TECHNICAL NOTE 1

DATE:	04 November 2022	**CONFIDENTIALITY:**	Public
SUBJECT:	Virtus London 3, 4 & 10 - Air Quality Assessment - Supplementary Information		
PROJECT:	70092911	**AUTHOR:**	Robyn Rand / Bethan Tuckett-Jones

INTRODUCTION

This document provides the additional information requested by email (14 October 2022, Kirstie Lythgo) in support of the Air Quality Assessment for the Virtus London 3, 4 & 10 data centres, prepared by WSP (August 2022).

The questions raised in the email were as follows:

1. In order that we can replicate and audit the dispersion modelling (e.g. the modelled concentrations and plume merging/source modelling), provide a revised AQ report that includes:
   a. For each individual engine before any mixing with cooling air occurs, a full set of stack/source parameters used to establish the inputs to the modelling (i.e. engine efflux parameters) including:
      - moisture and oxygen content at exit condition (%)
      - actual and normalised flow rate (m^3/s, Nm^3/s)
      - emission concentration (mg/m^3, mg/Nm^3)
      - emission rate (g/s)
      - efflux velocity (actual) (m/s)
      - efflux temperature (K, °C)
      - engine exit diameter (m)
   b. Provide the actual diameter (m) of each individual release stack.

2. Provide an explanation of why, in Table C-4, source 009 has the same calculated combined stack diameter as sources 001-008 despite accommodating an additional engine. If it is an error, update the table.

3. We are seeking to understand the low efflux temperatures stated in Tables C-1, C-2, C-3 and C-4 (stated as 58.1-93.79°C, when we would normally expect in the region of 450 °C). Is it because of the mixing with engine cooling air in the stacks? Please explain the low temperatures and the reasons for the mixing of engine emissions with cooling air.

   Table C-4 shows that LON10 temperatures are high but Table C-3 source A32 (which is LON10) has lower temperatures. Please explain this discrepancy.

4. Provide a justification for the use of the higher daily CLe of 200 µg/m³. This should include robust supporting evidence demonstrating that concentrations of SO_2 and O_3 are below their respective critical levels at the specific habitat sites being assessed for the higher daily NOx CLe to apply. The background concentrations and critical level values selected must be explained and justified, clearly citing all sources used.

5. Include an assessment of impacts from acid deposition. This is missing from the assessment.

Our response to these questions is provided below. As set out in the air quality assessment and discussed in further email correspondence between WSP and Environment Agency, the arrangement and operations of the generators in the data centre is such that a simple representation of the individual generator emissions is not necessarily representative of conditions at the point of exit of exhaust gases from the stacks and, as such, the responses to Q1 – Q3 are all interlinked. AS such, in the following text, we provide all of the information requested for these questions in a manner that represents both the generator information and the modelled emissions. This includes the individual generator information, the plume information after the merging of cooling air with the exhaust gases (where relevant), and the representation of the exhaust gases in the modelling.

Should you have any further queries, we would welcome the opportunity to meet and discuss the ongoing queries and/or respond by email.

Bethan Tuckett-Jones
Head of Air Quality, WSP

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QUESTION 1, 2 & 3: OVERARCHING BACKGROUND INFORMATION

Table 1 shows the engines installed at the Data Centre. The first point of note in the table is that the generators in Lon 3 and 4 are set up with the exhaust plume merging with cooling air prior to emission to air, whereas the generators in Lon 10 discharge directly to air (see below). Secondly, the expected operating load during emergency backup operations has been matched to the power requirement to support each Data Centre and varies between the data centres and the gensets.

Table 1 Installed engines in London 3, 4 & 10 Data Centre

Data Centre	Engine	No Installed	Generator Locations	Exhaust merged with Cooling Air	Load during backup generation
LON3	AVK DS2500 (MTU 4000G63)	6	A21 – A26	Yes	83.3%
LON4	AVK XC3300	5	A1 – A5	Yes	60%
	3516C	3	A6 – A8	Yes	100%
	3516B	3	A9 – A11	Yes	100%
	3516C - HD	8	A12 – A19	Yes	80%
LON10	AVK DS2500 (MTU 4000G84F)	6	A27 – A32	No	83.3%

Exhaust Arrangements Lon3 & 4

The generators for Lon3 & 4 are arranged as set out in the schematic below

1) There is a fixed volume ambient air intake to the generator housing unit (A)
2) The air intake serves two purposes, namely the air intake for the generator (B) and the generator cooling air (C)
3) The exhaust gases from the generator (D) merges with the cooling air (C) prior to exhaust from the stack (E)

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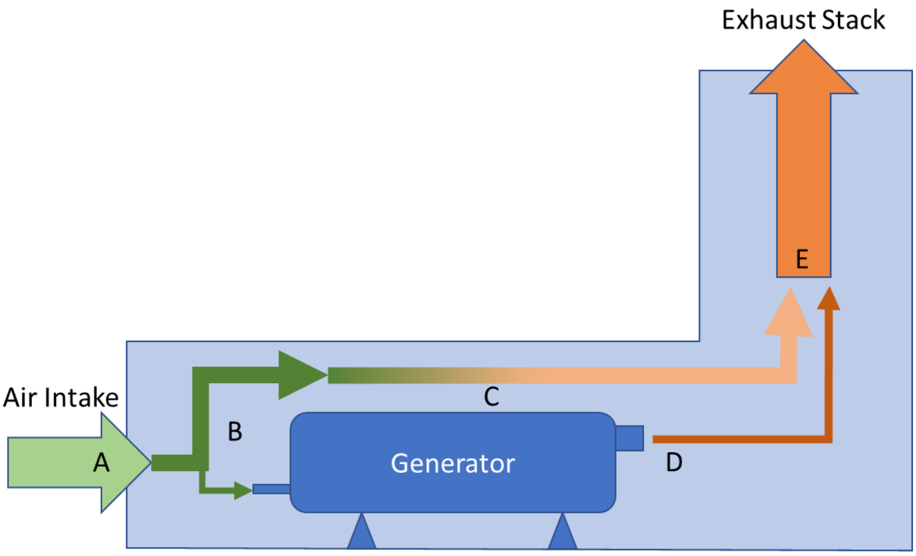

Figure 1 Generator arrangement in Lon 3 & 4

The generator exhaust parameters, as presented in technical data sheets, are representative of conditions at location D. The parameters used in the modelling of impacts i.e. for the bulk exhaust gases, are those representing the conditions at the stack exit (E).

Exhaust Arrangements Lon10

The generators for Lon10 use a standard set up, without the cooling air mixing, as per the schematic below, where the bulk exhaust gases at the stack exit (E) are the same as the generator exhaust (D).

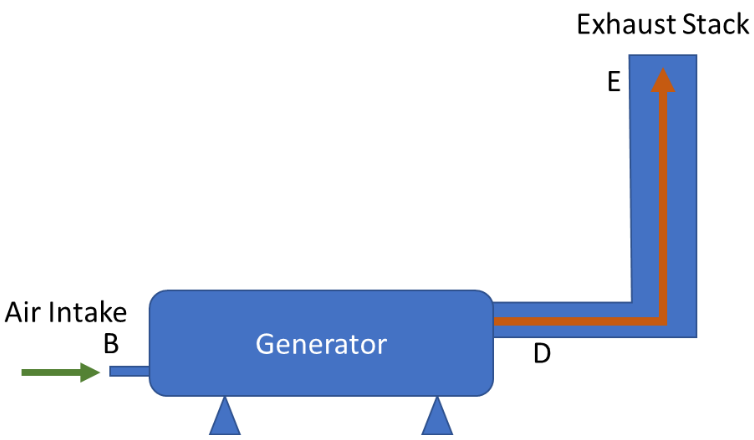

Figure 2 Generator arrangement in Lon 10

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Air Intakes (Location A, Figure 1)

The air intake for the generators in Lon 3 & 4 is via fixed volume fans with the capacity provided in **Table 2**.

For the calculation of exhaust parameters for modelling, this intake is assumed to be at 11.9°C, which is the annual average ambient temperature at Heathrow (2015 – 2019).

Table 2 Air Intake volumes

Data Centre	Engine	Fixed Volume Fan Air Intake (m^3/s)
LON3	AVK DS2500 (MTU 4000G63)	32.3
LON4	AVK XC3300	44.9
	3516B	35.5
	3516C - HD	32.3
	3516C - HD	35.5
LON10	AVK DS2500 (MTU 4000G84F)	*Not Applicable*

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QUESTION 1 (PART 1A): INDIVIDUAL ENGINE PARAMETERS PRIOR TO MIXING

As commonly encountered, the information provided by the individual manufacturers, as set out in technical data sheets, varies to a greater or lesser degree between the generators. As such, whilst some of the information requested by AQMAU is provided directly in the data sheet, some data must be calculated from provided information. Where calculations are made, this information has been indicated in the tables below.

The information in the tables below Table IE. 1- Table IE. 6 has been provided at engine loads relevant to those parameters required for modelling. The information is related to Location D in Figure 1 and Figure 2. The information on the calculation of mixed exhaust parameters is provided in the next section.

Table 3 Parameter table references

Data Centre	Engine	Emission Data Located in
LON3	AVK DS2500 (MTU 4000G63)	Table IE. 1
LON4	AVK XC3300	Table IE. 2
	3516C	Table IE. 3
	3516B	Table IE. 4
	3516C - HD	Table IE. 5
LON10	AVK DS2500 (MTU 4000G84F)	Table IE. 6

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Table IE. 1 Generator Information for Lon 3 AVK Engines (A21 – A26). Data in purple italics are interpolated from data sheet parameters.

%Load	Engine Power (kW)	Exhaust Volume (Actual) m^3/s	Exhaust Temp-erature (°C)	$\%O_2$ (Dry)	$\%H_2O$ (Calc from IV & comb-ustion of diesel)	NOx (mg/Nm^3 @5%O2, dry)	Exhaust Volume (dry, 0C, 1atm, 5% O2) Nm^3/s (Calc from II, III, IV & V)	NOx (g/s)	Inlet Air Volume m^3/s (NTP) (Calc from IV and comb-ustion of diesel	Exhaust Volume (0°C, 1atm, actual O_2/H_2O) Nm^3/s (Calc from II, III)
Col Ref.	I	II	III	IV	V	VI	VII	VIII	IX	X
100	**1966**	**5.8**	**480**	**8.8**	**8.4**	**4464**	**1.4**	**6.5**	**2.1**	**2.1**
83.3	***Interpolated***	***5.2***	***467***					***5.8***	***1.9***	***1.9***
75	**1475**	**4.9**	**461**	**10.1**	**7.8**	**4729**	**1.1**	**5.4**	**1.8**	**1.8**
10	**197**	**1.5**	**224**	**16.6**	**3.6**	**2294**	**0.2**	**0.5**	**0.9**	**0.8**

10% Load not modelled because LON4 3516C engines give worst case for Virtus Test 1;
75% bulk exhaust parameters used for modelling worst case Virtus Test 2 with emissions scaled by 20mins at 100% load + 40mins at 75%;
Emergency scenario parameters at 83.3% load interpolated from 100% & 75% information

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Table IE. 2 Generator information for Lon 4 AVK Engines (A1 – A5). Data in purple italics are interpolated from datasheet values

%Load	Engine Power (kW)	Exhaust Volume (Actual) m^3/s	Exhaust Temp-erature (°C)	$\%O_2$ (Dry)	$\%H_2O$ (Calc from IV & comb-ustion of diesel)	NOx (mg/Nm^3 @5%O2, dry)	Exhaust Volume (dry, 0C, 1atm, 5% O2) Nm^3/s (Calc from II, III, IV & V)	NOx (g/s)	Inlet Air Volume m^3/s (NTP) (Calc from IV and comb-ustion of diesel	Exhaust Volume (0°C, 1atm, actual O_2/H_2O) Nm^3/s (Calc from II, III)
Col Ref.	I	II	III	IV	V	VI	VII	VIII	IX	X
100	**2590**	**9.6**	**516.0**	**9.7**	**3.0**	**1537.0**	**2.3**	**3.5**	**3.4**	**3.3**
75	**1942**	**7.1**	**486.0**	**10.6**	**3.4**	**1534.0**	**1.6**	**2.5**	**2.6**	**2.6**
60	***Interpolated***	***5.7***	***464.4***					***2.0***	***2.2***	***2.1***
50	**1295**	**4.8**	**450.0**	**11.2**	**3.6**	**1612.0**	**1.1**	**1.7**	**1.9**	**1.8**
10	**259**	**1.9**	**232.0**	**16.5**	**2.1**	**2743.0**	**0.3**	**0.8**	**1.1**	**1.0**
10% load not modelled because LON4 3516C engines give worst case for Virtus Test 1; 75% load not modelled because LON3 AVK engines give worst case for Virtus Test 2 Emergency scenario parameters at 60% load interpolated from 75% & 50% information										

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Table IE. 3 Generator information for Lon 4 3516C – low emis Engines (A6 – A8).

%Load	Engine Power (kW)	Exhaust Volume (Actual) m^3/s	Exhaust Temp-erature (°C)	$\%O_2$ (Dry)	$\%H_2O$ (Calc from ratio of dry to wet flow)	NOx (mg/Nm^3 @5%O2, dry)	Exhaust Volume (dry, 0C, 1atm, 5% O2) Nm^3/s (Calc from II, III, IV & V)	NOx (g/s)	Inlet Air Volume m^3/s (NTP) (Calc from IV and comb-ustion of diesel	Exhaust Volume (0°C, 1atm, actual O_2/H_2O) Nm^3/s (Calc from II, III)
Col Ref.	I	II	III	IV	V	VI	VII	VIII	IX	X
100	**2415**	**8.0**	**462.4**	**10.0**	**8.6**	**2351.0**	**1.9**	**4.3**	**3.1**	**3.0**
75	**1826**	**6.5**	**436.3**	**11.0**	**8.0**	**1869.0**	**1.4**	**2.6**	**2.6**	**2.5**
10	**340**	**1.8**	**279.1**	**15.1**	**5.5**	**3432.4**	**0.3**	**1.1**	**1.0**	**0.9**
10% load modelled as worst case Virtus Test 1; 75% load not modelled because LON3 AVK engines give worst case for Virtus Test 2 Emergency scenario parameters modelled at 100% load										

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Table IE. 4 Generator information for Lon 4 3516B Engines (A9 – A11)

%Load	Engine Power (kW)	Exhaust Volume (Actual) m^3/s	Exhaust Temp-erature (°C)	$\%O_2$ (Dry)	$\%H_2O$ (Calc from ratio of dry to wet flow)	NOx (mg/Nm^3 @5%O2, dry)	Exhaust Volume (dry, 0C, 1atm, 5% O2) Nm^3/s (Calc from II, III, IV & VIII)	NOx (g/s)	Inlet Air Volume m^3/s (NTP) (Calc from IV and comb-ustion of diesel	Exhaust Volume (0°C, 1atm, actual O_2/H_2O) Nm^3/s (Calc from II, III)
Col Ref.	I	II	III	IV	V	VI	VII	VIII	IX	X
100	**2125**	**7.9**	**537.2**	**8.9**	**8.7**	**2480.9**	**1.7**	**4.3**	**2.8**	**2.7**
75	**1600**	**6.2**	**477.4**	**10.1**	**8.7**	**2214.7**	**1.3**	**2.8**	**2.4**	**2.3**
10	**259**	**1.8**	**321.5**	**14.1**	**8.7**	**3043.4**	**0.3**	**0.8**	**0.9**	**0.8**

10% load not modelled because LON4 3516C engines give worst case for Virtus Test 1;
75% load not modelled because LON3 AVK engines give worst case for Virtus Test 2
Emergency scenario parameters modelled at 100% load
Following manufacturer advice, data sheet values taken from interpolation of 3516B engine with outlet temperatures 60°C and 90°C to proposed outlet temperature of 72°C.

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Table IE. 5 Generator information for Lon 4 3516C – low fuel (A12 – A19). Data in purple italics are interpolated from datasheet data

%Load	Engine Power (kW)	Exhaust Volume (Actual) m^3/s	Exhaust Temp-erature (°C)	$\%O_2$ (Dry)	$\%H_2O$ (Calc from ratio of dry to wet flow)	NOx (mg/Nm^3 @5%O2, dry)	Exhaust Volume (dry, 0C, 1atm, 5% O2) Nm^3/s (Calc from II, III, IV & V)	NOx (g/s)	Inlet Air Volume m^3/s (NTP) (Calc from IV and comb-ustion of diesel	Exhaust Volume (0°C, 1atm, actual O_2/H_2O) Nm^3/s (Calc from II, III)
Col Ref.	I	II	III	IV	V	VI	VII	VIII	IX	X
100	**2399**	**8.1**	**477.8**	**9.2**	**9.1**	**2575.8**	**1.8**	**4.7**	**3.1**	**2.9**
80	***Interpolated***	***6.6***	***457.8***	***9.6***	***9.2***	***2487.2***	***1.5***	***3.7***	***2.6***	***2.5***
75	**1821**	**6.3**	**452.8**	**9.7**	**9.2**	**2465.1**	**1.4**	**3.4**	**2.5**	**2.4**
10	**339**	**1.9**	**308.0**	**13.1**	**9.1**	**3215.1**	**0.3**	**1.1**	**0.9**	**0.9**
10% load not modelled because LON4 3516C engines give worst case for Virtus Test 1; 75% load not modelled because LON3 AVK engines give worst case for Virtus Test 2 Emergency scenario parameters at 60% load interpolated from 75% & 50% information										

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Table IE. 6 Generator Information for Lon 10 AVK Engines (A27 – A32). Data in purple italics are interpolated from data sheet parameters.

%Load	Engine Power (kW)	Exhaust Volume (Actual) m^3/s	Exhaust Temp-erature (°C)	$\%O_2$ (Dry)	$\%H_2O$ (Calc from IV & comb-ustion of diesel)	NOx (mg/Nm^3 @5%O2, dry)	Exhaust Volume (dry, 0C, 1atm, 5% O2) Nm^3/s (Calc from II, III, IV & V)	NOx (g/s)
Col Ref.	I	II	III	IV	V	VI	VII	VIII
100	**2184**	***6.5***	**490.0**	**9.5**	**9.2**	**3489.0**	**1.5**	**5.3**
83.3	***Interpolated***	***5.4***	***480.0***					***5.4***
75	**1639**	***4.8***	**475.0**	**9.7**	**7.0**	**4704.0**	**1.1**	**5.4**
10	**218**	***1.6***	**223.0**	**16.6**	**3.6**	**2293.0**	**0.3**	**0.6**
10% load not modelled because LON4 3516C engines give worst case for Virtus Test 1; 75% load not modelled because LON3 AVK engines give worst case for Virtus Test 2 Emergency scenario parameters at 83.3% load interpolated from 100% & 75% information								

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QUESTION 1 (PART 1B) & QUESTION 3: INDIVIDUAL ENGINE PARAMETERS AFTER MIXING

As noted above, the generator sets in Lon 3 and 4 have the set up shown in Figure 1, with mixing of the cooling air and generator exhausts before release through the stack. Table ACA. 1 to Table ACA. 5 show the calculation of the mixing of gases within the stack. The tables correspond to the individual engine parameters set out in Table IE. 1 to Table IE. 5.

To recap, Lon 10 generators do not use cooling air mixing and have the layout shown in Figure 2.

As such, in response to your point 3, the reason for the exit temperature for plumes from Lon 3 & Long 4 generators being significantly lower than for Lon 10 is that the former account for mixing with cooling air, whilst the latter do not mix with cooling air.

Note:

- Worst Case: Virtus Testing 1 scenario modelled as 10% load emissions for Lon4 3516C – low emis Engine
- Worst Case: Virtus Testing 2 scenario modelled as 75% load bulk exhaust parameters for Lon 3 AVK Engine with NOx emissions pro-rata'd as 20mins @75% load, 40min @100% load. Using this approach is conservative since it combines the worst case hour of emissions during testing with the minimum flow rate during testing.
- Virtus Emergency 2 scenario is modelled at the percentage loads set out Table 1.

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Table ACA. 1. Cooling air mixing parameters for Lon 3 AVK Engines (A21 – A26)

Scenario	Load %	Air Intake (Ambient Temp, 11.9C) m^3/s	Air Intake (STP) m^3/s	Generator Intake at STP, m3/s Table IE. 1, Col IX, adjusted temp.	Cooling Air at STP m^3/s, from Cols ii - iii	Cooling Air Temperature (degC) - Ambient+ 40C	Exhaust Vol Flow (STP) m^3/s Table IE. 1, Col X	Exhaust Temperature (degC) Table IE. 1, Col III	Combined Air Temp (degC), from Cols iv - vii & Eq 3	Combined Exhaust Volume (Actual) m^3/s, from iv+vi, adjusted for temp viii	NOx Emission Rate (g/s) Table IE. 1, Col VIII
Col Ref.		i	ii	iii	iv	v	vi	vii	viii	ix	x
Emergency	83	32.3	30.9	1.8	29.1	51.9	1.9	467.3	77.4	39.8	5.8
Virtus Test 2	75	32.3	30.9	1.7	29.2	51.9	1.8	461.0	75.7	39.6	5.8[a]

a. Virtus Test 2 exhaust emissions follow 75% load parameters, mass emissions of NOx modelled as 20mins at 100% Load, 40mins @ 75% Load

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Table ACA. 2. Cooling air mixing parameters for Lon 4 AVK Engines (A1 – A5)

Scenario	Load %	Air Intake (Ambient Temp, 11.9C) m^3/s	Air Intake (STP) m^3/s	Generator Intake at STP, m3/s Table IE. 2 Col IX, adjusted temp.	Cooling Air at STP m^3/s, from Cols ii - iii	Cooling Air Temperature (degC) - Ambient+ 40C	Exhaust Vol Flow (STP) m^3/s Table IE. 2, Col X	Exhaust Temperature (degC) Table IE. 2, Col III	Combined Air Temp (degC), from Cols iv - vii & Eq 3	Combined Exhaust Volume (Actual) m^3/s, from iv+vi, adjusted for temp viii	NOx Emission Rate (g/s) Table IE. 2, Col VIII
Col Ref.		i	ii	iii	iv	v	vi	vii	viii	ix	x
Emergency	*60*	44.9	43.0	2.0	41.0	51.9	2.1	464	72.2	54.5	2.0

a. Emergency Scenario data interpolated from 75% and 50% datasheet parameters for exhaust gases and NOx emission rate
b. Virtus Test 1 & Test 2 not modelled in worst case

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Table ACA. 3. Cooling air mixing parameters for Lon 4 3516C – low emis Engines (A6 – A8)

Scenario	Load %	Air Intake (Ambient Temp, 11.9C) m^3/s	Air Intake (STP) m^3/s	Generator Intake at STP, m^3/s - Table IE. 3, Col IX, adjusted temp.	Cooling Air at STP m^3/s, from Cols ii - iii	Cooling Air Temperature (degC) - Ambient+ 40C	Exhaust Vol Flow (STP) m^3/s Table IE. 3, Col X	Exhaust Temperature (degC) Table IE. 3, Col III	Combined Air Temp (degC), from Cols iv - vii & Eq 3	Combined Exhaust Volume (Actual) m^3/s, from iv+vi, adjusted for temp viii	NOx Emission Rate (g/s) Table IE. 3, Col VIII
Col Ref.		i	ii	iii	iv	v	vi	vii	viii	ix	x
Emergency	100	35.5	34.0	2.91	31.1	51.9	3.0	462	87.6	45.0	4.3
Testing 1	10	35.5	34.0	0.9	33.1	51.9	0.9	279	58.0	41.2	1.1
Virtus Test 2 not modelled in worst case											

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Table ACA. 4. Cooling air mixing parameters for Lon 4 3516B Engines (A9 – A11)

Scenario	Load %	Air Intake (Ambient Temp, 11.9C) m^3/s	Air Intake (STP) m^3/s	Generator Intake at STP, m^3/s - Table 1b, Col IX, adjusted temp.	Cooling Air at STP m^3/s, from Cols ii - iii	Cooling Air Temperature (degC) - Ambient+ 40C	Exhaust Vol Flow (STP) m^3/s - Table 1b, Col X	Exhaust Temperature (degC) - Table 1b, Col III	Combined Air Temp (degC), from Cols iv - vii & Eq 3	Combined Exhaust Volume (Actual) m^3/s, from iv+vi, adjusted for temp viii	NOx Emission Rate (g/s) - Table 1, Col XI
Col Ref.		i	ii	iii	iv	v	vi	vii	viii	ix	x
Emergency	100	32.3	30.9	2.62	28.3	51.9	2.67	537	93.7	41.6	4.26
Virtus Test 1 & Test 2 not modelled in worst case											

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Table ACA. 5. Cooling air mixing parameters for Lon 4 3516C – low fuel Engines (A12 – A19)

Scenario	Load %	Air Intake (Ambient Temp, 11.9C) m^3/s	Air Intake (STP) m^3/s	Generator Intake at STP, m^3/s - Table 1b, Col IX, adjusted temp.	Cooling Air at STP m^3/s, from Cols ii - iii	Cooling Air Temperature (degC) - Ambient+ 40C	Exhaust Vol Flow (STP) m^3/s - Table 1b, Col X	Exhaust Temperature (degC) - Table 1b, Col III	Combined Air Temp (degC), from Cols iv - vii & Eq 3	Combined Exhaust Volume (Actual) m^3/s, from iv+vi, adjusted for temp viii	NOx Emission Rate (g/s) - Table 1, Col XI
Col Ref.		i	ii	iii	iv	v	vi	vii	viii	ix	x
Emergency	80	35.5	34.0	2.45	31.6	51.9	2.48	458	81.4	44.2	3.68
Virtus Test 1 & Test 2 not modelled in worst case											

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QUESTION 1 (PART 1C): STACK DIAMETERS

Lon 3 & 4

It is not possible to explicitly represent the exact conditions at the point of exit from the stacks at Lon3 & 4 in the ADMS model due to the presence of 'fins' (noise baffles) within the stack that reduce the effective release area.

The plume rise of the exhaust gases is determined both by the momentum of the plume, which is primarily dependent on the exit velocity, and the buoyancy of the plume. The final plume rise is dependent on the exit temperature, the volume flow rate, the exit velocity and the stack diameter. As stated above, all of these parameters cannot be simultaneously and accurately represented in the ADMS model.

As such, a pragmatic approach was adopted in which the initial, momentum driven plume rise was appropriately reproduced by reducing the effective diameter of the stack to represent the true 'open' area of the stack. The trade off using this approach is that in the later stages of plume rise, the buoyancy of the modelled plume will reduce more quickly than in reality since the plume diameter will be underrepresented – but this ensures a conservative assessment since reduced plume rise = increased ground level concentrations.

In reality, the stacks have a rectangular cross -section, with sides of approximately 2.8 x 2.2m and area 6.15m^2. This would give an effective diameter for a circular flue of 2.8m.

The noise baffles ('fins') occupy approximately 50% of the area, leaving an open area of 3.14m^2. This open area gives an effective diameter (per generator) of 2.0m.

The latter diameter has been used to ensure the correct exit velocity, and hence momentum plume rise, was represented in the modelling.

We do not have the diameter of the engine exhaust itself since this is not required by the modelling.

Lon 10

The individual stacks for the Lon 10 generators have diameter 0.6m

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QUESTION 1 (PART 1C) & QUESTION 2: EXIT VELOCITIES

Calculation of Merged Plumes between adjacent generators

Under the emergency scenario, all generators will be running at once. Plumes from adjacent generators will merge and provide enhanced buoyant plume rise in comparison to individual and independent plumes. This effect is most commonly associated with the merging of plumes from flues within a common wind shield.

With the data centre generators arranged linearly, rather than clustered, the plumes will merge to form an effective buoyant line source with an enhanced buoyancy that cannot be represented within the ADMS model.

Therefore, a pragmatic approach was adopted for the modelling, in which the plumes from adjacent generators are assumed to merge, but the merging is limited to groups of 2 generators (or 3 generators where an odd number of generators are present within a bank). All modelled sources for London 3, 4 and 10 are represented by 2 generators (although possibly different models), except Source 009 which represents 3 generators

In the case of 3 generators (e.g. Source_009), to avoid providing additional enhanced buoyancy for these generator group, the groups of 3 were modelled with the bulk exhaust parameters of 2 merged plumes – giving the same plume rise for all generator groups – and the mass emission rate of 3 generators – giving the correct overall pollutant emissions. This maintains the overall conservative approach adopted for the modelling.

As such, in response to your question – the source data for Source 009 are correct.

Details of the exhaust plumes after merging were provided in Appendix C, Table C-4.

Additional details of the calculation of the exit velocities for the combined stacks are shown overleaf.

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Table 4 Merged Plume Parameters for Emergency Scenario

Modelled Source	Engine(s)	Source	Individual Generator Parameters				Combined Generator Parameters (As Modelled)				
			Volume Flow (m3/s actual)	Temperature (°C)	Diameter (m)	NOx Emission Rate (g/s)	Volume Flow	Temperature	Effective Diameter	Exit Velocity	Pollutant Emission Rate
Source001	AVK/MTU	A1, A2	54.5	72.2	2	2.02	109.0	72.2	2.83	17.3	4.04
Source002	AVK/MTU	A3, A4	54.5	72.2	2	2.02	109.0	72.2	2.83	17.3	4.04
Source003	AVK/MTU and 3516C	A5, A6	54.5	72.2	2	2.02	99.5	79.1	2.83	15.8	6.36
			45.0	87.6	2	4.3					
Source004	3516C – HD	A7, A8	45.0	87.6	2.0	4.3	90.0	87.6	2.83	14.3	8.68
Source005	3516B	A9, A10	41.6	93.7	2	4.3	83.2	93.7	2.83	13.2	8.53
Source006	3526B and 3516C	A11, A12	41.6	93.7	2	4.3	85.8	87.4	2.83	13.7	7.94
			44.2	81.4	2	3.7					
Source007	3516C – HD	A13, A14	44.2	81.4	2.0	3.7	88.4	81.4	2.83	14.1	7.35
Source008	3516C – HD	A15, A16	44.2	81.4	2.0	3.7	88.4	81.4	2.83	14.1	7.35
Source009	3516C – HD	A17, A18, A19	44.2	81.4	2.0	3.7	88.4	81.4	2.83	14.1	11.03

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Modelled Source	Engine(s)	Source	Individual Generator Parameters				Combined Generator Parameters (As Modelled)				
			Volume Flow (m3/s actual)	Temperature (°C)	Diameter (m)	NOx Emission Rate (g/s)	Volume Flow	Temperature	Effective Diameter	Exit Velocity	Pollutant Emission Rate
Source010	AVK/MTU	A21, A22	39.8	77.4	2.0	5.8	79.6	77.4	2.83	12.7	11.52
Source011	AVK/MTU	A23, A24	39.8	77.4	2.0	5.8	79.6	77.4	2.83	12.7	11.52
Source012	AVK/MTU	A25, A26	39.8	77.4	2.0	5.8	79.6	77.4	2.83	12.7	11.52
Source013	AVK/MTU	A27, A28	5.4	480.0	0.6	5.4	10.7	480.0	0.85	19.0	10.73
Source014	AVK/MTU	A29, A30	5.4	480.0	0.6	5.4	10.7	480.0	0.85	19.0	10.73
Source015	AVK/MTU	A31, A32	5.4	480.0	0.6	5.4	10.7	480.0	0.85	19.0	10.73

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QUESTION 3: EXIT TEMPERATURES

You are correct in stating that Table C-4 shows that LON10 temperatures are high but Table C-3 source A32 (which is LON10) has lower temperatures.

The reason for this discrepancy is the methodology used to assess impacts during testing.

In summary, the methodology used an approximate approach to taking into account the sequential testing of generators by assuming that the worst case emissions could occur from any generator location on site and with impacts assessed as if the emissions all occurred at a single (worst case) location i.e. a highly conservative assumption.

In the case of the Lon10 generators, the approach taken included added conservatism whereby the efflux velocity and exit temperature for emissions from a Lon 3 AVK generator held for the Lon 10 stacks with reduced diameter.

This is a considerably more conservative approach than might have been taken if emissions from the Lon 10 generator locations were set to the Lon 10 generator emissions. However, with no significant effects modelled in the worst case, conservative scenario, the assumptions have no impact on the results or the conclusions of the assessment.

QUESTION 4: DAILY MEAN NOX CRITICAL LEVEL

The assessment of impacts on compliance with the daily mean NOx critical level has been made with reference to the precautionary 75µg/m^3 and not the 200µg/m^3 referenced in the question.

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QUESTION 5: ACID DEPOSITION

The table below provides a screening assessment of the combined impacts of testing and emergency operation of the Lon 3, 4 and 10 generators.

All impacts on acid deposition are insignificant, as they were for nitrogen deposition. The latter were shown in Table 9-2 of the air quality assessment.

The data are provided for the designated sites for which critical loads for acidity are provided on APIS, and the impacts are assessed against the minimum CLmaxN critical load..

ID	Site	Critical Load (keq/ha/yr)	Grassland Habitats		Woodland Habitats		Insignif-icant?
			Deposition (keq/ha/yr)	% of Critical Load	Deposition (keq/ha/yr)	% of Critical Load	
E1	Chiltern Beechwoods SAC	1.647			6.43-05	0.004%	Yes
E5	Burnham Beeches SAC	2.056			0.00059	0.028%	Yes
E7	South West London Waterbodies Ramsar / SPA	1.093	0.00012	0.010%			Yes
E8	South West London Waterbodies Ramsar / SPA	1.093	0.00011	0.012%			Yes
E9	South West London Waterbodies Ramsar / SPA	1.093	0.00014	0.012%			Yes
E10	Windsor Forest & Great Park SAC	1.044			0.00025	0.024%	Yes
E11	Windsor Forest & Great Park SAC	1.044			0.00040	0.038%	Yes