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Ref: Environmental Permit EPR/BK6483IU/V003

Date: 06/10/2014

Dear Lara,

With reference to our meeting on the 23rd July regarding investigating CO emissions on the ST2 melt process, please find attached an interim report.

If you have any queries, please do not hesitate to contact me.

Yours sincerely,

Keith Martin
Senior Engineer
Facilities and Environment

Enc: Interim Report on Melt Furnace Baghouse ST2 CO Emissions

ECF

Interim Report on Melt Furnace Baghouse ST2 CO Emissions

TMUK discussed the issue of achieving lower CO emissions from ST2 stack with NRW on the 23rd July and requested a derogation of the permit ELV whilst investigations were made to understand our process. NRW responded on the 11th August with permission to investigate the ST2 melt process and monitor emissions.

Initial Investigations

From 24th September to 26th September, five operating shifts were monitored for combustion gas emissions, with emphasis on CO. The monitoring was conducted in accordance with MCERTS requirements and across each entire shift. Process data was collected during the shift to support investigations.

The first four shifts collected baseline data:

Table 1.

Date	Shift	Time	Monitoring
24th	Day	0730 – 1600	Standard production dayshift baseline
24th	Night	2030 – 0500	Standard production nightshift baseline
25th	Day	0730 – 1600	Standard production dayshift baseline
25th	Night	2030 – 0500	Standard production nightshift baseline

Standard production = 1.5t furnace + 2.5t furnace + 1.0t furnace melting virgin + tolled + recovered swarf + all internal scrap types.

The fifth shift was used to start the investigation work and stress the process, under the agreement with NRW, by forcing a known problem.

Table 2.

Date	Shift	Time	Monitoring
26th	Day	0730 - 1600	Problem force – override metal charge frequency timer to allow quicker fill of melt tower.

Monitoring and Reporting Periods

As monitoring was conducted across a whole shift, any averaging period could be chosen for reporting. The following times were chosen:

1. Full shift average.
2. Maximum value from a rolling 1 hour average.
3. Maximum value from a rolling 4 hour average.

The current permit condition requires a 1 hour average, but does not specify which hour or a rolling average. A previous permit condition required a 4 hour average.

Results

The results from the baseline monitoring of a standard production shifts are as follows:

Table 3.

Date	Shift	CO mg/m3			NOx mg/m3		
		Shift avg	Max 1 hr avg	Max 4 hr avg	Shift avg	Max 1 hr avg	Max 4 hr avg
24th	Day	17.4	39	24	21.8	35	24
24th	Night	36.4	122	70	18.2	25	22
25th	Day	22.4	52	34	17.6	25	19
25th	Night	36.6	137	70	17.6	23	21

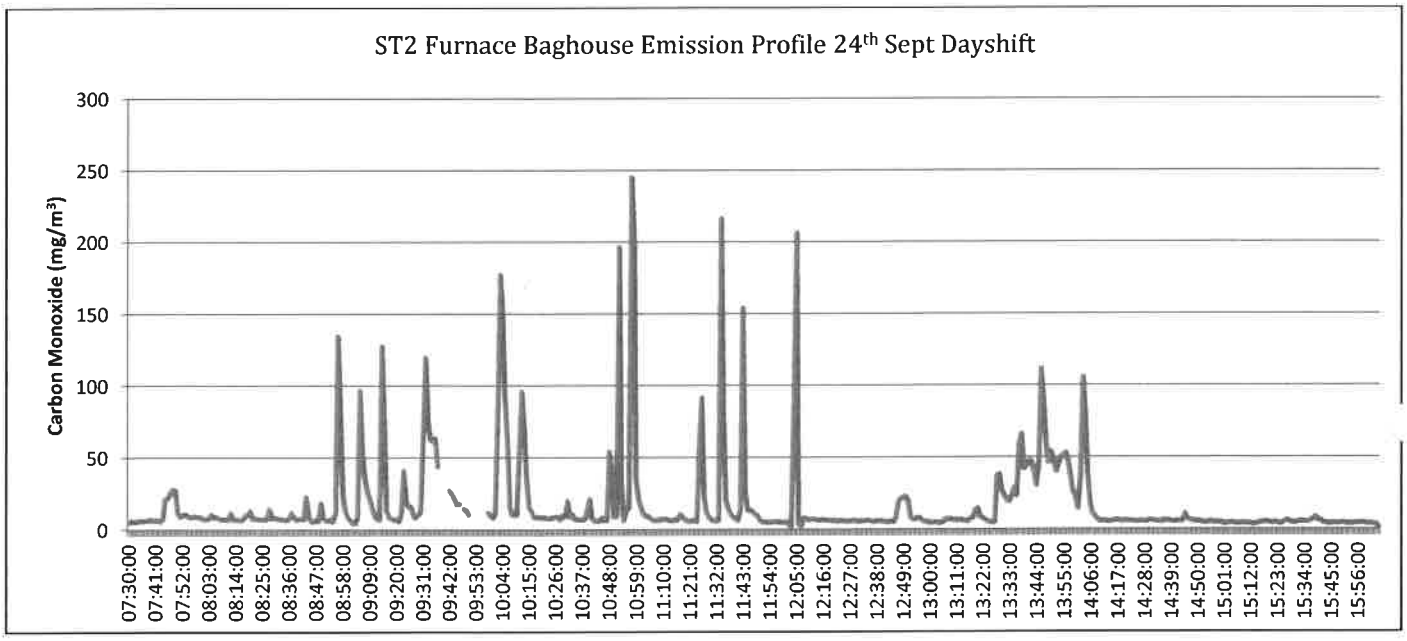
All results are compliant with the permit ELVs of 150 mg/m3 for CO and 100 mg/m3 for NOx, regardless of the averaging period used. However, there are significant differences between the maximum 1 hour average, maximum 4 hour average and the full shift average. This is to be expected once the melt operation is understood.

Typically, the melt towers will be loaded at the start of shift as quickly as possible, reducing energy demand as the exhaust gases from the furnace melt burners pre-heat the cold metal stacked in the tower awaiting melting. Therefore, a typical shift will see loading concentrated in the morning, with less melt activity in the second half of the shift. During loading the melt burners will be on high fire, with the hearth, holding and pot heater burners operating also. Without loading, the melt burners will turn off and the aluminium is held molten reading for draw off by the holding burners.

Every charge into the melt tower will see a corresponding peak in CO emissions. This is thought to be due to burner flame disturbance and/or flame chilling leading to incomplete combustion of the gas fuel. Therefore, a standard shift will see CO emissions peak periodically in the first half of the shift and reduce in the second half of the shift, mirroring metal loading. A charge timer interlock restricts loading to every 7 – 10 minutes, preventing the tower from being packed too quickly (with corresponding high CO emissions) but still allowing good heat recovery.

The current permit requirement of a 1 hour averaging period is not representative of emissions over the whole shift and could show either a higher result if readings are taken in the first half of the shift, or a lower result if readings are taken in the last half of the shift. For instance, if the minimum 1 hour average is taken (rather than the maximum shown in Table 3), the result would be 3.0 – 4.0 mg/m3 over the baseline shifts. This is significantly less than any of the other averages.

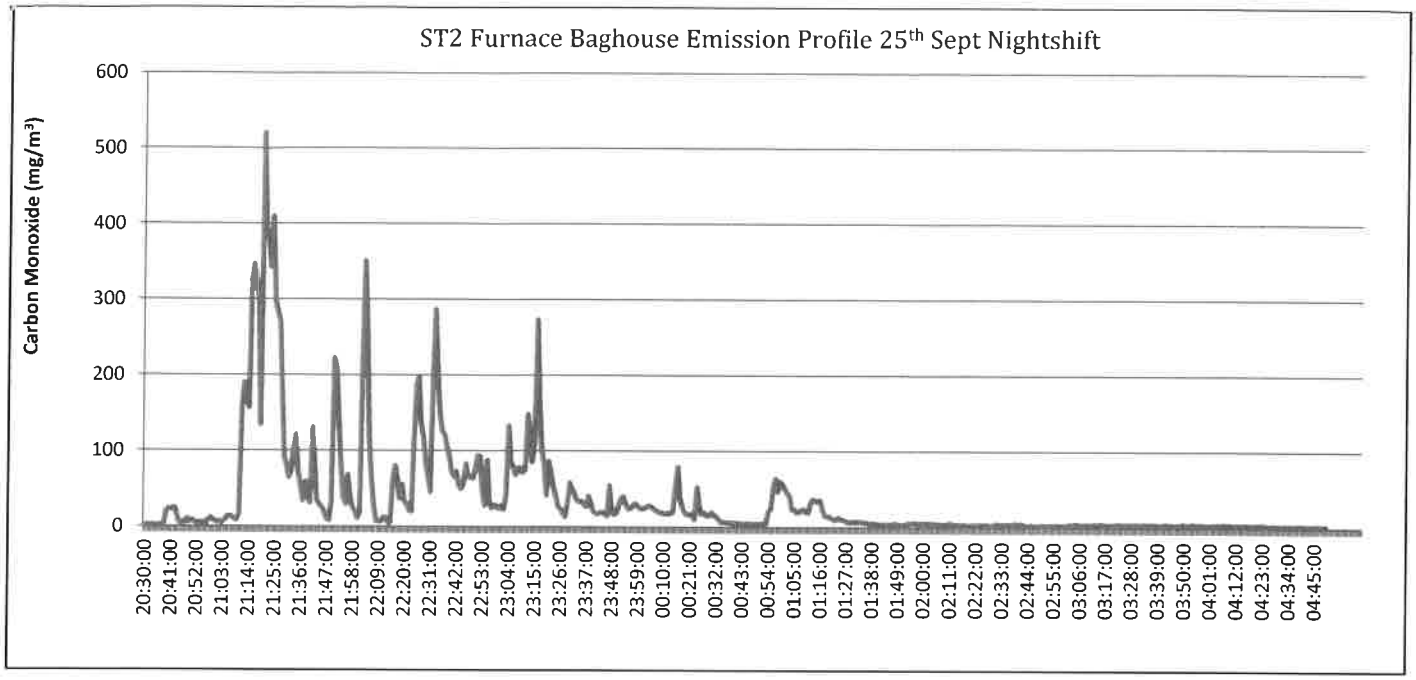
The following CO trace from baseline monitoring demonstrates a typical shift pattern with CO peaks during metal loading:



Note: gaps in chart are due to data logger fault.

From the monitoring results it is also evident that the nightshifts produced a higher CO result than dayshifts. It is thought that this is due to a difference in scrap loading, with nightshift loading more "jumbo" ingots made from internal scrap in the 1.0t melt furnace. The "jumbo" ingots have less surface area relative to mass compared to multiple ingots of virgin or tolled aluminium. This is because after melting the scrap in the 1.0 t furnace, the molten metal is pigged into a single cast rather than multiple ingots. It is possible that the bulk of the "jumbo" ingots disturbs the combustion process, e.g. flame disruption, however understanding the exact cause needs further investigation. Loading of "jumbo" ingots isn't limited to nightshift, but instead is a function of how much internal scrap is generated.

The following CO trace demonstrates the nightshift pattern with higher CO peaks during "jumbo" ingot loading:

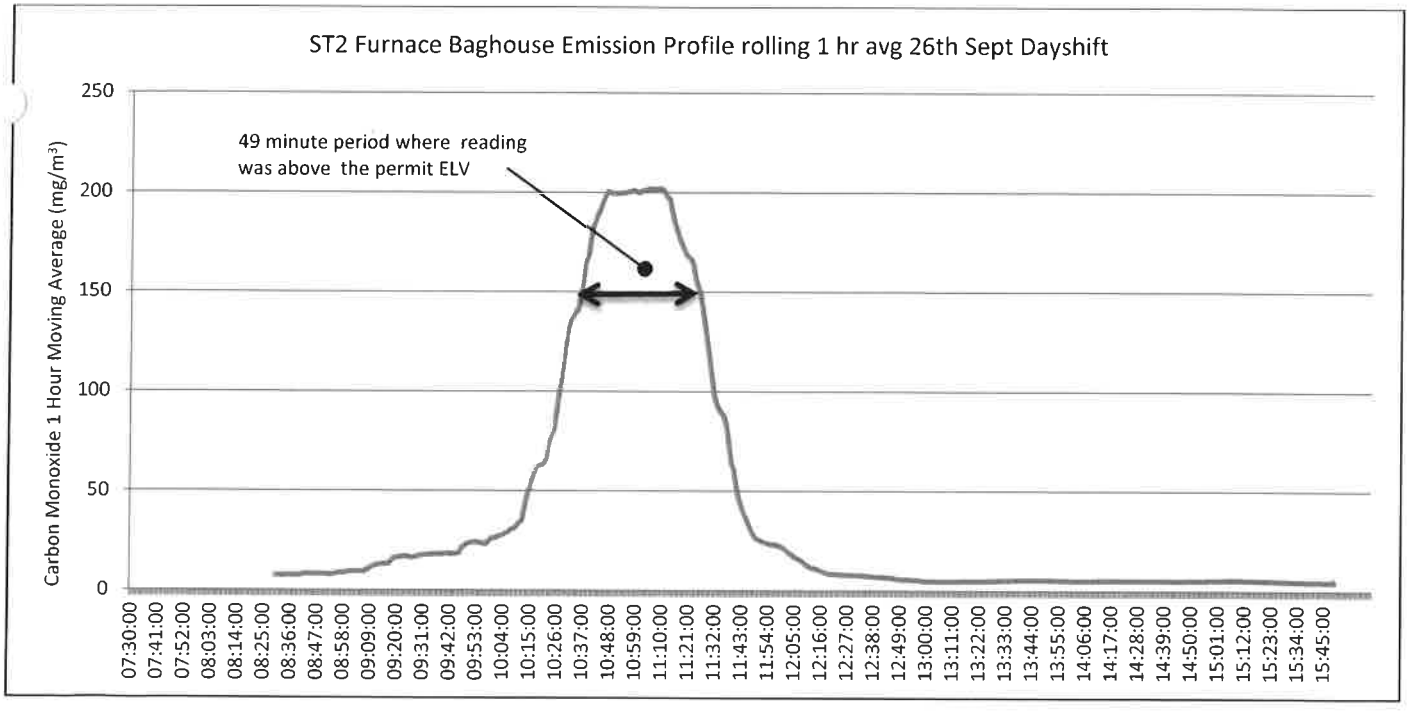


The result from the 5th production shift, starting the investigation by forcing a problem, is shown below. The metal charge frequency timer was forced off to allow quick charging at the operator's discretion, allowing the tower to be filled as quickly as possible.

Table 4.

Date	Shift	CO mg/m3			NOx mg/m3			Comment
		Shift avg	Max 1 hr avg	Max 4 hr avg	Shift avg	Max 1 hr avg	Max 4 hr avg	
26th	Day	28.6	202	65	19.7	29	25	Charge timer removed

The shift average and 4 hour average results are compliant with the permit ELVs of 150 mg/m3 for CO and 100 mg/m3 for NOx. The rolling 1 hour average maximum result breached the CO ELV for a 49 minute period as shown on the graph below. As this result is part of the investigation, agreed with the regulator, it is not representative of a typical shift and not reportable as a result.



This demonstrates that removing the charge timer can cause an increase in short-term CO emissions, but no difference to longer term results.

Interim Conclusion

The CO emissions from baseline monitoring show compliant results for combustion gases.

The reporting period chosen does significantly alter the result. Neither the current 1 hour average or previous 4 hour average are representative of the full process cycle for ST2 melt furnace. To ensure all process activity is represented in the furnace cycle of load, melt, hold, draw off and dross cleaning, a full shift averaging period is representative.

Request to Change ST2 Melt Furnace Monitoring & Reporting Condition

I would like to request that the averaging period for combustion gases, CO and NOx from release point ST2 is changed from 1 hour to a full shift average. A full shift would typically be:

Production day:
0730 – 1548 hrs minimum + any overtime + any furnace cleaning activity. (2030 – 0448 hrs on nightshift).

This request is limited to ST2 CO and NOx emissions.

Please can NRW consider my proposal to allow full shift average reporting. If in agreement, I will report the minimum and maximum full shift average results from the baseline monitoring as shown in Table 3, I.E. 17.4 mg/m3 and 36.6 mg/m3 in the annual return, unless ongoing investigations reveal significantly different results.

On-going Investigation

I would like to request continued support from NRW with our investigations on ST2 CO emission reduction, including a derogation of the permit ELV when the process is in non-standard condition. This will allow TMUK to continue making process adjustments and forcing problems with associated monitoring in an attempt to understand the causes of CO emission peaks and develop control measures.