



**A.Lanfranco  
& Associates Inc.**

Environmental Consultants

Prepared for  
**METRO VANCOUVER**

**Metrotower III  
4515 Central Boulevard  
Burnaby, BC, V5H 0C6**

# **Waste-to-Energy Facility**

**Emissions Test Report  
Third Quarter 2023 Survey  
Operational Certificate 107051  
Prepared by Louis Agassiz  
Issued: August 30, 2023**

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## **CERTIFICATION**

The field monitoring for this survey was conducted by certified stack test technicians as required by the British Columbia Ministry of Environment (BC MOE) Field Sampling Manual.

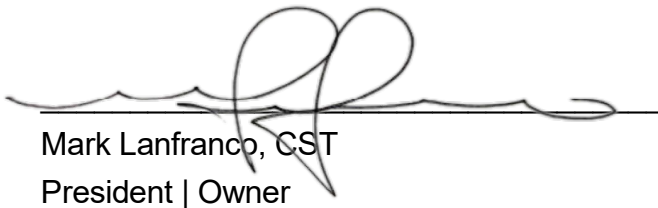
The field crew consisted of:

Mr. S. Harrington (certified), Mr. C. Lanfranco (certified), Mr. J. Gibbs (certified), Mr. D. Sampson (certified), Mr. C. De La O, and Mr B. Lester.

The report was prepared by Mr. L. Agassiz using reporting principles and guidelines generally acceptable to Metro Vancouver (MV).

The field crew and A. Lanfranco and Associates Inc. certify that the test methods used were BC MOE/MV approved reference methods for the parameters investigated.

Report reviewed on August 29, 2023, by:



Mark Lanfranco, CST  
President | Owner

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## TEST PROGRAM ORGANIZATION

### Primary Stakeholders:

Mr. Brent Kirkpatrick

Metro Vancouver

Lead Senior Engineer

Email: [brent.kirkpatrick@metrovancover.org](mailto:brent.kirkpatrick@metrovancover.org)

Tel: (604) 451-6623

Ms. Nicole Victor

Covanta Burnaby Renewable Energy

Facility Manager

Email: [nvictor@covanta.com](mailto:nvictor@covanta.com)

Tel: (604) 521-1025 ext.211

### Project Manager:

Mr. Mark Lanfranco

President | Owner

A. Lanfranco and Associates Inc.

101 – 9488 189 St

Surrey, BC Canada V4N 4W7

Tel: (604) 881-2582

Email: [mark.lanfranco@alanfranco.com](mailto:mark.lanfranco@alanfranco.com)

### Sampling Crew:

Mr. S. Harrington - A. Lanfranco and Associates Inc.

Mr. C. Lanfranco - A. Lanfranco and Associates Inc.

Mr. D. Sampson - A. Lanfranco and Associates Inc.

Mr. J. Gibbs - A. Lanfranco and Associates Inc.

Mr. C. De La O – A. Lanfranco and Associates Inc.

Mr. B. Lester – A. Lanfranco and Associates Inc.

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## SUMMARY

The following table displays the emission results from the three units located at Metro Vancouver's Waste-To-Energy Facility (WTEF) as well as the current emission limits as defined by the Operational Certificate (OC) issued by BC Ministry of Environment & Climate Change Strategy. This compliance survey represents the third quarter of 2023.

**Table 1: Summary Comparison of Emissions Test Results with Limits**

Parameter	Limit	Unit 1	Unit 2	Unit 3	Facility Average
<b>Test Date</b>		17+19-July-23	18-Jul-23	19-20-July-23	
<b>Particulate</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	<b>9.0</b>	1.05	0.47	0.11	<b>0.54</b>
<b>Hydrogen Fluoride</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	<b>1.0</b>	0.09	0.09	0.07	<b>0.08</b>
<b>Hexavalent Chromium</b> (mg/Sm <sup>3</sup> @11% O <sub>2</sub> )	-	-	-	0.00017	<b>0.00017</b>
<b>Trace Metals - OC Class</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )					
Lead (Pb)	-	0.0005	0.0009	0.0005	<b>0.0006</b>
Arsenic (As)	-	0.0003	0.0006	0.0004	<b>0.0005</b>
Chromium (Cr)	-	0.0034	0.0029	0.0008	<b>0.0024</b>
<b>OC Class Sum</b> (Pb, As and Cr)	<b>0.064</b>	0.0042	0.0044	0.0018	<b>0.0035</b>
<b>Mercury</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	<b>0.020</b>	0.000023	0.000057	0.000046	<b>0.00004</b>
<b>Cadmium</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	<b>0.007</b>	0.000157	0.000081	0.000133	<b>0.00012</b>

All data is corrected to standard conditions (S) of 20 °C, 101.325 kPa (dry) unless otherwise noted.

Hexavalent Chromium emission tests were completed on July 25-26, 2023

Compared to previous testing in 2023, the results for all three units are similar. The results are within the expected range based on normal operations and the variability observed is not considered significant.

Hexavalent Chromium was measured on Unit 3 this survey and reported in Table 4. These results are similar to historical data and at the analytical reporting limit.

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## 1 INTRODUCTION

Metro Vancouver (MV) commissioned an emission survey at the Waste-To-Energy Facility (WTEF) in Burnaby BC, as required by the provincially approved Operational Certificate (OC). This report documents the results of a survey on Units 1, 2 and 3 for the third survey of four for the year 2023. This survey includes filterable particulate matter, trace metals, mercury (Hg), hydrogen fluoride (HF), hexavalent chromium ( $\text{Cr}^{6+}$ ), volatile organic compounds (VOC), and nitrous oxide ( $\text{N}_2\text{O}$ ). A. Lanfranco and Associates Inc. (ALAA), of Surrey, B.C., conducted the sampling program on behalf of MV. The sampling program consisted of, but was not limited to, the planning, execution, analysis, and reporting of three emission sources located at the WTEF.

This report includes a comparison of emission results to limits established in the OC, detailed emission results, a brief outline of methods employed, equipment used, and a discussion of the survey. All supporting data and appendices are presented under separate cover.

The individual sources that were monitored for compliance are identified as Unit 1, Unit 2 and Unit 3 which represent the three distinct processing lines at the WTEF. The three boilers are identified as discharge E300670 in the operational certificate.

Sampling was conducted on July 17-20, 2023. Hexavalent Chromium emission tests were performed on July 25-26, 2023.

## 2 METHODOLOGY

All services provided by A. Lanfranco and Associates Inc. were conducted in accordance with approved reference methods as issued by:

- Metro Vancouver (MV)
- BC Ministry of Environment & Climate Change Strategy (BC MOE)
- Environment Canada (EC)
- US Environmental Protection Agency (EPA)

### 2.1 Sampling and Analytical Methods

The following table lists the test methods used for the different parameters measured. The subsequent paragraphs briefly describe each method.

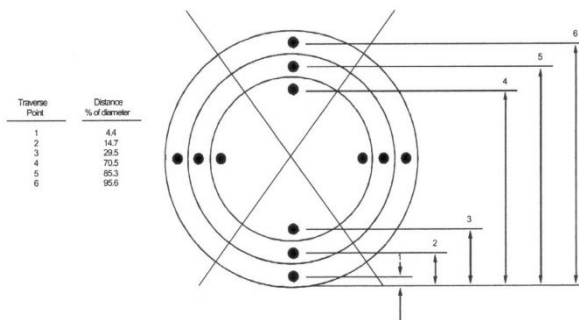
**Table 2: Reference Methods**

<u>Parameter</u>	<u>Reference Method</u>
Sample and Velocity traverse points	EPS 1/RM/8 A Determination of Sampling Site and Traverse Points
Velocity and flowrate	EPS 1/RM/8 B Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)
Gas molecular weight (O <sub>2</sub> /CO <sub>2</sub> )	EPS 1/RM/8 C Determination of Molecular Weight by Gas Analysis
Flue gas Moisture	EPS 1/RM/8 D Determination of Moisture Content
Particulate Matter	EPS 1/RM/8 E Determination of Particulate Matter Emissions from Stationary Sources
Trace Metals with Mercury	EPA Method 29 Determination of Metals Emissions from Stationary Sources
Hydrogen Fluoride (HF)	EPS1/RM/1 Reference Method for Source Testing: Measurement of Releases of Gaseous Hydrogen Chloride from Stationary Sources
Nitrous Oxide (N <sub>2</sub> O)	N/A
Ammonia	EPA Method CTM 027 Procedure For Collection and Analysis of Ammonia in Stationary Sources
Volatile Organic Compounds (VOC)	EPA Method TO-15 Determination of Volatile Organic Compounds in Air
Hexavalent Chromium (Cr <sup>6+</sup> )	EPA Method 0061

### Sampling Site and Traverse Points

This method is designed to aid in the representative measurement of pollutant emissions and/or total volumetric flow rate from a stationary source. A measurement site where the effluent stream is flowing in a known direction is selected, and the cross-section of the stack is divided into a number of equal areas. Traverse points are then located within each of these equal areas.

Primary: EPS 1/RM/8 Method A  
 Supporting: EPA Method 1

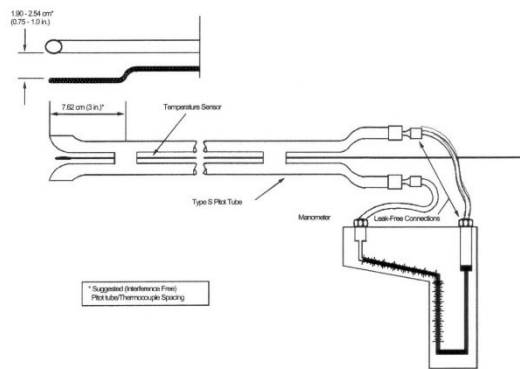


**Figure 1: Example showing circular stack cross section divided**

### Stack Gas Velocity and Volumetric Flow Rate

The average gas velocity in a stack or duct is determined from the gas density and from the measurement of velocity pressure with an S-type pitot tube. A standard pitot tube may be used where plugging of the tube openings due to particulate matter and/or moisture is not likely to occur. Stack gas volumetric flow rate is determined from measurements of stack gas velocity, temperature, absolute pressure, dry gas composition, moisture content, and stack diameter.

Primary: EPS 1/RM/8 Method B  
 Supporting: EPA Method 2



**Figure 2: Type S Pitot Tube Manometer Assembly**



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Molecular Weight by Gas Analysis

Primary: EPS 1/RM/8 Method C  
Supporting: EPA Method 3

An integrated or grab sample is extracted from a single point in the gas stream and analyzed for its components using a Fyrite analyzer, a gas chromatograph, or calibrated continuous analyzers.

Moisture Content

Primary: EPS 1/RM/8 Method D  
Supporting: EPA Method 4

A gas sample is extracted from a single point in the enclosed gas stream being sampled. The moisture is condensed, and its weight measured. This weight, together with the volume of gas sampled, enables the stack gas moisture content to be calculated.

Particulate Matter

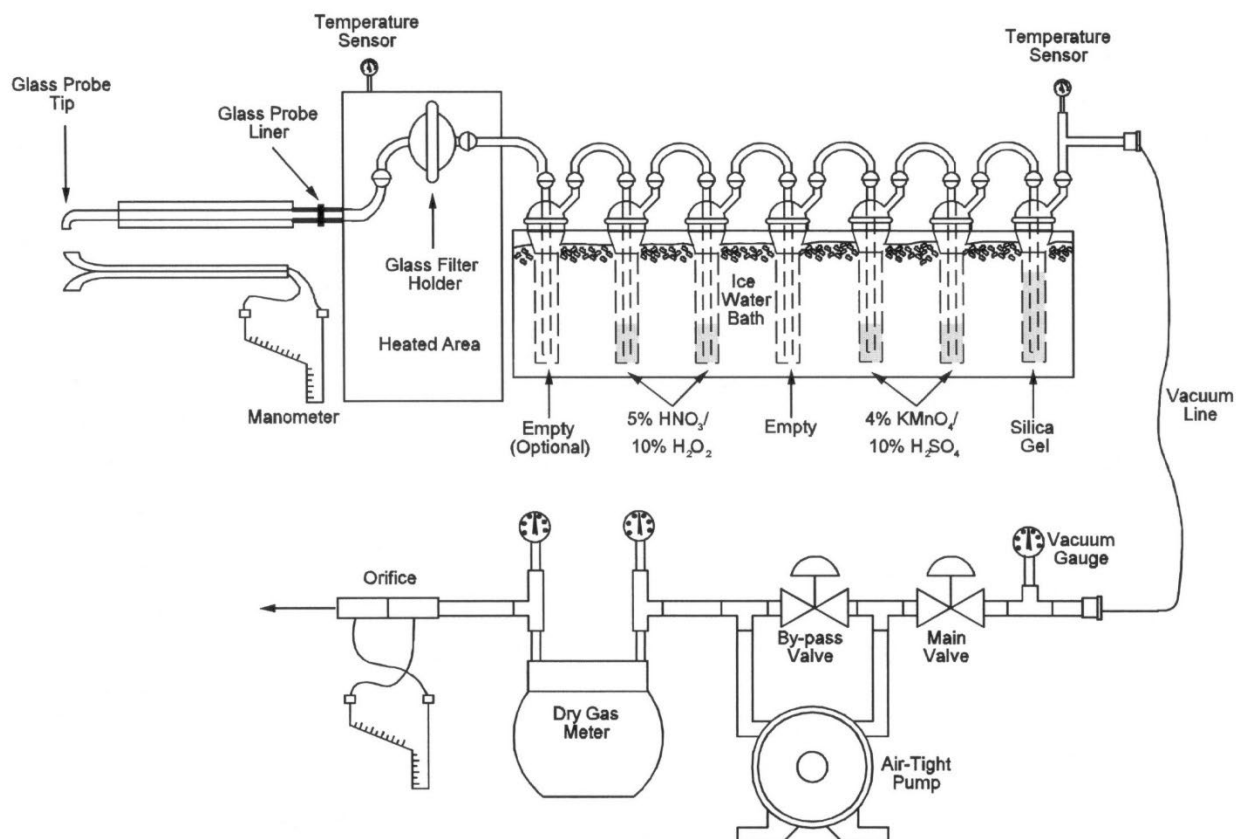
Primary: EPS 1/RM/8 Method E  
Supporting: EPA Method 5

Particulate matter is withdrawn isokinetically from a number of sampling or traverse points in an enclosed gas stream. The particulate sample is collected in the nozzle, probe, and on a glass fibre filter, all maintained at a temperature of  $120 \pm 14^{\circ}\text{C}$  or such other temperature as is necessary to prevent blinding of the filter from condensation. The particulate weight is determined gravimetrically after removal of uncombined water. Simultaneous determinations of the gas stream moisture content, velocity, temperature, and molecular weight allow calculations of the particulate concentration and the particulate mass emission or release rate to be made.

Trace Metal

Primary: EPA Method 29 (modified)

This method is used in conjunction with the above Method 5. A stack sample is withdrawn isokinetically from the source. Particulate emissions are collected in the probe and on a heated filter, and gaseous emissions are then collected in an aqueous acidic solution of hydrogen peroxide (analyzed for all metals including Hg) and an aqueous acidic solution of potassium permanganate (analyzed only for Hg). The recovered samples are digested, and appropriate fractions are analyzed for Hg by cold vapour atomic absorption spectroscopy (CVAAS). The remaining trace metals are analyzed with inductively coupled argon plasma emission spectroscopy (ICAP), atomic absorption spectroscopy (AAS) and graphite furnace atomic absorption spectroscopy (GFAAS). Figure 3 displays the sample train and its configuration.



**Figure 3: Particulate / Trace Metals Sampling Train**

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Hydrogen Fluoride

Primary: EPS 1/RM/1

Supporting: BC Method 7176106 & 7066101

HF is sampled in a four-impinger train consisting of two impingers containing distilled/deionized H<sub>2</sub>O, one empty impinger, and a fourth containing silica gel. A sample of the stack gas is extracted from a single point near the centre of the stack over the sample duration at a constant rate. The collected samples are measured for F by ion chromatography at ALS Environmental in Burnaby, BC.

N<sub>2</sub>O

Primary: N/A

Three N<sub>2</sub>O samples were collected from each source using Viasensor G200 Medical Grade gas analyser, factory calibrated to Nitrous Oxide. The flue gas was introduced to the G200 after passing through a soda lime filter to remove CO<sub>2</sub>. Multiple readings were taken over a one hour period, these readings were averaged on the analyzer and recorded on the data sheet.

Ammonia

Primary: EPA Method CTM-027

The absorbing solution in the first two impingers is 0.1 N H<sub>2</sub>SO<sub>4</sub> and the triplicate samples were extracted at a constant rate for 60-minute durations. The collected samples are analyzed at Element laboratory in Surrey, BC.

Chromium <sup>+6</sup>

Primary: EPA Method 0061

The Method 0061 sampling train (see Fig. 4) was used to collect samples, where all train components were Teflon or borosilicate glass. A small amount of 0.1 N KOH is re-circulated through the probe and first impinger via peristaltic pump. The impinger components were:

**Stack Impingers**

150 ml 0.1 N KOH

75 ml 0.1 N KOH

75 ml 0.1 N KOH

Empty

200 silica gel

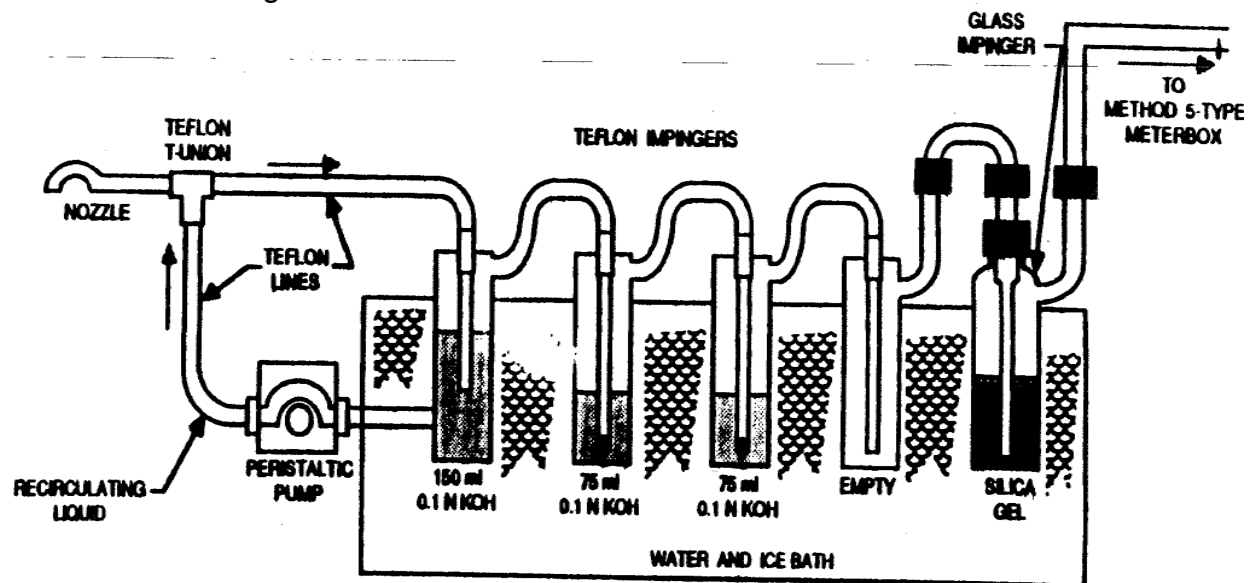


Figure 4: Hexavalent Chromium Sampling Train

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### Method Modifications

Three minor method modifications were instituted for this work.

1. Reagent blanks for metals trains were made to the same volumes as all samples. In other words, exactly 100 ml of the various reagents used to recover samples was NOT done, as some sample components (probe washing for example) required more than 100 ml to adequately clean and rinse the probe. Instead, sample recovery was conducted with however much rinsing was deemed adequate. In the laboratory, the blanks and samples were made up with the appropriate reagent so that all samples and blanks were the same volume.
2. Filter and residue weighing were not conducted with the six-hour interval technique. Instead, the sample filters and beakers were conditioned with cooling and desiccation and then weighed on two separate laboratory scales after 24 hours. Duplicate or triplicate Blank samples were carried through the gravimetric analysis, and the sample results were adjusted with the Blank data to determine the net filter and probe wash residue weight gain. This is the Environment Canada approved modified approach for weighing probe wash residue.
3. For the purposes of calculating a result, all parameters were given the value of  $\frac{1}{2}$  the detection limit when the analysis yielded 'non-detect' results.

All results are expressed using the metric system and corrected to standard conditions of 20 °C and 101.325 kPa, dry gas (unless otherwise noted).

## 2.2 Calculations

The following sections show the equations and define the variables that were used for this survey. The equations are organized in three sections. Equations 1-11 were used to calculate parameter concentration at standard conditions on a dry basis. Equations 12-26 were used to sample within the  $100 \pm 10\%$  isokinetic variation and to confirm that sampling meets this isokinetic variation threshold. Equations 27-29 were used to calculate the volumetric flowrate of the stack flue gas.

### 2.2.1 Parameter Concentration Calculations

$$c = \frac{m}{V_{std}} \quad \text{Equation 1}$$

$$m_{part} = m_{filter} + m_{pw} \quad \text{Equation 2}$$

$$m_i = m_{ana,i} - m_{blank} \quad \text{Equation 3}$$

$$m_{HF} = \frac{20.006}{18.998} (m_F - m_{blank}) / 1000 \quad \text{Equation 4}$$

$$V_{std} = \frac{V_{std(imp)}}{35.315} \quad \text{Equation 5}$$

$$V_{std(imp)} = \frac{V_{samp} \times y \times P_m \times (T_{std} + 459.67)}{P_{std} \times (T_{m(ave)} + 459.67)} \quad \text{Equation 6}$$

$$V_{samp} = V_{final} - V_{init} \quad \text{Equation 7}$$

$$P_m = P_B + \frac{\Delta H_{ave}}{13.6} \quad \text{Equation 8}$$

$$\Delta H_{ave} = \frac{1}{n} \sum_{i=1}^n \Delta H_{i(act)}, \text{ where } n = \text{the number of points} \quad \text{Equation 9}$$

$$OC = \frac{20.9 - \%O_{2c}}{20.9 - \%O_{2m}} \quad \text{Equation 10}$$

$$\%O_{2m} = \frac{1}{n} \sum_{i=1}^n \%O_{2i}, \text{ where } n = \text{the number of } O_2 \text{ measurements} \quad \text{Equation 11}$$

Where,

$c$	= Parameter concentration
$m$	= Parameter mass
$m_i$	= Net analytical mass (mg, ng, or $\mu\text{g}$ )
$m_{ana,i}$	= Analytical mass (mg, ng, or $\mu\text{g}$ )
$m_{blank}$	= Blank analytical mass (mg, ng, or $\mu\text{g}$ )
$m_{part}$	= Total particulate mass (mg)
$m_{filter}$	= Net particulate gain from filter (mg)
$m_{pw}$	= Net particulate gain from probe wash (mg)
$m_{HF}$	= Net mass of HF (mg)
$m_F$	= Net mass of F ( $\mu\text{g}$ )
$V_{std(imp)}$	= Sample volume at standard conditions ( $\text{ft}^3$ )
$V_{std}$	= Sample volume at standard conditions ( $\text{m}^3$ )
$V_{samp}$	= Sample volume at actual conditions ( $\text{ft}^3$ )
$V_{final}$	= Final gas meter reading ( $\text{ft}^3$ )
$V_{init}$	= Initial gas meter reading ( $\text{ft}^3$ )
$T_{std}$	= Standard temperature (68 °F)
$T_m$	= Gas meter temperature (°F)
$T_{m(ave)}$	= Average gas meter temperature (°F)
$P_m$	= Absolute meter pressure (inches of Hg)
$P_B$	= Barometric pressure (inches of Hg)
$P_{std}$	= Standard barometric pressure (29.92 inches of Hg)
$\Delta H_{ave}$	= Average of individual point orifice pressures (inches of $\text{H}_2\text{O}$ )
$\Delta H_{i(act)}$	= Individual recorded point orifice pressures (inches of $\text{H}_2\text{O}$ )
$OC$	= Oxygen correction factor (dimensionless)
$\%O_{2c}$	= Oxygen concentration to correct to (% dry basis)
$\%O_{2i}$	= Individual oxygen measurements (% dry basis)
$\%O_{2m}$	= Average measured stack gas oxygen concentration (% dry basis)

Equation 1 is the general concentration calculation used for all parameters. The mass,  $m$ , is the net analytic mass for the given parameter. For particulate,  $m$  is the sum of the mass contributed from probe washing and filter particulate.

For trace metals and Hg,  $m$  is the blank corrected (Equation 3) analytical result (Appendix 1) for each metals species and run. If the analytical result was below the detection limit, half of the detection limit (DL) was used for  $m$  in Equation 1.

The HF concentration was calculated from analytic results. Equation 4 was used to convert the F mass to HF, and this result was used as  $m$  in equation 1. As with the trace metals, half the detection limit was substituted for results that were non-detectable.

### 2.2.2 Isokinetic Variation Calculations

$$\Delta H_i = \frac{2.62 \times 10^7 \times c_p \times A_n \times (1 - B_{wo}) \times M_D \times (T_m + 459.67) \times \Delta p_i}{k_o \times M_w \times (T_{stk} + 459.67)} \quad \text{Equation 12}$$

$$R_m = 85.49 \times c_p \times \sqrt{\Delta p_i} \times \sqrt{\frac{(T_{stk_i} + 459.67)}{M_w \times P_B}} \times 60 \times A_n \times \frac{(T_{m_i} + 459.67) \times (1 - B_{wo})}{(T_{stk_i} + 459.67) \times y} \quad \text{Equation 13}$$

$$A_n = \pi \left( \frac{d_n}{24} \right)^2 \quad \text{Equation 14}$$

$$M_w = M_D \times (1 - B_{wo}) + 18 \times B_{wo} \quad \text{Equation 15}$$

$$M_D = 0.44 \times \%CO_2 + 0.32 \times \%O_2 + 0.28 \times (100 - \%CO_2 - \%O_2) \quad \text{Equation 16}$$

$$T_{stk} = \frac{1}{n} \sum_{i=1}^n T_{stk_i}, \text{ where } n = \text{the number of points} \quad \text{Equation 17}$$

$$B_{wo} = \frac{V_{cond}}{V_{cond} + V_{std(imp)}} \quad \text{Equation 18}$$

$$V_{cond} = 0.04707 \times V_{gain} \quad \text{Equation 19}$$

$$Iso = \frac{1}{n} \sum_{i=1}^n Iso_i, \text{ where } n = \text{the number of points} \quad \text{Equation 20}$$

$$Iso_i = \frac{v_{nzi}}{v_i} \quad \text{Equation 21}$$

$$v_i = 85.49 \times c_p \times \sqrt{\Delta p_i} \times \sqrt{\frac{(T_{stk_i} + 459.67)}{(P_{stk} \times M_w)}} \quad \text{Equation 22}$$

$$v_{nzi} = \frac{(V_i - V_{i-1}) \times y \times (T_{stk_i} + 459.67) \times (P_B + \frac{\Delta H_{i(act)}}{13.6})}{A_n \times t_i \times 60 \times (T_{m(i)} + 459.67) \times P_{stk} \times (1 - B_{wo})} \quad \text{Equation 23}$$



$$P_{stk} = P_B + \frac{P_g}{13.6} \quad \text{Equation 24}$$

$$v_{stk} = \frac{1}{n} \sum_{i=1}^n v_i, \text{ where } n = \text{the number of points} \quad \text{Equation 25}$$

$$v_{nz} = \frac{1}{n} \sum_{i=1}^n v_{nzi}, \text{ where } n = \text{the number of points} \quad \text{Equation 26}$$

Where,

$A_n$	= Nozzle area (ft <sup>2</sup> )
$d_n$	= Diameter of nozzle (inches)
$c_p$	= Pitot coefficient (dimensionless)
$\Delta p_i$	= Individual point differential pressures (inches of H <sub>2</sub> O)
$T_{stk}$	= Average flue gas temperature (°F), second subscript i, indicates individual point measurements
$T_m$	= Average gas meter temperature (°F), second subscript i, indicates individual point measurements
$k_o$	= Gas meter calibration constant (dimensionless)
$y$	= Gas meter calibration factor (dimensionless)
$\Delta H_{i(act)}$	= Calculated individual point orifice pressures (inches of H <sub>2</sub> O)
$P_g$	= Stack Static pressure (inches of H <sub>2</sub> O)
$P_{stk}$	= Absolute stack pressure (inches of Hg)
$M_w$	= Wet gas molecular weight (g/gmol)
$M_D$	= Dry gas molecular weight (g/gmol)
%CO <sub>2</sub>	= Stack gas carbon dioxide concentration (% dry basis)
%O <sub>2</sub>	= Stack gas oxygen concentration (% dry basis)
$B_{wo}$	= Stack gas water vapour, proportion by volume
$V_i$	= Gas meter reading at individual point(ft <sup>3</sup> )
$t_i$	= Sample time at each point (minutes)
$V_{cond}$	= Total volume of water vapor collected, corrected to standard conditions (ft <sup>3</sup> )
$V_{gain}$	= Condensate gain of impinger contents (mL)
$P_{std}$	= Standard pressure (29.92 inches of Hg)
$v_{stk}$	= Average flue gas velocity (ft/sec)
$v_i$	= Individual point flue gas velocity (ft/sec)
$v_{nz}$	= Average velocity at nozzle(ft/sec)
$v_{nzi}$	= Individual point velocity at nozzle(ft/sec)
$ISO_i$	= Individual point isokinetic variation (%)
$ISO$	= Average isokinetic variation (%)
$R_m$	= Isokinetic sampling rate (ft <sup>3</sup> /min)

### 2.2.3 Volumetric Flowrate Calculations

$$Q_S = Q_A \times \frac{(T_{Std} + 459.67)}{(T_{Stk} + 459.67)} \times \frac{P_{Stk}}{P_{Std}} \quad \text{Equation 27}$$

$$Q_A = \frac{v_{stk} \times 60 \times A_{stk}}{35.315} \quad \text{Equation 28}$$

$$A_{stk} = \pi \left( \frac{d}{24} \right)^2 \quad \text{Equation 29}$$

Where,

$Q_A$  = Actual flowrate ( $\text{Am}^3/\text{min}$ )  
 $Q_S$  = Flowrate ( $\text{m}^3/\text{min}$ ) at standard conditions on a dry basis  
 $A_{stk}$  = Area of stack ( $\text{ft}^2$ )  
 $d$  = Diameter of stack (inches)

### 3 DETAILED TEST RESULTS

The results of stack emissions were calculated using a “STACK” computer program developed by A. Lanfranco and Associates for BC MOE requirements.

Tables 3-14 present the detailed results of all emissions parameters tested and operational conditions for each of the units. Additional data and the computer outputs can be found in the accompanying Appendices.

**Table 3: Unit 1 Summary of Emission Test Results**

Parameter	Run 1	Run 2	Run 3	Average
Test Date - Particulate/Metals	17-Jul-23	19-Jul-23	19-Jul-23	
Test Time - Particulate/Metals	11:15 - 13:16	08:57 - 11:01	11:30 - 13:32	
Duration - Minutes	120	120	120	
Test Date - Acid Gases	19-Jul-23	19-Jul-23	19-Jul-23	
Test Time - Acid Gases	09:35-10:35	10:51-11:51	12:08-13:08	
Duration - Minutes	60	60	60	
Stack Temperature (°C)	145	146	154	148
Average Gas Velocity (m/s)	13.8	13.9	13.9	13.9
Dry Flow Rate (Sm <sup>3</sup> /min)	1197	1173	1159	1176
Moisture (Vol. %)	14.9	17.2	17.1	16.4
Oxygen (Vol. %)(dry basis)	9.8	9.6	10.1	9.8
Carbon Dioxide (Vol. %)(dry basis)	10.0	10.0	10.2	10.1
<b>Particulate</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	1.08	0.34	1.72	<b>1.05</b>
<b>Hydrogen Fluoride</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	0.111	0.078	0.081	<b>0.090</b>
<b>Ammonia</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	1.43	2.40	2.85	<b>2.22</b>
<b>Nitrous Oxide</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )*	0.16	4.83	0.17	<b>1.72</b>
<b>Total Hydrocarbons</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	4.01	3.10	2.82	<b>3.31</b>
<b>Trace Metals - Operational Certificate List (mg/Sm<sup>3</sup> @ 11% O<sub>2</sub>)</b>				
<b>OC Class</b> (Pb, As and Cr)	0.00216	0.00199	0.00852	<b>0.00422</b>
<b>Aluminum</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	0.01815	0.00626	0.00660	0.01034
<b>Cadmium</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	0.00022	0.00016	0.00008	0.00016
<b>Lead</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	0.00048	0.00047	0.00049	0.00048
<b>Mercury</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	0.00005	0.00001	0.00001	0.00002
<b>Phosphorus</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	0.00127	0.00078	0.00033	0.00080
Isokinetic Variation ( % )	103	105	105	105

\*N<sub>2</sub>O was sampled on July 19, 2023

All data is corrected to standard conditions (S) of 20 °C, 101.325 kPa (dry) unless otherwise noted.

**Table 4: Unit 1 Trace Metals Emissions (OC Class)**

<b>Metal</b>	<b>Test 1</b> (mg/m <sup>3</sup> @ 11% O <sub>2</sub> )	<b>Test 2</b> (mg/m <sup>3</sup> @ 11% O <sub>2</sub> )	<b>Test 3</b> (mg/m <sup>3</sup> @ 11% O <sub>2</sub> )	<b>Average</b> (mg/m <sup>3</sup> @ 11% O <sub>2</sub> )
<b>OC Class</b>				
Pb	0.00048	0.00047	0.00049	0.00048
As	0.00032	0.00031	0.00033	0.00032
Cr	0.00136	0.00120	0.00769	0.00342
Sum of OC Class	0.00216	0.00199	0.00852	0.00422
<b>Other</b>				
Al	0.01815	0.00626	0.00660	0.01034
Cd	0.00022	0.00016	0.00008	0.00016
P	0.00127	0.00078	0.00033	0.00080
Hg	0.00005	0.00001	0.00001	0.00002

All data is corrected to standard conditions (S) of 20 °C, 101.325 kPa (dry) unless otherwise noted.

**Table 5: Unit 1 Detailed Trace Metals Emissions**

<b>Metal</b>	<b>Test 1</b> (mg/m <sup>3</sup> @ 11% O <sub>2</sub> )	<b>Test 2</b> (mg/m <sup>3</sup> @ 11% O <sub>2</sub> )	<b>Test 3</b> (mg/m <sup>3</sup> @ 11% O <sub>2</sub> )	<b>Average</b> (mg/m <sup>3</sup> @ 11% O <sub>2</sub> )
Pb	0.00048	0.00047	0.00049	0.00048
Sb	0.00080	0.00078	0.00082	0.00080
Cu	0.00036	0.00016	0.00008	0.00020
Mn	0.00446	0.00094	0.00079	0.00206
V	0.00032	0.00047	0.00033	0.00037
Zn	0.00589	0.00106	0.00188	0.00295
As	0.00032	0.00031	0.00033	0.00032
Cr	0.00136	0.00120	0.00769	0.00342
Co	0.00008	0.00026	0.00008	0.00014
Ni	0.00162	0.00150	0.00439	0.00251
Se	0.00030	0.00047	0.00398	0.00158
Te	0.00064	0.00063	0.00066	0.00064
Tl	0.00048	0.00070	0.00229	0.00116
Cd	0.00022	0.00016	0.00008	0.00016
Hg	0.00005	0.00001	0.00001	0.00002

All data is corrected to standard conditions (S) of 20 °C, 101.325 kPa (dry) unless otherwise noted.

**Table 6: Unit 1 - Summary of Operating Data**

Parameter		Run 1	Run 2	Run 3	Normal
Test Date - Particulate/Metals		17-Jul-23	19-Jul-23	19-Jul-23	
Test Time - Particulate/Metals		11:15 - 13:16	08:57 - 11:01	11:30 - 13:32	
Boiler Steam Production	(kg/h)	33995	33999	34028	36750
Percentage of normal	(%)	93%	93%	93%	
Boiler Secondary Combustion Zone Temp	(°C)	910	935	938	936
Percentage of normal	(%)	97%	100%	100%	
Rate of refuse fired	(tonnes/hr)	10.0	10.0	10.0	10
Percentage of normal	(%)	100%	100%	100%	
Rate of aux. fuel fired (Natural Gas)	m <sup>3</sup> /hr	170	0	0	257
Percentage of normal (%)	(%)	66%	0%	0%	

\*Normal refers to the average operating rate from the previous 30 days

**Table 7: Unit 2 Summary of Emission Test Results**

Parameter	Run 1	Run 2	Run 3	Average
Test Date - Particulate/Metals	18-Jul-23	18-Jul-23	18-Jul-23	
Test Time - Particulate/Metals	09:50 - 11:52	12:28 - 14:29	14:50 - 15:52	
Duration - Minutes	120	120	120	
Test Date - Acid Gases	18-Jul-23	18-Jul-23	18-Jul-23	
Test Time - Acid Gases	10:42-11:42	12:28 - 13:28	13:44-14:44	
Duration - Minutes	60	60	60	
Stack Temperature (°C)	150	151	149	150
Average Gas Velocity (m/s)	13.6	13.3	13.7	13.5
Dry Flow Rate (Sm <sup>3</sup> /min)	1147	1110	1156	1138
Moisture (Vol. %)	16.9	18.0	17.1	17.3
Oxygen (Vol. %)(dry basis)	10.1	8.6	9.8	9.5
Carbon Dioxide (Vol. %)(dry basis)	9.9	11.2	10.2	10.4
<b>Particulate</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	0.60	0.53	0.27	<b>0.47</b>
<b>Hydrogen Fluoride</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	0.078	0.098	0.093	<b>0.089</b>
<b>Ammonia</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	2.44	3.11	2.83	<b>2.79</b>
<b>Nitrous Oxide</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )*	0.17	0.15	0.16	<b>0.16</b>
<b>Total Hydrocarbons</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	5.51	2.90	2.58	<b>3.67</b>
<b>Trace Metals - Operational Certificate List (mg/Sm<sup>3</sup> @ 11% O<sub>2</sub>)</b>				
<b>OC Class</b> (Pb, As and Cr)	0.00780	0.00196	0.00334	<b>0.00437</b>
<b>Aluminum</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	0.00832	0.00282	0.00641	0.00585
<b>Cadmium</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	0.00008	0.00008	0.00008	0.00008
<b>Lead</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	0.00121	0.00086	0.00048	0.00085
<b>Mercury</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	0.00007	0.00004	0.00006	0.00006
<b>Phosphorus</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	0.00166	0.00078	0.00352	0.00199
Isokinetic Variation ( % )	105	107	106	106

\*N<sub>2</sub>O was sampled on July 18, 2023

All data is corrected to standard conditions (S) of 20 °C, 101.325 kPa (dry) unless otherwise noted.

**Table 8: Unit 2 Trace Metals Emissions (OC Class)**

<b>Metal</b>	<b>Test 1</b> (mg/m <sup>3</sup> @ 11% O <sub>2</sub> )	<b>Test 2</b> (mg/m <sup>3</sup> @ 11% O <sub>2</sub> )	<b>Test 3</b> (mg/m <sup>3</sup> @ 11% O <sub>2</sub> )	<b>Average</b> (mg/m <sup>3</sup> @ 11% O <sub>2</sub> )
<b>OC Class</b>				
Pb	0.0012	0.0009	0.0005	0.0009
As	0.0003	0.0003	0.0012	0.0006
Cr	0.0063	0.0008	0.0017	0.0029
Sum of OC Class	0.0078	0.0020	0.0033	0.0044
<b>Other</b>				
Al	0.00832	0.00282	0.00641	0.0059
Cd	0.00008	0.00008	0.00008	0.0001
P	0.00166	0.00078	0.00352	0.0020
Hg	0.00007	0.00004	0.00006	0.0001

All data is corrected to standard conditions (S) of 20 °C, 101.325 kPa (dry) unless otherwise noted.

**Table 9: Unit 2 Detailed Trace Metals Emissions**

<b>Metal</b>	<b>Test 1</b> (mg/m <sup>3</sup> @ 11% O <sub>2</sub> )	<b>Test 2</b> (mg/m <sup>3</sup> @ 11% O <sub>2</sub> )	<b>Test 3</b> (mg/m <sup>3</sup> @ 11% O <sub>2</sub> )	<b>Average</b> (mg/m <sup>3</sup> @ 11% O <sub>2</sub> )
Pb	0.00121	0.00086	0.00048	0.00085
Sb	0.00083	0.00228	0.00104	0.00138
Cu	0.00037	0.00008	0.00036	0.00027
Mn	0.00040	0.00072	0.00051	0.00054
V	0.00050	0.00047	0.00032	0.00043
Zn	0.00186	0.00179	0.00144	0.00170
As	0.00033	0.00031	0.00119	0.00061
Cr	0.00626	0.00078	0.00167	0.00290
Co	0.00014	0.00008	0.00014	0.00012
Ni	0.00113	0.00138	0.00141	0.00131
Se	0.00050	0.00240	0.00226	0.00172
Te	0.00067	0.00201	0.00103	0.00123
Tl	0.00050	0.00086	0.00048	0.00061
Cd	0.00008	0.00008	0.00008	0.00008
Hg	0.00007	0.00004	0.00006	0.00006

All data is corrected to standard conditions (S) of 20 °C, 101.325 kPa (dry) unless otherwise noted.

**Table 10: Unit 2 - Summary of Operating Data**

Parameter		Run 1	Run 2	Run 3	Normal
<b>Test Date - Particulate/Metals</b>		18-Jul-23	18-Jul-23	18-Jul-23	
<b>Test Time - Particulate/Metals</b>		09:50 - 11:52	12:28 - 14:29	14:50 - 15:52	
<b>Boiler Steam Production</b>	<b>(kg/h)</b>	32000	32000	32000	34160
<b>Percentage of normal</b>	<b>(%)</b>	94%	94%	94%	
<b>Boiler Secondary Combustion Zone Temp</b>	<b>(°C)</b>	919	914	918	935
<b>Percentage of normal</b>	<b>(%)</b>	98%	98%	98%	
<b>Rate of refuse fired</b>	<b>(tonnes/hr)</b>	10.0	10.0	10.0	10.0
<b>Percentage of normal</b>	<b>(%)</b>	100%	100%	100%	
<b>Rate of aux. fuel fired (Natural Gas)</b>	<b>m<sup>3</sup>/hr</b>	80	80	2.1	84
<b>Percentage of normal (%)</b>	<b>(%)</b>	95%	95%	3%	

\*Normal refers to the average operating rate from the previous 30 days



**Table 11: Unit 3 Summary of Emission Test Results**

Parameter	Run 1	Run 2	Run 3	Average
Test Date - Particulate/Metals	19-Jul-23	20-Jul-23	20-Jul-23	
Test Time - Particulate/Metals	10:20 - 12:23	09:17 - 11:18	11:45 - 13:46	
Duration - Minutes	120	120	120	
Test Date - Acid Gases	20-Jul-23	20-Jul-23	20-Jul-23	
Test Time - Acid Gases	10:10-11:10	11:35-12:35	12:45-13:45	
Duration - Minutes	60	60	60	
Stack Temperature (°C)	154	153	158	155
Average Gas Velocity (m/s)	13.5	13.4	13.2	13.4
Dry Flow Rate (Sm <sup>3</sup> /min)	1153	1162	1093	1136
Moisture (Vol. %)	15.1	14.1	16.9	15.4
Oxygen (Vol. %)(dry basis)	9.5	9.9	9.3	9.6
Carbon Dioxide (Vol. %)(dry basis)	10.7	10.1	10.6	10.4
<b>Particulate</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	0.23	0.03	0.07	<b>0.11</b>
<b>Hydrogen Fluoride</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	0.067	0.070	0.063	<b>0.067</b>
<b>Ammonia</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	6.95	3.82	3.21	<b>4.66</b>
<b>Nitrous Oxide</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )*	0.16	0.16	0.16	<b>0.16</b>
<b>Total Hydrocarbons</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	2.63	2.90	2.87	<b>2.80</b>
<b>Hexavalent Chromium</b> (mg/Sm <sup>3</sup> @11% O <sub>2</sub> )**	0.00017	0.00017	0.00017	<b>0.00017</b>
<b>Trace Metals - Operational Certificate List (mg/Sm<sup>3</sup> @ 11% O<sub>2</sub>)</b>				
<b>OC Class</b> (Pb, As and Cr)	0.00175	0.00170	0.00187	<b>0.00177</b>
<b>Aluminum</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	0.00652	0.00406	0.00532	0.00530
<b>Cadmium</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	0.00014	0.00008	0.00017	0.00013
<b>Lead</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	0.00049	0.00051	0.00050	0.00050
<b>Mercury</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	0.00005	0.00004	0.00005	0.00005
<b>Phosphorus</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )	0.00163	0.00169	0.00498	0.00277
<b>Hexavalent Chromium</b> (mg/Sm <sup>3</sup> @ 11% O <sub>2</sub> )*	0.00017	0.00017	0.00017	0.00017
Isokinetic Variation ( % )	104	102	105	104

\*N<sub>2</sub>O was sampled on July 20, 2023

\*\*Hexavalent Chromium was sampled on July 25-26, 2023

All data is corrected to standard conditions (S) of 20 °C, 101.325 kPa (dry) unless otherwise noted.

**Table 12: Unit 3 Trace Metals Emissions (OC Class)**

<b>Metal</b>	<b>Test 1</b> (mg/m <sup>3</sup> @ 11% O <sub>2</sub> )	<b>Test 2</b> (mg/m <sup>3</sup> @ 11% O <sub>2</sub> )	<b>Test 3</b> (mg/m <sup>3</sup> @ 11% O <sub>2</sub> )	<b>Average</b> (mg/m <sup>3</sup> @ 11% O <sub>2</sub> )
<b>OC Class</b>				
Pb	0.00049	0.00051	0.00050	0.00050
As	0.00046	0.00051	0.00033	0.00043
Cr	0.00081	0.00068	0.00104	0.00084
Sum of OC Class	0.00175	0.00170	0.00187	0.00177
<b>Other</b>				
Al	0.00652	0.00406	0.00532	0.0053
Cd	0.00014	0.00008	0.00017	0.0001
P	0.00163	0.00169	0.00498	0.0028
Hg	0.00005	0.00004	0.00005	0.0000

All data is corrected to standard conditions (S) of 20 °C, 101.325 kPa (dry) unless otherwise noted.

**Table 13: Unit 3 Detailed Trace Metals Emissions**

<b>Metal</b>	<b>Test 1</b> (mg/m <sup>3</sup> @ 11% O <sub>2</sub> )	<b>Test 2</b> (mg/m <sup>3</sup> @ 11% O <sub>2</sub> )	<b>Test 3</b> (mg/m <sup>3</sup> @ 11% O <sub>2</sub> )	<b>Average</b> (mg/m <sup>3</sup> @ 11% O <sub>2</sub> )
Pb	0.00049	0.00051	0.00050	0.00050
Sb	0.00081	0.00085	0.00083	0.00083
Cu	0.00069	0.00089	0.00008	0.00055
Mn	0.00059	0.00051	0.00047	0.00052
V	0.00033	0.00034	0.00033	0.00033
Zn	0.00453	0.00288	0.00359	0.00366
As	0.00046	0.00051	0.00033	0.00043
Cr	0.00081	0.00068	0.00104	0.00084
Co	0.00017	0.00008	0.00008	0.00011
Ni	0.00274	0.00129	0.00140	0.00181
Se	0.00049	0.00130	0.00228	0.00136
Te	0.00101	0.00014	0.00066	0.00060
Tl	0.00049	0.00327	0.00081	0.00152
Cd	0.00014	0.00008	0.00017	0.00013
Hg	0.00005	0.00004	0.00005	0.00005

All data is corrected to standard conditions (S) of 20 °C, 101.325 kPa (dry) unless otherwise noted.

**Table 14: Unit 3 - Summary of Operating Data**

Parameter		Run 1	Run 2	Run 3	Normal
Test Date - Particulate/Metals		19-Jul-23	20-Jul-23	20-Jul-23	
Test Time - Particulate/Metals		10:20 - 12:23	09:17 - 11:18	11:45 - 13:46	
Boiler Steam Production	(kg/h)	35000	35000	34115	36580
Percentage of normal	(%)	96%	96%	93%	
Boiler Secondary Combustion Zone Temp	(°C)	910	910	890	919
Percentage of normal	(%)	99%	99%	97%	
Rate of refuse fired	(tonnes/hr)	10.0	10.0	10.0	10.0
Percentage of normal	(%)	100%	100%	100%	
Rate of aux. fuel fired (Natural Gas)	m³/hr	80	84	85	88
Percentage of normal (%)	(%)	91%	95%	97%	

\*Normal refers to the average operating rate from the previous 30 days

Parameter		Run 1	Run 2	Run 3	Normal
Test Date - Hexavalent Chromium		25-Jul-23	26-Jul-23	26-Jul-23	
Test Time - Hexavalent Chromium		10:00 - 12:02	09:22 - 11:24	12:08 - 14:09	
Boiler Steam Production	(kg/h)	35000	35000	34115	36580
Percentage of normal	(%)	96%	96%	93%	
Boiler Secondary Combustion Zone Temp	(°C)	910	910	890	919
Percentage of normal	(%)	99%	99%	97%	
Rate of refuse fired	(tonnes/hr)	10.0	10.0	10.0	10.0
Percentage of normal	(%)	100%	100%	100%	
Rate of aux. fuel fired (Natural Gas)	m³/hr	80	84	85	88
Percentage of normal (%)	(%)	91%	95%	97%	

\*Normal refers to the average operating rate from the previous 30 days

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## 4 DISCUSSION

All Units are in compliance with limits as set out in the OC.

This survey meets the third quarter requirements and includes the annual test for hexavalent chromium. This year, Unit 3 was chosen for the hexavalent chromium testing.

After successful completion of Unit 1 testing on July 17, the Boiler throughput was not representative or normal conditions. Therefore, testing was not performed on July 18, but was completed on July 19 when throughput returned to a representative state.

As stated in Section 2.1, EPA Method 5/29 was modified slightly to accommodate performance based analytical protocols utilized in B.C. for trace metals sampling and analysis. The analytical modification consists of using volumes of recovery reagents different than the method stipulates. In order to validate (ie performance-based QA) the modification, sample Blanks and all samples were made up to the same volume, so that subtraction of the Blank data, was done on equivalent sample sizes. In addition, special Hg spiking of blank filters and peroxide solutions was conducted. This spiking is referred to as a “matrix spike” and is reported in Appendix B, Quality Control for mercury, where the recovery of spiked mercury was calculated to be an acceptable 85 to 115%. It should be noted that independent front half/back half analysis of all trace metals was conducted for this survey. In addition, individual quartz filter blanks were analyzed for each unit.

Sampling was conducted in accordance with their respective reference methods (EPA 29 except as discussed) and passed all appropriate quality assurance and quality control criteria. None of the sample points on any of the three units were outside of the allowable +/- 10% for isokinetic rate.

All sampling was conducted/supervised by certified emission testing personnel, using calibrated source sampling equipment and quality-controlled reagents. It is therefore

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stated that the survey and this report complies with the MV's WTEF compliance testing requirements for this third survey in 2023.