

# FICHTNER

Consulting Engineers Limited



## Margam Green Energy Plant



### Margam Green Energy Limited

IC3 Commissioning Performance Report

## Document approval

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# 1 Introduction

## 1.1 Background

An Environmental Permit (EP) (Ref: EPR/DP3137EG) for the operation of the Margam Green Energy Plant, (the Facility) was granted to Margam Green Energy Limited (MGEL) by Natural Resource Wales on 20 November 2014. Construction of the Facility commenced on 23 January 2015. Commissioning was commenced on 22 May 2018 and was completed on 20 June 2019.

The EP includes several Pre-Operational and Improvement Conditions. Improvement condition 3 (IC3) requires the following to be complete within 4 months of the completion of commissioning:

*"The Operator shall submit a written report to Natural Resource Wales for approval on the commissioning of the installation. The report shall summarise the environmental performance of the plant as installed against the design parameters set out in the Application. The report shall also include a review of the performance of the Facility against the conditions of this permit and details of procedures developed during commissioning for achieving and demonstrating compliance with permit conditions."*

Fichtner Consulting Engineers Ltd ("Fichtner") has been engaged by MGEL to produce a report summarising the environmental performance data of the Facility to demonstrate compliance with conditions of the permit during the commissioning phase of the Facility.

## 1.2 Objective

Within this report the performance of the Facility has been summarised in accordance with IC3.

The emission limit values (ELVs) specified in schedule 3, table S3.1 are presented in Table 1.

Table 1: Point source emissions to air - emission limits and monitoring requirements

Pollutant	Reference period	Emission limit (mg / Nm <sup>3</sup> )
Dust (fine particulate matter)	Half-hourly average	45
	Daily average	15
Total organic carbon (TOC)	Half-hourly average	30
	Daily average	15
Hydrogen chloride	Half-hourly average	90
	Daily average	15
Hydrogen fluoride	Half-hourly average	6
	Daily average	1.5
Carbon monoxide	Half hourly average	150
	Daily average	75
Sulphur dioxide	Half hourly average	300
	Daily average	75
Nitrogen oxides (NO and NO <sub>2</sub> expressed as NO <sub>2</sub> )	Half hourly average	600
	Daily average	300

<b>Pollutant</b>	<b>Reference period</b>	<b>Emission limit (mg / Nm<sup>3</sup>)</b>
Cadmium and thallium and their compounds (total)	Periodic (minimum 30 minutes, maximum 8-hour period)	0.05
Mercury and its compounds	Periodic (minimum 30 minutes, maximum 8-hour period)	0.05
Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V and their compounds (total)	Periodic (minimum 30 minutes, maximum 8-hour period)	0.5
Dioxins / furans (I-TEQ)	Periodic (minimum 30 minutes, maximum 8-hour period)	0.1 ng/Nm <sup>3</sup>

## 2 Conclusions

The data from the CEMS system, recorded during the commissioning period, has been validated in accordance with requirements of condition 3.5 of the EP. Additionally, periodic extractive monitoring data has been obtained for the first year of operation. The data has been presented in a graphical format to present the performance of the Facility in relation to the half-hourly and daily emission limits specified in Table S3.1 of the EP.

MGEL gained a better understanding of operation of the Facility through the commissioning process, as demonstrated by the emissions monitoring data, summarised in section 4. The Facility complies with the emission limits for continuously monitored and periodically monitored species, except for a limited number of total organic carbon and carbon monoxide exceedances. For all monitored pollutants the number of ELV exceedances in 2019 was lower than 2018. Except for a limited number of half-hourly and daily ELV exceedances for total organic carbon and carbon monoxide, there were no exceedances of daily or half-hourly ELV's during the final 4 weeks of commissioning. MGEL is identifying the root-cause of these exceedances and implementing corrective actions to prevent re-occurrence.

## 3 Emissions monitoring and application of confidence intervals

### 3.1 Continuous Monitoring

The emissions data was recorded using the continuous emission measurement system (CEMS) for the Facility. The CEMS records point source emissions at reference point A1, which is stack shown on the site plan (schedule 7).

#### 3.1.1 Half-hourly data processing and validation

The half-hourly emission monitoring data as recorded by the CEMS has been collated in accordance with condition 3.5.5 (Monitoring) of the EP, which describes the following requirements:

*“Valid half-hourly average values shall be determined within the effective operating time (excluding the start-up and shut-down periods) from the measured values having subtracted the value of the confidence intervals...”*

*“Where...data are not available for a complete half-hour period, the half-hourly average shall...be considered valid if measurements are available for a minimum of 20 minutes during the half-hour period. The number of half-hourly averages so validated shall not exceed 5 per day.”*

Emissions of nitrous oxide (N<sub>2</sub>O) and ammonia (NH<sub>3</sub>) have also been recorded; however, the EP contains no ELVs or confidence intervals for these pollutants, and so the recorded concentrations from the CEMS have not been considered within this report. All negative readings were treated as ‘invalid’ readings.

#### 3.1.2 Daily data validation

The daily average CEMS data has been processed to comply with condition 3 of the EP, which states that:

*“The values of the 95% confidence intervals of a single measured result at the daily emission limit value shall not exceed the following percentages:”*

<i>Carbon monoxide</i>	<i>10%</i>
<i>Sulphur dioxide</i>	<i>20%</i>
<i>Oxides of nitrogen (NO &amp; NO<sub>2</sub> expressed as NO<sub>2</sub>)</i>	<i>20%</i>
<i>Particulate matter</i>	<i>30%</i>
<i>Total organic carbon (TOC)</i>	<i>30%</i>
<i>Hydrogen chloride</i>	<i>40%</i>

*“Daily average values shall be determined as the average of all the valid half-hourly average values within a calendar day.”*

*“No more than ten daily average values per year shall be determined not to be valid.”*

### 3.2 Periodic Monitoring

The emission limits as presented in Schedule 3 of the EP for periodic monitoring are presented in Table 2.

Table 2: Pollutants listed in the EP to start monitoring post-handover

Pollutant	Reference period	Emission limit (mg / Nm <sup>3</sup> unless stated)
Cadmium and thallium and their compounds (total)	Periodic (minimum 30 minutes, maximum 8-hour period)	0.05
Mercury and its compounds	Periodic (minimum 30 minutes, maximum 8-hour period)	0.05
Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V and their compounds (total)	Periodic (minimum 30 minutes, maximum 8-hour period)	0.5
Dioxins / furans (I-TEQ)	Periodic (minimum 30 minutes, maximum 8-hour period)	0.1 ng/Nm <sup>3</sup>

Fichtner has been informed by MGEL that monitoring for these pollutants was not undertaken during the commissioning period. Stack emission testing was undertaken by Environmental Compliance Limited (ECL) in Q3 and Q4 of 2020 and in Q1 and Q2 of 2021 in accordance with the requirements of Table S3.1 of the EP. The monitoring results from each report have been collated and are detailed in section 5.2.

## 4 Continuous emissions monitoring system results

Commissioning of the Facility concluded on 20 June 2019, and commercial operation began after this date. Data from the CEMS for the period 22 May 2018 to 20 June 2019 has been reviewed to demonstrate with compliance with the emission limits stated in the EP.

Summaries of the monitoring data by pollutant are provided in the following sections, including comment on periods where half-hourly or daily average readings exceeded the respective ELVs

### 4.1 Particulate matter

Charts showing the performance of the Facility in accordance with the half-hourly and daily ELV's for particulate matter (dust) during the commissioning period are presented in Figure 1 (2018) and Figure 2 (2019).

Figure 1: Monitored particulate matter emissions for 2018

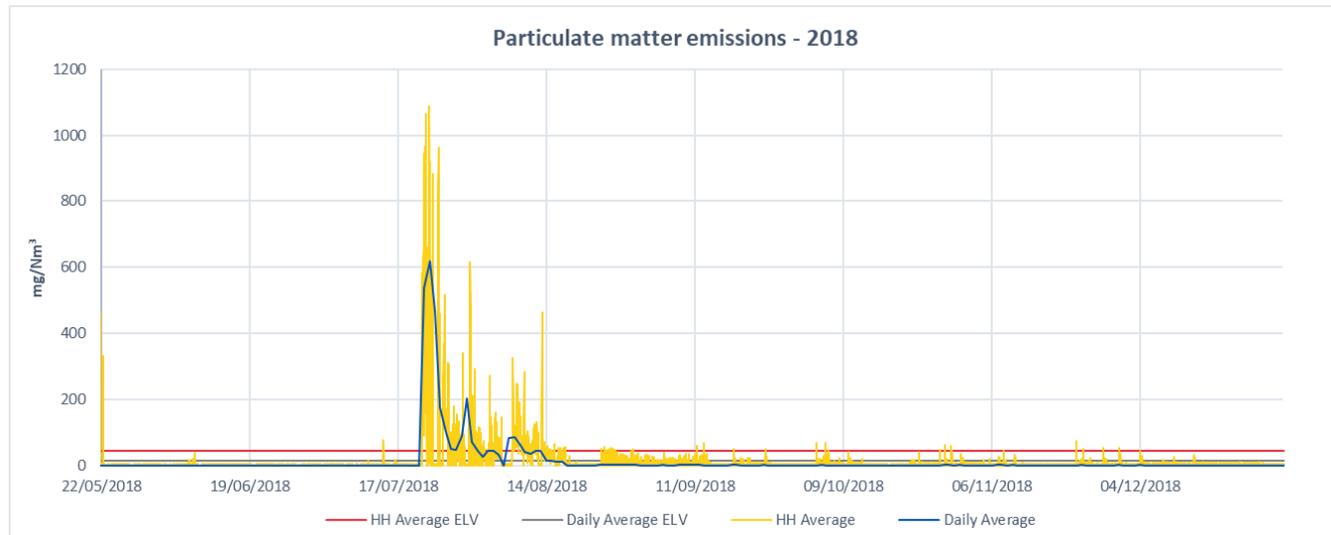
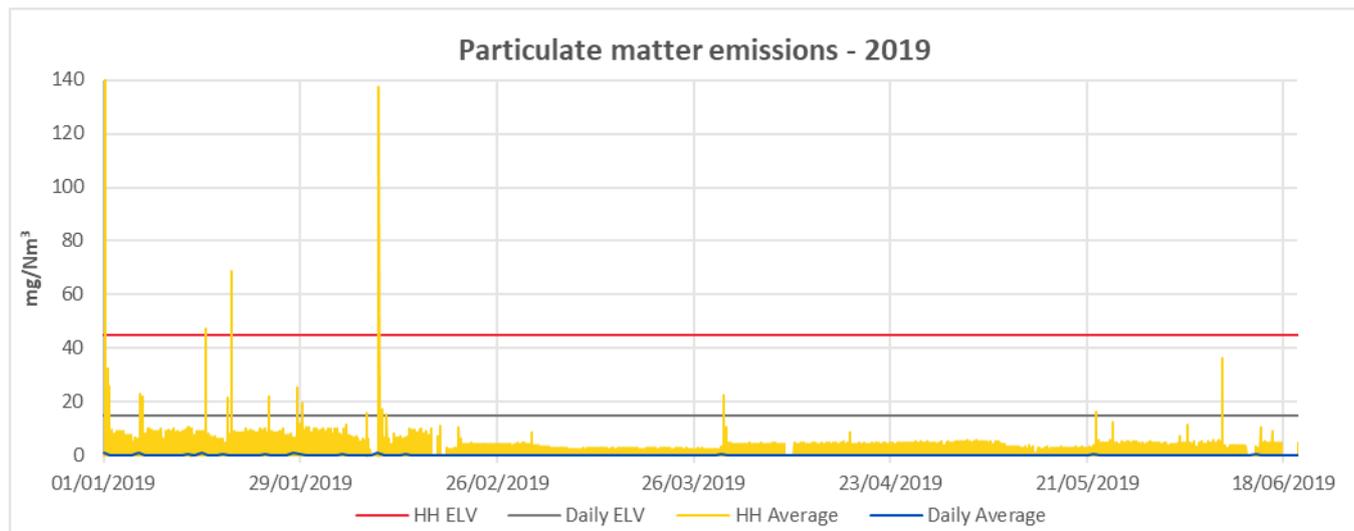


Figure 2: Monitored particulate matter emissions for 2019



In 2018, during July and August, there was a number of instances where the half hourly and daily ELV for particulates were exceeded (Figure 1). A total of 555 exceedances of the half-hourly ELV occurred in 2018. In 2019 there were fewer exceedances of the half-hourly ELV and no exceedances of the daily ELV as the Facility progressed through commissioning, shown in Figure 2. The half-hourly ELV was exceeded 4 times during commissioning in 2019. There were no exceedances of the dust ELV during the final 4 weeks of commissioning.

### 4.2 Total organic carbon

Charts showing the performance of the Facility in accordance with the half-hourly and daily emission limits for TOC are presented in Figure 3 (2018) and Figure 4 (2019).

Figure 3: Monitored TOC emissions for 2018

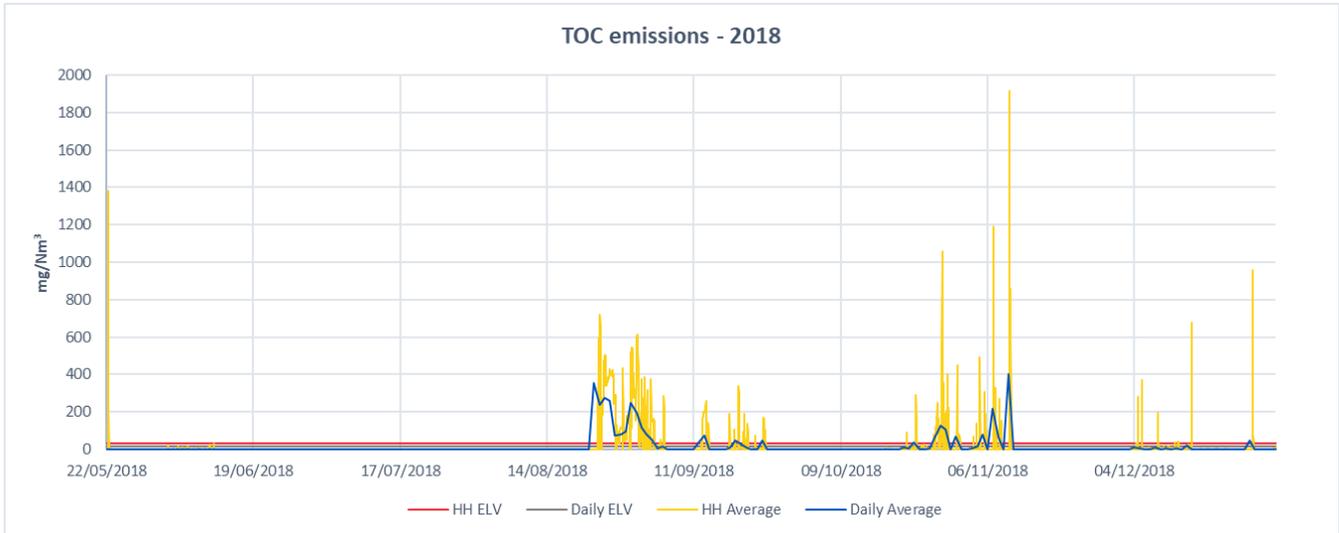
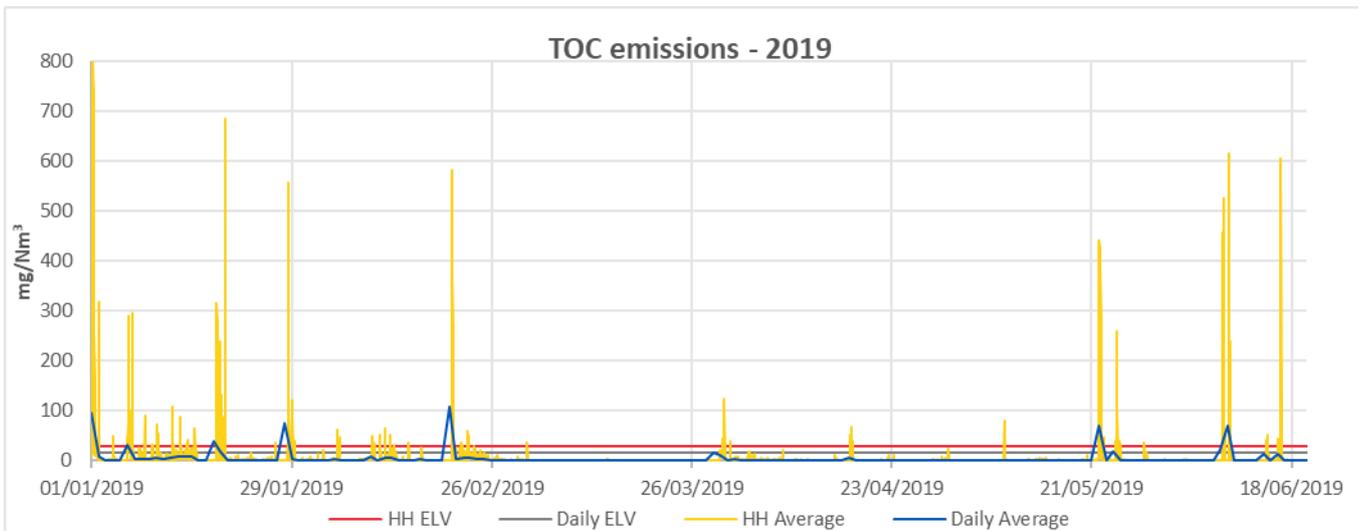


Figure 4: Monitored TOC emissions for 2019



In 2018 802 exceedances of the half-hourly ELV and 26 exceedances of the daily ELV for TOC occurred (Figure 3). In 2019 there were 188 exceedances of the half-hourly ELV and 7 exceedances of the daily ELV as the Facility progressed throughout commissioning, shown in Figure 4..

### 4.3 Hydrogen chloride

Charts showing the performance of the Facility in accordance with the half-hourly and daily emission limits for hydrogen chloride are presented in Figure 5 (2018) and Figure 6 (2019).

Figure 5: Monitored HCl emissions for 2018

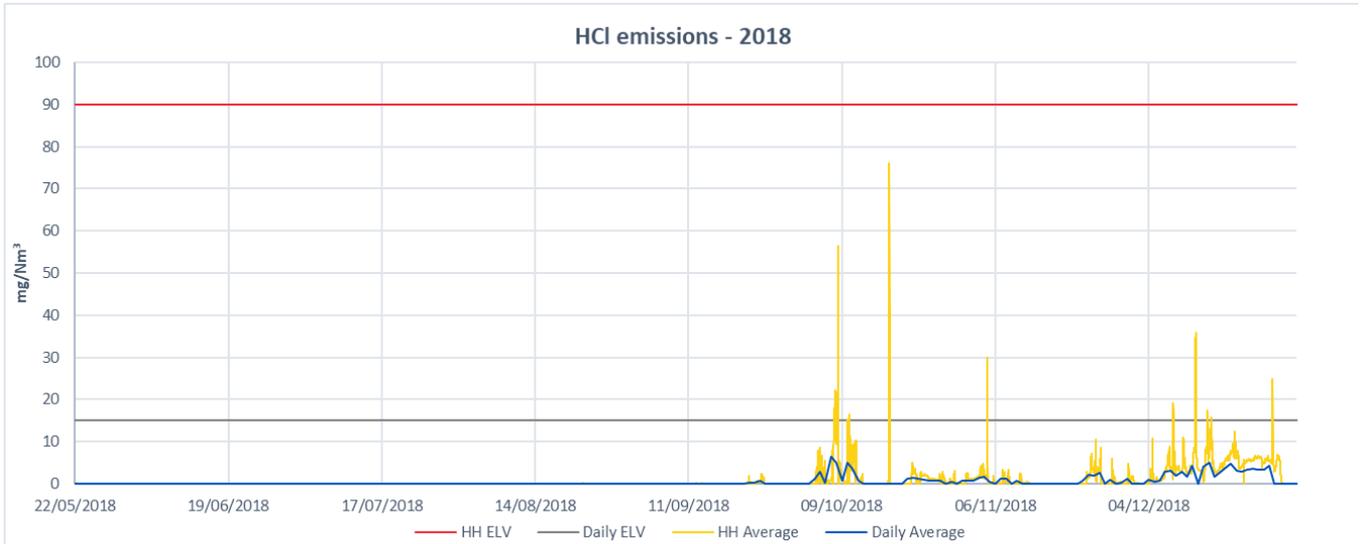
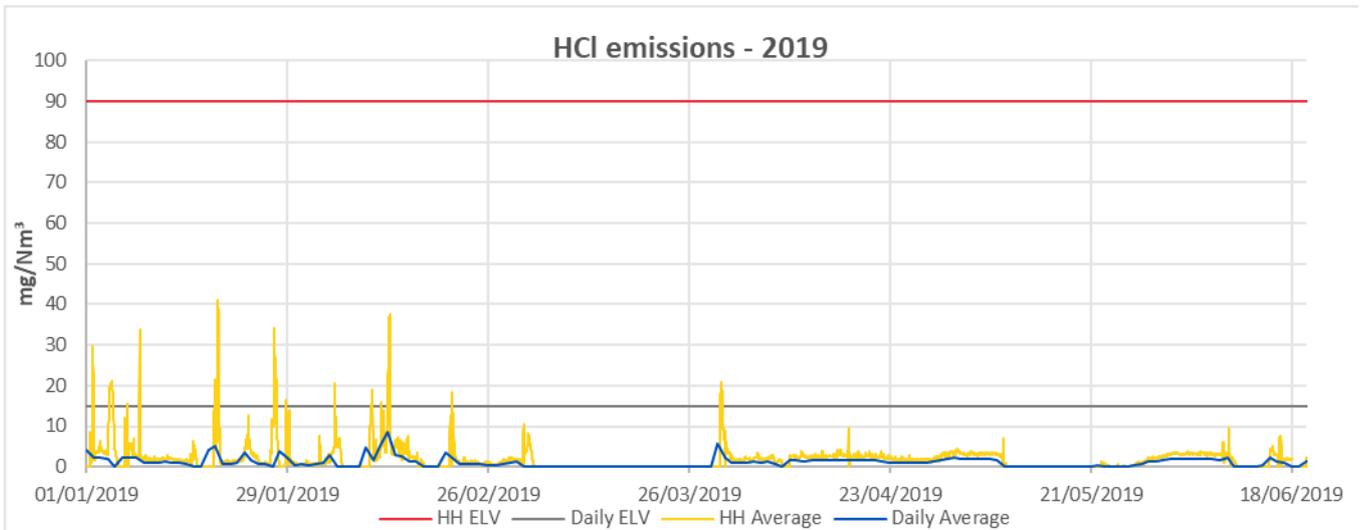


Figure 6: Monitored HCl emissions for 2019



The CEMS data, presented in Figure 5 and Figure 6, shows that the Facility operated within the HCl ELVs for all validated half-hourly and daily periods throughout the commissioning period.

### 4.4 Hydrogen fluoride

Charts showing the performance of the Facility in accordance with the half-hourly and daily emission limits for hydrogen fluoride are presented in Figure 7 (2018) and Figure 8 (2019).

Figure 7: Monitored HF emissions for 2018

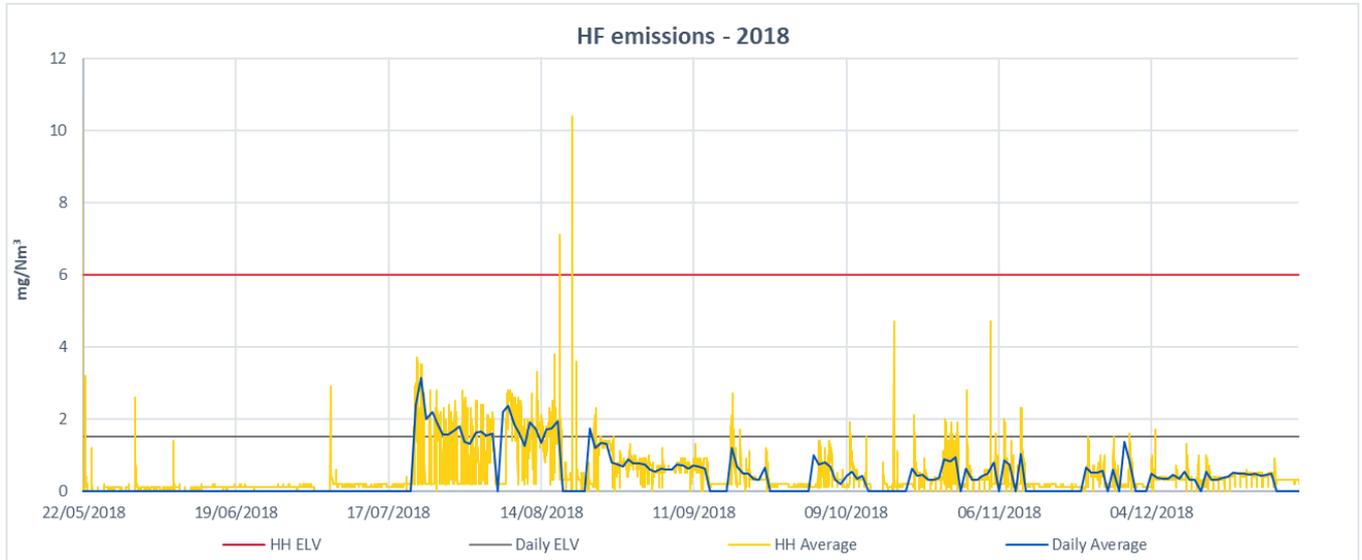
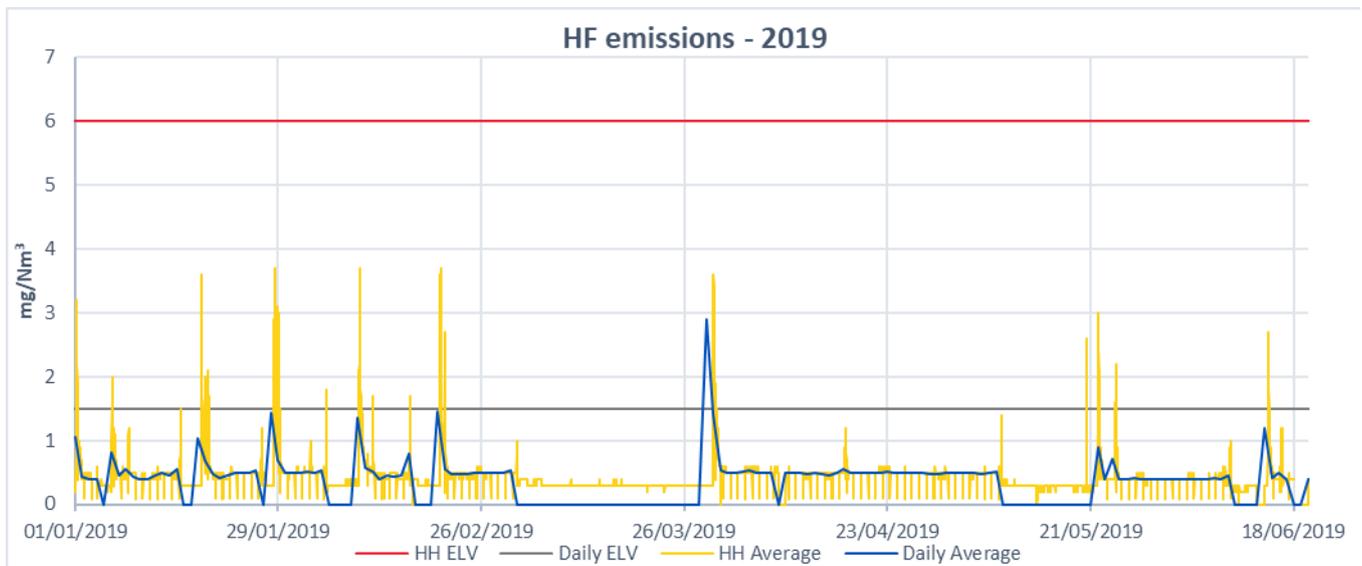


Figure 8: Monitored HF emissions for 2019



In 2018 3 exceedances of the half-hourly ELV and 23 exceedances of the daily ELV for HF occurred (Figure 7). In 2019 there were no half-hourly ELV exceedances and fewer exceedances of the daily as the Facility progressed through commissioning, shown in Figure 8. The daily ELV for HF was exceeded once during 2019. There were no exceedances of the HF ELVs during the final 4 weeks of commissioning.

### 4.5 Carbon monoxide

Charts showing the performance of the Facility in accordance with the half-hourly and daily emission limits for carbon monoxide are presented in Figure 9 (2018) and Figure 10 (2019).

Figure 9: Monitored CO emissions for 2018

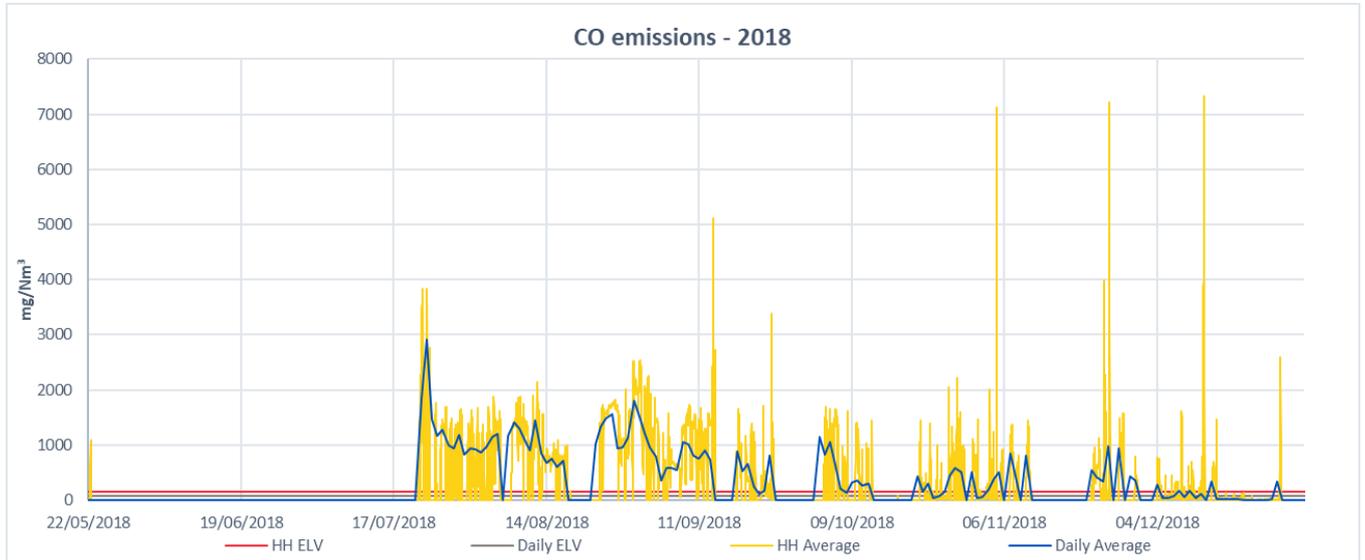
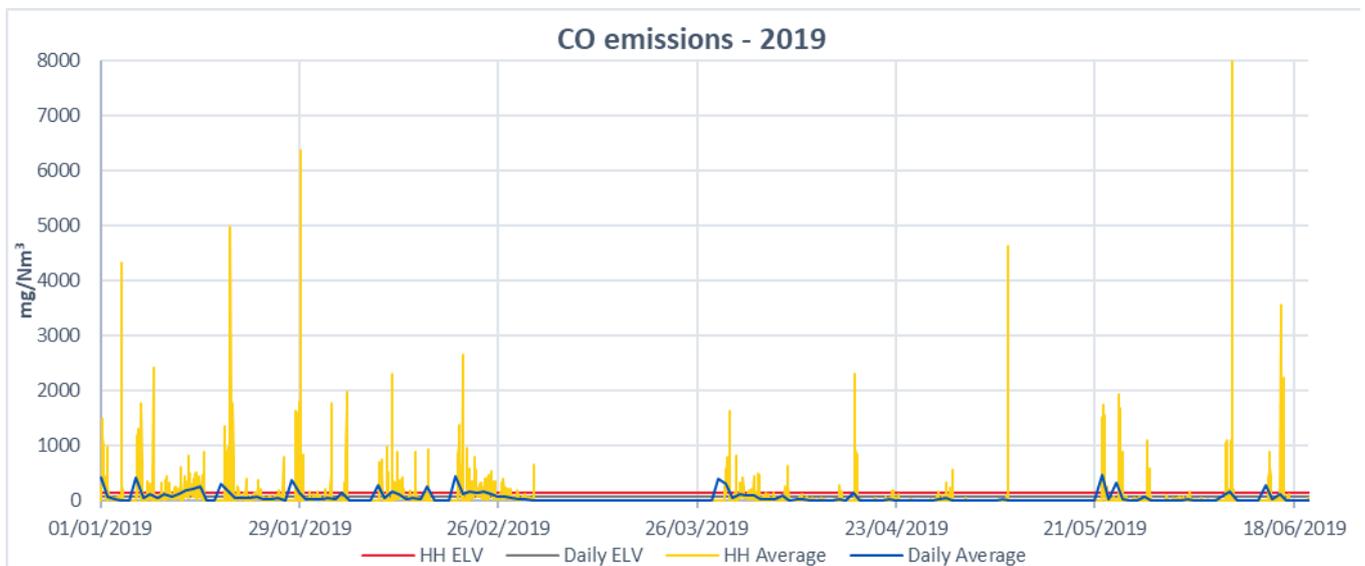


Figure 10: Monitored CO emissions for 2019



In 2018 2,880 exceedances of the half-hourly ELV and 93 exceedances of the daily ELV for CO occurred (Figure 9). In 2019 there were fewer ELV exceedances as the Facility progressed through the commissioning stage, shown in Figure 10. There were 702 exceedances of the half-hourly ELV and 40 exceedances of the daily ELV for CO in 2019. During the final 4 weeks of commissioning there were 6 exceedances of the daily ELV

### 4.6 Sulphur dioxide

Charts showing the performance of the Facility in accordance with the half-hourly and daily emission limits for sulphur dioxide are presented in Figure 11 (2018) and Figure 12 (2019).

Figure 11: Monitored SO<sub>2</sub> emissions for 2018

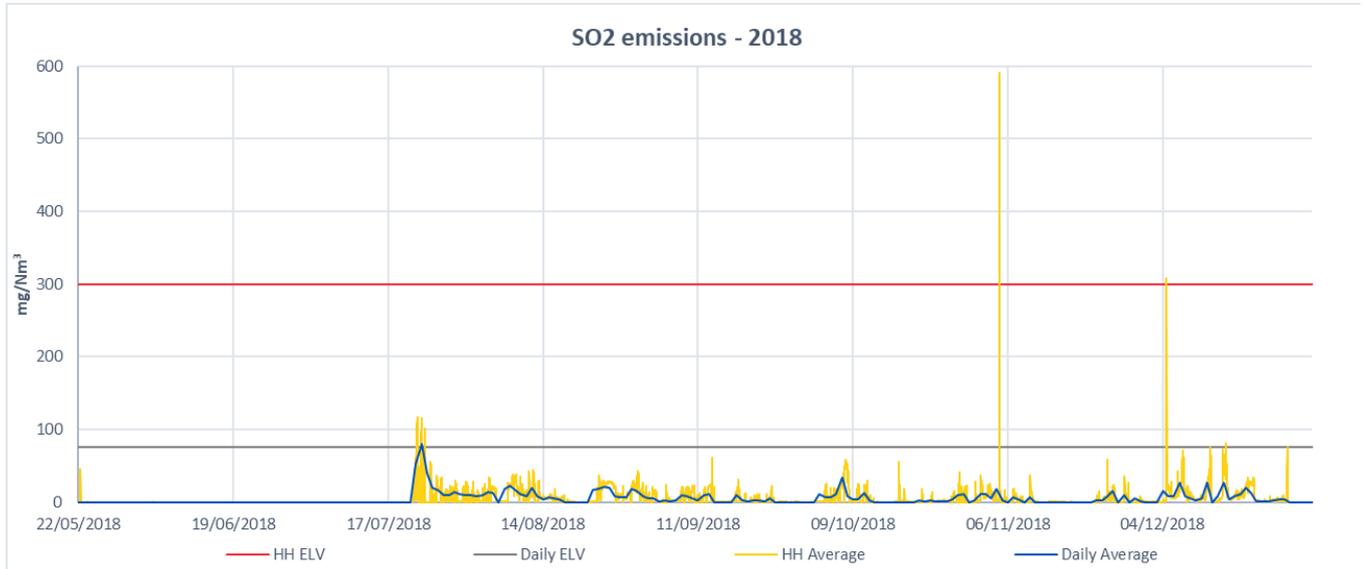
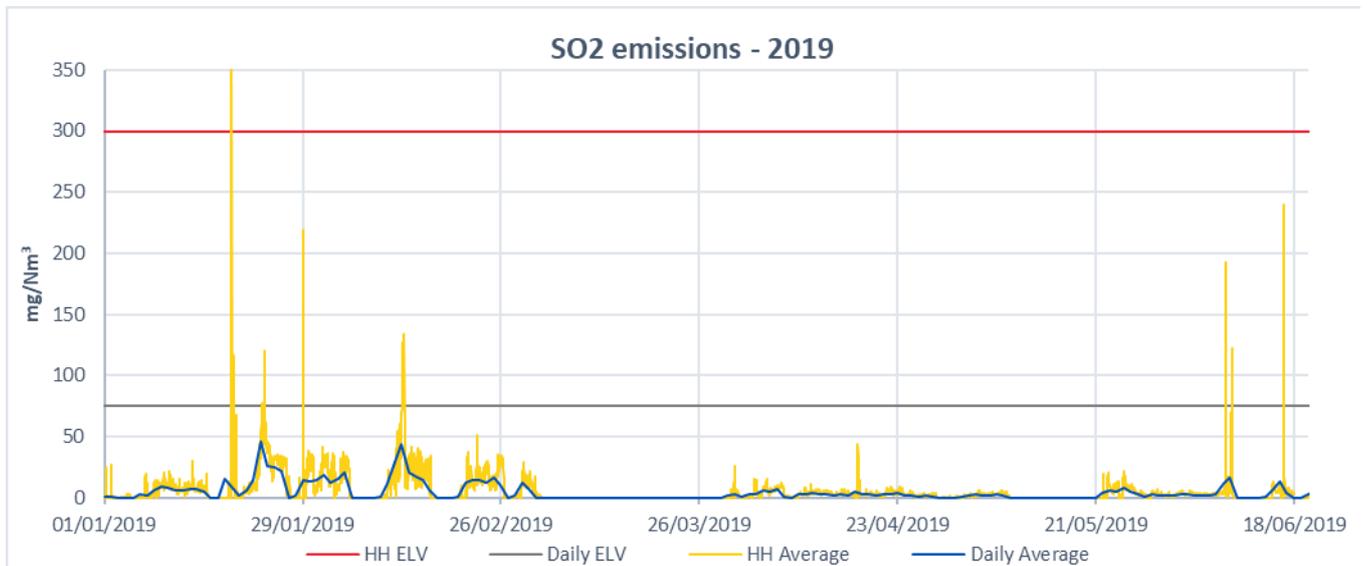


Figure 12: Monitored SO<sub>2</sub> emissions for 2019



In 2018 2 exceedances of the half-hourly ELV and 1 exceedance of the daily ELV occurred for SO<sub>2</sub> (Figure 11). In 2019 there were fewer exceedances of the ELV as the Facility progressed through commissioning, shown in Figure 12. There was 1 half-hourly ELV exceedance in 2019. There were no exceedances of the SO<sub>2</sub> ELV during the final 4 weeks of commissioning.

### 4.7 Oxides of nitrogen

Charts showing the performance of the Facility in accordance with the half-hourly and daily emission limits of oxides of nitrogen (NO<sub>2</sub> and NO expressed as NO<sub>2</sub>) are presented in Figure 13 (2018) and Figure 14 (2019).

Figure 13: Monitored NOx emissions for 2018

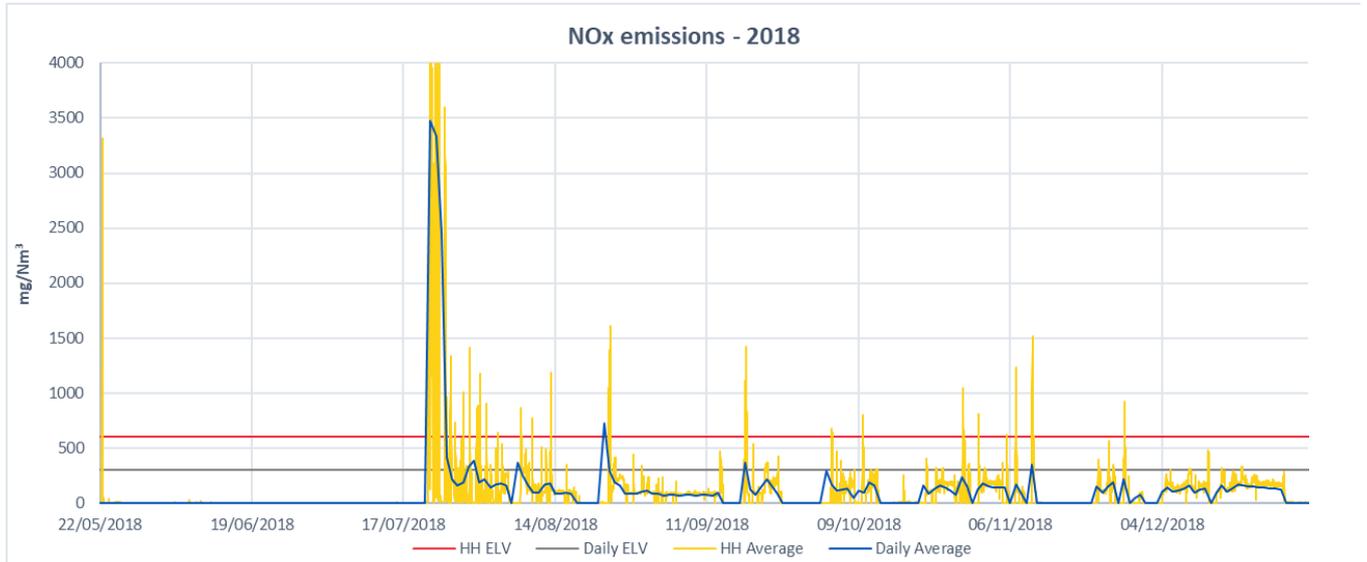
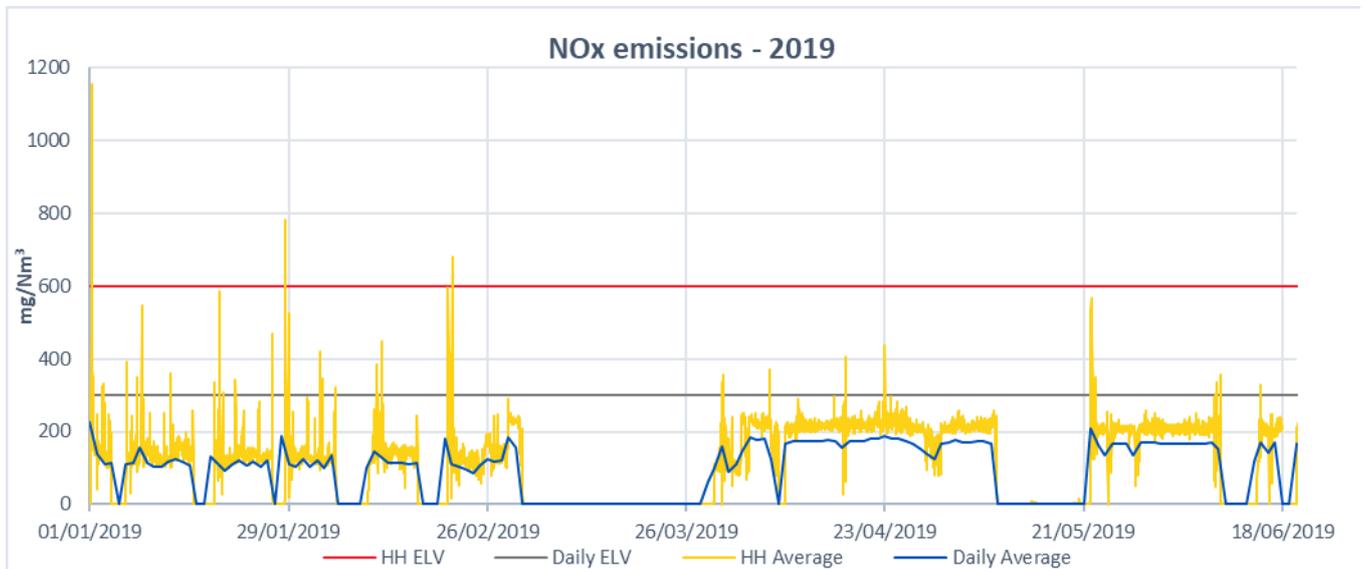


Figure 14: Monitored NOx emissions for 2019



In 2018 207 exceedances of the half-hourly ELV and 10 exceedances of the daily ELV for NOx occurred (Figure 13). In 2019 there were fewer exceedances of the ELV as the Facility progressed through commissioning, shown in Figure 14. There were 10 exceedances of the half-hourly ELV in 2019. Of the 10 exceedances of the half-hourly ELV in 2019, 8 were on 1<sup>st</sup> January. There were no exceedances of the NOx ELVs during the final 4 weeks of commissioning.

## 4.8 Summary of monitoring data

The number of instances where the ELVs were exceeded during commissioning of the Facility are summarised in Table 3.

Table 3: ELV exceedances by pollutant

Pollutant	Daily		Half-Hourly	
	2018	2019	2018	2019
Dust (fine particulate matter)	23	0	555	4
Total organic carbon (TOC)	26	7	802	188
Hydrogen chloride	0	0	0	0
Hydrogen fluoride	23	1	3	0
Carbon monoxide	93	40	2880	702
Sulphur dioxide	1	0	2	1
Nitrogen oxides (NO and NO <sub>2</sub> expressed as NO <sub>2</sub> )	10	0	207	10

For each pollutant monitored there was a reduction in the number of exceedances of the ELV's between the 2018 commissioning months and the 2019 commissioning months. There were no exceedances of the ELV for the following pollutants during the final 4 weeks of commissioning (24 May – 20 June 2019):

1. Dust (fine particulate matter)
2. Hydrogen chloride
3. Hydrogen fluoride
4. Sulphur dioxide
5. Nitrogen oxides (NO and NO<sub>2</sub> expressed as NO<sub>2</sub>)

## 4.9 Data quality and data capture

For the purposes of this report, MGEL provided two sets of CEMS data – set A and set B. These represent two different monitors at the same point on the plant and the B recorder is used as a backup in the event of the A recorder failing. CEMS A data has been used as the primary data source. However, the CEMS A data contains occasional negative readings which have been treated as erroneous. Where these negative readings arose the values from the CEMS B data have been used for the relevant time period.

## 5 Periodic extractive monitoring results

### 5.1 Data processing

The monitoring requirements as detailed in Schedule 3 of the EP are presented in Table 1. As shown, the following pollutants are required to be monitored periodically to demonstrate compliance with the ELVs stated in the EP:

- Cadmium & thallium and their compounds (total) (Cd + Tl);
- Mercury and its compounds;
- Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V (heavy metals) and their compounds (total); and
- Dioxins / furans (collectively referred to as dioxins), as I-TEQ.

The EP requires that monitoring of these pollutants is undertaken quarterly in the first year of operation, and bi-annually thereafter.

Stack emission testing was undertaken by Environmental Compliance Limited (ECL) in Q3 and Q4 of 2020 and in Q1 and Q2 of 2021.

### 5.2 Results

The results from the periodic monitoring have been collated from the monitoring reports and are presented in Table 4.

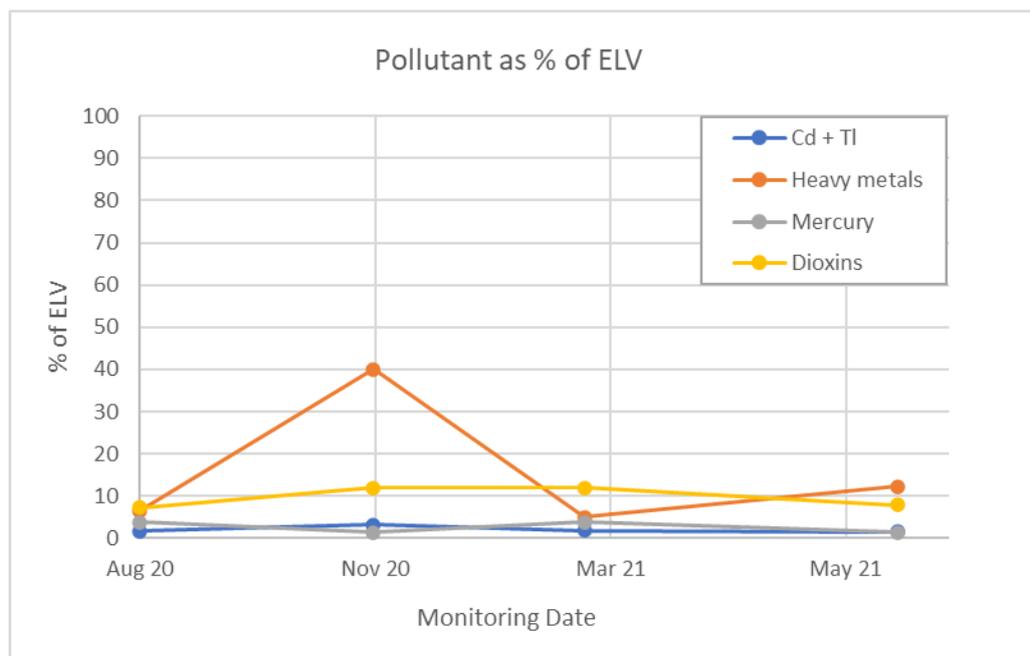
Table 4: Periodic Stack Emission Testing

Pollutant	Units	ELV	Q3 2020	Q4 2020	Q1 2021	Q2 2021
Cd + Tl	mg/Nm <sup>3</sup>	0.05	0.00083	0.00088	0.0016	0.0010
Heavy metals	mg/Nm <sup>3</sup>	0.5	0.033	0.062	0.2	0.035
Mercury	mg/Nm <sup>3</sup>	0.05	0.0019	0.0013	0.00069	0.00088
Dioxins	ng/Nm <sup>3</sup>	0.1	0.0073	0.0028	0.012	0.037

Notes:  
All emissions concentrations are presented at 6% oxygen standard reference conditions for temperature and pressure.

As shown from the periodic emission testing, the monitored concentrations of pollutants are well below the ELVs within the EP. Figure 15 shows the monitoring results for all pollutants monitored periodically as a percentage of the ELV within the EP.

Figure 15: Stack emission monitoring results



As shown in Figure 15, from the data available the Facility has complied with the ELVs for the pollutants that are required to be monitored periodically. During this period all measured emission concentrations have been less than 20% of the ELVs, with the exception of one heavy metals result which was approximately 40% of the ELV.

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