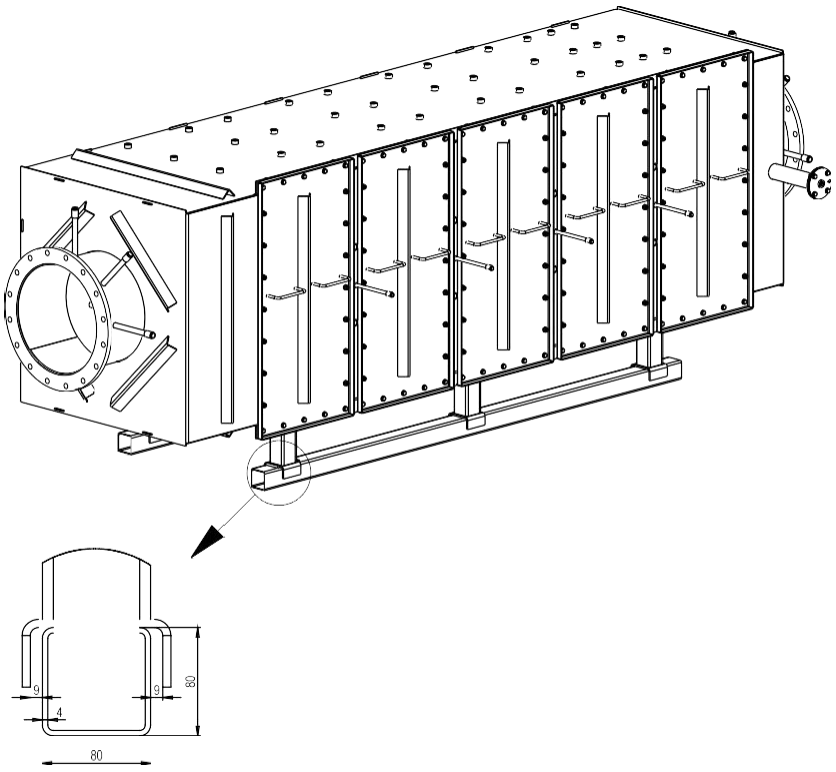
Back pressure

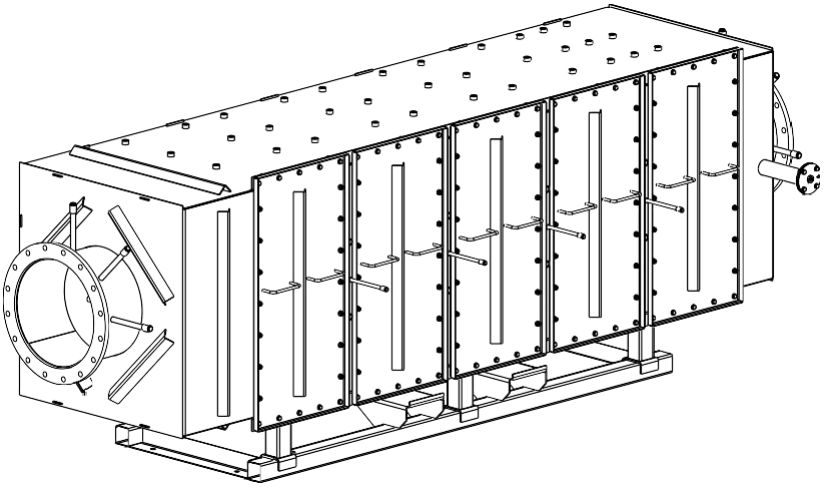
NOxBUSTER™ System, flange to flange, calculated value	25	mbar

Warranty values

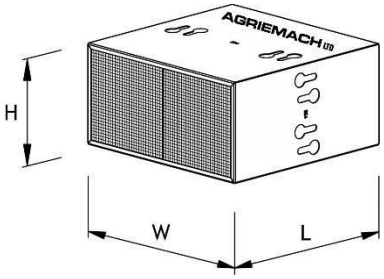
Nitrogen oxide	NOx <	9	ppm@5%O_2
Carbon monoxide	CO <	na	mg/Nm^3@5%O_2
Hydrocarbon	HC <	na	mg/Nm^3@5%O_2

Silencing Functionality to 55db


9
9
4
80
80

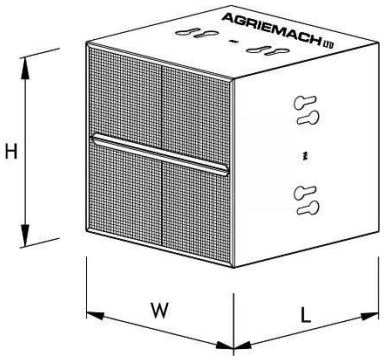


Catalyst packed in cassettes 2 x 1 / L = 300 mm



Catalyst is wrapped in steel plates, equipped with holding holes
H = 158 mm
W = 314 mm
L = 309 mm
m = 9 kg

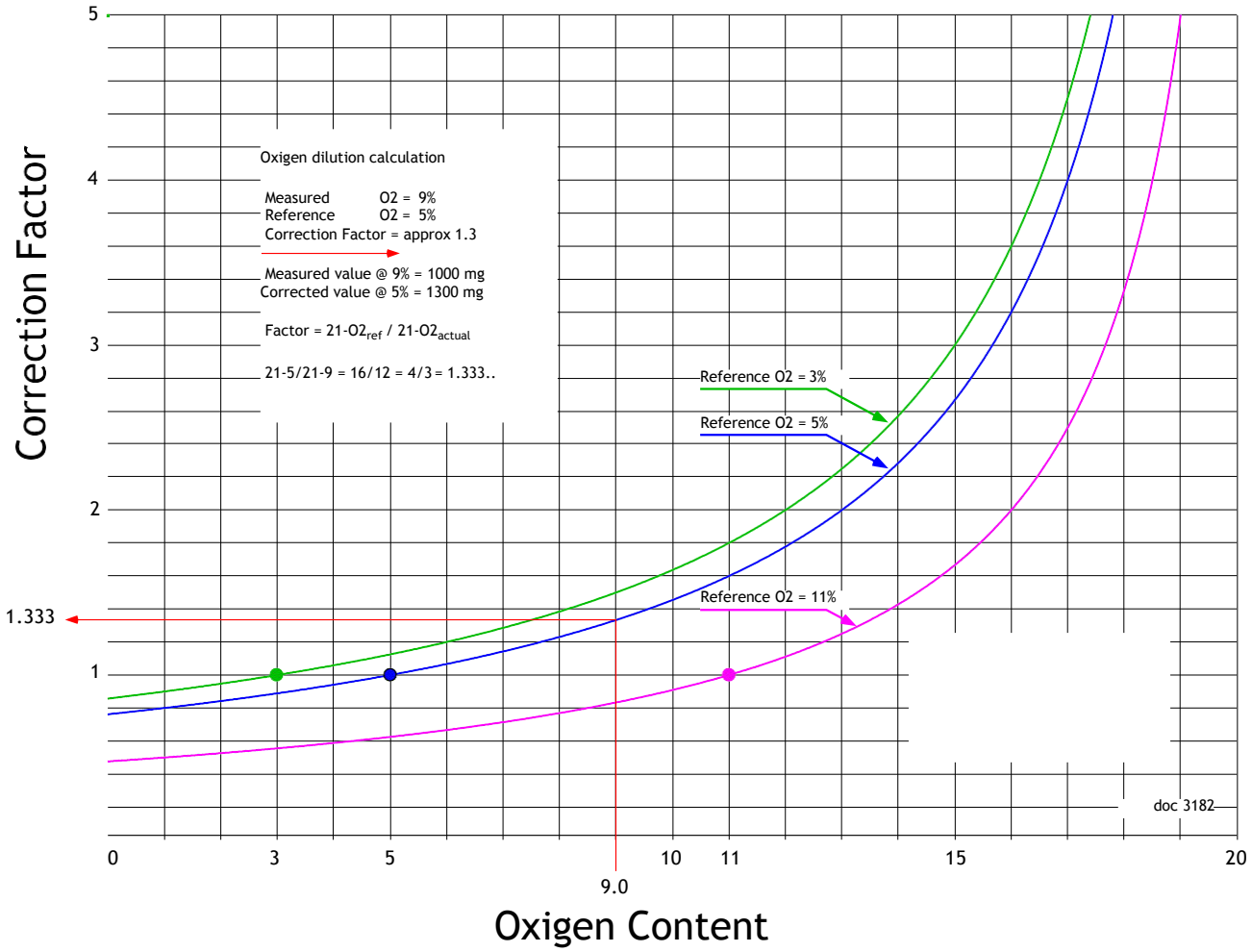
13.1.8 Catalyst packed in cassettes 2 x 2/ L = 300 mm

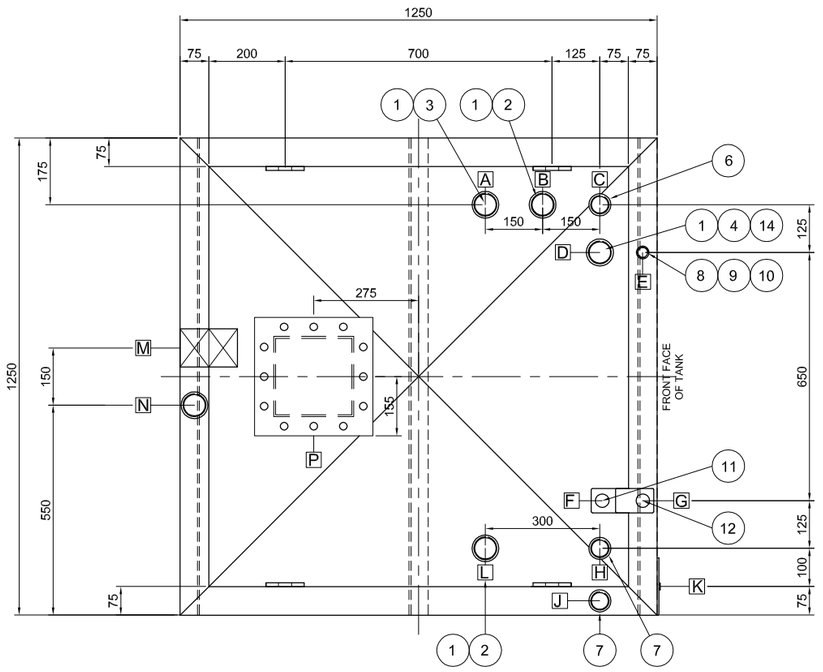


Catalyst is wrapped in steel plates, equipped with holding holes
H = 316 mm
W = 314 mm
L = 309 mm
m = 17 kg

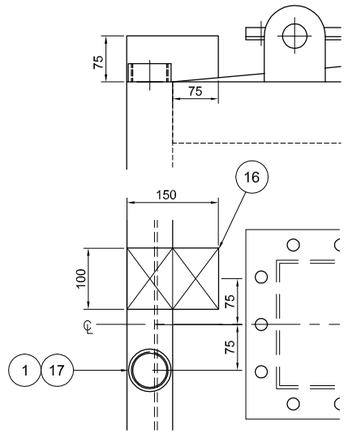
Actual Oxygen versus correction factor to reference Oxygen

Dilution calculation

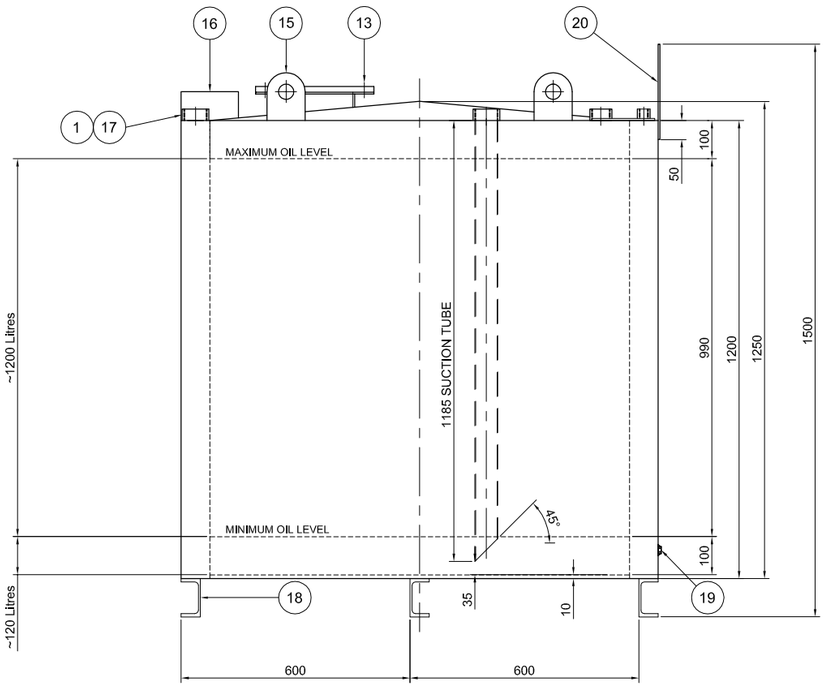




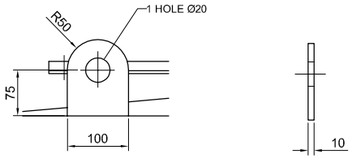
PLAN



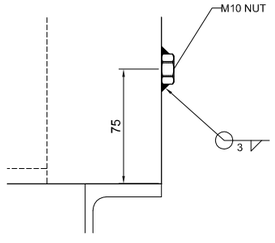
TANK VENT DETAIL (1:5)



ELEVATION



LIFTING LUG DETAIL (1:5)



EARTHING BOSS DETAIL (1:2)

COLOUR CODE	
Y	DESCRIPTION
1	PRIMED ONLY
2	HOLLY GREEN - BS4800
3	SILVER GRAY- RAL 7001
4	SADDLE BROWN
5	BLACK
6	OTHER

TERMINATION TABLE	
T.P. REF.	DESCRIPTION
A	2" BSP CLEAN OIL OUTLET
B	2" BSP SPARE (FOR HYDROSTATIC LEVEL GAUGE IF SUPPLIED)
C	1 1/2" BSP CONTENTS GAUGE
D	2" BSP CLEAN OIL INLET C/W LOCKING CAP
E	1" BSP BUND SUCTION TUBE
F	CALIBRATED TANK DIPSTICK
G	BUND DIPSTICK
H	1 1/2" BSP HIGH/LOW LEVEL SENSOR
J	1 1/2" BSP BUND LEVEL SENSOR
K	M12 TANK EARTH POINT
L	2" BSP SPARE (FOR ULTRASONIC LEVEL SENSOR IF SUPPLIED)
M	TANK VENT TO BUND
N	BUND VENT TO ATMOSPHERE C/W VENT COVER
P	200mm x 200mm RAISED NECK COVER

PARTS LIST			
ITEM No	DESCRIPTION	QTY	MATL
1	Ø2" SOCKET	5	M.S.
2	HEX PLUG FOR Ø2" SOCKET	2	M.S.
3	Ø2" SUCTION TUBE	1	M.S.
4	Ø2" LOCKING CAP	1	M.S.
5	Ø2" NIPPLE	0	M.S.
6	Ø1 1/2" SOCKET	1	M.S.
7	Ø1 1/2" NIPPLE	2	M.S.
8	Ø1" SOCKET	1	M.S.
9	HEX PLUG FOR Ø1" SOCKET	1	M.S.
10	Ø1" SUCTION TUBE	1	M.S.
11	CALIBRATED TANK DIPSTICK	1	M.S.
12	BUND DIPSTICK	1	M.S.
13	200mm x 200mm RAISED NECK COVER	1	M.S.
14	2" BSP OVERFILL PREVENTION VALVE	1	M.S.
15	LIFTING LUGS	4	M.S.
16	TANK VENT TO BUND	1	M.S.
17	2" BSP PLASTIC VENT COVER	1	-
18	100mm x 50mm CHANNEL	3	M.S.
19	M10 EARTHING STUD C/W NUT & WASHER	1	M.S.
20	MOUNTING PLATE 250mm x 150mm x 5mm	1	M.S.

GENERAL NOTES

1. TANK DESIGN SPECIFICATION IN ACCORDANCE WITH BS 799 PART 5.
2. TANK TO BE CONSTRUCTED USING 5mm THICK MILD STEEL TO BS EN 10 025 S275 WITH PYRAMID ROOF.
3. TANK AND BUND STIFFENED USING MILD STEEL ANGLE IRON. ALL FITTED INTO MILD STEEL BUND.
4. ALL SOCKETS AND NIPPLES TO BE BSPP AND STAND OUT 30mm FROM TANK SURFACE.
5. ALL EXTERNAL TANK SURFACES TO BE PAINTED WITH ONE COAT ZINC PHOSPHATE RED OXIDE & FINISHED WITH ONE COAT PAINT. (SEE COLOUR CODE).
6. INSIDE OF TANK AND BUND TO BE COATED WITH ENSIS OIL.
7. MAINS OPERATED TANK ALARM C/W RELAYS, DOUBLE HIGH/LOW LEVEL SENSOR AND SINGLE BUND LEVEL SENSOR SUPPLIED LOOSE BY TANK MANUFACTURER.
8. FLOAT TYPE CONTENTS GAUGE SUPPLIED LOOSE BY TANK MANUFACTURER.
9. THREADED 'SPILL STOP' TYPE OVERFILL PREVENTION VALVE WITH LOCKING CAP TO BE SUPPLIED AND FITTED BY TANK MANUFACTURER.
10. BUND SUCTION TUBE MUST FACILITATE TOTAL CONTENTS DRAINAGE.
11. FRONT FACE OF TANK TO BE LABELLED WITH 300mm x 200mm ADHESIVE STICKER (YELLOW WITH BLACK TEXT) STATING TANK CONTENTS **'CLEAN LUBRICATING OIL '** AND TANK CAPACITY **'1200L'**.
12. BASE CHANNELS TO BE POSITIONED AT CENTRES INDICATED.
13. TANK BASE TO BE TWIN SKINNED.
14. APPROX WEIGHT **TBC** KG (EMPTY).

REV	DATE	DESCRIPTION	DRN	CHK	APP

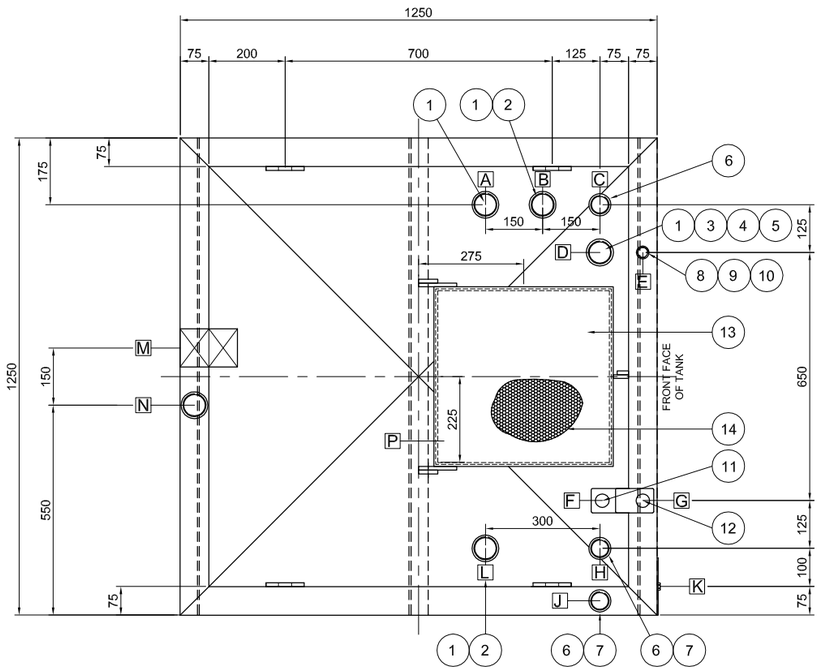
1. NO DIMENSIONS ARE TO BE SCALED FROM THIS DRAWING
2. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS ON SITE

ENER-G COMBINED POWER LIMITED
ENER-G HOUSE, DANIEL ADAMSON ROAD,
SALFORD, MANCHESTER, M50 1DT, U.K.
TEL: 0161 745 7450
FAX: 0161 745 7457
WEB: WWW.ENERG.CO.UK

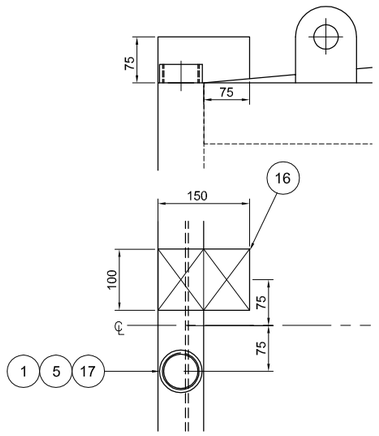
DRAWING TITLE
CLEAN OIL TANK 1200L

DRAWING No.		REVISION
A11-16131		P1
DATE	SCALE	SHEET SIZE
13.02.13	1:8	A1
DRAWN BY	CHECKED	APPROVED
PH	RAF	DPF

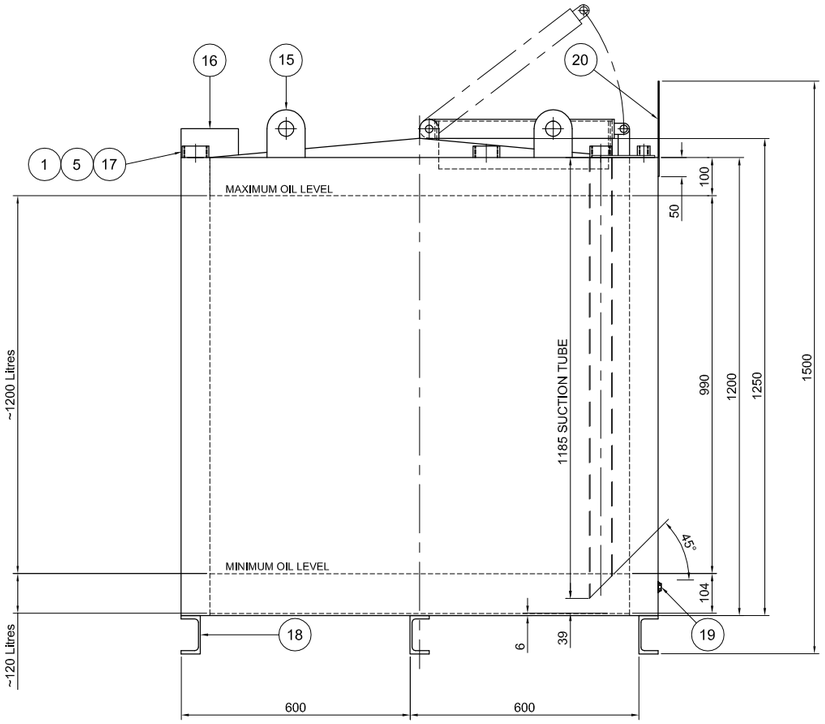
0 100mm



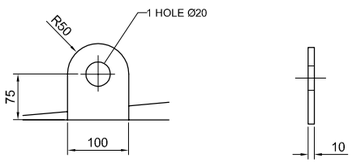
PLAN



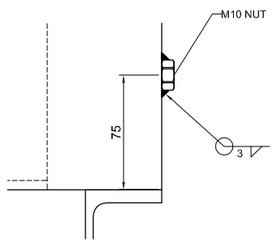
TANK VENT DETAIL (1:5)



ELEVATION



LIFTING LUG DETAIL (1:5)



EARTHING BOSS DETAIL (1:2)

TERMINATION TABLE	
T.P. REF.	DESCRIPTION
A	2" BSP WASTE OIL INLET
B	2" BSP SPARE (FOR HYDROSTATIC LEVEL GAUGE IF SUPPLIED)
C	1 1/2" BSP FLOAT GAUGE
D	2" BSP WASTE OIL OUTLET C/W LOCKING CAP
E	1" BSP BUND SUCTION TUBE
F	CALIBRATED TANK DIPSTICK
G	BUND DIPSTICK
H	1 1/2" BSP HIGH/LOW LEVEL SENSOR
J	1 1/2" BSP BUND LEVEL SENSOR
K	M12 TANK EARTH POINT
L	2" BSP SPARE (FOR ULTRASONIC LEVEL SENSOR IF SUPPLIED)
M	TANK VENT TO BUND
N	BUND VENT TO ATMOSPHERE C/W VENT COVER
P	450mm x 450mm RAISED NECK HATCH

PARTS LIST			
ITEM No	DESCRIPTION	QTY	MATL
1	Ø2" SOCKET	5	M.S.
2	HEX PLUG FOR Ø2" SOCKET	2	M.S.
3	Ø2" SUCTION TUBE	1	M.S.
4	Ø2" LOCKING CAP	1	M.S.
5	Ø2" NIPPLE	2	M.S.
6	Ø1 1/2" SOCKET	3	M.S.
7	Ø1 1/2" NIPPLE	2	M.S.
8	Ø1" SOCKET	1	M.S.
9	HEX PLUG FOR Ø1" SOCKET	1	M.S.
10	Ø1" SUCTION TUBE	1	M.S.
11	CALIBRATED TANK DIPSTICK	1	M.S.
12	BUND DIPSTICK	1	M.S.
13	450mm x 450mm RAISED NECK HATCH	1	M.S.
14	REMOVABLE STRAINER SCREEN (6mm MESH)	1	-
15	LIFTING LUGS	4	M.S.
16	TANK VENT TO BUND	1	M.S.
17	2" BSP PLASTIC VENT COVER	1	-
18	100mm x 50mm CHANNEL	3	M.S.
19	M10 EARTHING STUD C/W NUT & WASHER	1	M.S.
20	MOUNTING PLATE 250mm x 150mm x 3mm	1	M.S.

GENERAL NOTES

1. TANK DESIGN SPECIFICATION IN ACCORDANCE WITH BS 799 PART 5.
2. TANK TO BE CONSTRUCTED USING 3mm THICK MILD STEEL TO BS EN 10 025 S275 WITH PYRAMID ROOF.
3. TANK AND BUND STIFFENED USING MILD STEEL ANGLE IRON. ALL FITTED INTO MILD STEEL BUND.
4. ALL SOCKETS AND NIPPLES TO BE BSPP AND STAND OUT 30mm FROM TANK SURFACE.
5. ALL EXTERNAL TANK SURFACES TO BE PAINTED WITH ONE COAT ZINC PHOSPHATE RED OXIDE & FINISHED WITH ONE COAT PAINT; SADDLE BROWN COLOUR (BS 4800 06C39) UNLESS OTHERWISE SPECIFIED.
6. INSIDE OF TANK AND BUND TO BE COATED WITH ENSIS OIL.
7. MAINS OPERATED TANK ALARM C/W RELAYS, DOUBLE HIGH/LOW LEVEL SENSOR AND SINGLE BUND LEVEL SENSOR SUPPLIED LOOSE BY TANK MANUFACTURER.
8. FLOAT TYPE CONTENTS GAUGE SUPPLIED LOOSE BY TANK MANUFACTURER.
9. BUND SUCTION TUBE MUST FACILITATE TOTAL CONTENTS DRAINAGE.
10. FRONT FACE OF TANK TO BE LABELLED WITH 300mm x 200mm ADHESIVE STICKER (YELLOW WITH BLACK TEXT) STATING TANK CONTENTS **'WASTE LUBRICATING OIL '** AND TANK CAPACITY **'1200L'**.
11. BASE CHANNELS TO BE POSITIONED AT CENTRES INDICATED.
12. TANK BASE TO BE TWIN SKINNED.
13. APPROX WEIGHT **600** KG (EMPTY).

REV	DATE	DESCRIPTION	DRN	CHK	APP
1. NO DIMENSIONS ARE TO BE SCALED FROM THIS DRAWING 2. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS ON SITE					

ENER-G COMBINED POWER LIMITED
ENER-G HOUSE, DANIEL ADAMSON ROAD,
SALFORD, MANCHESTER, M50 1DT, U.K.
TEL: 0161 745 7450
FAX: 0161 745 7457
WEB: WWW.ENERG.CO.UK

DRAWING TITLE
WASTE OIL TANK 1200L

DRAWING No.		REVISION
A11-16132		A
DATE	SCALE	SHEET SIZE
02.08.13	1:8	A1
DRAWN BY	CHECKED	APPROVED
PH	BR	DPF

0 100mm

Adiabatic Cooler

Date	18/02/2016	Quote Reference	E-27582B-Rev 1
Customer	ENER.G Combined Power Ltd	Quoted By	
Customer Reference	Shell Centre ECP 14431	Quote ID	
Application	MTU 8V4000L33 Engine Intercooler - Extra Low Noise		
Model Number	1 off TA80W/HA-123/10D/2.0/36/DN65/S/D		

Performance Data[1]

Total cooling duty	(kW)	51.00	Total airflow	(sm^3/s)	5.54
Water on temperature	(°C)	38.00	Air on dry bulb	(°C)	35.00
Water off temperature	(°C)	36.00	Air on wet bulb	(°C)	22.00
Water flow rate	(l/s)	6.95	Reduced air on dry bulb	(°C)	25.00
Water velocity	(m/s)	1.79	Air off dry bulb	(°C)	33.10
Water pressure drop[2]	(kPa)	60.00	Available external static pressure	(Pa)	0.00
Mono-Ethylene glycol	(%)	35.00	Altitude	(masl)	0
Estimated annual water usage[3]	(m^3/year)	4.00	Maximum adiabatic water flow rate[4]	(l/min)	1.64
			5% Surface Margin 10% Duty Margin		

1. Stated performance relies on suitable siting and installation, including adequate air inlet and outlet conditions. If clarification is required, please contact us.
2. If over cooling prevention system is required, please refer to Additional Information for pressure drop information.
3. This figure allows for total estimated adiabatic spray water and regular UK standard system purging.
4. Ensure sufficient water feed is available for operation. Supply pressure must be between 2 and 4 bar.

Note : All adiabatic estimations are based on stated conditions and Met Office data for Coleshill. Water quality – For adiabatic use spray water must have pH 6 to pH 8 and Hardness <180 ppm.

Construction – Per Cooler[1]

Number of fans	2		Additional fabrications material[3]		Galvanised
Fin material	0.11mm Aluminium		Total fin and tube surface area	(m2)	225
Tube material	P3012/0.35mm Copper		Maximum fluid temperature	(°C)	100
Header material	Copper		Maximum fluid pressure	(bar)	16
Coil connections	Stainless Steel Flanged PN16 DN65		Coil test pressure	(bar)	24
Coil casing material[2]	Galvanised		Weight[4]	(kg)	Dry: 458, Operating: 509
Fan Speed	88%				

1. Please ensure that materials of construction quoted are suitable for intended site location.
2. Refers to the heat exchange coil casing that is in direct contact with the finned tube bundle.
3. Refers to construction fabrications such as support legs and fan plates. Materials for optional extras are detailed in "Optional Extras Detailed Information" section of this quote.
4. Weights are for bare units only. Any optional extras will increase this figure.

Electrical Data – Per Cooler[1]

Total cooler input power – maximum	(kW)	1.43
Full load current	(Amps)	8.37
Electrical supply[2]		380-420V/ 50Hz/ 3Ph
Inverter power consumption[3]	(kW)	0.09

1. Some optional extras will increase these figures. Equipment running current in relation to differing supply voltages and ambient air conditions.
2. Where the OEM control panel is being supplied, the mains supply may also require a neutral.
3. If a OEM Inverter Control Panel is being used then, due to heat losses within the variable speed inverter drive, the additional power consumption should be considered at all times when the cooler is operating.

Sound Power Spectrum

Frequency (Hz)	63	125	250	500	1000	2000	4000	8000	Total
Sound Power (LwA)	50	57	61	64	66	66	59	47	71

Sound pressure	(LpA)	:	37.0 at 14.0m calculated in accordance with BS EN:13487 Parallel Pipe Method.
Noise rating	(NR)	:	32.9 at 14.0m calculated in accordance with BS EN:13487 Parallel Pipe Method.

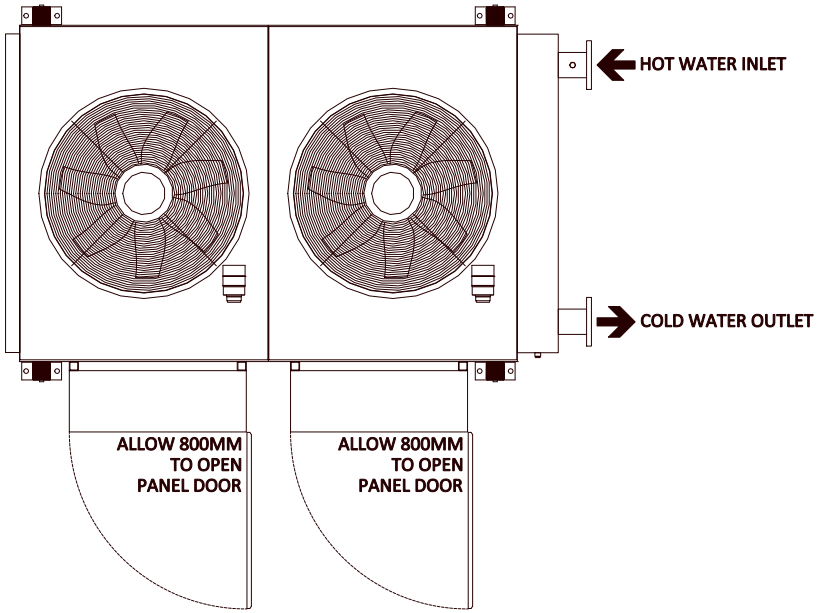
Levels are quoted for single units. Where multiple units are required due allowance must be made for the overall sound pressure level.

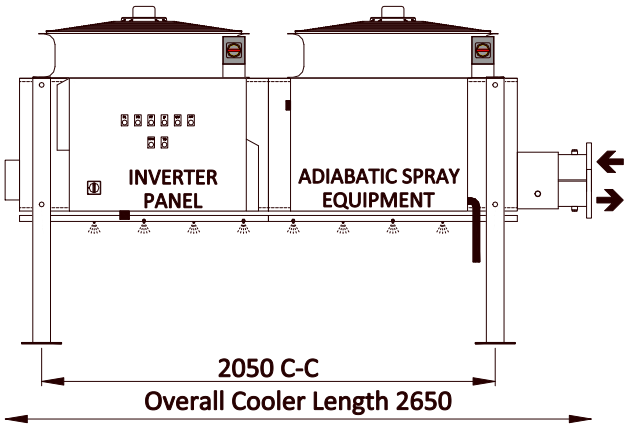
Additional Information

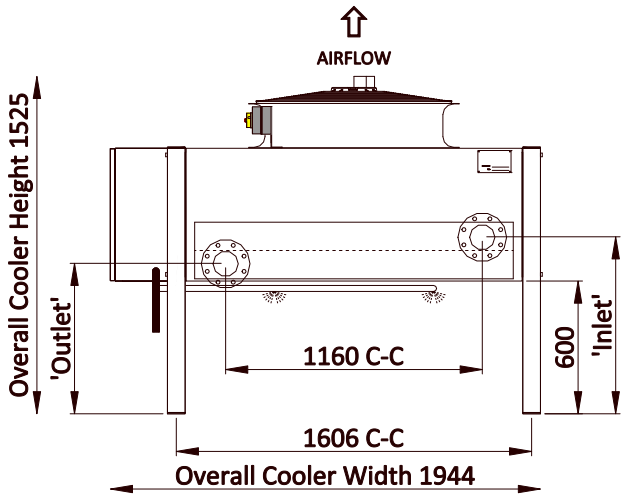
Over cooling prevention system valve size	:	DN65
Over cooling prevention system pressure drop[1]	(kPa)	16

1. As the cooler and 3 way valve are in series the 3 way valve adds an additional pressure drop of 16 kPa which must be added to the cooler pressure drop shown in the Performance Data.

Adiabatic Spray System Supply Pressure: 2-4 bar gauge pH 6-8 Hardness <130ppm	Electrical Supply Three Phase 380-420V/ 50Hz/3ph	• Header dimensions are for reference only. • Connecting pipework should be completed on cooler installation. • Connections shown are indicative only - refer to specification sheet. • Optional extras shown may not be included - refer to specification sheet.	'Flange Size' - PN16DN 'Inlet' - 'Outlet' - Dimensions ±15mm



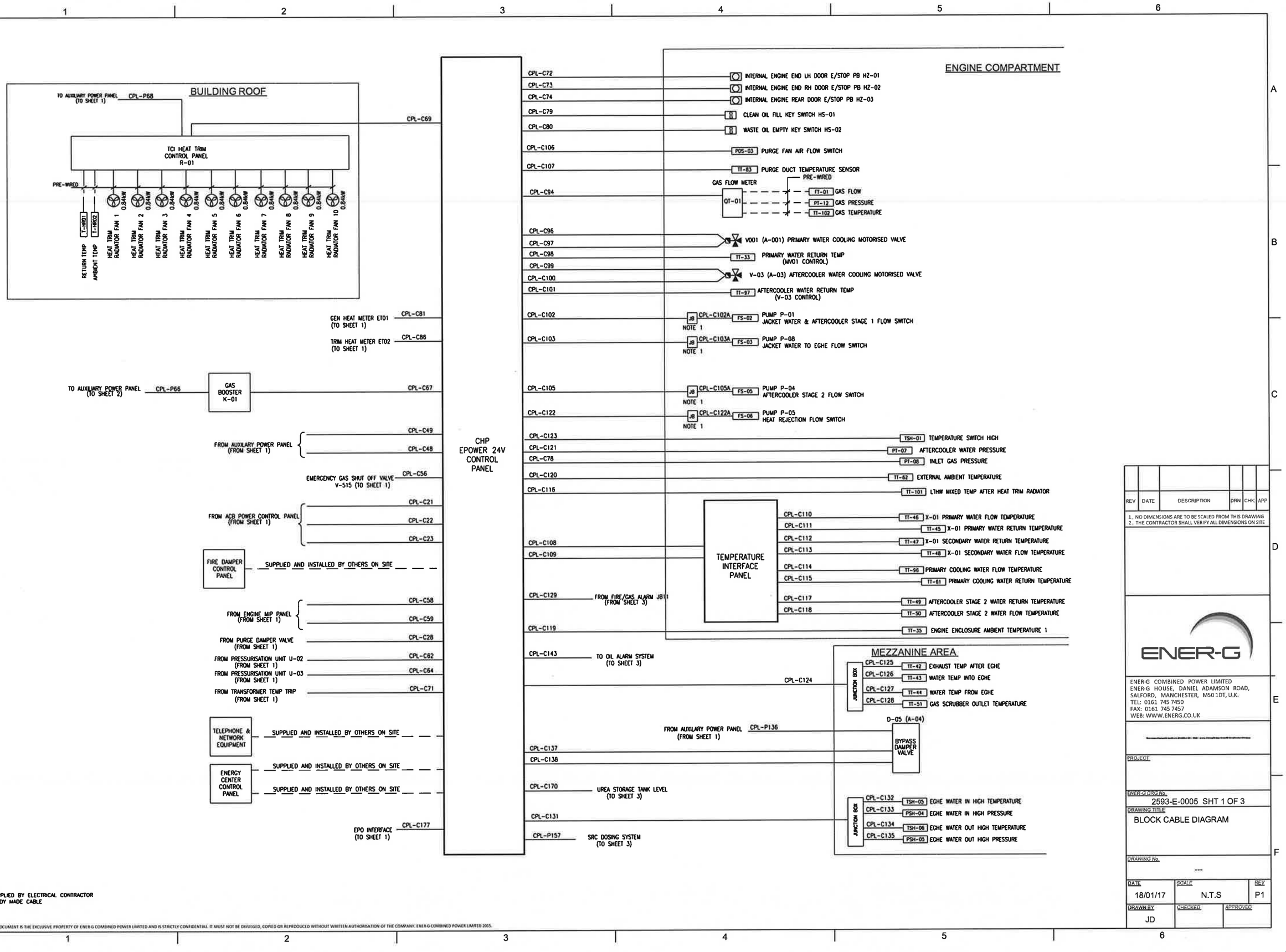




ENER·G COMBINED POWER LIMITED
ENER·G HOUSE, DANIEL ADAMSON ROAD,
SALFORD, MANCHESTER, M50 1DT, U.K.
TEL: 0161 745 7450
FAX: 0161 745 7457
WEB: WWW.ENERG.CO.UK

Title : TA80W/HA-12/D - Adiabatic Cooler

Drawn	Issue Date	Issue		No : T80-HA-AW-SII-12-ECP
EJL	05/01/15	1		



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ENER-G HOUSE, DANIEL ADAMSON ROAD,
SALFORD, MANCHESTER, M50 1DT, U.K.
TEL: 0161 745 7450
FAX: 0161 745 7457
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HV SWITCHROOM

TRANSFORMER 11kV/400V

CPL-E220

CPL-E220A

HV

(NOTE 1) (NOTE 1)

EPO EPO

OIL TEMP TRIP

CPL-C175 CPL-C176 CPL-C177 CPL-C71

INCOMER RMU SHUNT TRIP

TR1 RMU SHUNT TRIP

EPO INTERFACE

TO EPOWER 24V CONTROL PANEL (TO SHEET 2)

CPL-C174

CPL-C173

EPO 24V POWER SUPPLY

CPL-C172

CPL-P171

DISTRIBUTION BOARD X-XX

CPL-P201/P202/P203/P204 CPL/P207/P208/P209/P210
CPL-P213/P214/P215/P216 CPL-N219 CPL-E220

TT-85 AMBIENT TEMPERATURE

ACB POWER PANEL

CPL-E220 CPL-E20

ACB CONTROL SECTION

TO EPOWER 24V CONTROL PANEL (TO SHEET 2)

CPL-C21
CPL-C22
CPL-C23

CPL-P25

CPL-C24

ENGINE COMPARTMENT

CPL-P01/P02/P03/P04 CPL/P07/P08/P09/P10
CPL-P13/P14/P15/P16 CPL-N19 CPL-E20

1286kW @ 0.8pf
400V 3PH
OUTPUT 2318A

G

CPL-E20A

ENGINE FRAME

ENGINE COMPARTMENT

M.I.P CONTROL PANEL

PRE-WIRED	TT-30	JACKET WATER RETURN TEMPERATURE
PRE-WIRED	TT-31	JACKET WATER FLOW TEMPERATURE
PRE-WIRED	TT-36	COMBUSTION AIR
PRE-WIRED	TT-39	SUMP OIL TEMPERATURE
PRE-WIRED	TT-40	EXHAUST TEMPERATURE
PRE-WIRED	LSL-01	SUMP OIL LEVEL
CPL-C65A	V-090A	MTU GAS VALVE
CPL-C65B	V-090B	GAS VALVE PURGE
CPL-C65C	V-090LS	GAS VALVE LIMIT SWITCH
CPL-C65D	PSL-02	GAS VALVE MIN PRESSURE
CPL-C65E	PSH-01	GAS VALVE MAX PRESSURE

CPL-P26

CPL-P51

CPL-C58
CPL-C59

TO EPOWER 24V CONTROL PANEL (TO SHEET 2)

CPL-C60

ENGINE COMPARTMENT

OUTSIDE ENCLOSURE

STARTER 1

CPL-P45B CPL-P45C

ISOLATOR

CPL-P45 CPL-P45A

CPL-P44A CPL-P44B CPL-P44C CPL-P44

BATTERY 3 BATTERY 1 BATTERY 4 BATTERY 2

TO EPOWER 24V CONTROL PANEL (TO SHEET 2)

CPL-C28

PURGE VALVE D-04

CPL-P27

PURGE FAN F03 1.1kW

CPL-P29A

NOTE 1

CPL-P29

VSD

ENGINE ENCLOSURE AIR TEMPERATURE 2

TT-34

CPL-C34

CPL-P43

ENGINE ENCLOSURE INTAKE FAN F-01 4kW

CPL-P30A

NOTE 1

CPL-P30

VSD

ENGINE ENCLOSURE INLET FAN DP SWITCH

FDS-01

CPL-C31

ENGINE ENCLOSURE OUTLET FAN F-02 2.2kW

CPL-P32A

NOTE 1

CPL-P32

VSD

ENGINE ENCLOSURE OUTLET FAN DP SWITCH

FDS-02

CPL-C33

AUXILIARY POWER PANEL

PUMP P-01 JACKET WATER PRIMARY CIRCUIT 11kW

CPL-P35A

NOTE 1

CPL-P35

CPL-C36

PUMP P-08 JACKET WATER SECONDARY CIRCUIT TO ECHE 11kW

CPL-P37A

NOTE 1

CPL-P37

CPL-C38

PUMP P-04 AFTERCOOLER CIRCUIT 4kW

CPL-P41A

NOTE 1

CPL-P41

CPL-C42

PUMP P-05 HEAT TRIM CIRCUIT 5.5kW

CPL-P46A

NOTE 1

CPL-P46

CPL-C47

CPL-P136

TO BYPASS DAMPER (TO SHEET 2)

CPL-C48
CPL-C49

TO EPOWER 24V CONTROL PANEL (TO SHEET 2)

CPL-C56 TO EPOWER 24V CONTROL PANEL (TO SHEET 2)

CPL-P54

V-515 EMERGENCY GAS SHUT OFF VALVE

CPL-P61

PRESSURISATION UNIT U-02

CPL-C62

TO EPOWER 24V CONTROL PANEL (TO SHEET 2)

CPL-P63

PRESSURISATION UNIT U-03

CPL-C64

TO EPOWER 24V CONTROL PANEL (TO SHEET 2)

CPL-P68

TO HEAT TRIM R-01 CONTROL PANEL (TO SHEET 2)

CPL-P66

TO GAS BOOSTER CONTROL PANEL (TO SHEET 2)

CPL-P82

ET-01

GEN HEAT

CPL-C81

CPL-C83 CPL-C84

TT-88 TT-89

TO EPOWER 24V CONTROL PANEL (TO SHEET 2)

CPL-C85 CPL-C88

CHATTER BOX EM01 CBOX

CPL-C91

FT-06

HEAT METER

CPL-C86

TRIM HEAT

ET-02

CPL-C89 CPL-C90

TT-86 TT-87

CPL-P87

CPL-P93

CPL-P158

SRC DOSING SYSTEM (TO SHEET 3)

SYSTEM EARTHING REQUIREMENTS

ISOLATOR

GENERATOR

CHP CONTROL PANEL

REMOVABLE LINK

EARTH BAR

NEUTRAL BAR

TX

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ENER-G COMBINED POWER LIMITED
ENER-G HOUSE, DANIEL ADAMSON ROAD,
SALFORD, MANCHESTER, M50 1DT, U.K.
TEL: 0161 745 7450
FAX: 0161 745 7457
WEB: WWW.ENERG.CO.UK

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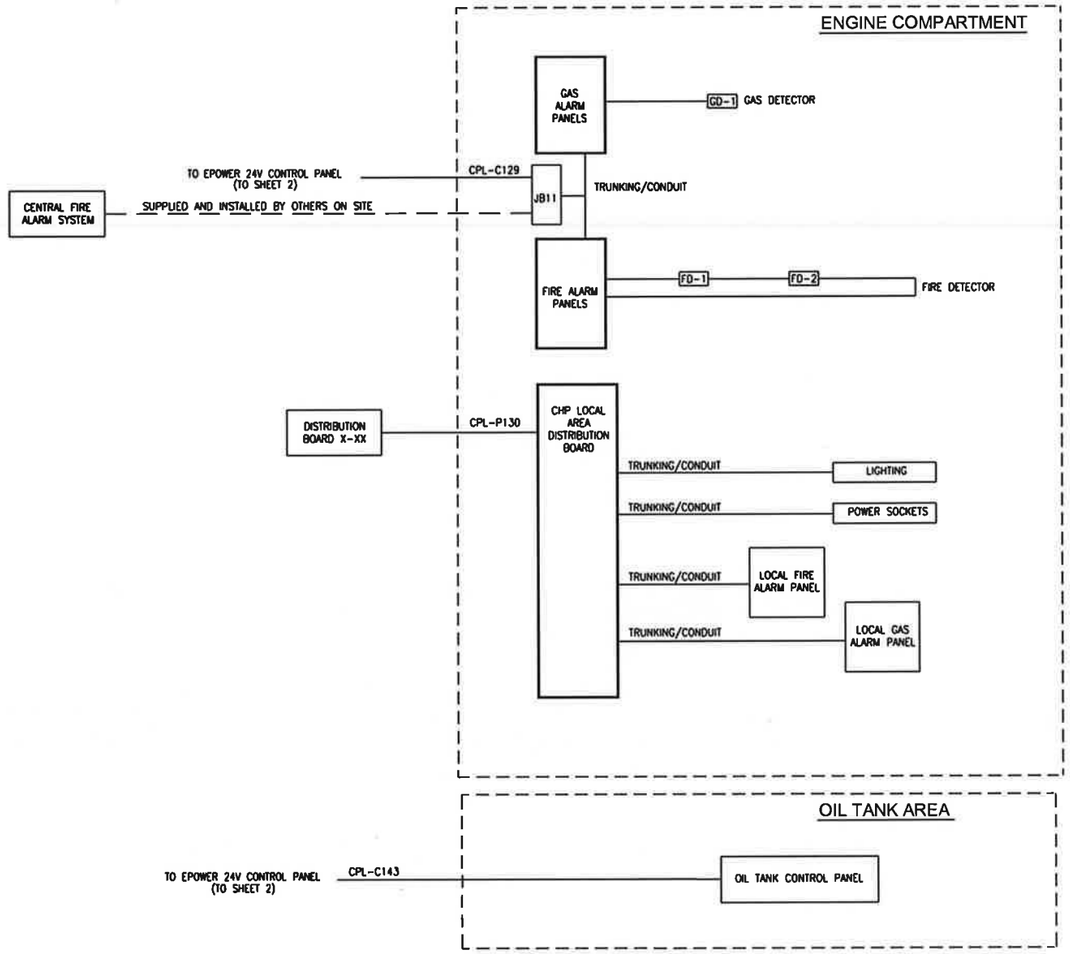

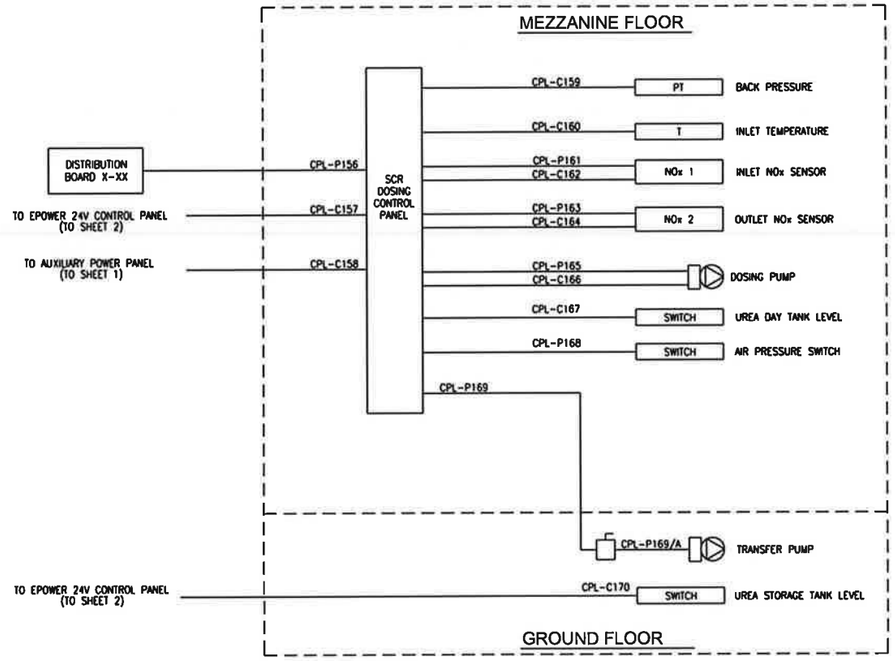

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SALFORD, MANCHESTER, M50 1DT, U.K.
TEL: 0161 745 7450
FAX: 0161 745 7457
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Appendix E - Dispersion Modelling Air Assessment

Southbank Place Energy Centre

Dispersion Modelling Report

Braeburn Estates Developments (Infrastructure) Limited

AECOM Document Ref.: 60302608
Environment Agency Application Ref.: EPR/UP3700BV/A001

November 2019

Quality information

Prepared by	Checked by	Verified by	Approved by
Patrick Froggatt Technical Director	Barry Roberts Technical Director	Garry Gray Lead Verifier	Alan McBryan Project Manager

Revision History

Revision	Revision date	Details	Authorized	Name	Position
0	22 November 2019	First Issue			

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Prepared for:

Braeburn Estates Developments (Infrastructure) Limited

Prepared by:

Patrick Froggatt
Technical Director
T: +44 (0) 7825 298620
E: patrick.froggatt@aecom.com

AECOM Infrastructure & Environment UK Limited
Sunley House
4 Bedford Park, Surrey
Croydon CRO 2AP
United Kingdom

T: +44 20 8639 3500
aecom.com

Table of Contents

Figures

Tables

1. Introduction

1.1 Overview

This air quality dispersion modelling assessment aims to provide supporting information to the application for an Environmental Permit for the Southbank Place Energy Centre (hereafter referred to as 'the site'), as required by the Environmental Permitting (England and Wales) Regulations 2016 (as amended)[1] ("the EPR Regulations"). The Environment Agency (EA) has produced guidance[2] to accompany the regulations, which has been referenced during the completion of this assessment. The pollutants regulated by the MCPD are oxides of nitrogen (NO_x), particle matter (PM_{10} and $PM_{2.5}$) and sulphur dioxide (SO_2).

The site is located in Central London, within the London Borough of Lambeth (LBL). It forms part of the wider mixed-use Southbank Place development, which includes several buildings providing high-end residential and commercial properties. The energy centre is located within the building called Eight Casson Square. Certain parts of the development are in the process of becoming occupied, whilst others are still being constructed, brought forward in phases. There are currently no regulated activities (as contemplated by the Environmental Permitting Regulations[3]) operating on site.

The Southbank Place development is bound to the west by Belvedere Road, to the east by York Road, and to the south by Chicheley Street. The mainline railway linking London Charing Cross and Waterloo East stations passes to the north of the development. There are many existing buildings surrounding the development, comprising a range of residential and commercial uses. Several of these buildings are multi-storey. Well known landmarks including the Jubilee Gardens, River Thames and the Thames Path are in close proximity to the west of the site.

1.2 Energy Centre

The Southbank Place energy centre in Eight Casson Square has been designed to serve the entire Southbank Place development, and includes a boiler room (located on Basement Level -2) and combined heat and power (CHP) room (located on Basement Level -1).

The CHP room houses a single gas-fired CHP unit, of approximately 2.05 MW thermal input (MW_{th}), to provide electricity and heating for the development. The CHP room also houses certain key components of the energy system, including the Selective Catalytic Reduction (SCR) emissions abatement plant and thermal stores. The CHP unit has been designed to operate as the 'lead boiler' for the energy centre.

The boiler room houses seven (7) gas-fired Hoval UltraGas 2000D twin boiler systems, each of which comprises two UltraGas 1000 boilers, each with a net rated thermal input of 943 kW. The boilers will operate on an "on demand" basis to provide balance heating requirements for the development during peak demand periods.

The CHP unit is served by a single exhaust flue, whilst the boilers are served by three exhaust flues. All four flues terminate at roof level of the 30-storey building.

1.3 Summary of Permitting Requirements

AECOM has undertaken pre-application consultation with the EA in relation to the environmental permitting requirements for the energy centre. Having reviewed the details of the energy centre within the context of current regulations, the EA confirmed that the CHP unit will require permitting under Schedules 25A (MCP) and 25B (Specified Generators) of the regulations. The gas-fired boilers, have however, been confirmed to fall outside of the scope of the regulations, and therefore do not need to be permitted.

[1] HM Government, Environmental Permitting (England and Wales) (Amendment) Regulations 2018, Statutory Instrument SI 110 2018.
[2] Environment Agency (2018), Medium Combustion Plant Directive and Specified Generator Regulations.
[3] HM Government, Environmental Permitting (England and Wales) Regulations 2016, Statutory Instrument SI 1154 2016.

1.4 Scope of Assessment

An air dispersion modelling assessment is required to support the application for an environmental permit for the CHP unit. Whilst emissions from the gas-fired boilers will not be regulated under the permit, the EA has requested that these be accounted for in the background component of the modelling assessment.

The assessment of emissions from these units is limited to NO_x which is oxidised in the atmosphere to nitrogen dioxide (NO_2). Air quality standards are set in national legislation for NO_2 for the protection of human health. Gas fired plant have negligible PM_{10} and $PM_{2.5}$ emissions and no emissions of SO_2; consequently this assessment does not consider these pollutants.

The predicted impacts of emissions from the operation of the facility are quantified through the use of the atmospheric dispersion model AERMOD (v18081).

The assessment considers the dispersion of emissions under all the meteorological conditions that have been experienced at a representative location during a period of 5 years. NO_x concentrations have been predicted at a number of existing receptors close to the site and at locations representing the façade of neighbouring buildings within the Southbank Place development. Receptors have been included at levels representative the habitable floors of the modelled buildings.

There are no European Designated ecologically sensitive receptors (i.e. RAMSAR, Special Areas of Conservation (SACs) or Special Protection Areas (SPAs)) located within 5 km of the site, and no Nationally Designated sites (i.e. Sites of Special Scientific Interest (SSSI), National Nature Reserves (NNR) or Local Nature Reserves (LNR)) within 2 km. As such, in accordance with the criteria for consideration of ecologically designated sites within the EA guidance, no ecological sites are included within this assessment.

The assessment considers the impact on the local air quality at relevant receptor locations. The assessment focusses on the likely changes in the long-term and short-term concentrations of NO_2.

2. Assessment Criteria

2.1 Environmental Standards for the Protection of Human Health for England

The UK National Air Quality Strategy (AQS)[4] was initially published in 2000, under the requirements of the Environment Act 1995[5]. The most recent revision of the strategy[6] sets objective values for key pollutants as a tool to help Local Authorities manage local air quality improvements in accordance with the EU Air Quality Framework Directive. Some of these objective values have subsequently been laid out within the Air Quality (England) Regulations 2000[7] and later amendments[8].

The AQS objectives and EU limit values listed in Table 1 are the current values applicable to this assessment at the time of writing.

Table 1. Environmental Standards

Pollutant	Source	Concentration (µg/m^3)	Measured as
Nitrogen dioxide (NO_2)	EU Limit value and AQS Objective	40	Annual Mean
		200	1-hour mean, not to be exceeded more than 18 times a year

The Environment Agency MCP guidance also requires an assessment of the predicted maximum hourly (100th percentile) pollutant concentrations though there is no air quality standard corresponding to this averaging period. As such, the results for the hourly maximum have been included in Appendix C for information only.

2.2 Environmental Permitting

The CHP unit will be categorised as a Tranche B generator under the regulations. As such, the operator must hold a permit for the CHP and maintain compliance with the applicable regulatory requirements and permit conditions upon commissioning, in order to operate legally.

The MCPD regulates emissions of NOx, SO_2 and dust into the air and also lays down rules to monitor emissions of carbon monoxide (CO). Table 2 sets out the MCPD emission limits for new combustion plant (engines) operating on natural gas.

Table 2. MCPD Emission Limits

Pollutant	Emission Limit (mg/Nm^3 @ 15% O_2)
Oxides of nitrogen (NO_x)	95

Note: 95 mg/m^3 @ 15% O_2 equates to 250 mg/Nm^3 @ 5% O_2. As the CHP engine will operate on natural gas there are no applicable emission limits set out in the MCPD for SO_2 or dust.

[4] Defra (2000), The Air Quality Strategy for England, Scotland, Wales and Northern Ireland.
[5] H.M. Government (1995), The Environment Act.
[6] Defra (2007), The Air Quality Strategy for England, Scotland, Wales and Northern Ireland.
[7] H.M. Government (2000), The Air Quality (England) Regulations 2000, Statutory Instrument No 928, The Stationary Office.
[8] H.M. Government (2002), The Air Quality (England) (Amendment) Regulations 2002, Statutory Instrument No 3043, The Stationary Office.

3. Background Air Quality

3.1 Local Air Quality Management

Under the requirements of Part IV of the Environment Act (1995) LBL compiled an Annual Status Report (ASR) on air quality in July 2019[9]. In respect of NO_2 monitoring results for 2018, the assessment report notes the following:

- The LB4 kerbside continuous monitoring site at Brixton Road significantly exceeded the annual mean objective in 2018. It has exceeded the objective for all years reported and consistently monitored some of the highest concentrations in London. The short-term objective was also not met at this location. NO_2 concentration levels are a concern at this site as numerous people live and work in the area. It is noted that LBL have raised concerns about potential distortion of results from this site, due to effects of moisture ingress to the instruments.
- The LB5 continuous monitoring site at Vauxhall Bondway Interchange exceeded the annual mean objective in 2018 but with a lower result than in 2017. The short-term objective was not exceeded. This site is located close to the busy Vauxhall gyratory and a major bus station. The nearest receptors at this site are people using the bus interchange.
- The background continuous monitoring site at Streatham Green (LB6) did not exceed either the annual mean objective or short-term objective in 2018.
- Annual mean NO_2 concentrations measured using diffusion tubes at numerous locations within the Borough revealed several sites in exceedance of the objective. Diffusion tube monitoring records are currently insufficient to comment on any potential trends.

LBL declared the whole Borough an Air Quality Management Area (AQMA) in 2007, due to exceedances of the AQS objectives for NO_2 and PM_{10}. Road transport was noted to be the principal contributing source sector to local air quality.

3.2 Local Monitoring Data

Table 3 summarises the latest published air quality monitoring data collected by LBL within a 2 km radius of the site[9]. The locations of these monitoring sites are also illustrated in Figure 1 in Appendix A.

Table 3. LBL NO_2 Monitoring Data within 2 km Radius of the Site

ID	Station Name	X&Y Co-ordinate	Type of Sampler	Location	Distance from Site (km)	Annual mean NO_2 Concentration (µg/m^3)				
						2014	2015	2016	2017	2018
LB5	Vauxhall Bondway Interchange	530317, 177952	Automatic monitor	Industrial (Roadside)	2.00	**<u>71</u>**	**<u>75</u>**	**<u>65</u>**	**<u>61</u>**	**51**
DT4	Waterloo Rd / Exton St	531139, 180048	Diffusion tube	Roadside	0.20	-	-	-	-	36.8
DT5	Waterloo Rd / Holmes Terrace	531214, 179951	Diffusion tube	Roadside	0.31	-	-	-	-	**<u>61.4</u>**
DT6	98 The Cut	531494, 179951	Diffusion tube	Roadside	0.56	-	-	-	-	**45.4**
DT7	278-282 Kennington Lane	530817, 178122	Diffusion tube	Roadside	1.76	-	-	-	-	**46.7**

Notes:
1. Exceedances of the NO_2 annual mean objective / limit value of 40µg/m^3 are shown in **bold**.
2. NO_2 annual mean concentrations above 60µg/m^3 (indicating that the potential for exceedances of the NO_2 1-hour mean objective exists) are shown in **<u>bold and underlined</u>**.

[9] Lambeth Council (2019), Air Quality Annual Status Report for 2018.

3.3 Background Concentrations

The total concentration of a pollutant comprises those contributions from explicit local emission sources such as roads, chimney-stacks, etc., and those that are transported into an area from indeterminate sources (e.g. by wind from further away). If all the explicit local sources were removed, all that would remain is that which comes from indeterminate sources; it is this component that is called 'background'. A good understanding of background concentrations is important when completing air quality assessments as it allows for a good understanding of local pollutant sources.

Background data for the relevant 1 km x 1 km grid squares (related to the study area) have been sourced from Defra Background Maps[10] for the assessment year of 2019. The background data considered in the assessment are presented below in Table 4.

Table 4. Defra Background NO_2 Concentrations for 2019

Grid Square Centre (X&Y)	Annual Mean NO_2 Concentration (µg/m^3)
531500, 180500	36.3
531500, 179500	33.1
530500, 180500	40.5
530500, 179500	34.0

[10] Defra (2019), 2017 Based Urban Background Maps and Tools, UK-AIR. https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html

4. Methodology

4.1 Overview

This section describes the approach taken for the assessment of emissions associated with the operation of the Southbank Place energy centre. The operation of the CHP unit is limited to between 06:00 and 18:00 daily by instrumentation forming part of the Building Management System (BMS)[11], though at times, actual operation will be less than this, particularly during periods where demand for heating is low. The BMS design document estimates that the CHP unit will operate for 4,000 hours per year, however the air quality assessment assumes that the unit operates at full load for 4,200 hours per year to provide an environmentally-conservative evaluation of annual and short-term impacts.

As per the EA's advice, the on-site gas-fired boilers have been included within the model, however these have been considered to contribute towards background pollutant concentrations. For the purposes of this assessment, the boilers have conservatively been assumed to operate at full load throughout the year (which is considered to be a significant over-estimate).

Point sources of emissions have been modelled using AERMOD.

4.2 Screening Assessment Methodology

4.2.1 Human Health

The EA's Risk Assessment guidance[12] provides staged screening criteria to inform the level of detail that an air quality assessment is required to cover. In respect of the first stage, the guidance advises that if both of the following criteria are met in respect of the predicted Process Contributions (PCs) of any substance, then no further assessment is required:

- PC <1% of the long-term environmental standard; and
- PC <10% of the short-term environmental standard.

If these first screening criteria are not met, then further assessment is required to determine the impact of the Predicted Environmental Concentration (PEC). The PEC is the PC plus the concentration of the substance already present in the environment.

The EA's screening criteria have been applied to the outputs of this dispersion modelling assessment.

The guidance indicates that where an environmental standard is likely to be breached as a result of contributions from an installation, or where installation releases constitute a major proportion of the standard, such releases are likely to be considered unacceptable.

4.2.2 Protected Conservation Areas

The EA's Risk Assessment guidance also provides screening criteria for the consideration and assessment of protected conservation areas. The first stage of screening is to identify whether there are any protected conservation areas are located within set distances of the site. The criteria which apply are:

- Within 10 km of the site:
  - Special protection areas (SPAs)
  - Special areas of conservation (SACs)
  - Ramsar sites (protected wetlands)
- Within 2 km of the site:
  - Sites of special scientific interest (SSSIs)
  - Local nature sites (ancient woods, local wildlife sites and national and local nature reserves).

[11] Sauter Automation Limited (2017), BMS Description of Operations: CHP & Thermal Storage.
[12] Environment Agency (2018), Air emissions risk assessment for your environmental permit.

There are none of these protected conservation areas within the specified distances of the site. The assessment of impacts to these areas is therefore screened out of this assessment, and no further consideration is provided in this report on this topic.

4.3 AERMOD Model Inputs

The general model inputs used in the assessment are summarised in Table 5. Note that as described above, the 7 gas-fired boilers are served by 3 stacks: 2 stacks serving 2 boilers each, and 1 stack serving 3 boilers.

It should also be noted that the on-site gas-fired boilers do not fall within the scope of an environmental permit, but have been modelled as contributors to the background conditions at all receptors.

Table 5. General Model Inputs

Variable	Southbank Place CHP Unit	Southbank Place Boilers
Receptors	X, Y coordinates set out in Table 12 (Appendix B). Z = 1.5 m representing ground level human health exposure locations. Other heights used for assessment of exposure at building façades (Table 12 in Appendix B).	
Emissions	Oxides of nitrogen (NO_x)	
Operating Hours per Annum	Modelled as operating 24 hours per day to assess worst-case short-term effects with annual result factored to reflect the maximum 4,200 hours of total operation per year.	Modelled as operating 24 hours per day to assess worst-case short-term effects.
Stack Height (m)	109.5	109.5
Building Height (m)	103.3	103.3
Stack Internal Diameter (m)	0.4	0.65 (3 boilers) 0.55 (2 boilers)
Flue temperature (^oC)	120	65
Volumetric flow (actual) m^3/s	1.5	2.50 (3 boilers combined) 1.67 (2 boilers combined)
Emission Velocity (m/s)	11.7	7.5 (3 boilers combined) 7.0 (2 boilers combined)
Volumetric flow (Normal) Nm^3/s	0.94 (dry, 0°C, 1 atm)	2.02 (3 boilers combined) 1.35 (2 boilers combined) (dry, 0°C, 1 atm)
Stack Locations (X,Y co-ordinates)	530875.2, 180019.7	530876.6, 180019.4 (3 boilers) 530877.8, 180018.9 (2 boilers) 530879.0, 180018.5 (2 boilers)
Meteorological Data	5 years of hourly sequential data from London City Airport (2014 – 2018)	

Note: Emissions have been calculated based on the information published by the CHP and boiler manufacturers.

4.4 Emissions Data

The CHP unit will have emissions that will achieve compliance with the MCPD emission limit value (ELV) presented in Table 2. This will in part be achieved due to the CHP being fitted with a Selective Catalytic Reduction (SCR) unit to reduce NOx emissions.

The emission concentrations and mass emission rates of the CHP unit (following SCR flue gas treatment) and the gas-fired boilers are set out in Table 6.

Table 6. Source Emission Rates

Source	NOx Emission Concentration	NOx Emission Rate (g/s)
CHP Unit	40 mg/Nm^3 @ 5% O_2 (Approx. 15 mg/Nm^3 @ 15% O_2 Note 1)	0.05
Gas Boilers (2 boilers combined)	37.7 mg/Nm^3 @ 0% O_2	0.037
Gas Boilers (3 boilers combined)	37.7 mg/Nm^3 @ 0% O_2	0.055

Note: Approximate NOx concentrations at 15% O_2 are presented to allow for direct comparison to the applicable ELV. Emissions from the Southbank Place Energy Centre CHP unit are significantly lower than the ELV.

4.5 Modelled Receptors

NO_2 concentrations have been predicted at 16 discrete air quality sensitive receptors off-site, and at 46 locations on-site. These receptors have been selected to represent locations where humans are likely to be present for periods corresponding to those of the applicable environmental standards. In all cases, receptors have been modelled at different heights corresponding approximately to relevant building floor levels (representing potential exposure locations).

The locations of the modelled receptors are illustrated in Figure 2 and Figure 3 (within Appendix A), with additional details provided in Table 12 (within Appendix B).

4.6 Meteorological Data

Hourly sequential data from London City Airport meteorological station for the years 2014 to 2018 inclusive were used in this study. The station is approximately 11 km to the east and is considered to be representative of meteorological conditions experienced at the site. A visual representation of the meteorological data used in the assessment is shown in the wind roses presented in Figure 5 (within Appendix A). The wind roses demonstrate that the wind is predominantly from the south west.

4.7 Building Downwash Effects

The buildings that make up the facility (and the wider Southbank Place development) have the potential to generate turbulence into the flow of air across the site. The net effect of such turbulence can be to entrain emissions and to reduce the effective release height of the emission. The location and heights of modelled buildings are provided in Figure 4 (Appendix A).

4.8 Terrain

The site and surrounding area is relatively flat with little significant change in terrain height, as such terrain data has been excluded from the modelling.

4.9 Surface Roughness

A surface roughness of 1 m was used to represent the surface roughness of the land surrounding the site and fits the description of the landscape between the emission points and the closest sensitive receptors.

4.10 Specialised Model Treatments

Emissions have been modelled such that they are not subject to dry and wet deposition or depleted through chemical reactions. The assumption of continuity of mass is likely to result in an overestimation of impacts at receptors (i.e. environmentally conservative).

4.11 Oxides of Nitrogen to NO_2 Conversion

Emissions of NO_x from the Southbank Place Energy Centre stacks will mainly consist of nitric oxide (NO) at the point of release. NO is subsequently oxidised to form NO_2 following release from the stacks, with the proportion of NO_2 in the exhaust plume increasing with distance from the point of release.

In order to assess the impact of the Energy Centre on local receptors, the following NO_x to NO_2 conversion rates recommended by the EA's Air Quality Modelling and Assessment Unit (AQMAU)[13] have been applied:

- assume 70% of NOx present as NO_2 at ground level, plus the background NO_2 concentration in the calculation of long-term annual mean calculations; and
- assume 35% of NOx present as NO_2 at ground level, plus double the background NO_2 concentration in the calculation of short-term hourly concentrations.

4.12 Summary of Background Air Quality

Table 7 presents the Defra background NO_2 concentration (from Table 4) corresponding to each modelled receptor location in the assessment year (2019).

Considering that all of the modelled receptors are located in very close proximity to one another, the highest background concentration (40.5 µg/m^3) was applied to all modelled receptors. This approach was taken to provide an environmentally conservative assessment.

Table 7. Background Pollutant Concentrations at Receptor Locations (2019)

Grid Square Centre (X&Y)	Receptors	Annual Mean NO_2 Concentration (µg/m^3)
530500, 180500	E01, E02, E08, E09 P01 to P20, P25, P26, P28	40.5
530500, 179500	E10, E11, E12, E13 P21 to P24, P27, P29 to P46	34.0
531500, 180500	E03 to E07, E14 to E16	36.3

[13] EA Air Quality Modelling and Assessment Unit (AQMAU) (2005), Conversion Ratios For NO_x and NO_2 Technical Note.

5. Impact Assessment

5.1 Predicted Off-site NO_2 Contributions

This section presents the magnitude of the impacts at representative off-site receptor locations in terms of the predicted PC from the Southbank Place Energy Centre CHP unit. The total pollutant concentration (PEC) is the sum of the contribution from background sources (including the contribution from the on-site gas-fired boilers) plus the modelled PC.

Table 8 presents the annual off-site NO_2 PC and PEC predicted due to emissions from the Southbank Place Energy Centre CHP unit.

Table 8. Annual NO_2 PC and PEC at Existing (Off-site) Receptors

Receptor ID	Height Note 1 (m)	Background + Gas Boilers Note 2 (µg/m^3)	PC from the Southbank Place Energy Centre CHP (µg/m^3)	Total Annual Mean PEC (µg/m^3)	Change as % of AQS
E01	1.5	40.9	<0.1	41.0	0.2%
E02	1.5	40.8	<0.1	40.9	0.2%
E03	1.5	40.8	<0.1	40.8	0.1%
E04	1.5	40.7	<0.1	40.7	0.1%
E05	1.5	40.6	<0.1	40.7	0.1%
E06	1.5	40.7	<0.1	40.7	0.1%
E07	1.5	40.6	<0.1	40.7	0.1%
E08	1.5	40.8	<0.1	40.9	0.2%
E09	1.5	40.9	<0.1	40.9	0.2%
E10	1.5	40.6	<0.1	40.7	0.1%
E11	1.5	40.6	<0.1	40.6	0.0%
E12	1.5	40.6	<0.1	40.6	0.1%
E13	1.5	40.6	<0.1	40.6	0.0%
E14	1.5	40.6	<0.1	40.6	0.0%
E15	1.5	40.6	<0.1	40.7	0.1%
E16	1.5	40.6	<0.1	40.6	0.1%

Notes:
1. Receptors have been modelled at multiple heights to ensure that the full extent of any impact from the energy centre is assessed, however, only the maximum PC at each receptor location is presented with the corresponding height at which this occurs presented in the height column.
2. These values represent the Defra annual mean background NO_2 concentration, plus the modelled contribution from the on-site gas-fired boilers.

The maximum predicted annual mean NO_2 PC is <0.1 µg/m^3 which occurs at Receptor E01 (The Tower Building) at 1.5 m above ground level.

The predicted annual mean PC NO_2 concentrations at all modelled receptors are below 1% of the environmental standard of 40 µg/m^3. In accordance with the EA screening criteria, these insignificant PCs from the Southbank Place Energy Centre CHP unit do not require any further assessment.

Table 9 presents the 99.79th percentile of hourly NO_2 concentrations at off-site receptor locations.

Table 9. 99.79th Percentile Hourly NO_2 PC and PEC at Existing (Off-site) Receptors

Receptor ID	Height Note 1 (m)	Background + Gas Boilers Note 2 (µg/m³)	PC from the Southbank Place Energy Centre CHP (µg/m³)	Total Short-term PEC (µg/m³)	Change as % of AQS
E01	1.5	82.2	0.4	82.6	0.2%
E02	1.5	82.2	0.4	82.6	0.2%
E03	1.5	82.0	0.3	82.3	0.2%
E04	1.5	82.1	0.4	82.4	0.2%
E05	1.5	82.3	0.4	82.7	0.2%
E06	1.5	81.9	0.3	82.3	0.2%
E07	1.5	82.0	0.3	82.3	0.2%
E08	1.5	82.5	0.5	83.0	0.2%
E09	1.5	82.4	0.5	82.9	0.2%
E10	1.5	81.6	0.2	81.9	0.1%
E11	1.5	81.6	0.2	81.8	0.1%
E12	1.5	81.6	0.2	81.9	0.1%
E13	1.5	81.5	0.2	81.7	0.1%
E14	1.5	82.3	0.4	82.7	0.2%
E15	1.5	82.4	0.5	82.9	0.2%
E16	1.5	82.8	0.6	83.4	0.3%

Notes:
1. Receptors have been modelled at multiple heights to ensure that the full extent of any impact from the energy centre is assessed, however, only the maximum PC at each receptor location is presented with the corresponding height at which this occurs presented in the height column.
2. The values represent a short-term background NO_2 concentration derived from double the Defra annual background, plus the modelled short-term contribution from the on-site gas-fired boilers.

The maximum predicted 1-hour 99.79th percentile NO_2 PC is 0.6 µg/m³ which occurs at Receptor E16 (County Hall) at 1.5m above ground level. The predicted PC NO_2 concentrations at all modelled receptors are below 10% of the environmental standard of 200 µg/m³. In accordance with the EA screening criteria, these insignificant PCs from the Southbank Place Energy Centre CHP unit do not require any further assessment.

5.2 Predicted On-site NO_2 Contributions

This section presents the magnitude of the impacts at representative on-site receptor locations in terms of the predicted PC from the Southbank Place Energy Centre CHP unit and PEC including background and the contribution from the on-site gas-fired boilers. Table 10 presents the annual on-site NO_2 PC and PEC predicted due to emissions from the facility.

Table 10. Annual NO_2 PC and PEC at Existing (On-site) Receptors

Receptor ID	Height (m) Note 1	Background + Gas Boilers Note 2 (µg/m³)	PC from the Southbank Place Energy Centre CHP (µg/m³)	Total Annual Mean PEC (µg/m³)	Change as % of AQS
P01	1.5	41.1	0.1	41.2	0.3%
P02	1.5	41.0	<0.1	41.1	0.2%
P03	1.5	41.1	0.1	41.3	0.3%
P04	1.5	41.0	<0.1	41.1	0.2%
P05	1.5	41.1	0.1	41.3	0.3%
P06	1.5	41.1	0.1	41.2	0.3%
P07	105.7	42.6	0.4	43.0	0.9%
P08	105.7	41.6	0.2	41.8	0.5%
P09	105.7	41.4	0.2	41.5	0.4%

Receptor ID	Height (m) Note 1	Background + Gas Boilers Note 2 (µg/m³)	PC from the Southbank Place Energy Centre CHP (µg/m³)	Total Annual Mean PEC (µg/m³)	Change as % of AQS
P10	105.7	41.6	0.2	41.8	0.5%
P11	1.5	41.1	0.1	41.2	0.3%
P12	1.5	41.1	0.1	41.2	0.3%
P13	1.5	40.9	<0.1	41.0	0.2%
P14	1.5	41.0	<0.1	41.0	0.2%
P15	1.5	41.1	0.1	41.2	0.3%
P16	1.5	41.0	<0.1	41.0	0.2%
P17	1.5	41.0	<0.1	41.1	0.2%
P18	1.5	40.8	<0.1	40.9	0.2%
P19	1.5	41.1	0.1	41.2	0.3%
P20	1.5	41.1	0.1	41.2	0.3%
P21	1.5	40.9	<0.1	40.9	0.2%
P22	1.5	41.1	0.1	41.2	0.3%
P23	1.5	40.9	<0.1	41.0	0.2%
P24	1.5	41.0	<0.1	41.0	0.2%
P25	1.5	41.1	0.1	41.2	0.3%
P26	1.5	41.0	0.1	41.1	0.3%
P27	1.5	41.0	<0.1	41.0	0.2%
P28	1.5	41.0	<0.1	41.1	0.2%
P29	1.5	40.9	<0.1	41.0	0.2%
P30	1.5	40.9	<0.1	40.9	0.2%
P31	1.5	40.9	<0.1	41.0	0.2%
P32	1.5	40.8	<0.1	40.8	0.1%
P33	1.5	40.8	<0.1	40.9	0.1%
P34	1.5	40.7	<0.1	40.8	0.1%
P35	1.5	40.8	<0.1	40.8	0.1%
P36	1.5	40.7	<0.1	40.7	0.1%
P37	1.5	40.7	<0.1	40.8	0.1%
P38	1.5	40.7	<0.1	40.7	0.1%
P39	1.5	40.7	<0.1	40.7	0.1%
P40	1.5	40.7	<0.1	40.7	0.1%
P41	1.5	40.7	<0.1	40.7	0.1%
P42	1.5	40.8	<0.1	40.9	0.2%
P43	1.5	40.8	<0.1	40.8	0.1%
P44	1.5	40.7	<0.1	40.7	0.1%
P45	1.5	40.7	<0.1	40.7	0.1%
P46	1.5	40.7	<0.1	40.8	0.1%

Notes:

1. On-site receptors have been modelled at multiple heights to ensure that the full extent of any impact from the energy centre is assessed, however, only the maximum PC at each receptor location is presented with the corresponding height at which this occurs presented in the height column.
2. These values represent the Defra annual mean background NO_2 concentration, plus the modelled contribution from the on-site gas-fired boilers.

The maximum predicted annual mean NO_2 PC is 0.35 µg/m³ (rounded up to 0.4 µg/m³ for presentation in the table above) which occurs at Receptor P07 on the 32nd storey of the One Casson Square building, 105.7 m above ground level.

The predicted annual mean PC NO_2 concentrations at all modelled receptors are below 1% of the environmental standard of 40 µg/m^3. In accordance with the EA screening criteria, these insignificant PCs from the Southbank Place Energy Centre CHP unit do not require any further assessment.

Table 11 presents the 99.79th percentile of hourly NO_2 concentrations at on-site receptor locations.

Table 11. 99.79th Percentile Hourly NO_2 PC and PEC at Existing (On-site) Receptors

Receptor ID	Height (m) Note 1	Background + Gas Boilers Note 2 (µg/m^3)	PC from the Southbank Place Energy Centre CHP (µg/m^3)	Total Short-term PEC (µg/m^3)	Change as % of AQS
P01	1.5	82.0	0.4	82.4	0.2%
P02	1.5	82.0	0.4	82.4	0.2%
P03	1.5	82.1	0.4	82.5	0.2%
P04	1.5	82.1	0.4	82.6	0.2%
P05	1.5	82.2	0.4	82.6	0.2%
P06	1.5	82.2	0.4	82.6	0.2%
P07	109.2	90.6	2.6	93.2	1.3%
P08	109.2	87.0	1.9	88.9	0.9%
P09	109.2	84.7	1.1	85.9	0.6%
P10	109.2	85.5	1.3	86.8	0.6%
P11	1.5	82.2	0.5	82.7	0.2%
P12	1.5	82.4	0.5	82.9	0.2%
P13	1.5	82.2	0.4	82.7	0.2%
P14	1.5	82.3	0.5	82.8	0.2%
P15	1.5	82.3	0.5	82.8	0.2%
P16	1.5	82.1	0.4	82.5	0.2%
P17	1.5	82.5	0.6	83.1	0.3%
P18	1.5	82.2	0.4	82.5	0.2%
P19	1.5	82.0	0.3	82.3	0.2%
P20	1.5	82.3	0.4	82.7	0.2%
P21	1.5	82.1	0.4	82.5	0.2%
P22	1.5	82.5	0.5	83.0	0.3%
P23	1.5	82.3	0.4	82.7	0.2%
P24	1.5	82.4	0.5	82.9	0.3%
P25	1.5	82.7	0.6	83.2	0.3%
P26	1.5	82.7	0.6	83.3	0.3%
P27	1.5	82.8	0.6	83.4	0.3%
P28	1.5	82.9	0.7	83.6	0.3%
P29	1.5	83.0	0.7	83.7	0.4%
P30	1.5	82.3	0.4	82.7	0.2%
P31	1.5	82.5	0.5	83.0	0.3%
P32	1.5	82.3	0.4	82.8	0.2%
P33	1.5	82.5	0.5	83.0	0.3%
P34	1.5	82.4	0.4	82.8	0.2%
P35	1.5	82.5	0.5	83.0	0.3%
P36	1.5	82.4	0.4	82.8	0.2%
P37	1.5	82.5	0.5	83.0	0.2%
P38	1.5	82.3	0.4	82.8	0.2%
P39	1.5	82.5	0.5	83.0	0.2%

Receptor ID	Height (m) Note 1	Background + Gas Boilers Note 2 (µg/m^3)	PC from the Southbank Place Energy Centre CHP (µg/m^3)	Total Short-term PEC (µg/m^3)	Change as % of AQS
P40	1.5	82.3	0.4	82.8	0.2%
P41	1.5	82.4	0.5	82.9	0.2%
P42	1.5	83.0	0.7	83.7	0.4%
P43	1.5	82.8	0.6	83.5	0.3%
P44	1.5	82.7	0.6	83.2	0.3%
P45	1.5	82.6	0.6	83.1	0.3%
P46	1.5	82.7	0.6	83.3	0.3%

Notes:

1. On-site receptors have been modelled at multiple heights to ensure that the full extent of any impact from the energy centre is assessed, however, only the maximum PC at each receptor location is presented with the corresponding height at which this occurs presented in the height column.

2. The values represent a short-term background NO_2 concentration derived from double the Defra annual background, plus the modelled short-term contribution from the on-site gas-fired boilers.

The maximum predicted 1-hour 99.79th percentile NO_2 PC is 2.6 µg/m^3 which occurs at Receptor P07 on the 33rd storey of the One Casson Square building, 109.2 m above ground level. The predicted PC NO_2 concentrations at all modelled receptors are below 10% of the environmental standard of 200 µg/m^3. In accordance with the EA screening criteria, these insignificant PCs from the Southbank Place Energy Centre CHP unit do not require any further assessment.

6. Conclusion

The air quality assessment has predicted the long- and short-term impacts on air quality at sensitive receptors in the area surrounding the Southbank Place development, based on the meteorological conditions experienced at a representative location during a period of five years. The modelled Process Contributions to ambient NO_2 concentrations from the Southbank Place Energy Centre CHP unit therefore represent the range of impacts that are likely to occur in future years, including the year-to-year variability of weather experienced within the study area.

The predicted contributions from the facility to ambient NO_2 concentrations at off-site existing sensitive receptors are less than 1% and 10% of the annual and short-term environmental standards, respectively. As such, off-site impacts are considered to be insignificant.

In relation to on-site receptors within the Southbank Place development, predicted contributions from the facility to ambient NO_2 concentrations are less also than 1% and 10% of the annual and short-term environmental standards respectively. As such, on-site impacts are also considered to be insignificant.

It is noted that the cumulative Predicted Environmental Concentrations at some receptors are likely to exceed the annual mean NO_2 environmental standard (either with or without the influence of the Southbank Place Energy Centre CHP unit). This is not uncommon within the Central London location (and within an AQMA), and the contribution of the Southbank Place Energy Centre CHP unit to the PEC is extremely small (insignificant).

This dispersion modelling study predicts that, based on the parameters assessed, the Southbank Place Energy Centre CHP unit is unlikely to have a significant impact on local air quality, either off- or on-site.

Appendix A Figures

Figure 1. Nearby LBL Air Quality Monitoring Locations

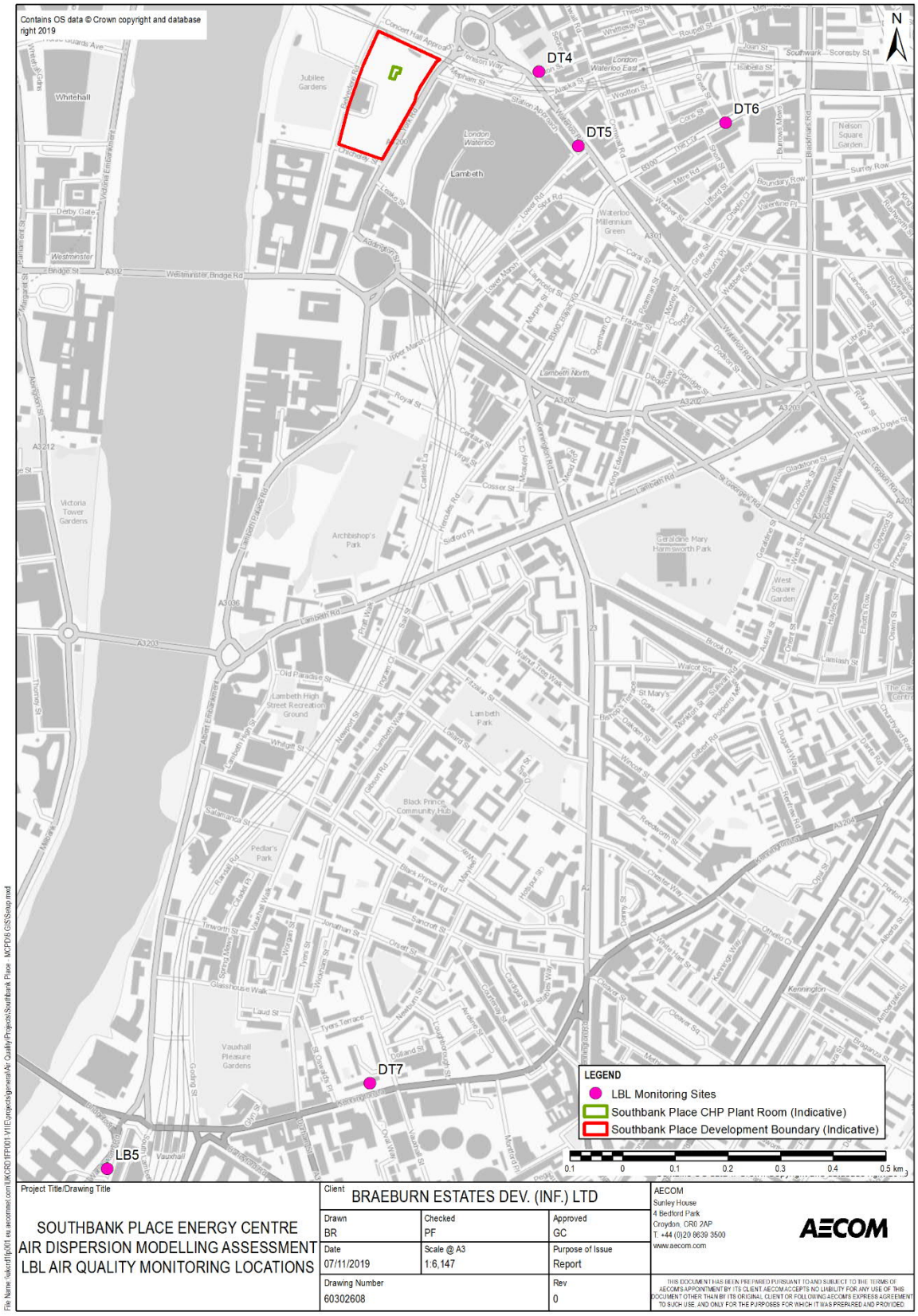


Figure 2. Modelled Off-Site Receptor Locations

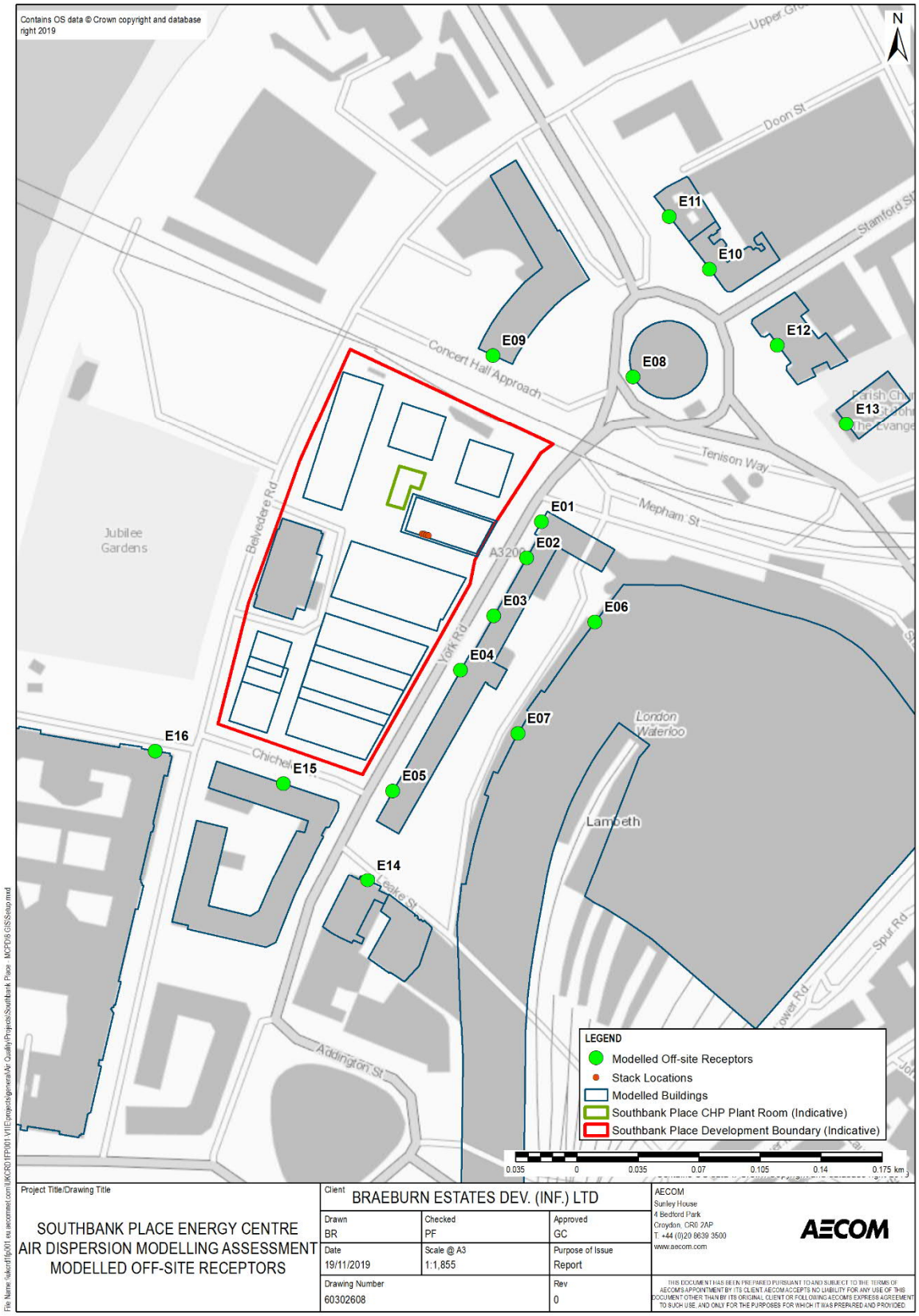


Figure 3. Modelled On-Site Receptor Locations

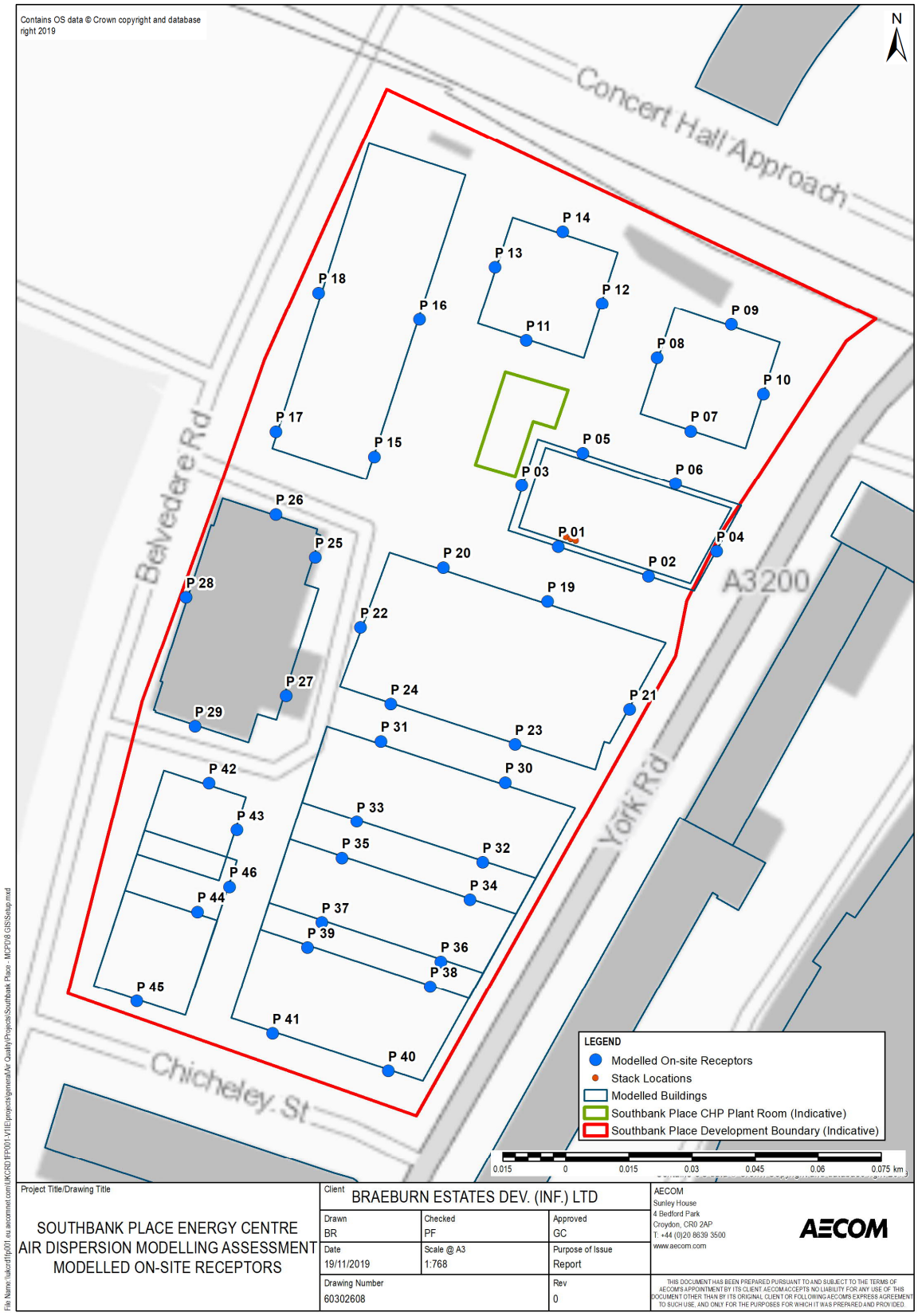


Figure 4. Details of Buildings Included Within the Model

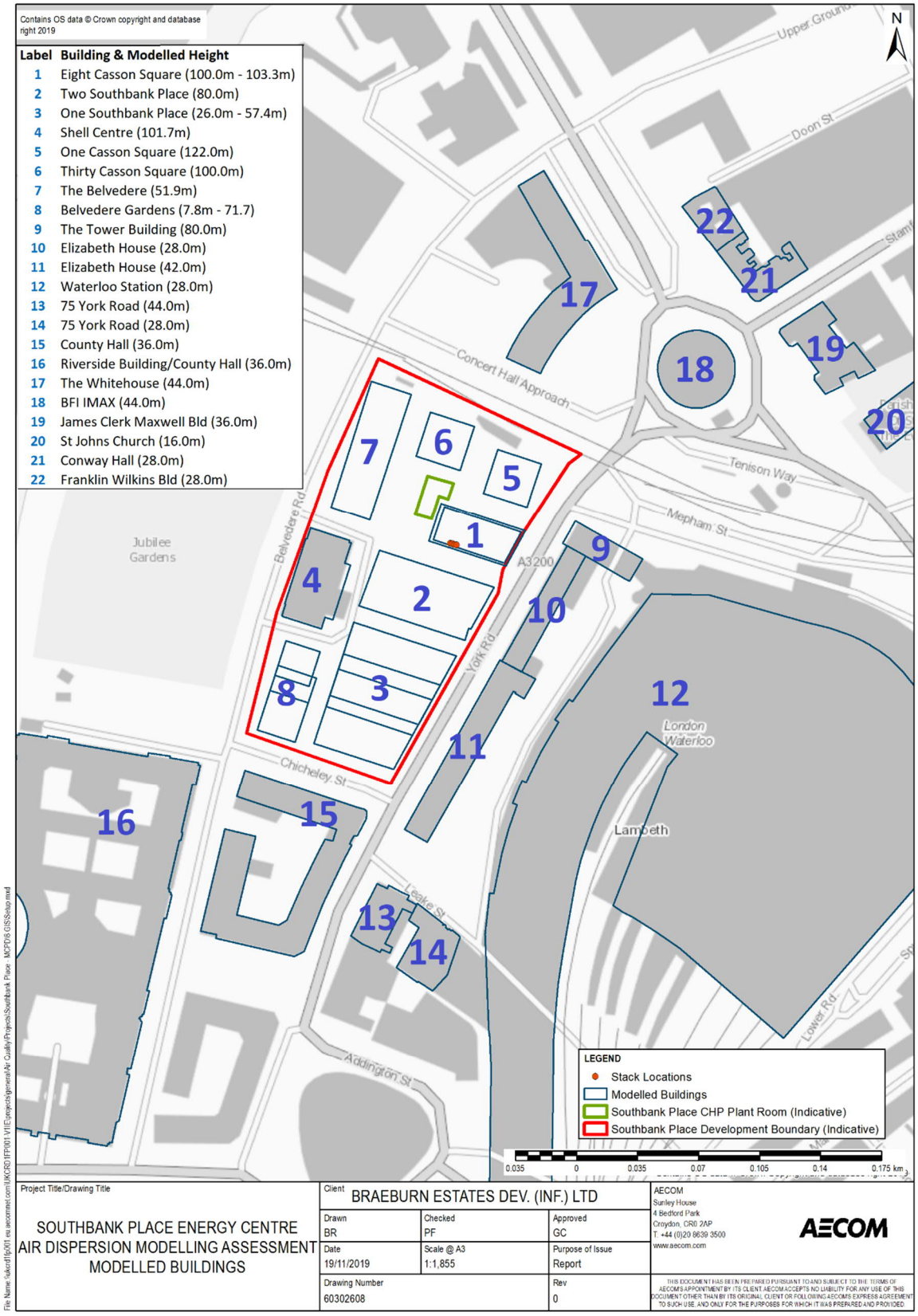
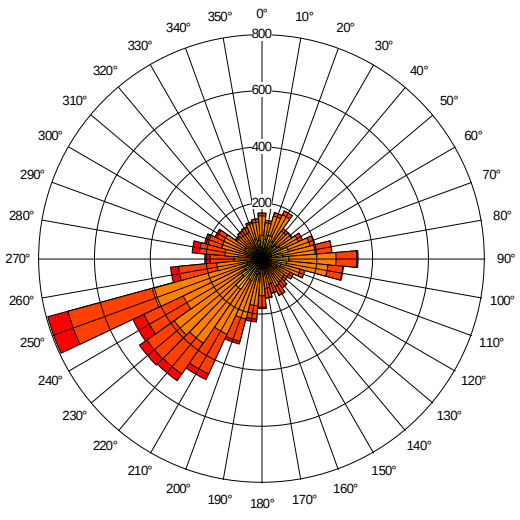
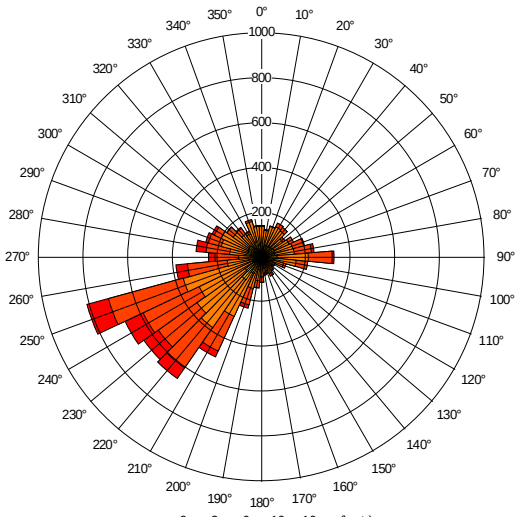


Figure 5. Wind Roses for London City Airport 2014 to 2018

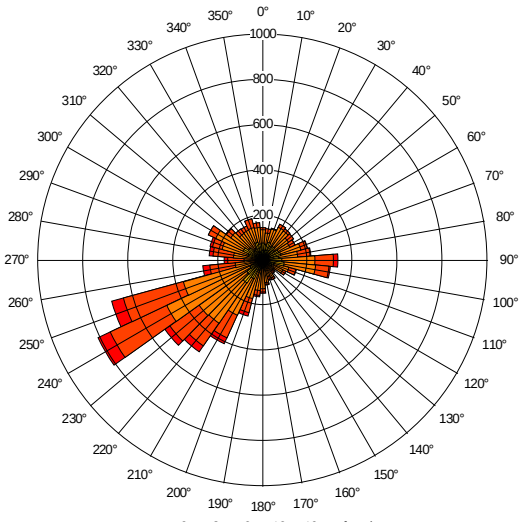
2014



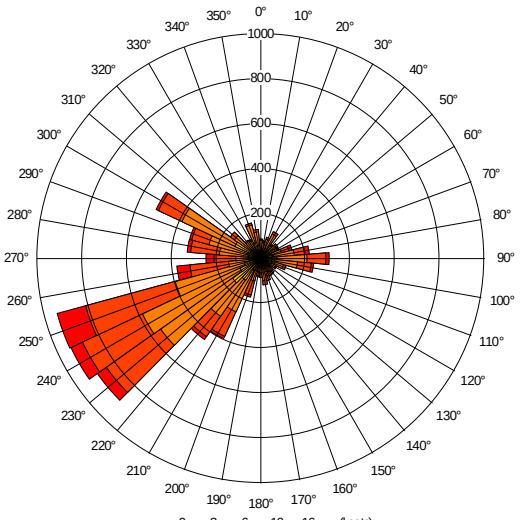
2015



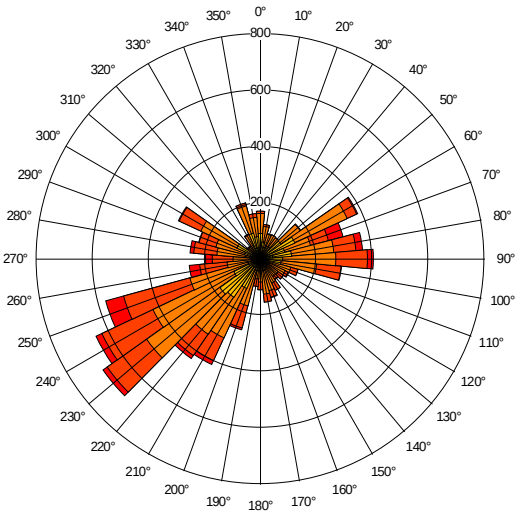
2016



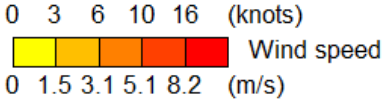
2017



2018



Scale



Appendix B Receptors

Table 12. Modelled Receptors

Receptor	On-site/Off-site Receptor	X co-ordinate	Y co-ordinate	Modelled Height/s (m)
E01	Off-site	530943.6	180026.7	1.5 to 72.2
E02	Off-site	530935.2	180005.9	1.5 to 25.5
E03	Off-site	530916.4	179972.6	1.5 to 39.3
E04	Off-site	530897.4	179941.7	1.5 to 39.3
E05	Off-site	530858.4	179872.2	1.5 to 39.3
E06	Off-site	530974.3	179969.2	1.5 to 10
E07	Off-site	530930.1	179905.3	1.5 to 10
E08	Off-site	530996.3	180110.0	1.5
E09	Off-site	530915.8	180122.3	1.5 to 41.5
E10	Off-site	531039.9	180171.7	1.5 to 23.9
E11	Off-site	531016.9	180201.8	1.5 to 25.0
E12	Off-site	531079.0	180128.2	1.5 to 33.5
E13	Off-site	531118.6	180083.0	1.5
E14	Off-site	530843.9	179821.0	1.5 to 41.1
E15	Off-site	530795.8	179876.5	1.5 to 33.0
E16	Off-site	530722.3	179895.3	1.5 to 32.7
P01	On-site	530874.7	180017.1	1.5 to 94.6
P02	On-site	530896.2	180010.0	1.5 to 94.6
P03	On-site	530866.1	180031.5	1.5 to 94.6
P04	On-site	530912.4	180015.9	1.5 to 94.6
P05	On-site	530880.6	180039.3	1.5 to 94.6
P06	On-site	530902.7	180032.1	1.5 to 94.6
P07	On-site	530906.2	180044.5	1.5 to 119.4
P08	On-site	530898.3	180061.8	1.5 to 119.4
P09	On-site	530915.9	180069.7	1.5 to 119.4
P10	On-site	530923.6	180053.2	1.5 to 119.4
P11	On-site	530867.1	180065.9	1.5 to 97.0
P12	On-site	530885.2	180074.7	1.5 to 97.0
P13	On-site	530859.7	180083.3	1.5 to 97.0
P14	On-site	530875.8	180091.7	1.5 to 97.0
P15	On-site	530831.0	180038.4	1.5 to 48.4
P16	On-site	530841.8	180070.8	1.5 to 48.4
P17	On-site	530807.6	180044.4	1.5 to 48.4
P18	On-site	530817.8	180077.3	1.5 to 48.4
P19	On-site	530872.2	180004.0	1.5 to 73.8
P20	On-site	530847.4	180012.1	1.5 to 73.8
P21	On-site	530891.7	179978.3	1.5 to 73.8
P22	On-site	530827.7	179997.9	1.5 to 73.8
P23	On-site	530864.5	179970.0	1.5 to 73.8

Receptor	On-site/Off-site Receptor	X co-ordinate	Y co-ordinate	Modelled Height/s (m)
P24	On-site	530834.9	179979.6	1.5 to 73.8
P25	On-site	530816.9	180014.5	1.5 to 98.0
P26	On-site	530807.6	180024.7	1.5 to 98.0
P27	On-site	530810.1	179981.5	1.5 to 98.0
P28	On-site	530786.3	180005.0	1.5 to 98.0
P29	On-site	530788.3	179974.3	1.5 to 98.0
P30	On-site	530862.2	179960.9	1.5 to 47.5
P31	On-site	530832.6	179970.7	1.5 to 47.5
P32	On-site	530856.8	179941.9	1.5 to 47.5
P33	On-site	530826.8	179951.6	1.5 to 47.5
P34	On-site	530853.7	179933.0	1.5 to 47.5
P35	On-site	530823.3	179942.9	1.5 to 47.5
P36	On-site	530846.9	179918.3	1.5 to 43.5
P37	On-site	530818.5	179927.6	1.5 to 43.5
P38	On-site	530844.3	179912.4	1.5 to 39.5
P39	On-site	530815.2	179921.7	1.5 to 39.5
P40	On-site	530834.4	179892.3	1.5 to 27.5
P41	On-site	530806.9	179901.1	1.5 to 27.5
P42	On-site	530791.7	179960.8	1.5 to 67.8
P43	On-site	530798.3	179949.6	1.5 to 67.8
P44	On-site	530789.0	179930.1	1.5 to 38.5
P45	On-site	530774.6	179908.9	1.5 to 38.5
P46	On-site	530796.5	179936.1	1.5 to 6.0

Appendix C Maximum 100th Percentile of Hourly Results

Table 13. 100th Percentile Hourly NO_2 PC and PEC at On- and Off-site Receptors

Receptor ID	Height (m) Note1	Background + Gas Boilers Note 2 (µg/m^3)	PC from the Southbank Place Energy Centre CHP (µg/m^3)	Total Short-term PEC (µg/m^3)
E01	1.5	82.9	0.7	83.6
E02	1.5	82.9	0.7	83.6
E03	1.5	82.3	0.5	82.8
E04	1.5	82.4	0.5	82.8
E05	1.5	82.9	0.7	83.5
E06	1.5	82.4	0.5	82.9
E07	1.5	82.1	0.4	82.5
E08	1.5	83.5	0.9	84.3
E09	1.5	83.3	0.8	84.1
E10	1.5	82.2	0.3	82.5
E11	1.5	82.1	0.3	82.4
E12	1.5	81.9	0.3	82.2
E13	1.5	81.8	0.3	82.1
E14	1.5	83.0	0.7	83.7
E15	1.5	84.3	1.1	85.4
E16	1.5	83.9	1.0	84.9
P01	1.5	82.7	0.5	83.2
P02	94.6	85.9	1.5	87.4
P03	94.6	87.3	2.6	89.8
P04	94.6	84.6	1.2	85.8
P05	94.6	85.9	1.8	87.7
P06	94.6	84.0	1.0	85.0
P07	119.4	112.4	5.5	117.8
P08	119.4	102.0	4.6	106.5
P09	119.4	92.6	2.3	94.9
P10	119.4	95.4	2.5	97.9
P11	97.0	85.1	1.4	86.5
P12	97.0	83.2	1.0	84.2
P13	97.0	83.9	1.1	85.0
P14	97.0	83.2	0.8	84.0
P15	1.5	83.0	0.7	83.8
P16	1.5	82.7	0.6	83.3
P17	1.5	83.5	0.9	84.4
P18	1.5	82.7	0.6	83.4
P19	1.5	82.5	0.5	83.1
P20	1.5	82.9	0.7	83.5
P21	1.5	82.3	0.4	82.8
P22	1.5	83.3	0.8	84.2
P23	1.5	82.9	0.7	83.6
P24	1.5	83.7	0.9	84.6
P25	1.5	83.5	0.8	84.3
P26	1.5	83.7	0.9	84.6
P27	1.5	83.8	1.0	84.8

Receptor ID	Height (m) Note1	Background + Gas Boilers Note 2 (µg/m^3)	PC from the Southbank Place Energy Centre CHP (µg/m^3)	Total Short-term PEC (µg/m^3)
P28	1.5	84.1	1.1	85.2
P29	1.5	84.3	1.2	85.4
P30	1.5	83.0	0.7	83.7
P31	1.5	83.8	1.0	84.8
P32	1.5	83.2	0.7	83.9
P33	1.5	84.3	1.1	85.4
P34	1.5	83.3	0.8	84.0
P35	1.5	84.4	1.1	85.5
P36	1.5	83.2	0.8	84.0
P37	1.5	84.3	1.1	85.4
P38	1.5	83.2	0.7	84.0
P39	1.5	84.3	1.1	85.5
P40	1.5	83.2	0.8	84.0
P41	1.5	84.3	1.1	85.4
P42	1.5	84.2	1.1	85.3
P43	1.5	84.1	1.1	85.3
P44	1.5	84.1	1.1	85.3
P45	1.5	84.1	1.1	85.3
P46	1.5	84.2	1.1	85.4

Notes:

1. On-site receptors have been modelled at multiple heights to ensure that the full extent of any impact from the energy centre is assessed, however, only the maximum PC at each receptor location is presented with the corresponding height at which this occurs presented in the height column.

2. The values represent a short-term background NO_2 concentration derived from double the Defra annual background, plus the short-term contribution from the on-site gas-fired boilers.

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Appendix F – List of Directors

Company name: Braeburn Estates Management Company Limited

Company registration number: 09216293

Registered office address: 30th Floor One Canada Square, Canary Wharf, London, E14 5AB

Name	Role	Appointed	Date of Birth
AL-ABDULLA, Tariq Khalid A A	Director	13 November 2018	September 1985
AL-ATTIYAH, Abdullah	Director	23 July 2018	October 1984
ARCHER, Richard David Stedman	Director	12 September 2014	April 1964
ASHRAF, Mashood	Director	30 November 2018	September 1973
IACOBESCU, George, Sir	Director	12 September 2014	November 1945
JORDAN, Anthony James Sidney	Director	9 December 2015	October 1949

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