ENVIRONMENTAL PERMIT VARIATION APPLICATION, DOCKLANDS CAMPUS

Best Available Techniques and Operating Techniques

Prepared for: Telehouse International Corporation of Europe Ltd

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APPENDICES

1.0 Introduction

SLR Consulting Limited (SLR) has been instructed by Telehouse International Corporation of Europe Limited (Telehouse) to prepare an Environmental Permit (EP) variation application for the Telehouse South (TS) data centre (EP reference EPR/EP3507SL), located at Blackwall Way, Poplar, London, E14 2EH.

The EP variation addresses the following:

- Consolidation of the currently separately permitted Docklands data centre (now referred to as Telehouse North (TN)) (EP reference EPR/SP3237JU)), located on Coriander Avenue, London, with the TS EP. The combined TN and TS data centres will be referred to as the Docklands Campus.

- TS is undergoing extensive refurbishment, including the replacement of diesel-fired standby generators (SBGs); this EP variation application includes details of the planned changes.

- Since issue of the TN EP, a number of SBGs, which were included as 'future SBGs' in the EP, have been installed, as agreed with the EA in accordance with the EP pre-operational condition. At the request of the EA, this EP variation includes details of all the SBGs currently in place at TN.

Telehouse North

The current EP for TN permits a total of 145MWth for 27 SBGs. At the time of the original EP application 19 of the 27 SBGs were in place, the aggregated total thermal rated input being 93.6MWth, with the option to increase to 145MWth if future expansion was required. Since issue of the EP an additional 8 SBGs have been installed:

- 3 SBGs in West Building were installed in September 2018; and
- 2 SBGs in North 2 Building were installed in December 2021.

Currently, there are a total of 24 SBGs operating at TN, totalling 125.61MWth; these leaves 19.78MWth for future expansion capacity.

Telehouse South

The TS EP currently permits operation of the following:

- 10 SBGs (4 x 6.4MWth and 6 x 6.3MWth); and
- 3 natural gas-fired heating boilers each with a thermal rated input of 1.172MWth.

The aggregated total combustion capacity for which is 66.916MWth.

The data centre is undergoing significant refurbishment, which will include the removal and replacement of all 10 permitted SBGs, removal of the 3 natural gas-fired heating boilers, and also removal of the 2 bulk diesel storage tanks serving the SBGs. The 10 proposed new SBGs will each be 8.816MWth.

This EP variation addresses these changes, along with requirement to consolidate TN on the TS EP.

Due to the close proximity of these data centres, the technical connections, and management of the data centres, the SBG thermal rated input for the two datacentres has been aggregated. In accordance with the Environmental Permitting (England and Wales) Regulations 2016 (as amended) (the EP Regulations):

"…where two or more appliances with an aggregate rated thermal input of 50 or more megawatts are operated on the same site by the same operator, those appliances must be treated as a single appliance with a rated thermal input of 50 or more megawatts."

The total rated thermal input (under standby power operating conditions) will be approximately 233.16MWth:

- TN data centre: 145.0MWth

- TS data centre: 88.16MWth

Therefore, the two data centres are considered to be an 'installation' as defined in Paragraph 1, Part 1, Schedule 1 of the EP Regulations. The 'activities' are defined in Chapter 1, Schedule 1 of the EP Regulations, under Section 1.1 (Combustion Activities).

This Best Available Techniques and Operating Techniques (BATOT) document is submitted on behalf of Telehouse, the operator, to support the application for a variation of the TS datacentre EP. This report is an integrated document which describes both the operating techniques that are implemented at the facility with respect to operation of the diesel SBGs to ensure compliance with the conditions of the EP, and also demonstrates that BAT will be employed.

For the purpose of this BATOT, key technical standards in the following documents have been referenced:

- *Develop a management system: environmental permits guidance, August 2022;*
- *Risk assessments for your environmental permit guidance, August 2022;*
- *Best Available Techniques: environmental permits, February 2016;*
- *Specified generator: comply with permit conditions, July 2019; and*
- *Data Centre FAQ, Draft Version 21.0 to TechUK for Discussion 15/11/22.*

2.0 Summary of Changes

Telehouse North

Five 'future SBGs', which are included on the original TN EP, have been installed since issue of the EP. These SBGs are different models and sizes compared to that stated in the original EP application. In accordance with the TN EP pre-operational condition, formal notification was provided to the EA of the installation and operation of these SBGs. Telehouse have installed the following SBGs:

- 3 SBGs (MTU 20V4000G23) in West Building in September 2018, each being 5.37MWth (total thermal rated input 16.11MWth); and
- 2 SBGs (MTU 20V4000G34F(EO)) in North (N2) Building in December 2021, each being 6.805MWth (total thermal rated input 13.61MWth).

Based on the existing and additional SBGs as summarised above, the aggregated total installed combustion capacity is now 125.61MWth.

As summary of all the SBGs in place at TN is provided in Table 2.1.

Table 2-1
TN Installed SBGs

Building	Type/Model of Diesel Engine	SBG Thermal Rated Input (MWth)	Number Currently Installed
North	MTU 16V4000	4.32	4
	MTU 16V4000	4.28	2
North 2	MTU 20V4000 G63L	5.6	4
	MTU 20V4000G34F(EO)	6.81	2 (installed 2021)
East	MTU 16V396	4.56	2
	MTU 16V4000	4.28	3
West	MTU 20V4000 G23E	6.16	4
	MTU 20V4000G23	5.37	3 (installed 2018)

Telehouse South - Refurbishment

TS is undergoing extensive refurbishment and the EP variation application includes details of the planned changes, including:

- Removal of all 10 existing SBGs and replacement with 10 diesel-fired SBGs (MTU 20V4000G94LF), each being 8.816MWth, fitted with selective catalytic reduction (SCR) abatement to reduce nitrous oxide (NO_x) emissions (each SCR abatement system will be powered by the SBG);
- Installation of 2 AdBlue bulk storage tanks in the SSB which will feed AdBlue to the SCR abatement systems;

- Changing of the existing horizontal SBG stacks to vertical stacks;
- Removal of the 3 natural gas-fired boilers and calorifiers; and
- Refurbishment and future removal of the 2 diesel bulk storage tanks.

The 10 existing SBGs and associated fuel systems, including the 2 bulk diesel tanks, along with the 3 natural gas-fired boilers and calorifiers will be removed from the Main Datacentre Building (DTC) and Energy Utility Building (EUB) (note that the EUB is now referred to as the South Support Building (SSB)).

10 new containerised SBGs will be installed in the SSB; these will be externally housed on Level 2 of this building (i.e. roof level). Each new SBG will be designed with an individual diesel belly tank (18,000 litre capacity per SBG) which will be located under each SBG within the container unit. Each SBG will be fitted with SCR abatement to reduce NO_x emissions to air as a result of the combustion of diesel by the SBGs.

A new fuel and AdBlue distribution network will be installed within the SSB, including a new diesel fill point and AdBlue fill point which will be located at ground level of the SSB; this will enable the delivery by bulk tanker of diesel to the SBGs and AdBlue to the 2 AdBlue bulk tanks (to be located on level 1 of the SSB).

In addition, all existing horizontal SBG stacks will be removed, and will be replaced with vertical SBG stacks. The planned maintenance and testing regime for the SBGs will also change (refer to Section 7 *Operating Regime* for details).

Based on the changes, the total rated thermal input (under standby power operating conditions) of the Docklands Campus will be approximately 233.16MWth:

- TN data centre: 145.0MWth; and
- TS data centre: 88.16MWth.

3.0 EA Pre-Application Meeting

3.1 Discussions with site officer

Following a site meeting in July 2022 and subsequent email liaison with the Environment Agency (EA) (Howard Tee, EA site officer), it has been agreed to consolidate the TN and TS EPs.

The EA provided advice to Telehouse in an email dated 13/07/2022 (provided in Appendix 01) that the approach to vary all the activities in one variation is recommended due to:

a) Shared technical connections (the sites share an IT cable and in the future will have shared power);

b) There would be a collective SBG test regime;

c) Proximity; and

d) Both data centres operate under the same ISO14001 certified environmental management system (EMS).

3.2 Enhanced EA Pre-Application Advice

Enhanced pre-application advice was sought from the EA in 2023. A pre-application meeting with the EA and Telehouse was held on the 5th April 2023 at TN; written advice was received from the EA on 17th April 2023 (reference EPR/SP3237JU/V002), a copy of which is provided in Appendix 01. The advice confirmed that the EA agrees to consolidation of the TN and TS EPs based on the technical connections between the two data centres. Possible partial surrender of the TS installation boundary was discussed, however TIE subsequently decided against this surrender, and therefore partial surrender of the TS Installation is not included in this EP variation application.

4.0 Regulated Activities

The regulated activities at the Docklands Campus will consist of:

- TN - 27 SGBs with a total of 145MWth; and
- TS - based on the proposed changes will comprise 10 new SBGs with a total of 88.16MWth.

The thermal rated input in total will be 233.16MWth (37 SBGs).

4.1 Schedule 1 Activities

Combustion activities that require an EP are defined in Part 2, Schedule 1 of the EP Regulations:

- Section 1.1 Part A(1)(a) burning any fuel in an appliance with a rated thermal input of 50 or more megawatts.

The EP Regulations clarify that:

"*…where two or more appliances with an aggregate rated thermal input of 50 or more megawatts are operated on the same site by the same operator, those appliances must be treated as a single appliance with a rated thermal input of 50 or more megawatts*."

The SBG provision includes for a level of redundancy to the SBG system such that, even in a worst-case blackout scenario, only the required number of SBGs would start up to deliver the required electricity IT load for the data centre; the number of operational SBGs at the time of a blackout would be dependent on the extent of the blackout. However, it is noted that, without specific physical controls preventing operation of an SBG, that the thermal input of all SBGs is required for determining the capacity of the sites. Therefore, the capacity in total will be 233.16MWth.

4.2 Stationary Technical Unit (STU)

The definition of a STU is not included in the EP Regulations. However, the EA '*RGN 2 Understanding the meaning of regulated facility*' (April 2019) states:

"*The essence of a "technical unit" is that it can carry out the Activity, or Activities, on its own. This means that the technical unit must include enough plant and machinery to allow the Activity to take place in a controlled manner for a sufficient period of time for the operation to reach its designed or intended output*."

Each SBG could be considered as an STU (for the purposes of combusting fuel) however, in accordance with A2.5 of RGN 2:

"*If there are two or more STUs on the same site they will be treated as a single STU if they are technically connected and one of the following criteria is met:*

a) they carry out successive steps in an integrated industrial activity;
b) one of the listed activities is a Directly Associated Activity (DAA) of the other; or
c) *both units are served by the same DAA*."

In the event of a worst-case blackout scenario of the local transmission system, Telehouse will utilise the required number of SBG's to deliver the required IT load. In the event of operational redundancy in case of engine failures or SBGs under maintenance, the required number of SBGs will be operated to the required load, but this can only be identified at that time. Therefore, the operation (under emergency) of individual SBGs is linked to the 'availability' of other engines and the SBGs in each of the data centre are thus considered to be technically connected.

For the purpose of the EP variation application, the installation will comprise the two data centre sites, with the SBGs, the associated diesel storage arrangements on each data centre and the SCR abatement systems at TS being considered independent STUs; the associated diesel storage arrangements and the SCR abatement systems will be considered as Directly Associated Activities to the SGBs for each STU, as described below.

4.3 Directly Associated Activities

Schedule 1, Part 1 Regulation 2(1) of the EP Regulations provides that a DAA is an operation that, in relation to any other activity:

- Has a technical connection with the activity;
- Is carried out on the same site as the activity; and
- Could have an effect on pollution.

As stated in A2.19 of RGN 2, a DAA must "serve" a STU. Therefore, a DAA will normally be something that would not be in place if the STU was not present on-site. A2.22 continues that there are four types of technical connection with a STU including "*…input activities concerned with the storage and treatment of inputs into the stationary technical unit*."

A2.11 of RGN 2 states:

"*Storage facilities may be technically connected*. […] *Stores at the same location are normally technically connected, and as their operation can give rise to pollution, either locally or at the Activity, they are likely to be DAAs*."

In addition to the above, it must also be clear how a DAA may affect emissions from the installation. Incorrect storage of a raw material/fuel could cause off-site releases of these substances.

Therefore, the storage of fuel oil at the two data centres and the SCR abatement systems at TS data are considered to be DAAs of the 'combustion' STU for the data centres.

4.4 Permitting Two Data Centres as a "Single Site"

The Data Centre FAQ states that "*for data centres the 'same site' with reference to RGN02 and several premises located over an area within a commercial/urban environment is aggregated on the assessment of Proximity, Coherence and Management Systems*".

An assessment of Proximity, Coherence and Management Systems is provided below.

4.4.1 Proximity

The Data Centre FAQ states:

"*there is no simple distance but is a site specific decision based on a reasonable interpretation and argument. For combustion activities in the urban/commercial environment 'proximity' may be considered as immediately adjacent to (with or without fencing demarking individual buildings on a campus); or broadly seen as a road width (up to around 100m segment*) and/or uninterrupted line of sight between buildings (plan view up to around 250m*). Outlier buildings, some distance apart, can be connected by other sites closer together on the basis of 'linking' chains of proximity (i.e. all buildings do not need to be in 'proximity' with each other). The role of permitting is ultimately to prevent or minimise pollution and harm to human health, so for air quality, consideration of proximity can take account that premises share sensitive receptors or could reasonably have adverse joint impacts or conversely are so far apart as to not have in-combination effects. A final factor may be that individual buildings/premises' short term process contributions (PC) do screen out as insignificant under our H1 guide*".

The TN and TS data centres are located circa 470m distance from each other. Whilst this does not satisfy the 250m rule for Proximity, the EA email correspondence presented in Appendix 01, notes that there is a precedent set by the EA of circa 450m distance for data centre clusters. In light of this, it is considered that the EA Proximity rule is satisfied.

4.4.2 Coherence

The Data Centre FAQ states:

"*Coherence is the way identified sites work together and their links. Aspects related to data centres might include:*

1. *Direct and dedicated power link between buildings to share standby generator capacity*
2. *sharing physical resources like fuel tanks*
3. *combined generator maintenance/test regimes (e.g. engine emissions at each location are not independent because they are tested as a group set or conversely whole buildings are tested separately because of staff availability or risk management)*
4. *the operator has a practical concern (or indeed actually take account of in planning and testing for), that each individual building may need to operate altogether due to a common but localised grid outage cause (i.e. managing a shared HV feed or common outage risk even if perhaps statistically unlikely)*
5. *ownership or management of the land/estate itself by the operator".*

There is coherence in that the two data centres are owned and operated by Telehouse. The level of coherence with respect to operation of the two datacentres is demonstrated by the following:

- There is a direct IT link between the two data centres, and Telehouse has a dedicated power link shared between these data centres.
- In terms of personnel, the two data centres each have independent security teams but have a shared management team, security contractor and a shared maintenance team.
- The SBG maintenance and testing regime for TN and TS will be completed independently, however there is potential that the SBGs at each data centre could at times be subject to maintenance and testing at the same time, however Telehouse recognises the need to minimise emissions to air during the planned maintenance and testing regime. The planned preventative maintenance (PPM) and testing regime at the two data centres will be managed via centralised PPM and controlled by the Telehouse operational team. To minimise the number of SBGs tested at each data centre at any one time, the PPM planner will be used to schedule this maintenance and testing.

4.4.3 Management Systems

The Data Centre FAQ states:

"Management Systems: Those buildings/data centres using the similar operator procedures, management systems, sharing of staffing, and corporate ownership or company. Common management system such that there is the opportunity to minimise the combined impacts of locations which are in proximity".

As stated later in this BATOT document, the data centres are both managed in accordance with the following standards:

- ISO/IEC 27001:2013 that specifies the requirements for establishing, implementing, maintaining and continually improving an information security management system; and
- ISO 14001:2015 that specifies the requirements for an environmental management system (EMS) to enable an organisation to develop and implement a policy and objectives which take into account legal requirements and other requirements to which the organisation subscribes, and information about significant environmental aspects.

Telehouse is certified to these standards at group level; these certified standards are applicable to TN and TS. The core processes/procedures in relation to these standards are applicable to the data centre sites. By way of example, for the EMS there is a single Environmental Policy which is applicable to the Telehouse group; additionally the EMS, in accordance with the ISO14001 standard, includes:

- An explanation of organisational context, including the key external and internal environmental and related issues.
- Register of environmental aspects, risks and opportunities for the data centres.
- Environmental objectives.
- Explanation of roles and responsibilities for the data centres.

Core EMS documents are applicable to the Telehouse data centre sites. These core documents include EMS processes for:

- Staff competence;
- Communications, including dealing with complaints and, if applicable, regulatory reporting;
- Document control;
- Operational management, including change management, contractor management, and emergency planning and response;
- Evaluation of performance (monitoring, measurement, analysis and evaluation), and evaluating compliance with legal requirements and any other relevant obligations;
- Internal audits;
- Management review; and
- Non-conformance and improvement.

For all management systems, where there are site-specific requirements at a data centre, separate procedures have been/will be developed as required, for example maintenance procedures for different models of generators.

In addition, the refurbishment of TS will align with the requirements of the following standards:

- TIA-568 Telecommunication Industry Association Commercial Building Wiring; and
- R1000S002 Standard Specification for the Electrical Engineering Services (Rev. S012. Red Engineering Site Condition Report.

5.0 Data Centre Location

5.1 Telehouse North

The Docklands Campus will consist of TN and TS. TN, which consists of four data centre buildings, is located on Coriander Avenue, London, E14 2AA. The approximate centre of TN is at a national grid reference (NGR) TQ 38770 81090.

The site is predominantly surrounded by commercial and residential properties. There are residential apartment complexes approximately 40m to the north and 55m to the east. There are further residential complexes within 100m and 180m to the south, 355m to the west and 370m to the east. The closest commercial properties to the site are a Travelodge hotel, located directly adjacent to the east of the site, and a data centre (Global Switch) 20m to the west.

The site falls within the Tower Hamlets Air Quality Management Area.

The setting for the site is summarised in Table 5-1.

Table 5-1
Site Setting for TN

Boundary	Description
North	Local road network including Coriander Avenue, Oregano Drive, East India Dock Road (A13), residential apartments and properties, and Braithwaite Park.
East	Travelodge London Docklands Central (adjacent), Leamouth Road (A1020), residential apartments (Russet House, approx. 55m, Handlebury House, approx. 85m), Tower Hamlets Transport Complex (Government office), a service depot, the River Lea, beyond which lies Limmo Peninsula Ecological Park and a railway line.
South	Local road network including Saffron Avenue and East India Dock Road (A1261), residential high-rise apartments, a railway line, beyond which is Virginia Quay Park, residential properties and the River Thames.
West	Commercial properties, including Global Switch data centre, local road network including Rosemary Drive, Coriander Avenue, Nutmeg Lane, Clove Crescent, an area of open water beyond which are several commercial and hospitality premises (circa 140m from the site boundary) including London Campus (UWS), East India Building (London University), York St John University, Pure Gym. The A102 is circa 320m from the site.

5.2 Telehouse South

TS data centre is within the London Borough of Tower Hamlets, located at 1 Blackwall Way, Paul Julius Close, London E14 2EH. The approximate centre of the site is at NGR TQ 38643 80627.

The site is in a heavily built-up area; to the north, north east and west are residential properties, and schools. The closest residential properties will be a new residential development that is under construction directly adjacent to the east/northeast of TS. The closest commercial premises are located in the adjacent apartment

complex immediately to the west of the site, including East River Spa and Elasko Fitness Centre. Further commercial premises are located opposite Aspen Way (A1261), approximately 100m to the north of the site.

Directly adjacent to the south of the site is the River Thames.

The nearest major road to the site is the A1261 (Aspen way) to the north; the site is located adjacent to the Blackwall Tunnel Vent.

The site falls within the Tower Hamlets Air Quality Management Area.

The site setting is summarised in Table 5-2.

Table 5-2
Site Setting for TS

Boundary	Description
North	Local road network including Thames Path (NE Extension) and Aspen Way (A1261) adjacent to the site, Dockland Light Railway approx. 80m from the site boundary, residential properties approx. 120m from the site, beyond which are commercial/industrial premises, the A102 and Robin Hood Gardens approx. 260m to the northwest; further residential properties are present 320m to the northwest.
East	New residential development that is under construction directly adjacent to the east/northeast, beyond which are residential properties approx. 110m from the site, and Virginia Quay Park (recreational park) approx. 170m from the site, and further afield East India Dock Basin.
South	River Thames (adjacent), Blackwall Tunnel and commercial premises (on the opposite side of the River Thames) including The 02 Arena approx. 370m from the site boundary.
West	Radisson Blu Hotel directly adjacent, beyond which are various residential apartment complexes and hospitality premises approx. 70m from the site boundary. Further afield are commercial premises approx. 180m from the site, the A1206, beyond which is Poplar Dock Marina approx. 310m from the site boundary.

The following drawings accompany this application for an EP variation:

- Drawing 001 – Site Location;
- Drawings 002 A & B – Site Layout and Emission Points; and
- Drawings 003 and 004 – Site Setting.

6.0 Docklands Campus Overview

Telehouse North

TN is permitted for 27 generators, with a total thermal input of 145MWth.

TN consists of four datacentres and incorporates in total 24 diesel-fired SBGs all of which are located internally within the four data centre buildings (North, North 2, West and East buildings). The generating capacity of the installed SBGs is summarised in Table 6-1, this table includes the additional 5 SBGs installed following issue of the EP for this data centre, specifically:

- In West Building, 3 new SBGs installed in the first-floor generator hall. These new SBGs were installed in September 2018.
- In N2 Building, 2 new SBGs installed in locations N2-7 and N2-8. These new SGBs were installed in Quarter 2, 2022.

The locations of the SBGs are indicated on Drawing 002A Site Layout and Emission Points.

Table 6-1
TN Generating Capacity

Building	Number of SBGs	SBG Model	SBG Thermal Rated Input (MWth)	Total Thermal Rated Input (MWth)
North	4 (existing)	MTU 16V4000	4.32	17.28
	2 (existing)	MTU 16V4000	4.28	8.56
North 2	4 (existing)	MTU 20V4000G63L	5.96	23.84
	2 (new, installed 2022: SBGs 7 & 8)	MTU 20V4000G34F(EO)	6.805	13.61
East	2 (existing)	MTU 16V396	4.56	9.12
	3 (existing)	MTU 16V4000	4.28	12.84
West	4 (existing)	MTU 20V4000G23	6.16	24.64
	3 (new, installed 2018: SBGs 6, 7 & 8)	MTU 20V4000G23	5.37	16.11
Total				**125.61**

Telehouse South

As stated previously, TS is undergoing extensive refurbishment, including the replacement of the 10 existing SBGs with 10 new SBGs. The existing generating capacity of the SBGs is summarised in Table 6-2.

Table 6-2
TS Permitted Generating Capacity

Building	Model	Thermal Rated Input (MWth)	No. Installed & Operational	Total Thermal Rated Input (MWth)
Main DTC	MTU 20V4000 (SBG)	6.4	4	25.6
	ST4000 (Boilers Hoval)	1.17	3	3.5
External Utility Building (EUB)	Caterpillar C175-16 (SBG)	6.3	6	37.8
Total				**66.9**

The 10 new SBGs will be located on the roof (level 2) of the SSB, as indicated on Drawing 002 B Site Layout and Emission Points. The new generating capacity of the SBGs at the TS data centre is summarised in Table 6-3.

Table 6-3
TS New Generating Capacity

Building	Brand	SBG Model	Thermal Rated Input (MWth)	No. to be Installed & Operational	Total Thermal Rated Input (MWth)
South Support Building (SSB)	Rolls Royce	MTU 20V4000G94LF	8.816	10	88.16

The overall thermal rated input for the TS data centre will now be 88.16MWth.

6.1 Staffing

Both TN and TS operate 24 hours 365 days a year.

- TN: there are no significant changes to staffing at the TN data centre to that stated in the EP application.
- TS: this data centre will have the following employees (these figures are approximate):
  - If office space is formed on level 8 as the new Telehouse headquarters this would increase staff numbers to 220 on site; and
  - Minimum of circa 8 staff (comprising security and facilities management personnel) on site.

6.2 SBG Selection and Resilience Configuration

Telehouse North

The 3 additional SBGs installed in West Building in 2018 and 2 additional SBGs installed in N2 Building in 2022 were approved in accordance with the EP pre-operational condition and therefore are not discussed further in this section.

Telehouse South

The TS data centre comprises of a number of customer suites. All 10 proposed SBGs will serve the entire TS data centre. The data centre has been designed to ensure the maximum number of SBGs are installed to service potential clients and to ensure resilience.

A smaller number of slightly larger SBGs will be installed compared to the currently permitted SBGs. To meet the business growth plans for the data centre, the proposed SBGs for TS are each 8.816MWth, compared to the existing permitted SBGs of which two are 6.4MWth and six are 6.3MWth. The proposed SBGs have been selected based on the customer demand electrical load for each customer suite, and have been designed to ensure the maximum number of SBGs per data centre suite are installed to service potential clients and to ensure resilience. This ensures that:

- The SBGs are operated at their optimal design capacity, as operating diesel SBG sets at low loads (i.e. underloading) for extended periods of time can potentially impact uptime and engine life; and
- That only the necessary minimum number of SBGs will be operated to deliver the required electrical load for each suite, this allows for the required number of SBGs to be run dependant on the failure/emergency scenario. In the event of a reduction in electrical power delivered from the National Grid, the minimum number of SBGs that are necessary to service the customer suites would be automatically started.

This approach will result in the reduced consumption of diesel fuel and hence generation of less emissions to air from the SBGs.

As part of the annual maintenance programme, testing of the SBGs throughout the year for short periods of time is required. To minimise the mass emission rate to air of combustion emissions and potential adverse impacts on air quality, to minimise NO_x emissions to air Telehouse will install SCR abatement on each of the proposed 10 SBGs.

The Data centre FAQ also requires NO_X emissions for new SBGs to not exceed 2,000mg/m^3. The proposed TS SBGs (MTU 20V4000G94LF) will be emissions optimised EPA Tier 2 compliant (refer to the manufacturers specification presented in Appendix 03). As stated in the Data centre FAQ, Tier II US EPA is the minimum appropriate for new SBGs. In addition, Telehouse will install SCR abatement on the 10 SBGs to minimise NO_x emissions to air. The SCR abatement is designed to reduce NO_x emissions to <236mg/m^3 (at 5% oxygen).

6.2.1 Resilience Configuration

The resilience configuration of the SBGs providing for the electrical load demand of a site (i.e. the data centre building and installed IT equipment) is referred to using ‘n’, where ‘n’ is the specified MWe rate delivered by a SBG unit. The EA Data centre FAQ states that 2n is the exemplar (i.e. twice as many SBGs as required are installed).

Telehouse North

The resilience configuration of TN remains unchanged. TN is a data centre with a resilience level of n+1 for each building (North, N2, East and West), meaning that each building load can be met with one of the generators not running for that particular building. For example, in the North building the load will still be met with one of the six generators not running. In the event of a failure in the electrical supply of one or more building, Telehouse will continue to utilise the SBG’s to maintain operational resilience.

Telehouse South

TS data centre will have a resilience level of n+1, meaning that the site load can be met with one of the 10 SBGs not running. In the event of a failure in the electrical supply, Telehouse will continue to utilise the SBG's to maintain operational resilience. All SBGs operate simultaneously (minus redundancy i.e. all but one of the SBGs will be run to meet the site IT load).

The n+1 configuration allows for a level of redundancy to the SBG system such that, even in a worse case blackout scenario, only the required number of SBGs needed to meet the electrical load demand would be run; the operational capacity of the SBGs at the time of a blackout would be dependent on the extent of blackout. Furthermore, in the event of failure of an SBG, the correct number of remaining SBGs will in an emergency event provide the required load. The n+1 configuration offers resilience and minimises the risk of disruption in service to the data centre's clients.

The proposed SBGs will be automated via the data centre's building management system (BMS). In the event of a reduction in electrical power delivered from the National Grid, the BMS will automatically start-up the required number of SBGs necessary to service the customer suites; this configuration allows for the required number of SBGs to be run dependant on the failure scenario. This results in the reduced consumption of diesel fuel and hence generation of less emissions to air from the SBGs.

The SBGs will not be operated on an 'elective' basis as an alternative source of electricity, nor will they be used to provide electricity (i.e. export) to the local transmission system.

6.2.2 SCR Abatement

In the TS data centre, each of the proposed 10 SBGs will be supplied with SCR abatement to reduce NO_X emissions generated as a result of the combustion of diesel; the SCR abatement is designed to reduce NO_x emissions to <236mg/m^3 at 5% oxygen.

Each SBG will have an SCR abatement system, which will be located on a mezzanine level above the SBG container unit. The abatement system will include a dosing station, with a control cabinet, which provides the urea pump and compressed air for the injection section of the abatement system. The injection section consists of a number of static mixers for the mixing of the urea (urea/water solution, more commonly known as AdBlue) and SBG exhaust gas, with the urea solution being atomised as it is injected. The abatement systems will include NO_x monitoring pre- and post- SCR.

The AdBlue solution will be stored in 2 bulk tanks (double walled tanks with bunding), located on level 1 of the SSB, which will be linked to the SBG container units. Refer to section 9.0 in this report for further details on the AdBlue bulk storage tanks.

Further details of the SCR abatement system are provided in Appendix 03.

6.3 Reliability Data

The magnitude of risk posed by operation of the SBGs (other than for SBG testing) is strongly linked to the reliability of the provision of electricity from the local transmission network.

The data centres are designed to provide the maximum reliability of the electrical power supply to the on-site systems that are critical for operation of each site as a data centre. The data centres are designed to Uptime Institute Tier IV standards, ensuring the required level of resilience to ensure maximum uptime for critical IT infrastructure.

Telehouse North

The electricity supply arrangements for the TN remain unchanged to that stated in the EP application for this data centre and are not discussed further in this assessment.

Telehouse South

The electricity supply arrangements for the TS remain unchanged to that stated in the initial EP application for this data centre (i.e. four incoming feeds from the National Grid).

In the event of a failure in the National Grid electrical supply, Telehouse will continue to utilise the SBG's to maintain operational resilience.

The TS data centre is designed to provide the maximum reliability of the electrical power supply to the on-site systems that are critical for operation of the site as a data centre. The data centre is designed to Uptime Institute Tier IV standards, ensuring the required level of resilience to ensure maximum uptime for critical IT infrastructure.

Operation of the SBGs (other than for testing) will only commence in the event that electricity is not available from the local transmission network (e.g. brown- or black-out) or if there is an internal failure of power supply. There have been no black or brown outages at the TS data centre since commencement of Telehouse ownership in 2020.

Whilst emergency operation (if required) would increase the total operational hours of each SBG within the site, it is extremely unlikely that operation of any single SBG would exceed 500 hours per annum (this being the definition of an 'emergency' unit).

The infrastructure design will provide the required reliability for each customer suite, and will provide the required reliability and resilience for the data centre and its customers. The electricity supply arrangement for the TS data centre is illustrated in the drawing presented in Appendix 04.

6.3.1 Technical Standards

Given the extensive refurbishment at TS, this section focuses on TS only; no refurbishment/significant changes are planned for TN.

TS is designed and operated in accordance with the relevant sections of the following key guidance:

- Develop a management system: environmental permits guidance, August 2022;
- Best Available Techniques: environmental permits, February 2016; and
- Specified generator: comply with permit conditions, July 2019.

In addition, the site is operated in accordance with the EA *Data Centre FAQ* with respect to standby operation. It is noted that this guidance, "*is not presently an official release but forms the basis for discussion of a common methodology and liaison with individual operators and their industry association*." However, for the purposes of this variation application, this guidance is considered to represent the current EA position of BAT for data centre back-up generation systems.

Operation of the SBGs (other than for maintenance and testing) will commence in the event that electricity is not available from the local transmission network (e.g. brown- or black-out) or on internal failure of electrical supply (e.g. transformer failure, UPS problem).

The SBGs on-site will also be operated for maintenance and testing purposes. Each SBG will operate for less than 50 hours per annum and will not be subject to the emission limit value (ELV) for NO_X (190mg/kg).

Emergency Operation

Emergency operations are taken to include unplanned hours required to come off grid to make emergency repair of electrical infrastructure associated within the data centre itself.

Given the short start-up and shutdown times for diesel engines, the SBGs are regarded, for the purposes of determining operating hours, as commencing operation at the first fuel ignition. This is taken to include the

shorter periods of plant 'overlap' when engines provided as redundancy are started as a precautionary measure before final customer load is reached with the optimum/minimum number of SBGs.

The Operator will notify the EA in accordance with the requirements as stated in the EP.

7.0 Operating Regime

7.1 SBG Scheduled Operating Regime

Telehouse North

Since issue of the EP, three additional SBGs have been installed in the West Building and two additional SBGs have been installed in the N2 Building.

In the N2 Building, the annual planned testing regime for the two new SBGs, which is detailed in Table 7-1, will involve operation of each SBG for 53 hours per year, this being the same testing regime for all the N2 SBGs. This annual planned testing regime is an improvement to that stated in the 2018 EP application for this data centre, specifically in the BATOT document submitted in support of the application which stated that the SBGs in N2 would be operated up to 60 hours per year.

In accordance with EP improvement condition IC2, Telehouse produced a report (dated 21st July 2020) outlining the maintenance and operating regime after the first year of operation following issue of the EP. This report highlighted that the Operations and Engineering teams at Telehouse had been reviewing the testing and maintenance regime to implement a reduction in SBG annual testing hours. The 53 hours is an improvement on the previous planned maintenance and testing regime, which was accepted by the EA.

For West Building, during normal operation (i.e. limited to planned testing/maintenance), the three new SBGs will operate under the same planned maintenance as the existing SBGs.

The latest planned operating regime for the SBGs (i.e. testing and maintenance) at the TN data centre is presented in Table 7-1.

Table 7-1
TN SBG Annual Planned Maintenance and Testing Regime

Operational Requirement	North Building	East Building	North 2 Building	West Building
3-monthly off-load testing during maintenance (1 hour per test / 3 months)	4	4	4	4
Annual UPS wrap around maintenance (4 hours per test / 3 months, except West building (10 hours per test))	15	15	39	18
Six times per year part load tests (2 or 4 hours per test per SBG)	18	18	2	18
Black Building Tests (4 hours per test twice per year) where SBGs are started, synchronised and take the associated building load	8	8	8	8
Total Annual Operational Hours Per SBG	**45**	**45**	**53**	**48**

The scheduled maintenance and testing regime for each SBG at TN is, overall, below the 50-hour testing regime for SBGs which are used purely for a stand-by emergency role, as stated in the EA Data centre FAQ, with the exception of the SBGs in N2 Building which only slightly exceed the 50 hours.

Telehouse South

The planned maintenance and testing regime for the replacement SBGs at the TS data centre will change compared to that for the currently permitted SBGs.

For planned maintenance and testing, the proposed SBGs will each be typically operated for up to 36 hours per year. The planned testing regime for the SBGs will be scheduled to ensure that the impact on air quality, as a result of the diesel combustion emissions, is minimised.

The planned operating regime for the proposed SBGs (i.e. testing and maintenance) at TS is presented in Table 7-2.

Table 7-2
TS SBG Annual Planned Maintenance and Testing Regime

Event	Detail	Event Operational Time Per SBG
Monthly testing during maintenance (100% load)	Each month each SBG (MTU 20V4000G94LF) will be powered-up at 100% load. All SBGs start up but only those required for the testing continue to operate, the rest drop off as required. Average duration 5 minutes up to 1 hour. Operation of the SBGs for monthly testing will be undertaken typically at any time on any day (accordingly with the short time (< 1 hour) each SBG will be in operation).	12 hours (per year)
Quarterly maintenance (100% load)	Quarterly testing will be undertaken on each SBG (MTU 20V4000G94LF). The SBGs will undergo a full load test. Testing will be for 10 SBGs running simultaneously for 6 hours. Operation of the SBGs for quarterly testing will be undertaken outside of working hours typically on a Saturday or Sunday.	24 hours (per year)

A summary of the proposed replacement SBG operating hours for TS is presented Table 7-3.

Table 7-3
Summary of TS SBG Planned Maintenance and Testing Hours

Operational Requirement	Annual Operational Hours per SBG (10 Kohler KD3750-E SBGs)
Monthly maintenance (1 hour per month)	12
Quarterly maintenance	24
Operational hours for planned maintenance and testing per year per SBG	**36**

The scheduled maintenance and testing regime for each SBG in TS will be significantly below the 50-hour testing regime for SBGs which are used purely for a stand-by emergency role as stated in the EA Data centre FAQ.

In relation to the above, whilst Telehouse will endeavour for the TS SBGs not to be tested concurrently with the TN SBGs, it is possible that TN and TS will happen on occasion. Telehouse will, whenever possible seek to avoid such concurrent testing in order to minimise adverse impacts on air quality.

7.2 TS SBG Commissioning

The 10 proposed SBGs will following on-site installation, be subject to a period of commissioning. Details of the commissioning, including operational hours, times and dates have yet to be decided. Telehouse will forward these details to the EA once available.

8.0 Emissions

8.1 Emissions to Air

The Air Emissions Risk Assessment (AERA) (SLR Ref: 410.064698.00001 AERA) has considered the proposed changes to the SBGs at Telehouse South, in addition to the transfer of Telehouse North to the Telehouse South EP. Potential air quality impacts as a result of routine testing and maintenance operations and non-routine emergency outage operation for Telehouse South, and Telehouse South cumulative with Telehouse North have been considered.

The AERA predicts for the following:

- **Planned maintenance and testing**: that there will be no significant adverse impacts on identified local human receptors and designated ecological receptors.

- **TS Emergency outage scenario (hypothetical 26 hour outage)**: overall there will be no significant adverse impacts on identified local human receptors and designated ecological receptors. Exceptions to this are as follows:

    - exceedance of the 1-hour mean NO_2 Acute Exposure Guideline Level (AEGL) is >1% at receptor HR37 (adjacent Hadley Application); and
    - one locally designated ecological site (ER18: River Thames and tidal tributaries (Site of Importance for Nature Conservation (SINC) and Local Wildlife Site (LWS)) where the maximum 24-hour Process Contribution (PC) is >100% of the daily mean standard for the protection of ecological receptors (known as Critical Levels (CLe)).

  Overall, however the risk of a prolonged emergency outage is considered to be low.

- **TS & TN Emergency Outage Scenario (hypothetical 26 hour outage):** overall it is considered that there will be no significant adverse impacts on identified local human receptors and designated ecological receptors. Exceptions to this are as follows:

    - the risk of exceedance of the 1-hour mean AEGL-1 is 'highly unlikely' or 'unlikely' at the majority of modelled receptor locations. However, there are potential exceedances predicted at 6 receptor locations; and
    - the maximum daily mean Process Contribution (PC) is >100% of the Cle at some of the locally designated sites (12 sites) (however <100% at the remaining sites).

  Overall, however the risk of a prolonged emergency outage is considered to be low.

Refer to the Environmental Risk Assessment for further information (document reference 416.064698.00001 ERA).

8.2 Emissions to Sewer and Surface Water

Telehouse North

There are no changes to the drainage arrangements at TN.

Telehouse South

The drainage systems at the TS data centre largely remain unchanged to that as detailed in the EP application, however, there are some new drainage features (as illustrated on the drainage plan (reference TSX002-SWE-TS-XX-DR-C-520201_Ver 1, in Appendix 05) as summarised below.

One notable change is that in the EP application, submitted by the previous data centre operator Thomas Reuters, it was stated that uncontaminated surface water discharged to sewer. Uncontaminated surface water in fact discharges to the River Thames via an outfall located off site, in accordance with the Port of London Authority consent (as presented in Appendix 06). The point at which this surface water discharge leaves the TS site is presented on Drawing 002B.

Foul Water Discharge

There will continue to be no discharges to foul sewer within the plant area where the SBGs will be located or from the new fill point location for diesel and AdBlue which will be located at ground level of the SSB.

Surface Water Discharge

- SBG Plant Area: As discussed, the existing SBGs in TS will be removed from the plant area in the main DTC and SSB and will be replaced by 10 new SBGs which are to be located on level 1 (roof level) of the SSB. In addition, a new fill point for diesel and AdBlue will be located at ground level of the SSB.

  Surface water runoff from the SSB roof where the SBGs will be located, will drain to the on-site surface water drainage system. The roof drainage will be directed to the surface water drainage system, via a newly installed full retention Class 1 forecourt petrol interceptor and Vortex separator, prior to discharge into the River Thames via the existing outfall, which is subject to a Port of London Authority consent (see below for further details).

- Loading Area: A dedicated loading area will be provided for the bulk delivery of diesel and AdBlue. This loading area will be designed to allow bulk tankers to park and connect to the fill points located on the ground floor of the SSB. The loading area, which will be concrete surfaced with raised kerbing around the perimeter, will be cambered so that any runoff will drain towards a central drainage channel. This Arco drain will direct the runoff via the surface water drainage system to a newly installed full retention Class 1 forecourt petrol interceptor designed with a holding capacity of 7,600 litres (this being the capacity of a single chamber of a diesel delivery tanker). This interceptor will have high level silt and oil alarms. During tanker offloading operations for diesel and AdBlue, the interceptor will be isolated via an isolation valve; closure of this valve will be an automated process via the site's BMS. From this interceptor the runoff will enter the site's surface water drainage system and will be directed via a new Vortex separator, designed to remove suspended solids entrained in the runoff, prior to being discharged into the River Thames via the existing outfall which is subject to a Port of London Authority consent.

There will be no changes in the nature/composition of the surface water runoff at TS as a result of the proposed changes.

8.3 Emissions to Land

There are no point source emissions to land from the TN and TS data centre sites.

8.4 Fugitive Emissions

Significant fugitive emissions, odours and noise are not anticipated in respect of any of the changes at TN and TS data centres.

A summary of the storage arrangements for diesel fuel and AdBlue is provided in Section 9 of this document.

Telehouse maintains a spill procedure, and relevant operating personnel have been provided with spill response training. Additionally, the requirement for completing regular inspections of the data centre sites is included in the EMS and maintenance procedures.

8.5 Noise and Vibration

Telehouse North

There are no changes with respect to noise at TN.

Telehouse South

Given the extent of the proposed refurbishment at TS, a Noise Assessment has been undertaken in accordance with British Standard 4142:2014+A1:2019 *Methods for rating and assessing industrial and commercial sound*. This is presented in this EP application.

It should be noted that this assessment is based on a different SBG model to that proposed for TS, however in terms of noise attenuation, the design of the modelled SBG and associated container unit is similar to that of the MTU SBGs planned for installation at TS (the MTU SBG containers have been designed to achieve a noise level of 65dB(A) @ 1.0m external to the SBG container unit), and therefore the results of the noise assessment are considered to be relevant for this EP variation application.

The noise assessment, which assessed the noise impact of the SBGs at TN and at TS during normal and emergency operations, concluded that the TN site and the TS site, each individually have a low impact in terms of noise emissions.

In terms of cumulative noise impacts, based on the significant separation distance between the two data centers, the presence of intervening buildings, the existing impact of transportation noise and ambient sources, and the confirmed low noise impact at the boundary of TN and TS, it is concluded that a cumulative noise assessment is not required. The existing conditions and factors are considered to adequately mitigate any potential cumulative noise effects between the two sites, and the potential cumulative impact of both sites would be negligible when assessed in accordance with EA guidance.

9.0 Resource Use and Efficiency

9.1 Resource Use and Efficiency

Telehouse North

There are no changes in the type of raw materials in use and stored at TN as a result of the installation of the SBGs in West and N2 buildings.

Telehouse South

Diesel and oil use at TS will not change significantly based on the proposed new SBGs, as summarised below:

- Diesel fuel oil:
    - MTU 20V4000G94LF (8.816MWth): each SBG will require up to 20.1 litres/minute (1,206 litres per hour) (at maximum fuel supply during normal mode).
- Lubricating oil: used in the engines and other mechanical equipment. Occasional top up or replacement will be required during scheduled or forced maintenance periods only.
- The lubricating oil for the SBGs will be stored within the engine and will be manually topped up during servicing by the Telehouse appointed service contractor.

AdBlue will now be stored and used on site for the SCR abatement systems. The anticipated use is summarised below:

- AdBlue: 460 litres per hour (at 100% load) for each SCR System. Based on ten SCR abatement systems, and the planned maintenance programme of 36 hours per SBG as detailed in this document, the estimated annual usage will be circa 165,600 litres.

The BAT objective with regard to raw materials is achieved by the appropriate design, operation and maintenance of the SBGs and the SCR abatement systems to ensure the lowest possible consumption rate by the selection of the least hazardous materials and by the provision of appropriate storage methods.

The SBG engines are designed for the combustion of diesel fuel and there is no alternative fuel for use by the site at this time (although selection of alternative suppliers is possible).

A typical composition of diesel fuel is shown in 8-1.

Table 9-1
Typical Diesel Fuel Oil Specification

Chemical	Typical % (mass basis)
Carbon	89.7
Hydrogen	10.2
Sulphur	<0.1

AdBlue is 32% urea in water. The abatement systems are design for the use of this chemical to reduce NO_x emissions to air as a result of the combustion of diesel fuel in the SBGs. There is no alternative chemical for use in the proposed abatement.

Cogeneration (Combined Heat and Power)

The provision/implementation of combined heat and power (CHP) is not applicable as the SBGs will each operate for substantially less than 500 hours per annum for the provision of emergency power generation; each engine inherently only operates for a small fraction of the year for planned maintenance and testing.

9.2 Fuel Storage

Telehouse North

There are no changes to the fuel storage arrangements for diesel at TN and therefore fuel storage is not discussed further in this EP variation application.

Telehouse South

The proposed changes to the TS data centre in relation to fuel storage include:

- The removal of fuel systems from the main DTC building and SSB and the 2 existing double skinned bulk fuel tanks.
- Removal of the 10 existing SBGs, all of which have belly tanks for the storage of diesel.
- Installation of 10 new containerised SBGs on the roof level of the SSB. Each replacement SBG will be designed with individual fuel belly tanks (18,000 litre capacity per SBG) located beneath the SBG in each container unit. The belly tanks will 110% contained. A new fuel distribution network will be installed within the SSB; a new fill point will be located externally at ground level of the SSB on the western elevation, which will allow the delivery of fuel directly to the SBGs by bulk road tanker.

Based on the belly tank capacities for the 10 SBGs, a total maximum of 180,000 litres of diesel can be stored at the TS data centre.

There will be no bulk storage of diesel at the TS data centre.

Further details of the diesel storage arrangements are provided Section 13.0. Best Available Techniques.

9.3 AdBlue Storage

Telehouse South

AdBlue will be stored in two 17,000l bulk storage tanks. These tanks will be located on level 1 of the SSB. Adjacent to each tank will be a urea tank pump to enable the refilling of these bulk tanks from tanker deliveries at ground level of the SSB, as described previously.

Each bulk storage tank will be of stainless steel construction; the tanks will be double skinned and provided with a bund (bund capacity 316 litres). Each bulk tank will be fitted with level sensors, a tank level gauge and high/low level alarms. There will be a senor in the AdBlue bund which will alarm on the detection of excessive liquid in the bund.

The tanks will be filled from a ground level fill point, which will be located in the same fill cabinet as that for the diesel fill point as described above.

The AdBlue tanks will be subject to regular preventative maintenance to minimise the risk of leaks.

9.4 Energy Efficiency

9.4.1 Climate Change Agreement

Telehouse is a participant to a Climate Change Agreement, (CAA) (agreement reference DATC/T00031 v1). Energy management techniques have been implemented to monitor, record and track energy consumption at the installation. The CCA Agreement is included in Appendix 02.

An ISO 50001 certified energy management system is also in place, via which energy efficiency and reduction is managed.

9.4.2 Energy Efficiency Directive (EED)

The EED exempts "those peak load and back-up electricity generating installations which are planned to operate under 1,500 operating hours per year as a rolling average over a period of five years".

Based on the planned maintenance and testing schedule, in total the SBGs at the TN and TS data centres will be operated for less than the 1,500 hour threshold. For the purpose of this EP variation application, the TN and TS data centres are therefore exempt from the EED requirements and an assessment of energy efficiency in accordance with the Reference Document on Best Available Techniques for Energy Efficiency, February 2009 is not required.

9.4.3 Basic Measures

Energy Management Policy

The management of energy is an integral part of the environmental and energy management system (MS), and Telehouse, in line with ISO 50001, has developed an energy policy. Training aimed at minimising energy use and developing good housekeeping techniques is a part of the staff training programme. Energy use and its minimisation are managed via the ISO 50001 certified energy MS. Improvement plans are managed through the ISO 50001 MS and identify the areas where energy is utilised, potential energy efficiency measures and ensure that the financial viability of any proposed measures is appraised.

Measures for the Improvement of Energy Efficiency

The SBGs are subject to periodic maintenance and inspections that include ensuring the engines are optimised to minimise the heat rate (energy consumption) whilst maintaining the relevant emissions standards.

Energy recovery is not reasonably practicable for engines with such small anticipated operational hours, however, as part of the ISO 50001 MS, assessment of the site's energy usage will be undertaken with a view to identifying measures to reduce energy consumption.

9.4.4 Energy Usage

Telehouse North

The overall efficiency of the TN data centre SBGs (27 SBGs) (under the provision of 'standby' power), will be approximately 37.6%, with SBG efficiencies of:

- North Building, 35.6%;
- East Building, 35.6%;
- North 2 Building, 39.6%; and
- West Building, 39.6%.

Telehouse South

The overall efficiency of the TS data centre SBGs (10 SBGs) (under the provision of 'standby' power), will be:

- MTU 20V4000G94LF, 37%.

9.5 Water Minimisation

There is no consumption of water associated with the SBG combustion activities, SCR abatement systems, and diesel use/storage at the TN and TS data centres.

9.6 Waste Minimisation

Management of waste oil generated as result of servicing will continue to be the same as that stated in the original EP applications.

Whilst the sites will inherently not produce significant amounts of waste, a waste minimisation audit will be performed periodically throughout the operational lifetime of the data centres in accordance with EP requirements. The aim of this audit will be to minimise the use of all raw materials and thus prevent waste at source.

Waste oils (EWC 13 02) from the SBGs at each data centre will unlikely exceed $5m^3$/4.5 tonnes per annum. Oily wastes are/will be stored in suitable containers, such as 205 litre drums, located on bunded stillages whilst awaiting collection for off-site disposal by a licensed waste contractor.

10.0 F Gases

Fluorinated gases (F-gases) are used at the data centres in the refrigeration systems for chiller units, air conditioning units and in fire suppression systems. The chiller and air conditioning units are subject to regular maintenance and leak testing; these requirements are included in the sites preventative maintenance system. Maintenance and testing is undertaken by a Telehouse approved external specialist contractor; copies of the certificates of the engineers qualified to install, maintain and service refrigeration equipment are maintained on file by Telehouse.

Telehouse maintains an F-gas register for each asset containing refrigerant; the register details the location of the asset, asset model and serial number, refrigerant type and charge, the global warming potential (GWP), carbon dioxide equivalent (CO_2e kg), maintenance/leak test frequency and refrigerant phase down details.

Leak detection and maintenance records are maintained which include details of the quantity of refrigerant used to recharge the units, date of recharge and leak re-test for those assets where leaks are identified. Telehouse has appointed a responsible third party engineer for undertaking maintenance activities.

11.0 Management Systems

The data storage services at the site are managed in accordance with the following standards:

- ISO/IEC 27001:2013 that specifies the requirements for establishing, implementing, maintaining and continually improving an information security management system.
- ISO 14001:2015 that specifies the requirements for an environmental management system to enable an organisation to develop and implement a policy and objectives which take into account legal requirements and other requirements to which the organization subscribes, and information about significant environmental aspects.
- ISO 50001:2018 that specifies requirements for establishing, implementing and maintaining an energy management system, whose purpose is to enable an organization to follow a systematic approach in achieving continual improvement of energy performance, including energy efficiency, energy use and consumption.

11.1 Environmental Management System (EMS)

TN and TS continue to be operated in accordance with the ISO14001 certified EMS. The EMS includes the policies, management principles, organisational structure, responsibilities, standards/ procedures, process controls and resources which are in place to manage environmental protection across all aspects of the business.

The EMS places particular importance on:

- Reducing risks to the environment to a level that is as low as reasonably practicable using best available techniques;
- Integrating EMS responsibilities within line management;
- A commitment to personnel environmental awareness and competence;
- The ongoing monitoring and review of environmental performance; and
- A commitment to working to achieve continuous improvement in environmental performance.

12.0 Monitoring

12.1 Emission Limits

Telehouse North

The additional 5 SBGs at TN (3 in the West Building and 2 in the N2 Building) are operated in accordance with the requirements of the EP.

Telehouse South

The proposed 10 SBGs at TS will each be operated for less than 500 hours per annum and will therefore not be subject to emissions limit values (ELV) for the substances listed in Annex V of Directive 2010/75/EU on industrial emissions (Industrial Emissions Directive, IED).

As the SBGs will not be used for the elective generation of electricity they will not be considered 'specified SBGs' in accordance with EPR 2018 and hence will not be subject to the ELV for NO_x (190mg/kg (within 10 minutes of the specified SBG commencing operation)).

The TS SBGs will be subject to the emissions monitoring requirements as stated in the EP (EPR/SP3237JU) for NO_x and CO. The initial monitoring will be completed within 4 months of receipt of the varied EP.

The operator will record:

- the operating hours of each engine for planned maintenance;
- the operating hours of each engine for emergency operation; and
- the amount of fuel used on an annual basis.

For the purposes of determining operating hours, the SBGs are regarded as having minimal start-up or shut-down times. Operational hours will be counted from the first fuel ignition. This will include the shorter periods of plant 'overlap' when redundant plant is started as a precautionary measure before final load is reached with the optimum/minimum number of SBGs.

12.2 Point Source Emissions to Atmosphere

Point source emissions to air are from the SBGs as a result of diesel combustion. Air emissions modelling has been completed for the existing SBGs at TN and the proposed SBGs at TS. Based on the findings of the air emissions risk assessment (410.064698.00001 AERA) the products of combustion which are released to air as a result of planned maintenance and testing of the SBGs will not result in an adverse impact on the environment.

For operation of all TN and TS SBGs under an emergency (brown- or black-out) scenario (26 hours modelled), overall there will be no significant adverse impacts on identified local human receptors and designated ecological receptors. Exceptions to this include impacts (risk of exceedance of the 1-hour mean AEGL-1) on a number of human receptors, including the Hadley development adjacent to TS, and impacts (risk of exceedance of the CLe) at a number of ecological designated sites, as detailed in Section 8.1 of this BATOT. Whilst there are predicted impacts on air quality in the event of a prolonged emergency outage, the risk of such an outage is considered to be low.

12.3 Point Source Emissions to Sewer

Telehouse North

There are no changes to the discharges to sewer at TN.

Telehouse South

TS is connected the municipal sewer system. Discharges to sewer are limited to sanitary effluent (sinks, toilets, cleaning water, etc.). This is not considered to be a trade effluent discharge and monitoring of this discharge is not considered necessary.

Monitoring of the discharges to foul sewer from the TS data centre is not considered necessary.

12.4 Point Source Emissions to Water

Telehouse North

There are no changes to the discharges to water at TN.

Telehouse South

As stated in section 8.0, uncontaminated surface water runoff from the SBG roof area and the fuel and AdBlue delivery area will drain to the on-site surface water drainage system, where it will be directed via a newly installed full retention Class 1 forecourt petrol interceptor and Vortex separator, prior to discharge into the River Thames via the existing outfall, which is subject to a Port of London Authority consent.

There will be no changes in the nature/composition of the surface water runoff at TS as a result of the proposed changes.

13.0 Best Available Techniques

The assessment for the implementation for Best Available Techniques (BAT) at the data centres is based on the following:

- The latest version of the '*Data Centre FAQ, Draft Version 21.0 to TechUK for Discussion 15/11/22*'; and
- With respect to technology selection, Department of Energy & Climate Change, Developing Best Available Techniques for Combustion Plants Operating in the Balancing Market, Final Report, June 2016.

The additional 5 SBGs installed at TN were approved by the EA via the EP Pre-operational condition, which included an assessment of BAT. Therefore, this BAT assessment focuses on TS only.

13.1 Data centre BAT – Operating Regime

13.1.1 Planned Maintenance and Testing

During operation for planned testing/maintenance at TS, the proposed SBGs will operate typically for 36 hours per year; this is within the 50 hour per annum data centre BAT requirement.

In the event that electricity is not available from the local transmission network (e.g. brown- or black-out) the SBGs will be operated to deliver the required data centre customer load.

Whilst emergency operation (if required) would increase the total operational hours of each SBG, it is extremely unlikely that operation of any single SBG would exceed 500 hours per annum (this being the definition of an 'emergency' unit).

The SBG provision includes for a level of redundancy to the SBG system such that, even in a worse case blackout scenario, whilst all SBGs would start up they would not be operated at full capacity; the operational capacity of the SBGs at the time of a blackout would be dependent on extent of blackout. Should an SBG fail, the engine is covered by the duty standby SBG for that suite and, if required, the remaining engine/s (should the maximum electrical demand for that suite be required).

Emergency operations are taken to include unplanned hours required to come off grid to make emergency repair of electrical infrastructure associated only within the data centre.

Telehouse will notify the EA in accordance with the requirements as stated in the EP.

13.1.2 Elective Electricity Generation

The SBGs at the TS data centre will not be operated for elective electricity generation.

13.1.3 Operating Regime Time Limit

The air emissions modelling (410.064698.00001 AERA) has confirmed that operation of the SBGs for the annual planned maintenance and testing regime per SBG per year at TS (36 hours) will not result in adverse impacts on air quality, Telehouse will therefore not operate the SBGs for more than these hours per year for the purpose of planned maintenance and testing.

13.2 Data centre BAT: Engine Selection

Diesel-fired SBGs have been chosen for the provision of emergency back-up energy in the event of a black- or brown out at the facility. A BAT assessment has been undertaken which compares diesel SBGs to other available technologies to support the chosen technology.

The following key requirements for the SBGs to provide emergency back-up electricity have been considered for the selected technologies:

- Start-up time;
- Reliability;
- Independence of off-system services; and
- Causing the least environmental impact.

A comparison of these technology types is presented in Table 13-1. Start up, efficiency and emissions data as stated has been obtained from a report prepared by DECC (Department of Energy & Climate Change, Developing Best Available Techniques for Combustion Plants Operating in the Balancing Market, Final Report, June 2016) unless otherwise stated. Figures are reported at oxygen reference values of 15%.

Table 13-1
Comparison of Technologies

	Combined Cycle Gas Turbines (CCGT)	Open Cycle Gas Turbines (OCGT)	Aero Derivative Gas Turbines[1]	Gas Engines	Diesel Engines
Process Description	CCGT technology uses a primary gas turbine coupled to a secondary steam turbine. Air is compressed through a rotating compressor, then mixed with fuel and combusted before being expanded through a gas turbine, converting the thermal energy into rotation of the turbine blades. Some of the mechanical energy powers the compressor, with the majority turning a SBG which converts the mechanical energy to electricity. The hot turbine exhaust gases then pass through a boiler to generate steam. The steam is fed to a steam turbine which powers a second SBG, producing further electricity.	OCGT consist of a compressor, combustion chamber and gas turbine. They differ from CCGTs in that they operate without the secondary component to recover heat. Air is fed into the compressor, pressurised and then passed to the combustion chamber where fuel is added and combusted. The hot exhaust gas turns the turbine blades and energy is converted to electricity. OCGTs can provide STOR and peaking services but not fast reserve services as during start-up thermal stresses need to be managed through a slow heating up process.	Aero Derivative Gas Turbines are similar to open cycle gas turbines, but have been derived from turbines used for aeronautical applications. As a result of the different requirements for use of gas turbines in aircraft, they are more flexible than OCGT plant, and are able to operate under wider ranges of load and start up and shut down quicker than other turbines.	A gas engine consists of a bank of fixed cylinders inside which pistons move, injecting air and fuel, compressing the mixture, igniting the mixture and then expanding the hot gas produced converting the thermal energy into rotation of a crank shaft. The engine load is adjusted by controlling the amount of gas and air injected into the cylinder, which is controlled by an automated system. A SBG connected to the crank shaft of the engine converts the mechanical energy into electricity.	Diesel engines work in a similar fashion to gas engines with the key difference being that diesel fuel is injected into the cylinder after compression of the air has taken place, and automatically ignites as a result of the high temperature of the compressed air. Engines are generally rated for a continuous power output, but can exceed this by stated amounts for shorter periods of time in modes named Standby (1hr maximum) and Prime (12hr maximum). These higher power outputs come at the cost of higher emissions and greater equipment stress.

[1] *GE Power Systems, Aero Derivative Gas Turbines – Design and Operating Features*

	Combined Cycle Gas Turbines (CCGT)	Open Cycle Gas Turbines (OCGT)	Aero Derivative Gas Turbines[1]	Gas Engines	Diesel Engines
Start-Up Time[2]	1 – >3.5 hours	15 -30 minutes	As low as 1 minute	1-10 minutes	>10 minutes
Thermal Efficiency (LHV%)	58.8-60.7	38.3-39.9	35-39	35.0-45.0	35.0-37.0
Notes	The secondary steam turbine increases the start-up time of the facility, as it requires slow warming. The complexity and footprint of a combined cycle, combined with the efficiency of steam cycles only being high at relatively large capacities means that CCGT systems are only suitable for large facilities (c.100MW+)	The significant amount of heat lost in the exhaust gas makes open cycle gas turbines significantly less efficient than combined cycle systems.	As with the open-cycle gas turbine, heat loss in exhaust gases means these systems are not as efficient as other options. Certain enhancements can be added, e.g. steam injection, but these are relatively novel and difficult to apply in a non-continuous scenario.	Gas engines are proven, reliable technology and are known to perform well and emit relatively low amounts of NO_x, SO_x and particulates when compared to diesel fired engines.	Diesel engines, unabated, emit relatively high amounts of SO_2 and particulate matter as well as NO_x. The use of low sulphur fuel, catalysts and particle filters can reduce this but diesel engine emissions are considerably higher than other options.

[2] *Note that this is based on typical industrial facilities.*

Technology Selection

Gas Turbines

As per Table 13.1, CCGTs are not considered BAT for the provision of emergency/standby power. This is due to their lengthy start up times and their size limitations; the efficiency of steam cycles being relatively low at small capacity and the overall system complexity being more appropriate to larger size installations.

OCGTs have relatively high capital investment, operating and maintenance costs and lower thermal efficiencies than can be achieved by CCGTs and gas engines.

Aero derivative gas turbines can achieve suitably short start-up times of as low as one minute, however they suffer from relatively low efficiencies compared to engines and the enhancements which have recently become available to improve these are relatively novel and unproven. This is especially applicable for non-continuous operation, where steam or water injection may become a problem as a result of potential condensation within turbine sections.

Reciprocating Engines

Reciprocating engines perform well in terms of their thermal efficiencies. At the upper end of their efficiency range, gas engines have higher thermal efficiencies than diesel engines and OCGTs.

Reciprocating engines also have shorter start up times and are thus more suitable for the provision of emergency/standby power. Under standby conditions, higher emissions are produced, including NO_x, SO_2 and particulate matter as soot.

Gas engines benefit from lower NO_x emissions than diesel engines and can utilise gas delivered by the national gas grid, avoiding the additional transport and fuel storage issues associated with diesel systems.

Reciprocating engines fired on diesel fuel oil have a high response (i.e. low start-up duration) and good independent performance reliability due to the on-site storage of diesel fuel in sufficient quantities, which is managed and controlled by the facility, with the option for fuel oil to be sourced from more than one supplier for delivery to the site. Diesel-fired engines do have a large number of moving parts which can be subject to failure and require regular ongoing maintenance to ensure reliability, however these moving parts can be readily obtained and replaced and are typically included as part of the service agreement with the generator vendor. Due to the number of moving parts, diesel generators when operated can be noisy and generate vibration.

When compared to gas-fired generators diesel engines produce polluting emissions to air, most notably NO_x and particulate matter, which can impact local air quality if operated for prolonged periods of time.

Final Choice of Engine

From the above options, and considering all the aspects required of the plant to provide emergency/standby power for the data centre, diesel engines have been determined as BAT on the basis that:

- These engines provide a fast response speed to the required load; as stated previously, fast start-up of standby generators for data centre is fundamental as an almost instantaneous supply of electricity is required in the event of power loss to the site.
- The need for a reliable supply of fuel (diesel) is essential to ensure reliance, the on-site storage of sufficient quantities of diesel fuel provides the required level of independent performance reliability.
- Diesel engines have low maintenance costs and replacement parts are readily available.

13.3 Data centre BAT: Emissions

The *Data Centre FAQ* specifies the BAT emissions specification for new diesel-fired reciprocating engines as 2g TA-Luft or EPA Tier 2 with guaranteed emissions compliant (or equivalent standard).

The 10 proposed SBGs at the TS data centre (MTU 20V4000G94LF) will be Tier 2 (optimized emissions) compliant. In addition, Telehouse will install SCR abatement on the 10 SBGs. The SCR abatement will reduce NO_x emissions by 90% to <236mg/Nm^3 (@ 5% oxygen), and hence below 2,000mg/m^3. The SGBs are therefore considered to be compliant with BAT.

With respect to emissions management options, the air/fuel mix of each SBG will be automatically optimised via an electronic fuel management system to ensure combustion efficiency. Additionally, the SBGs will be subject to regular planned maintenance in accordance with manufacturer requirements to ensure optimal performance and efficient combustion. Regular maintenance ensures that the products of combustion emitted to air are minimised. Furthermore, Telehouse staff, and the Telehouse appointed maintenance subcontractor, are suitably experienced and trained in the operation of and the maintenance and testing requirements for the SBGs.

The SBGs in an emergency event will be operated automatically by the BMS. In the event of a reduction in electrical power delivered from the National Grid, the BMS phase failure relay would automatically start-up the minimum number of generators necessary to service the customer suites; this configuration allows for the minimum number of generators to be run dependant on the failure scenario. This will result in the reduced consumption of diesel fuel and hence generation of less emissions to air from the SBGs.

Given the short start-up and shutdown times for diesel engines, the SBGs are regarded, for the purposes of determining operating hours, as commencing operation at the first fuel ignition. This is taken to include the shorter periods of plant 'overlap' when engines provided as redundancy are started as a precautionary measure before final load is reached with the optimum/minimum number of SBGs.

13.4 Data centre BAT: Stacks

The *Data Centre FAQ* states that data centres usually have very low profile sites and as such can have short, below roof level emission stacks and that this can impact on the efficiency of dispersion of emissions and BAT is that release stacks are vertical to aid the dispersion of emissions from the SBGs.

By elevating stack heights it is possible to increase the dispersion of exhaust gases as a result of mixing with the surrounding air once the plume of exhaust gases leaves the stack. Whilst this will not reduce the concentration of pollutants leaving the stack, it will result in a lower concentration at ground level, i.e. a lesser impact on the receptor. Increasing the stack height also avoids the effects of building wake and entrainment of the emissions in the locality of the emission source. The use of taller stacks does have an impact on the operation of the engine(s) as it will marginally increase the back pressure on the engine.

By bringing together the exhaust streams for multiple engines, it is possible to improve the mixing of flue gases with the surrounding air. This aggregation does not decrease the absolute quantities of NO_x emitted but does lead to a lower concentration at ground level – i.e. a lesser impact on the receptor.

The reduction in ground level concentration is achieved through improved mixing with the surrounding air once the plume of exhaust gases leaves the stack. A higher mass flowrate of gases will result in a greater momentum that increases the final height of the plume after it has left the aggregated stack. This increased mixing leads to a lower concentration of pollutants at receptors.

Each new SBG at the TS data centre will have a dedicated stack to aid the dispersion of the engine flue. The stacks will be vertical with a release height of 20m above ground level and will terminate at the level of the roof, at the same level as the roof parapet. The stacks are considered to be BAT.

The AERA has taken into account the profiles and heights of all the stacks and building downwash impacts at the data centre and has concluded that:

- For planned maintenance and testing there will be no significant impacts on air quality; and
- For a 26 hour 'electrical grid outage', NO_x emissions will result in impacts on air quality and as such on certain local sensitive receptors (as identified in the AERA).

13.5 Data centre BAT: Electrical System Reliability

Section 6.3 provides a description of the on-site electricity supply system for the data centre which has been implemented to service the 'customer load' that, in addition to this the SBGs incorporate physical connections to the local transmission network (to allow for the failure of any single connection).

The electrical system for the TS data centre provides significant protection against the failure of (or fluctuation in) the electrical supply to the site, before it would become necessary to start the SBGs.

Telehouse is certified to ISO/IEC 27001:2013 that specifies the requirements for establishing, implementing, maintaining and continually improving an information security management system.

Operation of the proposed SBGs at TS will in the main be limited to maintenance and testing. Telehouse will implement a programme of planned maintenance and testing in accordance with manufacturer requirements, to limit unplanned maintenance/testing of the SBGs and thus avoiding the unnecessary use of diesel and the generation of emissions to air.

13.6 Data centre BAT: Air Quality Emergency Action Plan

Telehouse has developed an Air Quality Emergency Action Plan (AQEAP) for both TN and TS; these have been incorporated into Telehouse's EMS. The AQEAPs detail the management actions to be taken in the event of an emergency outage of the national electricity transmission system that could result in the prolonged usage of the SBGs which could potentially result in adverse impacts on local air quality.

The TN & TS AQEAPs will be consolidated into one AQEAP and submitted to the EA. The consolidated AQEAP, once approved by the EA will be provided to the Local Authority.

Telehouse will maintain open lines of communication with the Local Authority, particularly to manage any risks that may be identified in the future as becoming significant threats to the local air quality, for example identification of new emissions sources (cumulative impacts) or potential for future site expansion.

13.7 Data Centre BAT: Fuel Storage

As part of the refurbishment programme for TS, all existing SBGs, 2 bulk fuel storage tanks and fuel systems will be removed from the main DTC building and SSB. 10 new containerised SBGs will be installed, each with individual belly tanks (18,000 litre capacity per SBG) for the storage of diesel. Additionally, a new fuel distribution network within the SSB will be installed, with a new fill point located externally at ground level of the SSB.

The 10 new SBGs will be housed within proprietary steel container units located on the roof of the SSB. Beneath the floor of the container unit for each SBG will be a belly tank, this being integral to the SBG container unit; this belly tank will automatically supply diesel to the SBG. The belly tanks will be bunded (110% capacity) and will be designed to British Standard BS799 Part 5 2010 (Oil Burning Equipment. Carbon steel oil storage tanks. Specification). The belly tanks are therefore considered to comply with The Control of pollution (Oil Storage) (England) Regulations 2001.

The belly tanks will be filled directly from refuelling vehicles (the fuel being delivered by a Telehouse appointed fuel supplier and in accordance with fuel delivery procedures that have been developed as part of the EMS for the data centre). Fuel will be delivered directly to the belly tanks via the new diesel fill point located at ground level of the SSB.

The diesel belly tanks will have the following protection measures:

- Bund designed to provide 110% containment.

- Tank level gauge.
- High and low level alarms connected to the BMS.
- A pressure delivery over-fill prevention valve.
- Leak detection alarms connected to the BMS.
- The generator sets will have pressure relief valves to prevent over pressurisation of diesel supplied from the belly tanks.
- To minimise the risk or corrosion all pipework will be painted or constructed of corrosion resistant material.

13.7.1 Fuel Delivery

Bulk fuel deliveries will be fully supervised by the Telehouse. Fuel delivery tankers will be required to park in a dedicated tanker refuelling area, as indicated on Drawing 002B. Once the vehicle is in position, and prior to fuel dispatch, the isolation valve on the interceptor serving this area will be closed via the BMS.

Fuel deliveries will be managed in accordance with a fuel delivery procedure.

Further details of the surface water drainage system are provided in Section 8.2 *Emissions to Sewer and Surface Water*.

13.7.2 Tertiary Containment

Tertiary containment will be provided by the roof level of the SSB where the generators will be located, and by the contoured hardstanding of the area where the road tanker refuelling area and refuelling point will be located, additionally raised kerbing will be present along the site perimeter. These tertiary containment measures (along with the capacity of the oil interceptor and surface water drainage) will be designed to provide containment of a single chamber of a fuel delivery tanker (7,600 litres).

Any unplanned release of diesel would be prevented from percolating into the ground by the hardstanding; should such a release enter the local on-site surface water drainage system it would be captured by the alarmed interceptor (Class 1 forecourt petrol interceptor designed with a holding capacity of 7,600 litres) which will have an automatic shut off device that will activate on detection of diesel in the interceptor (this alarm will be connected to the BMS). In such an event, spillage procedures would be implemented.

Further details of the surface water drainage system and alarmed interceptor are provided in Section 8.2 *Emissions to Sewer and Surface Water*.

13.7.3 Preventative and Predictive Maintenance (PPM)

Telehouse has a PPM system in place for TS. This PPM system will define regular checks required for the SBG belly tanks and associated fuel infrastructure.

PPM is completed and recorded by Telehouse's appointed facility management contractor.

The TS PPM system details routine preventative maintenance and informs Telehouse of plant status and any system issues. There is a Building Control Room (BCR) which is responsible for the following:

- Issue of all permits for plant modification and repair (the permit issuers also control and approve Risk Analysis and Method Statements (RAMS));
- Monitoring of all fuel deliveries;
- Monitoring tank levels, tank level alarms and leak alarms;
- Control of interceptor isolation valves and alarms; and

- Control and monitoring of all fuel transfers between bulk diesel tanks and SBG belly tanks.

Additionally, emergency SBG operation and testing is controlled by the BCR.

Telehouse has implemented a leak detection and repair programme (LDRP) for storage tanks and associated infrastructure.

The facility will be manned 24 hours a day by facility management personnel.

It is considered that diesel delivery and storage arrangements at the TS data centre are BAT.

14.0 Conclusion

Based on the above discussions, it is considered that TN and TS comply with the relevant data centre BAT and that Telehouse will operate the SBGs and associated diesel storage arrangements at the data centres in accordance with all relevant BAT.

APPENDIX 01

Environmental Permit Variation Approach EA Correspondence

From:	Tee, Howard
To:	Carolina Uribe
Cc:	Jamie Slater; Sharon Abram; Young, Adrian; Richards, Clare
Subject:	Unification and expansion with abated diesel 2g/EPA standby RE: Permit Variation approach
Date:	13 July 2022 10:50:05
Attachments:	image001.jpg image002.jpg image003.png image004.png

Hi,

I assume you confirmed yourselves then that 'London banning diesel engines from 2030' was one around actual transport/NRMM and not a ban on permanent diesel emergency standby per se – I couldn't find anything when I Googled specifically – even the London plan for Air quality Neutral allows emergency diesel standby see 3.3.1 *air_quality_neutral_lpg_-_consultation_draft_0.pdf (london.gov.uk) and the draft air quality guidance does have a seemingly aspirational 'example' of using zero-emission generators lithium-ion tech see air_quality_positive_lpg_-_consultation_draft_0.pdf (london.gov.uk) " but I know there are technical challenges of doing batteries at scale for the possible outage durations at data centres etc; and a dual fuel gas/diesel standby engine (with or without a MW lithium battery) still looked like diesel testing requirements to me! And I'm sure fitting SCR to better than a London specific target like EuroV or say MCP ELV for standby etc would be acceptable either way (EuroV might apply to actual mobile diesel generators at worst). I have asked my expert colleague Adrian to double check all this for me and I think he agrees.

So I think you have justification that Telehouse North and South will now be technically connected (data link, power and management etc) and the precedent for around 450m apart is I think applied for clusters like Slough now. (I'm beginning to wonder if the distance criteria in my FAQ shouldn't have been simply 'a short walk apart'!)

So the correct answer I feel is 'a combined single permit of South and North + west2 expansion' with a combination EMS, test regime and AQ model justifying the whole group.

Especially as you're rightly, in my view, are applying the South upgrade of package abated (SCR) diesel emission optimised engines (you were going to confirm target spec & design, monitoring ports to me) and I anticipate now the same for the west2 expansion* – as I mentioned I think there are pressures for London Plan and local authorities with air quality focus areas (AQFA) to do better than EA 2g/EPA emission optimised engines so doing that upfront for west2 and south is both environmentally beneficial, a risk reduction of having to retro-fit abatement later and easier to permit for AQ.

The questions is really one of two steps

- South upgrade + north unified permit ready for restart after refurb Dec23+
- Combined Telehouse + west2 expansion install/commission Feb25

I would recommend plumping for one variation of everything soonest the reason being:-

1. I think technically the South upgrade is something we can deal with wrt delays with NPS/permitting because in essence (accepting nuisances around SCR BAT ops – the main concern is ammonia slip I think) it should be better than what is already permitted with roughly the same MWth (basically you're asking if you can improve the site and fit

abatement SCR – I don't think there'd be any pragmatic justification for not doing it soonest in deed across all my legacy data centres to be honest, so a local position should cover things)

2. I think there's a risk that you might still not have quite got your variation in time (Dec23), so we might be in position 1 anyway.
3. It should be a lot easier to add west2 to a combined single permit AQ model because you can basically assume a 'worst case spec' in the model but one that should have a very low impact being * for peak NO_2 etc – I'd suggest you assume an emission optimised, max MWelec with SCR to target emission rate g/s, vertical stacks locations are probably already fixed? and justify the largest scale plant net mass emission envelope – you can always follow-up with the details in a pre-op condition once permitted and/or as an addendum to the variation application if not determined.
4. The variation application will be consulted with Tower Hamlets, so the sooner they agree the West2 design is fine for the EA to permit the better.

I'll just slip it in here since it is a current topic and extra justification going forward, would be if part of the expansion with west2 included a review of the west1 and east building plant with a plan to upgrade those with SCR too i.e. once you have a whole site with west2 AQ model, you can model the 'what ifs' of the remaining plant for improvements.

Please can I remind you that you had said you'd be emailing me the Powerpoint presentations.

Kind regards,

Howard

Howard Tee
Installations Regulatory Officer
Hertfordshire and North London

Environment Agency
Alchemy, Bessemer Road, Welwyn Garden City, AL7 1HE
External: 020 84747319 Mobile: 07876 397771
P**ollution or environmental incident reporting** 0800 807060

From: Carolina Uribe <Carolina.Uribe@uk.telehouse.net>
Sent: 12 July 2022 16:10
To: Tee, Howard <howard.tee@environment-agency.gov.uk>
Cc: Jamie Slater <Jamie.Slater@uk.telehouse.net>; Sharon Abram <sabram@slrconsulting.com>
Subject: Permit Variation approach

Hi Howard,

We have been discussing internally the permit variation approach for TS after the meeting and the advice that we have from you on Friday. We discussed different options on Friday and we wanted to get your support regarding the most viable option.

These are some of the options that we discussed:

1. Stage 1 - Permit variation Docklands to Include TS as part of this variation – this will be the most beneficial as the two data centres are currently connected, managed by the same management team, same M&E contractor and we currently recognise TS as an extension of the Docklands campus. This is our preferred option, and we would like to start the variation as soon as possible. Do you think this approach is viable? Do you have any concerns?
2. Stage 2 - Permit variation Docklands /TS and extension to West 2 - potentially get the first variation as detailed above, and then submit another variation to add the West 2 (future data centre).
3. TS permit variation only – Variation of the TS permit will be valid for a short period of time, as we will need to include TS and West 2 as part of the Docklands permit. Taking this approach would effectively add the need for an additional variation, however if we followed Stage 1 (bullet 1 above) this would be avoided.

As you mentioned, there are currently long queues to get the permit variations, so we would like to agree the best approach with you before we arrange the pre-application meeting.

We are looking to start the variation as soon as possible and Sharon from SLR will be supporting us.

Below are indicative key dates for TS and West 2:

- TS - Full Refurbishment start Dec 2023
- West 2 - Generator installation Feb 2025 (The PM team has reviewed the approach and they are going for Diesel generators after the meeting with you).

We would appreciate your advice and support.

Thanks

Carolina

Carolina Uribe
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Telehouse is committed to upholding the highest environmental, security and corporate social responsibility standards. Click here to view our certifications.

Mr M Sargent

Telehouse International Corporation Of Europe Ltd

By email

Our reference: EPR/SP3237JU/V002

Date: 17/04/2023

Dear Matt

Pre application advice – Enhanced service

Site: Docklands Data Centre (Docklands South), Coriander Avenue, London, E14 2AA

Thank you for your pre application enquiry on 20/02/2023.

I am pleased to provide you with your enhanced level of pre-application advice. This advice is based on the information provided on your pre application advice form and the meeting on the 05/04/2023.

The advice is provided in response to each of your queries (in italics), as follows:

Confirm the approach and scope of the permit variation, specifically the transfer of the South DC installation on to the Docklands Permit

Given the distance between the two sites, in order to consolidate them into one permit, there must be a technical connection between the two sites. You have confirmed that both sites are managed in the same way, that they have the same IT and maintenance regime and that in future they will share a power cable. Based on this information, it appears that there is a technical connection.

You confirmed that the engines at the Docklands South site are being replaced and that the new engines will only be located at the northern end of the site. Therefore, a change to the permit is being made.

In order to consolidate two permits, a normal variation based on the highest applicable application charge is payable together with a minor variation charge for each permit being consolidated where no changes to either permit are being made. However, as the Docklands South permit will also be varied, the applicable fee will be a substantial variation charge for the Docklands South permit and a minor variation charge for the consolidation of the Docklands North permit. No additional fee for the consolidation of the Docklands South permit will apply as this will be covered by the substantial variation charge for the proposed changes to the permit.

Application forms Parts A, C2, C3 and F1 will be required. For the consolidation, you should respond to question 2c2 in the Part C2 application form and provide the permit number for the Docklands North permit.

Possible surrender of part of the South DC installation

You confirmed that you are proposing to replace the current engines at the Docklands South permit with new engines located in the northern part of the site and to surrender the southern part of the site as no activities requiring a permit will be carried on in that area.

In order to apply to remove part of the permitted area from a permit, a part surrender is required. In this case, we have confirmed that this part surrender is a low risk surrender so no intrusive investigation is required to be submitted with the application. However, a site condition report to demonstrate that the condition of the land has not changed since the permit was issued and how pollution risk has been avoided will be required to be submitted with the application.

The application charge for a low risk partial surrender is 20% of the applicable application fee.

You can apply for the part surrender at the same time as you apply to vary the permit and consolidate it with the permit for Docklands North. As well as the Parts A, C2, C3 and F1 forms, you will also have to submit the Part E2 application form.

Confirm the scope of the application and supporting documents required

If it is assumed that the variation and part surrender to the Docklands South permit and the consolidation of the Docklands North permit are applied for at the same time, then the following information is required:

- Parts A, C2, C3, E2 and F1 forms.
- Application fee (see below).
- Non-technical summary.
- Environmental risk assessment for the variation to the Docklands South area.
- Revised site boundary plan – with surrendered area removed and Docklands North area added.
- New drainage plan for varied Docklands South area.
- Confirmation that surface water at Docklands South is drained to the River Thames and not to sewer as stated in the current permit.
- New emission points location plan for varied Docklands South area, including emission point to water.
- Site condition report for the part surrender.
- Updated site condition report for the consolidated permit.
- Updated operating techniques for the varied Docklands South permit and inclusion of the operating techniques for Docklands North. (Note it would be helpful if a combined operating techniques table could be submitted with the application with the new techniques covering both sites as well as the parts of the current operating techniques tables from each permit that are still relevant.)
- Noise assessment for the varied Docklands South permit.
- BAT assessment for the varied Docklands South area.
- New air quality assessment for the varied Docklands South permit and a combined assessment with Docklands North.

- New combined Air Quality Management Plan for the consolidated permit.

Confirm the application fee

The charging scheme with the tables of charges is here:

Environmental permits and abstraction licences: tables of charges - GOV.UK (www.gov.uk)

The guidance on how and when we charge is here:

Environmental permits: when and how you are charged - GOV.UK (www.gov.uk)

- Consolidation – section 3.11.2 of the guidance.
- Low risk surrender – section 5.2.2 of the guidance

The charges are based on table reference 1.10.1 in the charging scheme, relating to combustion activities.

- Variation to Docklands South = substantial variation = £17,193
- Consolidation of Docklands North = minor variation = £5,731
- Low risk, part surrender of Docklands South = 20% of application fee = £3,820.60

Additional charges – table 1.19 of the scheme:

- Reference 1.19.2 – Habitats assessment fee = £779
- Reference 1.19.7 - Assessment of noise management plan fee is required (where one is required based on the outcome of the noise impact assessment) = £1,246

Confirming the guidance and standards that apply for the application

BAT for data centres is the FAQ. The current version is version 11.0, dated 11/05/2020, a copy is attached.

Risk assessment guidance is here: Risk assessments for your environmental permit - GOV.UK (www.gov.uk) and within this guidance are links to guidance for noise and air quality impact assessments.

See also the attached supplementary basic pre-application guidance for combustion activities.

Proposed variation to Docklands North to add new data centre

In addition to the above, we also discussed the proposed new data centre adjacent to the Docklands North permit and how this could be added.

As this would be adding a new listed activity the variation type would be substantial. If this is added at the same time as the variation, part surrender and consolidation already described above, then you would also have to pay the substantial variation fee for the Docklands North permit.

The information required would be as already described above and as included in the attached supplementary guidance.

If you are not yet ready to submit an application for the new data centre then you can either apply to vary the consolidated permit once the variation, part surrender and consolidation application is determined or, if that application is not yet allocated, you could update the application and pay the additional fee whilst it is still on our queue.

What enhanced pre application covers

Further information on the enhanced pre-application service is detailed on section 2 of the Environmental permitting charges guidance on GOV.UK.

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

Application reference number	EPR/SP3237JU/V002
Habitats screening	Two Screening reports with maps
Documents attached	Combustion (Part A) pre-app basic advice Combustion (Part A) Supplementary Data Centre FAQ
Application charge required	See above
Forms required to be submitted	See above
Additional documents required	See above
Additional information	See above

A complete application must contain the following information below:

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.
Site Plan	Site plan must be clearly marked with the full site boundary
Payment	Please note your application will not be processed until we receive the full payment.

What happens next?

If you submit an environmental permit application, then please quote this pre-application reference number: EPR/SP3237JU/V002.

If the advice above details using the online digital application form, your application can be submitted using this method. If not, please send your completed application documents via email to:

psc@environment-agency.gov.uk

Please email applications where possible. If email is not possible you can submit by post to:

Environment Agency, Permitting Support Centre, Quadrant 2, 99 Parkway Avenue, Sheffield, S9 4WF

Current application timescales

Our current queues are large and we are taking longer than usual to allocate work for initial assessment, known as duly making. The table below shows our estimated queue times by application type. Please note, this is based on our average times and some applications may be picked up before or after the timescales listed below.

Application type	Estimated time to allocation
New bespoke	29-33 weeks
New standard rules	14-18 weeks
Admin variation	2-6 weeks
Minor variation	22-26 weeks
Normal variation	24-28 weeks
Substantial variation	34-38 weeks
Transfer	8-12 weeks
Surrender	20-24 weeks
Medium Combustion Plant	10-14 weeks

Disclaimer

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 duly making and then full technical checks during determination, and additional information may be required based on your detailed submission and site specific requirements. The advice given is to address the specific pre-application request.

This advice covers installation activities only.

Other permissions from the Environment Agency and/or other bodies may be required for associated or other activities.

Enhanced pre application cost estimate

At this stage the pre-application advice is expected to cost up to £800 plus VAT. An invoice will be sent separately at a later date.

This pre-application request is now closed.

We consider this pre application request is now closed. However, if you have any questions regarding this letter please contact Miriam Townshend.

If you require additional enhanced pre-application advice please complete our online form.

We look forward to working with you on this project.

If you have any questions please call 03708 506 506.

Yours sincerely

Miriam

Miriam Townshend

Senior Permitting Officer

miriam.townshend@environment-agency.gov.uk

APPENDIX 02

Climate Change Agreement, (CAA) (agreement reference DATCT_00031 v1)

UNDERLYING CLIMATE CHANGE AGREEMENT FOR THE DATA CENTRES SECTOR
Agreement Dated: 21st day of October 2014
Agreement Identifier: DATC/T00031 v1
TU Identifier: DATC/T00031

THIS AGREEMENT is made the 21st day of October 2014

BETWEEN:

(1) the Environment Agency ("the Administrator"); and

(2) the operator set out in Schedule 2 ("the Operator")

RECITALS

(A) Section 30 of and Schedule 6 to the Finance Act 2000 ("the Act") make provision for a tax known as the climate change levy ("the Levy"). The Levy is charged on the supply of taxable commodities as defined in paragraph 3 of Schedule 6 to the Finance Act 2000.

(B) Paragraphs 42(1)(ba) and 42(1)(c) of Schedule 6 to the Act provide that the amount payable by way of the Levy shall be discounted from the full rate where the supply is a reduced-rate supply. A reduced-rate supply is a taxable supply supplied to a facility specified in a certificate given by the Administrator to the Commissioners for Her Majesty's Revenue and Customs as a facility which is covered by a climate change agreement for a period specified in the certificate in accordance with paragraphs 42 to 52F of Schedule 6 to the Act.

(C) A climate change agreement is defined in paragraph 46 of Schedule 6 to the Act. It may consist of a combination of agreements that falls within paragraph 48. A combination of agreements falls within paragraph 48 if a number of conditions are satisfied. The first condition is that the combination of agreements is a combination of an umbrella agreement and an agreement that, in relation to the umbrella agreement, is an underlying agreement.

(D) This agreement is an underlying agreement in relation to an umbrella agreement, entered into for the purposes of the reduced rate of Levy. It is not intended to give rise to contractual obligations between the parties.

(E) The facility or facilities set out in Schedule 4 to this agreement are a facility or facilities to which an agreement applies.

(F) The Operator is a representative of each facility to which this agreement applies, as defined in paragraph 47(2) of Schedule 6.

AGREED TERMS

IT IS AGREED as follows:

1. INTERPRETATION

1.1 In this Agreement, unless the context otherwise requires:

"account" means the account in the Register of a sector association or an operator;

"agreement" means an umbrella agreement or an underlying agreement;

"base year" in respect of a target unit which does not include a greenfield facility means a 12 month period agreed between an operator and the administrator, ending prior to the date of an underlying agreement, for which data is supplied by an operator to the administrator prior to the operator entering into the underlying agreement;

"base year" in respect of a target unit which does include a greenfield facility means the 12 month period starting on the date of an underlying agreement";

"buy-out fee" means the fee calculated in accordance with Rule 7;

"certification period" means, any of the following periods:

(a) 1st April 2013 to 30th June 2015;

(b) 1st July 2015 to 30th June 2017;

(c) 1st July 2017 to 30th June 2019;

(d) 1st July 2019 to 30th June 2021; or

(e) 1st July 2021 to 31st March 2023;

"charges" means charges due to the Administrator under the charging scheme;

"charging scheme" means the Climate Change Agreements Charges Scheme 2012 made by the Administrator or any replacement or revision of that charging scheme;

"emissions" means the total emissions in tCO_2 equivalent for a target period;

"EU ETS Directive" means Directive 2003/87/EC of the European Parliament and of the Council establishing a scheme for greenhouse gas emissions allowance trading within the Community and amending Council Directive 96/61/EC, as amended from time to time;[1]

"facility" means a facility within the meaning of paragraph 50(2) to (6) of Schedule 6 to the Act;

"facility number" means the unique identification number of a facility set out in schedule 6 of this Agreement;

"greenfield facility" means a facility which started to carry out the process by virtue of which it is a facility within the meaning of paragraph 50 of Schedule 6 during the 12 month period ending on the date the operator applies for the facility to be covered by an agreement"

"Novem ratio target" has the meaning set out in the technical annex;

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[1] *OJ No L 275, 25.10.03, p 32. The Directive was amended by European Parliament and Council Directives 2004/101/EC (OJ No. L 338, 13.11.2004, p 18), 2008/101/EC (OJ No L 8, 13.1.2009, p 3) and 2009/29/EC (OJ No L 140, 5.6.2009, p 63), and by Regulation (EC) No 219/2009 of the European Parliament and of the Council (OJ No L 87, 31.3.2009, p 109).

"operator" means, as the context requires, either:

a) the party to this Agreement other than the Administrator; or

b) a party to an underlying agreement other than the Administrator;

"personal information" means:

a) the address of the registered office of the sector association or operator;

b) the name, address and email address of:

i) in the case of a sector association, a person who can be contacted in respect of the sector association;

ii) in the case of an Operator, the responsible person; and

c) the name, address and email address of a person who can be contacted in respect of the facility or each facility covered by an agreement;

"the Register" means the electronic system established and operated by the Administrator for the administration of agreements;

"the Regulations" means the Climate Change Agreements (Administration) Regulations 2012 S.I. 2012/1976;

"responsible person" means an individual who is legally authorised by the Operator to enter as the Operator's agent into an underlying agreement, to agree any amendments to an underlying agreement, and to accept service of notices on behalf of the Operator;

"Rule or Rules" means the Rules for the Operation of Climate Change Agreements or any of them set out in Schedule 1 to this Agreement as varied from time to time;

"Schedule 6" means Schedule 6 to the Finance Act 2000;

"sector" means the sector consisting of facilities which are covered by the same umbrella agreement;

"sector association" means the sector association set out in Schedule 3;

"sector commitment" means the commitment set out in Schedule 5 of the umbrella agreement, as varied from time to time;

"surplus" means the amount by which the emissions have fallen below the target for any target period;

"target" means the percentage improvement in energy efficiency or carbon efficiency from the base year applicable to the target unit, set out in Schedule 6 to this Agreement, as varied from time to time;

"target period" means any of the following periods:

a) 1st January 2013 to 31st December 2014;

b) 1st January 2015 to 31st December 2016;

c) 1st January 2017 to 31st December 2018; or

d) 1st January 2019 to 31st December 2020;

"target unit" means the facility or group of facilities to which this Agreement applies;

"tCO_2 equivalent" means tonnes of carbon dioxide equivalent;

"technical annex" means the technical annex dated 6 March 2013 and published by the Administrator or the Secretary of State, available via the Administrator's website;

"throughput" means the measure of production, or factor related to production, used to determine the relationship between the amount of energy used by the target unit and the levels of activity of the target unit, as set out in Schedule 6 of this agreement;

"the Tribunal" means the First-tier Tribunal established under the Tribunal Courts and Enforcement Act 2007[2];

"umbrella agreement" means an agreement that is an umbrella agreement for the purposes of paragraph 48 of Schedule 6 to the Act;

"underlying agreement" means, as the context requires, either:

a) this Agreement; or

b) an agreement that is an underlying agreement for the purposes of paragraph 48 of Schedule 6 to the Act.

1.2 Other words and expressions used in this Agreement have the same meaning as they bear in Schedule 6 to the Finance Act 2000 or the Regulations.

2. FACILITIES TO WHICH THIS AGREEMENT APPLIES

2.1 This Agreement applies to the facility or facilities set out in Schedule 5 to this Agreement which carry out some or all of the activities set out in Schedule 4 to this Agreement.

[2] Appeals are assigned to the General Regulatory Chamber of the First-tier Tribunal by virtue of article 3(a) of the First-tier Tribunal and Upper Tribunal (Chambers) Order 2010 (S.I. 2010/2655). The Tribunal Procedure (First-tier Tribunal) (General Regulatory Chamber) Rules 2009 (S.I. 2009/1976) sets out procedural rules relating to such appeals.

3. TARGET

3.1 The target is set out in Schedule 6 to this Agreement, as varied from time to time.

3.2 Whether the target has been met must be determined in accordance with Rule 6.

3.3 The Secretary of State may carry out a review of the sector commitment during 2016 for the target periods 1st January 2017 to 31st December 2018 and 1st January 2019 to 31st December 2020. The target may be varied to take account of the review in accordance with the procedure set out in Rule 12.

3.4 The target may also be varied in accordance with Rules 6, 9, 10 and 11.

4. THE RULES

4.1 Schedule 1 to this Agreement which sets out the Rules for the operation of Climate Change Agreements has effect.

4.2 The Operator agrees to comply with the Rules.

5. DURATION AND TERMINATION OF THIS AGREEMENT

5.1 Subject to clause 5.2 below, this Agreement comes into force on 1 April 2013 or the date on which it is made, if later, and ends on 31 March 2023.

5.2 This Agreement may be terminated before 31 March 2023:

5.2.1 at any time by a notice served by the Operator giving at least 20 working days notice served on the Administrator; or

5.2.2 in accordance with the Regulations.

6. VARIATION OF AGREEMENT

6.1 Subject to clauses, 6.2 and 6.3 below, this Agreement may be varied at any time if agreed between the Administrator and the Operator.

6.2 The facilities to which this Agreement applies may be varied in accordance with Rules 9 and 10.

6.3 This Agreement may be varied by the Administrator at any time to take account of changes to the terms specified in the Regulations.

7. AUTHORITY

7.1 The Operator warrants that it has the power to enter into this Agreement and is authorised and has obtained all necessary approvals to enter into this Agreement on behalf of the included facilities and the responsible person warrants that he or she is authorised to sign this Agreement on behalf of the operator.

Signed on behalf of the Environment Agency	Signed by the responsible person on behalf of the Operator
	……
CCA Manager	Suzanne Lee Finance Director suzanne.lee@uk.telehouse.net

SCHEDULE 1

RULES FOR THE OPERATION OF CLIMATE CHANGE AGREEMENTS

1. OBLIGATIONS OF A SECTOR ASSOCIATION AND OF AN OPERATOR

1.1 An Operator and a Sector Association must:

1.1.1 supply such information to the Administrator as the Administrator may request in connection with an agreement, by the date specified in the request;

1.1.2 notify the Administrator of any changes to its personal information within 20 working days of the change;

1.1.3 co-operate with any person appointed by the Administrator to undertake an independent audit of information provided to the Administrator; and

1.1.4 comply with the provisions of the charging scheme. If a charge remains unpaid after the date on which it is due, it may be recovered by the Administrator as a civil debt.

2. OBLIGATIONS OF A SECTOR ASSOCIATION

2.1 Following the setting of the sector commitment by the Secretary of State, or following a variation of the sector commitment under Rule 12.1, a Sector Association must distribute the sector commitment between each target unit under the umbrella agreement.

3. OBLIGATIONS OF AN OPERATOR

3.1 An Operator must:

3.1.1 notify the Administrator and the Sector Association within 20 working days of the date when the Operator has reason to believe that a facility covered by an underlying agreement may not be eligible for inclusion in the underlying agreement;

3.1.2 notify the Administrator within 20 working days of becoming aware of any structural change or other change set out in the technical annex which may give rise to a variation to the target in accordance with Rule 11;

3.1.3 notify the Administrator within 20 working days of discovering any error in the data provided to the Administrator for the base year;

3.1.4 provide to the Administrator on or before 1st May following the end of a target period such information as has been requested by the

Administrator in order to determine whether progress towards meeting the target is, or is likely to be, taken to be satisfactory;

3.1.5 provide any other information requested at any time by the Administrator by the date specified in the request to enable the Administrator to determine that:

(a) the target has been met; or

(b) the Operator is complying with the terms of the underlying agreement;

3.1.6 notify the Administrator within 5 working days of the Operator or a facility in a target unit becoming a firm in difficulty, within the meaning of the European Commission Guidelines on State Aid for Rescuing and Restructuring Firms in Difficulty (2004/C 244/02);

3.1.7 provide the responsible person with full authority to carry out his or her functions, including authorisation to accept on behalf of the Operator the service of any notice; and

3.1.8 provide a current UK postal address and an operational email address of the responsible person for service of any notice.

3.2 If the Administrator enters into an underlying agreement before a target has been agreed, conditional upon the Operator providing sufficient information within a specified period in order to set the target for the target unit, the Operator must supply any data requested by the Administrator within the period specified by the Administrator on energy use and throughput of the target unit.

4. OPERATION OF THE REGISTER

4.1 Subject to Rules 4.2 and 4.3, to the extent possible, a Sector Association and an Operator must communicate with the Administrator using the Register.

4.2 Until a Sector Association and an Operator have been notified by the Administrator that the Operator is able to operate an account on its own behalf, an Operator must provide all information to the Sector Association to comply with the obligations of an Operator under an underlying agreement. The Sector Association must then operate the register on behalf of the Operator to provide the information to the Administrator.

4.3 After receiving notification from the Administrator that an Operator is able to operate an account on its own behalf, an Operator must notify the Administrator if it wishes to access its account directly to comply with its obligations under an underlying agreement. If an Operator makes such notification, the Operator must then operate the Register on its own behalf in order to comply with its obligations under an underlying agreement. If an Operator does not make such notification, the Operator must continue to provide all information to the Sector Association to comply with the obligations of an Operator under an underlying agreement and

the Sector Association must continue to operate the register on behalf of the Operator to provide information to the Administrator.

5. CERTIFICATION OF A FACILITY

5.1 The Administrator must certify that a facility is covered by an agreement from the signing of an underlying agreement to the end of the certification period in which the underlying agreement is signed.

5.2 The Administrator must certify that a facility is covered by an agreement for any certification period other than the certification period in which the underlying agreement is signed, where it appears to the Administrator that progress made in the immediately preceding certification period, whether under the underlying agreement or under any previous underlying agreement, towards meeting targets set for the target unit is, or is likely to be, satisfactory.

5.3 For the purposes of this Rule, progress made in the immediately preceding certification period towards meeting targets set for the target unit is, or is likely to be satisfactory only where condition 1 and condition 2 are satisfied.

5.4 Condition 1 is that:

5.4.1 the target set for the target unit for the relevant target period is met, in accordance with Rule 6; or

5.4.2 if the target set for the target unit has not been met, the target unit has paid the buy-out fee in accordance with Rule 7.

5.5 Condition 2 is that obligations imposed under or by virtue of regulations made for the purpose of implementing the EU ETS Directive have been complied with in respect of each facility comprising the target unit.

5.6 If:

5.6.1 a target unit has failed to meet its target in accordance with Rule 6 and the Operator has failed to pay the buy-out fee in accordance with Rule 7;

5.6.2 obligations imposed under or by virtue of regulations made for the purpose of implementing the EU ETS Directive have not been complied with in respect of any facility in a target unit; or

5.6.3 the underlying agreement or umbrella agreement is terminated in accordance with Regulation 17(1)(2), or (3) or Regulation 18,

the Administrator must not certify that the facility or facilities comprising the target unit are covered by an agreement or, where a certificate has been issued, the Administrator must vary the certificate in accordance with paragraph 45 of Schedule 6.

5.7 If:

5.7.1 a facility is not or ceases to be eligible for inclusion in an agreement; or

5.7.2 a facility is excluded from an underlying agreement under Rule 10;

the Administrator must not certify that the facility is covered by an agreement or, where a certificate has been issued, the Administrator must vary the certificate in accordance with paragraph 45 of Schedule 6.

5.8 If the information supplied to the Administrator is insufficient to determine whether:

5.8.1 the target for the target period has been met; or

5.8.2 obligations imposed under or by virtue of regulations made for the purpose of implementing the EU ETS Directive have been complied with in respect of each facility comprising the target unit;

the Administrator may refuse to certify that the facility or facilities are covered by an agreement or, where a certificate has been issued, the Administrator may vary that certificate in accordance with paragraph 45 of Schedule 6.

5.9 Subject to Rule 5.10, if the Administrator does not certify a facility or varies a certificate that has been issued, the Administrator must serve a decision notice on the Sector Association and the Operator of the facility setting out the reasons for the decision, unless a notice of termination has already been served.

5.10 The Administrator is not required to serve a decision notice where a facility has been certified under this Rule and it is subsequently discovered that the target unit for the relevant target period had not been met because of an error in the information originally supplied to the Administrator provided that:

5.10.1 the Sector Association and the Operator have satisfied the Administrator that the error was unintentional; and

5.10.2 the Operator has paid any buy-out fee in accordance with Rule 7.

6. MEETING THE TARGET

6.1 A target unit meets its target for the purpose of Rule 5 if it meets or exceeds the percentage improvement in energy efficiency or carbon efficiency from the base year set out in Schedule 6 to the underlying agreement.

6.2 The Administrator must determine whether the target has been met in accordance with the principles, methodologies and procedures set out in the technical annex.

6.3 An Operator must notify the Administrator on or before 31st January in the year following the end of a target period of any circumstances which may give rise to an adjustment to the target for the previous target period, as set out in the technical annex.

6.4 If an Operator makes a notification under Rule 6.3, the Administrator may adjust the previous target in accordance with the principles, methodologies and calculations set out in the technical annex and must serve a notice on the Operator, setting out:

6.4.1 whether or not it had decided to vary the target; and

6.4.2 any revised target (as varied) for the target unit.

7. BUY-OUT MECHANISM

7.1 If the administrator finds that the target unit has failed to meet its targets:

7.1.1 at any time in the period beginning with 1st May in the year following the end of a target period and ending immediately before the first day of the next certification period; or

7.1.2 at any other time,

the obligation to make progress towards meeting targets may instead be satisfied by the payment to the administrator of a fee in accordance with Rule 7.2.

7.2 If Rule 7.1 applies, the administrator must serve a notice on the Operator containing the following information:

7.2.1 that the target unit has failed to meet its target;

7.2.2 the fee to be paid, calculated in accordance with Rule 7.3 or Rule 7.4;

7.2.3 the date by which the fee must be paid, determined in accordance with Rule 7.5 or Rule 7.6;

7.2.4 to whom the fee must be paid;

7.2.5 how the fee is to be paid; and

7.2.6 that failure to pay the fee in accordance with the notice will result in the issue of a variation certificate in accordance with paragraph 45 of Schedule 6.

7.3 If Rule 7.1.1 applies, the amount of the fee is:

£12 × (W – S)

where W in units of tCO_2 equivalent represents the amount by which the emissions for the target period exceed the target and S in units of tCO_2 equivalent represents any surplus.

7.4 If Rule 7.1.2 applies, the amount of the fee is:

£12 × W

where W in units of tCO_2 equivalent represents the amount by which the emissions for the target period exceed the target.

7.5 If Rule 7.1.1 applies, the fee must be paid on or before 1st July in the year in which the target unit is found to have failed to meet its targets.

7.6 If Rule 7.1.2 applies, the fee must be paid within 30 working days beginning with the date of the notice.

7.7 Payment of the fee is deemed to have been made when the person to whom the fee must be paid as specified in the notice receives full cleared funds.

7.8 For the purposes of calculating the buy-out fee under this Rule and for calculating the amount of any surplus, the Administrator must calculate the difference between the target for the target period and the actual performance achieved during the target period, where the target and the actual performance achieved are expressed in the same units, and convert any difference between the two into a quantity of carbon dioxide equivalent, expressed in units of tCO_2 equivalent, using the principles, methodologies and calculations set out in the technical annex.

8. SURPLUS

8.1 If a facility is excluded from a target unit, the Operator must determine how any surplus should be distributed between the facilities that have been excluded from the target unit and the facilities remaining in the target unit and must notify the Administrator of the redistribution within 20 working days of the facility being excluded from the target unit.

8.2 If an Operator fails to notify the Administrator of the redistribution in accordance with Rule 8.1 any surplus remains with the facilities remaining in the target unit.

8.3 If facilities join a target unit, any surplus attributable to those joining facilities may be used by the target unit as a whole.

9. VARIATION BY INCLUSION OF ADDITIONAL FACILITIES

9.1 A facility which is not already included in another umbrella agreement is eligible at any time to be considered for inclusion in an umbrella agreement where:

9.1.1 it is a facility within the meaning of paragraph 50 of Schedule 6; and

9.1.2 it is a facility undertaking the activities set out in Schedule 3 to an umbrella agreement.

9.2 A facility which is not already included in another underlying agreement is eligible at any time to be considered for inclusion in an underlying agreement where:

9.2.1 it is a facility within the meaning of paragraph 50 of Schedule 6;

9.2.2 it is a facility undertaking the activities set out in Schedule 3 to an umbrella agreement; and

9.2.3 it has the same operator as the operator of the underlying agreement under which it will be included, as set out in the technical annex.

9.3 A facility which is already included in another underlying agreement is eligible to be considered for inclusion in a different underlying agreement on or before 30 September 2013 where:

9.3.1 it is a facility within the meaning of paragraph 50 of Schedule 6;

9.3.2 it is a facility undertaking the activities set out in Schedule 3 to an umbrella agreement; and

9.3.3 it has the same operator as the operator of the underlying agreement under which it will be included, as set out in the technical annex.

9.4 A facility which is already included in another underlying agreement is eligible to be considered for inclusion in a different underlying agreement on or after 1 October 2013 where:

9.4.1 it is a facility within the meaning of paragraph 50 of Schedule 6;

9.4.2 it is a facility undertaking the activities set out in Schedule 3 to an umbrella agreement;

9.4.3 it has the same operator as the operator of the underlying agreement under which it will be included, as set out in the technical annex; and

9.4.4 there has been a change of operator of the facility.

9.5 An additional facility cannot be added to an umbrella agreement or an underlying agreement:

9.5.1 during the final target period under the umbrella agreement or the underlying agreement; or

9.5.2 during the last two months of a target period.

9.6 The administrator may vary the target of a target unit to take account of the inclusion of additional facilities following the principles, methodologies and calculations set out in the technical annex.

9.7 If a Sector Association wishes to add an additional facility to an umbrella agreement or an Operator wishes to add an additional facility to an underlying agreement the Sector Association or the Operator must notify the Administrator not less than two months before the commencement of the next target period setting out:

9.7.1 the name of the Operator of the facility;

9.7.2 the address of the facility;

9.7.3 a description of the facility;

9.7.4 such information as will enable the Administrator to reach a decision on establishing eligibility of the facility, as requested by the Administrator; and

9.7.5 such information as will enable the Administrator to determine the revised target for the target unit, as requested by the Administrator.

9.8 If the Administrator receives a notification under Rule 9.4, the Administrator must serve a notice on the Operator, copied to the Sector Association:

9.8.1 consenting to include the additional facility in an umbrella agreement or an underlying agreement and setting out whether or not it has decided to vary the target, and if so, the revised target (as varied) for the target unit;

9.8.2 refusing consent to include the facility in an umbrella agreement or an underlying agreement, giving reasons for the decision; or

9.8.3 requesting such further information as is required in order to establish eligibility of the facility or reach a decision on the target for the facility.

10. VARIATION BY EXCLUSION OF FACILITIES

10.1 If a Sector Association or an Operator wishes to exclude a facility, or part of it, from an umbrella agreement or an underlying agreement, it must notify the Administrator of the proposed exclusion, setting out:

10.1.1 the name of the Operator of the facility;

10.1.2 the facility number, or a description of the part that is to be excluded; and

10.1.3 the reason for the exclusion.

10.2 If:

10.2.1 a Sector Association or an Operator has notified the Administrator that it wishes to exclude a facility under Rule 10.1; or

10.2.2 the Administrator has terminated an agreement so far as it relates to an individual facility under Regulation 17(4),

the Administrator may vary the target to take account of the exclusion or termination following the principles, methodologies and calculations set out in the technical annex, and may request such information from the Sector Association or the Operator as it requires in order to determine the revised target.

10.3 If the Administrator decides to vary or not to vary the target under Rule 10.2, it must serve a notice on the Operator, copied to the Sector Association, setting out whether or not it has decided to vary the target, and if so the revised target (as varied) for the target unit.

11. VARIATION OF TARGETS IN OTHER CIRCUMSTANCES

11.1 The Administrator may vary the target to take account of:

11.1.1 any structural changes or other changes to the target unit which the Operator must notify to the Administrator under Rule 3.1.2;

11.1.2 any errors in the data provided to the Administrator for the base year; or

11.1.3 in respect of a target unit which has a Novem ratio target, the removal of a product produced in the target period which was produced in the base year.

following the principles, methodologies and calculations set out in the technical annex.

11.2 The Administrator may request any information of a Sector Association or an Operator as it requires in order to determine the revised target under Rule 11.1.

11.3 If the Administrator decides to vary or not to vary a target under Rule 11.1, it must serve a notice on the Operator, copied to the Sector Association, setting out:

11.3.1 whether or not it has decided to vary the target; and

11.3.2 any revised target (as varied) for the target unit.

12. VARIATION OF SECTOR COMMITMENT FOLLOWING A REVIEW

12.1 The sector commitment may be reviewed by the Secretary of State during 2016 for the target periods from 1 January 2017 to 31 December 2018 and from 1 January 2019 to 31 December 2020.

12.2 If the Sector Association and the Secretary of State agree on a variation to the sector commitment following a review, the Secretary of State may issue a direction to the Administrator that the sector commitment must be varied and then the Administrator must serve a variation notice on the Sector Association.

12.3 The variation notice must state:

12.3.1 the agreed variation; and

12.3.2 the date from which the agreed variation will take effect.

12.4 The Sector Association must, within 20 working days of receipt of a variation notice, serve notice on the Administrator setting out the proposed distribution of the revised sector commitment between each target unit under the umbrella agreement.

12.5 The Administrator must:

12.5.1 agree to the proposed distribution and vary the targets of each target unit accordingly;

12.5.2 request further information in relation to the proposed distribution; or

12.5.3 refuse the proposed distribution and propose an alternative distribution, giving reasons for the decision.

12.6 If the Sector Association and the Secretary of State fail to agree on a variation of the sector commitment, either party may refer any dispute as to matters of fact to an adjudicator for adjudication, in accordance with the procedure set out in guidance published by the Secretary of State.

12.7 The adjudicator must, on the basis of representations provided to the adjudicator and any additional information considered necessary by the adjudicator, make a finding on the disputed questions of fact and notify the parties of that finding.

12.8 The adjudicator's finding on a disputed question of fact shall be binding on the parties but it shall be for the Secretary of State and the Sector Association to agree, in the light of that finding, what variations to the sector commitment are required.

12.9 If the Secretary of State and the Sector Association fail to agree on the variation to the sector commitment, the Administrator may terminate the agreement in accordance with Regulation 18.

13. RIGHT OF APPEAL

13.1 If the Administrator:

13.1.1 decides not to certify a facility or to vary a certificate which has been issued;

13.1.2 serves a notice imposing a buy-out fee under Rule 7 upon determining that a target unit has failed to meet its target; or

13.1.3 decides to vary or not to vary the target for a target unit,

the Operator may appeal to the Tribunal against the decision.

13.2 In respect of an Operator which enters into an agreement after 1 April 2013, the Operator may appeal to the Tribunal against the target that has been set for the target unit by the Administrator.

13.3 For the purposes of Rule 13.2, the date on which notice of the decision is deemed to have been sent to the Operator is the later of the date the agreement is entered into or the date the Administrator sends notice to the Operator of the target for the target unit.

13.4 The grounds on which an Operator may appeal under Rule 13.1 and 13.2 are:

13.4.1 that the decision was based on an error of fact;

13.4.2 that the decision was wrong in law;

13.4.3 that the decision was unreasonable;

13.4.4 any other reason.

13.5 The bringing of an appeal suspends the effect of the decision pending final determination by the Tribunal of the appeal or its withdrawal.

13.6 On determining an appeal under these Rules the Tribunal must either:

13.6.1 affirm the decision;

13.6.2 quash the decision; or

13.6.3 vary the decision.

14. RECORDS AND INFORMATION

14.1 A Sector Association and an Operator must retain records of all information required to be supplied to the Administrator under these Rules.

14.2 In particular, an Operator must retain:

14.2.1 sufficient records to allow the Administrator to verify whether a target unit has met its target, including sufficient records to allow the accurate verification of throughput and annual consumption of energy of a target unit; and

14.2.2 records of energy saving actions and measures implemented during each target period.

14.3 A Sector Association and an Operator must make all records which it is required to retain under these Rules available for inspection by the Administrator or a person appointed by the Administrator and must provide copies of such records in response to a request by the date specified in the request.

14.4 All records required to be retained under these Rules must be retained throughout the duration of an agreement and for a period of four years following the termination of an agreement.

15. PUBLICATION AND DISCLOSURE OF INFORMATION

15.1 The Administrator must publish such information as required under the Regulations.

15.2 In respect of the disclosure of information other than disclosure of information required to be published under the Regulations, information supplied by a Sector Association or an Operator to the Administrator or the Secretary of State, to any agent of the Administrator or the Secretary of State, or to any person appointed by the Administrator or Secretary of State to carry out an independent audit, may be disclosed without the consent of the Sector Association or Operator, where such disclosure is:

15.2.1 by the Administrator to the Secretary of State, for any purpose connected with the functions of the Secretary of State;

15.2.2 by the Secretary of State to the Administrator, for any purpose connected with the functions of the Administrator;

15.2.3 to a relevant authority, for any purpose connected with the functions of the relevant authority;

15.2.4 to any person appointed by the Administrator or the Secretary of State to carry out an independent audit;

15.2.5 to an adjudicator appointed under these Rules;

15.2.6 to any person appointed by the Administrator or the Secretary of State to act as agent, consultant, adviser or contractor to the Administrator or the Secretary of State, in connection with the functions of the Administrator of the Secretary of State;

15.2.7 necessary for the purpose of or in connection with any legal proceedings, including the obtaining of legal advice;

15.2.8 required to comply with any Act of Parliament or subordinate legislation made under an Act of Parliament, including requests made under the Freedom of Information Act 2000 or the Environmental Information Regulations 2004; or

15.2.9 required to meet any obligation to the European Union.

15.3 A relevant authority referred to in this Rule means:

15.3.1 either House of Parliament including any committee of either or both Houses;

15.3.2 any Government department;

15.3.3 the European Commission;

15.3.4 the Committee on Climate Change;

15.3.5 the Commissioners of Her Majesty's Revenue and Customs;

15.3.6 a person or body prescribed by or appointed under Part I of the Environmental Protection Act 1990 or regulations made under section 2 of the Pollution Prevention and Control Act 1999 or any corresponding legislation for Northern Ireland;

15.3.7 any regulator appointed under section 54 of the Competition Act 1998; or

15.3.8 any other public body, regulatory agency or government advisory body, where in the absolute discretion of the Administrator or the Secretary of State, as appropriate, the Administrator or Secretary of State considers that it would be obliged to disclose such information in response to a request for information under the Freedom of Information Act 2000 or the Environmental Information Regulations 2004, if such a request were made.

16. COLLECTION OF CHARGES

16.1 A Sector Association may request the consent of the Administrator to collect charges due from Operators to the Administrator in respect of facilities under the charging scheme.

16.2 If a Sector Association wishes to collect charges due from an Operator to the Administrator under the charging scheme, the Sector Association may serve a notice in writing on the Administrator by the last working day in February in the calendar year in which the charges fall due.

16.3 A notice served under Rule 16.2 must specify the facilities in respect of which the Sector Association intends to collect charges, being not fewer than 50% of the facilities covered by an umbrella agreement.

16.4 Following receipt of the notice, the Administrator must:

16.4.1 consent to the Sector Association collecting charges; or

16.4.2 refuse consent to the Sector Association collecting charges, giving reasons for the decision.

16.5 If the Administrator consents to the Sector Association collecting charges the Sector Association must:

16.5.1 itemise charges separately in any invoices that it issues in respect of charges;

16.5.2 collect and remit all charges collected to the Administrator without deduction or set off by the last working day in September in each year;

16.5.3 prepare an annual report to the Administrator by the last working day in October in the year in which it has collected charges setting out which Operators it has collected charges from and which Operators have failed to pay charges due to the Sector Association.

16.6 A Sector Association must not actively pursue any outstanding charges after the last working day in September in any year in which they fall due. If a Sector Association receives charges after this date the Sector Association must accept the payment and remit this to the Environment Agency along with information identifying the Operator making the payment.

16.7 If a Sector Association fails to comply with any of its obligations under this Rule the Administrator may serve a notice on the Sector Association that consent to the Sector Association continuing to collect charges is withdrawn at the expiry of 20 working days from the date of the notice.

17. SERVICE OF NOTICES

17.1 Any notice served under these Rules must be in writing and may be served by sending it by post or electronically.

17.2 The address for the service of all notices on the Administrator is:

Postal: Environment Agency
Lutra House
Dodd Way, Off Seedlee Road
Walton Summit, Bamber Bridge,
Preston, Lancs
PR5 8BCX

Electronic: CCA-operations@environment-agency.gov.uk

17.3 The address for the service of all notices on the Sector Association is the address of the person set out in Schedule 2 to the umbrella agreement.

17.4 The address for the service of all notices on the Operator is the address of the responsible person.

SCHEDULE 2

THE OPERATOR

Telehouse International Ltd

Whose address for service of all notices under this Agreement is
By post:
Coriander Avenue
London
E14 2AA
England

Administrative contact
Suzanne Lee

Electronically:
suzanne.lee@uk.telehouse.net

SCHEDULE 3

THE SECTOR ASSOCIATION

Information Technology Telecommunications and Electronics Association (techUK)

Whose address for service of all notices under this Agreement is
By post:
10 St Bride Street
London
EC4A 4AD
England

Sector Contact
Ms. Emma Fryer

Electronically:
emma.fryer@techuk.org

THE UMBRELLA AGREEMENT

The Agreement dated 17 Apr 2014 made between the Administrator and the Sector Association.

SCHEDULE 4

ACTIVITIES UNDERTAKEN BY A FACILITY FALLING WITHIN THE SECTOR

The business activity is the leasing or licensing of a data facility which is being used as a data centre.

'data facility' means a room, or rooms sharing the same electricity supply circuit, occupied mainly or exclusively by computer equipment which is enabled to transfer data electronically, and where in respect of the room or rooms—
(a) the temperature and humidity is regulated in connection with the operation of the computer equipment;
(b) the electricity supply is at least 200kW; and
(c) electricity is supplied by a back-up electricity supply when the mains supply is interrupted.

SCHEDULE 5

FACILITIES TO WHICH THIS AGREEMENT APPLIES

Facility Identifier	Site Name & Address	EU ETS Identification / NAP number
DATC/F00091	Telehouse Coriander Avenue, London, E14 2AA, England	

SCHEDULE 6

TARGET UNIT TARGET

The throughput of the target unit shall be given in the following units:

IT energy (MWh)

The throughput of the target unit in the agreed base year was (number of units):

124,499.089

The primary energy consumption of the target unit shall be given in the following units:

kWh

The primary energy consumption of the target unit in the agreed base year was (number of units):

300,696,609

The targets are Relative in Energy:

TU Identifier	Target period	Target in kWh/IT energy (MWh) (percentage reduction from base year)
DATC/T00031	1 January 2013 to 31 December 2014	2,386.946 (1.172%)
	1 January 2015 to 31 December 2016	2,179.386 (9.766%)
	1 January 2017 to 31 December 2018	2,026.057 (16.114%)
	1 January 2019 to 31 December 2020	1,990.676 (17.579%)

SCHEDULE 7

VALUE OF FINANCIAL PENALTY

54,289 GBP
See CCA operations manual.

APPENDIX 03

TS New SBGs Manufacturer Spec (MTU 20V4000G94LF) and SCR Spec

AVK

THE POWER PEOPLE

Acoustic Technical Submittal JN430890

Head Office: AVK, Power Systems House, Malvern Road, Maidenhead, SL6 7RE Tel: 01628 503900 sales@avk-seg.co.uk

Maidenhead: 01628 503900 **London:** 020 3856 7210 **Huddersfield:** 01484 860238 **Dublin:** 01431 9847

1.0 Technical Submission Front Page

Trade Contractor:	AVK-SEG (UK) Ltd	**From:**	Darren Hadland
Trade Contractor Sub No:	Jn430890 TS – 06 TSX002-AVK-SSB-XX-TS-X-000002	**Date:**	24/05/2023
Revision:	00		
Reason for Revision	Initial Issue		

Approval of the following equipment is required:

Equipment:	Generator Acoustic Container	**Make:**	AVK
Equipment References:	DS4000 Generating Set	**Areas Used:**	Telehouse Generator Room
Description:	Supply and Installation of 4 no. 65dB(A) @1m bespoke containers for MTU DS4000 Generating Sets with remote Dry Air-cooling system for each		
Planned On Site Date:	See project schedule		

Attached detail documents:

(Tick if included and Insert references within boxes identifying supporting documentation included within this submission)

Description	Tick	Section	Description	Tick	Doc Ref
Technical submission front sheet	✓	1.0	*Interfaces & Dependencies Schedule*	✓	6.0
Equipment Description	✓	2.0	*Builders Work Requirements*	X	7.0
List of Exceptions & Clarifications	✓	3.0	*Schedule of Comments*	X	8.0
Manufacturers Documents	✓	4.0	*Appendices*	✓	9.0
Certified Drawings	X	5.0			

Signed by Trade Contractor:	Darren Hadland
Date:	24/05/2023

Approval:

Company	Sign	Date	Status	Comments
Client				

Note: If client sign off and/or comments have not been received within 2 weeks of the date stated on this technical submission then the products and/or services detailed in the technical submission are deemed to be acceptable and final technical submission from AVK Projects will be based upon the scope covered within this document.

2.0 – Equipment Description

2.1 Overview

The bespoke generators are to be installed into Telehouse South in 2 rows of 2 containers within the generator room to begin with (totalling 4 Generators), future scope for an additional 2 rows of 3 containers (totalling 10 Generators within the generator room). Containers have been designed to reduce acoustic sound pressure from internally installed components, including the Generator to meet the required sound pressure of **65dB(A) @ 1.0m (external to generator enclosure), with one unit running at 100% in free field conditions.**

Acoustic limits of 65dB(A) @ 1.0m also applies to critical power and remote dry air-cooling systems.

Container and Attenuation overview:

Cooling air flow:	= 25m^3/s
Combustion air flow:	= 4.7m^3/s
Design Inlet air flow:	= 29.7 m^3/s
Pressure drop allowance:	= 300Pa
Attenuation pressure drop	= 248.0Pa

Each container will also be supplied with a remote dry air cooling (DAC) installed at roof level. DAC noise level has been controlled to **63dB(A) @ 1.0m** by setting the max cooling fan RPM to 63%.

See the following appendixes for further details:

Appendix 9.01 - Generator Datasheet

Appendix 9.02 - Engine Surface Noise Datasheet

Appendix 9.03 - Dry Air Cooler Datasheet

2.2 Enclosure

4 no weatherproof acoustic containers each sized 10,000mm (L) x 3,500mm (W) x 3,800mm(H).

Constructed using 150mm thick preformed construction comprising of corrugated skin sides and a 0.7mm thick galvanised perforated steel inner skin. The intervening space packed with high-density mineral wool and additional high mass layers as required. The floor is finished in bunded steel durbar plate with generator mounting pads.

Access to the container will be via Three single access hinged lockable personnel doors provide access to the sides of the enclosure. All access doors complete with locking handles and internal handles, heavy duty rubber seals, door retainers and have latches and handles which allow doors to be lifted off.

Walls / Enclosure 64.8 dB(A) @ 1.0 m ΔP N/A Pa

See the following appendixes for further details:

Appendix 9.04 - Container and Attenuation Acoustic Calculations

2.3 Inlet Attenuation

Container cooling and combustion air will be provided by 1 no container roof mounter attenuator.

Louver motorised fire damper Model number BSB PM24-TF with a thermal fuse of 72°C will be provided and will close when instructed. This can be utilised by extinguisher system to close the inlet fire damper when required to restrict fire and smoke breakout from the canopy.

Attenuation details:

Height = 2.75 m

Width = 3.30 m

Length = 2.10 m

Airflow Volume = 29.7 m^3/s

Inlet Attenuator sound pressure = **64.8 dB(A) @ 1.0 m ΔP 90.4 Pa**

Attenuation Octave breakdown

Freq	31.5	63	125	250	500	1000	2000	4000	8000
L		80.0	77.0	58.0	42.0	44.0	45.0	44.0	62.0
Atten	0	-26	-16	-9	-3	0	1	1	-1
L (A)	0.0	54.0	61.0	49.0	39.0	44.0	46.0	45.0	61.0
Total	**64.80**	dBA							

BSB PM24-TF Details:

Motor sound Pressure = 34.01dB(a) (Sound power = 45 dB(a))

Spring return = 62 dB(A)

See the following appendixes for further details:

Appendix 9.04 - Container and Attenuation Acoustic Calculations

Appendix 9.05 - BSB PM24-TF Motor Datasheet

2.4 Outlet Attenuation

Container air outlet will be provided by 1 no container roof mounter outlet attenuator.

As with the inlet attenuator, Louver motorised fire damper Model number BSB PM24-TF with a thermal fuse of 72°C will be provided and will close when instructed. This can be utilised by extinguisher system to close the inlet fire damper when required to restrict fire and smoke breakout from the canopy.

Height	= 1.75 m
Width	= 3.30 m
Length	= 3.00 m
Airflow Volume	= 25 m^3/s
Outlet Attenuator sound pressure	= **62.7 dB(A) @ 1.0 m ΔP 157.6 Pa**

Attenuation Octave breakdown

Freq	31.5	63	125	250	500	1000	2000	4000	8000
L		77.0	71.0	51.0	47.0	49.0	50.0	48.0	61.0
Atten	0	-26	-16	-9	-3	0	1	1	-1
L (A)	0.0	51.0	55.0	42.0	44.0	49.0	51.0	49.0	60.0
Total	**62.7**	dBA							

BSB PM24-TF Details:

Motor sound Pressure	= 34.01dB(a) (Sound power = 45 dB(a))
Spring return	= 62 dB(A)

See the following appendixes for further details:

Appendix 9.04 - Container and Attenuation Acoustic Calculations

Appendix 9.05 - BSB PM24-TF Motor Datasheet

2.5 Combustion air flow fan

Combustion airflow will be provided by and internally installed fan within the attenuations. The model SC100P4-A6/14, will provide an airflow of 7.50 m³/s to meet the engines 4.7 m³/s combustion air requirement, with a static pressure of 328Pa and total of 383Pa.

Fan Inlet Octave breakdown

Freq	31.5	63	125	250	500	1000	2000	4000	8000
L		98.0	90.0	96.0	94.0	94.0	94.0	93.0	88.0
Atten	0	0	0	0	0	0	0	0	0
L (A)	0.0	98.0	90.0	96.0	94.0	94.0	94.0	93.0	88.0
Total	**103.31**	dBA							

Fan Outlet Octave breakdown

Freq	31.5	63	125	250	500	1000	2000	4000	8000
L		99.0	92.0	95.0	92.0	92.0	93.0	92.0	87.0
Atten	0	0	0	0	0	0	0	0	0
L (A)	0.0	99.0	92.0	95.0	92.0	92.0	93.0	92.0	87.0
Total	**103.00**	dBA							

See the following appendixes for further details:

Appendix 9.04 - Container and Attenuation Acoustic Calculations

Appendix 9.06 - Fan SC100P4-A6-14 Datasheet

2.6 Remote Dry Air Cooling

Each generator has its own V-Bank type remote air-cooling system, located on the roof of Telehouse south.

The fans for the cooling system have been RPM rated to 63%, to ensure a noise pressure level of 63dB(A) @ 1.0 m. RPM Rated if set to 100% will give a sound pressure value of 74.01dB(A) @ 1.0 m.

Octave breakdown at 100% Fan RPM rating

Frequency (Hz)	125	250	500	1000	2000	4000	8000
Sound power (dB(A))	86,6	76,9	74,2	78,0	80,8	76,3	71,1

See the following appendixes for further details:

Appendix 9.03 - Dry Air Cooler Datasheet

2.7 Exhaust and SCR System

Each container will be provided with roof penetration for the exhaust system and is designed to support the weight of a roof mounted exhaust silencer and SCR system. The combined acoustic performance of the exhaust system shall meet the 65dB(A) @ 1m with genset running at 100%.

See the following appendixes for further details:

Appendix 9.07 - SCR Specification

3.0 - List of Exceptions & Clarifications

N/A

4.0 - Manufacturers Documents

See list of appendices in section 9.0

5.0 - Certified Drawings

Provided as separate attachments.

6.0 – Interfaces and Dependencies Schedule

Auxiliary Supply Required	Detail	Quantity Required	Provided By	Final Connection By

Note: The above list is based on initial design information and may be subject to change as the project progresses.

7.0 - Builders Work Requirements

To be issued separately following completion of detailed design.

8.0 – Schedule of Comments

The following table provides a schedule of all comments required against this document and details the AVK response and status of each comment.

Item	Client Comment	AVK Response	Status

Note: Client to advise status of comment from the following list;

- Accepted (no further action)

- Rejected (refer to comments)

9.0 – Appendices

Item	Document Name
9.01	Generator Datasheet
9.02	Engine surface noise Datasheet
9.03	Dry Air Cooler Datasheet
9.04	Container and Attenuation acoustic calculations
9.05	BSB PM24-TF Motor Datasheet
9.06	Fan SC100P4-A6-14 Datasheet
9.07	SCR Specification

APPENDIX 9.01

Generator Datasheet

Technical Sales Document

- Product Data -

A Rolls-Royce solution

Name	20V4000G94LF	**Speed [rpm]**	1500
Application Group	3D	**Nominal power [kW]**	3308
Dataset	Ref. 25°C/45°C	**Nominal power [bhp]**	4436
		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50
Exhaust Regulations	NEA Singapore for ORDE;		

Reference conditions

No.	Description	Index	Value	Unit
6	Intake air temperature		25	°C
7	Charge-air coolant temperature		45	°C
8	Barometric pressure		1000	mbar
9	Site altitude above sea level		100	m

[BL] **Reference value: fuel stop power**
Maximum engine power that cannot be run continuously on some applications (stabilization reserve)
[DL] **Reference value: continuous power**
Engine power that can be run continuously under standard conditions

[>] **Actual value must be greater than specified value**
[<] **Actual value must be less than specified value**

[X] **Applicable**
The module is valid for this product type
[-] **Non-applicable**
The module is not valid for this product type
[N] **Value not named**
The value has not yet been named or will not be named

[*] **Adequate verification not yet available (tolerance +/- 10%)**
[**] **Adequate verification not yet available (tolerance +/- 5%)**

[A] **Design value**
Value required for the design of an external system (plant)
[R] **Guideline value**
Typical average value as information – only suitable for design purposes to a limited extent
[L] **Limit value**
A value representing the lower limit/minimum value or upper limit/maximum value that may not be exceeded. Not suitable for design purposes

Technical Sales Document

- Product Data -

A Rolls-Royce solution

Name	20V4000G94LF	**Speed [rpm]**	1500
Application Group	3D	**Nominal power [kW]**	3308
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		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50
Exhaust Regulations	NEA Singapore for ORDE;		

0. Data-relevant engine design configuration

No.	Description	Index	Value	Unit
13	Engine without sequential turbocharging (turbochargers without cut-in/cut-out control)		X	-

[BL] **Reference value: fuel stop power**
Maximum engine power that cannot be run continuously on some applications (stabilization reserve)
[DL] **Reference value: continuous power**
Engine power that can be run continuously under standard conditions

[>] **Actual value must be greater than specified value**
[<] **Actual value must be less than specified value**

[X] **Applicable**
The module is valid for this product type
[-] **Non-applicable**
The module is not valid for this product type
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[A] **Design value**
Value required for the design of an external system (plant)
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Technical Sales Document

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A Rolls-Royce solution

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Application Group	3D	**Nominal power [kW]**	3308
Dataset	Ref. 25°C/45°C	**Nominal power [bhp]**	4436
		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50
Exhaust Regulations	NEA Singapore for ORDE;		

1. Power-related data

No.	Description	Index	Value	Unit
1	Engine rated speed	A	1500	rpm
3	Mean piston speed		10.5	m/s
5	Fuel stop power ISO 3046	A	3308	kW
9	Mean effective pressure (MEP) (Fuel stop power ISO 3046)		27.8	bar

[BL] **Reference value: fuel stop power**
Maximum engine power that cannot be run continuously on some applications (stabilization reserve)
[DL] **Reference value: continuous power**
Engine power that can be run continuously under standard conditions

[>] **Actual value must be greater than specified value**
[<] **Actual value must be less than specified value**

[X] **Applicable**
The module is valid for this product type
[-] **Non-applicable**
The module is not valid for this product type
[N] **Value not named**
The value has not yet been named or will not be named

[*] **Adequate verification not yet available (tolerance +/- 10%)**
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Value required for the design of an external system (plant)
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Technical Sales Document

- Product Data -

A Rolls-Royce solution

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Dataset	Ref. 25°C/45°C	**Nominal power [bhp]**	4436
		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50
Exhaust Regulations	NEA Singapore for ORDE;		

2. General Conditions (for maximum power)

No.	Description	Index	Value	Unit
46	Individual power calculation (ESCM) required for maximum power		X	-
3726	Site altitude above sea level, max. (special hardware required for altitudes > site altitude)	L	1300	m
3727	Special hardware for altitude > site altitude needed (see chapter 2, item No. 3726)		X	-
1	Intake air depression (new filter)	A	15	mbar
2	Intake air depression, max.	L	30	mbar
51	Exhaust overpressure (total pressure against atmosphere)	A	30	mbar
52	Exhaust overpressure, max. (total pressure against atmosphere)	L	50	mbar
5	Fuel temperature at fuel feed connection	R	25	°C
6	Fuel temperature at fuel feed connection, max.	L	55	°C

[BL] **Reference value: fuel stop power**
Maximum engine power that cannot be run continuously on some applications (stabilization reserve)
[DL] **Reference value: continuous power**
Engine power that can be run continuously under standard conditions

[>] **Actual value must be greater than specified value**
[<] **Actual value must be less than specified value**

[X] **Applicable**
The module is valid for this product type
[-] **Non-applicable**
The module is not valid for this product type
[N] **Value not named**
The value has not yet been named or will not be named

[*] **Adequate verification not yet available (tolerance +/- 10%)**
[**] **Adequate verification not yet available (tolerance +/- 5%)**

[A] **Design value**
Value required for the design of an external system (plant)
[R] **Guideline value**
Typical average value as information – only suitable for design purposes to a limited extent
[L] **Limit value**
A value representing the lower limit/minimum value or upper limit/maximum value that may not be exceeded. Not suitable for design purposes

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Dataset	Ref. 25°C/45°C	**Nominal power [bhp]**	4436
		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50
Exhaust Regulations	NEA Singapore for ORDE;		

3. Consumption

No.	Description	Index	Value	Unit
56	Specific fuel consumption (be) - 100 % FSP (+ 5 %; EN 590; 42.8 MJ/kg)	R	202	g/kWh
57	Specific fuel consumption (be) - 75 % FSP (+ 5 %; EN 590; 42.8 MJ/kg)	R	198	g/kWh
58	Specific fuel consumption (be) - 50 % FSP (+ 5 %; EN 590; 42.8 MJ/kg)	R	215	g/kWh
59	Specific fuel consumption (be) - 25 % FSP (+ 5 %; EN 590; 42.8 MJ/kg)	R	233	g/kWh
73	No-load fuel consumption	R	50	kg/h
92	Lube oil consumption after 100 h of operation (B = fuel consumption per hour) Guideline value does not apply for the design of EGAT systems. Please consult the Applications Center with regard to the layout of EGA systems.	R	0.2	% of B
62	Lube oil consumption after 100 h of operation, max. (B = fuel consumption per hour)	L	0.5	% of B

[BL] **Reference value: fuel stop power**
Maximum engine power that cannot be run continuously on some applications (stabilization reserve)
[DL] **Reference value: continuous power**
Engine power that can be run continuously under standard conditions

[>] **Actual value must be greater than specified value**
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Technical Sales Document

- Product Data -

A Rolls-Royce solution

Name	20V4000G94LF	**Speed [rpm]**	1500
Application Group	3D	**Nominal power [kW]**	3308
Dataset	Ref. 25°C/45°C	**Nominal power [bhp]**	4436
		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50
Exhaust Regulations	NEA Singapore for ORDE;		

4. Model-related data (basic design)

No.	Description	Index	Value	Unit
3	Engine with exhaust turbocharger (ETC) and intercooler		X	-
4	Exhaust piping, non-cooled		X	-
33	Working method: four-cycle, diesel, single-acting		X	-
34	Combustion method: direct injection		X	-
36	Cooling system: conditioned water		X	-
37	Direction of rotation: c.c.w. (facing driving end)		X	-
6	Number of cylinders		20	-
7	Cylinder configuration: V angle		90	degrees (°)
10	Bore		170	mm
11	Stroke		210	mm
12	Displacement, cylinder		4.77	liter
13	Displacement, total		95.4	liter
14	Compression ratio		16.4	-
40	Cylinder heads: single-cylinder		X	-
41	Cylinder liners: wet, replaceable		X	-
49	Piston design: solid-skirt piston		X	-
21	Number of piston compression rings		2	-
22	Number of piston oil control rings		1	-
24	Number of inlet valves, per cylinder		2	-
25	Number of exhaust valves, per cylinder		2	-
15	Number of turbochargers		2	-
16	Number of L.P. turbochargers		2	-
18	Number of intercoolers		1	-

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Maximum engine power that cannot be run continuously on some applications (stabilization reserve)
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		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50

Exhaust Regulations NEA Singapore for ORDE;

19	Number of L.P. intercoolers		1	-
28	Standard flywheel housing flange (engine main PTO)		00	SAE
50	Static bending moment at standard flywheel housing flange, max.	L	15	kNm
51	Dynamic bending moment at standard flywheel housing flange, max.	L	75	kNm
43	Flywheel interface (DISC)		21	-

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		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50
Exhaust Regulations	NEA Singapore for ORDE;		

5. Combustion air / exhaust gas

No.	Description	Index	Value	Unit
27	Charge-air pressure before cylinder - FSP	R	4.0	bar abs
10	Combustion air volume flow - FSP	R	4.7	m³/s
12	Exhaust volume flow (at exhaust temperature) - FSP	R	11.9	m³/s
14	Exhaust temperature before turbocharger - FSP	R	693	°C
4083	Exhaust temperature after engine - FSP (Position of interface according to installation drawing)	R	482	°C

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		Nominal power [kWel]	-
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Exhaust Regulations	NEA Singapore for ORDE;		

6. Heat dissipation

No.	Description	Index	Value	Unit
16	Heat dissipated by engine coolant - FSP with oil heat, without charge-air heat	R	1270	kW
27	Charge-air heat dissipation - FSP	R	930	kW
32	Heat dissipated by return fuel flow - FSP	R	7.5	kW
34	Radiation and convection heat, engine - FSP	R	105	kW

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		Nominal power [kWel]	-
		Frequency [Hz]	50
Exhaust Regulations	NEA Singapore for ORDE;		

7. Coolant system (high-temperature circuit)

No.	Description	Index	Value	Unit
17	Coolant temperature (at engine outlet to cooling equipment)	A	100.0	°C
57	Coolant temperature differential after/before engine, from	R	10.0	K
58	Coolant temperature differential after/before engine, to	R	12.0	K
23	Coolant temperature differential after/before engine	L	14.0	K
20	Coolant temperature after engine, limit 1	L	102.0	°C
21	Coolant temperature after engine, limit 2	L	104.0	°C
25	Coolant antifreeze content, max.	L	50	%
30	Cooling equipment: coolant flow rate	A	80.0	m³/h
127	Cooling equipment: coolant flow rate at max. pressure loss in off-engine cooling System (see chapter 7, item No. 41)	A	75	m³/h
128	Cooling equipment: coolant flow rate at min. pressure loss in off-engine cooling System (see chapter 7, item No. 72)	A	80	m³/h
31	Coolant pump: pressure differential	R	2.25	bar
35	Coolant pump: inlet pressure, min.	L	0.50	bar
36	Coolant pump: inlet pressure, max.	L	2.50	bar
39	Engine: coolant pressure differential with thermostat	R	1.70	bar
41	Pressure loss in off-engine cooling system, max.	L	0.70	bar
72	Pressure loss in off-engine cooling system, min.	L	0.3	bar
43	Pressure loss in off-engine cooling system, max. without thermostat	L	0.70	bar
70	Pressure loss in off-engine cooling system, min. without thermostat	L	0.3	bar

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		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50

Exhaust Regulations NEA Singapore for ORDE;

47	Breather valve (expansion tank) opening pressure (excess pressure)	R	1.00	bar
54	Cooling equipment: height above engine, max.	L	15	m
53	Cooling equipment: operating pressure	A	2.50	bar
74	Coolant level in expansion tank, below min. shutdown	L	X	-
50	Thermostat, starts to open	R	79.0	°C
51	Thermostat, bypass closed	R	92.0	°C
52	Thermostat, fully open	R	92.0	°C
48	Breather valve (expansion tank) opening pressure (depression)	R	-0.1	bar
49	Pressure in cooling system, max.	L	5.00	bar

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		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50
Exhaust Regulations	NEA Singapore for ORDE;		

8. Coolant system (low-temperature circuit)

No.	Description	Index	Value	Unit
53	Coolant temperature (at engine outlet to cooling equipment)	R	70.0	°C
9	Coolant temperature before intercooler (at engine inlet from cooling equipment)	A	45.0	°C
14	Coolant temperature before intercooler, limit 1	L	75.0	°C
15	Coolant temperature before intercooler, limit 2	L	78.0	°C
54	Coolant temperature differential after/before intercooler, min.	L	18.0 *	K
55	Coolant temperature differential after/before intercooler, max.	L	30.0 *	K
13	Coolant antifreeze content, max.	L	50	%
17	Charge-air temperature after intercooler, max.	L	80.0	°C
76	Temperature differential between intake air and charge-air coolant before intercooler	A	20.0	K
75	Temperature differential between intake air and charge-air coolant before intercooler, max.	L	22.0	K
56	Coolant pump: flow rate	A	44.0	m³/h
18	Coolant pump: flow rate (± 5 %)	R	44.0	m³/h
20	Cooling equipment: coolant flow rate	A	44.0	m³/h
80	Cooling equipment: coolant flow rate at max. pressure loss in off-engine cooling system	A	43	m³/h
81	Cooling equipment: coolant flow rate at min. pressure loss in off-engine cooling system	A	50	m³/h
21	Intercooler: coolant flow rate	R	44.0	m³/h
24	Coolant pump: inlet pressure, min.	L	0.5	bar
25	Coolant pump: inlet pressure, max.	L	2.5	bar
29	Pressure loss in off-engine cooling system, max.	L	1.0	bar

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		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50

Exhaust Regulations NEA Singapore for ORDE;

62	Pressure loss in off-engine cooling system, min.	L	0.3	bar
31	Pressure loss in off-engine cooling system, max. without thermostat	L	1.0	bar
63	Pressure loss in off-engine cooling system, min. without thermostat	L	0.3	bar
43	Cooling equipment: height above engine, max.	L	15	m
36	Breather valve (expansion tank) opening pressure (excess pressure)	R	1.00	bar
37	Breather valve (expansion tank) opening pressure (depression)	R	-0.10	bar
42	Cooling equipment: operating pressure	A	2.50	bar
68	Coolant level in expansion tank, below min. shutdown	L	X	-
39	Thermostat, starts to open	R	38.0	°C
40	Thermostat, bypass closed	R	51.0	°C
41	Thermostat, fully open	R	51.0	°C

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		Nominal power [kVA]	-
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Exhaust Regulations	NEA Singapore for ORDE;		

10. Lube oil system

No.	Description	Index	Value	Unit
1	Lube oil operating temp. before engine, from	R	85	°C
2	Lube oil operating temp. before engine, to	R	98	°C
3	Lube oil operating temp. after engine, from	R	98	°C
4	Lube oil operating temp. after engine, to	R	108	°C
5	Lube oil temperature before engine, limit 1	L	99	°C
6	Lube oil temperature before engine, limit 2	L	101	°C
7	Lube oil operating pressure before engine (measuring block)	R	5.1	bar
8	Lube oil operating press. bef. engine, from	R	4.3	bar
9	Lube oil operating press. bef. engine, to	R	7.1	bar
33	Lube oil pressure before engine, limit 1(speed-related value, consult Rolls-Royce Solutions GmbH)	L	3.5	bar
34	Lube oil pressure before engine, limit 2 (speed-related value, consult Rolls-Royce Solutions GmbH)	L	3.2	bar
17	Lube oil pump(s): oil flow, total	R	835	liter/min
19	Lube oil fine filter (main circuit): number of units		1	-
20	Lube oil fine filter (main circuit): number of elements per unit		5	-
21	Lube oil fine filter (main circuit): particle retention	R	0.012	mm
32	Lube oil fine filter (main circuit): pressure differential, max.	L	1.5	bar
35	Lube oil fine filter (main circuit): make (standard): MANN & HUMMEL		X	-

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		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50
Exhaust Regulations	NEA Singapore for ORDE;		

11. Fuel system

No.	Description	Index	Value	Unit
1	Fuel pressure at engine fuel feed connection, min. (when engine is starting)	L	-0.1	bar
2	Fuel pressure at engine fuel feed connection, max. (when engine is starting)	L	1.5	bar
57	Fuel pressure at engine fuel feed connection, min. (when engine is running)	L	-0.3	bar
65	Fuel pressure at engine fuel feed connection, max. (when engine is running)	L	0.5	bar
37	Fuel supply flow, max.	A	*	liter/min
4211	Max. fuel supply volume Normal mode	A	20.1	liter/min
4212	Max. fuel supply volume Failure mode	A	22.6	liter/min
4	Fuel pressure before injection pump, from (high-pressure pump)	R	7.0	bar
5	Fuel pressure before injection pump, to (high-pressure pump)	R	9.0	bar
6	Fuel pressure before injection pump, min. (high-pressure pump)	L	5.0	bar
7	Fuel pressure before injection pump with engine not running, max. (high-pressure pump)	L	1.5	bar
4213	Max. fuel return volume Normal mode	A	5.5	liter/min
4214	Max. fuel return volume Failure mode	A	21.8	liter/min
10	Fuel pressure at return connection on engine, max.	L	0.5	bar
18	Fuel fine filter (main circuit): number of units	A	1	-
19	Fuel fine filter (main circuit): number of elements per unit	A	2	-

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		Nominal power [kVA]	-
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Exhaust Regulations NEA Singapore for ORDE;

21	Fuel fine filter (main circuit): pressure differential, max.	L	2.0	bar

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		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50
Exhaust Regulations	NEA Singapore for ORDE;		

12. General operating data

No.	Description	Index	Value	Unit
1	Cold start capability: air temperature (w/o starting aid, w/o preheating) - (case A)	R	10	°C
2	Additional condition (to case A): engine coolant temperature	R	10	°C
3	Additional condition (to case A): lube oil temperature	R	10	°C
4	Additional condition (to case A): lube oil viscosity	R	15W40	SAE
9	Cold start capability: air temperature (w/o starting aid, w/ preheating) - (case C)	R	0	°C
10	Additional condition (to case C): engine coolant temperature	R	40	°C
11	Additional condition (to case C): lube oil temperature	R	-10	°C
12	Additional condition (to case C): lube oil viscosity	R	15W40	SAE
21	Coolant preheating, heater performance (standard)	R	9.0	kW
22	Coolant preheating, preheating temperature, min.	L	32	°C
3506	Coolant preheating, preheating temperature, max.	L	55	°C
28	Breakaway torque (without driven machinery) coolant temperature +5°C	R	2600	Nm
30	Breakaway torque (without driven machinery) coolant temperature +40°C	R	2200	Nm
29	Cranking torque at firing speed (without driven machinery) coolant temperature +5°C	R	1400	Nm
31	Cranking torque at firing speed (without driven machinery) coolant temperature +40°C	R	1100	Nm
37	High idling speed, max. (static)	L	1613	rpm
38	Limit speed for overspeed alarm / emergency shutdown	L	1950	rpm
39	Limit speed for overspeed alarm	L	1950	rpm

[BL] **Reference value: fuel stop power**
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Technical Sales Document

- Product Data -

A Rolls-Royce solution

Name	20V4000G94LF	**Speed [rpm]**	1500
Application Group	3D	**Nominal power [kW]**	3308
Dataset	Ref. 25°C/45°C	**Nominal power [bhp]**	4436
		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50

Exhaust Regulations NEA Singapore for ORDE;

42	Firing speed, from	R	80	rpm
43	Firing speed, to	R	120	rpm
44	Engine coolant temperature before starting full-load operation, recommended min. (for emergency/standby sets with coolant preheating the minimum preheating temperature referred to extended property No.22 is sufficient)	R	60	°C
3515	Minimum continuous load (operation > 10h)	R	30	kW/cyl
50	Engine mass moment of inertia (without flywheel)	R	24.6	kgm²
52	Standard flywheel mass moment of inertia	R	10.2	kgm²
51	Engine mass moment of inertia (with standard flywheel)	R	34.8	kgm²
69	Speed droop (with electronic governor) adjustable, from	R	0	%
70	Speed droop (with electronic governor) adjustable, to	R	7	%
95	Number of starter ring-gear teeth on engine flywheel		182	-

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- Product Data -

A Rolls-Royce solution

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Application Group	3D	**Nominal power [kW]**	3308
Dataset	Ref. 25°C/45°C	**Nominal power [bhp]**	4436
		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50
Exhaust Regulations	NEA Singapore for ORDE;		

13. Starting (electric)

No.	Description	Index	Value	Unit
2309	Manufacturer		Delco	-
4101	Type		50MT	-
2310	Number of starter		2	-
2312	Starter electrically redundant		-	-
2313	Rated power per starter	R	9	kW
2314	Starter, rated voltage	R	24	VDC
2315	Rated short-circuit current per starter	L	1900	A
2316	Power consumption per starter (at an engine speed of 100 rpm)	R	580	A
2317	Internal resistance of power supply + line resistance per starter	A	0.008	Ω
2318	Manufacturer		Bosch	-
4118	Type		HEP	-
2319	Number of starter		2	-
2320	Starter electrically redundant		-	-
2321	Rated power per starter	R	11.3	kW
2322	Starter, rated voltage	R	24	VDC
2323	Rated short-circuit current per starter	L	2190	A
2324	Power consumption per starter (at an engine speed of 100 rpm)	R	750	A
2325	Internal resistance of power supply + line resistance per starter	A	0.0047	Ω
2326	Manufacturer		Prestolite	-
4119	Type		S-152	-
2327	Number of starter		1	-
2328	Starter electrically redundant		-	-

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- Product Data -

A Rolls-Royce solution

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Application Group	3D	**Nominal power [kW]**	3308
Dataset	Ref. 25°C/45°C	**Nominal power [bhp]**	4436
		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50

Exhaust Regulations NEA Singapore for ORDE;

2329	Rated power per starter	R	15	kW
2330	Starter, rated voltage	R	24	VDC
2331	Rated short-circuit current per starter	L	3000	A
2332	Power consumption per starter (at an engine speed of 100 rpm)	R	1400	A
2333	Internal resistance of power supply + line resistance per starter	A	0.0049	Ω
2334	Manufacturer		Prestolite	-
4120	Type		S-152	-
2335	Number of starter		2	-
2336	Starter electrically redundant		X	-
2337	Rated power per starter	R	15	kW
2338	Starter, rated voltage	R	24	VDC
2339	Rated short-circuit current per starter	L	3000	A
2340	Power consumption per starter (at an engine speed of 100 rpm)	R	1400	A
2341	Internal resistance of power supply + line resistance per starter	A	0.0049	Ω
4104	Manufacturer		Prestolite	-
4105	Type		M128R	-
4106	Number of starter		2	-
4107	Starter electrically redundant		-	-
4108	Rated power per starter	R	9.4	kW
4109	Starter, rated voltage	R	24	VDC
4110	Rated short-circuit current per starter	L	2000	A
4111	Power consumption per starter (at an engine speed of 100 rpm)	R	600	A
4112	Power consumption per starter (at an engine speed of 100 rpm, SAE0)	R	-	A
4113	Power consumption per starter (at an engine speed of 100 rpm, SAE1)	R	-	A

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- Product Data -

A Rolls-Royce solution

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Application Group	3D	**Nominal power [kW]**	3308
Dataset	Ref. 25°C/45°C	**Nominal power [bhp]**	4436
		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50

Exhaust Regulations NEA Singapore for ORDE;

4114	Internal resistance of power supply + line resistance per starter	A	0.008	Ω
2347	Generally valid data for starter		X	-
2342	Rated starting-attempt Duration (at +20°C ambient temperature with battery full)	R	5	s
2343	Interval between starts (at rated starting-attempt duration), min.	L	20	s
2345	Maximum acceptable starting-attempt duration	L	15	s
2344	Interval between starts (when starting-attempt duration > rated starting-attempt duration)	R	60	s
2346	Starting attempts within 30 minutes (at +20°C ambient temperature with battery full), max.	L	6	-
3565	Disengagement of starter pinion at engine Speed Note: Exceeding the guideline value of the disengagement speed will reduce the life cycle of the starter depending on how often and how much the speed has been exceeded	R	400	rpm
3566	Disengagement of starter pinion at engine speed, max.	L	500	rpm

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Application Group	3D	**Nominal power [kW]**	3308
Dataset	Ref. 25°C/45°C	**Nominal power [bhp]**	4436
		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50
Exhaust Regulations	NEA Singapore for ORDE;		

15. Starting (pneumatic/oil pressure starter)

No.	Description	Index	Value	Unit
36	Pneumatic starter: make TDI		X	-
5	Starting air pressure before starter motor, min.	R	8	bar
6	Starting air pressure before starter motor, max.	R	9	bar
7	Starting air pressure before starter motor, min.	L	8	bar
8	Starting air pressure before starter motor, max.	L	9	bar
18	Start attempt duration (engine preheated)	R	3	s
19	Start attempt duration (engine not preheated)	R	5	s
114	Air consumption/start attempt (engine preheated) Engine without generator Control with engine controller	R	1.4	m³n
116	Air consumption with external control for air-starter (per second	R	0.5	m³n
29	Starting air tank for 3 start attempts (max. 40 bar) (engine not preheated)	R	N	liter
30	Starting air tank for 3 start attempts (max. 30 bar) (engine not preheated)	R	N	liter
31	Starting air tank for 6 start attempts (max. 40 bar) (engine not preheated)	R	N	liter
32	Starting air tank for 6 start attempts (max. 30 bar) (engine not preheated)	R	N	liter
33	Starting air tank for 10 start attempts (max. 40 bar) (engine not preheated)	R	N	liter
34	Starting air tank for 10 start attempts (max. 30 bar) (engine not preheated)	R	N	liter
103	Starting oil pressure before starter motor, max.	R	207	bar
105	Starting oil pressure before starter motor, max.	L	207	bar
106	Start attempt duration (engine preheated)	R	2.5	s

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Application Group	3D	**Nominal power [kW]**	3308
Dataset	Ref. 25°C/45°C	**Nominal power [bhp]**	4436
		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50

Exhaust Regulations NEA Singapore for ORDE;

108	Start attempt duration, max.	L	15	s

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Application Group	3D	**Nominal power [kW]**	3308
Dataset	Ref. 25°C/45°C	**Nominal power [bhp]**	4436
		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50
Exhaust Regulations	NEA Singapore for ORDE;		

16. Inclinations - standard oil system (ref.: waterline)

No.	Description	Index	Value	Unit
15	Longitudinal inclination, continuous max. driving end down (Option: max. operating inclinations)	L	5	degrees (°)
17	Longitudinal inclination, continuous max. driving end up (Option: max. operating inclinations)	L	5	degrees (°)
19	Transverse inclination, continuous max. (Option: max. operating inclinations)	L	10	degrees (°)

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Application Group	3D	**Nominal power [kW]**	3308
Dataset	Ref. 25°C/45°C	**Nominal power [bhp]**	4436
		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50
Exhaust Regulations	NEA Singapore for ORDE;		

18. Capacities

No.	Description	Index	Value	Unit
1	Engine coolant capacity (without cooling equipment)	R	260	liter
10	Intercooler coolant capacity	R	50	liter
11	On-engine fuel capacity	R	9	liter
14	Engine oil capacity, initial filling (standard oil system) (Option: max. operating inclinations)	R	390	liter
20	Oil change quantity, max. (standard oil system) (Option: max. operating inclinations)	R	340	liter
28	Oil pan capacity, dipstick mark min. (standard oil system) (Option: max. operating inclinations)	L	270	liter
29	Oil pan capacity, dipstick mark max. (standard oil system) (Option: max. operating inclinations)	L	315	liter

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Application Group	3D	**Nominal power [kW]**	3308
Dataset	Ref. 25°C/45°C	**Nominal power [bhp]**	4436
		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50
Exhaust Regulations	NEA Singapore for ORDE;		

19. Masses / dimensions

No.	Description	Index	Value	Unit
1	Engine dry mass (standard scope of supply)	R	9650	kg
2	Engine dry mass (with engine-mounted standard accessories incl. coupling)	R	10050	kg
4	Engine length (standard scope of supply)	R	3479	mm
5	Engine width (standard scope of supply)	R	1700	mm
6	Engine height (standard scope of supply)	R	2252	mm

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A Rolls-Royce solution

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Application Group	3D	**Nominal power [kW]**	3308
Dataset	Ref. 25°C/45°C	**Nominal power [bhp]**	4436
		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50
Exhaust Regulations	NEA Singapore for ORDE;		

21. Exhaust emissions

No.	Description	Index	Value	Unit
2005	Emissions data sheet: NEA Singapore for ORDE		X	-

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Application Group	3D	**Nominal power [kW]**	3308
Dataset	Ref. 25°C/45°C	**Nominal power [bhp]**	4436
		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50
Exhaust Regulations	NEA Singapore for ORDE;		

22. Acoustics

No.	Description	Index	Value	Unit
102	Exhaust noise, unsilenced - FSP (free-field sound-pressure level Lp, 1m distance, ISO 6798, +3dB(A) tolerance)	R	122	dB(A)
202	Exhaust noise, unsilenced - FSP (sound power level LW, ISO 6798, +3dB(A) tolerance)	R	135	dB(A)
104	Exhaust noise, unsilenced - FSP (free-field sound-pressure level Lp, 1m distance, ISO 6798) Spectrum No.	R	737699e	-
110	Engine surface noise with attenuated intake noise (filter) - FSP (free-field sound-pressure level Lp, 1m distance, ISO 6798, +2dB(A) tolerance)	R	111	dB(A)
210	Engine surface noise with attenuated intake noise (filter) - FSP (sound power level LW, ISO 6798, +2dB(A) tolerance)	R	130	dB(A)
112	Engine surface noise with attenuated intake noise (filter) - FSP (free-field sound-pressure level Lp, 1m distance, ISO 6798) Spectrum No.	R	737693e	-
126	Structure borne noise at engine mounting brackets in vertical direction above resilient engine mounts - FSP Spectrum No.	R	737697e	-

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APPENDIX 9.02

Engine Surface Noise Datasheet

	20V 4000 G94LF NEA AIRBORNE NOISE ANALYSIS **3308 kW / 1500 rpm**	TCE Leuthäußer Drawing No.: 737 693e Date: 03.05.2017

Engine Surface Noise Analysis - 1/3-Octave

ENGINE TYPE:	**20V 4000 G94LF NEA**	ENGINE NO.:	V122
POWER / SPEED:	**3308 kW / 1500 rpm**	TEST CELL:	126
		DATE MEASURED:	10.04.2017

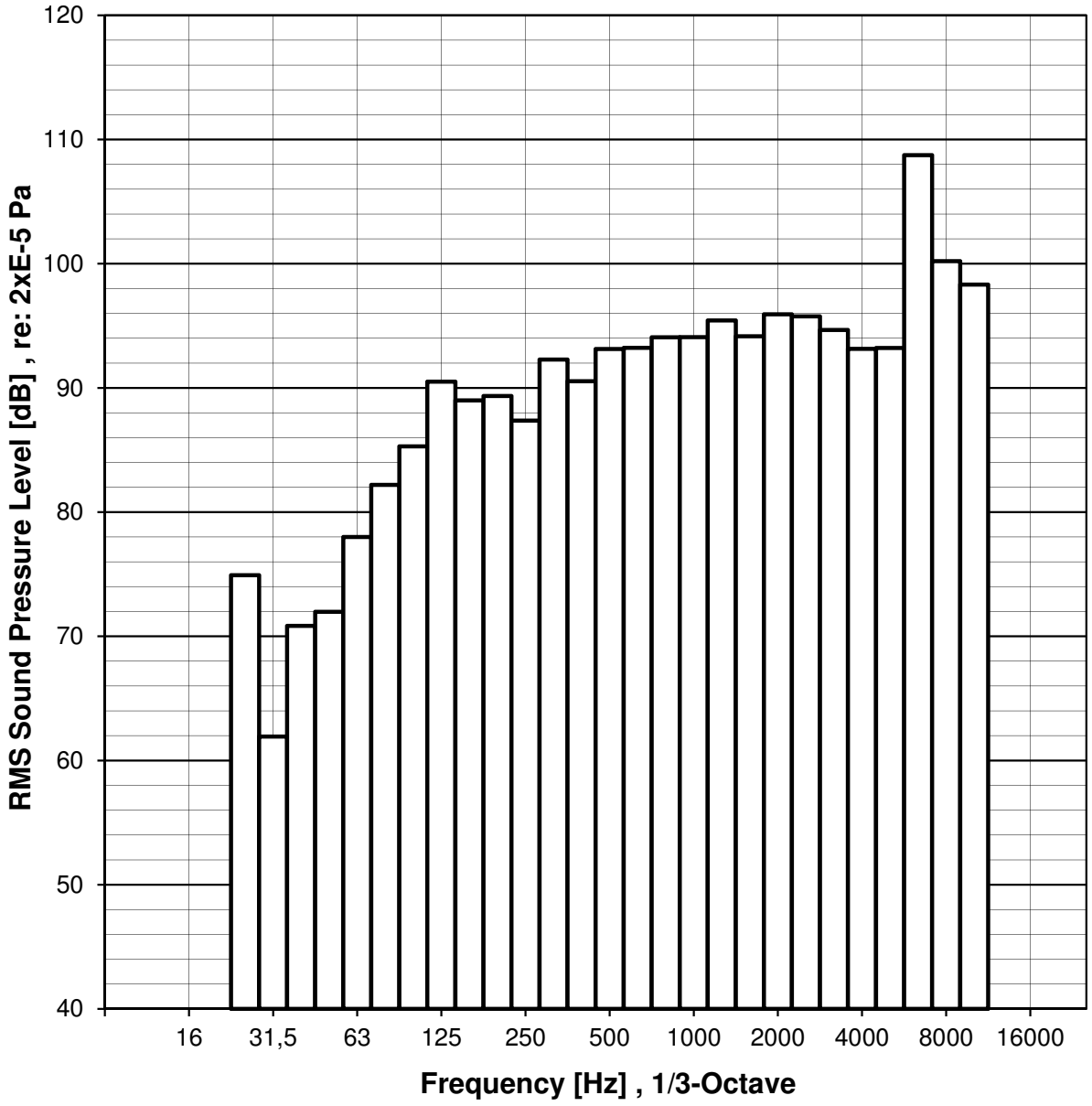
TURBOCHARGER:	2 x MTU ZR3.210.FB
INTAKE AIR OPENING:	Paper filters without housing
MEASURING DISTANCE:	1 m
MEASURING SURFACE DIMENSION:	19.1dB
NO. OF MEASURING POINTS:	5
SOUND PROPAGATION:	Free-Field
MEASUREMENT STANDARD:	similar to ISO 6798
TOLERANCE:	+5 dB for single 1/3-octave band, +2 dB(A) for total A-weighted level.

Energy mean sound pressure levels of the airborne noise that is emitted by the engine surface.
For project purposes only.

Energy mean free-field levels Total: L = 111.1 dB LA = 110.8 dB(A)

f [Hz]	12.5	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500
LpF [dB				74.9	61.9	70.8	72.0	78.0	82.2	85.3	90.5	89.0	89.3	87.4	92.3	90.5	93.1

f [Hz]	630	800	1k	1.25k	1.6k	2k	2.5k	3.15k	4k	5k	6.3k	8k	10k	12.5k	16k	20k
LpF [dB	93.2	94.1	94.1	95.4	94.2	95.9	95.8	94.7	93.1	93.2	108.7	100.2	98.3			



APPENDIX 9.03

Dry Air Cooler Datasheet

Aqua The Temperature Control People.

ACL-CN4523-001

DRY COOLER

Model : FVD9114E4EX D P2,1 CG EC QE RE SW PV SA

DESCRIPITION

- Frame of finned coil in galvanized steel
- Copper pipes diameter 12mm smooth
- Standard fins in aluminium with very high efficiency corrugation
- External frame in galvanized steel epoxy painted RAL 9016
- Expanded pipes on an Aluminium counterplate to avoid any contact between copper and galvanized steel and therefore any possible leaking due to prolonged vibrations
- Enlarged holes for headers nipples
- Unit modules completely independent for each fan, perfectly separate with dedicated internal steel
- High efficiency cowls with high collar to get the max. air flow and the min. noise level of the fans
- Fans with wings in die-casting Aluminium or in composite material
- Fan grids in steel painted by cataphoresis or epoxypolyester RAL 9005
- Fans with external rotor IP54 (according to N60529) insulation class F
- Standard supply voltage 400V - 3ph - 50 Hz + neutral
- Copper headers
- AISI connections, threaded till diameter 1 1/2”, flanged beginning from 2”
- Standard shipment without packaging

TESTING

- Max. design pressure 10 bar
- Pneumatic test with dry air
- Units produced according to (2006/42/EC) - EMC (2004/108/EEC)

Aqua The Temperature Control People.

DRY COOLER

Model : FVD9114E4EX D P2,1 CG EC QE RE SW PV SA

Real Capacity	**2537,00** kW	Fluid	**ETHYLENE GLYCOL 50%**
Margin	**0,2** %	Fluid Inlet Temperature	**92,0** °C
Air Flow	**256000,00** m³/h	Fluid Outlet Temp. Real	**55,4** °C
		Pressure Drops	**60,0** kPa
Air temp.(switching temp dry/wet)/RH	**42,0 / 50,0** °C / %	Volumetric fluidflow	**67,45** m³/h
Outlet air temperature / RH	**72,8 / 11,6** °C / %	Massic fluidflow	**69574** kg/h
Available static pressure	**0,0** Pa	Fluid Velocity	**1,02** m/s
Altitude	**0** m		

Fans data

Fan Piece(s)	**14**	Sound Power	**85** dB(A)
Blade Diameter	**910** mm	Noise Pressure Level	**63** dB(A) (a)
Speed/Max	**643/1020** rpm	Distance	**1** m
Capacity x 1	**712** W	% RPM	**63** %
Capacity	**9968** W	Power supply	**EC 400/3/50**
Current x 1	**1,0** A (b)	Op. Mode	**Delta**
Current	**14** A		

Frequency (Hz)	125	250	500	1000	2000	4000	8000
Sound power (dB(A))	86,6	76,9	74,2	78,0	80,8	76,3	71,1

Unit data

Surface	**3673,9** m²	IN and OUT Connection number	**2**
Internal Volume	**596,8** dm³	Inlet Header	**4"**
Fin Spacing	**2,1** mm	Outlet Header	**4"**
Dry Weight	**3800,00** kg (c)		
Max Working Pressure	**10** bar		
Connections position	**Same side**	Circuits / Skipped tubes	**170 / 0**

(a) according EN13487 / EN ISO3744

(b) nominal current 20°C

(c) dimensions, weight and connections refer to the standard execution and don't include ant option/accessory
for specific dimensional drawing please contact our technical office

(d) The use of inverter not supplied by Onda spa should be previously approved

(e) the unit is supplied with fans according to 2009/125/EC (ERP)

Aqua The Temperature Control People.

DRY COOLER

Model : FVD9114E4EX D P2,1 CG EC QE RE SW PV SA

EC

Electronic fans with integrated regulation and very high power efficiency. Granting maximum silence, even during regulation in any working point.

- Protection Class IP54
- Standard working voltage 3ph 380/480V 50/60Hz

PV

Prepainted aluminium fins, polyester grey RAL 1087.

- Salt fog durability 1000h according to ASTMb117 - 5% NaCl a 35°C pH 6,5 - 7,2

QE

Electrical box wired and assembled with metallic protection against rain, designed and produced for managing and protecting of 3Ph EC electronic fans (control module for EC fans and pressure / temperature sensor are NOT included).

- Standard supply voltage 400V 50Hz 3ph + N
- Electrical box in epoxy painted galvanized steel IP54, for external application
- General switch for door blocking
- Protection fuses for power circuit
- Protection fuses for transformer primary circuit
- Protection fuses for transformer secondary circuit
- Motor overcurrent protection switches for each fan, with hand re-starting
- Auxiliary contacts for motor protection switches
- Auxiliary contacts for fans blocking
- Voltage transformer for primary circuit 24V AC
- Min. / Max. allowable working temperature -15 / +55°C

RE

Control module for EC fans inside the electrical box, with programmable display and pressure / temperature sensor.

- 6 analogical inputs (0-10 V ; 0-20mA ; 4-20 mA , temperature sensor ; pressure sensor)
- 11 programmable digital inputs
- 4 analogical output 0-10V programmable
- 8 programmable digital outputs
- MODBUS protocol interface RS485 on request
- Panel protection code
- According to Standard execution, all units have an only regulation circuit with all fans checked by an only control and by an only sensor (also V-shaped and double-headers units)
- The control manages the starting of fans keeping invariable pressure / temperature at settled point. The pressure / temperature sensor is located on fluid inlet of the unit
- Min. / Max. allowable working temperature -15 / +55°C

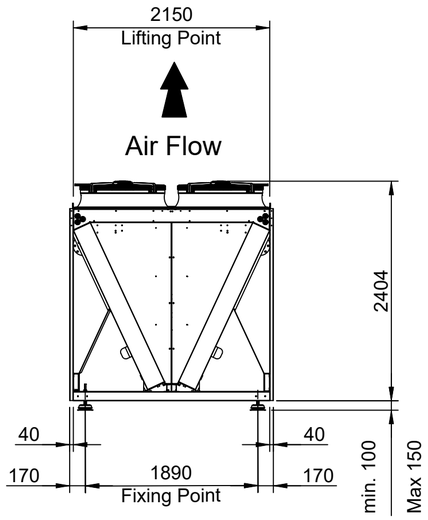
SW

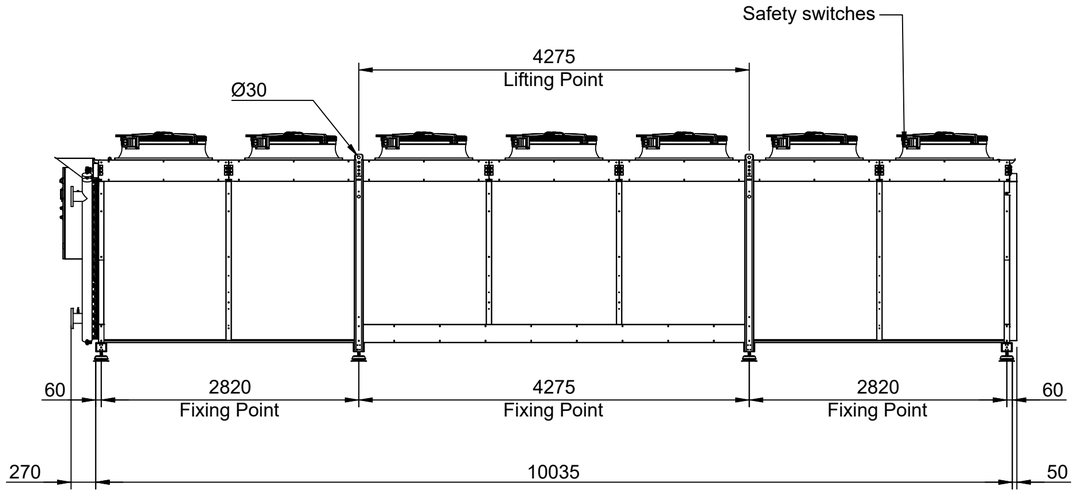
Line isolating switches 4P installed near the fans (on the cowls) with metallic protection against rain.

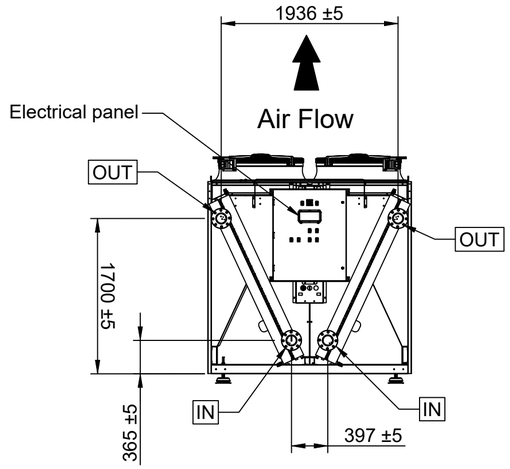
- Protection Class IP65
- Min. / Max. allowable working temperature -20 / +50°C

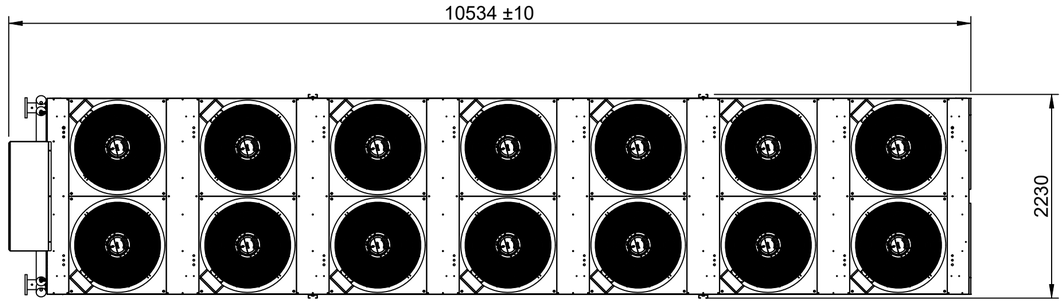
SA

Anti damping supports supplied as kit.



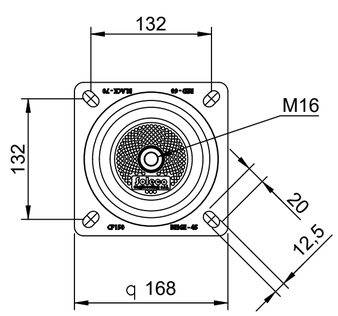






CONNECTIONS:	
- IN: (4x) DN100 PN10	
- OUT: (4x) DN100 PN10	
UNI EN 1092-1 Type 02	
ACCESSORIES LIST:	
Electrical Option:	
- Electronic Fans	EC
- Electrical Panel	QA/QE
- EC control Module	RE
- Safety switches 4P	SW
Supports:	
- Anti-vibration dampers	SA
Fins treatments:	
- Prepainted fins	PV

Anti-vibration damper



E			
D			
C			
B			
A	.	.	.
*	Name	Date	Modification

Aqua Cooling Ltd
Unit 6, Brickfield Lane
Chandler's Ford
Easteigh. SO53 4DP

t 0333 004 4433
e sales@aquacooling.co.uk
w www.aquacooling.co.uk

Aqua
Temperature Control Specialists.

Drawn:	E.T.	Client:	AVK
Date:	12.04.23	Title:	DRY AIR COOLER GA
Final:			
Quote:		Drawing Ref:	ACL-CN4523-302

APPENDIX 9.04

Container and Attenuation Acoustic Calculations

ADE
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A PBE COMPANY

14 Langthwaite Business Park
South Kirkby, Pontefract
WF9 3AP, UK
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ade-power.com

GENERATOR ENCLOSURE NOISE CALCULATIONS

Customer	AVK-SEG
Project Name	Telehouse South
Date	18.04.2023

Noise Level	65	dB(A) @	1.0	m

Engine Selection	MTU	DS4000		kVA

Dimensions (m)	Length	Width	Height
Engine	6.34	1.81	2.42
Container - main body	10.00	3.50	3.80

Measurement surface area 114.9 m^2

Frequency - Hz	62.5	125	250	500	1000	2000	4000	8000	Total	
Engine SPL - dB	84	94	95	97	99	100	99	110	110.2	dB(A)
Engine SWL - dB	105	114	116	118	120	121	119	130	130.9	dB(A)

Combustion Air Intake	4.70	m^3/sec
Cooling Air Intake	25.00	m^3/sec
Maximum Total Allowable ΔP	300	Pa

Maximum Ambient Temp.	40	°C

Selection Overview							
Walls / Enclosure	64.8	dB(A) @	1.0	m	ΔP	N/A	Pa
Inlet Attenuator	64.8	dB(A) @	1.0	m	ΔP	90.4	Pa
Outlet Attenuator	62.7	dB(A) @	1.0	m	ΔP	157.6	Pa

Overall 64.8 dB(A) @ Total 248.0 Pa

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GENERATOR ENCLOSURE WALL CONSTRUCTION

Customer	AVK-SEG
Project Name	Telehouse South
Date	18.04.2023

Noise Level	65	dB(A) @	1.0	m

Receiver In Free Field (Enclosure reverb and direct field contribution)

Reverberant Field Contribution

Frequency - Hz	62.5	125	250	500	1K	2K	4K	8K
Engine SPL - dB	84	94	95	97	99	100	99	110
Engine SWL - dB	105	114	116	118	120	121	119	130
Surface Area (Floor) - m²	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5
Absorption Coefficient (Floor) - α	0.064	0.016	0.005	0.001	0.000	0.000	0.000	0.000
Surface Area (Walls) - m²	116	116	116	116	116	116	116	116
Absorption Coefficient (Walls) - α	0.35	0.55	1.00	1.00	1.00	1.00	1.00	0.95
Surface Area (Ceiling) - m²	35	35	35	35	35	35	35	35
Absorption Coefficient (Ceiling) - α	0.35	0.55	1.00	1.00	1.00	1.00	1.00	0.95
Surface Area (Total) - m²	174	174	174	174	174	174	174	174
Average Absorption Coefficient - α	0.31	0.48	0.87	0.87	0.87	0.87	0.87	0.82
Room Constant - R	78.9	159.7	1,125.6	1,120.4	1,119.1	1,119.1	1,119.1	804.9
Reverberant SPL Sound (Inside Enclosure)	92	98	91	93	95	96	95	107
Wall Construction **SRI** - dB	20	23	35	48	50	50	50	50
Area Correction	10	10	10	10	10	10	10	10
Enclosure SWL, SPLrev+10logA-6-SRI	81	85	66	55	55	56	54	67
Correction Source Centre to Receiver - m 2.8	-20	-20	-20	-20	-20	-20	-20	-20
Surface Directivity	6	6	6	6	6	6	6	6
Enclosure Near Field Correction	-5	-5	-5	-5	-5	-5	-5	-5
SPL @ Receiver due to Reverberant Field - dB	63	66	47	36	36	37	36	48

Direct Field Contribution

Frequency - Hz	62.5	125	250	500	1K	2K	4K	8K
Engine SWL - dB	105	114	116	118	120	121	119	130
Wall Construction **SRI** - dB	20	23	35	48	50	50	50	50
Correction Source Centre to Receiver - m 2.8	-20	-20	-20	-20	-20	-20	-20	-20
Surface Directivity	6	6	6	6	6	6	6	6
Source Near Field Correction	-4	-4	-4	-4	-4	-4	-4	-4
SPL @ Receiver due to Direct Field - dB	67	73	63	52	52	53	51	62

Direct + Reverberant Field Contribution

Frequency - Hz	62.5	125	250	500	1K	2K	4K	8K
SPL @ Receiver (Direct + Reverb.) in FFC - dB	68	74	63	52	52	53	51	63
'A'-weighting Correction	-26	-16	-9	-3	0	1	1	-1
SPL @ Receiver (Direct + Reverb.) in FFC - dB(A)	42	58	54	49	52	54	52	62
Resultant Single Figure SPL - dB(A)	**64.8**							

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GENERATOR ENCLOSURE - INLET ATTENUATOR

Customer	AVK-SEG
Project Name	Telehouse South
Date	18.04.2023

Noise Level	65	dB(A) @	1.0	m

Inlet Airflow Volume	29.70	m^3/sec
Maximum Total Allowable ΔP	300.00	Pa

Attenuator Configuration

Attenuator Width (W)	3.30	m	Attenuator ΔP	65.4
Attenuator Height (H)	2.75	m	Louvre ΔP	25.0
Attenuator Length (L)	2.10	m	Total ΔP	90.4
Splitter Thickness	200	mm		
Airway Width	90	mm		

Receiver In Free Field (Enclosure reverb and direct field contribution)

Inlet Attenuator Cross-Section (m^2)	9.08		
Distance - Source Centre to Inlet Aperture (m)	6.00	Distance - Source Centre to Receiver (m)	7.00

Reverberant Field Contribution

Frequency - Hz	62.5	125	250	500	1K	2K	4K	8K
Reverberant SPL Sound (Inside Enclosure)	92	98	91	93	95	96	95	107
Aperture SWL, SPLrev+10logA-6 - dB	95	102	95	97	99	100	98	111

Direct Field Contribution

Frequency - Hz	63	125	250	500	1K	2K	4K	8K
Engine SWL - dB	105	114	116	118	120	121	119	130
Correction, Source Centre to Aperture - dB	-27	-27	-27	-27	-27	-27	-27	-27
SPL @Aperture due to Direct Field - dB	78	88	89	91	93	94	93	104
Aperture SWL, SPLrev+10logA - dB	88	97	99	101	103	104	102	113
Inlet Fan SWL - dB	0	0	0	0	0	0	0	0
Total Fan SWL - dB - based on no. fans 0	0	0	0	0	0	0	0	0

Direct + Reverberant Field Contribution

Frequency - Hz	63	125	250	500	1K	2K	4K	8K
Combined Inlet Aperture SWL - dB	96	103	100	102	104	105	104	115
Distance from aperture to reciever (m) 1	-11	-11	-11	-11	-11	-11	-11	-11
Aperture directivity correction (deg) 0	5	5	5	5	5	5	5	5
Surface Directivity	3	3	3	3	3	3	3	3
Near Field Correction	-2	-2	-2	-2	-2	-2	-2	-2
SPL @ Receiver (Direct + Reverb.) in FFC - dB	91	98	95	97	99	100	99	110
Attenuator Insertion Loss - dB	11	21	37	55	55	55	55	48
Louvre Insertion Loss - dB	0	0	0	0	0	0	0	0
Bend Attenuation - dB	0	0	0	0	0	0	0	0
Other Attenuation - dB	0	0	0	0	0	0	0	0
Total Attenuation - dB	11	21	37	55	55	55	55	48
SPL @ Receiver (Direct + Reverb.) in FFC - dB	80	77	58	42	44	45	44	62
'A'-weighting Correction - dB	-26	-16	-9	-3	0	1	1	-1
SPL @ Receiver (Direct + Reverb.) in FFC - dB(A)	54	61	49	39	44	46	45	61
Resultant Single Figure SPL - dB(A)	**64.8**							

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GENERATOR ENCLOSURE - OUTLET ATTENUATOR

Customer	AVK-SEG
Project Name	Telehouse South
Date	18.04.2023

Noise Level	65	dB(A) @	1.0	m

Outlet Airflow Volume	25.00	m^3/sec
Maximum Total Allowable ΔP	300.00	Pa

Attenuator Configuration

Attenuator Width (W)	3.30	m	Attenuator ΔP	107.6
Attenuator Height (H)	1.75	m	Louvre ΔP	40.0
Attenuator Length (L)	3.00	m	Total ΔP	147.6
Splitter Thickness	200	mm		
Airway Width	100	mm		

Receiver In Free Field (Enclosure reverb and direct field contribution)

Outlet Attenuator Cross-Section (m^2)	5.78		
Distance - Source Centre to Outlet Aperture (m)	2.51	Distance - Source Centre to Receiver (m)	3.51

Reverberant Field Contribution

Frequency - Hz	62.5	125	250	500	1K	2K	4K	8K
Reverberant SPL Sound (Inside Enclosure)	92	98	91	93	95	96	95	107
Aperture SWL, SPLrev+10logA-6 - dB	93	100	93	95	97	98	96	109

Direct Field Contribution

Frequency - Hz	63	125	250	500	1K	2K	4K	8K
Engine SWL - dB	105	114	116	118	120	121	119	130
Correction, Source Centre to Aperture - dB	-19	-19	-19	-19	-19	-19	-19	-19
SPL @Aperture due to Direct Field - dB	85	95	96	99	101	102	100	111
Aperture SWL, SPLrev+10logA - dB	93	103	104	106	109	109	108	119
Inlet Fan SWL - dB	0	0	0	0	0	0	0	0
Total Fan SWL - dB - based on no. fans 0	0	0	0	0	0	0	0	0

Direct + Reverberant Field Contribution

Frequency - Hz	63	125	250	500	1K	2K	4K	8K
Combined Inlet Aperture SWL - dB	96	104	104	107	109	110	108	119
Distance from aperture to reciever (m) 1	-11	-11	-11	-11	-11	-11	-11	-11
Aperture directivity correction (deg) 0	4	5	5	5	5	5	5	5
Surface Directivity	3	3	3	3	3	3	3	3
Near Field Correction	-2	-2	-2	-2	-2	-2	-2	-2
SPL @ Receiver (Direct + Reverb.) in FFC - dB	90	99	99	102	104	105	103	114
Attenuator Insertion Loss - dB	13	28	48	55	55	55	55	53
Louvre Insertion Loss - dB	0	0	0	0	0	0	0	0
Bend Attenuation - dB	0	0	0	0	0	0	0	0
Other Attenuation - dB	0	0	0	0	0	0	0	0
Total Attenuation - dB	13	28	48	55	55	55	55	53
SPL @ Receiver (Direct + Reverb.) in FFC - dB	77	71	51	47	49	50	48	61
'A'-weighting Correction - dB	-26	-16	-9	-3	0	1	1	-1
SPL @ Receiver (Direct + Reverb.) in FFC - dB(A)	51	55	42	44	49	51	49	60
Resultant Single Figure SPL - dB(A)	**62.7**							

APPENDIX 9.05

BSB PM24-TF Motor Datasheet

FSD-TD Series

Fire and Smoke Dampers – Electrical Actuator Specifications

	BSB PM24 -TF	BSB PM230 -TF	BSB PM24 -NTF	BSB PM230 -NTF
Electrical data				
Nominal voltage	24 V AC, 50/60 Hz / 24V DC	230 V AC, 50/60 Hz	24 V AC, 50/60 Hz / 24V DC	230 V AC, 50/60 Hz
Nominal voltage range	AC 19.2...28.8V / DC 21.6...28.8V	AC 196...264V	AC 19.2...28.8V / DC 21.6...28.8V	AC 196...264V
Power consumption motoring	10 W @ nominal torque	12 W @ nominal torque	10 W @ nominal torque	12 W @ nominal torque
Holding	2 W	4 W	2 W	4 W
For wire sizing	12.5 VA / Imax. 8.3 A @ 5 ms	14 VA	12.5 VA / Imax. 8.3 A @ 5 ms	14 VA
Auxiliary switch	2 x 1 SPDT	2 x 1 SPDT	2 x 1 SPST	2 x 1 SPST
Contact rating *(contacts gold plate on silver)*	1 mA ... 6 A (3 A) DC 5 V ... AC 250 V	1 mA ... 6 A (3 A) DC 5 V ... AC 250 V	1 mA ... 6 A (3 A) DC 5 V ... AC 250 V	1 mA ... 6 A (3 A) DC 5 V ... AC 250 V
Switching points	5° / 85°	5° / 85°	5° / 85°	5° / 85°
Thermal fuse	72°C	72°C	-	-
Supply cable *(halogen free)*	1.0 m, 2 x 0.75 mm^2	1.0 m, 2 x 0.75 mm^2	1.2 m, 2 x 0.75 mm^2 *(300°C for 1 hour)*	1.2 m, 2 x 0.75 mm^2 *(300°C for 1 hour)*
Signal cable *(halogen free)*	1.0 m, 6 x 0.75 mm^2	1.0 m, 6 x 0.75 mm^2	1.2 m, 4 x 0.75 mm^2 *(300°C for 1 hour)*	1.2 m, 4 x 0.75 mm^2 *(300°C for 1 hour)*
Functional data				
Running time motor	< 60 s	< 60 s	< 60 s	< 60 s
Spring-return (at 20°C)	< 30 s	< 30 s	< 30 s	< 30 s
Sound power level motor	Max. 45 dB (A)	Max. 45 dB (A)	Max. 45 dB (A)	Max. 45 dB (A)
Spring-return	~62 dB (A)	~62 dB (A)	~62 dB (A)	~62 dB (A)
Position indication	Mechanical with pointer	Mechanical with pointer	Mechanical with pointer	Mechanical with pointer
Service life	Min. 10,000 full cycles @ 15Nm followed by 50 full cycles @ 20Nm	Min. 10,000 full cycles @ 15Nm followed by 50 full cycles @ 20Nm	Min. 10,000 full cycles @ 15Nm followed by 50 full cycles @ 20Nm	Min. 10,000 full cycles @ 15Nm followed by 50 full cycles @ 20Nm
Safety				
Protection class	III Safety extra low voltage	II totally insulated	III Safety extra low voltage	II totally insulated
Degree of protection (including Thermal Fuse)	IP54 in all mounting positions	IP54 in all mounting positions	IP54 in all mounting positions	IP54 in all mounting positions
EMC	CE according to 89/336/EEC, 92/31/EEC, 93/68/EEC	CE according to 89/336/EEC, 92/31/EEC, 93/68/EEC	CE according to 89/336/EEC, 92/31/EEC, 93/68/EEC	CE according to 89/336/EEC, 92/31/EEC, 93/68/EEC
Ambient temperature range	normal duty –30°C to +50°C	normal duty –30°C to +50°C	normal duty –30°C to +50°C	normal duty –30°C to +50°C
Non-operating temperature	–40°C ... +50°C	–40°C ... +50°C	–40°C ... +50°C	–40°C ... +50°C
Ambient humidity range	95% r.H., non-condensing (EN60730-1)	95% r.H., non-condensing (EN60730-1)	95% r.H., non-condensing (EN60730-1)	95% r.H., non-condensing (EN60730-1)
Maintenance	Maintenance-free	Maintenance-free	Maintenance-free	Maintenance-free
Weight				
Weight	Approx. 3.1kg	Approx. 3.5kg	Approx. 3.1kg	Approx. 3.5kg

APPENDIX 9.06

Fan SC100P4-A6-14 Datasheet

Represented by:
ELTA FANS LTD - APPLIED TECHNOLOGY
email: mailbox@eltafans.co.uk
Tel: +44 (0)1489 566500 Fax: +44 (0)1489 566555
17, Barnes Wallis Road, Segensworth East, Hampshire PO15 5ST, UK

Technical Data - Fan Model SC100P4-A6/14

Location: EC

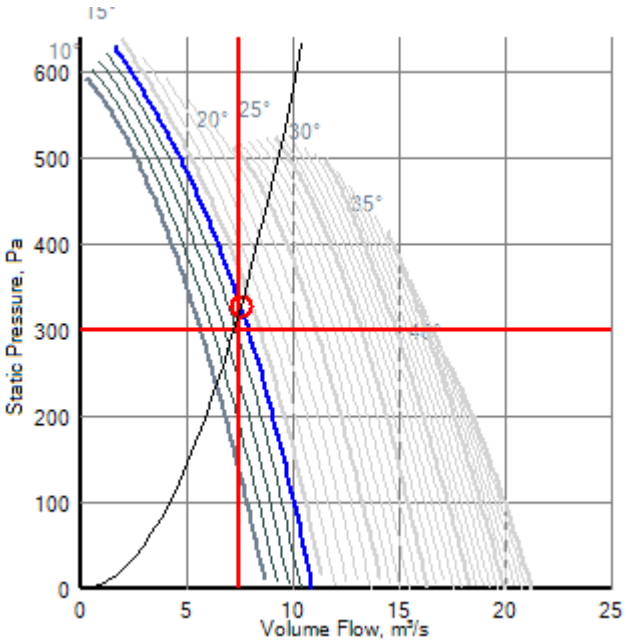
Designation:

Performance - Required

Air Flow :	7.43 m³/s
Static Pressure :	300 Pa
Selection Pressure:	322 Pa
Installation Type:	TYPE A
Air Density:	1.204 kg/m³
- Atmos. Temp:	20 °C
- Altitude:	0 m
- Humidity:	0.0 %

Actual

Air Flow:	7.50 m³/s
Static Pressure:	328 Pa
Total Pressure:	383 Pa

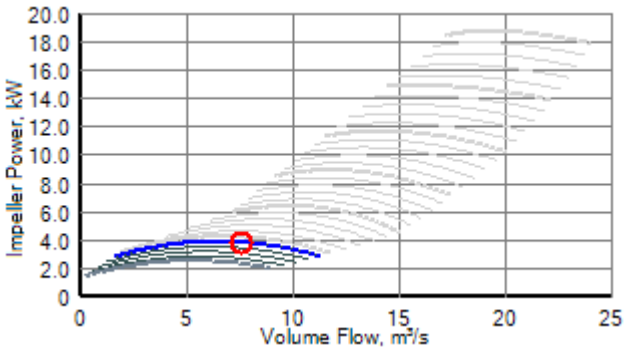


Fan Data

Catalogue Code:	SC100P4-A6/14 (SC100-612-3-100-4-15-255-28-RA6)		
Description:	Short-Cased EC Axial		
Diameter:	1000 mm	Hub:	255 mm
Impeller Type:	Axial	Pitch:	14°
Blade Material:	Aluminium	Blades:	6
Speed:	1489 r/min @50 Hz		
Power, Abs:	3.85 kW	Form:	A
Input Power:	4.28 kW	Peak:	3.90 kW
Efficiency Total:	74.7%		
SFP:	0.58	Static:	64.0%
Fan Weight:	89.6 kg		

Motor Data (at STP)

Motor Type:	EC
Electrical Supply:	400V 3ph 50Hz
Motor Frame:	100L
Motor Power:	4.00kW
FLC/Start (DOL):	7.51A / 7.51A
Motor Speed:	4 pole
Motor Efficiency:	89.8%



Sound Data

Spectrum (Hz):	63	125	250	500	1K	2K	4K	8K	dBW	dB(A) @ 3m
Inlet (dB):	98	90	96	94	94	94	93	88	103	80
Outlet (dB):	99	92	95	92	92	93	92	87	103	78

Sound levels are quoted as in-duct values. dB(A) values are average spherical free-field for comparative use only.

Represented by:
ELTA FANS LTD - APPLIED TECHNOLOGY
email: mailbox@eltafans.co.uk
Tel: +44 (0)1489 566500 Fax: +44 (0)1489 566555
17, Barnes Wallis Road, Segensworth East, Hampshire PO15 5ST, UK

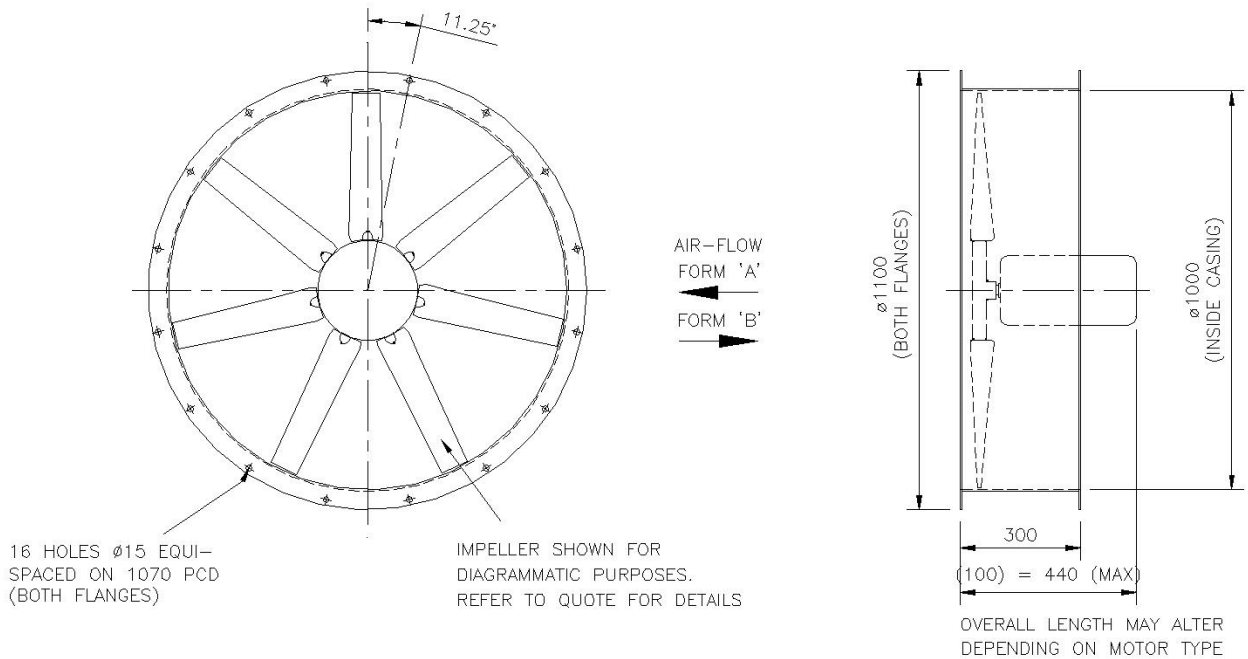
Technical Data - Fan Model SC100P4-A6/14

Location: EC **Designation:**

Energy Related Product Data

		At Maximum Efficiency Point	
Overall Efficiency:	70.1%	Input Power:	4.28 kW
Measurement Category:	D	Air Flow:	7.56 m³/s
Efficiency Category:	Total	Pressure:	380 Pa
FMEG:	72 (Integrated)	Speed:	1489 r/min
Specific Ratio:	1		

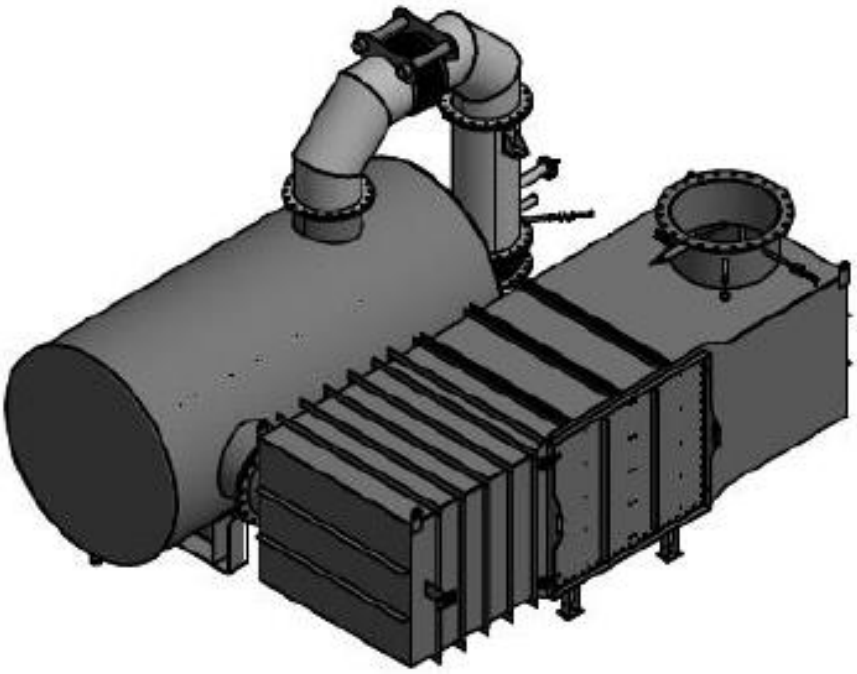
Drawing for Fan Model SC100P4-A6/14

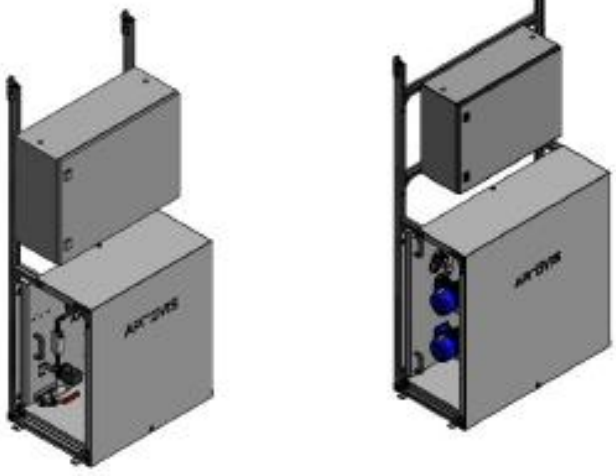


APPENDIX 9.07

SCR Specification

APROVIS Exhaust gas treatment





Customer: AVK-SEG (UK) LTD

Project: E2021-2360 - Telehouse South (Project X)

Pos. 1	EXHAUST GAS SILENCER	SDR-1745-6501/3400-3-1H-1A

working principle:
reactive

(horizontal version)

DESIGN PARAMETERS

engine type	MTU 20V4000 G94LF	
number of cylinders	V20	
rotating speed	1500	rpm
sound pressure level at silencer inlet *	**122 in 1m**	**dB(A)**
sound pressure level after silencer *	**65 in 1m**	**dB(A)**
flow rate (wet)	19196	kg/hr
inlet temperature	482	°C
max. operating temperature	505	°C
max. operating pressure	0.1	barg

DIMENSIONS

outside diameter	Ø 1745		mm
total length	+/- 3400		mm
inlet connection	500/10	radial	DN/PN
outlet connection	600/10	radial	DN/PN
weight	+/- 1300		kg
additions			

MATERIAL

exhaust gas silencer	steel
flanges	steel
surface treatment	priming coat

When the aforementioned design parameters are found to be inaccurate or require to be revised, we recommend recalculating the silencer. We do not accept any responsibility when our design is based on incorrect information.

* Measurement position according to DIN 45635-11 / ISO 6798. Tolerance according to engine data sheet.
To realise an optimal acoustic performance, it is of great importance that vibration free mounting and correct installation of the complete air-intake or exhaust gas system is given, to avoid possible transfer of vibration and/or constructional borne noise. The given sound pressure level/ sound attenuation at open field conditions is a theoretical value, which could turn out to be higher in practice.
Unfavourable layout of the exhaust line downstream of the silencer (e.g. narrow bends) can lead to an increased sound pressure level due to flow generated noise.
With unfavourable pipe lengths in the exhaust system, resonances may occur, whereby individual frequencies may be amplified. No warranty is given for this.

The reactive part of this silencer is **without heat insulation**. Because of the radiated heat and the structure-borne noise we recommend urgently insulation on site.

Prognosis of Sound Level at silencer outlet *2)						
Octave Frequency	Lp sound pressure level at silencer inlet in 1m *2)	Transmission Loss	Lp sound pressure level after silencer in 1m *2)	LpA sound pressure level after silencer in 1m *2)	con-version	LpA sound pressure level after silencer in 1m *2)
31,5 Hz	105 dB	15 dB	91 dB	51 dB(A)		
63 Hz	115 dB	34 dB	81 dB	55 dB(A)		
125 Hz	124 dB	49 dB	75 dB	59 dB(A)		
250 Hz	124 dB	58 dB	66 dB	57 dB(A)		
500 Hz	116 dB	57 dB	59 dB	56 dB(A)		
1000 Hz	118 dB	61 dB	57 dB	57 dB(A)		
2000 Hz	116 dB	64 dB	52 dB	53 dB(A)		
4000 Hz	107 dB	55 dB	52 dB	53 dB(A)		
Sum dB:	**128 dB in 1m**					
Sum dB(A):	**122 dB(A) in 1m**			**65 dB(A) in 1m**	**0 dB**	**65 dB(A) in 1m**
Target dB(A):				**65 dB(A) in 1m**		**65 dB(A) in 1m**

*2) measurement position according to DIN 45635-11 / ISO 6798

Pos. 2	CATALYST	SCR-500/1-X-S108.45-31-0-K

general data

Engine:	MTU 20V4000G94LF	
Fuel:	Diesel	
Operation of engine:	λ > 1	
Exhaust gas mass flow:	19196	kg/h
Exhaust gas temperature:	482	°C
Maximum Exhaust gas temperature:	505	°C
Maximum Exhaust gas pressure:	0,1	barg
Pressure Loss total: (silencer, mixing tube, SCR)	**45**	**mbar**
Urea consumption (32,5%):	46	L/h

Emissions [5% O2]

	Before Catalytic Converter	After Catalytic Converter	
NOx	< 2362	< 236	mg/Nm³
NH_3		< 10	mg/Nm³

Equipment SCR

SCR

Number of rows SCR	3	pc.
Number of empty rows	0	pc.

Material

Material injection	Stainless steel	
Material flanges injection	Stainless steel	
Material housing	Steel	
Material flanges housing	Steel	

Installation and connection

Place of installation	Inside installation; no ex zone Outdoor installation by arrangement	
Min. ambient temperature	5	°C
Max. ambient temperature	40	°C
Exhaustgas piping inlet	600/10	DN/PN
Exhaustgas piping outlet	800/10	DN/PN

Dimensions of injection section

L x W x H	+/- 3100 x 500 x 1000	mm
Transport weight	+/- 200	kg
Operating weight	+/- 200	kg

Dimensions of housing

L x W x H	+/- 5004 x 1500 x 2068	mm
Transport weight	+/- 3800	kg
Operating weight	+/- 3800	kg

Dimensions of dosing unit

L x W x H	+/- 550 x 800 x 1925	mm
Transport weight	+/- 170	kg
Operating weight	+/- 170	kg

Pos. 2.1 HOUSING

For integration of catalyst honeycombs

Consisting of:

- 1x opening (on the side), for catalyst insertion
- Integrated measuring nozzles for:
  - 2x Temperature
  - 1x Pressure
  - 1x NOx
  - 1x Reserve

Design example

Pos. 2.2a INJECTION SECTION

Designed as complete assembly (with Pos. 1.1b);

Consisting of:

- Static mixers for homogeneus mixing of ammonia and exhaust gas
- Integrated measuring nozzles for:
  - 1x Pressure
  - 1x Temperature
  - 1x NOx

Design example

Pos. 2.2b ATOMISING LANCE WITH TWO PHASE NOZZLE

For injection of urea-water-solution with compressed air

Consisting of:

- Atomising lance with two phase nozzle

Pos. 2.3 CATALYST HONEYCOMBS SCR

Catalyst honeycombs will be integrated in the factory.
For integration engine setup must be completed as misfiring will lead to destruction of the catalysts.

Consisting of:

- SCR-Honeycombs
- incl. sealing

Integration in factory

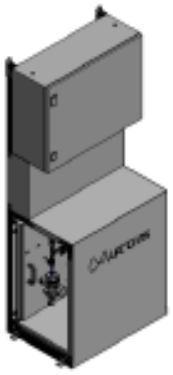
Design example

Pos. 2.4 DOSING STATION AND CONTROL CABINET

Dosing station and control cabinet pre-assembled and piped as a unit on a base frame

Consisting of:

- 1 pc. Switching valve for flushing and cooling the urea line with air
- 1 pc. Oil-free compressor for continuous operation
- 1 pc. Overflow valve for the controlled air supply to the nozzle
- 3 pc. Pressure sensor for leakage monitoring
- Ready-to-operate dosing station pre-assembled on base frame
- Assembly of the control cabinet
- Wiring of the electrical components on the base frame



Design Example

Pos. 2.5a CONTROL CABINET CONFORM 44BIMSCHV AND VDMA 6299

For controlling the entire SCR plant.

Consisting of:

- Control cabinet with PLC control and 10" touch panel for visualization of the system parameters

Design example

Data for control cabinet:

material:	Sheet steel, painted
Protection class:	IP54
Supply line:	1~230V+N+PE 50 Hz, TN-C-S
Fuse protection:	16A (depending on customer's requirements, final confirmation after approval of the circuit diagram!)

- Control elements: Main switch and touch panel
- Messages and displays on the control cabinet:
  - Visualization via touch panel including trend recording, alarm history, user administration and parameter switching
  - Message and fault display as plain text
  - Display of all actual values on the touch panel
  -

Integrated data recording for:

- Current NOx value
- Evaluated NOx values:
  - Daily average values incl. evaluation
  - Compliance with daily mean value
  - Validity Daily mean value
  - Compliance "not double limit value" exceeded
  - Downtime NOx Sensor
- Exhaust gas temperatures
- Exhaust gas back pressure
- Air pressure
- Pressure urea
- Storage of the daily mean value on an external storage medium - e.g. USB stick or SD card (external storage media not included in the scope of delivery; min. 16GB are required for recording the mean values over 6 years)

Required signals from the higher-level control:

- Engine on/off (potential-free contact on terminal strip)
- Engine load (analog signal)

Signals for higher-level control (potential-free contacts on terminal strip):

- Readiness
- Fault in the system
- Engine stop
- Pre-alarm - collective message
- Urea requirement

Remark: Switch cabinet only approved for indoor installation.

Pos. 2.5b COMMUNICATION BUS

Interface for signal transmission

System as interface is:
- Modbus TCP

Pos. 2.6 MEASUREMENT EQUIPMENT EXHAUST

For recording measurements

Consisting of:

- 2 pc. Pressure transducer for measuring the exhaust side counter pressure
- 2 pc. NOx sensor for concentration measurement
- 2 pc. Temperature sensor for monitoring the temperature in the exhaust gas
  - 1x before SCR
  - 1x after SCR

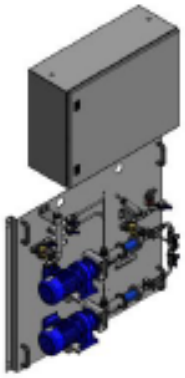
Wiring is carried out by the customer or by arrangement

Pos. 2.7 PUMP UNIT

Duty standby pump unit delivered mounting frame
Wiring between pumps and control box has to be done by customer.

Consisting of:

- 2 pc. Solenoid diaphragm dosing pump
- 1 pc. Control box: loose supply
- 1 pc. Strainer
- 1 pc. Pressure transmitter
- 2 pc. Solenoid valves



Design Example

AVK
THE POWER PEOPLE

SCR Technical Submission TS-05

Head Office: AVK, Power Systems House, Malvern Road, Maidenhead, SL6 7RE Tel: 01628 503900 sales@avk-seg.co.uk
Maidenhead: 01628 503900 **London:** 020 3856 7210 **Huddersfield:** 01484 860238 **Dublin:** 01431 9847

1.0 Technical Submission Front Page

Trade Contractor:	AVK-SEG (UK) Ltd	**From:**	Darren Hadland
Trade Contractor Sub No:	Jn430890 TS-05 TSX002-AVK-SSB-XX-TS-X-000005	**Date:**	25/05/2023
Revision:	00		
Reason for Revision	Initial Issue		

Approval of the following equipment is required:

Equipment:	SCR	**Make:**	AVK
Equipment References:	DS4000 Generating Set	**Areas Used:**	Generator Room
Description:	Supply and installation of 4 X Selective Catalytic Reducers (SCR) for use on DS 4000 20V4000G94L3D NEA Optimised-Standby, No Overload 4000kVA/3200kW at 11kV diesel generating sets. (Future scope for 10 SCR systems in total)		
Planned On Site Date:	See project schedule		

Attached detail documents:

(Tick if included and Insert references within boxes identifying supporting documentation included within this submission)

Description	Tick	Section	Description	Tick	Doc Ref
Technical submission front sheet	✓	1.0	*Interfaces & Dependencies Schedule*	✓	6.0
Equipment Description	✓	2.0	*Builders Work Requirements*	X	7.0
List of Exceptions & Clarifications	X	3.0	*Client Comments*	✓	8.0
Manufacturers Documents	✓	4.0	*Appendices*	✓	9.0
Certified Drawings	X	5.0			

Signed by Trade Contractor:	Darren Hadland
Date:	25/05/2023

Approval:

Company	Sign	Date	Status	Comments
Client				

Note: If client sign off and/or comments have not been received within 2 weeks of the date stated on this technical submission then the products and/or services detailed in the technical submission are deemed to be accepted at status A.

2.0 – Equipment Description

2.1 Overview

Supply of 4 no. SCR exhaust emissions systems (including dosing and SCR control) for DS 4000 Standby Rating 3D NEA Optimised-Standby, No Overload) rated Gross output of 4000kVA/3200kW at 11kV Turbocharged Diesel Engine. Also supplied will be 2 no 17,000 Ltr urea storage tanks, 2 no pump units feeding a supply ring main (complying to the uptime institute requirement) and 2 filling points, 1 for each 17,000 Ltr Urea Tank.

Future scope to have the Urea system supplying 10 containers in total.

The SCR system shall reduce NOx emissions to <236mg/Nm^3 @ 5% O2 (To comply with the Medium Combustion Plant Directive (MCPD) and an acoustic target of 65dB(A) @ 1m.

Silencer/SCR conditions:

Exhaust flow Rate:	19,196 kg/hr
Exhaust gas Temp (Inlet temp):	482 °C
Max operating temperature:	505 °C
Max Exhaust gas pressure:	0.1BarG
Pressure loss (Inc Honeycombs):	45 mbar
Urea consumption (Per Generator):	46 Ltr/Hr

See the following appendices for further details:
Appendix 9.01 – 20V4000G94LF Technical sales document
Appendix 9.02 – 20V4000G94LF Engine Data Sheet
Appendix 9.03 – SCR Specification
Appendix 9.04 – 20V4000G94LF 5% 02

2.2 Dosing Unit and Control cabinet.

The dosing station with incorporated control cabinet provides the urea pump and compressed air required for the injection section. The control cabinet will come with PLC control and a 10” touch panel for system parameter visualisation.

The system provides integrated data recording for:

- Current NOx value
- Evaluated NOx values:
  - Daily average values (including evaluation).
  - Compliance with daily mean value.
  - Validity Daily mean value.
  - Compliance "not double limit value" exceeded.
  - Downtime NOx Sensor.

- Exhaust gas temperatures
- Exhaust gas back pressure
- Air pressure
- Urea pressure
- Storage of the daily mean value on an external storage medium (e.g. USB stick or SD card (external
- storage media not included in the scope of delivery; min. 16GB are required for recording the mean values over 6 years)

The control Cabinet will be constructed of sheet steel to IP54, requiring a 1~230V+N+PE 50 Hz, TN-C-S supply line.

See the following appendices for further details:
Appendix 9.03 – SCR Specification

2.3 Injection Section

The injection section of the SCR system consists of static mixers for homogeneous mixing of ammonia and the exhaust gas, with 3 integrated measuring nozzles for:

- 1x pressure
- 1x Temperature
- 1x NOx

The atomising lance with its 2-phase nozzle injects the urea-water solution into the injection section with compressed air provided by the dosing unit.

See the following appendices for further details:
Appendix 9.03 – SCR Specification

2.4 Acoustic Design and octave breakdown

The SCR system includes a silencer system to reduce the engine exhaust noise in line with the required levels. Acoustic target (As per requirement) of 65dB(A) @ 1m

Sound Pressure at Engine outlet = 122dB(A) @ 1m
Sound pressure silencer/SCR outlet = 65 dB(A) @ 1m

Silencer Octave breakdown

Measurement position according to DIN 45635-11 / ISO 6798.

Prognosis of Sound Level at silencer outlet *2)						
Octave Frequency	Lp sound pressure level at silencer inlet in 1m *2)	Transmission Loss	Lp sound pressure level after silencer in 1m *2)	LpA sound pressure level after silencer in 1m *2)	con-version	LpA sound pressure level after silencer in 1m *2)
31,5 Hz	105 dB	15 dB	91 dB	51 dB(A)		
63 Hz	115 dB	34 dB	81 dB	55 dB(A)		
125 Hz	124 dB	49 dB	75 dB	59 dB(A)		
250 Hz	124 dB	58 dB	66 dB	57 dB(A)		
500 Hz	116 dB	57 dB	59 dB	56 dB(A)		
1000 Hz	118 dB	61 dB	57 dB	57 dB(A)		
2000 Hz	116 dB	64 dB	52 dB	53 dB(A)		
4000 Hz	107 dB	55 dB	52 dB	53 dB(A)		
Sum dB:	**128 dB in 1m**					
Sum dB(A):	**122 dB(A) in 1m**			**65 dB(A) in 1m**	**0 dB**	**65 dB(A) in 1m**
Target dB(A):				**65 dB(A) in 1m**		**65 dB(A) in 1m**

See the following appendices for further details:
Appendix 9.03 – SCR Specification

2.5 Urea Tank

The 2 bulk urea tanks will provide storage for 4 Generator containers (Project forecast for 10 Generators in total) and will be linked to of the tanks 4 containers via a ring main. With the ring main connecting to a total of 10 in the future.

The tank construction will be double wall stainless steel tank and bund arrangement, with the inner tank comprising of stainless steel 316L and the Bund being constructed of stainless steel 316L.

Each of the tanks will come with an OLE 2020 located near or on the tank in the generator room with a tank contents gauge, an OLE 2020-A-Mirror will locate on the ground floor fill point for fill point tank contents visibility, during tanker operations. Each tank will have its own fill point and tank installed overfill prevention valve (OPV).

Each tank will also come with High- and Low-level warning sensors, vent, and feed/return urea lines from the urea ring main.

Dimensions Inner Tank –

Height:	**= 3510 mm**
Width:	**= 1900 mm**
Length:	**= 2700 mm**

Dimensions Bund –

Height:	**= 3522 mm**
Width:	**= 2000 mm**
Length:	**= 3800 mm**

Individual Tank Weight –

Dry:	**= 4.5 Tonnes**
Wet (1500 Ltrs Urea 32.5%):	**= 20 Tonnes**

Individual Tank Urea Volumes –

Nominal:	**= 17,000 Litres**
Brimmed:	**= 18,000 Litres**

Dual Tank Urea Volumes –

Both Nominal Total:	**= 34,000 Litres**
Both Brimmed Total:	**= 36,000 Litres**
Medium Total:	**= 35,000 Litres**

Project specification run time **= 72 Hours**

Single Container demand Tank Performance (100% Load):

Urea Consumption:	**= 46 Ltr/Hr**
Runtime with both tanks at Nominal:	**= 369.6 Hours**
Runtime with both tanks at Brimmed:	**= 391.3 Hours**

4 Container demand Tank Performance (100% Load):

Urea Consumption:	**= 184 Ltr/Hr**
Runtime with Nominal):	**= 184.8 Hours**
Runtime with Brimmed:	**= 194.8 Hours**

10 Container demand Tank Performance (100% Load, Future expectation):

Urea Consumption:	**= 460 Ltr/Hr**
Runtime with both tanks at Nominal:	**= 73.9 Hours**
Runtime with both tanks at Brimmed:	**= 78.3 Hours**

Each Urea tank shall contain the following connection:

- 600mm ID Raised Manway flanged neck.
- 50mm Fill Point piped to Cabinet.
- 50mm Vent pipe to bund
- 80mm bund vent to atmosphere
- 15/25mm Socket for Contents gauge {Plugged}
- 40mm Nipple for Alarm probe x 2 {Tank unit capped}
- 25mm Drain line c/w suction pipe {Capped}
- 25mm Socket for level probe {Plugged}.
- 50mm Socket - spare {Plugged}
- 25mm Draw line c/w Lockable Valve & shaft key
- 25mm Return line Piped to low level
- Security Cover over roof fittings c/w cut out into bund & 3 - 15mm sockets {Plugged if not used}.
- Tank welded fill point cabinet recessed into bund c/w 50mm cable ducting tube.

See the following appendices for further details:
Appendix 9.03 – SCR Specification
Appendix 9.05 – OLE C2020 Datasheet

2.6 Exhaust and NOx Measuring Equipment

Measurements are recorded via:

- 2 no. pressure transducers to ascertain the exhaust side counter pressure.
- 2 no. NOx sensors for concentration measurement
- 2 no. temperature sensors for exhaust gas temperature monitoring
  - 1X Before SCR
  - 1x after SCR

See the following appendices for further details:
Appendix 9.03 – SCR Specification

2.7 Emissions

The SCR has been designed to meet the below parameters at 100% design load (3,300kVA) @ 5% O^2 utilising Diesel. NOx Emissions will also comply with the MCPD (500 mg/Nm³).

	Before Catalytic Converter	After Catalytic Converter	Units
NOx	< 2362	< 236	mg/Nm³
NH3		< 10	mg/Nm³

See the following appendices for further details:
Appendix 9.03 – SCR Specification

3.0 - List of Exceptions & Clarifications

Issued Separately.

4.0 - Manufacturers Documents

See list of appendices in section 9

5.0 - Certified Drawings

Issued separately.

6.0 – Interfaces and Dependencies Schedule

Auxiliary Supply Required	Detail	Quantity Required	Provided By	Final Connection By
230V 50Hz	SCR Control Cabinet (Each Container)	1 Per Genset	AVK	AVK
24VDC	OLE 2020 Power (Urea Tank)	1 Per 17,000 Ltr Urea Tank	AVK	AVK
24VDC	OLE 2020 Mirror Power (Fill Point Location)	1 Per fill point	AVK	AVK
400V 50Hz	Pump Control Power (Near Urea Tank)	1 Per Pump unit	AVK	AVK

7.0 - Builders Work Requirements

N/A

8.0 – Schedule of Comments

The following table provides a schedule of all comments required against this document and details the AVK response and status of each comment.

Item	Client Comment	AVK Response	Status

Note: *Client to advise status of comment from the following list;*

- Accepted (no further action)

- Rejected (refer to comments)

9.0 – Appendices

Item	Document Name
9.01	20V4000G94LF Technical sales document
9.02	20V4000G94LF Engine Data Sheet
9.03	SCR Specification
9.04	20V4000G94LF - 5% O2 - Telehouse South
9.05	OLE C2020 Datasheet

APPENDIX 9.01

20V4000G94LF Technical sales document

Technical Sales Document

- Product Data -

A Rolls-Royce solution

Name	20V4000G94LF	**Speed [rpm]**	1500
Application Group	3D	**Nominal power [kW]**	3308
Dataset	Ref. 25°C/45°C	**Nominal power [bhp]**	4436
		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50
Exhaust Regulations	NEA Singapore for ORDE;		

Reference conditions

No.	Description	Index	Value	Unit
6	Intake air temperature		25	°C
7	Charge-air coolant temperature		45	°C
8	Barometric pressure		1000	mbar
9	Site altitude above sea level		100	m

[BL] **Reference value: fuel stop power**
Maximum engine power that cannot be run continuously on some applications (stabilization reserve)
[DL] **Reference value: continuous power**
Engine power that can be run continuously under standard conditions

[>] **Actual value must be greater than specified value**
[<] **Actual value must be less than specified value**

[X] **Applicable**
The module is valid for this product type
[-] **Non-applicable**
The module is not valid for this product type
[N] **Value not named**
The value has not yet been named or will not be named

[*] **Adequate verification not yet available (tolerance +/- 10%)**
[**] **Adequate verification not yet available (tolerance +/- 5%)**

[A] **Design value**
Value required for the design of an external system (plant)
[R] **Guideline value**
Typical average value as information – only suitable for design purposes to a limited extent
[L] **Limit value**
A value representing the lower limit/minimum value or upper limit/maximum value that may not be exceeded. Not suitable for design purposes

Technical Sales Document

- Product Data -

A Rolls-Royce solution

Name	20V4000G94LF	**Speed [rpm]**	1500
Application Group	3D	**Nominal power [kW]**	3308
Dataset	Ref. 25°C/45°C	**Nominal power [bhp]**	4436
		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50
Exhaust Regulations	NEA Singapore for ORDE;		

0. Data-relevant engine design configuration

No.	Description	Index	Value	Unit
13	Engine without sequential turbocharging (turbochargers without cut-in/cut-out control)		X	-

[BL] **Reference value: fuel stop power**
Maximum engine power that cannot be run continuously on some applications (stabilization reserve)
[DL] **Reference value: continuous power**
Engine power that can be run continuously under standard conditions

[>] **Actual value must be greater than specified value**
[<] **Actual value must be less than specified value**

[X] **Applicable**
The module is valid for this product type
[-] **Non-applicable**
The module is not valid for this product type
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[*] **Adequate verification not yet available (tolerance +/- 10%)**
[**] **Adequate verification not yet available (tolerance +/- 5%)**

[A] **Design value**
Value required for the design of an external system (plant)
[R] **Guideline value**
Typical average value as information – only suitable for design purposes to a limited extent
[L] **Limit value**
A value representing the lower limit/minimum value or upper limit/maximum value that may not be exceeded. Not suitable for design purposes

Technical Sales Document

- Product Data -

A Rolls-Royce solution

Name	20V4000G94LF	**Speed [rpm]**	1500
Application Group	3D	**Nominal power [kW]**	3308
Dataset	Ref. 25°C/45°C	**Nominal power [bhp]**	4436
		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50
Exhaust Regulations	NEA Singapore for ORDE;		

1. Power-related data

No.	Description	Index	Value	Unit
1	Engine rated speed	A	1500	rpm
3	Mean piston speed		10.5	m/s
5	Fuel stop power ISO 3046	A	3308	kW
9	Mean effective pressure (MEP) (Fuel stop power ISO 3046)		27.8	bar

[BL] **Reference value: fuel stop power**
Maximum engine power that cannot be run continuously on some applications (stabilization reserve)
[DL] **Reference value: continuous power**
Engine power that can be run continuously under standard conditions

[>] **Actual value must be greater than specified value**
[<] **Actual value must be less than specified value**

[X] **Applicable**
The module is valid for this product type
[-] **Non-applicable**
The module is not valid for this product type
[N] **Value not named**
The value has not yet been named or will not be named

[*] **Adequate verification not yet available (tolerance +/- 10%)**
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Technical Sales Document

- Product Data -

A Rolls-Royce solution

Name	20V4000G94LF	**Speed [rpm]**	1500
Application Group	3D	**Nominal power [kW]**	3308
Dataset	Ref. 25°C/45°C	**Nominal power [bhp]**	4436
		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50
Exhaust Regulations	NEA Singapore for ORDE;		

2. General Conditions (for maximum power)

No.	Description	Index	Value	Unit
46	Individual power calculation (ESCM) required for maximum power		X	-
3726	Site altitude above sea level, max. (special hardware required for altitudes > site altitude)	L	1300	m
3727	Special hardware for altitude > site altitude needed (see chapter 2, item No. 3726)		X	-
1	Intake air depression (new filter)	A	15	mbar
2	Intake air depression, max.	L	30	mbar
51	Exhaust overpressure (total pressure against atmosphere)	A	30	mbar
52	Exhaust overpressure, max. (total pressure against atmosphere)	L	50	mbar
5	Fuel temperature at fuel feed connection	R	25	°C
6	Fuel temperature at fuel feed connection, max.	L	55	°C

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		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50
Exhaust Regulations	NEA Singapore for ORDE;		

3. Consumption

No.	Description	Index	Value	Unit
56	Specific fuel consumption (be) - 100 % FSP (+ 5 %; EN 590; 42.8 MJ/kg)	R	202	g/kWh
57	Specific fuel consumption (be) - 75 % FSP (+ 5 %; EN 590; 42.8 MJ/kg)	R	198	g/kWh
58	Specific fuel consumption (be) - 50 % FSP (+ 5 %; EN 590; 42.8 MJ/kg)	R	215	g/kWh
59	Specific fuel consumption (be) - 25 % FSP (+ 5 %; EN 590; 42.8 MJ/kg)	R	233	g/kWh
73	No-load fuel consumption	R	50	kg/h
92	Lube oil consumption after 100 h of operation (B = fuel consumption per hour) Guideline value does not apply for the design of EGAT systems. Please consult the Applications Center with regard to the layout of EGA systems.	R	0.2	% of B
62	Lube oil consumption after 100 h of operation, max. (B = fuel consumption per hour)	L	0.5	% of B

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Exhaust Regulations	NEA Singapore for ORDE;		

4. Model-related data (basic design)

No.	Description	Index	Value	Unit
3	Engine with exhaust turbocharger (ETC) and intercooler		X	-
4	Exhaust piping, non-cooled		X	-
33	Working method: four-cycle, diesel, single-acting		X	-
34	Combustion method: direct injection		X	-
36	Cooling system: conditioned water		X	-
37	Direction of rotation: c.c.w. (facing driving end)		X	-
6	Number of cylinders		20	-
7	Cylinder configuration: V angle		90	degrees (°)
10	Bore		170	mm
11	Stroke		210	mm
12	Displacement, cylinder		4.77	liter
13	Displacement, total		95.4	liter
14	Compression ratio		16.4	-
40	Cylinder heads: single-cylinder		X	-
41	Cylinder liners: wet, replaceable		X	-
49	Piston design: solid-skirt piston		X	-
21	Number of piston compression rings		2	-
22	Number of piston oil control rings		1	-
24	Number of inlet valves, per cylinder		2	-
25	Number of exhaust valves, per cylinder		2	-
15	Number of turbochargers		2	-
16	Number of L.P. turbochargers		2	-
18	Number of intercoolers		1	-

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		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50

Exhaust Regulations NEA Singapore for ORDE;

19	Number of L.P. intercoolers		1	-
28	Standard flywheel housing flange (engine main PTO)		00	SAE
50	Static bending moment at standard flywheel housing flange, max.	L	15	kNm
51	Dynamic bending moment at standard flywheel housing flange, max.	L	75	kNm
43	Flywheel interface (DISC)		21	-

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		Nominal power [kWel]	-
		Frequency [Hz]	50
Exhaust Regulations	NEA Singapore for ORDE;		

5. Combustion air / exhaust gas

No.	Description	Index	Value	Unit
27	Charge-air pressure before cylinder - FSP	R	4.0	bar abs
10	Combustion air volume flow - FSP	R	4.7	m³/s
12	Exhaust volume flow (at exhaust temperature) - FSP	R	11.9	m³/s
14	Exhaust temperature before turbocharger - FSP	R	693	°C
4083	Exhaust temperature after engine - FSP (Position of interface according to installation drawing)	R	482	°C

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		Nominal power [kWel]	-
		Frequency [Hz]	50
Exhaust Regulations	NEA Singapore for ORDE;		

6. Heat dissipation

No.	Description	Index	Value	Unit
16	Heat dissipated by engine coolant - FSP with oil heat, without charge-air heat	R	1270	kW
27	Charge-air heat dissipation - FSP	R	930	kW
32	Heat dissipated by return fuel flow - FSP	R	7.5	kW
34	Radiation and convection heat, engine - FSP	R	105	kW

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		Nominal power [kVA]	-
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		Frequency [Hz]	50
Exhaust Regulations	NEA Singapore for ORDE;		

7. Coolant system (high-temperature circuit)

No.	Description	Index	Value	Unit
17	Coolant temperature (at engine outlet to cooling equipment)	A	100.0	°C
57	Coolant temperature differential after/before engine, from	R	10.0	K
58	Coolant temperature differential after/before engine, to	R	12.0	K
23	Coolant temperature differential after/before engine	L	14.0	K
20	Coolant temperature after engine, limit 1	L	102.0	°C
21	Coolant temperature after engine, limit 2	L	104.0	°C
25	Coolant antifreeze content, max.	L	50	%
30	Cooling equipment: coolant flow rate	A	80.0	m³/h
127	Cooling equipment: coolant flow rate at max. pressure loss in off-engine cooling System (see chapter 7, item No. 41)	A	75	m³/h
128	Cooling equipment: coolant flow rate at min. pressure loss in off-engine cooling System (see chapter 7, item No. 72)	A	80	m³/h
31	Coolant pump: pressure differential	R	2.25	bar
35	Coolant pump: inlet pressure, min.	L	0.50	bar
36	Coolant pump: inlet pressure, max.	L	2.50	bar
39	Engine: coolant pressure differential with thermostat	R	1.70	bar
41	Pressure loss in off-engine cooling system, max.	L	0.70	bar
72	Pressure loss in off-engine cooling system, min.	L	0.3	bar
43	Pressure loss in off-engine cooling system, max. without thermostat	L	0.70	bar
70	Pressure loss in off-engine cooling system, min. without thermostat	L	0.3	bar

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		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50

Exhaust Regulations NEA Singapore for ORDE;

47	Breather valve (expansion tank) opening pressure (excess pressure)	R	1.00	bar
54	Cooling equipment: height above engine, max.	L	15	m
53	Cooling equipment: operating pressure	A	2.50	bar
74	Coolant level in expansion tank, below min. shutdown	L	X	-
50	Thermostat, starts to open	R	79.0	°C
51	Thermostat, bypass closed	R	92.0	°C
52	Thermostat, fully open	R	92.0	°C
48	Breather valve (expansion tank) opening pressure (depression)	R	-0.1	bar
49	Pressure in cooling system, max.	L	5.00	bar

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Exhaust Regulations	NEA Singapore for ORDE;		

8. Coolant system (low-temperature circuit)

No.	Description	Index	Value	Unit
53	Coolant temperature (at engine outlet to cooling equipment)	R	70.0	°C
9	Coolant temperature before intercooler (at engine inlet from cooling equipment)	A	45.0	°C
14	Coolant temperature before intercooler, limit 1	L	75.0	°C
15	Coolant temperature before intercooler, limit 2	L	78.0	°C
54	Coolant temperature differential after/before intercooler, min.	L	18.0 *	K
55	Coolant temperature differential after/before intercooler, max.	L	30.0 *	K
13	Coolant antifreeze content, max.	L	50	%
17	Charge-air temperature after intercooler, max.	L	80.0	°C
76	Temperature differential between intake air and charge-air coolant before intercooler	A	20.0	K
75	Temperature differential between intake air and charge-air coolant before intercooler, max.	L	22.0	K
56	Coolant pump: flow rate	A	44.0	m³/h
18	Coolant pump: flow rate (± 5 %)	R	44.0	m³/h
20	Cooling equipment: coolant flow rate	A	44.0	m³/h
80	Cooling equipment: coolant flow rate at max. pressure loss in off-engine cooling system	A	43	m³/h
81	Cooling equipment: coolant flow rate at min. pressure loss in off-engine cooling system	A	50	m³/h
21	Intercooler: coolant flow rate	R	44.0	m³/h
24	Coolant pump: inlet pressure, min.	L	0.5	bar
25	Coolant pump: inlet pressure, max.	L	2.5	bar
29	Pressure loss in off-engine cooling system, max.	L	1.0	bar

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		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50

Exhaust Regulations NEA Singapore for ORDE;

62	Pressure loss in off-engine cooling system, min.	L	0.3	bar
31	Pressure loss in off-engine cooling system, max. without thermostat	L	1.0	bar
63	Pressure loss in off-engine cooling system, min. without thermostat	L	0.3	bar
43	Cooling equipment: height above engine, max.	L	15	m
36	Breather valve (expansion tank) opening pressure (excess pressure)	R	1.00	bar
37	Breather valve (expansion tank) opening pressure (depression)	R	-0.10	bar
42	Cooling equipment: operating pressure	A	2.50	bar
68	Coolant level in expansion tank, below min. shutdown	L	X	-
39	Thermostat, starts to open	R	38.0	°C
40	Thermostat, bypass closed	R	51.0	°C
41	Thermostat, fully open	R	51.0	°C

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Exhaust Regulations	NEA Singapore for ORDE;		

10. Lube oil system

No.	Description	Index	Value	Unit
1	Lube oil operating temp. before engine, from	R	85	°C
2	Lube oil operating temp. before engine, to	R	98	°C
3	Lube oil operating temp. after engine, from	R	98	°C
4	Lube oil operating temp. after engine, to	R	108	°C
5	Lube oil temperature before engine, limit 1	L	99	°C
6	Lube oil temperature before engine, limit 2	L	101	°C
7	Lube oil operating pressure before engine (measuring block)	R	5.1	bar
8	Lube oil operating press. bef. engine, from	R	4.3	bar
9	Lube oil operating press. bef. engine, to	R	7.1	bar
33	Lube oil pressure before engine, limit 1(speed-related value, consult Rolls-Royce Solutions GmbH)	L	3.5	bar
34	Lube oil pressure before engine, limit 2 (speed-related value, consult Rolls-Royce Solutions GmbH)	L	3.2	bar
17	Lube oil pump(s): oil flow, total	R	835	liter/min
19	Lube oil fine filter (main circuit): number of units		1	-
20	Lube oil fine filter (main circuit): number of elements per unit		5	-
21	Lube oil fine filter (main circuit): particle retention	R	0.012	mm
32	Lube oil fine filter (main circuit): pressure differential, max.	L	1.5	bar
35	Lube oil fine filter (main circuit): make (standard): MANN & HUMMEL		X	-

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		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50
Exhaust Regulations	NEA Singapore for ORDE;		

11. Fuel system

No.	Description	Index	Value	Unit
1	Fuel pressure at engine fuel feed connection, min. (when engine is starting)	L	-0.1	bar
2	Fuel pressure at engine fuel feed connection, max. (when engine is starting)	L	1.5	bar
57	Fuel pressure at engine fuel feed connection, min. (when engine is running)	L	-0.3	bar
65	Fuel pressure at engine fuel feed connection, max. (when engine is running)	L	0.5	bar
37	Fuel supply flow, max.	A	*	liter/min
4211	Max. fuel supply volume Normal mode	A	20.1	liter/min
4212	Max. fuel supply volume Failure mode	A	22.6	liter/min
4	Fuel pressure before injection pump, from (high-pressure pump)	R	7.0	bar
5	Fuel pressure before injection pump, to (high-pressure pump)	R	9.0	bar
6	Fuel pressure before injection pump, min. (high-pressure pump)	L	5.0	bar
7	Fuel pressure before injection pump with engine not running, max. (high-pressure pump)	L	1.5	bar
4213	Max. fuel return volume Normal mode	A	5.5	liter/min
4214	Max. fuel return volume Failure mode	A	21.8	liter/min
10	Fuel pressure at return connection on engine, max.	L	0.5	bar
18	Fuel fine filter (main circuit): number of units	A	1	-
19	Fuel fine filter (main circuit): number of elements per unit	A	2	-

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Technical Sales Document

- Product Data -

A Rolls-Royce solution

Name	20V4000G94LF	**Speed [rpm]**	1500
Application Group	3D	**Nominal power [kW]**	3308
Dataset	Ref. 25°C/45°C	**Nominal power [bhp]**	4436
		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50

Exhaust Regulations NEA Singapore for ORDE;

21	Fuel fine filter (main circuit): pressure differential, max.	L	2.0	bar

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Exhaust Regulations	NEA Singapore for ORDE;		

12. General operating data

No.	Description	Index	Value	Unit
1	Cold start capability: air temperature (w/o starting aid, w/o preheating) - (case A)	R	10	°C
2	Additional condition (to case A): engine coolant temperature	R	10	°C
3	Additional condition (to case A): lube oil temperature	R	10	°C
4	Additional condition (to case A): lube oil viscosity	R	15W40	SAE
9	Cold start capability: air temperature (w/o starting aid, w/ preheating) - (case C)	R	0	°C
10	Additional condition (to case C): engine coolant temperature	R	40	°C
11	Additional condition (to case C): lube oil temperature	R	-10	°C
12	Additional condition (to case C): lube oil viscosity	R	15W40	SAE
21	Coolant preheating, heater performance (standard)	R	9.0	kW
22	Coolant preheating, preheating temperature, min.	L	32	°C
3506	Coolant preheating, preheating temperature, max.	L	55	°C
28	Breakaway torque (without driven machinery) coolant temperature +5°C	R	2600	Nm
30	Breakaway torque (without driven machinery) coolant temperature +40°C	R	2200	Nm
29	Cranking torque at firing speed (without driven machinery) coolant temperature +5°C	R	1400	Nm
31	Cranking torque at firing speed (without driven machinery) coolant temperature +40°C	R	1100	Nm
37	High idling speed, max. (static)	L	1613	rpm
38	Limit speed for overspeed alarm / emergency shutdown	L	1950	rpm
39	Limit speed for overspeed alarm	L	1950	rpm

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Exhaust Regulations NEA Singapore for ORDE;

42	Firing speed, from	R	80	rpm
43	Firing speed, to	R	120	rpm
44	Engine coolant temperature before starting full-load operation, recommended min. (for emergency/standby sets with coolant preheating the minimum preheating temperature referred to extended property No.22 is sufficient)	R	60	°C
3515	Minimum continuous load (operation > 10h)	R	30	kW/cyl
50	Engine mass moment of inertia (without flywheel)	R	24.6	kgm²
52	Standard flywheel mass moment of inertia	R	10.2	kgm²
51	Engine mass moment of inertia (with standard flywheel)	R	34.8	kgm²
69	Speed droop (with electronic governor) adjustable, from	R	0	%
70	Speed droop (with electronic governor) adjustable, to	R	7	%
95	Number of starter ring-gear teeth on engine flywheel		182	-

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Exhaust Regulations	NEA Singapore for ORDE;		

13. Starting (electric)

No.	Description	Index	Value	Unit
2309	Manufacturer		Delco	-
4101	Type		50MT	-
2310	Number of starter		2	-
2312	Starter electrically redundant		-	-
2313	Rated power per starter	R	9	kW
2314	Starter, rated voltage	R	24	VDC
2315	Rated short-circuit current per starter	L	1900	A
2316	Power consumption per starter (at an engine speed of 100 rpm)	R	580	A
2317	Internal resistance of power supply + line resistance per starter	A	0.008	Ω
2318	Manufacturer		Bosch	-
4118	Type		HEP	-
2319	Number of starter		2	-
2320	Starter electrically redundant		-	-
2321	Rated power per starter	R	11.3	kW
2322	Starter, rated voltage	R	24	VDC
2323	Rated short-circuit current per starter	L	2190	A
2324	Power consumption per starter (at an engine speed of 100 rpm)	R	750	A
2325	Internal resistance of power supply + line resistance per starter	A	0.0047	Ω
2326	Manufacturer		Prestolite	-
4119	Type		S-152	-
2327	Number of starter		1	-
2328	Starter electrically redundant		-	-

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Exhaust Regulations NEA Singapore for ORDE;

2329	Rated power per starter	R	15	kW
2330	Starter, rated voltage	R	24	VDC
2331	Rated short-circuit current per starter	L	3000	A
2332	Power consumption per starter (at an engine speed of 100 rpm)	R	1400	A
2333	Internal resistance of power supply + line resistance per starter	A	0.0049	Ω
2334	Manufacturer		Prestolite	-
4120	Type		S-152	-
2335	Number of starter		2	-
2336	Starter electrically redundant		X	-
2337	Rated power per starter	R	15	kW
2338	Starter, rated voltage	R	24	VDC
2339	Rated short-circuit current per starter	L	3000	A
2340	Power consumption per starter (at an engine speed of 100 rpm)	R	1400	A
2341	Internal resistance of power supply + line resistance per starter	A	0.0049	Ω
4104	Manufacturer		Prestolite	-
4105	Type		M128R	-
4106	Number of starter		2	-
4107	Starter electrically redundant		-	-
4108	Rated power per starter	R	9.4	kW
4109	Starter, rated voltage	R	24	VDC
4110	Rated short-circuit current per starter	L	2000	A
4111	Power consumption per starter (at an engine speed of 100 rpm)	R	600	A
4112	Power consumption per starter (at an engine speed of 100 rpm, SAE0)	R	-	A
4113	Power consumption per starter (at an engine speed of 100 rpm, SAE1)	R	-	A

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		Frequency [Hz]	50

Exhaust Regulations NEA Singapore for ORDE;

4114	Internal resistance of power supply + line resistance per starter	A	0.008	Ω
2347	Generally valid data for starter		X	-
2342	Rated starting-attempt Duration (at +20°C ambient temperature with battery full)	R	5	s
2343	Interval between starts (at rated starting-attempt duration), min.	L	20	s
2345	Maximum acceptable starting-attempt duration	L	15	s
2344	Interval between starts (when starting-attempt duration > rated starting-attempt duration)	R	60	s
2346	Starting attempts within 30 minutes (at +20°C ambient temperature with battery full), max.	L	6	-
3565	Disengagement of starter pinion at engine Speed Note: Exceeding the guideline value of the disengagement speed will reduce the life cycle of the starter depending on how often and how much the speed has been exceeded	R	400	rpm
3566	Disengagement of starter pinion at engine speed, max.	L	500	rpm

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Exhaust Regulations	NEA Singapore for ORDE;		

15. Starting (pneumatic/oil pressure starter)

No.	Description	Index	Value	Unit
36	Pneumatic starter: make TDI		X	-
5	Starting air pressure before starter motor, min.	R	8	bar
6	Starting air pressure before starter motor, max.	R	9	bar
7	Starting air pressure before starter motor, min.	L	8	bar
8	Starting air pressure before starter motor, max.	L	9	bar
18	Start attempt duration (engine preheated)	R	3	s
19	Start attempt duration (engine not preheated)	R	5	s
114	Air consumption/start attempt (engine preheated) Engine without generator Control with engine controller	R	1.4	m³n
116	Air consumption with external control for air-starter (per second	R	0.5	m³n
29	Starting air tank for 3 start attempts (max. 40 bar) (engine not preheated)	R	N	liter
30	Starting air tank for 3 start attempts (max. 30 bar) (engine not preheated)	R	N	liter
31	Starting air tank for 6 start attempts (max. 40 bar) (engine not preheated)	R	N	liter
32	Starting air tank for 6 start attempts (max. 30 bar) (engine not preheated)	R	N	liter
33	Starting air tank for 10 start attempts (max. 40 bar) (engine not preheated)	R	N	liter
34	Starting air tank for 10 start attempts (max. 30 bar) (engine not preheated)	R	N	liter
103	Starting oil pressure before starter motor, max.	R	207	bar
105	Starting oil pressure before starter motor, max.	L	207	bar
106	Start attempt duration (engine preheated)	R	2.5	s

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Exhaust Regulations NEA Singapore for ORDE;

108	Start attempt duration, max.	L	15	s

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Exhaust Regulations	NEA Singapore for ORDE;		

16. Inclinations - standard oil system (ref.: waterline)

No.	Description	Index	Value	Unit
15	Longitudinal inclination, continuous max. driving end down (Option: max. operating inclinations)	L	5	degrees (°)
17	Longitudinal inclination, continuous max. driving end up (Option: max. operating inclinations)	L	5	degrees (°)
19	Transverse inclination, continuous max. (Option: max. operating inclinations)	L	10	degrees (°)

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Exhaust Regulations	NEA Singapore for ORDE;		

18. Capacities

No.	Description	Index	Value	Unit
1	Engine coolant capacity (without cooling equipment)	R	260	liter
10	Intercooler coolant capacity	R	50	liter
11	On-engine fuel capacity	R	9	liter
14	Engine oil capacity, initial filling (standard oil system) (Option: max. operating inclinations)	R	390	liter
20	Oil change quantity, max. (standard oil system) (Option: max. operating inclinations)	R	340	liter
28	Oil pan capacity, dipstick mark min. (standard oil system) (Option: max. operating inclinations)	L	270	liter
29	Oil pan capacity, dipstick mark max. (standard oil system) (Option: max. operating inclinations)	L	315	liter

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Exhaust Regulations	NEA Singapore for ORDE;		

19. Masses / dimensions

No.	Description	Index	Value	Unit
1	Engine dry mass (standard scope of supply)	R	9650	kg
2	Engine dry mass (with engine-mounted standard accessories incl. coupling)	R	10050	kg
4	Engine length (standard scope of supply)	R	3479	mm
5	Engine width (standard scope of supply)	R	1700	mm
6	Engine height (standard scope of supply)	R	2252	mm

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Exhaust Regulations	NEA Singapore for ORDE;		

21. Exhaust emissions

No.	Description	Index	Value	Unit
2005	Emissions data sheet: NEA Singapore for ORDE		X	-

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Exhaust Regulations	NEA Singapore for ORDE;		

22. Acoustics

No.	Description	Index	Value	Unit
102	Exhaust noise, unsilenced - FSP (free-field sound-pressure level Lp, 1m distance, ISO 6798, +3dB(A) tolerance)	R	122	dB(A)
202	Exhaust noise, unsilenced - FSP (sound power level LW, ISO 6798, +3dB(A) tolerance)	R	135	dB(A)
104	Exhaust noise, unsilenced - FSP (free-field sound-pressure level Lp, 1m distance, ISO 6798) Spectrum No.	R	737699e	-
110	Engine surface noise with attenuated intake noise (filter) - FSP (free-field sound-pressure level Lp, 1m distance, ISO 6798, +2dB(A) tolerance)	R	111	dB(A)
210	Engine surface noise with attenuated intake noise (filter) - FSP (sound power level LW, ISO 6798, +2dB(A) tolerance)	R	130	dB(A)
112	Engine surface noise with attenuated intake noise (filter) - FSP (free-field sound-pressure level Lp, 1m distance, ISO 6798) Spectrum No.	R	737693e	-
126	Structure borne noise at engine mounting brackets in vertical direction above resilient engine mounts - FSP Spectrum No.	R	737697e	-

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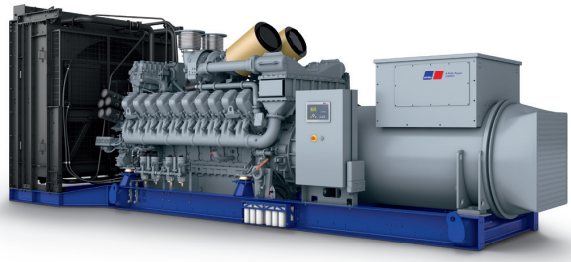
APPENDIX 9.02

20V4000G94LF Engine Data Sheet

Diesel Generator Set

mtu 20V4000 DS4000

400 V - 11 kV/50 Hz/standby power/NEA (ORDE) + Tier 2 optimized 20V4000G94LF/water charge air cooling



Optional equipment and finishing shown. Standard may vary.

Product highlights

Benefits
- Low fuel consumption
- Optimized system integration ability
- High reliability
- High availability of power
- Long maintenance intervals

Support
- Global product support offered

Standards
- Engine-generator set is designed and manufactured in facilities certified to standards ISO 2008:9001 and ISO 2004:14001
- Generator set complies to ISO 8528
- Generator meets NEMA MG1, BS 5000, ISO, DIN EN and IEC standards
- NFPA 110

Power rating
- System ratings: 3950 kVA - 4000 kVA
- Accepts rated load in one step per NFPA 110*
- Generator set complies to G3 according to ISO 8528-5
- Generator set exceeds load steps according to ISO 8528-5*

Performance assurance certification (PAC)
- Engine-generator set tested to ISO 8528-5 for transient response
- 85% load factor
- Verified product design, quality and performance integrity
- All engine systems are prototype and factory tested

Complete range of accessories available
- Control panel
- Power panel
- Fuel system
- Fuel connections with shut-off valve mounted to base frame
- Starting/charging system
- Exhaust system
- Electrical driven radiators
- Medium and oversized voltage alternators
- Low voltage alternator

Emissions
- Tier 2 optimized engine
- NEA (ORDE) optimized

Certifications
- CE certification option
- Unit certificate acc. to VDE-AR-N 4110

* Changes to the standard parameter sets (alternator-regulator and genset-controller) are necessary

A Rolls-Royce solution

Application data [1)]

Engine

Manufacturer	***mtu***
Model	20V4000G94LF
Type	4-cycle
Arrangement	20V
Displacement: l	95.4
Bore: mm	170
Stroke: mm	210
Compression ratio	16.4
Rated speed: rpm	1500
Engine governor	ADEC (ECU 9)
Max power: kWm	3308
Air cleaner	dry

Fuel system

Maximum fuel lift: m	5
Total fuel flow: l/min	27

Fuel consumption [2)]

	l/hr	g/kwh
At 100% of power rating:	818	205
At 75% of power rating:	598	200
At 50% of power rating:	429	215

Liquid capacity (lubrication)

Total oil system capacity: l	390
Engine jacket water capacity: l	260
Intercooler coolant capacity: l	50

Combustion air requirements

Combustion air volume: m^3/s	4.7
Max. air intake restriction: mbar	30

Cooling/radiator system

Coolant flow rate (HT circuit): m^3/hr	80
Coolant flow rate (LT circuit): m^3/hr	44
Heat rejection to coolant: kW	1270
Heat radiated to charge air cooling: kW	930
Heat radiated to ambient: kW	105
Fan power for electr. radiator (40°C): kW	105

Exhaust system

Exhaust gas temp. (after engine, max.): °C	482
Exhaust gas temp. (before turbocharger): °C	693
Exhaust gas volume: m^3/s	11.9
Maximum allowable back pressure: mbar	50
Minimum allowable back pressure: mbar	–

Standard and optional features

System ratings (kW/kVA)

Generator model	Voltage	NEA (ORDE) + Tier 2 optimized		
		without radiator		
		kWel	kVA*	AMPS
Leroy Somer LSA54.2 ZL17 (LV Leroy Somer standard)	400 V	3200	4000	5774
Leroy Somer LSA54.2 ZL12 (Medium volt. Leroy Somer)	11 kV	3160	3950	207
Marathon 1040FDH7105 (Medium volt. Marathon)	11 kV	3200	4000	210
Leroy Somer LSA54.2 ZL14 (MV Leroy Somer oversized)	11 kV	3160	3950	207
Leroy Somer LSA54.2 ZL14 (Engine output optimized)	11 kV	3200	4000	210

* cos phi = 0.8

1 All data refers only to the engine and is based on ISO standard conditions (25°C and 100m above sea level).

2 Values referenced are in accordance with ISO 3046-1. Conversion calculated with fuel density of 0.83 g/ml. All fuel consumption values refer to rated engine power.

Standard and optional features

Engine

- ■ 4-cycle
- ■ Standard single stage air filter
- ■ Oil drain extension & shut-off valve
- ■ Closed crankcase ventilation
- ■ Governor-electronic isochronous
- ■ Common rail fuel injection
- ■ Tier 2 optimized engine
- ■ NEA (ORDE) optimized engine

Generator

- ■ 4 pole three-phase synchronous generator
- ■ Brushless, self-excited, self-regulating, self-ventilated
- ■ Digital voltage regulator
- ■ Anti condensation heater
- ■ Stator winding Y-connected, accessible neutral (brought out)
- ■ Protection IP23
- ■ Insulation class H, utilization acc. to H
- ■ Radio suppression EN 55011, group 1, cl. B
- ■ Short circuit capability 3xIn for 10sec
- ■ Winding and bearing RTDs (without monitoring)
- ■ Excitation by AREP + PMI
- ■ Mounting of CT´s: 3x 1 core CT´s
- ■ Winding pitch: 127° pitch
- ■ Voltage setpoint adjustment ± 5%
- ■ Meets NEMA MG-1, BS 5000, IEC 60034-1, VDE 0530, DIN EN 12601, AS 1359 and ISO 8528-3 requirements
- ■ Leroy Somer low voltage generator
- □ Leroy Somer medium voltage generator
- □ Marathon medium voltage generator
- □ Oversized generator

Cooling system

- ■ Jacket water pump
- ■ Thermostat(s)
- ■ Water charge air cooling
- □ Electrical driven front-end cooler
- □ Jacket water heater
- □ Pulley for fan drive

Control panel

- ■ Unit cabling with coded plugs for easy connection of customer-specific controls (V0)
- □ Pre-wired control cabinet for easy application of customized controller (V1+)
- □ Island operation (V2)
- □ Automatic mains failure operation with ATS (V3a)
- □ Automatic mains failure operation incl. control of generator and mains breaker (V3b)
- □ Island parallel operation of multiple gensets (V4)
- □ Automatic mains failure operation with short (< 10s) mains parallel overlap synchronization (V5)
- □ Mains parallel operation of a single genset (V6)
- □ Mains parallel operation of multiple gensets (V7)
- □ Basler controller
- □ Deif controller
- □ Complete system metering
- ■ Digital metering
- ■ Engine parameters
- ■ Generator protection functions
- ■ Engine protection
- ■ SAE J1939 engine ECU communications
- ■ Parametrization software
- ■ Multilingual capability
- ■ Multiple programmable contact inputs
- ■ Multiple contact outputs
- ■ Event recording
- □ IP 54 front panel rating with integrated gasket
- □ Remote annunciator
- □ Daytank control
- □ Generator winding- and bearing temperature monitoring
- □ Modbus TCP-IP

Connectivity

The engine system automatically collects and transfers engine data to the manufacturer from time to time. The data is used by the manufacturer for the purposes of product development and improvement as well as service optimization. Users can log in or register via https://mtu-go.com and also gain insight into the data.

■ Represents standard features
□ Represents optional features

Standard and optional features

Power panel

- ☐ Supply electrical driven radiator from 45kW – 75kW

Fuel system

- ■ Flexible fuel connectors mounted to base frame
- ☐ Fuel filter with water separator
- ☐ Fuel filter with water separator heavy-duty
- ☐ Switchable fuel filter with water separator
- ☐ Switchable fuel filter with water separator heavy-duty
- ☐ Seperate fuel cooler
- ☐ Fuel cooler integrated into cooling equipment

Starting/charging system

- ■ 24V starter
- ☐ Redundant starting system
- ☐ Starter batteries, cables, rack, disconnect switch (lockable)
- ☐ Battery charger
- ☐ Alternator

Mounting system

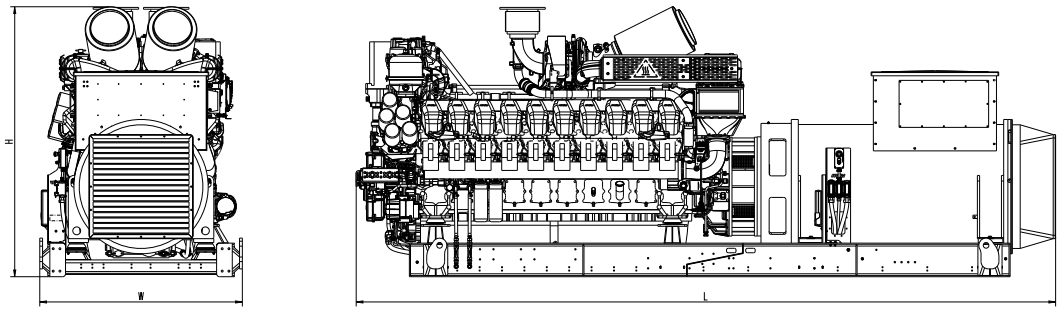
- ■ Welded base frame
- ■ Resilient engine and generator mounting
- ■ Modular base frame design
- ☐ Base frame mounting on foundation/base plate with using clamping brackets

Exhaust system

- ■ Exhaust bellows with connection flange
- ☐ Exhaust silencer with 10 dB(A) sound attenuation
- ☐ Exhaust silencer with 30 dB(A) sound attenuation
- ☐ Exhaust silencer with 40 dB(A) sound attenuation
- ☐ Y-connection-pipe

■ Represents standard features
☐ Represents optional features

Weights and dimensions



Drawing above for illustration purposes only, based on a standard open power 11 kV engine-generator set. Lengths may vary with other voltages. Do not use for installation design. See website for unit specific template drawings.

System	Dimensions (LxWxH)	Weight (dry/less tank)
Open power unit (OPU)	6343 x 1810 x 2421 mm	20810 kg

Weights and dimensions are based on open power units and are estimates only. Consult the factory for accurate weights and dimensions for your specific engine-generator set.

Sound data

— Consult your local ***mtu*** distributor for sound data.

Emissions data

— Consult your local ***mtu*** distributor for emissions data.

Rating definitions and conditions

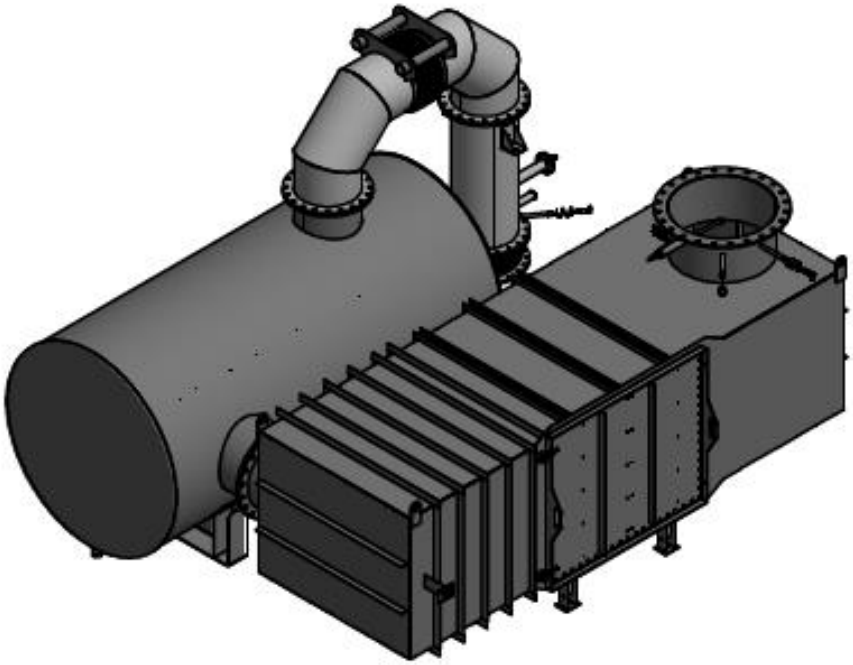
— Standby ratings apply to installations served by a reliable utility source. The standby rating is applicable to varying loads for the duration of a power outage. No overload capability for this rating. Ratings are in accordance with ISO 8528-1, ISO-3046-1, BS 5514 and AS 2789. Average load factor: ≤ 85%.
Operating hours/year: max. 500.
— Consult your local ***mtu*** distributor for derating information.

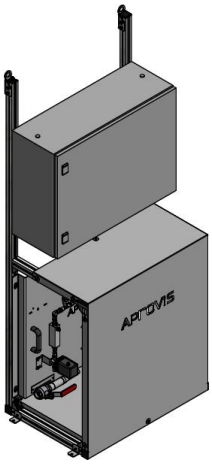
Subject to change. | 32310771 | Edition 02/22 | BMC 2022-05.

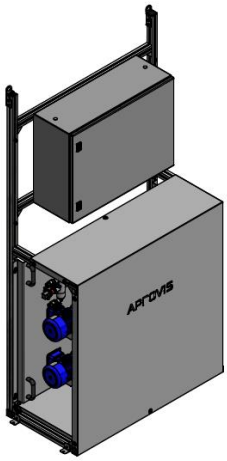
APPENDIX 9.03

SCR Specification

APROVIS Exhaust gas treatment







Customer: AVK-SEG (UK) LTD

Project: E2021-2360 - Telehouse South (Project X)

Pos. 1 **EXHAUST GAS SILENCER** **SDR-1745-6501/3400-3-1H-1A**

working principle:
reactive

(horizontal version)

DESIGN PARAMETERS

engine type	MTU 20V4000 G94LF		
number of cylinders	V20		
rotating speed	1500		rpm
sound pressure level at silencer inlet *	**122 in 1m**		**dB(A)**
sound pressure level after silencer *	**65 in 1m**		**dB(A)**
flow rate (wet)	19196		kg/hr
inlet temperature	482		°C
max. operating temperature	505		°C
max. operating pressure	0.1		barg

DIMENSIONS

outside diameter	Ø 1745		mm
total length	+/- 3400		mm
inlet connection	500/10	radial	DN/PN
outlet connection	600/10	radial	DN/PN
weight	+/- 1300		kg
additions			

MATERIAL

exhaust gas silencer	steel
flanges	steel
surface treatment	priming coat

When the aforementioned design parameters are found to be inaccurate or require to be revised, we recommend recalculating the silencer. We do not accept any responsibility when our design is based on incorrect information.

***** Measurement position according to DIN 45635-11 / ISO 6798. Tolerance according to engine data sheet.
To realise an optimal acoustic performance, it is of great importance that vibration free mounting and correct installation of the complete air-intake or exhaust gas system is given, to avoid possible transfer of vibration and/or constructional borne noise. The given sound pressure level/ sound attenuation at open field conditions is a theoretical value, which could turn out to be higher in practice.
Unfavourable layout of the exhaust line downstream of the silencer (e.g. narrow bends) can lead to an increased sound pressure level due to flow generated noise.
With unfavourable pipe lengths in the exhaust system, resonances may occur, whereby individual frequencies may be amplified. No warranty is given for this.

The reactive part of this silencer is **without heat insulation**. Because of the radiated heat and the structure-borne noise we recommend urgently insulation on site.

Prognosis of Sound Level at silencer outlet *2)						
Octave Frequency	Lp sound pressure level at silencer inlet in 1m *2)	Transmission Loss	Lp sound pressure level after silencer in 1m *2)	LpA sound pressure level after silencer in 1m *2)	con-version	LpA sound pressure level after silencer in 1m *2)
31,5 Hz	105 dB	15 dB	91 dB	51 dB(A)		
63 Hz	115 dB	34 dB	81 dB	55 dB(A)		
125 Hz	124 dB	49 dB	75 dB	59 dB(A)		
250 Hz	124 dB	58 dB	66 dB	57 dB(A)		
500 Hz	116 dB	57 dB	59 dB	56 dB(A)		
1000 Hz	118 dB	61 dB	57 dB	57 dB(A)		
2000 Hz	116 dB	64 dB	52 dB	53 dB(A)		
4000 Hz	107 dB	55 dB	52 dB	53 dB(A)		
Sum dB:	**128 dB in 1m**					
Sum dB(A):	**122 dB(A) in 1m**			**65 dB(A) in 1m**	**0 dB**	**65 dB(A) in 1m**
Target dB(A):				**65 dB(A) in 1m**		**65 dB(A) in 1m**

***2)** measurement position according to DIN 45635-11 / ISO 6798

Pos. 2	CATALYST	SCR-500/1-X-S108.45-31-0-K

general data

Engine:	MTU 20V4000G94LF	
Fuel:	Diesel	
Operation of engine:	λ > 1	
Exhaust gas mass flow:	19196	kg/h
Exhaust gas temperature:	482	°C
Maximum Exhaust gas temperature:	505	°C
Maximum Exhaust gas pressure:	0,1	barg
Pressure Loss total: (silencer, mixing tube, SCR)	**45**	**mbar**
Urea consumption (32,5%):	46	L/h

Emissions [5% O2]

	Before Catalytic Converter	After Catalytic Converter	
NOx	< 2362	< 236	mg/Nm³
NH_3		< 10	mg/Nm³

Equipment SCR

SCR

Number of rows SCR	3	pc.
Number of empty rows	0	pc.

Material

Material injection	Stainless steel	
Material flanges injection	Stainless steel	
Material housing	Steel	
Material flanges housing	Steel	

Installation and connection

Place of installation	Inside installation; no ex zone Outdoor installation by arrangement	
Min. ambient temperature	5	°C
Max. ambient temperature	40	°C
Exhaustgas piping inlet	600/10	DN/PN
Exhaustgas piping outlet	800/10	DN/PN

Dimensions of injection section

L x W x H	+/- 3100 x 500 x 1000	mm
Transport weight	+/- 200	kg
Operating weight	+/- 200	kg

Dimensions of housing

L x W x H	+/- 5004 x 1500 x 2068	mm
Transport weight	+/- 3800	kg
Operating weight	+/- 3800	kg

Dimensions of dosing unit

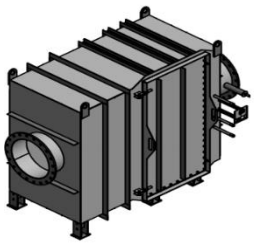
L x W x H	+/- 550 x 800 x 1925	mm
Transport weight	+/- 170	kg
Operating weight	+/- 170	kg

Pos. 2.1 HOUSING

For integration of catalyst honeycombs

Consisting of:

- 1x opening (on the side), for catalyst insertion
- Integrated measuring nozzles for:
  - 2x Temperature
  - 1x Pressure
  - 1x NOx
  - 1x Reserve



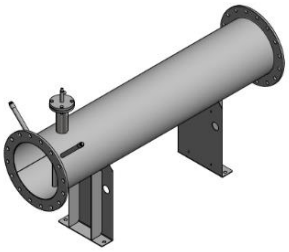
Design example

Pos. 2.2a INJECTION SECTION

Designed as complete assembly (with Pos. 1.1b);

Consisting of:

- Static mixers for homogeneus mixing of ammonia and exhaust gas
- Integrated measuring nozzles for:
  - 1x Pressure
  - 1x Temperature
  - 1x NOx



Design example

Pos. 2.2b ATOMISING LANCE WITH TWO PHASE NOZZLE

For injection of urea-water-solution with compressed air

Consisting of:

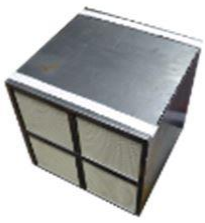
- Atomising lance with two phase nozzle

Pos. 2.3 CATALYST HONEYCOMBS SCR

Catalyst honeycombs will be integrated in the factory.
For integration engine setup must be completed as misfiring will lead to destruction of the catalysts.

Consisting of:

- SCR-Honeycombs
- incl. sealing

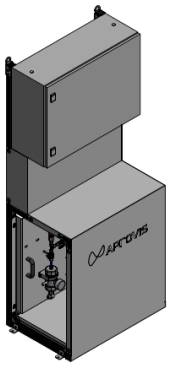


Design example

Integration in factory

Pos. 2.4 DOSING STATION AND CONTROL CABINET

Dosing station and control cabinet pre-assembled and piped as a unit on a base frame



Design Example

Consisting of:

- 1 pc. Switching valve for flushing and cooling the urea line with air
- 1 pc. Oil-free compressor for continuous operation
- 1 pc. Overflow valve for the controlled air supply to the nozzle
- 3 pc. Pressure sensor for leakage monitoring
- Ready-to-operate dosing station pre-assembled on base frame
- Assembly of the control cabinet
- Wiring of the electrical components on the base frame

Pos. 2.5a CONTROL CABINET CONFORM 44BIMSCHV AND VDMA 6299

For controlling the entire SCR plant.

Consisting of:

- Control cabinet with PLC control and 10" touch panel for visualization of the system parameters

Design example

Data for control cabinet:

material:	Sheet steel, painted
Protection class:	IP54
Supply line:	1~230V+N+PE 50 Hz, TN-C-S
Fuse protection:	16A (depending on customer's requirements, final confirmation after approval of the circuit diagram!)

- Control elements: Main switch and touch panel
- Messages and displays on the control cabinet:
  - Visualization via touch panel including trend recording, alarm history, user administration and parameter switching
  - Message and fault display as plain text
  - Display of all actual values on the touch panel
  -

Integrated data recording for:

- Current NOx value
- Evaluated NOx values:
  - Daily average values incl. evaluation
  - Compliance with daily mean value
  - Validity Daily mean value
  - Compliance "not double limit value" exceeded
  - Downtime NOx Sensor
- Exhaust gas temperatures
- Exhaust gas back pressure
- Air pressure
- Pressure urea
- Storage of the daily mean value on an external storage medium - e.g. USB stick or SD card (external storage media not included in the scope of delivery; min. 16GB are required for recording the mean values over 6 years)

Required signals from the higher-level control:

- Engine on/off (potential-free contact on terminal strip)
- Engine load (analog signal)

Signals for higher-level control (potential-free contacts on terminal strip):

- Readiness
- Fault in the system
- Engine stop
- Pre-alarm - collective message
- Urea requirement

Remark: Switch cabinet only approved for indoor installation.

Pos. 2.5b COMMUNICATION BUS

Interface for signal transmission

System as interface is:
- Modbus TCP

Pos. 2.6 MEASUREMENT EQUIPMENT EXHAUST

For recording measurements

Consisting of:

- 2 pc. Pressure transducer for measuring the exhaust side counter pressure
- 2 pc. NOx sensor for concentration measurement
- 2 pc. Temperature sensor for monitoring the temperature in the exhaust gas
  - 1x before SCR
  - 1x after SCR

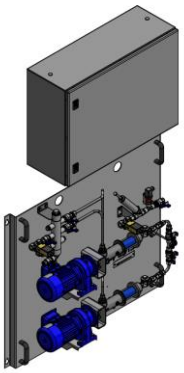
Wiring is carried out by the customer or by arrangement

Pos. 2.7 PUMP UNIT

Duty standby pump unit delivered mounting frame
Wiring between pumps and control box has to be done by customer.

Consisting of:

- 2 pc. Solenoid diaphragm dosing pump
- 1 pc. Control box: loose supply
- 1 pc. Strainer
- 1 pc. Pressure transmitter
- 2 pc. Solenoid valves



Design Example

APPENDIX 9.04

20V4000G94LF - 5% O2 - Telehouse South

Contents

	Genset	Marine	O & G	Rail	C & I
Application	X				
Engine model	20V4000G94LF				
Rated power [kW]	3308				
Rated speed [rpm]	1500				
Application Group	3D				
Legislative body	NEA Singapore for ORDE				
Test cycle	D2				
Data Set No.	XZ54954100068				
Data Set Basis	NEA Singapore for ORDE				
Fuel sulphur content [ppm]	7				

Content **Page**

PDF	Name	Project no. **Telehouse South**	Size **A4**
Configurator	Lenhof, Torsten (TARC)	Order no. **Telehouse South**	
Approver1	Kneifel, Alexander (TSLE)	EDS-ID **2498-16.03.2023**	
Approver2	Breuer, Joerg (TVA)		
Approver3			
Approver4			
User	FN2\I170260		

Engine model **20V4000G94LF**

Title **Emission data sheet**

Description of Revision	Frequency

Data generated by EDS Creator version 1.0 and uniplot.
Ref.-dataset: 420122_364_NEA_G94LF_D2.nc for 295 in EDS platfrom.

Emissionstage **NEA Singapore for ORDE**

Sheet **1** of **6**

Configuration-ID	Documentation
295	

Emissionstage basis **NEA Singapore for ORDE**

General Disclaimers (valid for Measured and NTE values)

Please note that these data are physical and/or technical values only referring to and representing a normative defined operating condition. Any change in operating time and conditions will have impact on physical values and engine behavior, which must be considered and assessed within the complete propulsion system especially in regard to emission compliance and product safety.

Measurements listed in this EDS are representative of the listed engine rating at the time of testing. These measurements and results can change according to instrumentation, boundary condition, and engine to engine variability. In addition - changes to the engine family hard or software may occur which could result in changes to some of the listed values.

Emissions data measurement procedures are conducted according to applicable rules and standards as per “Emission Stage/Optimization”. Potential deviations from these procedures are documented internally.

The listed emission values relate to the corresponding certification data. Seller doesn´t take any responsibility or liability neither out or in connection with the contract nor on any other basis
- beyond these specified operating conditions of the engine
- and for any installation/modification of the entire propulsion system by the customer itself or any third party
and the customer will indemnify MTU on first demand for any third party claim out or in connection with this.

Seller reserves the right to amend specifications and information without notice and without obligation or liability. No liability for any errors, facts or opinions is accepted. Customers must satisfy themselves as to the suitability of this product for their application. No responsibility for any loss as a result of any person placing reliance on any material contained in this data sheet will be accepted.

Seller reserves all rights in the information contained in this data sheet. It shall not be reproduced, made available to a third party or otherwise used in any way whatsoever.

When applicable, emission values are measured after combined exhaust streams.

Measured Emissions data is based on single operating points and thus cannot be used to compare to regulations which use values based on a weighted cycle.

Field emission test data are not guaranteed to these levels. Actual field test results may vary due to test site conditions, installation, fuel specification, test procedures, and instrumentation. Over time deterioration may occur which may have an impact on emission levels.

The SO2 emission rates comprehend exclusively the SO2 content as found in the fuel source, oil consumption effects are not included. Variation of sulfur content in the fuel changes only the stated SO2 emissions, cross sensitivity to other emissions (e.g. particulates) is not possible.

All values based on metric units, inaccuracies for non metric values can occur, values are not binding.

Specific to gas engines: The listed emission values are based on gas composition at the time of certification measurement. Gas composition is as displayed in the EDS-document. Carbon dioxide and methane concentrations have direct influence on the corresponding displayed carbon dioxide and methane emissions.

EAT Specific Disclaimers (valid for EDS values)

NH3 emissions levels measured with AVL SESAM i60/ 4 FT Multi Component Exhaust Measurement System (FTIR) including EPA 40 CFR 1065 legislation compliant automated checks for linearity.
Generators or engines with exhaust after-treatment systems require a stabilization period of approximately 1 hour to ensure stable temperatures across SCR prior to performing an emissions test. Performing emissions measurements before a stable temperature has been achieved can result in inconsistent emission values. NOx Values only applicable if temperatures across SCR reached for DEF Dosing.

NTE Disclaimers (valid for NTE calculated values)

Calculated not to exceed values (NTE) are not proven by tests and therefore the accuracy is not guaranteed.

All emission data shown in chapters Emission Data Sheet, Not to Exceed Values, and Type Approval were gathered from a corresponding certification engine under test conditions shown above and complying to corresponding TEN data.

PDF	Name	Project no.	Size
		Telehouse South	**A4**
Configurator	Lenhof, Torsten (TARC)	Order no. **Telehouse South**	
Approver1	Kneifel, Alexander (TSLE)	EDS-ID **2498-16.03.2023**	
Approver2	Breuer, Joerg (TVA)		
Approver3			
Approver4			
User	FN2\I170260		

Engine model **20V4000G94LF**

Title **Emission data sheet**

Description of Revision	Frequency
Data generated by EDS Creator version 1.0 and uniplot. Ref.-dataset: 420122_364_NEA_G94LF_D2.nc for 295 in EDS platfrom.	

Emissionstage **NEA Singapore for ORDE**

Sheet **2** of **6**

Configuration-ID	Documentation
295	

Emissionstage basis **NEA Singapore for ORDE**

Engine data

	Genset	Marine	O & G	Rail	C & I
Application	X				
Engine model	20V4000G94LF				
Application Group	3D				
Legislative body	NEA Singapore for ORDE				
Test cycle	D2				
Fuel sulphur content [ppm]	7				
mg/mN^3 values base on residual oxygen value of [%]	5				

Engine raw emissions*

Cycle point	[-]	n1	n2	n3	n4	n5
Power	kW	3307	2480	1653	827	331
Power relative	[-]	1	0.75	0.5	0.25	0.1
Engine speed	1/min	1500	1499	1499	1500	1499
Engine speed relative	[-]	1	1	1	1	1
Filter smoke number	Bosch	0.2	0.23	0.62	0.97	0.07
Exhaust temperature after ETC	grdC	474.5	420.2	420.8	386.2	264
Exhaust back pressure after ETC (static)	mbar	39	23	9	6	2
Exhaust back pressure after ETC (total)	mbar	52	32	14	5	0
Exhaust mass flow wet	kg/h	19196	15930	12083	7485	5323
NOX-Emissions specific	g/kWh	6.6	5.94	4.79	4.41	9.06
SO2-Emissions specific	g/kWh	0.003	0.003	0.003	0.003	0.004
CO-Emissions specific	g/kWh	0.32	0.39	1.02	1.45	2.79
HC1-Emissions specific	g/kWh	0.05	0.07	0.09	0.16	0.72
NMHC-Emissions specific	g/kWh	0.05	0.06	0.08	0.16	0.71

PDF	Name	Project no.	Size
		Telehouse South	**A4**
Configurator	Lenhof, Torsten (TARC)	Order no. **Telehouse South**	
Approver1	Kneifel, Alexander (TSLE)	EDS-ID	
Approver2	Breuer, Joerg (TVA)	**2498-16.03.2023**	
Approver3			
Approver4			
User	FN2\I170260		

Engine model
20V4000G94LF

Title
Emission data sheet

Description of Revision	Frequency

Data generated by EDS Creator version 1.0 and uniplot.
Ref.-dataset: 420122_364_NEA_G94LF_D2.nc for 295 in EDS platfrom.

Emissionstage
NEA Singapore for ORDE

Sheet
3
of
6

Configuration-ID	Documentation
295	

Emissionstage basis
NEA Singapore for ORDE

NOX+HC1-Emissions specific	g/kWh	6.65	6.01	4.88	4.57	9.78
NOX+NMHC-Emissions specific	g/kWh	6.65	6.01	4.88	4.57	9.76
CO2-Emissions specific	g/kWh	645.7	632.1	669.3	721.6	844.5
PM-Emissions specific (Meas.)	g/kWh	0.02	0.029	0.098	0.178	0.052
NOX-Emissions (based on 5% O2)	mg/m3N	2362	2172	1639	1375	2411
NOX+HC1-Emissions (based on 5% O2)	mg/m3N	2381	2195	1668	1426	2598
NOX+NMHC-Emissions (based on 5% O2)	mg/m3N	2381	2195	1667	1425	2594
CO2-Emissions (based on 5% O2)	mg/m3N	223605	223062	222523	222036	219217
CO-Emissions (based on 5% O2)	mg/m3N	111.4	138.5	339.2	444.6	723
HC1-Emissions (based on 5% O2)	mg/m3N	18.5	23.1	28.8	50.4	186.9
SO2-Emissions (based on 5% O2)	mg/m3N	1	1	1	1	1
PM-Emissions (based on 5% O2)	mg/m3N	6.9	10.3	32.7	54.6	13.5
Oxygen (O2)	%	9.9	11.2	11.9	13.1	15.8

PDF	Name	Project no. **Telehouse South**	Size **A4**
Configurator	Lenhof, Torsten (TARC)	Order no. **Telehouse South**	
Approver1	Kneifel, Alexander (TSLE)	EDS-ID **2498-16.03.2023**	
Approver2	Breuer, Joerg (TVA)		
Approver3			
Approver4			
User	FN2\I170260		

Engine model
20V4000G94LF

Title
Emission data sheet

Description of Revision	Frequency

Data generated by EDS Creator version 1.0 and uniplot.
Ref.-dataset: 420122_364_NEA_G94LF_D2.nc for 295 in EDS platfrom.

Emissionstage
NEA Singapore for ORDE

Sheet
4
of
6

Configuration-ID	Documentation
295	

Emissionstage basis
NEA Singapore for ORDE

Engine data

	Genset	Marine	O & G	Rail	C & I
Application	X				
Engine model	20V4000G94LF				
Application Group	3D				
Legislative body	NEA Singapore for ORDE				
Test cycle	D2				
Fuel sulphur content [ppm]	7				
mg/mN^3 values base on residual oxygen value of [%]	5				

Not to exceed emission values*

Cycle point	[-]	n1	n2	n3	n4	n5
Power	kW	3307	2480	1653	827	331
Power relative	[-]	1	0.75	0.5	0.25	0.1
Engine speed	1/min	1500	1499	1499	1500	1499
Engine speed relative	[-]	1	1	1	1	1
NOX-Emissions specific	g/kWh	8.58	7.72	6.23	6.61	17.21
CO-Emissions specific	g/kWh	0.55	0.67	1.94	2.89	5.57
HC1-Emissions specific	g/kWh	0.09	0.11	0.16	0.33	2.09
NMHC-Emissions specific	g/kWh	0.09	0.11	0.16	0.32	
NOX+HC1-Emissions specific	g/kWh	8.67	7.84	6.39	6.94	19.3
NOX+NMHC-Emissions specific	g/kWh	8.67	7.83	6.39	6.93	
PM-Emissions specific (Meas.)	g/kWh	0.03	0.046	0.147	0.266	0.192
NOX-Emissions (based on 5% O2)	mg/m3N	3071	2824	2130	2063	4581
NOX+HC1-Emissions (based on 5% O2)	mg/m3N	3103	2863	2185	2164	5123
NOX+NMHC-Emissions (based on 5% O2)	mg/m3N	3102	2862	2184	2162	

PDF	Name	Project no.	Size
		Telehouse South	**A4**
Configurator	Lenhof, Torsten (TARC)	Order no. **Telehouse South**	
Approver1	Kneifel, Alexander (TSLE)	EDS-ID	
Approver2	Breuer, Joerg (TVA)	**2498-16.03.2023**	
Approver3			
Approver4			
User	FN2\I170260		

Engine model
20V4000G94LF

Title
Emission data sheet

Description of Revision	Frequency

Data generated by EDS Creator version 1.0 and uniplot.
Ref.-dataset: 420122_364_NEA_G94LF_D2.nc for 295 in EDS platfrom.

Emissionstage
NEA Singapore for ORDE

Sheet
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of
6

Configuration-ID	Documentation
295	

Emissionstage basis
NEA Singapore for ORDE

CO-Emissions (based on 5% O2)	mg/m3N	189.4	235.5	644.5	889.1	1446
HC1-Emissions (based on 5% O2)	mg/m3N	31.5	39.2	54.7	100.8	542
PM-Emissions (based on 5% O2)	mg/m3N	10.4	16.4	49	81.9	49.8

PDF	Name	Project no.	Size
		Telehouse South	**A4**
Configurator	Lenhof, Torsten (TARC)	Order no. **Telehouse South**	
Approver1	Kneifel, Alexander (TSLE)	EDS-ID	
Approver2	Breuer, Joerg (TVA)	**2498-16.03.2023**	
Approver3			
Approver4			
User	FN2\I170260		

Engine model
20V4000G94LF

Title
Emission data sheet

Description of Revision	Frequency

Data generated by EDS Creator version 1.0 and uniplot.
Ref.-dataset: 420122_364_NEA_G94LF_D2.nc for 295 in EDS platfrom.

Emissionstage
NEA Singapore for ORDE

Sheet
6
of
6

Configuration-ID	Documentation
295	

Emissionstage basis
NEA Singapore for ORDE

APPENDIX 9.05

OLE C2020 Datasheet

OLE (UK) LTD

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South Mundham Chichester
West Sussex PO20 1NB UK
Tel +44 (0)1243 267 930

www.oleuk.com sales@oleuk.com

C2020

Illustration shows standard kit supplied as C2020-A-C22

1.0% TANK GAUGE.

Features:

Continuous reading 1% Tank Gauge

High & Low Local Alarm (option -A kit)

Bund Alarm Circuit (Float supplied seperately)

Output 4-20 mA as standard

Local Calibration settings

Push Button Back light for 1 hour

Flashing Backlight when in Alarm

IP65 Weatherproof Enclosure.

Easy Installation

Lower sensor into tank, tighten nut, and join 3 wires, plug in and set-up.

A Tank fitting is supplied to fit into a 1" threaded Socket or a special 30 mm bored hole fitting is available, providing an IP65 seal.

The Hydrostatic Tank sensor comes with 7 meters of cable on a 3 meter probe and 10 meters on a 5 and 10 meter probe.(This can be extended by using an extention kit up to 100 meters)

Standard probe suits tanks from **0.3** up to **3.5 meters high for fuel oils**, and up to **2.8 meters high for water based products** (higher tank options available, C25, C27)

Power requirements/ Options
The Unit operates from 12 to 24 VDC and

ANY TANK SHAPE

Input tank sizes on simple screen,

Rectangular,
Horizontal with elliptical ends, or flat ends.
Vertical cylindrical flat base

Base Models

C2020-0-C23 = Gauge Kit with 3.00 M Probe
C2020-A-C23 = Gauge Kit std 3.00 M Probe + High/Low Alarm
C2020-A-C25 = Gauge Kit with 5.00 M Probe + High/Low Alarm
C2020-A-C27 = Gauge Kit with 10.0 M Probe + High/Low Alarm

Typical Applications

GASOIL , DIESEL, KEROSENE, ADBLUE

LUBE OIL, COOKING OIL, GEAR OIL

WATER, ANTI-FREEZE, WINDSCREEN WASH

Options

B8 = Bund Alarm Probe
OJ = Tank fitting expanding type
for 30 mm bored hole.
EK= 10 meter extension kit

See also "420-WWW" web logger attachment.

APPENDIX 04

TS Electricity Supply Arrangement

For continuation refer to Drg No TSX002-BWE-TS-ZZ-SD-E-613100

West Bridge

East Bridge

Joint

Joint

HVS 19
ASSET TAG
SBB.01.13.HVS19
DATA SHEET
TSX002-BWE-TS-ZZ-SH-E-613002

HVS 20
ASSET TAG
SBB.01.16.HVS20
DATA SHEET
TSX002-BWE-TS-ZZ-SH-E-613002

Load Bank Connection box See note 9

NEC 19 NO

TX/ NET19

To SSB Switchboard & Gens Auxiliary Panel B

LVS 19/01

Load Bank Connection box See note 9

NEC 20 NO

TX/ NET20

To SSB Switchboard & Gens Auxiliary Panel A

LVS 20/01

Future Level 1 NE Switchboard LVS02

Future Level 1 NE Switchboard LVS01

HVS 21
ASSET TAG
SBB.01.13.HVS21
DATA SHEET
TSX002-BWE-TS-ZZ-SH-E-613001

HVS 23
ASSET TAG
SBB.01.13.HVS23
DATA SHEET
TSX002-BWE-TS-ZZ-SH-E-613001

HVS 22
ASSET TAG
SBB.01.16.HVS22
DATA SHEET
TSX002-BWE-TS-ZZ-SH-E-613001

HVS 24
ASSET TAG
SBB.01.16.HVS24
DATA SHEET
TSX002-BWE-TS-ZZ-SH-E-613001

UKPN B

UKPN A

ASSET TAG
SBB.02.XXX.HVG01
3.0MW Generator
See note 5
HVGS
SSB 01

ASSET TAG
SBB.02.XXX.HVG02
3.0MW Generator
See note 5
HVGS
SSB 02

ASSET TAG
SBB.02.XXX.HVG03
3.0MW Generator
See note 5
HVGS
SSB 03

ASSET TAG
SBB.02.XXX.HVG04
3.0MW Generator
See note 5
HVGS
SSB 04

GENERATOR DATA SHEET
TSX002-BWE-TS-ZZ-SH-E-611001

Future Generators

SSB Level 2

General Notes

1. This drawing has been checked in accordance with Black & White Engineering (B&W) QA checking procedures.
2. Do not scale from this drawing. All dimensions indicated are in millimeters unless otherwise stated. Validate all measurements on site.
3. All plant and equipment dimensions are typical. The Contractor should show actual, approved plant and equipment sizes.
4. This drawing is to be read in conjunction with all relevant B&W MEP specifications, schedules and standard key to symbols sheet.
5. Any discrepancies between the drawings and other documents should be brought to the attention of the engineer.
6. This drawing is not an installation drawing. It is the Contractors responsibility to make final coordinated installation shop drawings.
7. Final ceiling coordination subject to interior design package.
8. Contractor to coordinate final distribution routes with available sleeves and openings in beams / structure.
9. The contents of this drawing shall be read in conjunction with the current revisions of other relevant Architectural, Structural, Mechanical and Electrical drawings and all relevant sections of the specifications.

Notes

1. Drawing to be read in conjunction with Project Specification, schedules and drawings.
2. For Interlocking Tables see drawing reference _____.
3. For Day Final Schematic see drawing reference _____.
4. Differential protection provided on ring feeders to IT and Mechanical Substations with auto close facility.
5. Three way differential protection on generators covering alternator star point to incomers on generator Synchronisation panel.
6. Existing generator disconnected once new generators are commissioned and brought on line.
7. Interlocking to be provided on all switchboards such that busbar earths can only be closed on proof of isolation of all incoming and outgoing VCB's.
8. Interlocking to be provided to generator connection boxes such that box can be opened when all three breakers supplying box are isolated and in cable earth position.
9. Interlock to be provided so that load bank cable connection box can only be opened when load bank breaker is isolated and in circuit earth.
10. "All plant/asset tag references shown within the Stage 4a design are indicative and are to be finalised and agreed by the contractor with the client at the next design stage."

Legend

- Denotes Future Works
- NO — Normally Open
- NC — Normally Closed
- Withdrawable VCB with switch disconnector and circuit earth switch
- Earth switch with bus bar VT
- Bus Bar mounted earth switch with bus bar VT
- Bus coupler with bus bar earth RHS & bus bar VT
- Generator Cable connection box with interlocked access
- Neutral earthing transformer with zig zag primary. Star point earthed through earthing contactor and resistor. LV winding feeding LV switchboard for generator ancillaries.
- HVS 01/29 — Client asset tag
- 01 — Panel sequential number
- P01 — Panel type in data sheet
- 630A — Rating
- NC — Normally closed or open
- ACB — Device type

Rev	Date	By	Description
C01	14/04/2022	GDC/IC/WT	Issued for Tender
P02	25/03/2022	GDC/IC/WT	Issued for Comment
P01	18/02/2022	GDC/IC/WT	Draft - Issued for Comment

DRAWING STATUS: Stage 4a

TELEHOUSE

TELEHOUSE EUROPE
Docklands Site, Coriander Avenue, E14 2AA, London
T: +44 (0) 207 512 0000 W: www.telehouse.net

DESIGNER/CONTRACTOR: Black & White Engineering

PROJECT: Telehouse South Mains Work
DESIGNER/CONTRACTOR PROJECT NO: P20116

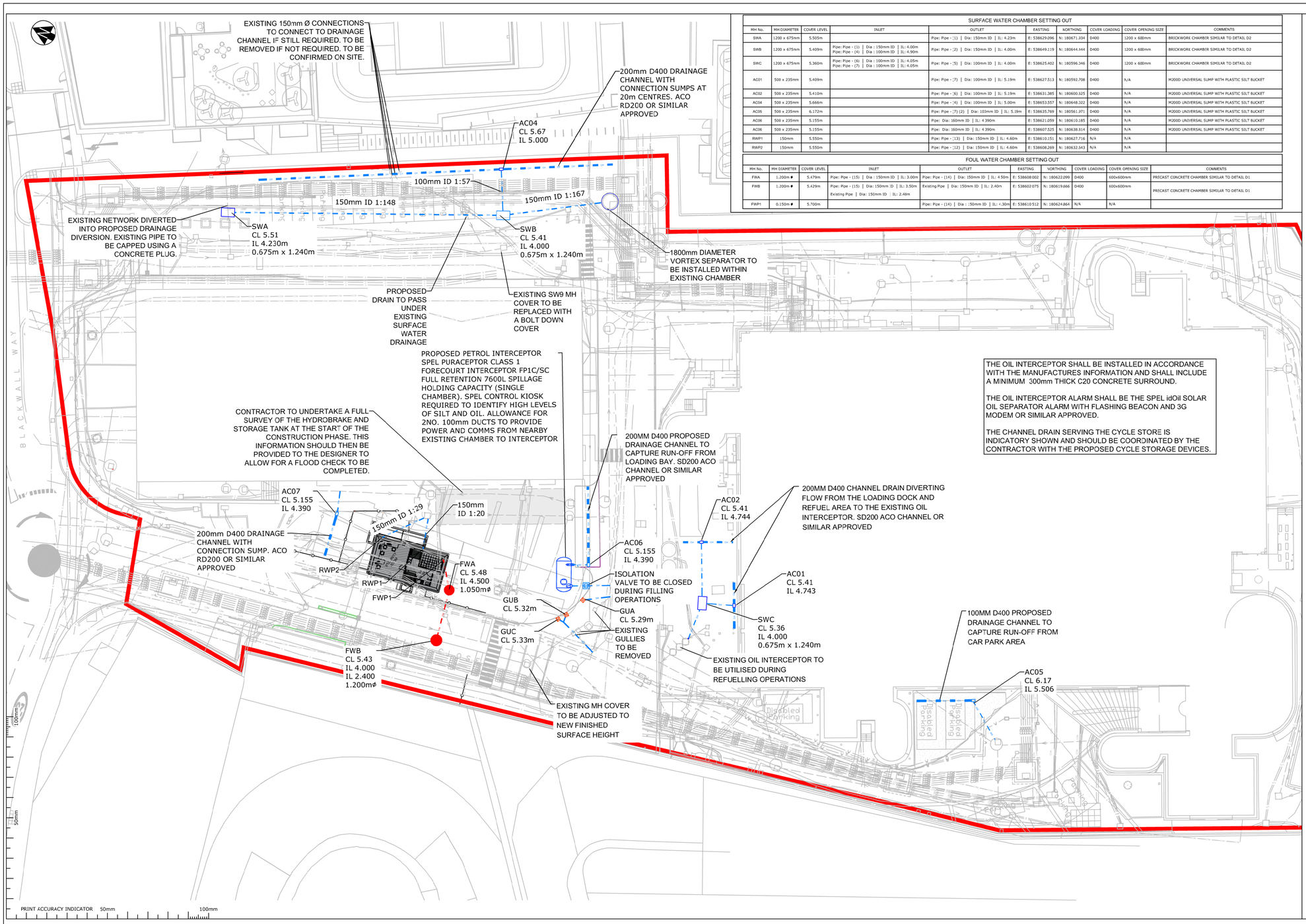
TITLE: MV Schematic Day 1 Sheet 2 of 2

DRAWN BY:	Date	CHECKED BY:	Date	Sheet Size	Scale(s)
GDC	14/04/2022	IC	14/04/2022	A0 @	NTS

DRAWING No: TSX002-BWE-TS-ZZ-SD-E-613103 REV: C01

APPENDIX 05

TS Drainage Plan



SURFACE WATER CHAMBER SETTING OUT								
MH No.	MH DIAMETER	COVER LEVEL	INLET	OUTLET	EASTING	NORTHING	COVER LOADING	COVER OPENING SIZE	COMMENTS
SWA	1200 x 675mm	5.505m		Pipe: Pipe - ;1) | Dia: 150mm ID | IL: 4.23m	E: 538629.096	N: 180671.934	D400	1200 x 600mm	BRICKWORK CHAMBER SIMILAR TO DETAIL D2
SWB	1200 x 675mm	5.409m	Pipe: Pipe - (1) | Dia : 150mm ID | IL: 4.00m Pipe: Pipe - (4) | Dia : 100mm ID | IL: 4.90m	Pipe: Pipe - ;2) | Dia: 150mm ID | IL: 4.00m	E: 538649.119	N: 180644.444	D400	1200 x 600mm	BRICKWORK CHAMBER SIMILAR TO DETAIL D2
SWC	1200 x 675mm	5.360m	Pipe: Pipe - (6) | Dia : 100mm ID | IL: 4.05m Pipe: Pipe - (7) | Dia : 100mm ID | IL: 4.05m	Pipe: Pipe - ;5) | Dia: 100mm ID | IL: 4.00m	E: 538625.402	N: 180596.346	D400	1200 x 600mm	BRICKWORK CHAMBER SIMILAR TO DETAIL D2
AC01	500 x 235mm	5.409m		Pipe: Pipe - ;7) | Dia: 100mm ID | IL: 5.19m	E: 538627.513	N: 180592.708	D400	N/A	M200D UNIVERSAL SUMP WITH PLASTIC SILT BUCKET
AC02	500 x 235mm	5.410m		Pipe: Pipe - ;6) | Dia: 100mm ID | IL: 5.19m	E: 538631.385	N: 180600.525	D400	N/A	M200D UNIVERSAL SUMP WITH PLASTIC SILT BUCKET
AC04	500 x 235mm	5.666m		Pipe: Pipe - ;4) | Dia: 100mm ID | IL: 5.00m	E: 538653.557	N: 180648.322	D400	N/A	M200D UNIVERSAL SUMP WITH PLASTIC SILT BUCKET
AC05	500 x 235mm	6.172m		Pipe: Pipe - ;7) (2) | Dia: 100mm ID | IL: 5.19m	E: 538635.769	N: 180561.371	D400	N/A	M200D UNIVERSAL SUMP WITH PLASTIC SILT BUCKET
AC06	500 x 235mm	5.155m		Pipe: Dia: 160mm ID | IL: 4.390m	E: 538621.059	N: 180610.185	D400	N/A	M200D UNIVERSAL SUMP WITH PLASTIC SILT BUCKET
AC06	500 x 235mm	5.155m		Pipe: Dia: 160mm ID | IL: 4.390m	E: 538607.525	N: 180638.814	D400	N/A	M200D UNIVERSAL SUMP WITH PLASTIC SILT BUCKET
RWP1	150mm	5.550m		Pipe: Pipe - ;13) | Dia: 150mm ID | IL: 4.60m	E: 538610.151	N: 180627.716	N/A	N/A	
RWP2	150mm	5.550m		Pipe: Pipe - ;12) | Dia: 150mm ID | IL: 4.60m	E: 538608.269	N: 180632.543	N/A	N/A	

FOUL WATER CHAMBER SETTING OUT									
MH No.	MH DIAMETER	COVER LEVEL	INLET	OUTLET	EASTING	NORTHING	COVER LOADING	COVER OPENING SIZE	COMMENTS
FWA	1.200m ø	5.479m	Pipe: Pipe - (15) | Dia : 150mm ID | IL: 3.00m	Pipe: Pipe - (14) | Dia: 150mm ID | IL: 4.50m	E: 538608.002	N: 180622.099	D400	600x600mm	PRECAST CONCRETE CHAMBER SIMILAR TO DETAIL D1
FWB	1.200m ø	5.429m	Pipe: Pipe - (15) | Dia: 150mm ID | IL: 3.50m Existing Pipe | Dia: 150mm ID | IL: 2.40m	Existing Pipe | Dia: 150mm ID | IL: 2.40m	E: 538602.075	N: 180619.666	D400	600x600mm	PRECAST CONCRETE CHAMBER SIMILAR TO DETAIL D1
FWP1	0.150m ø	5.700m		Pipe: Pipe - (14) | Dia : 150mm ID | IL: 4.30m	E: 538610.512	N: 180624.864	N/A	N/A	

THE OIL INTERCEPTOR SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURES INFORMATION AND SHALL INCLUDE A MINIMUM 300mm THICK C20 CONCRETE SURROUND.

THE OIL INTERCEPTOR ALARM SHALL BE THE SPEL idOil SOLAR OIL SEPARATOR ALARM WITH FLASHING BEACON AND 3G MODEM OR SIMILAR APPROVED.

THE CHANNEL DRAIN SERVING THE CYCLE STORE IS INDICATORY SHOWN AND SHOULD BE COORDINATED BY THE CONTRACTOR WITH THE PROPOSED CYCLE STORAGE DEVICES.

NOTES:

1. DO NOT SCALE FROM THIS DRAWING MANUALLY OR ELECTRONICALLY.
2. ALL LEVELS ARE IN METRES ABOVE DATUM UNLESS STATED OTHERWISE
3. SERVICES INFORMATION SHOWN HAS BEEN INTERPRETED FROM SERVICE UNDERTAKERS INFORMATION AND OTHER SOURCES (EG. TRIAL HOLES, GPR, STATUTORY PLANS). COPIES OF THE ORIGINAL DRAWINGS ARE-- AVAILABLE FOR INSPECTION ALTHOUGH ONLY VALID FOR 3 MONTHS FROM RECEIPT OF THE STATUTORY PLANS. ADDITIONAL OVERHEAD CABLE INFORMATION IS ALSO BASED ON OBSERVATIONS ON SITE. NO GUARANTEE IS GIVEN AS TO THE ACCURACY OR COMPLETENESS OF THE INFORMATION SHOWN AND THE CONTRACTOR SHOULD MAKE ADEQUATE PROVISION WITHIN THEIR TENDER TO CONFIRM THE LOCATION OF SERVICES ON SITE, INCLUDING ALL PRIVATE SERVICE CONNECTIONS TO PROPERTIES, AND PLAN HIS WORK ACCORDINGLY.
4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL ARCHITECT'S, M+E, ENGINEERS AND SPECIALIST'S DRAWINGS AND SPECIFICATIONS. ANY DISCREPANCY BETWEEN DRAWINGS SHALL BE REFERRED TO THE ARCHITECT FOR CLARIFICATION.
5. ALL WORK IS TO BE CARRIED OUT IN ACCORDANCE WITH THE RELEVANT BS STANDARDS, CODES OF PRACTICE AND BUILDING PRACTICE.
6. THE CONTRACTOR IS RESPONSIBLE FOR CHECKING ALL LEVELS AND DIMENSIONS PRIOR TO STARTING THE WORKS ON SITE. ANY DISCREPANCIES ARE TO BE REPORTED TO THE ENGINEER IMMEDIATELY.
7. ALL SANITARY PIPEWORK SHALL BE CONSTRUCTED AND INSTALLED IN ACCORDANCE WITH EN:12056-2 2000.
8. ALL EXTERNAL BUILDING DRAINAGE SHALL BE CONSTRUCTED AND INSTALLED IN ACCORDANCE WITH EN 12056-1:2000,EN:752-3:1997 (AMENDMENT 2),EN:752-4:1988 AND EN:1610:1998.
9. THE CONTRACTOR SHALL UNDERTAKE TESTING OF THE COMPLETED WASTEWATER SYSTEM SHALL BE CARRIED OUT IN ACCORDANCE WITH EN:12056-2:2000 (SANITARY PIPEWORK) AND EN:1610-1995. FOR DRAINAGE UNDER AND AROUND THE BUILDING
10. THE CONTRACTOR SHALL UNDERTAKE TESTING OF ALL GUTTER AND RAINWATER PIPES SHALL BE CONSTRUCTED IN ACCORDANCE WITH EN:12056-3:2000.
11. THE CONTRACTOR SHALL UNDERTAKE TESTING OF THE SURFACE WATER SYSTEM SHALL BE UNDERTAKEN IN ACCORDANCE WITH THE GUIDANCE IN EN:1610:1998.
12. ALL FLOOR GULLIES AND DRAINS ARE TO BE RODABLE ALL SINKS, SHOWERS, ETC ARE TO BE FITTED WITH ANTI VACUUM TRAPS. ALL TRAPS TO SANITARY APPLIANCES MUST BE REMOVABLE.
13. ALL BRANCH CONNECTIONS AT GROUND LEVEL TO BE 150MM DIA, UNLESS NOTED OTHERWISE, WITH GRADIENT NOT FLATTER THAN 1 IN 80.
14. THE CONTRACTOR SHALL MAKE ANY ALLOWANCES FOR DEALING WITH LIVE FLOWS IN EXISTING DRAINS OR SEWERS.
15. ALL EXISTING CHAMBERS, GULLY CHANNELS, PIPES AND OTHER DRAINAGE APPARATUS SHALL BE PROTECTED FROM DAMAGE DURING THE WORKS.
16.
17. THE CONTRACTOR SHALL TAKE ALL NECESSARY MEASURES TO ENSURE THAT NO MATERIAL ENTERS THE DRAINS (OTHER THAN WHICH THEY ARE DESIGNED TO CARRY).
18. ALL EXISTING CHAMBERS, GULLIES, ETC. AND THEIR COVERS, GRATINGS AND FRAMES TO BE IMPROVED. REPAIRED OR REPLACED AS NECESSARY TO SUIT THEIR LOCATION WITHIN THE FINISHED DEVELOPMENT.
19. ROAD GULLY CONNECTIONS TO BE 150MM DIAMETER VITRIFIED CLAY MATERIAL AT NO FLATTER THAN 1 IN 150 GRADE.
20. ALL CHAMBERS SHALL HAVE A MINIMUM OF 150MM CONCRETE SURROUND TO PREVENT FLOTATION DUE TO THE PRESENCE OF GROUND WATER UNLESS STATED OTHERWISE

KEY:

- SITE BOUNDARY
- EXISTING FOUL WATER DRAINAGE
- EXISTING SURFACE WATER DRAINAGE
- PROPOSED SURFACE WATER DRAINAGE
- PROPOSED DRAINAGE CHANNEL
- PROPOSED FOUL WATER DRAINAGE

EXISTING SERVICE KEY:

- ELECTRICITY
- BRITISH TELECOM
- GTT
- COLT
- LUMEN
- VERIZON
- VODAFONE
- ZAYO
- CCTV
- EMPTY DUCTS
- SCAR
- WATER
- GAS
- UNKNOWN
- CHAMBER

Rev	Date	Amendment Details	Dr'n	Chk'	App'
C01	14.04.2022	ISSUED FOR TENDER	LS	JF	JL
P05	25.03.2022	RIBA STAGE 3/4A ISSUE	MJS	JF	JL
P04	22.02.2022	ISSUED FOR INFORMATION	MJS	JF	JL
P03	04.11.2021	PRE-APP ISSUE	GD	JF	JL
P02	16.09.2021	RIBA STAGE 2 ISSUE	AC	JF	JL
P01	16.09.2021	RIBA STAGE 2 ISSUE	AC	JF	JL

DRAWING STATUS: FOR INFORMATION

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EC2M 7LS
Tel: +44 (0)20 3002 1210
Web: www.sweco.co.uk
SWECO

PROJECT: TELEHOUSE SOUTH MAIN WORKS
DESIGNER/CONTRACTOR PROJECT NO: 65202635
TITLE: SITE DRAINAGE LAYOUT

DRAWN BY:	Date	CHECKED BY:	Date	Sheet Size	Scale(s)
AC	16/09/2021	JF	16/09/2021	A1 @	1:250

DRAWING No: TSX002-SWE-XX-XX-DR-C-100007
REV: P05

APPENDIX 06

Port of London Authority Consent

Dated 6 September 2019

PORT OF LONDON AUTHORITY

to

Blaxmill Limited

RIVER WORKS LICENCE

relating to

Timber Fenders and Walings; Surface water outfall pipe and Tidal Flap valve;
Remains of piles

at

Blackwall Yard, London E14

CHM Ref: AN-28-384
28N384002701

PORT OF LONDON AUTHORITY

Index to Licence granted

under the port of London Act 1968 Section 66

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Licence granted under the

Port of London Act 1968 Section 66

Definitions

1.1 In this Licence:

"the Act" means	the Port of London Act 1968
Adjoining Land	means the Licensee's property registered at HM Land Registry with title number EGL337077
"Arbitrator" means	an arbitrator appointed by the President for the time being of the Royal Institution of Chartered Surveyors or his deputy or other authorised officer.
Base Sum	the published Index Figure twelve months prior to the last published Index Figure before the relevant Calculation Date
"Calculation Dates" means	every anniversary of the Starting Date (except for where such anniversary is a Review Date), each one being a "Calculation Date"
"Consideration" means	the amount payable pursuant to Clause 3.1
"Consideration Notice"	Means a notice which sets out the revised Consideration for this Licence.
"Consideration Response"	Means a response containing an objection to the revised Consideration specified in the Consideration Notice pursuant to clause 3.4
"Index Figure" means	the All Items Index figure of the Retail Prices Index
"the Licensee" means	the person or persons named in Schedule 1
Licence Period	the period from the Starting date until the date on which this licence is determined in accordance with the provisions as set out in this licence.
New Licence	means a licence for the Works between the PLA and the Transferee

"the Payment Days"	shall be the date three months from the Starting Date and at three monthly intervals thereafter each one being a Payment Day
"the PLA" means	The Port of London Authority
PLA Plan Number 126.0501	means the drawings supplied by the Licensee to the PLA numbered: - C033 - C036 - C010 - C012 - C013
PLA Plan Number 126.1718	means the drawings supplied by the Licensee to the PLA named or numbered: - 01/05 C3 - PLA chart - Pile cut off record for Thompsons Reuters pier dated 05.07.17 - 88153/201 C
"Review Dates" mean	the fifth anniversary of the Starting Date and at five yearly intervals thereafter each one being a "Review Date".
"the Starting Date" means	1 February 2019
The Transferee	means any third party who purchases the Works
"the Works" means	the works described in Schedule 2 and where the context so admits any part of them

1.2 In this Licence:

1.2.1 references to clauses and sub-clauses paragraphs subparagraphs and schedules are references to those contained in this Licence unless otherwise specified.

1.2.2 where any party comprises more than one person the obligations and liabilities of that party under this Licence are to be joint and several.

1.2.3 the headings and table of contents are for assistance in locating references in the text and are not to be taken into account in the construction or interpretation of this Licence.

1.2.4 words that indicate one gender include all other genders.

1.2.5 reference to the "River Thames" means the bed, soil and foreshore of the River Thames including the airspace above as vested in the PLA by the Act.

Grant

2. The Port of London Authority ("PLA") under section 66 of the Act permits the Licensee to renew and maintain the Works in the River Thames for the Licence Period.

Consideration

3.1 The amount payable under this Licence shall be:

3.1.1 from the Starting Date the annual sum of £3,690 plus VAT per annum and thereafter:

3.1.2 such increased annual sum calculated in accordance with clause 3.3; or

3.1.3 the reviewed annual sum agreed between the parties or assessed pursuant to clause 3.4.

3.2 The Licensee shall pay to the PLA the Consideration without any deduction in advance quarterly on each Payment Day, the first payment to be made on the date of this licence for the period from the Starting Date to the next Payment Day thereafter with such VAT as may be payable on the Consideration.

3.3 on any Calculation Date the Consideration shall be the either the Consideration payable immediately before the relevant Calculation Date or the indexed amount calculated pursuant to this clause 3.3 (whichever is the greater);

(a) the indexed amount shall be the sum determined by multiplying the Consideration payable immediately before that

Calculation Date by the last published Index Figure before that Calculation Date and dividing the result by the Base Sum

3.4 The Consideration shall be reviewed on a Review Date to equal:

(a) the Consideration payable immediately before the relevant Review Date; or if greater

(b) the Consideration agreed or determined pursuant to this Clause 3.4

3.4.1 the revised Consideration may be agreed between the PLA and the Licensee at any time or until such time as it is determined by the arbitrator under section 67 of the Act (if such determination takes place)

3.4.2 The PLA shall serve a Consideration Notice not earlier than 6 months before the relevant Review Date

3.4.3 within 28 days (time being of the essence) from the service of the Consideration Notice the Licensee shall;

i. notify the PLA they agree to the amount specified in the Consideration Notice; or

ii. serve to the PLA a Consideration Response which shall include details as to the reason for the objection and any alternative amount proposed by the Licensee along with material evidence in support of any such alternative amount.

3.4.4 if the Licensee does not serve a Consideration Response in accordance with clause 3.4.3 then the Licensee acknowledges and accepts that the amount specified in the Consideration Notice shall be the Consideration payable from the relevant Review Date

3.4.5 If the revised Consideration has not been agreed between the PLA and the Licensee by the date one month after the service of the Consideration Response then either party may apply for the Consideration to be assessed pursuant to section 67 of the Port of London Act 1968 ("the Act")

3.4.6 should the revised Consideration be assessed in accordance with section 67(2) of the Act, each party to this Licence shall bear the costs of such fees and expenses incurred as the arbitrator directs (or if the arbitrator makes no direction, then equally)

3.4.7 If the revised Consideration has not been agreed by the PLA and the Licensee or determined by the arbitrator on or before the relevant Review Date, the Consideration payable beginning on that Review Date shall continue at the rate payable immediately before that Review Date. No later than five Working Days after the revised Consideration is agreed or the arbitrator's determination is notified to the PLA and the Licensee, the Licensee shall pay the shortfall (if any) between the amount that it has paid for the period beginning on the Review Date and ending on the Payment Date following the date of agreement or notification of the revised Consideration and the amount that would have been payable had the revised Consideration been agreed or determined on or before that Review Date.

Licensee's Covenant

4. The Licensee agrees to observe and perform the obligations set out in Schedule 3 of this Licence and procure that the Licensee's employees agents and contractors observe and perform these obligations.

Revocation

5. Subject to Section 69 of the Act (Appeal to the Board of Trade (now Department for Transport)) the PLA may in any of the following circumstances revoke this Licence:

5.1. on any expiry of 3 months notice given by the PLA to the Licensee at any time;

5.1.1. if the Licensee or the Licensee's employees agents or contractors shall be in breach of any of the terms of the Licence

5.1.2. if any person with the collusion or agreement of the Licensee shall carry out any activity in relation to the Works in breach of Section 70(1) of the Act.

5.2. immediately on any notice given by the PLA to the Licensee at any time:

5.2.1. if the PLA shall require revocation of the Licence for navigational, river regime or environmental reasons connected with its statutory duties

5.2.2. if the Licensee being a corporation shall be wound up either voluntarily (save for the purpose of amalgamation and reconstruction) or compulsorily or suffer a receiver to be appointed or if the Licensee being an individual (or if individuals any one of them) shall become bankrupt or make any assignment for the benefit of or enter into any arrangement with his or her creditors either by composition or otherwise

5.2.3. if the Licensee cannot carry out any of its obligations under Schedule 3 as a result of the revocation or termination of any grant, easement or other ancillary right entered into by the Licensee with any third party

5.3. if the Licensee parts with the ownership of the Works and this Licence is not terminated on the grant of the New Licence in accordance with Clause 7.

and provided always that such revocation under this Clause 5 shall be without prejudice to any right or remedy of either party in respect of any breach of the provisions of this Licence before or on the date of any termination of this Licence

Removal of Works by Licensee

6.1 Either party may end this Licence by giving to the other notice expiring at any time after the Works have been removed from the River Thames and River Thames has been reinstated to the PLA's reasonable satisfaction.

6.2 If the Licensee does not alter or remove the Works in accordance with the Licensee's obligations in Schedule 3 of this Licence the PLA may at

its option remove or alter the Works and recover from the Licensee on demand any reasonable expenses incurred by the PLA in so doing

6.3 Such termination under this Clause 6 is to be without prejudice to any right or remedy of either party in respect of any breach of the provisions of this Licence which existed at or before the date of termination.

Alienation

7.1 This Licence is personal to the Licensee (save that the rights granted by this Licence may be exercised by the Licensee's employee's agents and contractors subject to the terms and conditions of this Licence and under the Licensee's supervision and control) and is not assignable.

7.2 Where the Works are sold by the Licensee to a Transferee the Licensee shall procure:

(i) the PLA are provided with documentary evidence of the transfer of ownership of Works; and

(ii) the Transferee applies for, executes and releases for completion a New Licence.

7.3 Subject to 7.4 the PLA undertakes with the Licensee that it will not unreasonably refuse to grant a New Licence in accordance with Section 66 of the Act to retain the Works.

7.4 The PLA shall not be unreasonable in refusing the grant of a New Licence if:

(i) in the reasonable opinion of the PLA, the Transferee, when assessed is of a lower financial standing than the Licensee or the Transferee cannot perform its obligations under the New Licence; and

(ii) the New Licence is not executed in accordance with the conditions as set out in clause 7.5.

7.5 The New Licence (if granted), shall:

(i) be substantially in the same form as this Licence

(ii) be subject to such further or amended terms and conditions as the PLA shall reasonably require.

7.6 This Licence shall terminate of the date of the New Licence PROVIDED THAT the New Licence to the Transferee is for the whole of the Works and not any part thereof. Such termination shall not affect any right or remedy of either party in respect of any breach of the provisions of this Licence which existed at or before the date of termination.

Limitation of Rights Granted

8.1 This Licence does not confer on the Licensee any right which would or might obstruct private rights appurtenant to any riparian land

8.2 The PLA retains control, possession and management of the River Thames and the Licensee has no right to exclude the PLA from the River Thames.

No Warranty

9.1 This Licence is issued under Section 66 of the Port of London Act 1968 and does not constitute consent under any other provisions of that Act or under any other private or general Act of Parliament.

9.2 Nothing in this Licence shall imply or warrant that the Works may be used or are suitable for any of the purposes herein authorised.

9.3 The PLA gives no warranty that the foreshore, banks or riverbed of the River Thames are physically fit for any of the purposes specified in this Licence.

Service

10. Any notice or other document to be served under this Licence shall be delivered by hand or sent by a postal service which provides for the delivery of the document by post to be recorded to the party to be served at that party's current address as follows:

10.1 if to the PLA to the Secretary of the Port of London Authority at its principal office from time to time

10.2 if to the Licensee to the address set out in Schedule 1 of this Licence

10.3 or to such other address as the PLA or the Licensee may have notified in writing to the other party from time to time.

Third Parties

11. The parties do not intend the terms of this Licence to be enforceable by third parties under the provisions of the Contracts (Rights of Third Parties) Act 1999.

SCHEDULE 1

The Licensee

Name	Address
Blaxmill Limited Company no. 01743653	The Thomson Reuters Building 30 South Colonnade Canary Wharf London E14 5EP

SCHEDULE 2

The Works

Description	Location	PLA Number(s) [LIST PLA NUMBER]
Timber fenders and walings on river wall; 450mm outfall with tidal flap valve	Blackwall Yard, London E14	126.0501
Remains of 9 cut off piles as shown on the deposited plan	Reuter's Pier, Blackwall	126.1718
Previously Licensed to: Thomson Reuters		

Starting Date: 1 February 2019

SCHEDULE 3

Obligations of the Licensee

Consideration

1. To pay the Consideration promptly as it falls due and also to pay the PLA's reasonable charges and costs of £619 plus VAT in connection with the initial negotiation of the consideration.

Interest

2.1 To pay to the PLA on demand interest at the rate of 2% above National Westminster Bank Plc base lending rate from time to time on:

2.1.1 any increased sum by way of Consideration agreed or assessed after any Calculation Date or Review Date and which is payable from the relevant Calculation Date or Review Date until the date of payment of such increased sum is made;

2.1.2 any consideration agreed or assessed which is not paid on any Payment Day for the period commencing on that Payment Day until payment of such consideration is made;

2.2 any other sum payable under the provisions of this Licence which is not paid within 21 days of being invoiced for the period commencing on the 21 day after the date of the invoice until payment of such sum is made.

2.3 Where interest is demanded it is to be paid before as well as after judgment.

Value Added Tax

3. To pay any Value Added Tax that may be chargeable on the consideration or any other sums payable by the Licensee under the provisions of this Licence.

Outgoings

4. To pay all outgoings including (without prejudice to the generality of the foregoing) any rates or commercial property tax in respect of the Works.

Maintenance of Works

5.1 To maintain the Works to the PLA's reasonable satisfaction.

5.2 The Licensee must immediately make good any damage, to the reasonable satisfaction of the PLA, to any of the River Thames or any adjoining land or plant or machinery which is caused by the maintenance or alteration of the Works.

Alteration of Works

6.1 Subject to Clause 6.2 not to make any alteration or addition to the Works.

62 Should the PLA require any alteration of the Works for navigational, conservancy or environmental reasons connected to its statutory duties, the Licensee shall alter the Works from time to time to such extent and within such time as the PLA may reasonably require.

Removal of Works

7. Before expiration of any notice of revocation or on expiry of this Licence, should the PLA so require by notice in writing or (unless the Department for Transport have already approved the Works) immediately if at any time the Department for Transport so requires to remove the Works from the River Thames and to reinstate the river bed to the PLA's reasonable satisfaction.

Indemnity

8. To indemnify the PLA (save to the extent that the following is attributable to any negligent act or default or fraud of the PLA its employees agents and contractors or any other liability or class of liability which may not by virtue of any statutory provision or other law be excluded by the PLA) against all actions, proceedings, claims, demands, damages, expenses, costs and losses in any way arising out of the Works or their use, any breach of the Licensees obligations in Schedule 3 or the grant of this Licence, including without prejudice to the foregoing any claims by other holders of licences under Section 66 of the Act.

Release of PLA Liability

9. Not to make any claim against the PLA in respect of any loss or damage to the Works arising out of the proper exercise by the PLA of its statutory duties or powers.

Siltation and Erosion

10.1 Maintain suitable riverbed protection on the River Thames beneath the Works should the PLA reasonably so require to prevent erosion of the foreshore by the Works.

10.2 If any siltation or erosion of the riverbed is caused by the Works, to use all reasonable endeavours make good the riverbed and obtain any necessary consents, licences or permissions (including any required from the PLA) to remove the siltation or fill in the eroded riverbed to the reasonable satisfaction of the PLA.

10.3 If the Licensee fails to comply with any of their obligations under this paragraph 10 within a reasonable period of time (to be determined by the PLA) to pay to the PLA as a debt on demand any reasonable costs and expenses the PLA incurs in restoring the riverbed as a result of the Licensee's breach of this paragraph 10.

Marking Lighting and Fendering

11. To mark, light and fender the Works and to maintain such marking lighting and fendering as the PLA's harbourmaster may require from time to time and if the Licensee fails to comply with such a requirement to permit the PLA to enter onto the Works to carry out such requirement and to pay to the PLA as a debt on demand any reasonable costs and expenses it properly incurs in so doing.

Use

12.1 Not to use the surface water outfall other than for the discharge of surface water only from the Adjoining Land at a flow rate through the 450mm outfall pipe of no more than 185litres per second.

12.2 Not to increase the flow rates from the outfall forming part of the Works without the PLA's written consent: and

12.3 to seek the PLA's written consent (which may be given subject to conditions) for the continued discharge of surface water through the

outfall forming part of the Works if there is any change of use or redevelopment of the Adjoining Land.

12.4 Not to use the timber fenders and walings or the cut off piles forming part of the Works.

Nuisance

13.1 Not to do or allow to remain upon in under or at the Works anything which may constitute a nuisance (whether actionable or not), disturbance or inconvenience to the PLA or anyone or anything on the River Thames or any owner or occupier of any neighbouring property.

13.2 Not to use the Works for any illegal or immoral purpose.

13.3 Not to display any advertisement, signboard, flag, banner, nameplate, inscription, placard, poster, signs or notices on the Works without prior written consent of the PLA.

Statutory Obligations

14.1 To comply:

14.1.1 with any statutory provisions (including any European Union directives which are directly applicable) or subordinate legislation and in particular to obtain any necessary planning permission and any necessary consents from the Marine Management Organisation and the Environment Agency; and

14.1.2 with the lawful requirements of any government department, local or public authority regarding the works

14.2 and to indemnify the PLA against any expenses reasonably incurred by the PLA in complying with such requirements as may be imposed on the PLA with regard to the Works.

Production of Notices

15. To immediately notify and provide the PLA with a copy of any notice or order or proposal for an order or notice received by the Licensee affecting the Works or anything on or done thereon and to take such

action as may reasonably be required by the PLA in relation to such order or notice.

Entry by PLA

16. To permit the PLA to enter on the Works without notice in the case of an emergency or at reasonable times on 48 hours notice to inspect the Works and where to conveniently access the Works entry is required across adjoining riparian land to permit (in so far as the Licensee is in a position to do so) the PLA to cross the adjoining riparian land to obtain access to the Works.

This Licence must be signed by the Licensee or in the case of a Company by a person authorised to sign for the Company

Signature

J STOKES

Print Name

J STOKES

The Licensee/PLA

Date

6/9/19

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