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Stack Emissions Testing Report Commissioned by
Thallia (Previously AmeyCespa Ltd)

Installation Name & Address
Thallia (Previously AmeyCespa Ltd)
Allerton Park Quarry
Moor Lane
Knaresborough
HG5 0SD

EPR Permit: EPR/NP3034CG

Stack Reference
A3 - Line 2

Dates of the Monitoring Campaign
7th - 8th November 2024

Job Reference Number
EMT11466

Report Written by
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Report Date
6th December 2024
Version
Version 1
Signature of Report Approver
[REDACTED]

TITLE PAGE

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APPENDIX 2 - Raw Data, Sampling Equations & Charts

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Executive Summary

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MONITORING OBJECTIVES

Thallia (Previously AmeyCespa Ltd), Knaresborough

A3 - Line 2

7th - 8th November 2024

Overall Aim of the Monitoring Campaign

Element were commissioned by Thallia (Previously AmeyCespa Ltd) to carry out stack emissions testing on the A3 - Line 2 at Knaresborough.

The aim of the monitoring campaign was to demonstrate compliance with a set of emission limit values (ELVs) as specified in the Site's Permit.

Special Requirements

There were no special requirements.

Target Parameters

Dioxins & Furans, Brominated Dioxins & FuransPCBs

Executive Summary

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MONITORING RESULTS

Thallia (Previously AmeyCespa Ltd), Knaresborough

A3 - Line 2

7th - 8th November 2024

where MU = Measurement Uncertainty associated with the Result

Parameter	Concentration				Mass Emission			
	Units	Result	MU +/-	Limit	Units	Result	MU +/-	Limit
Dioxins & Furans Upper Limit (worst case where <LOD = LOD)								
Dioxins & Furans (NATO I-TEQ)	¹ ng/m ³	0.0089	0.0018	0.06	µg/hr	1.01	0.22	-
Dioxins & Furans (WHO TEQ Humans / Mammals)	¹ ng/m ³	0.0086	0.0018	-	µg/hr	0.98	0.21	-
Dioxins & Furans (WHO TEQ Fish)	¹ ng/m ³	0.0092	0.0019	-	µg/hr	1.05	0.22	-
Dioxins & Furans (WHO TEQ Birds)	¹ ng/m ³	0.0137	0.0028	-	µg/hr	1.56	0.33	-
Dioxins & Furans Lower Limit (best case where <LOD = 0)								
Dioxins & Furans (NATO I-TEQ)	¹ ng/m ³	0.0087	0.0018	-	µg/hr	0.99	0.21	-
Dioxins & Furans (WHO TEQ Humans / Mammals)	¹ ng/m ³	0.0084	0.0017	-	µg/hr	0.96	0.20	-
Dioxins & Furans (WHO TEQ Fish)	¹ ng/m ³	0.0090	0.0019	-	µg/hr	1.03	0.22	-
Dioxins & Furans (WHO TEQ Birds)	¹ ng/m ³	0.0135	0.0028	-	µg/hr	1.54	0.33	-
Brominated Dioxins & Furans Upper Limit (worst case where <LOD = LOD)								
Brominated Dioxins & Furans (NATO I-TEQ)	¹ ng/m ³	0.0014	0.0003	-	µg/hr	0.16	0.03	-
Brominated Dioxins & Furans Lower Limit (best case where <LOD = 0)								
Brominated Dioxins & Furans (NATO I-TEQ)	¹ ng/m ³	0.0008	0.0002	-	µg/hr	0.09	0.02	-
PCBs Upper Limit (worst case where <LOD = LOD)								
PCBs (WHO TEQ Humans / Mammals)	¹ ng/m ³	0.0009	0.00018	-	µg/hr	0.10	0.02	-
PCBs (WHO TEQ Fish)	¹ ng/m ³	0.00004	0.00001	-	µg/hr	0.01	0.001	-
PCBs (WHO TEQ Birds)	¹ ng/m ³	0.0027	0.00057	-	µg/hr	0.31	0.07	-
PCBs Lower Limit (best case where <LOD = 0)								
PCBs (WHO TEQ Humans / Mammals)	¹ ng/m ³	0.0009	0.00018	-	µg/hr	0.10	0.02	-
PCBs (WHO TEQ Fish)	¹ ng/m ³	0.00004	0.00001	-	µg/hr	0.01	0.001	-
PCBs (WHO TEQ Birds)	¹ ng/m ³	0.0027	0.00057	-	µg/hr	0.31	0.07	-
Oxygen	% v/v	Dry 9.3	0.24					
Water Vapour	% v/v	18.1	0.97					
Stack Gas Temperature	°C	166						
Stack Gas Velocity	m/s	21.1	0.20					
Volumetric Flow Rate (ACTUAL)	m ³ /hr	193388	8943					
Volumetric Flow Rate (REF)	¹ m ³ /hr	114306	5286					

NOTE: VOLUMETRIC FLOW RATE & VELOCITY DATA TAKEN FROM AN AVERAGE OF ALL OF THE ISOKINETIC RUNS.

¹ Reference Conditions (REF) are: 273K, 101.3kPa, dry gas, 11% oxygen.

Executive Summary

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MONITORING DATE(S) & TIMES

Thallia (Previously AmeyCespa Ltd), Knaresborough

A3 - Line 2

7th - 8th November 2024

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins	
Dioxins & Furans	(NATO)	R1	ng/m³	0.0089	µg/hr	1.01	07/11/2024	13:30 - 16:30 , 16:40 - 19:40	360
Brominated Dioxins & Furans	(NATO)	R1	ng/m³	0.0014	µg/hr	0.16	07/11/2024	13:30 - 16:30 , 16:40 - 19:40	360
PCBs		R1	ng/m³	0.0009	µg/hr	0.10	07/11/2024	13:30 - 16:30 , 16:40 - 19:40	360
Oxygen		R1	% v/v	9.3			07/11/2024	13:30 - 19:40	360
Velocity Traverse		R1					07/11/2024	10:32 - 10:47	

All results are expressed at the respective reference conditions.

PROCESS DETAILS

Thallia (Previously AmeyCespa Ltd), Knaresborough
A3 - Line 2
7th - 8th November 2024

Standard Operating Conditions

Parameter	Value
Process Status	Normal Operation
Capacity (of 100%) and Tonnes / Hour	Full Capacity
Continuous or Batch Process	Continuous
Feedstock (if applicable)	Municipal Waste
Abatement System	Bag Filtration with Carbon and Lime Injection
Abatement System Running Status	On
Fuel	Natural Gas
Plume Appearance	No Plume Visible

Executive Summary

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MONITORING & ANALYTICAL METHODS

Thallia (Previously AmeyCespa Ltd), Knaresborough

A3 - Line 2

7th - 8th November 2024

Parameter	Monitoring				Analysis				Overall Status	LOD (Average)
	Standard	Technical Procedure	Sampling Status	Testing Lab	Analytical Procedure	Analytical Technique	Analysis Status	Analysis Lab		
Dioxins & Furans	EN 1948	MD 007	MCERTS	EET	WI 1122	GC-HRMS	MCERTS	MAR	MCERTS	0.0006 ng/m ³
Brominated Dioxins & Furans	EN 1948	MD 007	None	EET	2002	GC-HRMS	None	MAR	None	0.001 ng/m ³
PCBs	EN 1948	MD 007	MCERTS	EET	WI 1180	GC-HRMS	MCERTS	MAR	MCERTS	0.00002 ng/m ³
Water Vapour	EN 14790	MD 005	MCERTS	EET	MD 005	Gravimetric	MCERTS	EET	MCERTS	0.10 % v/v
Oxygen	EN 14789	MD 039	MCERTS	EET	Dry Paramagnetic Cell by Horiba PG-350E				MCERTS	0.1 %
Velocity & Vol. Flow Rate	EN 16911-1 (MID)	MD 041	MCERTS	EET	Pitot Tube and Thermocouple				MCERTS	1.2 m/s

ANALYSIS LABORATORIES

(with short name reference as appears in the table above)

Element (Stockport Lab - EET)	ISO 17025 Accreditation Number: UKAS 4279
Marchwood Scientific Services Ltd (MAR)	ISO 17025 Accreditation Number: UKAS 1668

SUMMARY OF SAMPLING DEVIATIONS

Parameter	Run	Deviation
All	All	There are no deviations associated with the sampling employed.

SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	1.80
Width	m	-
Area	m ²	2.54
Port Depth	cm	25
Orientation of Duct	-	Vertical
Number of Ports	-	2
Sample Port Size	-	5" Flange

Location of Sampling Platform

General Platform Information	Value
Permanent / Temporary Platform	Permanent
Inside / Outside	Outside

Platform Details

EA Technical Guidance Note M1 / EN 15259 Platform Requirements	Value
Sufficient working area to manipulate probe and operate the measuring instruments	Yes
Platform has 2 levels of handrails (approx. 0.5m & 1.0m high)	Yes
Platform has vertical base boards (approx. 0.25m high)	Yes
Platform has chains / self closing gates at top of ladders	N/A
There are no obstructions present which hamper insertion of sampling equipment	Yes
Safe Access Available	Yes
Easy Access Available	Yes

Sampling Location / Platform Improvement Recommendations

The sampling location meets all the requirements specified in EA Guidance Note M1 and EN 15259, and therefore there are no improvement recommendations.

EN 15259 Homogeneity Test Requirements

A valid EN 15259 Homogeneity test was performed by Exova Catalyst on this Stack on 9th October 2017, Report ID: CAT-3709, and the stack gas profile was found to be homogenous.

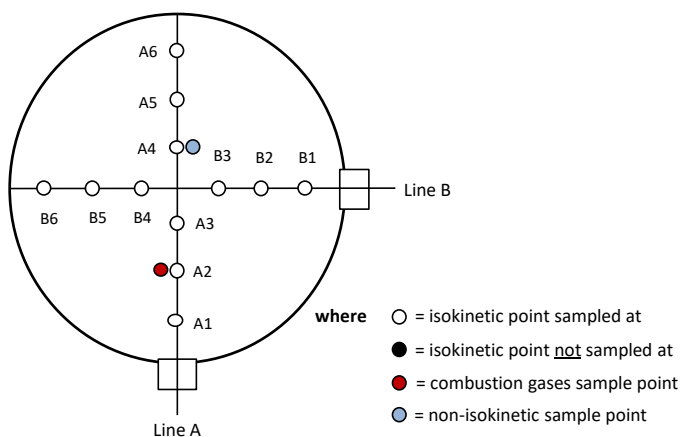
Sampling Plane Validation Criteria (from EN 15259)

Criteria in EN 15259	Units	Traverse 1	Required	Compliant
Lowest Differential Pressure	Pa	212.0	> 5 Pa	Yes
Mean Velocity	m/s	21.38	-	-
Lowest Gas Velocity	m/s	20.55	-	-
Highest Gas Velocity	m/s	22.15	-	-
Ratio of Above	: 1	1.08	< 3 : 1	Yes
Maximum Angle of Swirl	°	8.00	< 15°	Yes
No Local Negative Flow	-	Yes	-	Yes

PLANT PHOTOS



SAMPLE POINTS



APPENDIX CONTENTS

APPENDIX 1 - Stack Emissions Monitoring Personnel, List of Equipment & Methods and Technical Procedures Used

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

STACK EMISSIONS MONITORING PERSONNEL

Position	Name	MCERTS Accreditation	MCERTS Number	Technical Endorsements
Team Leader	Arnold Ulewicz	MCERTS Level 2	MM 18 1476	TE1 TE2 TE3 TE4
Technician	Nigel Merrick	MCERTS Level 1	MM 02 118	None
Technician	Richard Oxley	MCERTS Level 1	MM 22 1737	None

LIST OF EQUIPMENT

Extractive Sampling		Instrumental Analysers		Miscellaneous Items	
Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.
Control Box DGM (1)	CAT 7.51	Horiba PG-350E	CAT 39.42	Digital Manometer (1)	CAT 3.303
Control Box DGM (2)	-	Horiba PG-250	-	Digital Manometer (2)	CAT 3.304
Box Thermocouples (1)	CAT 3.162	Servomex 4900	-	Digital Temperature Meter	CAT 3.303
Box Thermocouples (2)	-	Eco Physics CLD 822Mh	-	Stopwatch	CAT 14.77
Umbilical (1)	CAT 3.104	ABB AO2020-URAS26	-	Barometer	MET Office
Umbilical (2)	-	Testo 350 XL	-	Stack Thermocouple (1)	CAT 4.1722
Oven Box (1)	CAT 12.111	JCT JCC P1 Cooler	CAT 4.0107	Stack Thermocouple (2)	-
Oven Box (2)	CAT 12.34	Gasmeter DX4000	-	Stack Thermocouple (3)	-
Heated Probe (1)	CAT 5.124	Gasmeter Sampling System	-	1m Heated Line (1)	-
Heated Probe (2)	-	Sick 3006	-	1m Heated Line (2)	-
Heated Probe (3)	-	M&C PSS	CAT 12.965	1m Heated Line (3)	-
S-Pitot (1)	CAT 21P.147	Mass Flow Controller (1)	CAT 6.47	5m Heated Line (1)	-
S-Pitot (2)	-	Mass Flow Controller (2)	CAT 6.46	15m Heated Line (1)	-
L-Pitot	-	Mass View (1)	CAT 25.45	20m Heated Line (1)	CAT 20.262
Site Balance	CAT 17.106	Mass View (2)	-	20m Heated Line (2)	-
500g / 1Kg Check Weights	CAT 17.99	Hioki 5043 (V)	-	Dual Channel Heater Controller	CAT 20.262
Last Impinger Arm	CAT 4.0035	Hioki 5043 (V)	-	Single Channel Heater Controller	-
Callipers	CAT 23.64	Bioaerosols Temperature Logger	-	Laboratory Balance	-
Tubes Kit Thermocouple	-	Electronic Refrigerator	-	Tape Measure	CAT 16.24

METHODS & TECHNICAL PROCEDURES USED

Parameter	Standard	Technical Procedure
Dioxins & Furans	EN 1948	MD 007
Brominated Dioxins & Furans	EN 1948	MD 007
PCBs	EN 1948	MD 007
Water Vapour	EN 14790	MD 005
Oxygen	EN 14789	MD 039
Velocity & Vol. Flow Rate	EN 16911-1 (MID)	MD 041

PRELIMINARY STACK SURVEY: CALCULATIONS

General Stack Details

Stack Details (from Traverse)	Units	Value
Stack Diameter / Depth, D	m	1.80
Stack Width, W	m	-
Stack Area, A	m ²	2.54
Average Stack Gas Temperature, T _a	°C	165.4
Average Stack Gas Pressure	Pa	229.7
Average Stack Static Pressure, P _{static}	kPa	-0.338
Average Barometric Pressure, P _b	kPa	101.2
Average Pitot Tube Calibration Coefficient, C _p	-	0.88

Stack Gas Composition & Molecular Weights

Component	Conc ppm	Conc Dry % v/v	Conc Wet % v/v	Volume Fraction r	Molar Mass M	Density kg/m ³ p	Conc kg/m ³ p _i
CO ₂ (Estimated)	-	10.57	8.66	0.1057	44.01	1.9635	0.20754
O ₂	-	9.26	7.58	0.0926	32.00	1.4277	0.13217
N ₂	-	80.17	65.69	0.8017	28.01	1.2498	1.00203
Moisture (H ₂ O)	-	-	18.07	0.1807	18.02	0.8037	0.14521

Where: $p = M / 22.41$

$p_i = r \times p$

Calculation of Stack Gas Densities

Determinand	Units	Result
Dry Density (STP), P _{STD}	kg/m ³	1.342
Wet Density (STP), P _{STW}	kg/m ³	1.245
Dry Density (Actual), P _{Actual}	kg/m ³	0.832
Average Wet Density (Actual), P _{ActualW}	kg/m ³	0.773

Where: P_{STD} = sum of component concentrations, kg/m³ (not including water vapour)
 P_{STW} = sum of all wet concentrations / 100 x density, kg/m³ (including water vapour)
 $P_{Actual} = P_{STD} \times (T_{STP} / (P_{STP})) \times ((P_{static} + P_b) / T_a)$
 $P_{ActualW}$ (at each sampling point) = $P_{STW} \times (T_s / P_s) \times (P_a / T_a)$

Calculation of Stack Gas Volumetric Flowrate, Q

Duct gas flow conditions	Units	Actual	REF ¹
Temperature	°C	165.4	0.0
Total Pressure	kPa	100.9	101.3
Moisture	%	18.07	0.00
Oxygen (Dry)	%	9.3	11.0

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m ³ /hr	195851
Gas Volumetric Flowrate (STP, Wet)	m ³ /hr	121431
Gas Volumetric Flowrate (STP, Dry)	m ³ /hr	99492
Gas Volumetric Flowrate REF ¹	m ³ /hr	116829

PRELIMINARY STACK SURVEY: VELOCITY TRAVERSE TO EN 16911-1 (MID)

(1 of 1)

Parameter	Units	Value
Date of Survey	-	07/11/2024
Time of Survey	-	10:32 - 10:47
Atmospheric Pressure	kPa	101.2
Average Stack Static Pressure	Pa	-169
Result of Pitot Stagnation Test	-	Pass
Are Water Droplets Present?	-	No
Device Used	S-Type Pitot with KIMO MP 200 (500Pa)	

Parameter	Units	Value
Initial Pitot Leak Check	-	Pass
Final Pitot Leak Check	-	Pass
Orientation of Duct	-	Vertical
Pitot Tube, C_p	-	0.88
Number of Lines Available	-	2
Number of Lines Used	-	2

Sampling Line A							Sampling Line B				
Traverse Point	Depth m	ΔP Pa	Temp °C	Wet Density kg/m ³	Velocity m/s	Swirl °	ΔP Pa	Temp °C	Wet Density kg/m ³	Velocity m/s	Swirl °
STATIC (Units: Pa)		-338.0					0.0				
Mean		231.7	165.2	0.773	21.47		227.7	165.6	0.773	21.29	
1	0.08	212.0	165.7	0.772	20.55	7.0	223.0	164.8	0.774	21.06	8.0
2	0.26	234.0	165.7	0.772	21.59	6.0	231.0	165.4	0.773	21.45	7.0
3	0.53	245.0	165.4	0.773	22.09	5.0	225.0	165.4	0.773	21.17	5.0
4	1.27	232.0	165.1	0.773	21.49	5.0	216.0	166.2	0.772	20.76	7.0
5	1.54	221.0	164.9	0.774	20.97	4.0	246.0	166.1	0.772	22.15	7.0
6	1.72	246.0	164.3	0.775	22.10	6.0	225.0	165.9	0.772	21.18	4.0

PRELIMINARY STACK SURVEY: VELOCITY TRAVERSE TO EN 16911-1 (MID) - MEASUREMENT UNCERTAINTY

(1 of 1)

Performance characteristics (Uncertainty Components)	Uncertainty	Value	Units
Standard Uncertainty on the coefficient of the Pitot Tube	$u(k)$	0.005	-
Standard Uncertainty associated with the mean local dynamic pressures	$u(\Delta p_i)$	4.496	Pa
- Resolution	$u(res)$	0.00087	
- Calibration	$u(cal)$	5.492	
- Drift	$u(drift)$	0.083	
- Lack of Fit	$u(fit)$	13.636	
- Overall corrections to dynamic measurements	$u(C_f)$	19.213	
Standard uncertainty associated with the molar mass of the gas	$u(M)$	0.00010	-
- $\varphi_{O_2,w}$	-	7.585	
- $\varphi_{CO_2,w}$	-	8.660	
- Oxygen, dry	$u(\phi_{O_2,d})$	0.283	
- Carbon Dioxide, dry	$u(\phi_{CO_2,d})$	0.324	
- Water Vapour	$u(\phi_{H_2O})$	0.922	
- Oxygen, wet	$u(\phi_{O_2,w})$	0.247	
- Carbon Dioxide, wet	$u(\phi_{CO_2,w})$	0.282	
Standard uncertainty associated with the stack temperature	$u(T_c)$	2.237	K
Standard uncertainty associated with the absolute pressure in the duct	$u(p_c)$	175.721	Pa
- Atmospheric Pressure	$u(p_{atm})$	175.692	
- Static Pressure	$u(p_{stat})$	3.179	
Standard uncertainty associated with the density in the duct	$u(\rho)$	0.00417	-
Standard uncertainty associated with the local velocities	$u(v_i)$	0.226	Pa
Standard uncertainty associated with the mean velocity	$u(\bar{v})$	0.103	m/s
Standard uncertainty associated with the mean velocity (95% Confidence)	$U_c(v)$	0.202	m/s
Standard uncertainty associated with the mean velocity (95% Confidence), relative	$U_{c,rel}(v)$	0.95	%
Standard uncertainty associated with the volume flow rate (95% Confidence)	$U_c(qV,w)$	9056.7	m ³ /hr
- $u^2(a)/a^2$	-	0.00053	
- $u^2(qV,w)/q^2V,w$	-	0.00056	
- $u^2(qV,w)$	-	21351403	
- $u(qV,w)$	-	4620.8	
Standard uncertainty associated with the volume flow rate (95% Confidence), relative	$U_{c,rel}(qV,w)$	4.62	%

DIOXINS & FURANS: RESULTS SUMMARY

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Thallia (Previously AmeyCespa Ltd), Knaresborough
A3 - Line 2

TEQ1 - UPPER LIMITS (worst case where <LOD = LOD)

Sample Runs (UPPER NATO I-TEQ)

Parameter	Units	Run 1	Mean
Concentration	ng/m ³	0.0089	0.0089
Uncertainty	±ng/m ³	0.0018	0.0018
Mass Emission	µg/hr	1.01	1.01
Uncertainty	±µg/hr	0.22	0.22

Sample Runs (UPPER WHO TEQ Humans / Mammals)

Parameter	Units	Run 1	Mean
Concentration	ng/m ³	0.0086	0.0086
Uncertainty	±ng/m ³	0.0018	0.0018
Mass Emission	µg/hr	0.98	0.98
Uncertainty	±µg/hr	0.21	0.21

Sample Runs (UPPER WHO TEQ Fish)

Parameter	Units	Run 1	Mean
Concentration	ng/m ³	0.0092	0.0092
Uncertainty	±ng/m ³	0.0019	0.0019
Mass Emission	µg/hr	1.05	1.05
Uncertainty	±µg/hr	0.22	0.22

Sample Runs (UPPER WHO TEQ Birds)

Parameter	Units	Run 1	Mean
Concentration	ng/m ³	0.0137	0.0137
Uncertainty	±ng/m ³	0.0028	0.0028
Mass Emission	µg/hr	1.56	1.56
Uncertainty	±µg/hr	0.33	0.33

DIOXINS & FURANS: RESULTS SUMMARY

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Thallia (Previously AmeyCespa Ltd), Knaresborough
A3 - Line 2

TEQ2 - LOWER LIMITS (best case where <LOD = 0)

Sample Runs (LOWER NATO I-TEQ)

Parameter	Units	Run 1	Mean
Concentration	ng/m ³	0.0087	0.0087
Uncertainty	±ng/m ³	0.0018	0.0018
Mass Emission	µg/hr	0.99	0.99
Uncertainty	±µg/hr	0.21	0.21

Sample Runs (LOWER WHO TEQ Humans / Mammals)

Parameter	Units	Run 1	Mean
Concentration	ng/m ³	0.0084	0.0084
Uncertainty	±ng/m ³	0.0017	0.0017
Mass Emission	µg/hr	0.96	0.96
Uncertainty	±µg/hr	0.20	0.20

Sample Runs (LOWER WHO TEQ Fish)

Parameter	Units	Run 1	Mean
Concentration	ng/m ³	0.0090	0.0090
Uncertainty	±ng/m ³	0.0019	0.0019
Mass Emission	µg/hr	1.03	1.03
Uncertainty	±µg/hr	0.22	0.22

Sample Runs (LOWER WHO TEQ Birds)

Parameter	Units	Run 1	Mean
Concentration	ng/m ³	0.0135	0.0135
Uncertainty	±ng/m ³	0.0028	0.0028
Mass Emission	µg/hr	1.54	1.54
Uncertainty	±µg/hr	0.33	0.33

DIOXINS & FURANS: RESULTS SUMMARY

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Thallia (Previously AmeyCespa Ltd), Knaresborough
A3 - Line 2

TEQ1 - UPPER LIMITS (worst case where <LOD = LOD)

Blank Runs (UPPER NATO I-TEQ)

Parameter	Units	Blank 1	Maximum
Concentration	ng/m ³	0.00015	0.00015

Blank Runs (UPPER WHO TEQ Humans / Mammals)

Parameter	Units	Blank 1	Maximum
Concentration	ng/m ³	0.00016	0.00016

Blank Runs (UPPER WHO TEQ Fish)

Parameter	Units	Blank 1	Maximum
Concentration	ng/m ³	0.00013	0.00013

Blank Runs (UPPER WHO TEQ Birds)

Parameter	Units	Blank 1	Maximum
Concentration	ng/m ³	0.0009	0.0009

TEQ2 - LOWER LIMITS (best case where <LOD = 0)

Blank Runs (LOWER NATO I-TEQ)

Parameter	Units	Blank 1	Maximum
Concentration	ng/m ³	0.00008	0.00008

Blank Runs (LOWER WHO TEQ Humans / Mammals)

Parameter	Units	Blank 1	Maximum
Concentration	ng/m ³	0.00008	0.00008

Blank Runs (LOWER WHO TEQ Fish)

Parameter	Units	Blank 1	Maximum
Concentration	ng/m ³	0.00004	0.00004

Blank Runs (LOWER WHO TEQ Birds)

Parameter	Units	Blank 1	Maximum
Concentration	ng/m ³	0.00076	0.00076

DIOXINS & FURANS: RESULTS SUMMARY

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Thallia (Previously AmeyCespa Ltd), Knaresborough
A3 - Line 2

Parameter	Units	Run 1	Mean
Water Vapour	% v/v	18.1	18.1
Uncertainty	±% v/v	0.97	0.97

General Sampling Information

Parameter	Value
Standard	EN 1948
Technical Procedure	MD 007
Name of Analytical Laboratory	MAR
Analytical Laboratory's Procedure	WI 1122
ISO 17025 Accredited Analysis?	MCERTS
Date of Sample Analysis	26/11/2024
Probe Material	Titanium
Filter Housing Material	Titanium
Glassware Material	Borosilicate Glass
Absorption Material	XAD-2
Positioning of Filter	Out Stack
Filter Size and Material	90mm Quartz Fibre
Number of Sampling Lines Used	2 / 2
Number of Sampling Points Used	12 / 12
Sample Point I.D.'s	A1 - A6 , B6 - B1

FORMAT: Number Used / Number Required

FORMAT: Number Used / Number Required

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 11% oxygen.

DIOXINS & FURANS: ISOKINETIC SAMPLING CALCULATIONS

Test	Units	Run 1	
Absolute pressure of stack gas, P_s			
Barometric pressure, P_b	mmHg	759.1	
Stack static pressure, P_{static}	mmH ₂ O	-34.5	
$P_s = (P_b + (P_{static} / 13.6))$	mmHg	756.5	
Volume of water vapour collected, V_{wstd}			
Total mass collected in impingers (liquid trap)	g	1044.1	
Total mass collected in impingers (silica trap)	g	126.9	
Total mass of liquid collected, V_{lc}	g	1171.0	
$V_{wstd} = (0.001246)(V_{lc})$	m ³	1.4591	
Volume of gas metered dry, V_{mstd}			
Volume of gas sample through gas meter, V_m	m ³	6.9480	
Gas meter correction factor, V_d	-	1.0190	
Average dry gas meter temperature, T_m	°C	19.9	
Average pressure drop across orifice, ΔH	mmH ₂ O	41.5	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(V_d)) / (T_m + 273)$	m ³	6.6168	
Moisture content, B_{wo} & R_{wv}			
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m ³	0.1807	
B_{wo} as a percentage	% v/v	18.07	
Reported Water Vapour, checked with Tables in EN 14790, R_{wv}	% v/v	18.07	
Volume of gas metered wet, V_{mstw}			
$V_{mstw} = (V_{mstd})(100/(100 - R_{wv}))$	m ³	8.0758	
Volume of gas metered at Oxygen Reference Conditions, $V_{mstd@X\%O_2}$ & $V_{mstw@X\%O_2}$			
IED & Incinerates Hazardous Material? (Yes = no positive O ₂ correction)	-	No	
% wet oxygen measured in gas stream, ACT%O _{2w}	% v/v	7.61	
% dry oxygen measured in gas stream, ACT%O _{2d}	% v/v	9.34	
% oxygen reference condition, REF%O ₂	% v/v	11.00	
O ₂ Reference Factor wet ($O_{2REFw} = (21 - REF\%O_2) / (21 - ACT\%O_{2w})$)	-	0.75	
O ₂ Reference Factor dry ($O_{2REFd} = (21 - REF\%O_2) / (21 - ACT\%O_{2d})$)	-	0.86	
$V_{mstw@X\%oxygen} = (V_{mstw}) / (O_{2REFw})$	m ³	10.8097	
$V_{mstd@X\%oxygen} = (V_{mstd}) / (O_{2REFd})$	m ³	7.7184	
Molecular weight of dry gas stream, M_d			
CO ₂ (Estimated)	% v/v	10.11	
O ₂	% v/v	9.34	
Total	% v/v	19.45	
N ₂	% v/v	80.55	
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$	g/gmol	29.99	
Molecular weight of stack gas (wet), M_s			
$M_s = M_d(1 - (R_{wv}/100)) + 18(R_{wv}/100)$	g/gmol	27.82	
Velocity of stack gas, V_s			
Pitot tube velocity constant, K_p	-	34.97	
Velocity pressure coefficient, C_p	-	0.88	
Average of velocity heads, ΔP_{avg}	mmH ₂ O	22.59	
Average square root of velocity heads, $\sqrt{\Delta P}$	√mmH ₂ O	4.75	
Average stack gas temperature, T_s	°C	166.4	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(V_{Ts} + 273)) / (V(M_s)(P_s))$	m/s	21.11	
Total flow of stack gas: Actual (Q_a), Wet (Q_{stw}), Dry (Q_{std}), Wet@O_{2REF} (Q_{stwO_2}), Dry@O_{2REF} (Q_{stdO_2})			
Area of stack, A_s	m ²	2.54	
$Q_a = (60)(A_s)(V_s)$	m ³ /min	3223.1	
Conversion factor (K/mm.Hg), C_f	-	0.3592	
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m ³ /min	1993.3	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m ³ /min	1633.2	
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273) / (O_{2REFw})$	m ³ /min	2668.1	
$Q_{stdO_2} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273) / (O_{2REFd})$	m ³ /min	1905.1	
Percent isokinetic, %I			
Nozzle diameter, D_n	mm	5.88	
Nozzle area, A_n	mm ²	27.19	
Total sampling time, q	min	360	
$\%I = (4.6398E^6)(T_s + 273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	105.3	

DIOXINS & FURANS: SAMPLING DETAILS

RUN 1

Parameter	Units	Value
Sampling Times	-	13:30 - 16:30 , 16:40 - 19:40
Sampling Dates	-	07/11/2024
Sampling Device	-	ISO
Volume Sampled (REF)	m ³	7.7184

Where: ISO stands for Manual Isokinetic Sampling Train

Parameter	Units	Result	DL	NATO I-TEQ		WHO Humans / Mammals		WHO Fish		WHO Birds		% Rec
				TEQ1	TEQ2	TEQ1	TEQ2	TEQ1	TEQ2	TEQ1	TEQ2	
2378-TCDD	ng	ND	0.0016	0.0016	0.0000	0.0016	0.0000	0.0016	0.0000	0.0016	0.0000	109
12378-PeCDD	ng	0.0166	0.0016	0.0083	0.0083	0.0166	0.0166	0.0166	0.0166	0.0166	0.0166	115
123478-HxCDD	ng	0.0279	0.0018	0.0028	0.0028	0.0028	0.0028	0.0140	0.0140	0.0014	0.0014	108
123678-HxCDD	ng	0.0772	0.0020	0.0077	0.0077	0.0077	0.0077	0.0008	0.0008	0.0008	0.0008	82
123789-HxCDD	ng	0.0518	0.0025	0.0052	0.0052	0.0052	0.0052	0.0005	0.0005	0.0052	0.0052	-
1234678-HPeCDD	ng	0.4650	0.0010	0.0047	0.0047	0.0047	0.0047	0.0005	0.0005	0.0005	0.0005	89
OCDD	ng	0.2230	0.0006	0.0002	0.0002	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	101
Total Dioxins	ng	0.8615	-	0.0305	0.0289	0.0386	0.0370	0.0340	0.0323	0.0261	0.0244	-
2378-TCDF	ng	0.0178	0.0025	0.0018	0.0018	0.0018	0.0018	0.0009	0.0009	0.0178	0.0178	83
12378-PeCDF	ng	0.0193	0.0016	0.0010	0.0010	0.0006	0.0006	0.0010	0.0010	0.0019	0.0019	95
23478-PeCDF	ng	0.0490	0.0016	0.0245	0.0245	0.0147	0.0147	0.0245	0.0245	0.0490	0.0490	105
123478-HxCDF	ng	0.0250	0.0009	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	95
123678-HxCDF	ng	0.0290	0.0010	0.0029	0.0029	0.0029	0.0029	0.0029	0.0029	0.0029	0.0029	72
234678-HxCDF	ng	0.0406	0.0009	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	85
123789-HxCDF	ng	0.0041	0.0009	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	84
1234678-HPeCDF	ng	0.0674	0.0006	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	77
1234789-HPeCDF	ng	0.0125	0.0009	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	102
OCDF	ng	0.0126	0.0004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	78
Total Furans	ng	0.2773	-	0.0379	0.0379	0.0277	0.0277	0.0370	0.0370	0.0794	0.0794	-
Totals	ng	1.1388	-	0.0684	0.0668	0.0664	0.0647	0.0710	0.0694	0.1055	0.1038	-
Total Concentration	ng/m ³	-	-	0.0089	0.0087	0.0086	0.0084	0.0092	0.0090	0.0137	0.0135	-
Limit of Detection	ng/m ³	-	-	0.0006	-	0.0007	-	0.0007	-	0.0011	-	-

Where: ND stands for Non Detected
DL stands for Analytical Detection Limit
TEQ1 refers to Non Detected Congeners at the Detection Limit
TEQ2 refers to Non Detected Congeners at Zero
% Rec stands for the Recovery Percentage of the Sample

DIOXINS & FURANS: SAMPLING DETAILS

(Continued)

BLANK 1

Parameter	Units	Value
Sampling Dates	-	07/11/2024
Sampling Device	-	ISO
Average Volume Sampled (REF)	m ³	7.7184

Where: ISO stands for Manual Isokinetic Sampling Train

Parameter	Units	Result	DL	NATO I-TEQ		WHO Humans / Mammals		WHO Fish		WHO Birds		% Rec
				TEQ1	TEQ2	TEQ1	TEQ2	TEQ1	TEQ2	TEQ1	TEQ2	
2378-TCDD	ng	ND	0.0003	0.0003	0.0000	0.0003	0.0000	0.0003	0.0000	0.0003	0.0000	114
12378-PeCDD	ng	ND	0.0002	0.0001	0.0000	0.0002	0.0000	0.0002	0.0000	0.0002	0.0000	114
123478-HxCDD	ng	ND	0.0002	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	100
123678-HxCDD	ng	ND	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	84
123789-HxCDD	ng	ND	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-
1234678-HPeCDD	ng	ND	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	83
OCDD	ng	ND	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	102
Total Dioxins	ng	0.0000	-	0.0005	0.0000	0.0005	0.0000	0.0006	0.0000	0.0005	0.0000	-
2378-TCDF	ng	0.0059	0.0009	0.0006	0.0006	0.0006	0.0006	0.0003	0.0003	0.0059	0.0059	85
12378-PeCDF	ng	ND	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	98
23478-PeCDF	ng	ND	0.0002	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.0002	0.0000	101
123478-HxCDF	ng	ND	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	85
123678-HxCDF	ng	ND	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	71
234678-HxCDF	ng	ND	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	83
123789-HxCDF	ng	ND	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	86
1234678-HPeCDF	ng	ND	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	68
1234789-HPeCDF	ng	ND	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	102
OCDF	ng	ND	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	84
Total Furans	ng	0.0059	-	0.0007	0.0006	0.0007	0.0006	0.0004	0.0003	0.0061	0.0059	-
Totals	ng	0.0059	-	0.0012	0.0006	0.0012	0.0006	0.0010	0.0003	0.0066	0.0059	-
Total Concentration	ng/m ³	-	-	0.0002	0.0001	0.0002	0.0001	0.0001	0.0000	0.0009	0.0008	-

Where: ND stands for Non Detected
DL stands for Analytical Detection Limit
TEQ1 refers to Non Detected Congeners at the Detection Limit
TEQ2 refers to Non Detected Congeners at Zero
% Rec stands for the Recovery Percentage of the Sample

DIOXINS & FURANS: QUALITY ASSURANCE

(PAGE 1 OF 2)

Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	19.7	
Pre-Sampling Leak Rate	l/min	0.35	
Post-Sampling Leak Rate	l/min	0.37	
Allowable Leak Rate	l/min	0.98	
Leak Test Acceptable	-	Yes	
Water Droplets	Units	Run 1	
Are Water Droplets Present	-	No	
MU (Concurrent Water Vapour)	Units	Run 1	
Measurement Uncertainty (MU)	%	5.4	
Allowable MU	%	20.0	
MU Acceptable	%	Yes	
Silica Gel (Concurrent Water Vapour)	Units	Run 1	
Less than 50% Faded	%	Yes	
Isokinetic Criterion Compliance	Units	Run 1	
Isokinetic Variation	%	105.3	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	
Filter Temperatures	Units	Run 1	
Maximum Filter Temperature	°C	120	
Maximum Allowable Temperature	°C	125	
Temperature Acceptable	-	Yes	
Condenser Exit Temperature	Units	Run 1	
Maximum Temperature Recorded	°C	19	
Maximum Allowable Temperature	°C	20	
Exit Temperature Acceptable	-	Yes	
Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	No	

DIOXINS & FURANS: QUALITY ASSURANCE

(PAGE 2 OF 2)

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	20.0	
Sampling Leak Rate	l/min	0.41	
Allowable Leak Rate	l/min	1.00	
Leak Test Acceptable	-	Yes	

Validity of NATO I-TEQ Blank vs ELV	Units	Blank 1	
Allowable Blank	ng/m ³	0.0	
Blank Acceptable	-	Yes	

Method Deviations

Nature of Deviation	Run Number	
(x = deviation applies to the associated run, wx = deviation also applies to the concurrent water vapour run)	1	
There are no deviations associated with the sampling employed.	wx	

DIOXINS & FURANS (NATO I-TEQ): MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value		Standard uncertainty		
	Symbol	Run 1	Symbol	Units	Run 1
Sampled Volume (Actual)	V _m	6.9480	uV _m	m ³	0.1390
Sampled Gas Temperature	T _m	292.9	uT _m	K	2.00
Sampled Gas Pressure	p _m	100.9	up _m	kPa	0.50
Sampled Gas Humidity	H _m	0.00	uH _m	% v/v	1.00
Leak	L	1.88	uL	%	-
Laboratory Result	L _r	10.0	uL _r	%	-

Uncertainty as a Percentage				Requirement of Standard
Measured Quantities	Units	Run 1		
Sampled Volume (Actual)	%	2.00		≤2%
Sampled Gas Temperature	%	0.68		≤1%
Sampled Gas Pressure	%	0.50		≤1%
Sampled Gas Humidity	%	1.00		≤1%
Leak	%	1.88		≤5%
Laboratory Result	%	10.0		No Requirement

Uncertainty in Measurement Units				Sensitivity Coefficient	
Measured Quantities	Symbol	Units	Run 1	Run 1	
Sampled Volume (STP)	V _m	m ³	6.6168	0.001	
Leak	L	ng/m ³	0.0001	1.00	
Laboratory Result	L _r	ng/m ³	0.0009	1.00	

Uncertainty in Result		
Measured Quantities	Units	Run 1
Sampled Volume (STP)	ng/m ³	0.0002
Leak	ng/m ³	0.0001
Laboratory Result	ng/m ³	0.0009

Oxygen Correction Part of MU Budget		
Measured Quantities	Units	Run 1
O ₂ Correction Factor	-	0.86
Stack Gas O ₂ Content	% v/v	9.34
MU for O ₂ Correction	-	0.04
Overall MU For O ₂ Measurement	%	4.29

Parameter	Units	Run 1
Combined uncertainty	ng/m ³	0.0009
Expanded uncertainty (95% confidence), without Oxygen Correction	ng/m ³	0.0018
Expanded uncertainty (95% confidence), with Oxygen Correction	ng/m ³	0.0018
Expanded uncertainty (95% confidence), estimated with Method Deviations	ng/m ³	0.0018
Reported Uncertainty	ng/m ³	0.0018
Expanded uncertainty (95% confidence), without Oxygen Correction	%	20.3
Expanded uncertainty (95% confidence), with Oxygen Correction	%	20.8
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	20.8
Reported Uncertainty	%	20.8
Reported Uncertainty as % of ELV	%	3.1

BROMINATED DIOXINS & FURANS: RESULTS SUMMARY

(PAGE 1 OF 2)

Thallia (Previously AmeyCespa Ltd), Knaresborough
A3 - Line 2

TEQ1 - UPPER LIMITS (worst case where <LOD = LOD)

Sample Runs (UPPER NATO I-TEQ)

Parameter	Units	Run 1	Mean
Concentration	ng/m ³	0.0014	0.0014
Uncertainty	±ng/m ³	0.0003	0.0003
Mass Emission	µg/hr	0.16	0.16
Uncertainty	±µg/hr	0.03	0.03

TEQ2 - LOWER LIMITS (best case where <LOD = 0)

Sample Runs (LOWER NATO I-TEQ)

Parameter	Units	Run 1	Mean
Concentration	ng/m ³	0.0008	0.0008
Uncertainty	±ng/m ³	0.0002	0.0002
Mass Emission	µg/hr	0.09	0.09
Uncertainty	±µg/hr	0.02	0.02

TEQ1 - UPPER LIMITS (worst case where <LOD = LOD)

Blank Runs (UPPER NATO I-TEQ)

Parameter	Units	Blank 1	Maximum
Concentration	ng/m ³	0.0004	0.0004

TEQ2 - LOWER LIMITS (best case where <LOD = 0)

Blank Runs (LOWER NATO I-TEQ)

Parameter	Units	Blank 1	Maximum
Concentration	ng/m ³	0.0002	0.0002

BROMINATED DIOXINS & FURANS: RESULTS SUMMARY

(PAGE 2 OF 2)

Thallia (Previously AmeyCespa Ltd), Knaresborough
A3 - Line 2

Parameter	Units	Run 1	Mean
Water Vapour	% v/v	18.1	18.1
Uncertainty	±% v/v	0.97	0.97

General Sampling Information

Parameter	Value
Standard	EN 1948
Technical Procedure	MD 007
Name of Analytical Laboratory	Marchwood
Analytical Laboratory's Procedure	2002
ISO 17025 Accredited Analysis?	None
Date of Sample Analysis	26/11/2024
Probe Material	Titanium
Filter Housing Material	Titanium
Glassware Material	Borosilicate Glass
Absorption Material	XAD-2
Positioning of Filter	Out Stack
Filter Size and Material	90mm Quartz Fibre
Number of Sampling Lines Used	2 / 2
Number of Sampling Points Used	12 / 12
Sample Point I.D.'s	A1 - A6 , B6 - B1

FORMAT: Number Used / Number Required

FORMAT: Number Used / Number Required

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 11% oxygen.

BROMINATED DIOXINS & FURANS: ISOKINETIC SAMPLING CALCULATIONS

Test	Units	Run 1	
Absolute pressure of stack gas, P_s			
Barometric pressure, P_b	mmHg	759.1	
Stack static pressure, P_{static}	mmH ₂ O	-34.5	
$P_s = (P_b + (P_{static} / 13.6))$	mmHg	756.5	
Volume of water vapour collected, V_{wstd}			
Total mass collected in impingers (liquid trap)	g	1044.1	
Total mass collected in impingers (silica trap)	g	126.9	
Total mass of liquid collected, V_{lc}	g	1171.0	
$V_{wstd} = (0.001246)(V_{lc})$	m ³	1.4591	
Volume of gas metered dry, V_{mstd}			
Volume of gas sample through gas meter, V_m	m ³	6.9480	
Gas meter correction factor, V_d	-	1.0190	
Average dry gas meter temperature, T_m	°C	19.9	
Average pressure drop across orifice, ΔH	mmH ₂ O	41.5	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(V_d)) / (T_m + 273)$	m ³	6.6168	
Moisture content, B_{wo} & R_{wv}			
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m ³	0.1807	
B_{wo} as a percentage	% v/v	18.07	
Reported Water Vapour, checked with Tables in EN 14790, R_{wv}	% v/v	18.07	
Volume of gas metered wet, V_{mstw}			
$V_{mstw} = (V_{mstd})(100/(100 - R_{wv}))$	m ³	8.0758	
Volume of gas metered at Oxygen Reference Conditions, $V_{mstd@X\%O_2}$ & $V_{mstw@X\%O_2}$			
IED & Incinerates Hazardous Material? (Yes = no positive O ₂ correction)	-	No	
% wet oxygen measured in gas stream, ACT%O _{2w}	% v/v	7.61	
% dry oxygen measured in gas stream, ACT%O _{2d}	% v/v	9.34	
% oxygen reference condition, REF%O ₂	% v/v	11.00	
O ₂ Reference Factor wet ($O_{2REFw} = (21 - REF\%O_2) / (21 - ACT\%O_{2w})$)	-	0.75	
O ₂ Reference Factor dry ($O_{2REFd} = (21 - REF\%O_2) / (21 - ACT\%O_{2d})$)	-	0.86	
$V_{mstw@X\%oxygen} = (V_{mstw}) / (O_{2REFw})$	m ³	10.8097	
$V_{mstd@X\%oxygen} = (V_{mstd}) / (O_{2REFd})$	m ³	7.7184	
Molecular weight of dry gas stream, M_d			
CO ₂ (Estimated)	% v/v	10.11	
O ₂	% v/v	9.34	
Total	% v/v	19.45	
N ₂	% v/v	80.55	
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$	g/gmol	29.99	
Molecular weight of stack gas (wet), M_s			
$M_s = M_d(1 - (R_{wv}/100)) + 18(R_{wv}/100)$	g/gmol	27.82	
Velocity of stack gas, V_s			
Pitot tube velocity constant, K_p	-	34.97	
Velocity pressure coefficient, C_p	-	0.88	
Average of velocity heads, ΔP_{avg}	mmH ₂ O	22.59	
Average square root of velocity heads, $\sqrt{\Delta P}$	√mmH ₂ O	4.75	
Average stack gas temperature, T_s	°C	166.4	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(T_s + 273)) / (V(M_s)(P_s))$	m/s	21.11	
Total flow of stack gas: Actual (Q_a), Wet (Q_{stw}), Dry (Q_{std}), Wet@O_{2REF} (Q_{stwO_2}), Dry@O_{2REF} (Q_{stdO_2})			
Area of stack, A_s	m ²	2.54	
$Q_a = (60)(A_s)(V_s)$	m ³ /min	3223.1	
Conversion factor (K/mm.Hg), C_f	-	0.3592	
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m ³ /min	1993.3	
$Q_{std} = ((Q_s)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m ³ /min	1633.2	
$Q_{stwO_2} = ((Q_s)(P_s)(C_f)) / ((T_s) + 273) / (O_{2REFw})$	m ³ /min	2668.1	
$Q_{stdO_2} = ((Q_s)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273) / (O_{2REFd})$	m ³ /min	1905.1	
Percent isokinetic, %I			
Nozzle diameter, D_n	mm	5.88	
Nozzle area, A_n	mm ²	27.19	
Total sampling time, q	min	360	
$\%I = (4.6398E^6)(T_s + 273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	105.3	

BROMINATED DIOXINS & FURANS: SAMPLING DETAILS

RUN 1

Parameter	Units	Value
Sampling Times	-	13:30 - 16:30 , 16:40 - 19:40
Sampling Dates	-	07/11/2024
Sampling Device	-	ISO
Volume Sampled (REF)	m ³	7.7184

Where: ISO stands for Manual Isokinetic Sampling Train

Parameter	Units	Result	DL	NATO		% Rec
				TEQ1	TEQ2	
2378-TBDD	ng	ND	0.0007	0.0007	0.0000	82
12378-PeBDD	ng	ND	0.0010	0.0005	0.0000	75
123478-HxBDD / 123678-HxBDD	ng	ND	0.0130	0.0013	0.0000	97
123789-HxBDD	ng	ND	0.0134	0.0013	0.0000	-
1234678-HPeBDD	ng	ND	0.0233	0.0002	0.0000	41
OBDD	ng	ND	0.1310	0.0001	0.0000	24
Total Brominated Dioxins	ng	0.0000	-	0.0042	0.0000	-
2378-TBDF	ng	0.0057	0.0010	0.0006	0.0006	113
12378-PeBDF	ng	ND	0.0042	0.0002	0.0000	-
23478-PeBDF	ng	0.0064	0.0043	0.0032	0.0032	85
123478-HxBDF / 123678-HxBDF	ng	0.0183	0.0082	0.0018	0.0018	115
234678-HxBDF	ng	ND	0.0000	0.0000	0.0000	-
123789-HxBDF	ng	ND	0.0000	0.0000	0.0000	-
1234678-HPeBDF	ng	0.0613	0.0178	0.0006	0.0006	46
1234789-HPeBDF	ng	ND	0.0000	0.0000	0.0000	-
OBDF	ng	ND	0.0877	0.0001	0.0000	21
Total Brominated Furans	ng	0.0917	-	0.0065	0.0062	-
Totals	ng	0.0917	-	0.0107	0.0062	-
Total Concentration	ng/m ³	-	-	0.0014	0.0008	-
Limit of Detection	ng/m ³	-	-	0.0010	-	-

Where: ND stands for Non Detected
DL stands for Analytical Detection Limit
TEQ1 refers to Non Detected Congeners at the Detection Limit
TEQ2 refers to Non Detected Congeners at Zero
% Rec stands for the Recovery Percentage of the Sample

BROMINATED DIOXINS & FURANS: QUALITY ASSURANCE

(PAGE 1 OF 2)

Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	19.7	
Pre-Sampling Leak Rate	l/min	0.35	
Post-Sampling Leak Rate	l/min	0.37	
Allowable Leak Rate	l/min	0.98	
Leak Test Acceptable	-	Yes	

Water Droplets	Units	Run 1	
Are Water Droplets Present	-	No	

MU (Concurrent Water Vapour)	Units	Run 1	
Measurement Uncertainty (MU)	%	5.4	
Allowable MU	%	20.0	
MU Acceptable	%	Yes	

Silica Gel (Concurrent Water Vapour)	Units	Run 1	
Less than 50% Faded	%	Yes	

Isokinetic Criterion Compliance	Units	Run 1	
Isokinetic Variation	%	105.3	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	

Filter Temperatures	Units	Run 1	
Maximum Filter Temperature	°C	120	
Maximum Allowable Temperature	°C	125	
Temperature Acceptable	-	Yes	

Condenser Exit Temperature	Units	Run 1	
Maximum Temperature Recorded	°C	19	
Maximum Allowable Temperature	°C	20	
Exit Temperature Acceptable	-	Yes	

Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	No	

BROMINATED DIOXINS & FURANS: QUALITY ASSURANCE

(PAGE 2 OF 2)

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	20.0	
Sampling Leak Rate	l/min	0.41	
Allowable Leak Rate	l/min	1.00	
Leak Test Acceptable	-	Yes	
Validity of NATO I-TEQ Blank vs ELV	Units	Blank 1	
Allowable Blank	ng/m ³	N/A	
Blank Acceptable	-	N/A	

Method Deviations

Nature of Deviation	Run Number	
(x = deviation applies to the associated run, wx = deviation also applies to the concurrent water vapour run)	1	
There are no deviations associated with the sampling employed.	wx	

BROMINATED DIOXINS & FURANS (NATO I-TEQ): MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value		Standard uncertainty		
	Symbol	Run 1	Symbol	Units	Run 1
Sampled Volume (Actual)	V_m	6.9480	uV_m	m ³	0.1390
Sampled Gas Temperature	T_m	292.9	uT_m	K	2.00
Sampled Gas Pressure	p_m	100.9	up_m	kPa	0.50
Sampled Gas Humidity	H_m	0.00	uH_m	% v/v	1.00
Leak	L	1.88	uL	%	-
Laboratory Result	L_r	10.0	uL_r	%	-

Uncertainty as a Percentage			
Measured Quantities	Units	Run 1	Requirement of Standard
Sampled Volume (Actual)	%	2.00	≤2%
Sampled Gas Temperature	%	0.68	≤1%
Sampled Gas Pressure	%	0.50	≤1%
Sampled Gas Humidity	%	1.00	≤1%
Leak	%	1.88	≤5%
Laboratory Result	%	10.0	No Requirement

Uncertainty in Measurement Units				Sensitivity Coefficient	
Measured Quantities	Symbol	Units	Run 1	Run 1	
Sampled Volume (STP)	V_m	m ³	6.6168	0.0002	
Leak	L	ng/m ³	0.00002	1.00	
Laboratory Result	L_r	ng/m ³	0.0001	1.00	

Uncertainty in Result		
Measured Quantities	Units	Run 1
Sampled Volume (STP)	ng/m ³	0.00003
Leak	ng/m ³	0.00002
Laboratory Result	ng/m ³	0.0001

Oxygen Correction Part of MU Budget		
Measured Quantities	Units	Run 1
O ₂ Correction Factor	-	0.86
Stack Gas O ₂ Content	% v/v	9.34
MU for O ₂ Correction	-	0.04
Overall MU For O ₂ Measurement	%	4.29

Parameter	Units	Run 1
Combined uncertainty	ng/m ³	0.0001
Expanded uncertainty (95% confidence), without Oxygen Correction	ng/m ³	0.0003
Expanded uncertainty (95% confidence), with Oxygen Correction	ng/m ³	0.0003
Expanded uncertainty (95% confidence), estimated with Method Deviations	ng/m ³	0.0003
Reported Uncertainty	ng/m ³	0.0003
Expanded uncertainty (95% confidence), without Oxygen Correction	%	20.3
Expanded uncertainty (95% confidence), with Oxygen Correction	%	20.8
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	20.8
Reported Uncertainty	%	20.8
Reported Uncertainty as % of ELV	%	N/A

PCBs: RESULTS SUMMARY

(PAGE 1 OF 4)

Thallia (Previously AmeyCespa Ltd), Knaresborough
A3 - Line 2

TEQ1 - UPPER LIMITS (worst case where <LOD = LOD)

Sample Runs (UPPER WHO TEQ Humans / Mammals)

Parameter	Units	Run 1	Mean
Concentration	ng/m ³	0.0009	0.0009
Uncertainty	±ng/m ³	0.0002	0.0002
Mass Emission	µg/hr	0.10	0.10
Uncertainty	±µg/hr	0.02	0.02

Sample Runs (UPPER WHO TEQ Fish)

Parameter	Units	Run 1	Mean
Concentration	ng/m ³	0.00004	0.00004
Uncertainty	±ng/m ³	0.00001	0.00001
Mass Emission	µg/hr	0.01	0.01
Uncertainty	±µg/hr	0.001	0.001

Sample Runs (UPPER WHO TEQ Birds)

Parameter	Units	Run 1	Mean
Concentration	ng/m ³	0.0027	0.0027
Uncertainty	±ng/m ³	0.0006	0.0006
Mass Emission	µg/hr	0.31	0.31
Uncertainty	±µg/hr	0.07	0.07

PCBs: RESULTS SUMMARY

(PAGE 2 OF 4)

Thallia (Previously AmeyCespa Ltd), Knaresborough
A3 - Line 2

TEQ2 - LOWER LIMITS (best case where <LOD = 0)

Sample Runs (LOWER WHO TEQ Humans / Mammals)

Parameter	Units	Run 1	Mean
Concentration	ng/m ³	0.0009	0.0009
Uncertainty	±ng/m ³	0.0002	0.0002
Mass Emission	µg/hr	0.10	0.10
Uncertainty	±µg/hr	0.02	0.02

Sample Runs (LOWER WHO TEQ Fish)

Parameter	Units	Run 1	Mean
Concentration	ng/m ³	0.00004	0.00004
Uncertainty	±ng/m ³	0.00001	0.00001
Mass Emission	µg/hr	0.01	0.01
Uncertainty	±µg/hr	0.001	0.001

Sample Runs (LOWER WHO TEQ Birds)

Parameter	Units	Run 1	Mean
Concentration	ng/m ³	0.0027	0.0027
Uncertainty	±ng/m ³	0.0006	0.0006
Mass Emission	µg/hr	0.31	0.31
Uncertainty	±µg/hr	0.07	0.07

PCBs: RESULTS SUMMARY

(PAGE 3 OF 4)

Thallia (Previously AmeyCespa Ltd), Knaresborough
A3 - Line 2

TEQ1 - UPPER LIMITS (worst case where <LOD = LOD)

Blank Runs (UPPER WHO TEQ Humans / Mammals)

Parameter	Units	Blank 1	Maximum
Concentration	ng/m ³	0.0000162	0.0000162

Blank Runs (UPPER WHO TEQ Fish)

Parameter	Units	Blank 1	Maximum
Concentration	ng/m ³	0.0000010	0.0000010

Blank Runs (UPPER WHO TEQ Birds)

Parameter	Units	Blank 1	Maximum
Concentration	ng/m ³	0.0001	0.0001

TEQ2 - LOWER LIMITS (best case where <LOD = 0)

Blank Runs (LOWER WHO TEQ Humans / Mammals)

Parameter	Units	Blank 1	Maximum
Concentration	ng/m ³	0.0000003	0.0000003

Blank Runs (LOWER WHO TEQ Fish)

Parameter	Units	Blank 1	Maximum
Concentration	ng/m ³	0.0000002	0.0000002

Blank Runs (LOWER WHO TEQ Birds)

Parameter	Units	Blank 1	Maximum
Concentration	ng/m ³	0.00006	0.00006

PCBs: RESULTS SUMMARY

(PAGE 4 OF 4)

Thallia (Previously AmeyCespa Ltd), Knaresborough
A3 - Line 2

Parameter	Units	Run 1	Mean
Water Vapour	% v/v	18.1	18.1
Uncertainty	±% v/v	0.97	0.97

General Sampling Information

Parameter	Value
Standard	EN 1948
Technical Procedure	MD 007
Name of Analytical Laboratory	MAR
Analytical Laboratory's Procedure	WI 1180
ISO 17025 Accredited Analysis?	MCERTS
Date of Sample Analysis	26/11/2024
Probe Material	Titanium
Filter Housing Material	Titanium
Glassware Material	Borosilicate Glass
Absorption Material	XAD-2
Positioning of Filter	Out Stack
Filter Size and Material	90mm Quartz Fibre
Number of Sampling Lines Used	2 / 2
Number of Sampling Points Used	12 / 12
Sample Point I.D.'s	A1 - A6 , B6 - B1

FORMAT: Number Used / Number Required

FORMAT: Number Used / Number Required

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 11% oxygen.

PCBs: ISOKINETIC SAMPLING CALCULATIONS

Test	Units	Run 1	
Absolute pressure of stack gas, P_s			
Barometric pressure, P_b	mmHg	759.1	
Stack static pressure, P_{static}	mmH ₂ O	-34.5	
$P_s = (P_b + (P_{static} / 13.6))$	mmHg	756.5	
Volume of water vapour collected, V_{wstd}			
Total mass collected in impingers (liquid trap)	g	1044.1	
Total mass collected in impingers (silica trap)	g	126.9	
Total mass of liquid collected, V_{lc}	g	1171.0	
$V_{wstd} = (0.001246)(V_{lc})$	m ³	1.4591	
Volume of gas metered dry, V_{mstd}			
Volume of gas sample through gas meter, V_m	m ³	6.9480	
Gas meter correction factor, V_d	-	1.0190	
Average dry gas meter temperature, T_m	°C	19.9	
Average pressure drop across orifice, ΔH	mmH ₂ O	41.5	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(V_d)) / (T_m + 273)$	m ³	6.6168	
Moisture content, B_{wo} & R_{wv}			
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m ³	0.1807	
B_{wo} as a percentage	% v/v	18.07	
Reported Water Vapour, checked with Tables in EN 14790, R_{wv}	% v/v	18.07	
Volume of gas metered wet, V_{mstw}			
$V_{mstw} = (V_{mstd})(100/(100 - R_{wv}))$	m ³	8.0758	
Volume of gas metered at Oxygen Reference Conditions, $V_{mstd@X\%O_2}$ & $V_{mstw@X\%O_2}$			
IED & Incinerates Hazardous Material? (Yes = no positive O ₂ correction)	-	No	
% wet oxygen measured in gas stream, ACT%O _{2w}	% v/v	7.61	
% dry oxygen measured in gas stream, ACT%O _{2d}	% v/v	9.34	
% oxygen reference condition, REF%O ₂	% v/v	11.00	
O ₂ Reference Factor wet ($O_{2REFw} = (21 - REF\%O_2) / (21 - ACT\%O_{2w})$)	-	0.75	
O ₂ Reference Factor dry ($O_{2REFd} = (21 - REF\%O_2) / (21 - ACT\%O_{2d})$)	-	0.86	
$V_{mstw@X\%oxygen} = (V_{mstw}) / (O_{2REFw})$	m ³	10.8097	
$V_{mstd@X\%oxygen} = (V_{mstd}) / (O_{2REFd})$	m ³	7.7184	
Molecular weight of dry gas stream, M_d			
CO ₂ (Estimated)	% v/v	10.11	
O ₂	% v/v	9.34	
Total	% v/v	19.45	
N ₂	% v/v	80.55	
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$	g/gmol	29.99	
Molecular weight of stack gas (wet), M_s			
$M_s = M_d(1 - (R_{wv}/100)) + 18(R_{wv}/100)$	g/gmol	27.82	
Velocity of stack gas, V_s			
Pitot tube velocity constant, K_p	-	34.97	
Velocity pressure coefficient, C_p	-	0.88	
Average of velocity heads, ΔP_{avg}	mmH ₂ O	22.59	
Average square root of velocity heads, $\sqrt{\Delta P}$	√mmH ₂ O	4.75	
Average stack gas temperature, T_s	°C	166.4	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(T_s + 273)) / (V(M_s)(P_s))$	m/s	21.11	
Total flow of stack gas: Actual (Q_a), Wet (Q_{stw}), Dry (Q_{std}), Wet@O_{2REF} (Q_{stwO_2}), Dry@O_{2REF} (Q_{stdO_2})			
Area of stack, A_s	m ²	2.54	
$Q_a = (60)(A_s)(V_s)$	m ³ /min	3223.1	
Conversion factor (K/mm.Hg), C_f	-	0.3592	
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m ³ /min	1993.3	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m ³ /min	1633.2	
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273) / (O_{2REFw})$	m ³ /min	2668.1	
$Q_{stdO_2} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273) / (O_{2REFd})$	m ³ /min	1905.1	
Percent isokinetic, %I			
Nozzle diameter, D_n	mm	5.88	
Nozzle area, A_n	mm ²	27.19	
Total sampling time, q	min	360	
$\%I = (4.6398E^6)(T_s + 273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	105.3	

PCBs: SAMPLING DETAILS

RUN 1

Parameter	Units	Value
Sampling Times	-	13:30 - 16:30 , 16:40 - 19:40
Sampling Dates	-	07/11/2024
Sampling Device	-	ISO
Volume Sampled (REF)	m ³	7.7184

Where: ISO stands for Manual Isokinetic Sampling Train

Parameter	Units	Result	DL	WHO Humans / Mammals		WHO Fish		WHO Birds		% Rec
				TEQ1	TEQ2	TEQ1	TEQ2	TEQ1	TEQ2	
PCB-81	ng	0.0299	0.0005	0.0000090	0.0000090	0.0000150	0.0000150	0.0029900	0.0029900	98
PCB-77	ng	0.2410	0.0005	0.0000241	0.0000241	0.0000241	0.0000241	0.0120500	0.0120500	107
PCB-123	ng	0.0095	0.0011	0.0000003	0.0000003	0.0000000	0.0000000	0.0000001	0.0000001	100
PCB-118	ng	0.1200	0.0010	0.0000036	0.0000036	0.0000006	0.0000006	0.0000012	0.0000012	99
PCB-114	ng	0.0182	0.0011	0.0000005	0.0000005	0.0000001	0.0000001	0.0000018	0.0000018	99
PCB-105	ng	0.0747	0.0013	0.0000022	0.0000022	0.0000004	0.0000004	0.0000075	0.0000075	94
PCB-126	ng	0.0599	0.0015	0.0059900	0.0059900	0.0002995	0.0002995	0.0059900	0.0059900	98
PCB-167	ng	0.0199	0.0005	0.0000006	0.0000006	0.0000001	0.0000001	0.0000002	0.0000002	100
PCB-156	ng	0.0477	0.0004	0.0000014	0.0000014	0.0000002	0.0000002	0.0000048	0.0000048	108
PCB-157	ng	0.0406	0.0005	0.0000012	0.0000012	0.0000002	0.0000002	0.0000041	0.0000041	107
PCB-169	ng	0.0255	0.0007	0.0007650	0.0007650	0.0000013	0.0000013	0.0000255	0.0000255	100
PCB-189	ng	0.0475	0.0004	0.0000014	0.0000014	0.0000002	0.0000002	0.0000005	0.0000005	101
Totals	ng	0.7344	-	0.006799	0.006799	0.000342	0.000342	0.021076	0.021076	-
Total Concentration	ng/m ³	-	-	0.000881	0.000881	0.000044	0.000044	0.002731	0.002731	-
Limit of Detection	ng/m ³	-	-	0.000022	-	0.000001	-	0.000030	-	-

Where: ND stands for Non Detected
DL stands for Analytical Detection Limit
TEQ1 refers to Non Detected Congeners at the Detection Limit
TEQ2 refers to Non Detected Congeners at Zero
% Rec stands for the Recovery Percentage of the Sample

PCBs: SAMPLING DETAILS

BLANK 1

Parameter	Units	Value
Sampling Dates	-	07/11/2024
Sampling Device	-	ISO
Volume Sampled (REF)	m ³	7.7184

Where: ISO stands for Manual Isokinetic Sampling Train

Parameter	Units	Result	DL	WHO Humans / Mammals		WHO Fish		WHO Birds		% Rec
				TEQ1	TEQ2	TEQ1	TEQ2	TEQ1	TEQ2	
PCB-81	ng	ND	0.0002	0.0000001	0.0000000	0.0000001	0.0000000	0.0000197	0.0000000	113
PCB-77	ng	0.0093	0.0002	0.0000009	0.0000009	0.0000009	0.0000009	0.0004625	0.0004625	118
PCB-123	ng	ND	0.0017	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	99
PCB-118	ng	0.0362	0.0016	0.0000011	0.0000011	0.0000002	0.0000002	0.0000004	0.0000004	98
PCB-114	ng	ND	0.0018	0.0000001	0.0000000	0.0000000	0.0000000	0.0000002	0.0000000	94
PCB-105	ng	0.0188	0.0020	0.0000006	0.0000006	0.0000001	0.0000001	0.0000019	0.0000019	91
PCB-126	ng	ND	0.0012	0.0001210	0.0000000	0.0000061	0.0000000	0.0001210	0.0000000	104
PCB-167	ng	0.0005	0.0002	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	107
PCB-156	ng	0.0024	0.0002	0.0000001	0.0000001	0.0000000	0.0000000	0.0000002	0.0000002	113
PCB-157	ng	ND	0.0002	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	108
PCB-169	ng	ND	0.0001	0.0000015	0.0000000	0.0000000	0.0000000	0.0000001	0.0000000	104
PCB-189	ng	ND	0.0001	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	96
Totals	ng	0.0671	-	0.000125	0.000003	0.000007	0.000001	0.000606	0.000465	-
Total Concentration	ng/m ³	-	-	0.000016	0.000000	0.000001	0.000000	0.000079	0.000060	-

Where: ND stands for Non Detected
DL stands for Analytical Detection Limit
TEQ1 refers to Non Detected Congeners at the Detection Limit
TEQ2 refers to Non Detected Congeners at Zero
% Rec stands for the Recovery Percentage of the Sample

PCBs: QUALITY ASSURANCE

(PAGE 1 OF 2)

Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	19.7	
Pre-Sampling Leak Rate	l/min	0.35	
Post-Sampling Leak Rate	l/min	0.37	
Allowable Leak Rate	l/min	0.98	
Leak Test Acceptable	-	Yes	
Water Droplets	Units	Run 1	
Are Water Droplets Present	-	No	
MU (Concurrent Water Vapour)	Units	Run 1	
Measurement Uncertainty (MU)	%	5.4	
Allowable MU	%	20.0	
MU Acceptable	%	Yes	
Silica Gel (Concurrent Water Vapour)	Units	Run 1	
Less than 50% Faded	%	Yes	
Isokinetic Criterion Compliance	Units	Run 1	
Isokinetic Variation	%	105.3	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	
Filter Temperatures	Units	Run 1	
Maximum Filter Temperature	°C	120	
Maximum Allowable Temperature	°C	125	
Temperature Acceptable	-	Yes	
Condenser Exit Temperature	Units	Run 1	
Maximum Temperature Recorded	°C	19	
Maximum Allowable Temperature	°C	20	
Exit Temperature Acceptable	-	Yes	
Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	No	

PCBs: QUALITY ASSURANCE

(PAGE 2 OF 2)

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	20.0	
Sampling Leak Rate	l/min	0.41	
Allowable Leak Rate	l/min	1.00	
Leak Test Acceptable	-	Yes	
Validity of WHO TEQ H/M Blank vs ELV	Units	Blank 1	
Allowable Blank	ng/m ³	N/A	
Blank Acceptable	-	N/A	

Method Deviations

Nature of Deviation	Run Number	
(x = deviation applies to the associated run, wx = deviation also applies to the concurrent water vapour run)	1	
There are no deviations associated with the sampling employed.	wx	

PCBs (WHO TEQ HUMANS / MAMMALS): MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value		Standard uncertainty		
	Symbol	Run 1	Symbol	Units	Run 1
Sampled Volume (Actual)	V _m	6.9480	uV _m	m ³	0.1390
Sampled Gas Temperature	T _m	292.9	uT _m	K	2.00
Sampled Gas Pressure	p _m	100.9	up _m	kPa	0.50
Sampled Gas Humidity	H _m	0.00	uH _m	% v/v	1.00
Leak	L	1.88	uL	%	-
Laboratory Result	L _r	10.0	uL _r	%	-

Uncertainty as a Percentage				Requirement of Standard
Measured Quantities	Units	Run 1		
Sampled Volume (Actual)	%	2.00		≤2%
Sampled Gas Temperature	%	0.68		≤1%
Sampled Gas Pressure	%	0.50		≤1%
Sampled Gas Humidity	%	1.00		≤1%
Leak	%	1.88		≤5%
Laboratory Result	%	10.0		No Requirement

Uncertainty in Measurement Units				Sensitivity Coefficient	
Measured Quantities	Symbol	Units	Run 1	Run 1	
Sampled Volume (STP)	V _m	m ³	6.6168	0.0001	
Leak	L	ng/m ³	0.00001	1.00	
Laboratory Result	L _r	ng/m ³	0.0001	1.00	

Uncertainty in Result		
Measured Quantities	Units	Run 1
Sampled Volume (STP)	ng/m ³	0.00002
Leak	ng/m ³	0.00001
Laboratory Result	ng/m ³	0.0001

Oxygen Correction Part of MU Budget		
Measured Quantities	Units	Run 1
O ₂ Correction Factor	-	0.86
Stack Gas O ₂ Content	% v/v	9.34
MU for O ₂ Correction	-	0.04
Overall MU For O ₂ Measurement	%	4.29

Parameter	Units	Run 1
Combined uncertainty	ng/m ³	0.0001
Expanded uncertainty (95% confidence), without Oxygen Correction	ng/m ³	0.0002
Expanded uncertainty (95% confidence), with Oxygen Correction	ng/m ³	0.0002
Expanded uncertainty (95% confidence), estimated with Method Deviations	ng/m ³	0.0002
Reported Uncertainty	ng/m ³	0.0002
Expanded uncertainty (95% confidence), without Oxygen Correction	%	20.3
Expanded uncertainty (95% confidence), with Oxygen Correction	%	20.8
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	20.8
Reported Uncertainty	%	20.8
Reported Uncertainty as % of ELV	%	N/A

OXYGEN: RESULTS SUMMARY

Thallia (Previously AmeyCespa Ltd), Knaresborough
A3 - Line 2

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	% v/v	9.34		9.34
Uncertainty	±% v/v	0.25		0.25

General Sampling Information

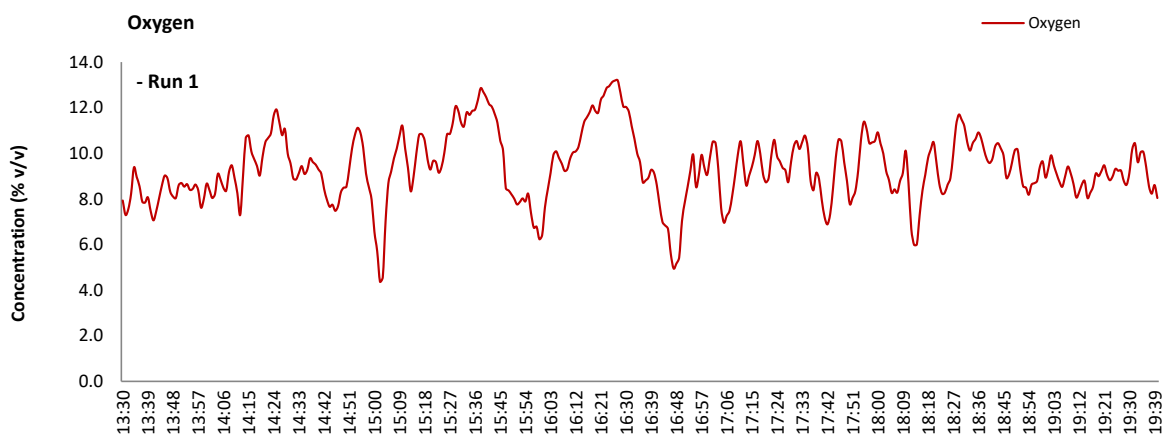
Parameter	Value
Standard	EN 14789
Technical Procedure	MD 039
Probe Material	Titanium
Filtration Type / Size	0.1µm Glass Fibre
Heated Head Filter Used	Yes
Heated Line Temperature	180°C
Span Gas Type	Synthetic Air (5 Grade)
Span Gas Reference Number	11.0635
Span Gas Expiry Date	01/02/2029
Span Gas Start Pressure (bar)	130
Gas Cylinder Concentration (% v/v)	22.1
Span Gas Uncertainty (%)	2
Zero Gas Type	Nitrogen (5 Grade)
Number of Sampling Lines Used	1 / 1
Number of Sampling Points Used	1 / 1
Sample Point I.D.'s	A2

FORMAT: Number Used / Number Required

FORMAT: Number Used / Number Required

OXYGEN: DATA TREND

Graphical Trend of Data



OXYGEN: SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

Parameter	Units	Run 1
Sampling Times	-	13:30 - 19:40
Sampling Dates	-	07/11/2024
Instrument Range	% v/v	25.0
Span Gas Value	% v/v	11.0

Quality Assurance

Conditioning Unit Temperature	Units	Run 1
Average Temperature	°C	2.6
Allowable Temperature	< °C	4.0
Temperature Acceptable	-	Yes
Zero Drift	Units	Run 1
Zero at Analyser (Pre)	% v/v	0.00
Zero at Analyser (Post)	% v/v	0.06
Zero Drift	% v/v	0.07
Zero Drift	%	0.60
Drift Correction Applied	2-5%	No
Allowable Zero Drift	± %	5.00
Zero Drift Acceptable	-	#REF!
Span Drift	Units	Run 1
Span at Analyser (Pre)	% v/v	10.98
Span at Analyser (Post)	% v/v	11.00
Span Drift	% v/v	0.02
Zero Adj. Span Drift	%	0.43
Drift Correction Applied	2-5%	No
Allowable Span Drift	± %	5.00
Span Drift Acceptable	-	#REF!
Test Conditions	Units	Run 1
Run Ambient Temperature Range	°C	7 - 14

Method Deviations

Nature of Deviation	Run Number
(x = deviation applies to the associated run)	1
There are no deviations associated with the sampling employed.	x

OXYGEN: MEASUREMENT UNCERTAINTY CALCULATIONS

Performance characteristics	RUN 1	Units
Limit value	N/A	%vol
Allowable MU	6.0	%
Measured concentration	9.34	%vol
Range Used	25.0	%vol
Cal gas conc.	22.1	%vol

Performance characteristics	RUN 1	Units
Response time	41	seconds
Number of readings in measurement	360	-
Repeatability at zero	0.02	% full scale
Repeatability at span level	0.02	% full scale
Deviation from linearity	0.06	% of value
Zero drift	0.60	% full scale
Span drift	-0.43	% full scale
Volume or pressure flow dependence	0.10	% of full scale
Atmospheric pressure dependence	0.19	% of value/kPa
Ambient temperature dependence	-0.21	% full scale/10K
Combined interference	0.00	% range
Dependence on voltage	0.02	% full scale/10V
Losses in the line (leak)	0.07	% of value
Uncertainty of calibration gas	2.00	% of value

Performance characteristic	RUN 1	Units
Standard deviation of repeatability at zero	use rep at span	%vol
Standard deviation of repeatability at span level	0.00	%vol
Lack of fit	0.01	%vol
Drift	0.05	%vol
Volume or pressure flow dependence	0.00	%vol
Atmospheric pressure dependence	0.01	%vol
Ambient temperature dependence	-0.03	%vol
Combined interference (from MCERTS Certificate)	0.00	%vol
Dependence on voltage	0.00	%vol
Losses in the line (leak)	0.00	%vol
Uncertainty of calibration gas	0.11	%vol

Measurement uncertainty	Result	RUN 1	Units
Combined uncertainty		9.34	%vol
Expanded uncertainty	k = 1.96	0.13	%vol
		0.25	%vol

	RUN 1	Units
Expanded uncertainty (no O ₂) - at 95% Confidence	2.63	% of Value
Result of Compliance with Uncertainty Requirement	COMPLIANT	-

Requirement for SRM is that Uncertainty should be 0.3% vol absolute or 6% relative whichever is the lower, on a dry gas basis. Source, EN 14789.

VERSION HISTORY

Version Number	Record of changes made within this version of the document
V1	The original document issued to the client