

TATA STEEL (UK) LARGE COMBUSTION PLANT EMISSIONS

Report on Proposed Emission Limit Values for Permit Reviews

Introduction

This report brings together the analysis of emissions and fuel data for the Large Combustion Plants (LCPs) within Tata Steel in the UK and presents proposals for the Emission Limit Values (ELVs) for each of the units for application from 1st January 2016. It is intended that these proposed ELVs should be considered for the ongoing permit reviews for the respective sites.

It is also proposed that the finally agreed ELVs will form the base conditions for entry in to the UK Transitional National Plan (TNP) from 1st January 2016 until 30th June 2020.

Plant Description

Tata Steel operates a number of LCPs at its two integrated steel-making sites at Port Talbot and Scunthorpe. All of the units are primarily fired with a combination of steel process gases (Blast Furnace Gas-BFG, Coke Oven Gas-COG and BOS Gas-BOSG) but also variable quantities of supplementary or back-up natural gas (NG) or heavy fuel oil (HFO).

The emissions from these LCPs are strongly linked with the specific fuel mix available to each LCP and this mix will vary over both short and longer timescales, determined largely through other operations on the site.

There are a number of specific features of LCPs within steelworks which are very different to the LCPs in utility power stations, in particular the need to maintain operational flexibility over a broad range of site conditions. This will require a greater level of flexibility in the application of ELVs and the attached permit conditions.

The following features should be considered in any determination of permit conditions:-

- The primary purpose of steel plant LCPs is to produce site essential services (e.g. steam for BF blowing and coke oven exhausters) rather than to generate electricity, although electricity generation for own consumption is also an important requirement.
- Steel plant LCPs are primarily fuelled from internal process gases, which have very different calorific values (CVs) and are variable in quality and quantity.
- The LCPs are generally dispatched for fuel after the other process units (e.g. stoves, mill reheat furnaces) exacerbating the variability of supply. If the LCPs cannot use the fuel then the surplus is generally flared (and hence wasted).
- Each site is unique in the way it manages the overall site energy balance.
- Most of the units are at the lower end of the LCP range (<100 MW_{th}) and generate higher emission concentrations for only limited periods of time, making it difficult to justify expensive secondary abatement options.

Port Talbot – this site has a total of seven boilers, with a total capacity of 612 MW_{th}. There are five emission points, with Nos. 6 & 7 boilers discharging through separate flues in a common stack and similarly for the two Service Boilers. No.3 boiler is not included in this analysis, as permit conditions have already been agreed for this boiler and it is not included in the TNP.

Scunthorpe – this site has a total of nine boilers, with a total capacity of 529 MW_{th}. There are only three emission points, with the three boilers at the Central Power Station (CPS) discharging into a common flue. Similarly the six boilers at the Turbo Blower House (TBH) discharge, in two groups, into two common flues. Four of the boilers at TBH are individually below the 50 MW_{th} threshold for consideration as LCPs, but are captured under the aggregation rules. Scunthorpe

also has a complex fuel distribution system, with centralised facilities to mix the process gases together, including a synthetic COG from natural gas and BFG. It also ‘enhances’ the BFG to the CPS with variable quantities of a Mixed Enhanced Gas (BOSG/COG or BFG/COG). This complexity has been largely ignored in setting fuel-weighted ELVs, as the effect is likely to be minor and neutral overall.

Operator	Site	Plant	Unit	Capacity (MWth)	Discharge Arrangement	Fuel Mix
Tata Steel Europe	Port Talbot	Margam A	No.3 Boiler	99		NG Pilots BFG/BOSG Main Fuel NG Back-up
			No.5 Boiler	50		NG Pilots BFG Main Fuel BOSG Main on No.5 COG Sec Fuel HFO/NG Back-up
		Margam B	Mitchell Boiler	81	Common Stack (Total Capacity =268MWth)	NG Pilots BFG/BOSG Main Fuel COG/NG Sec Fuel HFO Back-up
		Margam C	No.6 Boiler	134		
			No.7 Boiler	134		
		General	Service Boiler 4	57	Common Stack (Total Capacity =114MWth)	COG Pilot&Main Fuel BFG Main Fuel HFO Back-up NG on SB4
			Service Boiler 5	57		
		Scunthorpe	Central Power Station	No.1 Boiler	108	Common Flue (Total LCP Capacity =265MWth)
	No.2 Boiler			108		
	No.3 Boiler			49	COG Pilots Only BFG Main Fuel HFO Back-up	
	Turbo Blower House		No.1 Boiler	39	Common Flue (Total LCP Capacity =156MWth)	All TBH Boilers COG Pilots Only BFG Main Fuel HFO Back-up
			No.2 Boiler	39		
			No.3 Boiler	39		
			No.4 Boiler	39		
			No.5 Boiler	54	Common Flue (Total LCP Capacity =108MWth)	
			No.6 Boiler	54		

Table 1: Tata Steel Large Combustion Plants (LCPs) in the UK

Defining Compliance Requirements

Once Emission Limit Values (ELVs) are defined in a permit, it is expected that the following assessments of Continuous Emissions Monitor (CEM) measurements will need to be undertaken to demonstrate compliance from 1st January 2016, based on discussions with the regulator and the text of the relevant legislation. For obvious reasons the analysis is carried out on measurements during operating hours only and potentially ignoring measurements during the short duration start-up and shutdown periods.

For the proposed new permit conditions and during the TNP :-

- a) No validated **monthly** average measurement value shall exceed the relevant ELV.

- b) 95% of validated **daily** average values (over a calendar year) shall be below 121% of the relevant ELV **or**
- c) 97% of validated **48-hourly** average values shall be below 110% of the relevant ELV

When the IED is fully applied (after the end of the TNP period), the ELVs and compliance conditions are specified in Annex V of the Directive.

- a) No validated **monthly** average measurement value shall exceed the relevant ELV.
- b) No validated **daily** average value shall exceed 110% of the relevant ELV.
- c) 95% of validated **hourly** average values (over a calendar year) shall be below 200% of the relevant ELV.

The daily/48-hourly compliance measure during the TNP is a new requirement from the regulator. Although this is not a requirement of the original LCPD, the Environment Agency/Natural Resources Wales is stipulating that a shorter-term compliance measure should be included in any permits. This will encourage operators to understand their emission profiles in more detail, to take any necessary actions to comply and to prepare for the still tighter requirements in the IED. The EA/NRW would be prepared to consider alternative ELV multiplication factors (e.g. 121% of ELV) if evidence was produced to substantiate.

Tata Steel has investigated the two alternative compliance measures and will report its preference later in the report.

Methodology

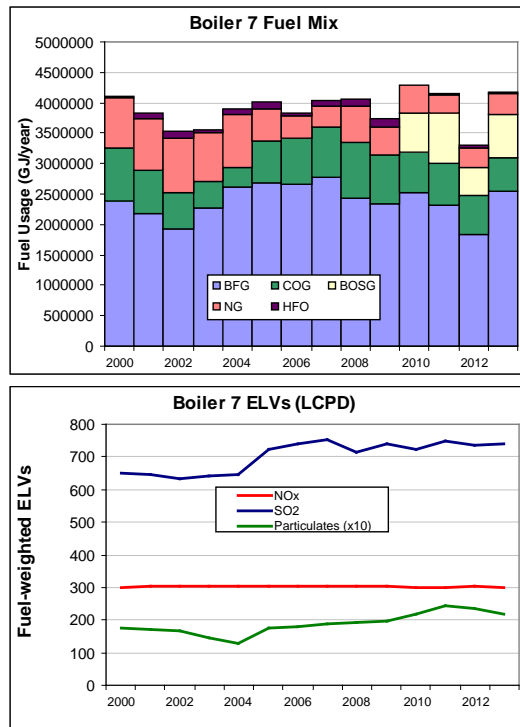
Fuel usage records for each boiler/LCP have been collated for a number of previous years.

Each of the steelworks gases has a different ELV tabulated within the LCPD/IED annexes (see Table 2 below). Where combustion units are multi-fuel fired, as with all of the units at Tata Steel, the overall ELV for the unit should be determined via a fuel-weighting based on the proportionate thermal input from each fuel.

	LCPD – ELVs (mg/m ³)			IED – ELVs (mg/m ³)		
	Particulates	NOx	SO2	Particulates	NOx	SO2
BFG	10	300	800	10	200	200
COG	50	300	800	30	200	400
BOSG	50	300	800	30	200	35
NG	5	300	35	5	100	35
HFO (50-100 MW_{th})	50	450	1700	30	450	350
HFO (100-300 MW_{th})				25	200	250

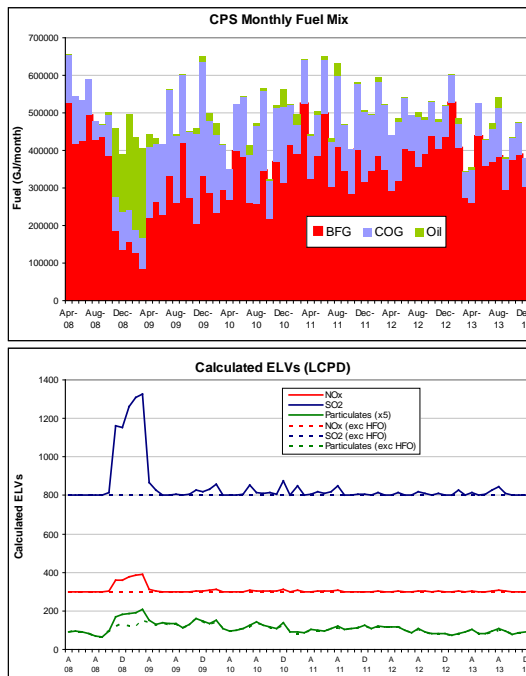
Table 2: Emission Limit Values for Fuels Used on Tata Steel Sites

Port Talbot – data were gathered on the **annual** fuel mixes for each boiler for the last 14 years (2000-2013 inclusive). Each of these annual fuel mixes was used to calculate the fuel-weighted ELV for each LCP. An example is shown below for Boiler 7.



The analyses for all the boilers at Port Talbot are shown in Appendix 1.

Scunthorpe – here the **monthly** fuel data for each LCP (not boiler) from 2008 to 2013 were used to calculate the equivalent fuel-weighted ELV. An example is shown for the Central Power Station (CPS).



The analyses for all the LCPs at Scunthorpe are shown in Appendix 2.

General – because the fuel mix has changed on most units, in response to the overall site operational needs (and could do so again in future), it is proposed to look at the range of ELV values calculated in this way and to use the **maximum** value in the first instance. However,

these values have been moderated to reflect the actual plant emissions (generally moderated downwards) and to recognise that monthly performance, with a potential for more extreme fuel proportions, may need an increase in the ELV. The reasoning for each ELV is set out in the comments on the table of proposed ELVs.

All of the LCPs above 100 MW_{th} (individually or through aggregation) require to be fitted with Continuous Emissions Monitors (CEMs) for measuring the emission concentrations of sulphur dioxide (SO₂), oxides of nitrogen (NO_x) and particulate matter. These CEMs have been installed, maintained and calibrated in line with BS EN 14181, although some QAL2 tests are still outstanding and are planned for later this year at Port Talbot.

To assess the likely compliance with the proposed ELVs, CEMs data were analysed against the proposed permit compliance conditions set out above.

Port Talbot – CEMs data for the full calendar year 2013 were used, although there is greater confidence in the CEMs results for the latter few months than the first part of the year, following spot calibrations.

Scunthorpe – CEMs data for the first quarter (Jan-Mar) of 2014 were used, following detailed calibrations QAL2 completed in late 2013.

Proposed Emission Limit Values

Collating the various individual LCP/boiler analyses from the Appendices, the following ELVs are proposed for the new permit variations under the LCPD, to be applied from 1st January 2016. These would set the relevant monthly limits for reporting and annually a compliance assessment on short-term emissions (see below).

Boiler/LCP	Emission Limit Values (ELVs) mg/m ³			Comments
	Particulates	NO _x	SO ₂	
PT No.3 Boiler	Not covered in this paper. Not in TNP			
PT No.5 Boiler	20	300	800	
PT Mitchell Blr	20	300	800	
PT No.6 Boiler	25	300	800	
PT No.7 Boiler	25	300	800	
PT Service Blrs	40	300	800	Higher particulates for oil firing
Scun-CPS	40	300	800	Higher particulates for oil firing
Scun-TBH 1-4	20	300	800	
Scun TBH 5&6	20	300	800	

Table 3 : Proposed Emission Limit Values for Tata Steel LCPs

In exceptional site circumstances (e.g. a prolonged blast furnace outage), when higher than normal proportions of either natural gas or heavy fuel oil may be used to maintain site integrity, there may be a need to seek a derogation to exclude periods of higher emissions, which would not be able to meet the proposed ELVs or the derived daily/48-hourly compliance requirements.

The NO_x ELVs have generally been rounded down, as the compliance assessments suggest that these can be readily achieved in typical operations. The SO₂ and particulate ELVs have been rounded up slightly to accommodate monthly variability of fuel mix. The compliance assessments for SO₂ suggest that some of the boilers could readily achieve this on their current fuel mix, but flexibility may be required for the future. It is also desirable to have a level of simplicity and consistency of ELVs across ‘the fleet’.

Compliance Assessment

i) LCPD/TNP (from 2016 to 2020)

The appendices show print-outs for the compliance assessments for each boiler/LCP.

At the proposed ELVs shown above, all the boilers/LCPs should be able to meet both the monthly and daily/48-hourly requirements, with the exception of the Scunthorpe Central Power Station, which would potentially be non-compliant on particulates. Indeed, several of the Port Talbot boilers also come close on particulates, but would remain compliant for 95% (or 97%) of the time over the year.

The Scunthorpe CPS uses higher proportions of HFO than all the other boilers and generally fires HFO in frequent short bursts, when process gas is suddenly in short supply. With this stop-go firing pattern it is difficult to maintain the right levels of excess combustion air through the change-overs and invariably this leads to peaks of high particulate emission.

As a further problem, the high particulate emissions during oil firing will often lead to some deposition on the lens of the particulate monitors, causing the monitor to show higher emissions than in reality. This also affects the 'zero', as can be seen on several of the particulate graphs, and this will also shift upwards the 95th/97th percentiles. If these monitoring problems can be resolved then the CPS should be able to show compliance with the daily/48-hourly requirements.

The assessments have shown that there is not much difference between showing compliance on daily (95th percentile within 121% of ELV) or 48-hourly (97th percentile within 110% of ELV). Therefore, for simplicity and to better match the IED requirements it is **proposed that the conditions on daily emissions be included in permit variations**. It is not proposed to request any 'finessing' of the 121% factor, which seems reasonable in covering the flexibility requirements for our operations.

ii) IED (from 2020 onwards)

The full assessment of fuel-weighted ELVs and potential compliance is not reported here, as the focus is to resolve the immediate proposals for the imminent site permit variations, which are expected to apply only until the end of the TNP period in June 2020.

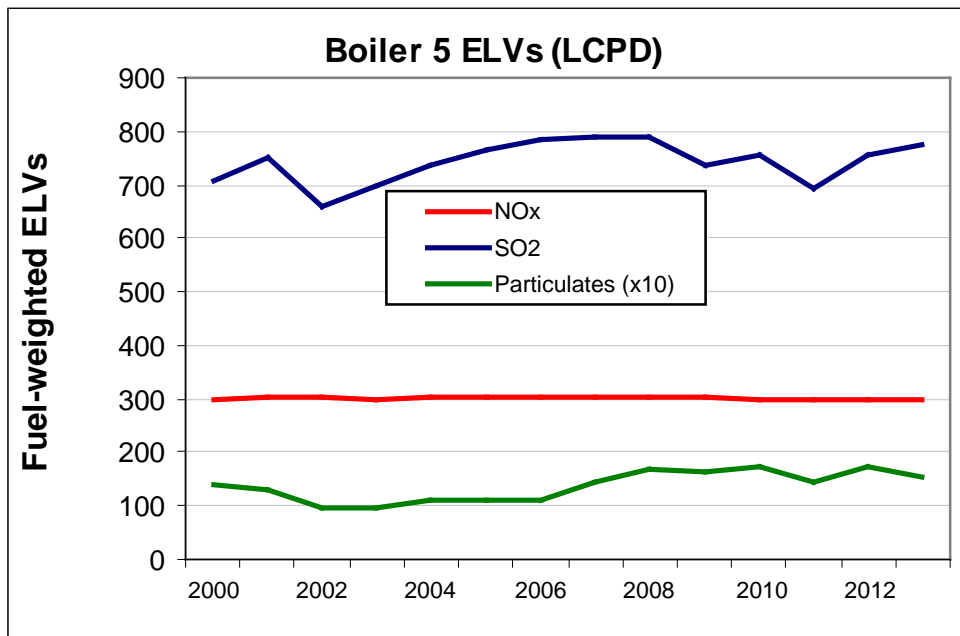
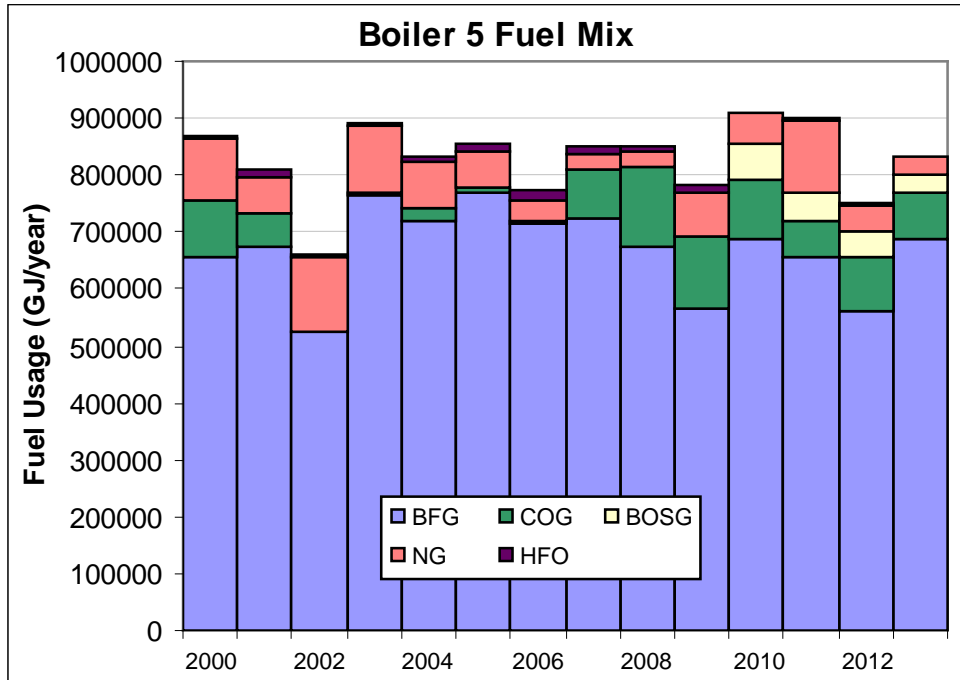
However, the first assessment of compliance under the IED fuel-weighted ELVs and tighter short-term requirements, has shown a number of problems with compliance. Most of the plants would still be capable of meeting the ELVs over full calendar months, the notable exception being the Scunthorpe CPS on particulates, for similar reasons to those stated above. Nearly all plants, however, would be unable to achieve 100% of daily values within 1.1x the ELV under current operations. The hourly target (95% within 2x ELV) is more achievable, but some plants could fail, particularly if there were prolonged periods of reduced BFG availability.

With this in mind, and given the EU steel sector's substantial concerns with the LCP BREF review process, we seek the UK regulators' support in our ongoing efforts to ensure realistic and achievable BAT-AELs are defined for LCPs consuming steel industry-arising gases, so that the ELVs currently prescribed in Annex V of IED can be moderated before the compliance period for TNP participants commences in July 2020.

APPENDIX 1 – Port Talbot Boilers – ELV Calculations & Compliance Assessments

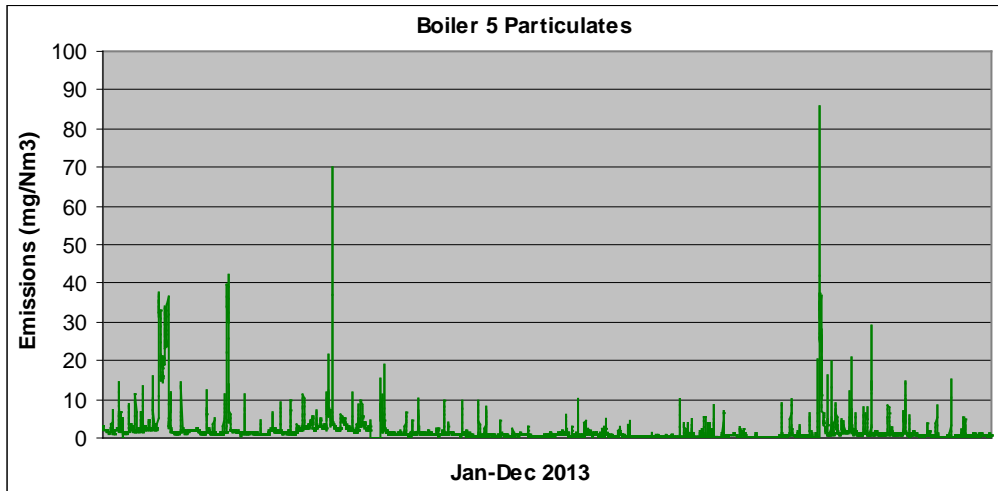
a) Boiler 5 – 50 MW_{th}

i) Fuel-weighted Emission Limit Values



Fuel-weighted ELVs	LCPD/TNP			IED			Comments
	Part.	NO _x	SO ₂	Part.	NO _x	SO ₂	
Average ELV	14	302	743	12	194	200	Particulates and SO ₂ ELVs rounded-up to cover monthly variation and greater oil firing.
Max. ELV	17	304	791	14	202	231	
Proposed ELV	20	300	800	15	-	-	

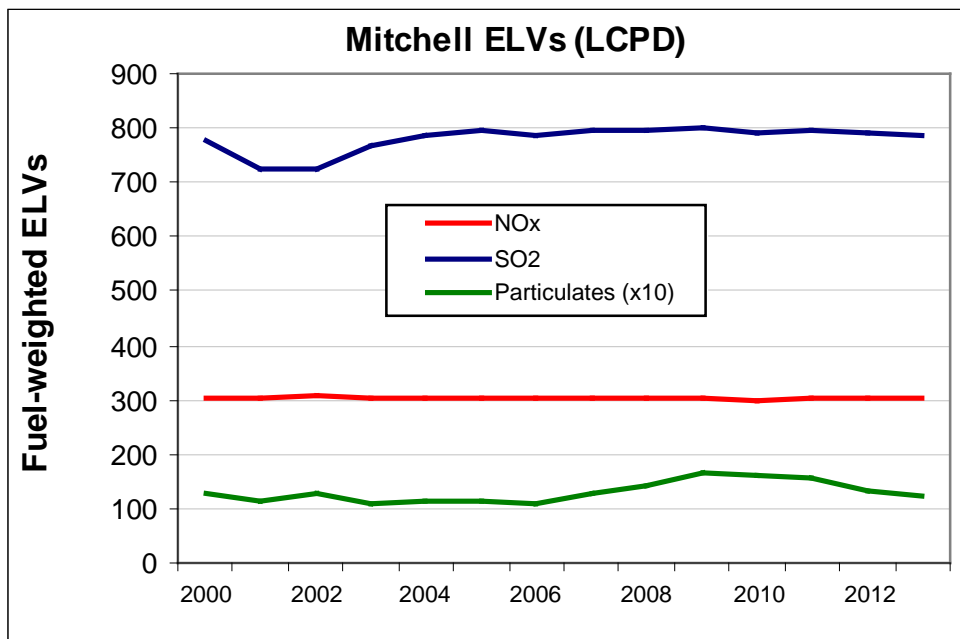
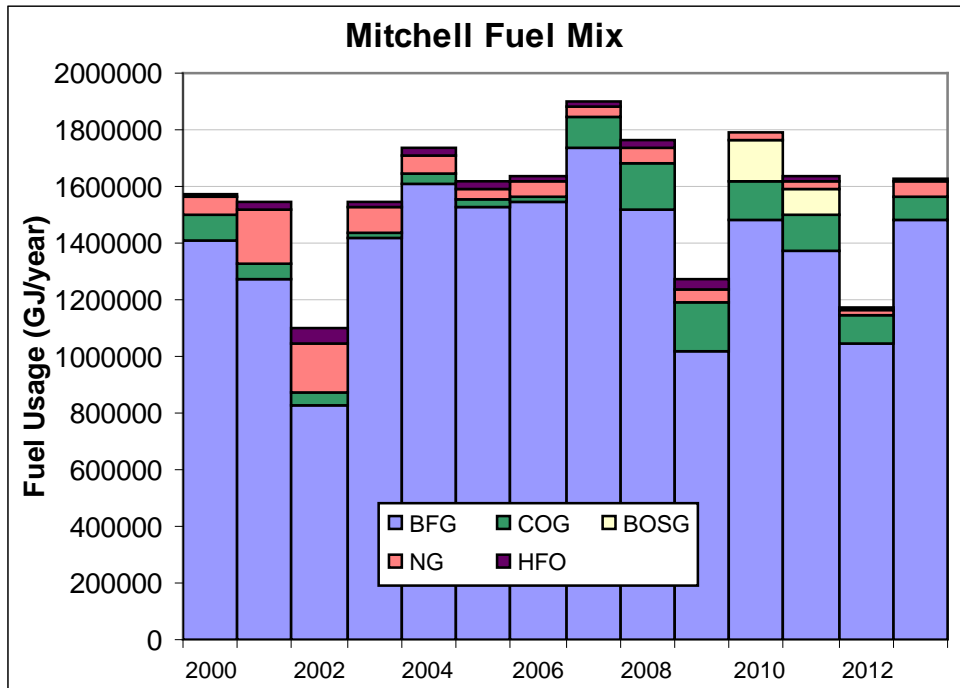
ii) Short-term Emissions & Compliance



	Boiler 5	<u>Comments</u>
	Partics	
Max monthly	5.7	<ul style="list-style-type: none"> Compliant on all requirements. Marginally better on 48-hourly compliance than daily, but either is achievable. NO_x and SO₂ assessed on spot measurements
LCPD Fuel-weighted ELV	20	
Max 48-hourly	22.0	
97th percentile of 48-hourlys	6.6	
48hrly Limit (110% of ELV)	22.0	
No. of Exceedences/yr	1	
Max daily	27.4	
95th percentile of dailys	4.7	
Daily Limit (121% of ELV)	24.2	
No. of Exceedences/yr	3	

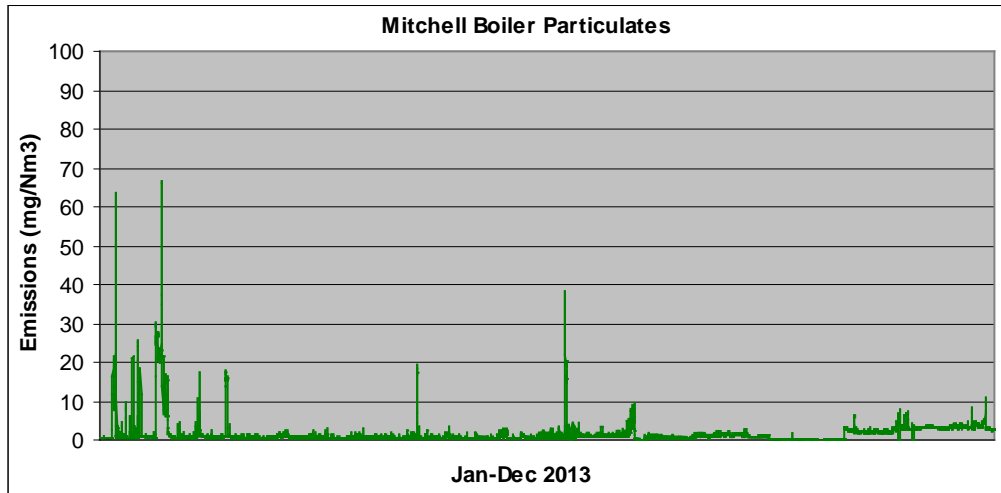
b) Mitchell Boiler – 81 MW_{th}

i) Fuel-weighted Emission Limit Values



Fuel-weighted ELVs	LCPD/TNP			IED			Comments
	Part.	NO _x	SO ₂	Part.	NO _x	SO ₂	
Average ELV	13	302	779	11	199	204	Particulates and SO ₂ ELVs rounded-up to cover monthly variation and greater oil firing.
Max. ELV	17	308	801	13	204	226	
Proposed ELV	20	300	800	15	-	-	

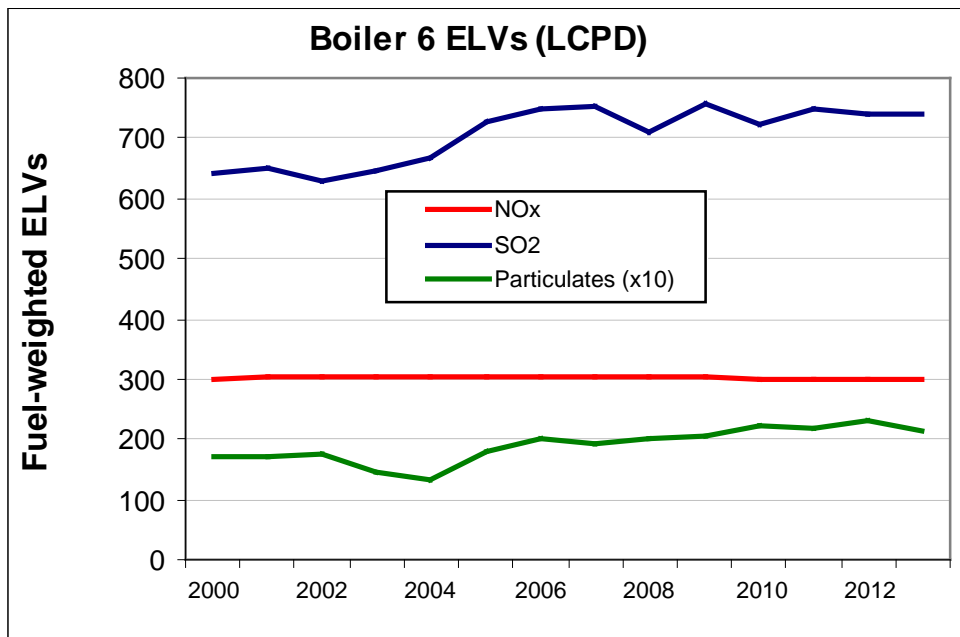
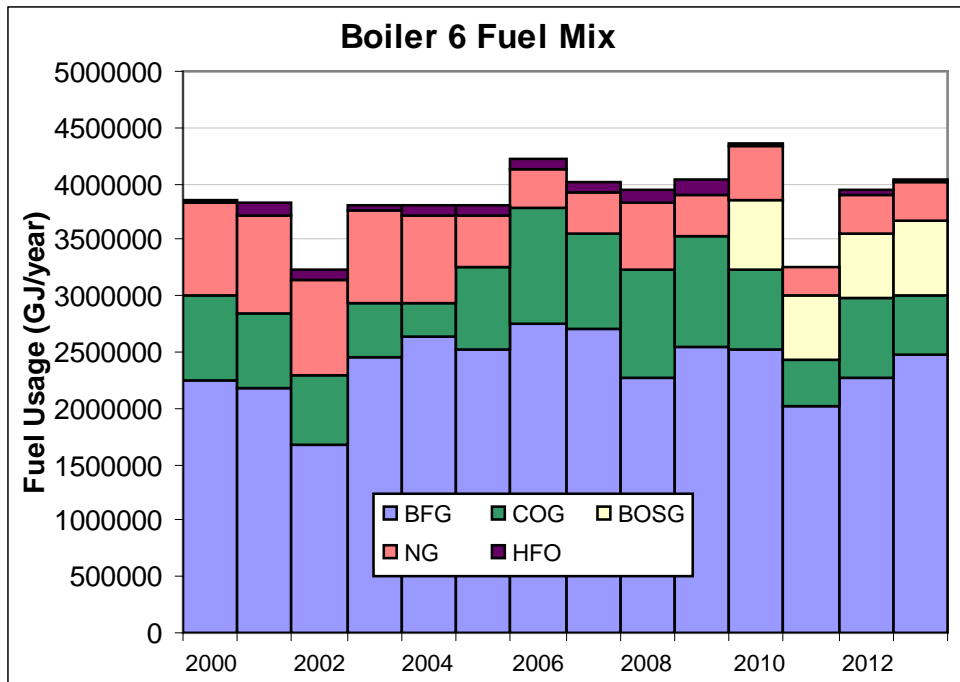
ii) Short-term Emissions & Compliance



	Mitchell Partics	Comments
Max monthly	4.8	<ul style="list-style-type: none"> Compliant on all requirements. Marginally better on daily compliance than 48-hourly, but either is achievable. NO_x and SO₂ assessed on spot measurements
LCPD Fuel-weighted ELV	20	
Max 48-hourly	22.6	
97th percentile of 48-hourlys	5.6	
48hrly Limit (110% of ELV)	22.0	
No. of Exceedences/yr	1	
Max daily	24.9	
95th percentile of dailys	4.1	
Daily Limit (121% of ELV)	24.2	
No. of Exceedences/yr	1	

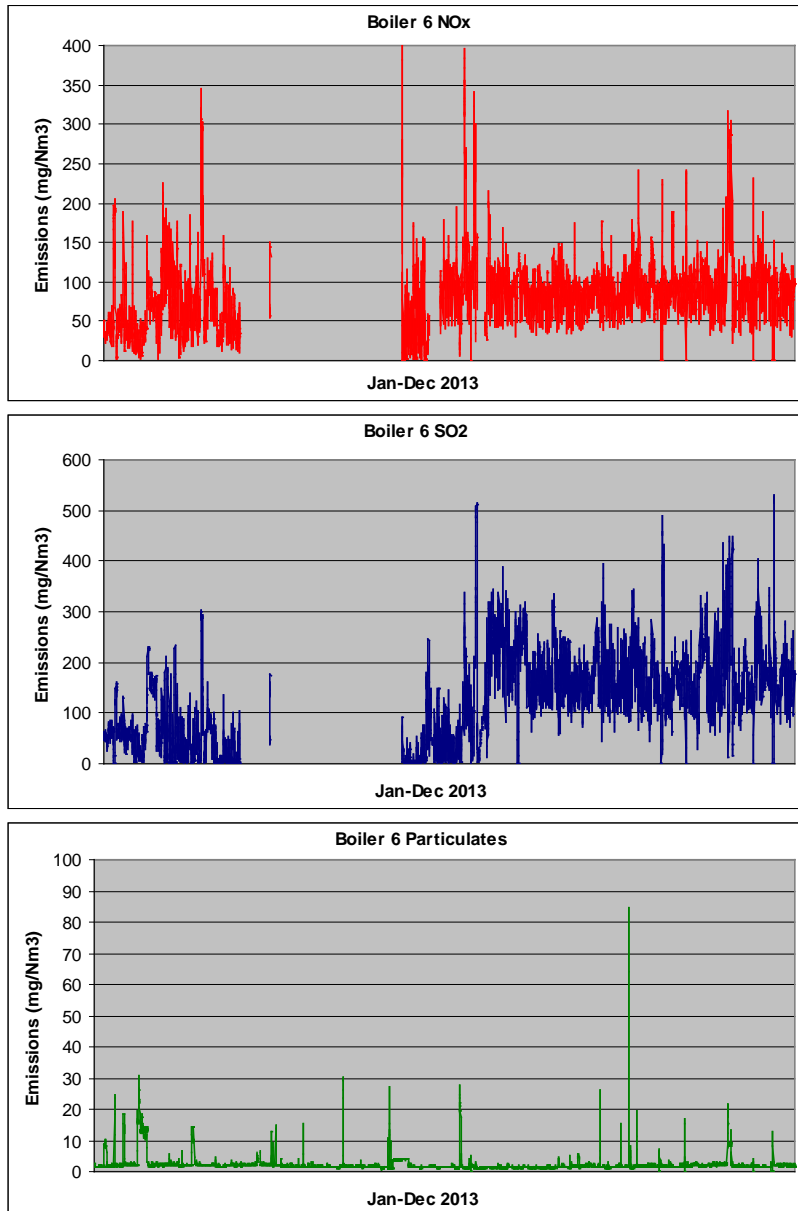
c) Boiler 6– 134 MW_{th}

i) Fuel-weighted Emission Limit Values



Fuel-weighted ELVs	LCPD/TNP			IED			Comments
	Part.	NO _x	SO ₂	Part.	NO _x	SO ₂	
Average ELV	19	303	706	14	190	207	Particulates and SO ₂ ELVs rounded-up to cover monthly variation and greater oil firing.
Max. ELV	23	305	758	16	199	238	
Proposed ELV	25	300	800	15	200	300	

ii) Short-term Emissions & Compliance



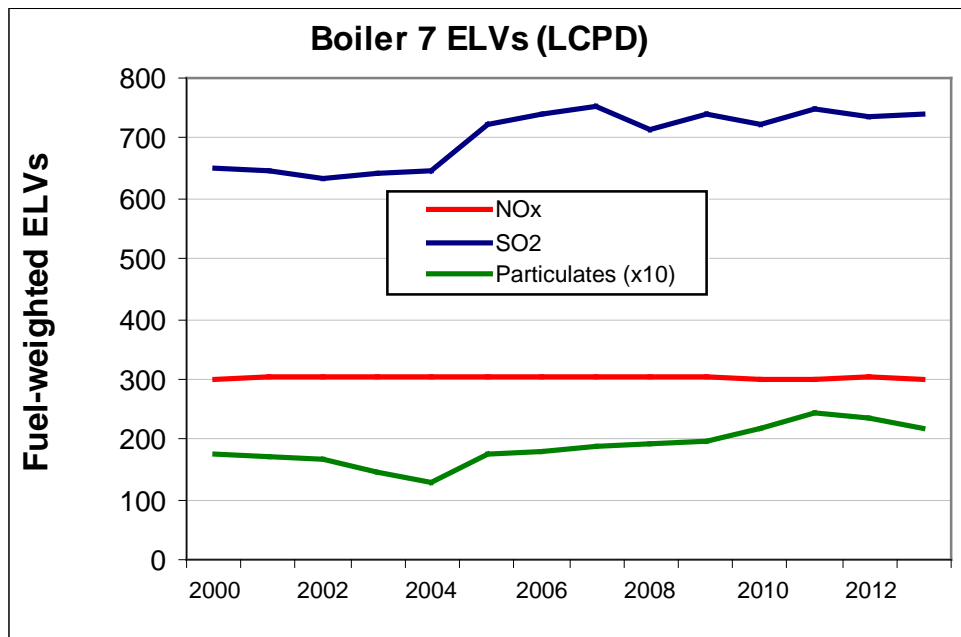
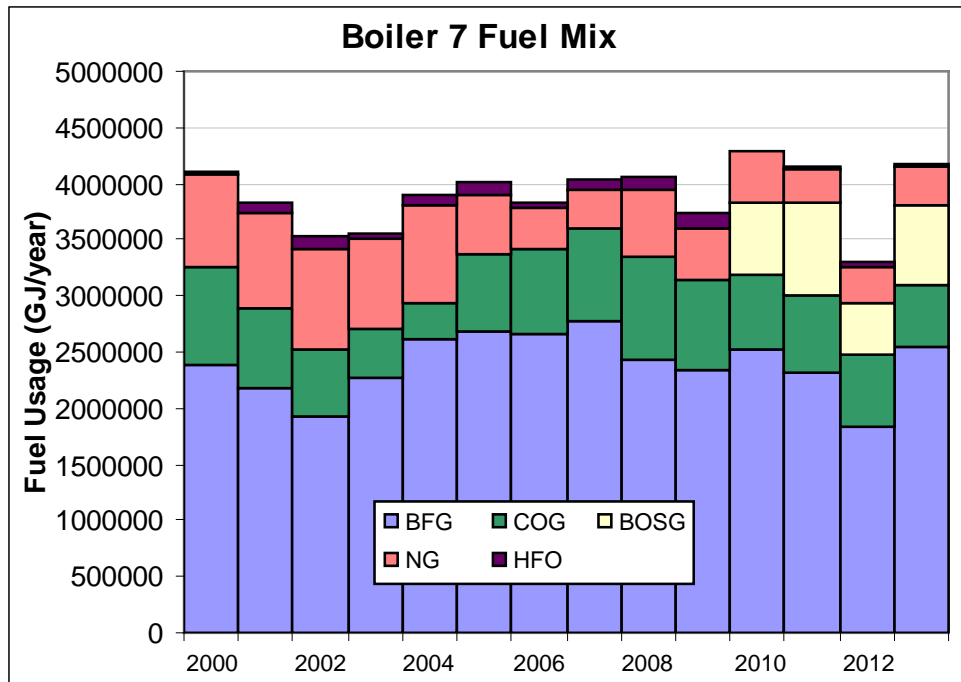
	Boiler 6		
	Partics	NOx	SO2 *
Max monthly	4.6	111	182
LCPD Fuel-weighted ELV	25	300	800
Max 48-hourly	14.4	237	296
97th percentile of 48-hourlys	6.4	156	255
48hrly Limit (110% of ELV)	27.5	330	880
No. of Exceedences/yr	0	0	0
Max daily	21.3	288	421
95th percentile of dailys	4.0	136	256
Daily Limit (121% of ELV)	30.3	363	968
No. of Exceedences/yr	0	0	0

Comments

- Compliant on all requirements.
- Either daily or 48-hourly compliance is readily achievable
- Some margin to reduce ELVs, particularly on NO_x and SO₂, if HFO quantities will remain low.

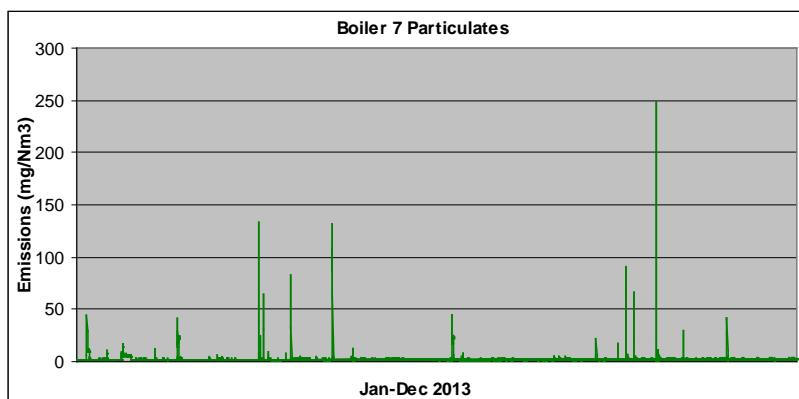
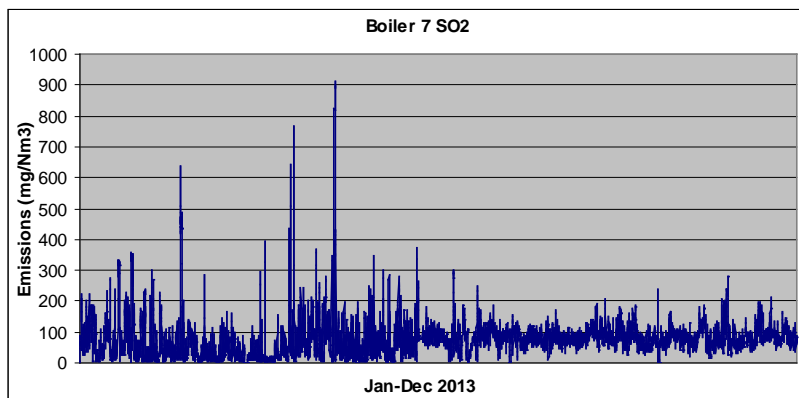
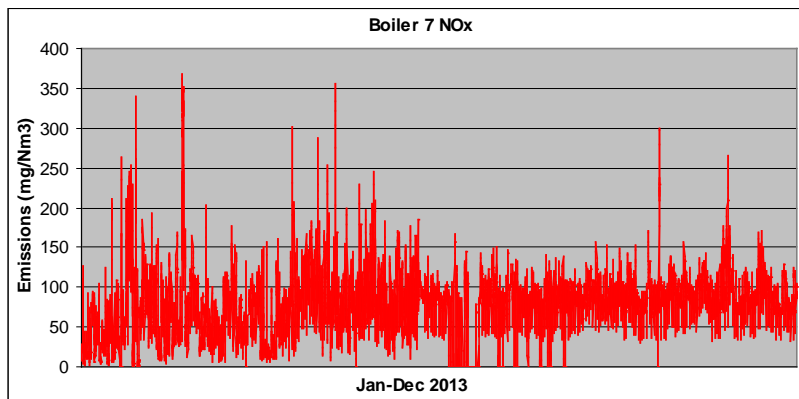
d) Boiler 7– 134 MW_{th}

i) Fuel-weighted Emission Limit Values



Fuel-weighted ELVs	LCPD/TNP			IED			Comments
	Part.	NO _x	SO ₂	Part.	NO _x	SO ₂	
Average ELV	19	303	703	14	190	205	Particulates and SO ₂ ELVs rounded-up to cover monthly variation and greater oil firing.
Max. ELV	24	305	755	17	197	230	
Proposed ELV	25	300	800	15	200	300	

ii) Short-term Emissions & Compliance



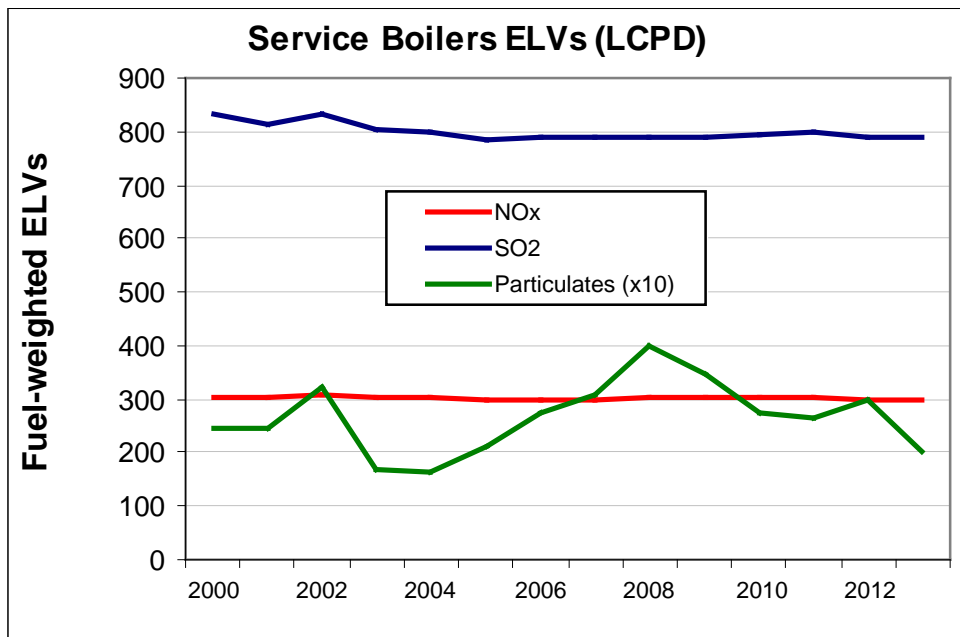
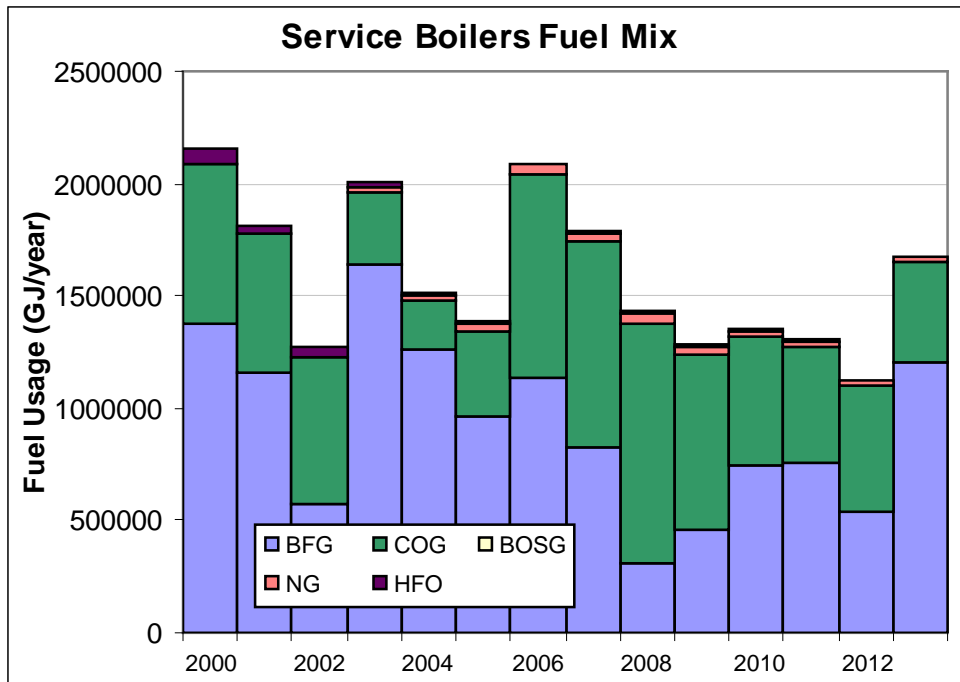
	Boiler 7		
	Partics	NOx	SO2 *
Max monthly	2.9	97	92
LCPD Fuel-weighted ELV	25	300	800
Max 48-hourly	15.0	180	238
97th percentile of 48-hourlys	6.2	123	136
48hrly Limit (110% of ELV)	27.5	330	880
No. of Exceedences/yr	0	0	0
Max daily	28.9	302	442
95th percentile of dailys	3.3	124	133
Daily Limit (121% of ELV)	30.3	363	968
No. of Exceedences/yr	0	0	0

Comments

- Compliant on all requirements.
- Either daily or 48-hourly compliance is achievable
- Some margin to reduce ELVs, particularly on SO₂, if HFO quantities will remain low.

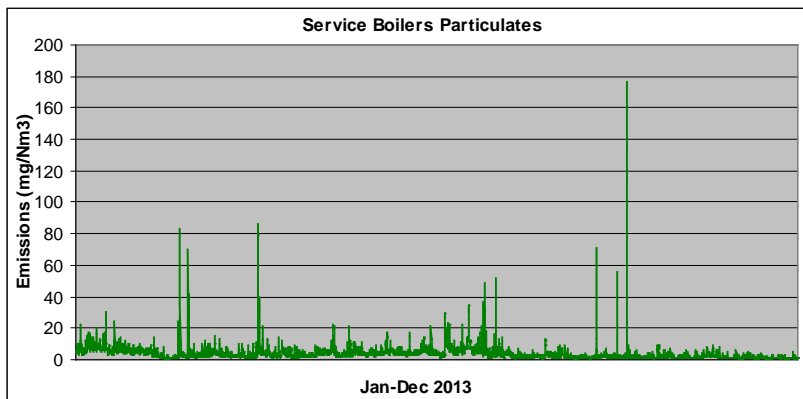
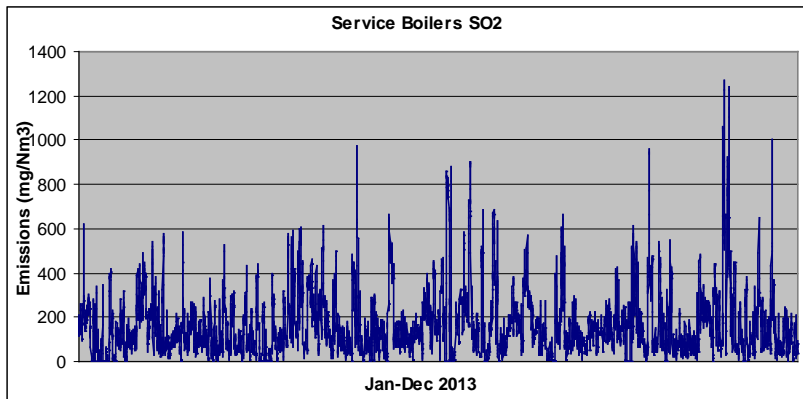
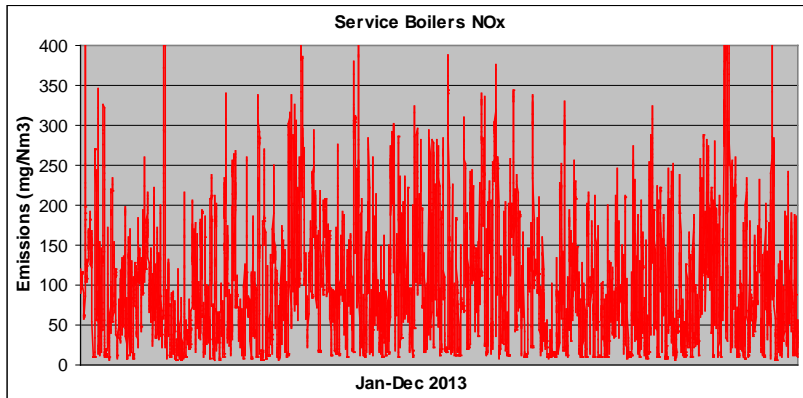
e) Service Boilers– 2 x 57 MW_{th}

i) Fuel-weighted Emission Limit Values



Fuel-weighted ELVs	LCPD/TNP			IED			Comments
	Part.	NO _x	SO ₂	Part.	NO _x	SO ₂	
Average ELV	27	302	799	18	201	280	All proposed ELVs rounded down, as generally able to comply and max. values occurred in exceptional op. period.
Max. ELV	40	306	834	25	210	347	
Proposed ELV	40	300	800	15	220	300	

ii) Short-term Emissions & Compliance



	Service Boilers		
	Partics	NOx	SO2 *
Max monthly	7.5	126	227
LCPD Fuel-weighted ELV	40	300	800
Max 48-hourly	20.9	279	550
97th percentile of 48-hourlys	10.7	197	378
48hrly Limit (110% of ELV)	44.0	330	880
No. of Exceedences/yr	0	0	0
Max daily	37.4	321	778
95th percentile of dailys	9.4	204	352
Daily Limit (121% of ELV)	48.4	363	968
No. of Exceedences/yr	0	0	0

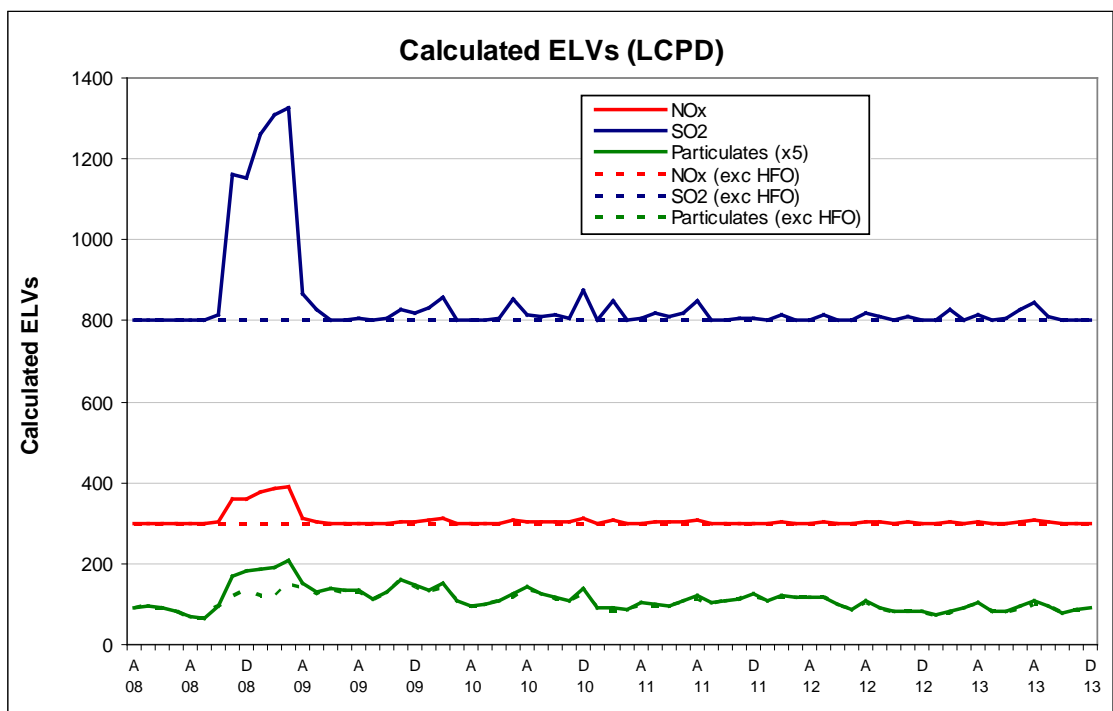
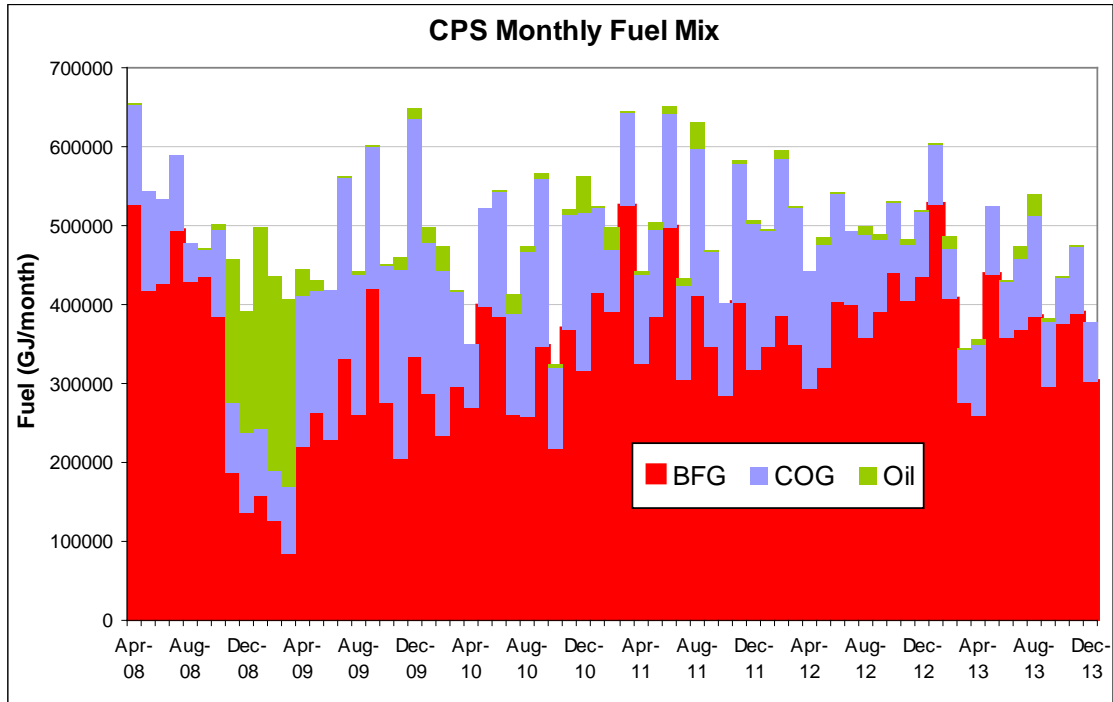
Comments

- Compliant on all requirements.
- Marginally better on 48-hourly compliance than daily, but either is achievable
- Little scope to reduce ELVs

APPENDIX 2 – Scunthorpe Boilers – ELV Calculations & Compliance Assessments

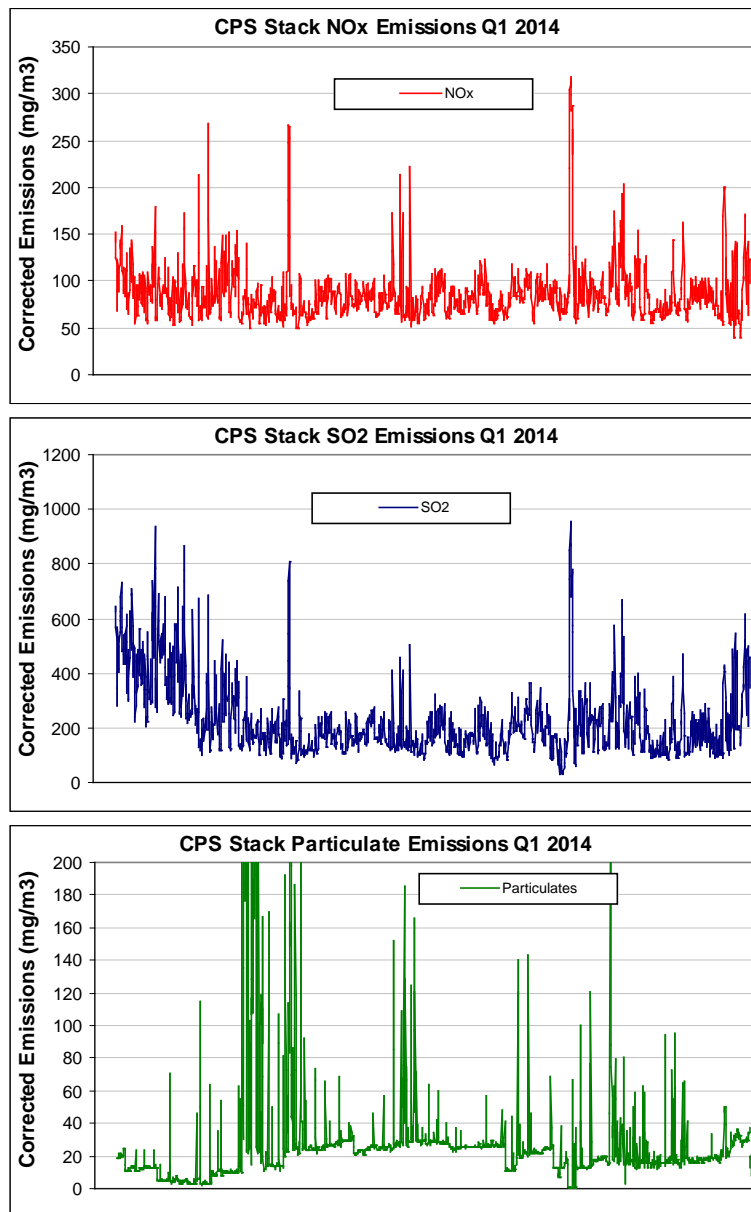
a) Central Power Station Boilers – 2 x 108, 1 x 54 MW_{th}

i) Fuel-weighted Emission Limit Values



Fuel-weighted ELVs	LCPD/TNP			IED			Comments
	Part.	NO _x	SO ₂	Part.	NO _x	SO ₂	
Average ELV	22	307	845	16	212	260	All proposed ELVs rounded down, as generally able to comply and max. values occurred in exceptional op. period.
Max. ELV	42	388	1328	26	347	329	
Proposed ELV	40	300	800	25	220	300	

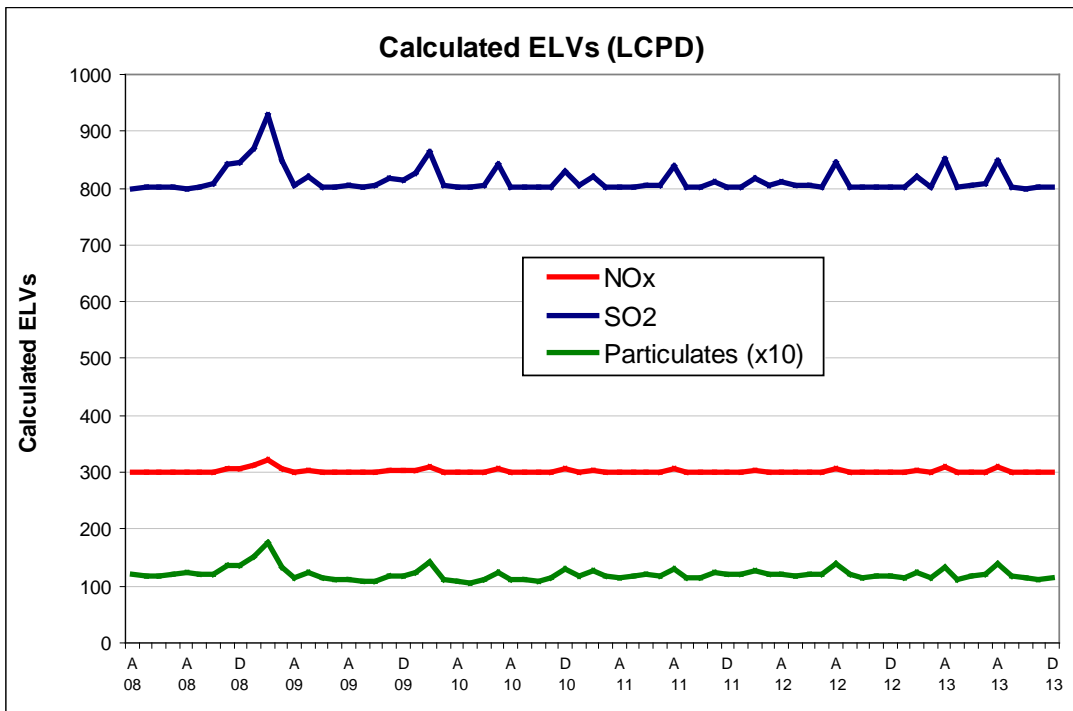
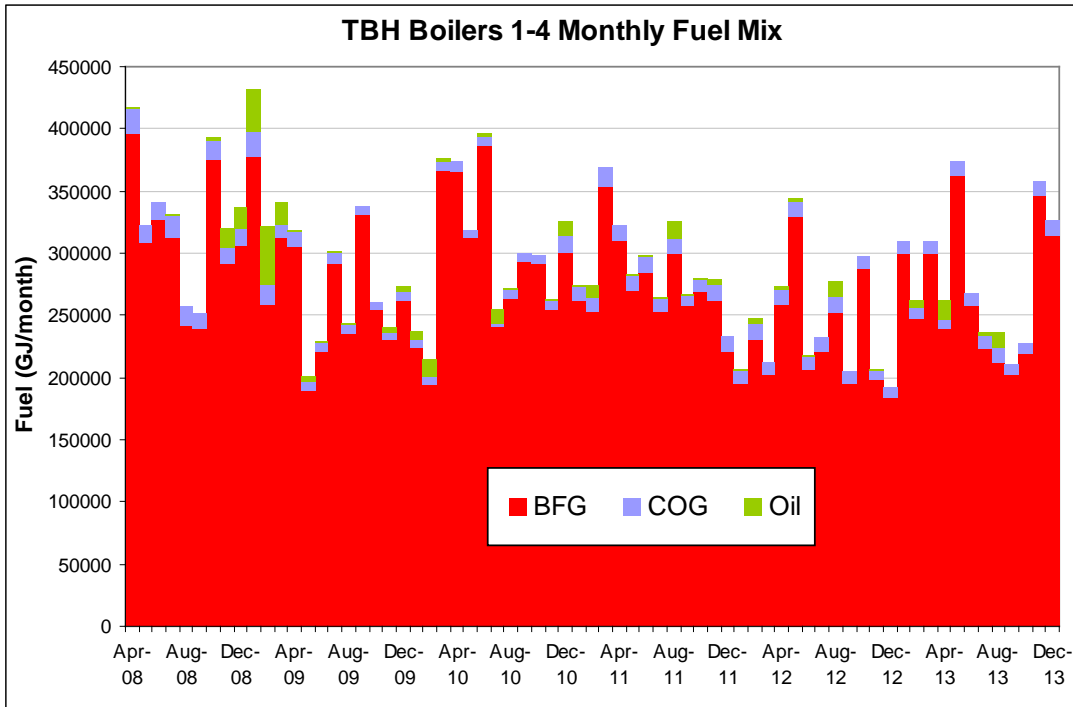
ii) Short-term Emissions & Compliance



Central Power Station	Dust	Nox-Dry	SO2-Dry	Comments
	mg/m3	mg/m3	mg/m3	
Max monthly	34.8	89	293	<ul style="list-style-type: none"> Compliant on NO_x and SO₂, but fails on short-term particulates. Similar issues with either daily or 48-hourly requirements, but minor preference for daily targets. Main issue due to high HFO firing, coupled with evidence of dirt build-up on particulate monitor!
LCPD Fuel-weighted ELV	40	300	800	
Max 48-hourly	190.5	137	543	
97th percentile of 48-hourlys	66.8	121	488	
48hrly Limit (110% of ELV)	44	330	880	
No. of Exceedences/yr	16	0	0	
Max daily	198.1	192	543	
95th percentile of dailys	56.8	116	468	
Daily Limit (121% of ELV)	48	363	968	
No. of Exceedences/yr	32	0	0	

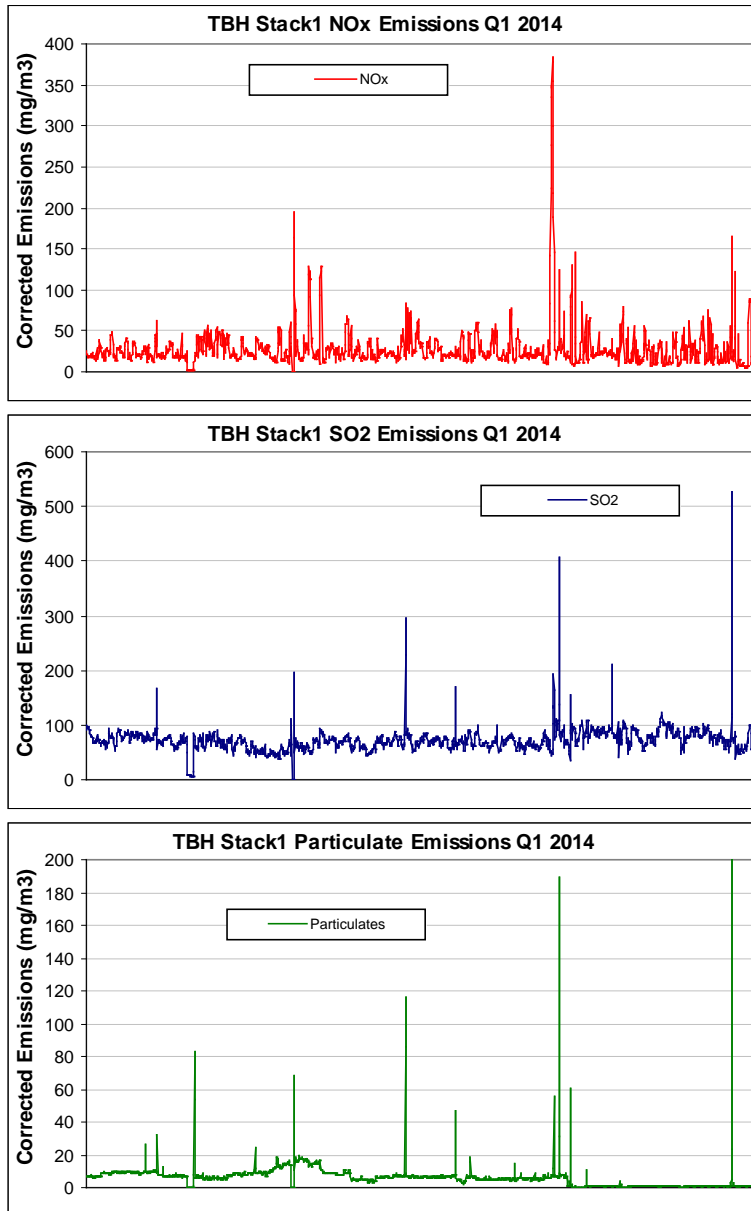
b) Turbo Blower House Boilers Nos. 1 to 4 – 4 x 39 MW_{th}

i) Fuel-weighted Emission Limit Values



Fuel-weighted ELVs	LCPD/TNP			IED			Comments
	Part.	NO _x	SO ₂	Part.	NO _x	SO ₂	
Average ELV	12	302	814	11	204	210	All proposed ELVs rounded down, as generally able to comply and max. values occurred in exceptional op. period.
Max. ELV	18	321	929	14	236	232	
Proposed ELV	20	300	800	15	200	300	

ii) Short-term Emissions & Compliance



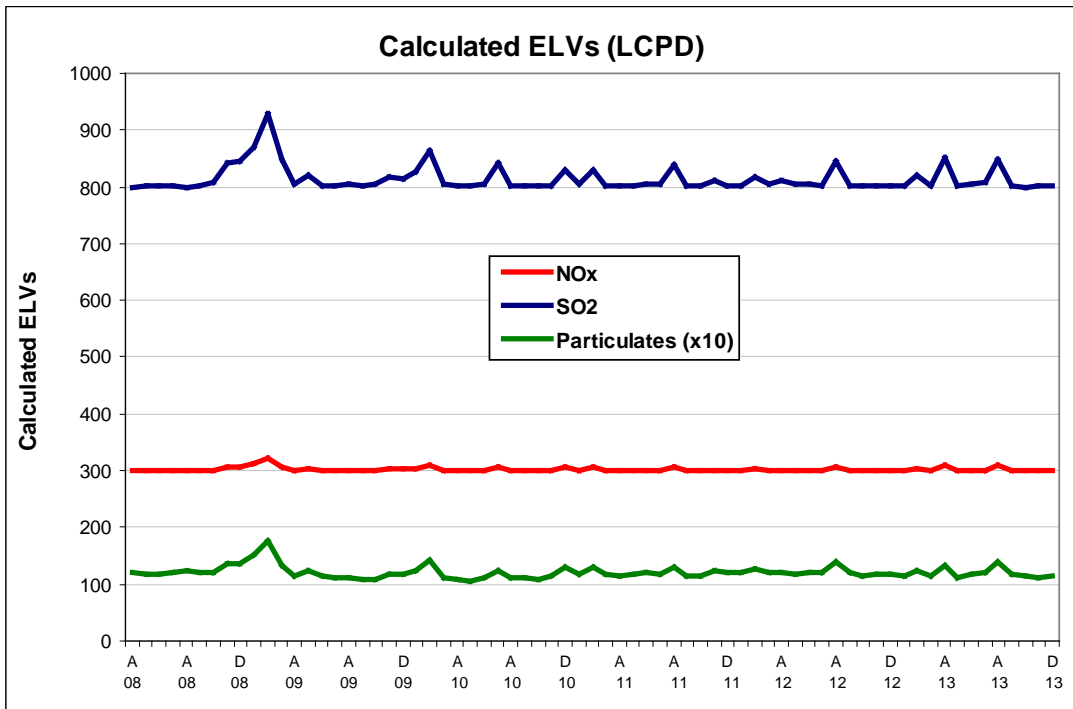
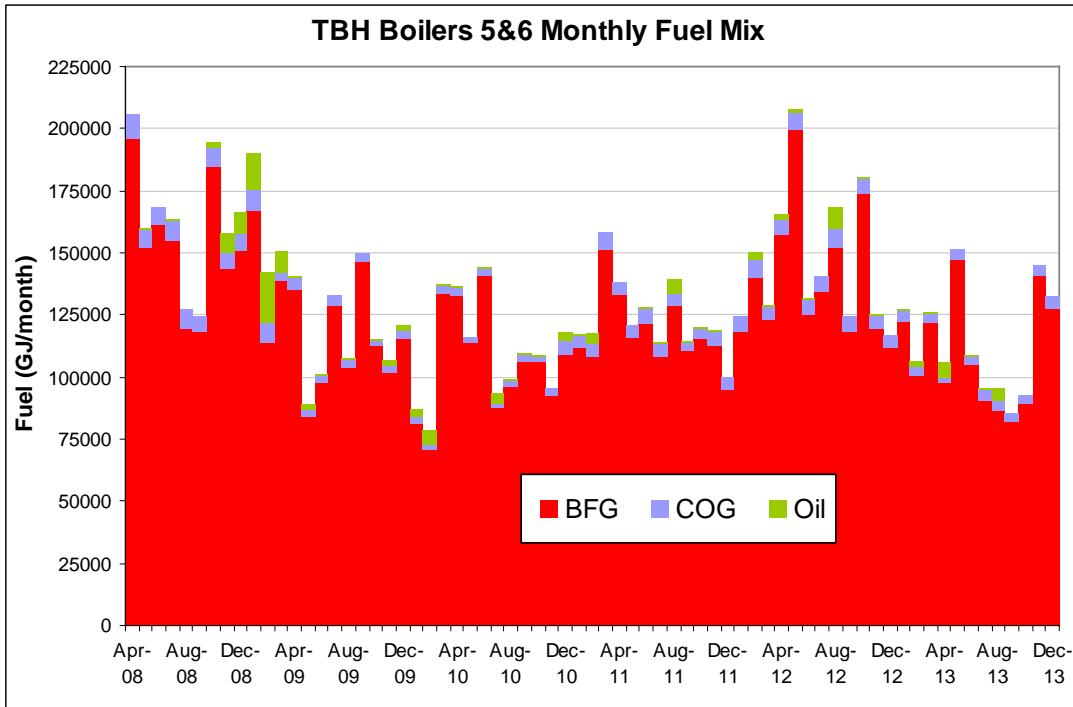
Turbo Blower House 1-4	Dust	Nox-Dry	SO2-Dry
	mg/m3	mg/m3	mg/m3
Max monthly	9.2	29	78
LCPD Fuel-weighted ELV	20	300	800
Max 48-hourly	17	101	96
97th percentile of 48-hourlys	13	38	91
48hrly Limit (110% of ELV)	22	330	880
No. of Exceedences/yr	0	0	0
Max daily	17	169	108
95th percentile of dailys	14	40	91
Daily Limit (121% of ELV)	24	363	968
No. of Exceedences/yr	0	0	0

Comments

- Compliant on all requirements.
- Marginally better on daily compliance than 48-hourly, but either is achievable
- Some margin to reduce ELVs, particularly on NO_x and SO₂, if HFO quantities will remain low.

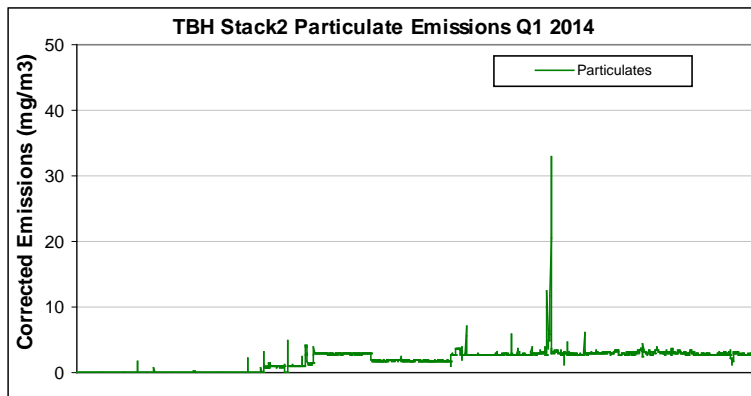
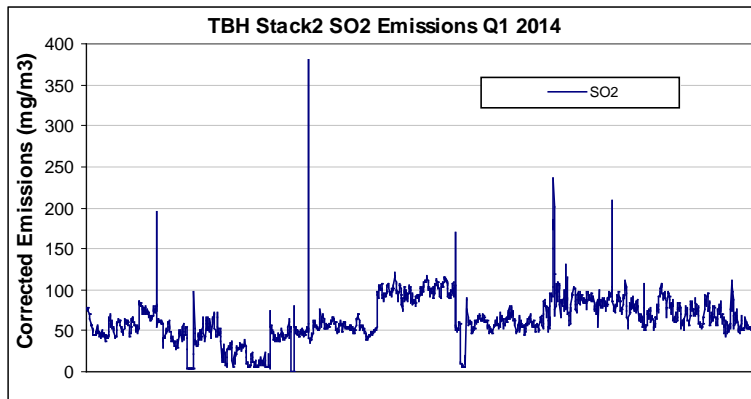
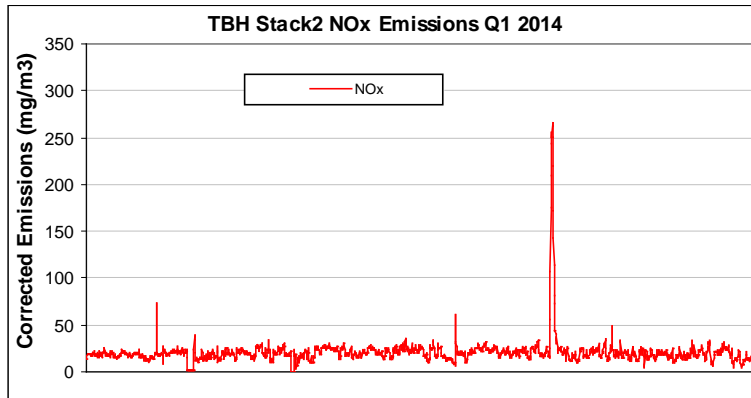
a) Turbo Blower House Boilers 5 & 6 – 2 x 54 MW_{th}

i) Fuel-weighted Emission Limit Values



Fuel-weighted ELVs	LCPD/TNP			IED			Comments
	Part.	NO _x	SO ₂	Part.	NO _x	SO ₂	
Average ELV	12	302	814	11	204	210	All proposed ELVs rounded down, as generally able to comply and max. values occurred in exceptional op. period.
Max. ELV	18	321	929	14	236	232	
Proposed ELV	20	300	800	15	200	300	

ii) Short-term Emissions & Compliance



Turbo Blower House 5&6	Dust	Nox-Dry	SO2-Dry
	mg/m3	mg/m3	mg/m3
Max monthly	3.1	23	75
LCPD Fuel-weighted ELV	20	300	800
Max 48-hourly	5	77	102
97th percentile of 48-hourlys	3	26	100
48hrly Limit (110% of ELV)	22	330	880
No. of Exceedences/yr	0	0	0
Max daily	7	131	108
95th percentile of dailys	3	26	101
Daily Limit (121% of ELV)	24	363	968
No. of Exceedences/yr	0	0	0

Comments

- Compliant on all requirements.
- Marginally better on daily compliance than 48-hourly, but either is achievable.
- Some margin to reduce ELVs, particularly on NO_x and SO₂, if HFO quantities will remain low.