NSW Environment Protection Authority Review of Coal Fired Power Stations Air Emissions and Monitoring

Attachment C:

Compliance with Air Emission Limits, Monitoring and Reporting Requirements

EPA 2018P0702

Contents

Purpose

The purpose of this appendix is to summarise analysis undertaken for the power station review and present data and discussions used to inform the *NSW EPA Review of Coal Fired Power Stations Air Emissions and Monitoring (March 2018)* report.

This appendix includes the following sections:

1) Overview of power station regulatory requirements
2) Compliance with EPL monitoring requirements
3) Compliance with EPL air emission limits
4) Compliance with reporting requirements

1) Overview of Power Station Regulatory Requirements

1.1 Protection of the Environment Operations Act (1997)

The *Protection of the Environment Operations (POEO) Act* 1997 (the Act) is the principal piece of environment protection legislation administered by the EPA. It establishes the NSW environmental regulatory framework including licensing.

Section 128(1) of the Act prescribes that:

> *The occupier of any premises must not carry on any activity, or operate any plant, in or on the premises in such a manner as to cause or permit the emission at any point specified in or determined in accordance with the regulations of air impurities in excess of:*
>
> *(a) the standard of concentration and the rate, or*
>
> *(b) the standard of concentration or the rate,*
>
> *prescribed by the regulations in respect of any such activity or any such plant.*

Clause 38 of the *Protection of the Environment Operations (Clean Air) Regulation 2010* (the Regulation) prescribes that:

> *For the purposes of section 128 (1) of the Act, the prescribed standards of concentration for emissions of air impurities are:*
>
> *(a) in relation to any plant referred to in Schedule 2, the standards of concentration specified in that Schedule in relation to that plant, and*
>
> *(b) in relation to any activity or plant specified in Schedule 3 in respect of a particular purpose, the standards of concentration specified in Schedule 3 in relation to that activity or plant and that purpose, and*
>
> *(c) in relation to any activity or plant specified in Schedule 4 (other than those covered by Schedule 2 or 3), the standards of concentration specified in Schedule 4 in relation to that activity or plant.*

1.2 POEO (Clean Air) Regulation

The Regulation sets emission limits for electricity generation in NSW. The Regulation limits are set based on reasonably available control technology.

Regulation limits for plant and equipment differ according to the general grouping of the activity and plant. Grouping is classified according to the plant vintage, with Group 1 plant being the oldest and Group 6 being the newest. The Regulation prescribes more stringent limits for newer activities and plant. Table 1 summarises the regulatory grouping of NSW power stations.

Table 1: POEO (Clean Air) Regulation (2010) groupings for NSW coal fired power stations.

Station	Commission Date	POEO Grouping
Bayswater	1985-1986	Group 3
Liddell	1971-1973	Group 5*
Mount Piper	1993	Group 4
Eraring	1982	Group 3
Vales Point	1978	Group 5*

**In accordance with clause 35 of the Protection of the Environment Operations (Clean Air) Regulation 2010, any activity or plant that, prior to 1 January 2012, belonged to Group 2 (including any activity or plant previously in Group 1) is taken to belong to Group 5. In accordance with clause 35 Liddell and Vales Point were granted an exemption from Group 5 for the emission of nitrogen oxides.*

The Regulation sets emission limits as standards of concentration, typically expressed as milligrams per cubic metre (mg/m^3), based on reasonably available control technology applicable to the vintage of the plant and equipment. The Regulation lists the standards of concentrations for electricity generation for standard and non- standard fuels in Schedule 3: *Standards of concentration for scheduled premises: activities and plant used for specific purposes.* A copy of the schedule 3 is presented in Table 2 over page.

Schedule 4 of the Regulation prescribes concentration limits for general activities and plant, for pollutants including metals, chlorine and sulfuric acid. The Regulation also restricts the use of high sulfur liquid fuels.

A standard fuel, as defined in the Regulation, means any unused and uncontaminated solid, liquid or gaseous fuel that is:

(a) a coal or coal-derived fuel (other than any tar or tar residues), or
(b) a liquid or gaseous petroleum-derived fuel, or
(c) a wood or wood-derived fuel, or
(d) bagasse.

A non-standard fuel means any fuel other than a standard fuel.

Table 2: POEO (Clean Air) Regulation (2010) Schedule 3: Standards of concentration for electricity generation

Electricity generation			
Air impurity	Activity or plant	Standard of concentration	
Solid particles (Total)	Any activity or plant using a liquid or solid standard fuel or a non-standard fuel	Group 1	400 mg/m^3
		Group 2, 3 or 4	250 mg/m^3
		Group 5	100 mg/m^3
		Group 6	50 mg/m^3
	Any crushing, grinding, separating or materials handling activity	Group 1	400 mg/m^3
		Group 2, 3 or 4	250 mg/m^3
		Group 5	100 mg/m^3
		Group 6	20 mg/m^3
Nitrogen dioxide (NO_2) or nitric oxide (NO) or both, as NO_2 equivalent	Any boiler operating on a fuel other than gas, including a boiler used in connection with an electricity generator that forms part of an electricity generating system with a capacity of 30 MW or more	Group 1, 2, 3 or 4	2,500 mg/m^3
		Group 5	800 mg/m^3
		Group 6	500 mg/m^3
	Any turbine operating on gas, being a turbine used in connection with an electricity generating system with a capacity of 30 MW or more	Group 1, 2, 3 or 4	2,500 mg/m^3
		Group 5 or 6	70 mg/m^3
	Any turbine operating on a fuel other than gas, being a turbine used in connection with an electricity generating system with a capacity of 30 MW or more	Group 1, 2, 3 or 4	2,500 mg/m^3
		Group 5	150 mg/m^3
		Group 6	90 mg/m^3
Fluorine (F_2) and any compound containing fluorine, as total fluoride (HF equivalent)	Any activity or plant using a liquid or solid standard fuel or a non-standard fuel	Group 1	100 mg/m^3
		Group 2, 3, 4, 5 or 6	50 mg/m^3
Type 1 substances (in aggregate)	Any activity or plant using a non-standard fuel	Group 1, 2 or 3	20 mg/m^3
		Group 4	10 mg/m^3
		Group 5 or 6	—
Type 1 substances and Type 2 substances (in aggregate)	Any activity or plant using a non-standard fuel	Group 1, 2, 3 or 4	—
		Group 5	5 mg/m^3
		Group 6	1 mg/m^3
Cadmium (Cd) or mercury (Hg) individually	Any activity or plant using a non-standard fuel	Group 1, 2 or 3	—
		Group 4	3 mg/m^3
		Group 5	1 mg/m^3
		Group 6	0.2 mg/m^3
Dioxins or furans	Any activity or plant using a non-standard fuel that contains precursors of dioxin or furan formation	Group 1, 2, 3, 4 or 5	—
		Group 6	0.1 ng/m^3
Volatile organic compounds (VOCs), as n-propane equivalent	Any activity or plant using a non-standard fuel	Group 1, 2, 3, 4 or 5	—
		Group 6	40 mg/m^3 VOCs or 125 mg/m^3 CO
Smoke	Any activity or plant using a liquid or solid standard fuel or a non-standard fuel	Group 1, in approved circumstances	Ringelmann 3 or 60% opacity
		Group 1, in other circumstances	Ringelmann 2 or 40% opacity
		Group 2, 3, 4, 5 or 6, in approved circumstances	Ringelmann 3 or 60% opacity
		Group 2, 3, 4, 5 or 6, in other circumstances	Ringelmann 1 or 20% opacity

1.3 Regulatory Air Emission Limits

Each of the coal fired power stations in NSW are required to comply with the following limits:

i. Protection of the Environment Operations (Clean Air) Regulation 2010
ii. Environment protection licence – Air Concentration Limits
iii. Environment protection licence – Reporting Limits

The regulatory air emission limits, applicable to the NSW coal fired power stations, are summarised in Table 3. If an EPL does not specify a concentration limit for a pollutant, the Regulation limit applies (green cells). As the EPL cannot be less stringent than the Regulation, EPL limits were used to determine compliance. Emission limits, specific to electricity generation, are prescribed in Schedule 3 of the Regulation.

Table 3: Summary of applicable regulatory air emission limits for NSW coal fired power stations.

	Environment Protection Licence Concentration Limits												POEO (2010)		EPL Reporting Limits		
	Solid particles (Total) (mg/m^3)	Total Fluoride (mg/m^3)	Type 1 & 2 Substances (Metals) (mg/m^3)	Cadmium (mg/m^3)	Mercury (mg/m^3)	NOx as Equivalent NO_2 (mg/m^3)	Dioxins & Furans ((mg/m^3)	Sulfuric Acid Mist (H_2SO_4 as SO_3) (mg/m^3)	Hydrogen Chloride (mg/m^3)	Chlorine (mg/m^3)	Volatile Organic Compounds (mg/m^3)	Coal Sulfur Content Limit (% weight)	Cadmium (mg/m^3)	Smoke (Opacity)	NOx as Equivalent NO_2 (mg/m^3)	Sulfur Dioxide (mg/m^3)	Smoke (Opacity)
Bayswater	100	50	5	1	1	1500	-	100	100	200	-	-	-	20%	-	1760	-
Liddell	100	50	5	1	1	1500*	-	100	100	200	-	1.0	-	20%	1438	1760	20%
Eraring	50	50	1	0.2	0.2	1100	-	100	100	200	-	0.5	-	20%	-	1760	-
Mount Piper	50	50	1	**	0.2	1500	0.1	100	100	200	40	-	3	20%	-	-	-
Vales Point	100	50	5	1	1	1500*	-	100	100	200	-	0.5	-	20%	-	1760	-

**In accordance with clause 35 of the Protection of the Environment Operations (Clean Air) Regulation 2010, Liddell and Vales Point were granted an exemption from Group 5 for the emission of nitrogen oxides.*

*** Cadmium is included in Type 1 and Type 2 Substances in aggregate.*

2) Compliance with EPL Monitoring Requirements

This section of the review provides an overview of the methods used by EPA to determine compliance with the following specific EPL monitoring conditions:

i. Specific pollutants sampled and sampling frequency
ii. Emission testing companies and accredited laboratories
iii. Sampling methods used

2.1 Pollutants Sampled and Sampling frequency

Each power station is required to monitor, by sampling and obtaining results by analysis, the concentration of each pollutant discharged, as specified in their EPL. Sampling frequency and units of measure are also prescribed. A summary of monitoring requirements is provided in table 5 (over page).

A review of 108 test reports identified two instances of failure to complete required testing:

- Liddell Power Station did not perform sampling on Unit 1 in 2014 – occurred due to unplanned boiler outages.
- Liddell Power Station did not sample for VOC emissions between 2011 and 2014 – occurred due to an oversight in the sampling program.

Liddell power station reported each of the non-compliances to the EPA in Annual Returns, as per the reporting requirements of their EPL. A summary of the reported non-compliances is provided in Table 4.

Table 4: Summary of Liddell power stations non-compliance reports

Location	Annual Return	Summary	Cause
Liddell Power Station	86566	Monitoring of VOC concentrations on points 2 & 4 were not carried out after change in requirements. Unit 1 out of service for major outage until 24/9/14. Unit was put back in service at this time and was scheduled to be emission tested on 2/12/14. The unit suffered a catastrophic failure on 18/11/14 and has been out of service since this time so was not tested.	Due to an oversight.
Liddell Power Station	86998	No VOC monitoring was completed during the reporting period, or the previous year, due to an oversight in the monitoring regime. The next monitoring event is scheduled for October 2014 and is to incorporate VOC monitoring.	An oversight in the monitoring regime.

Table 5: NSW Coal Fired power stations - Environment Protection Licence overview

Cell code	Interpretation
M	Monitoring only
1	Monitoring and limit
1	Limit more stringent than other plants
1	Limit only
	Point of inconsistency
	Not applicable

				Bayswater Power Station		Eraring Power Station	Liddell Power Station	Mount Piper Power Station	Vales Point Power Station
Group under Part V of POEO (Clean Air) Reg 2010:				*3*		*3 (EPL subject to more stringent limits)*	*5 (NOx subject to PRP)*	*4*	*5 (NOx = Group 2)*
Air emission monitoring point number(s):				*10*	*11, 12, 13*	*11, 12, 13, 14*	*1, 2, 3, 4*	*2, 3*	*11, 12*
Air emission monitoring point(s) description:				*10: Boiler 1*	*11: Boiler 2* *12: Boiler 3* *13: Boiler 4*	*11: Boiler 1* *12: Boiler 2* *13: Boiler 3* *14: Boiler 4*	*1: Unit 1 / Boiler 1-2* *2: Unit 2 / Boiler 1-2* *3: Unit 3 / Boiler 3-4* *4: Unit 4 / Boiler 3-4*	*2: Boiler 1* *3: Boiler 2*	*11: Boiler 5* *12: Boiler 6*
Reference basis:				Dry, 273 K, 101.3 kPa*	Dry, 273 K, 101.3 kPa*	Dry, 273 K, 101.3 kPa, 7% O2	Dry, 273 K, 101.3 kPa, 7% O2	Dry, 273 K, 101.3 kPa**	Dry, 273 K, 101.3 kPa**
Pollutant	**Method**	**Frequency**	**Unit Of Measure**						
Cadmium	TM-12	Yearly	mg/m3	1	1		1		
	TM-14	Yearly	mg/m3			0.2			1
Carbon dioxide	TM-24	Yearly	%	M	M	M		M	
			mg/m3				M		
Carbon monoxide	OM-1	Yearly	ppm			M			
	TM-32	Yearly	ppm	M	M				
Chlorine	TM-7 & TM-8	Yearly	mg/m3	200	200	200	200	200	200
Copper	TM-12, TM-13 & TM-14	Yearly	mg/m3	M	M	M	M	M	M
Dioxins & Furans	TM-18	Yearly	ng/m3					0.1	
Dry gas density	TM-23	Yearly	kg/m3	M	M	M	M	M	
Hydrogen chloride	TM-7 & TM-8	Yearly	mg/m3	100	100		100	100	100
	TM-8	Yearly	mg/m3			100			
Mercury	TM-12	Yearly	mg/m3	1	1		1		
	TM-12, TM-13 & TM-14	Yearly	mg/m3					0.2	
	TM-14	Yearly	mg/m3			0.2			1
Nitrogen Oxides	CEM-2	Continuous	g/m3	M					
			mg/m3	1500		1100			
	In line instrumentation	Continuous	mg/m3						1500
	Special Method 2	Quarterly	g/m3					1.5	
	TM-11	Yearly	g/m3		M				
			mg/m3		1500		1500		
Oxygen (O2)	CEM-3	Yearly	%					M	
	TM-25	Yearly	%	M	M		M		
Sulfuric acid mist and sulfur trioxide (as SO3)	TM-3	Yearly	mg/m3	100	100	100	100	100	100
Sulphur dioxide	CEM-2	Continuous	mg/m3	M		M			
	In line instrumentation	Continuous	ppm						M
	TM-4	Quarterly	mg/m3					M	
		Yearly	mg/m3		M		M		
Total Fluoride	TM-9	Yearly	mg/m3	50	50	50	50	50	50
Solid Particles	TM-15	Yearly	mg/m3	100	100	50	100	50	
Total Solid Particles	TM-15	Yearly	mg/m3						100
Type 1 and Type 2 substances in aggregate	TM-12 & TM-13	Yearly	mg/m3			1			5
	TM-12, TM-13 & TM-14	Yearly	mg/m3				5	1	
Hazardous substances	TM-12, TM-13 & TM-14	Yearly	mg/m3	5	5	M			
Undifferentiated Particulates	CEM-1	Continuous	%Opacity	M	M		M		
			mg/m3			M			
	In line instrumentation	Continuous	mg/m3						M
Volatile organic compounds	OM-2	Yearly	ppm						M
	TM-19	Yearly	mg/m3					40	
	TM-34	Yearly	mg/m3				M		
			ppm			M			

Tables 6 – 10 show the periodic testing completed at each power station between 2011-2016.

Table 6: Liddell Power Station - Summary of completed periodic testing requirements (2011-2016).

Liddell Power Station Testing Summary (2011-2016)															
	Reporting Year	Test Period	Testing Company	Report Number	Total Solid Particles	Total Fluoride	Cadmium	Sulfuric Acid Mist	Sulfur Dioxide	Type 1 & 2 Substances	Total Oxides of Nitrogen	Hydrogen Chloride	Chlorine	Total Volatile Organic Compounds (VOCs)	Mercury
Unit 1	2011/12	Mar-12	EML Air	N88907	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓
	2012/13	Jul-12	EML Air	N89572	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓
	2013/14	Dec-13	EML Air	N92004	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓
	2014/15	-	-	-	×	×	×	×	×	×	×	×	×	×	×
	2015/16	Sep-15	Ektimo	R001526	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Unit 2	2011/12	Apr-12	EML Air	N89101	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓
	2012/13	Mar-13	EML Air	N90665	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓
	2013/14	May-14	EML Air	N92641	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓
	2014/15	Sep-14	EML Air	N93227	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓
	2015/16	Sep-15	Ektimo	R001528	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Unit 3	2011/12	Feb-12	EML Air	N88719	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓
	2012/13	Nov-12	EML Air	N90222	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓
	2013/14	Oct-13	EML Air	N91777	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓
	2014/15	Dec-14, Apr-13	Ektimo	R000274/ R000983	✓	✓	✓		✓	✓	✓	✓	✓	×	✓
	2015/16	Jun-16	Ektimo	R002265	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Unit 4	2011/12	Mar-12	EML Air	N88907	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓
	2012/13	Feb-13	EML Air	N90538	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓
	2013/14	May-14	EML Air	N92641	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓
	2014/15	May-15	Ektimo	R000495	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2015/16	Jan-16	Ektimo	R002267	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 7: Bayswater Power Station - Summary of completed periodic testing requirements (2011-2016).

Bayswater Power Station Testing Summary (2011-2016)														
	Year	Testing Company	Month Tested	Report Number	Total Solid Particles	Oxides of Nitrogen	Mercury	Cadmium	Type 1 & 2 Substances (Metals)	Total Fluoride	Sulfuric Acid Mist (H2SO4 as SO3) (mg/m3)	Hydrogen Chloride	Chlorine	Total Volatile Organic Compounds (VOCs)
Unit 1	2011	AECOM	Nov	60238663	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2012	EML Air	Mar	N88963	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2013	EML Air	Mar	N90690	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2014	Ektimo	Dec	R000276	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2015	Ektimo	Oct	R001850	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Unit 2	2011	AECOM	April	60153034	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2012	EML Air	June July	N89366 N89570	✓	✓	✓	✓	✓	✓	✓ ✓	✓	✓	✓
	2013	EML Air	May	N90987	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2014	EML Air	Sep	N93228	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2015	Ektimo	July	R001382	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Unit 3	2011	AECOM	July	60153034	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2012	EML Air	Oct	N90008	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2013	EML Air	Nov	N91873	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2014	EML Air	Jun	N92798	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2015	Ektimo	Jul	R001380	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Unit 4	2011	AECOM	Nov	60238663	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2012	EML Air	Aug	N89695	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2013	EML Air	Aug	N91470	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2014	EML Air	Aug	N93026	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2015	Ektimo	May	R000514	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 8: Vales Point Power Station - Summary of completed periodic testing requirements (2011-2016).

Vales Point Power Station Testing Summary (2011-2016)														
	Reporting Year	Testing Company	Month Tested	Report Number	Total Solid Particles	Total Fluoride	Sulfuric Acid Mist	Hydrogen Chloride	Chlorine	Total Volatile Organic Compounds (VOCs)	Mercury	Cadmium	Type 1 & 2 Substances
Unit 5	2011/12	AECOM	August	60158957	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2012/13	AECOM	Nov	60158957	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2013/14	EML Air	Dec	N91964	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2014/15	AECOM	Jan/Feb	60337371_1.1	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2015/16	AECOM	Mar	60337371	✓	✓	✓	✓	✓	✓	✓	✓	✓
Unit 6	2011/12	AECOM	Apr/May	60158957	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2012/13	AECOM	Oct/ Nov	60158957	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2013/14	EML Air	Feb	N92198	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2014/15	AECOM	Feb	60337371_1.1	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2015/16	AECOM	Mar	60337371	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 9: Eraring Power Station - Summary of completed periodic testing requirements (2011-2016).

Eraring Power Station Testing Summary (2011-2016)													
	Reporting Year	Test Period	Report Number	Testing Company	Solid Particles	Mercury	Cadmium	Type 1 & 2 Substances	Total Fluoride	Sulfuric Acid Mist (H_2SO_4 as SO_3)	Hydrogen Chloride	Chlorine	Total Volatile Organic Compounds (VOCs)
Unit 1	2011/12	Feb-12	210261	Aurecon	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2012/13	Nov-12	210261	Aurecon	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2013/14	Feb-14	210261	Aurecon	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2014/15	Feb-15	60331358	AECOM	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2015/16	Apr-16	60331358	AECOM	✓	✓	✓	✓	✓	✓	✓	✓	✓
Unit 2	2011/12	May-12	210261	Aurecon	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2012/13	May-13	210261	Aurecon	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2013/14	May-14	210261	Aurecon	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2014/15	Aug-14	60290356	AECOM	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2015/16	Jan- 16	60331358	AECOM	✓	✓	✓	✓	✓	✓	✓	✓	✓
Unit 3	2011/12	Nov-11	210261	Aurecon	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2012/13	Aug-12	210261	Aurecon	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2013/14	Aug-13	210261	Aurecon	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2014/15	May, Aug-15	60331358	AECOM	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2015/16	Jun-16	60331358	Aurecon	✓	✓	✓	✓	✓	✓	✓	✓	✓
Unit 4	2011/12	Aug-11	210261	Aurecon	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2012/13	Jan-13	210261	Aurecon	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2013/14	Oct-13	210261	Aurecon	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2014/15	Nov, Dec, Feb-14	60331358	AECOM	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2015/16	Nov-15, Jun-16	60331358	AECOM	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 10: Mount Piper Power Station - Summary of completed periodic testing requirements (2011-2016).

Mount Piper Power Station Testing Summary (2011-2016)																
Unit	Reporting Year	Testing Company	Test Period	Report Number	Solid Particles	Sulfur trioxide as SO3	Total Fluoride	Hydrogen Chloride	Chlorine as Cl2	Copper	Mercury	Type 1 & 2 Substances	Volatile Organic Compounds	Dioxins and Furans	Nitrogen Oxides	Sulfur Dioxide
1	2011	EML Air	Feb-11	86925	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1	2011	EML Air	Feb-11	86870											✓	✓
1	2011	EML Air	May-11	87667											✓	✓
1	2011	EML Air	Jul-11	87916											✓	✓
1	2011	EML Air	Oct-11	88355											✓	✓
1	2012	EML Air	Feb-12	N88756	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1	2012	EML Air	May-12	N89474											✓	✓
1	2012	EML Air	Jul-12	N89515											✓	✓
1	2012	EML Air	Nov-12	N90182											✓	✓
1	2013	EML Air	Feb-13	N90367											✓	✓
1	2013	EML Air	May-13	N91005	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1	2013	EML Air	Jul-13	N91300											✓	✓
1	2013	EML Air	Nov-13	N91743											✓	✓
1	2014	EML Air	Feb-14	N92159											✓	✓
1	2014	EML Air	May-14	N92612	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1	2014	EML Air	Jul-14	N92972											✓	✓
1	2014	EML Air	Jul-14	N93009											✓	✓
1	2014	EML Air	Oct-14	N93310											✓	✓
1	2015	Ektimo	Mar-15	R000778											✓	✓
1	2015	Ektimo	May-15	R001085											✓	✓
1	2015	Ektimo	Jun-15	R001229a	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1	2015	Ektimo	Aug-15	R001461											✓	✓
1	2015	Ektimo	Oct-15	R001748											✓	✓
1	2016	Ektimo	Jan-16	R002263											✓	✓
1	2016	Ektimo	Apr-16	R002528	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1	2016	Ektimo	Aug-16	R003249											✓	✓
1	2016	Ektimo	Dec-16	R003428											✓	✓
2	2011	EML Air	Feb-11	86870											✓	✓
2	2011	EML Air	May-11	87667											✓	✓
2	2011	EML Air	May-11	87666	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2	2011	EML Air	Jul-11	87916											✓	✓
2	2011	EML Air	Oct-11	88355											✓	✓
2	2012	EML Air	Feb-12	N88795	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2	2012	EML Air	May-12	N89474											✓	✓
2	2012	EML Air	Jul-12	N89515											✓	✓
2	2012	EML Air	Nov-12	N90182											✓	✓
2	2013	EML Air	Feb-13	N90367											✓	✓
2	2013	EML Air	Jun-13	N91005	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2	2013	EML Air	Jul-13	N91300											✓	✓
2	2013	EML Air	Nov-13	N91743											✓	✓
2	2014	EML Air	Feb-14	N92159											✓	✓
2	2014	EML Air	Apr-14	N92464	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2	2014	EML Air	Jul-14	N92972		✓									✓	✓
2	2014	EML Air	Oct-14	N93310											✓	✓
2	2015	Ektimo	Mar-15	R000778											✓	✓
2	2015	Ektimo	Apr-15	R000965											✓	✓
2	2015	Ektimo	Jun-15	R001234	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2	2015	Ektimo	Aug-15	R001461											✓	✓
2	2015	Ektimo	Oct-15	R001748											✓	✓
2	2016	Ektimo	Jan-16	R002263											✓	✓
2	2016	Ektimo	Apr-16	R002528											✓	✓
2	2016	Ektimo	Apr-16	R002529	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2	2016	Ektimo	Aug-16	R003249											✓	✓
2	2016	Ektimo	Dec-16	R003428											✓	✓

2.2 Emission Testing Companies and Accredited Laboratories

Sampling and analysis of air emissions must be performed in accordance with test methods contained in the publication *Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (2007)* (Approved Methods Sampling)[1]. Section 3 of the Approved Methods Sampling states: "*Analysis should be carried out by a laboratory accredited to perform them, by an independent accreditation body acceptable to the EPA, such as the National Association of Testing Authorities (NATA)*".

The review found all analysis of samples collected from coal fired power stations was conducted by NATA accredited companies. A list of all testing companies contracted to perform sampling or analysis at NSW power stations between 2011 and 2016 is provided in Table 11.

Table 11: Summary of testing companies used to sample and analyse air emissions (2011-2016)

Testing Company / Laboratory Name	NATA #
AECOM	2778
AURECON (sampling at Eraring pre-2015)	
Australian Laboratory Services (ALS)	825
Ektimo	2732
EML (Chem)	2731
EML Air	2732
Envirolab Services	2901
Leeder Consulting	2562
Micro Analysis Australia (Particle sizing only – No regulatory requirement)	
SGS Environmental	2562
Steel River Testing	18079

2.3 Sampling Methods

Sampling of power station air emissions must be performed using the sampling method listed in the licensees EPL and in accordance with the Approved Methods Sampling.

The review found the sampling methods used by sampling consultants, as reported in stack testing reports, are consistent with EPL and Approved Methods Sampling requirements. A summary of stack test reports reviewed is provided in Table 12.

The review identified the following two points for further discussion:

1) The sampling planes for all power stations have been identified as non-ideal in accordance with Australian Standards 4323.1. As the sampling planes are non-ideal, all power stations measure stack gas flow rates using USEPA Method 1, in place of AS4323.1. This is in accordance with the approved circumstances of section 2: *Sample collection and handling,* of the NSW Approved Methods for Sampling.

2) The EPL for Mount Piper power station incorrectly references TM-19 as the sampling method for Volatile Organic Compounds (VOCs). Test Method 19 (TM-19) is the NSW Approved sampling method for Volatile Organic Liquids. The correct NSW Approved Method that should be referenced in the EPL is TM-34. Stack testing reports have referenced the correct sampling method (TM-34) for the period included in the review.

1 Approved Methods Sampling: http://www.environment.nsw.gov.au/resources/air/07001amsaap.pdf

3) Compliance with EPL Air Emission Limits

To determine if the power stations are compliant with their EPL air emission limits, five consecutive years (2011-2016) of stack test reports were reviewed for each power station – totalling 108 reports. Table 12 provides a list of reports reviewed.

Table 12: Summary of 108 stack sampling reports included in the power station review.

	Year	Month	Report #	Published By		Year	Month	Report #	Published By
Bayswater	2011	November	60238663	AECOM		2013	October	N91470	EML Air
	2011	May	60153034	AECOM		2013	December	N91873	EML Air
	2011	August	60153034	AECOM		2014	January	N92115	EML Air
	2012	January	60238663	AECOM		2014	July	N92798	EML Air
	2012	April	N88963	EML Air		2014	September	N93026	EML Air
	2012	July	N89366	EML Air		2014	October	N93228	EML Air
	2012	August	N89570	EML Air		2015	January	R000276	Ektimo
	2012	October	N89695	EML Air		2015	July	R000514	Ektimo
	2012	November	N90008	EML Air		2015	August	R001380	Ektimo
	2012	October	N90039	EML Air		2015	August	R001382	Ektimo
	2014	October	N90690	EML Air		2015	November	R001850	Ektimo
	2013	June	N90987	EML Air					
Eraring	2011	August	201261	Aurecon		2014	August	60290356/1.9_Report 1	AECOM
	2011	November	201261	Aurecon		2014	November	60331358/02.01.01_Report 1	AECOM
	2012	February	210261	Aurecon		2014	December	60331358/02.01.01_Report 2	AECOM
	2012	May	210261	Aurecon		2014	February	60331358/02.01.01_Report 3	AECOM
	2012	August	210261	Aurecon		2015	February	60331358/02.01.02_Report 1	AECOM
	2012	November	210261	Aurecon		2015	May	60331358/02.01.03_Report 1	AECOM
	2013	January	210261	Aurecon		2015	August	60331358/02.01.04_RPT	AECOM
	2013	May	210261	Aurecon		2015	November	60331358/02.01.05_RPT	AECOM
	2013	August	210261	Aurecon		2016	January	60331358_02.01.06	AECOM
	2013	October	210261	Aurecon		2016	April	60331358_02.01.07	AECOM
	2014	February	210261	Aurecon		2016	June	60331358_02.01.0	AECOM
	2014	May	210261	Aurecon					
Liddell	2012	February	N88719	EML Air		2014	June	N92641	EML Air
	2012	March	N88907	EML Air		2014	October	N93227	EML Air
	2012	April	N89101	EML Air		2015	January	R000274	Ektimo
	2013	February	N90538	EML Air		2015	June	R000495	Ektimo
	2012	July	N89572	EML Air		2015	May	R000983	Ektimo
	2013	March	N90665	EML Air		2015	November	R001526	Ektimo
	2012	November	N90222	EML Air		2015	November	R001528	Ektimo
	2013	October	N91777	EML Air		2016	July	R002265	Ektimo
	2013	December	N92004	EML Air		2016	March	R002267	Ektimo
Vales Point	2011	September	60158957	AECOM		2014	February	N92198	EML Air
	2012	June	60158957	AECOM		2015	July	60337371	AECOM
	2013	February	60158957	AECOM		2016	June	60337371	AECOM
	2013	December	N91964	EML Air					
Mount Piper	2011	May	N87667	EML Air		2014	may	N92621	EML Air
	2011	May	N87666	EML Air		2014	April	N92464	EML Air
	2011	July	N87916	EML Air		2014	July	N92972	EML Air
	2011	October	N88355	EML Air		2014	October	N93310	EML Air
	2012	July	N88756	EML Air		2015	March	R000778	Ektimo
	2012	July	N88795	EML Air		2015	April	R000965	Ektimo
	2012	March	N88873	EML Air		2015	may	R001085	Ektimo
	2012	February	N88796	EML Air		2015	June	R001234	Ektimo
	2012	may	N89474	EML Air		2015	June	R001229a	Ektimo
	2012	July	N89515	EML Air		2015	June	R001236	Ektimo
	2012	November	N90182	EML Air		2015	August	R001461	Ektimo
	2013	February	N90367	EML Air		2015	October	R001748	Ektimo
	2013	February	N90367	EML Air		2016	January	R002263	Ektimo
	2013	may	N91005	EML Air		2016	January	R002263	Ektimo
	2013	June	N91005	EML Air		2016	April	R002528 & R002527	Ektimo
	2013	July	N91300	EML Air		2016	April	R002528 & R002529	Ektimo
	2013	November	N91743	EML Air		2016	August	R003249	Ektimo
	2014	February	N92159	EML Air		2016	December	R003428	Ektimo

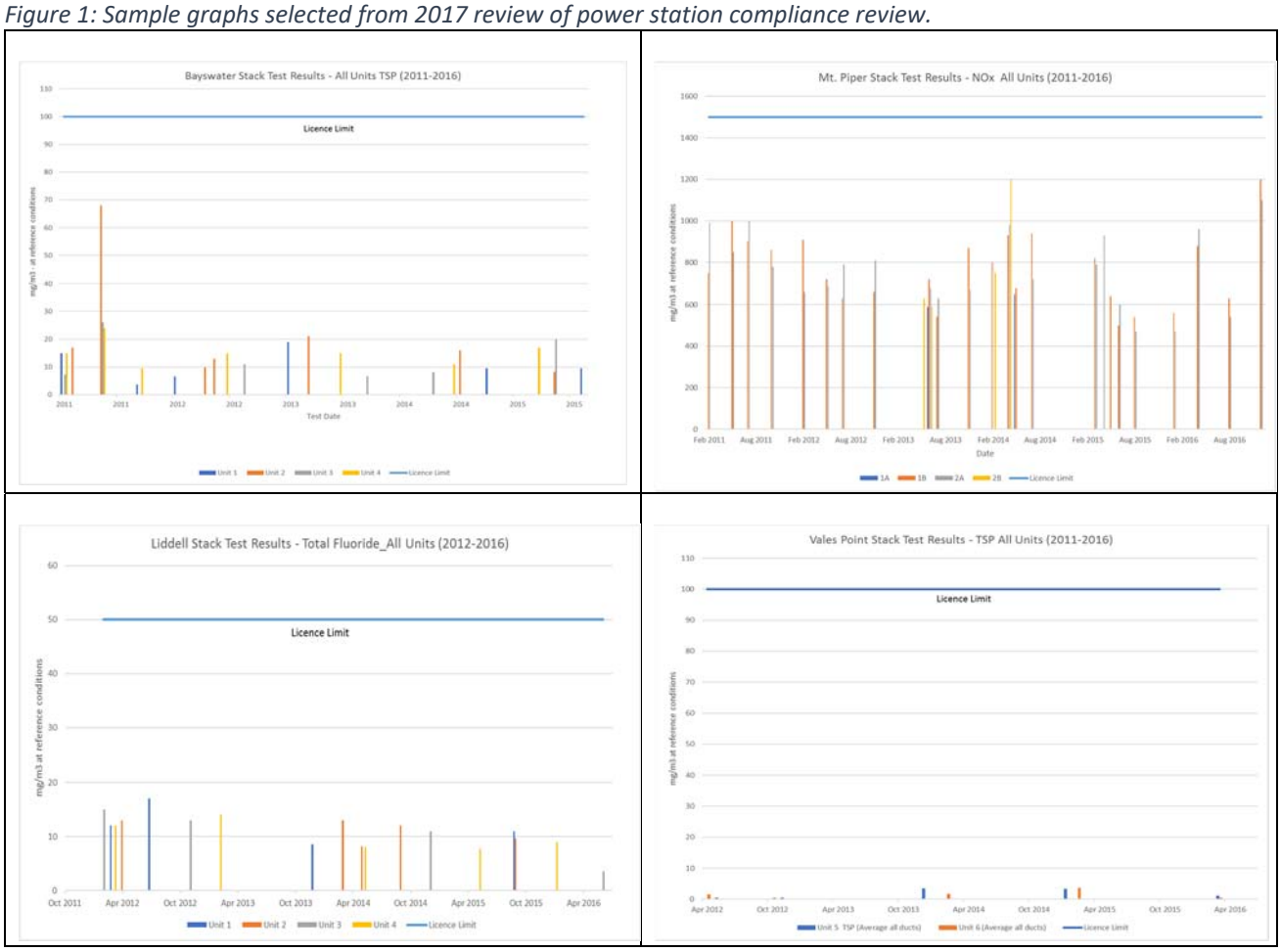
Reported emission concentrations were graphed to assist with the identification of any high concentrations of pollutants. A sample of graphs that were used in the review are provided in Figure 1 below, the EPL emission limits are identified by the blue line.

The review identified a number of pollutants routinely measured at levels appreciably below EPL emission limits. For example:

- Solid particles are routinely measured below 20 mg/m^3 at Bayswater and Vales Point power stations – approximately 20% of the EPL limit.
- Chlorine concentrations are routinely reported below 10 mg/m^3 – approximately 5% of the 200mg/m^3 EPL limits.
- Cadmium and Mercury concentrations are routinely measured far below EPL emission limits.

Based on historical data trends and reported concentrations of emissions, there may be opportunities for the EPA to review current licence limits and consider revising limits which are more reflective of achievable levels informed by proper and efficient operation of the plant.

Figure 1: Sample graphs selected from 2017 review of power station compliance review.



3.1 EPL Air Emission Limits – Identified non-compliances

To investigate if the power stations are compliant with EPL emission limits, reported pollutant concentrations from stack test reports were compared to EPL emission concentration limits.

As per Table 3, EPL limits are equal to or more stringent than the Regulation limits. Compliance with EPL limits was used to determine compliance with the Regulation.

Of the 108 test reports reviewed (refer to Table 12), two exceedances of EPL air emission concentration limits were identified:

1. Bayswater had a single exceedance of the EPL air emission limit for total fluoride in June 2012.
2. Mount Piper had a single exceedance of the EPL air emission limit for sulfuric acid in April 2014.

A summary of the two EPL concentration limit exceedances identified in this review is provided in Table 13. Further information and discussion regarding each exceedance is presented in Section 3.2 and 3.3 below.

Table 13: Summary of licence limit exceedances - Periodic sampling results (2011-2016).

Summary of Licence Limit Exceedances – From Stack Sampling Results						
Exceedance No.	Station	EPL No.	Reporting Year	Parameter	Licence Limit	Reported Value
1	Bayswater	779	2012/2013	Total Fluoride	50 mg/m^3	54 mg/m^3
2	Mount Piper	13007	2013/2014	Sulfuric Acid Mist as SO_3	100 mg/m^3	120 mg/m^3

A summary of the results is provided in Table 14 over page.

Table 14: EPL emission limits vs measured concentrations of air pollutants from NSW Coal Fired power stations (2011-2016)

		Solid particles (Total) (mg/m^3)	Total Fluoride (mg/m^3)	Type 1 & 2 Substances (Metals) (mg/m^3)	Cadmium (mg/m^3)	Mercury (mg/m^3)	Total Oxides of Nitrogen (NOx as Equivalent NO_2) (mg/m^3)	Dioxins & Furans (ng/m^3)	Total Volatile Organic Compounds (VOCs) (mg/m^3)	Sulfuric Acid Mist (H_2SO_4 as SO_3) (mg/m^3)	Hydrogen Chloride (mg/m^3)	Chlorine (mg/m^3)
Bayswater	Licence Limit	100	50	5	1	1	1500	-	-	100	100	200
	Average	15	13	0.13	0.0004	0.0014	659	-	1.5	13	13	18.8
	Max	68	**54**	1.30	0.0017	0.0053	940	-	2.9	55	24	200.0
Liddell	Licence Limit	100	50	5	1	1	1500	-	-	100	100	200
	Average	24	11	0.22	0.0015	0.0004	724	-	0.03	9	14	0.04
	Max	58	17	1.80	0.0260	0.0015	930	-	0.1	58	28	0.2
Eraring	Licence Limit	50	50	1	0.2	0.2	1100	-	-	100	100	200
	Average	9	10	0.04	0.0067	0.0010	415	-	2.8	11	4	0.4
	Max	19	32	0.31	0.0580	0.0022	593	-	5.7	68	13	1.8
Mount Piper	Licence Limit	50	50	1	3	0.2	1500	0.1	40	100	100	200
	Average	11	6	0.10	0.0002	0.0010	770	0.019	0.2	21	1	1.3
	Max	39	11	0.66	0.0008	0.0019	1200	0.071	1.0	**120**	2	13.0
Vales Point	Licence Limit	100	50	5	1	1	1500	-	-	100	100	200
	Average	2	3	0.04	0.0069	0.0012	881	-	0.6	15	4	1.1
	Max	7	12	0.21	0.0310	0.0078	1099	-	2.2	42	8	3.8

Note: 1 Results highlighted in red indicate an exceedance of EPL concentration limit.

3.2 Bayswater Non-Compliance: Total Fluoride

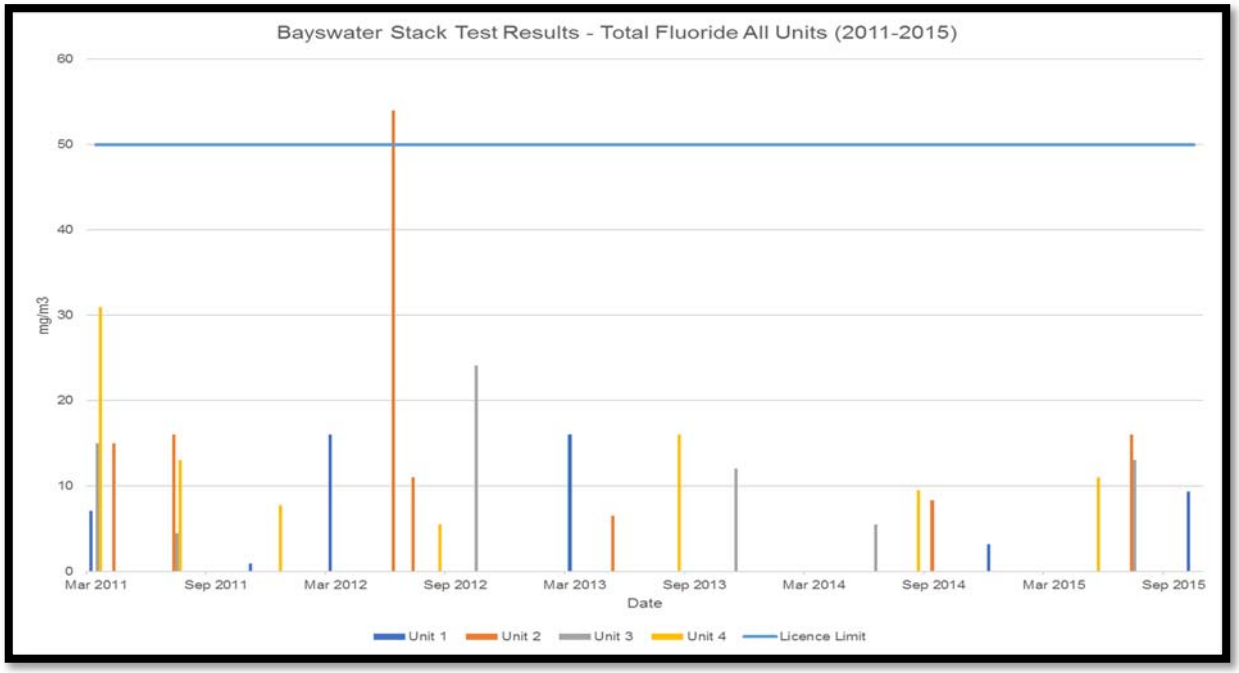
The emission monitoring requirements for Bayswater Power Station are detailed in EPL 779. The EPL requires Bayswater to periodically monitor total fluoride emissions to air and report the concentration. The concentration limit for total fluoride at Bayswater is 50 milligrams per cubic metre (mg/m^3) - reported at reference conditions.

The review of periodic stack sampling conducted at Bayswater found measured in-stack concentrations of total fluoride exceeded the 50 mg/m^3 limit on 5th June 2012. The result was 54 mg/m^3, measured from boiler Unit 2, Duct B. The result was reported in EML Air report N89366[2]. The exceedance was not reported in Bayswater's Annual Return for the reporting period.

Retesting was conducted by EML Air on 24 July 2012. The results of the testing measured in-stack total fluoride concentrations of 6.9 mg/m^3 from Unit 2, Duct A and 9.1 mg/m^3 from Unit 2, Duct B, for an average result of 8 mg/m^3. Results were reported in EML Air report N89570[3].

The periodic test results of total fluoride, measured at Bayswater power station are displayed in Figure 2. The licence limit is indicated by a blue line.

Figure 2: Fluoride reported air emission concentrations, from stack tests, at Bayswater Power Station (2011-2016).



To investigate if the reported concentration is representative of actual in-stack concentrations at the time of sampling, EPA reviewed coal analysis data and stack sampling records.

3.2.1 Coal Fluorine vs In-Stack Fluoride Concentrations

The fluorine content of coal and the in-stack measured fluoride concentrations were reviewed to determine if a simple relationship could be identified.

Coal is supplied to Bayswater by the following mines: Wilpinjong, Mount Arthur, Mangoola, Bengalla and Ravensworth. On arrival at the station the coal is directed to either the Unit 1/2 end or Unit 3/4 end of the station via two parallel conveyor trains located in the centre of the station, between Units 2 and 3.

[2] EML Air Pty Ltd: *BAYSWATER POWER STATION Emission Testing Report - JUNE 2012.* Reference N89366 (4 July 2012).
[3] EML Air Pty Ltd: *BAYSWATER POWER STATION Emission Testing Report - JULY 2012.* Reference N89570 (28 Aug 2012).

Accredited laboratories are used to analyse "as-fired" fuel samples taken at Bayswater power station. Samples are analysed monthly for fluorine content. As-fired samplers are located on each of the two conveyors i.e. two for boiler Unit 1/2 (1A and 1B) and two for boiler Unit 3/4 (2A and 2B).

Table 15 provides a 12 month summary of the fluorine content (mg/kg) in coal used at Bayswater power station. Table 15 shows:

- In June 2012, the as-fired coal fluorine content, burnt in Boiler 2, was the highest concentration measured in 2012 at 156 mg/kg. Stack sampling results for Boiler 2 in June 2012, reported in-stack fluoride concentrations of 54 mg/m^3.
- In July 2012, the as-fired coal fluorine content, was the lowest concentration measured in 2012, at 18.7 mg/kg. Stack sampling results collected in July, reported average in-stack fluoride concentrations of 8.0 mg/m^3.

Table 15: Comparison of fluoride content in coal, Bayswater power station.

Average Daily As-Fired Coal Fluorine Content mg/kg			
Month	Year	Boiler Unit 1 and 2 Analysis Results from Samplers 1A/B	Boiler Unit 3 and 4 Analysis Results from Samplers 2A/B
December	2011	147.38	140.46
January	2012	108.46	151.45
February	2012	130.08	78.42
March	2012	80.04	72.89
April	2012	141.59	139.85
May	2012	122.65	141.68
June	**2012**	**155.66**	179.29
July	**2012**	**18.69**	37.50
August	2012	140.31	145.54
September	2012	92.20	61.22
October	2012	141.21	127.08
November	2012	104.18	88.06
December	2012	117.83	99.53

Data sourced from Bayswater as fired coal analysis data sheet "Coal Analysis Data 2012-2013 - HRL.xlsx".

Paired coal fluorine content and stack test results, for the period March 2011 - October 2015, were reviewed to further investigate the June 2012 fluoride exceedance. Table 16 contains a summary of stack test results and monthly, as fired coal fluorine concentrations.

The data shows that from March 2011 to November 2011, coal fluorine content was routinely measured at concentrations above 156 mg/kg, ranging from 171 – 232 mg/kg. Stack testing for the same period, measured in-stack total fluoride concentrations between 0.96 to 31 mg/m^3.

Table 16: Bayswater Fluoride stack test results compared with coal fluorine concentration.

	Fluoride Stack test result mg/m^3				Coal Fluorine
Date Sampled	Unit 1	Unit 2	Unit 3	Unit 4	Content (mg/kg)
Mar-11			15		171
Mar-11				31	171
Mar-11	7.1				142
Apr-11		15			232
Jul-11			4.5		180
Jul-11				13	180
Jul-11		16			185
Nov-11	0.96				174
Dec-11				7.7	140
Mar-12	16				80
Jun-12		**54**			**156**
Jul-12		**8**			**19**
Aug-12				5.5	146
Oct-12			24		127
Mar-13	16				99
May-13		6.5			104
Aug-13				16	104
Nov-13			12		132
Aug-14				9.5	130
Sep-14		8.3			141
Dec-14	3.2				130
May-15				11	119
Jul-15			13		107
Jul-15		16			107
Oct-15	9.3				93

Figures 3 and 4 below, depict analysis used to help determine if high in-stack fluoride concentrations can be attributed to elevated coal fluorine content. The analysis was inconclusive, possibly due to confounding factors such as the averaging periods of coal sample analysis and stack sampling periods; temperature; moisture and pollution control efficiency which were not accounted for in the the analysis.

The review could not confidently determine if the reported total fluoride concentration of 54mg/m^3 was a 'real exceedance', at the time of sampling, or if the elevated result was due to sampling/ analysis error. It is noted that there is no clear indication or evidence of a sampling error.

Figure 3: Bayswater correlation graph comparing in-stack measured fluoride concentrations to coal fluorine concentrations.

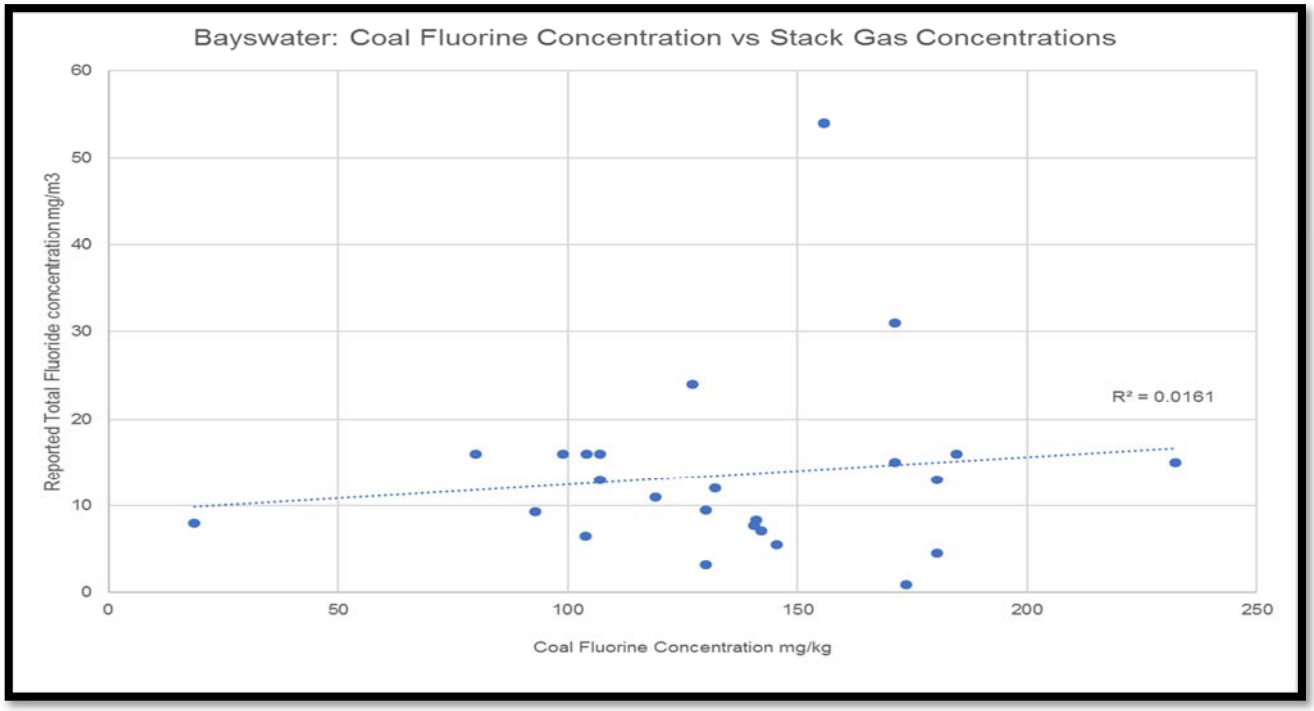
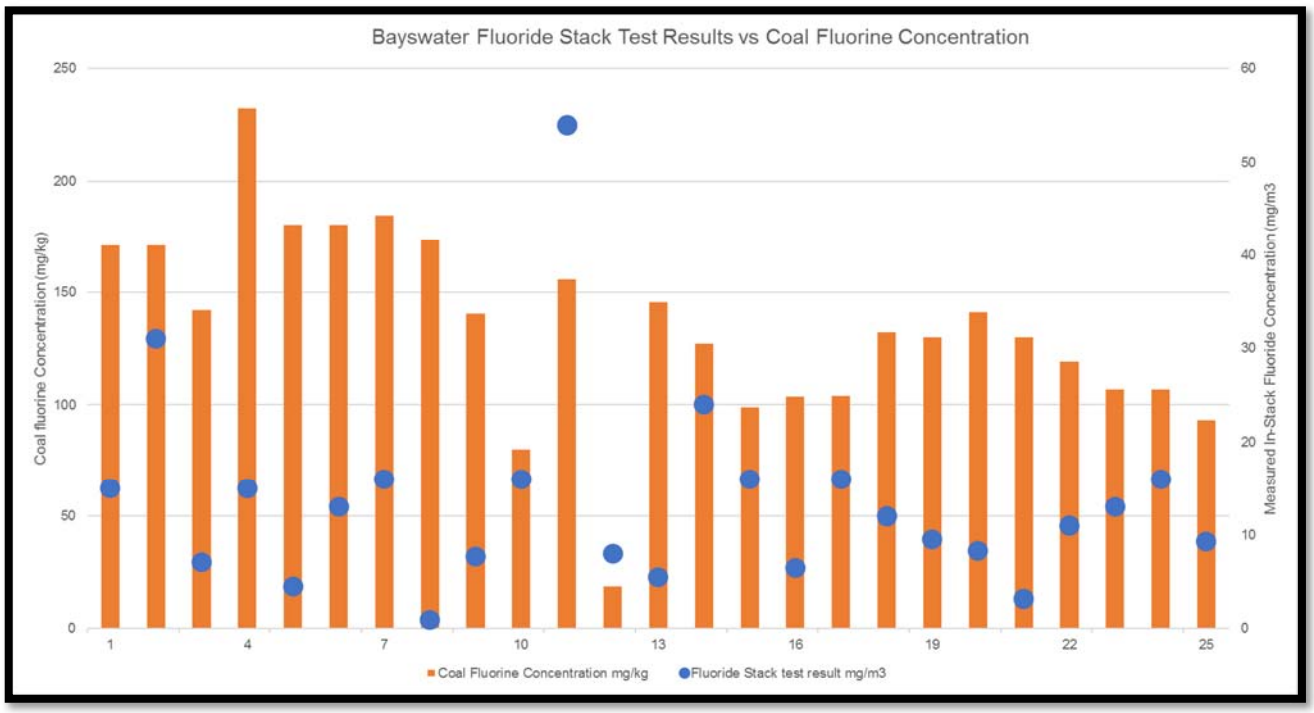


Figure 4: Bayswater comparison of in-stack measured fluoride concentrations mg/m³ (blue dots) to coal fluorine concentrations mg/kg.



3.3 Mount Piper Non-Compliance: Sulfuric Acid Mist

The air emission monitoring requirements for Mount Piper Power Station are detailed in EPL 13007. The EPL requires the licensee to periodically monitor sulfuric acid mist (H_2SO_4) and sulfur trioxide (SO_3) emissions and report the concentration, expressed as SO_3.

Mount Piper exceeded its SO_3 EPL concentration limit on 10 April 2014. The result was 120 mg/m^3, measured from Duct A of Boiler 2, compared with an EPL limit of 100 mg/m^3. The result was reported in EML Air Report

N92464[4] prepared for Energy Australia NSW, Mount Piper Power Station. Mount Piper did not record any non-compliances related to air emission exceedances in its Annual Return or published data during this period. A retest was conducted on 22 July 2014, the new test result was 2.2 mg/m^3 as reported in EML Air Report N92972[5] prepared for Energy Australia NSW, Mount Piper Power Station.

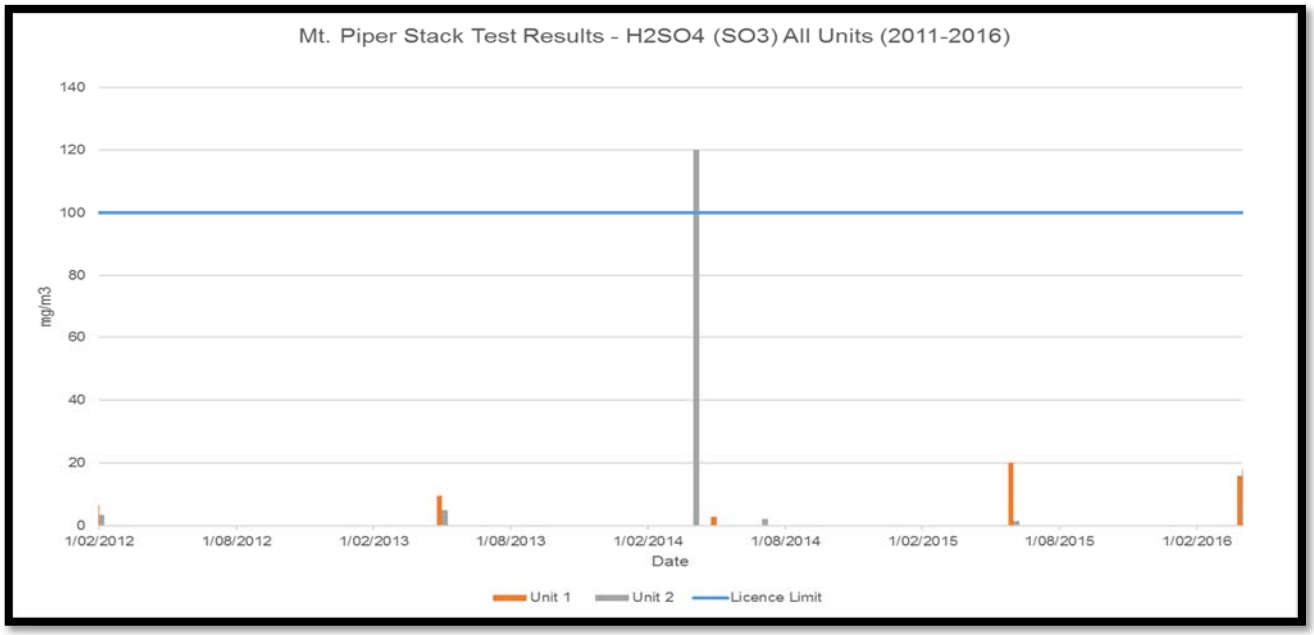
The periodic test results of sulfuric acid, measured at Mount Piper Power Station are displayed in Figure 5.

To determine if the elevated SO_3 concentration reported is representative of in stack concentrations, the following factors were considered:

- coal sulfur content
- formation of H_2SO_4 and SO_3
- stack test results for SO_2 and SO_3.

The review concluded that the elevated H_2SO_4 (SO_3) concentration of 120 mg/m^3, measured in April 2014, is unlikely to be representative of in stack concentrations at the time of sampling. The high concentration may be due to sampling or analysis error.

Figure 5: Mount Piper SO_3 results (2011-2016). The 2014 exceedance is clearly identifiable.



3.3.1 Mount Piper Coal Sulfur Content

All coal burnt at Mount Piper Power Station is received from Springvale coal mine. Springvale is, and has been for a number of years, the only coal mine supplying Mount Piper. All Springvale coal supplied to Mount Piper comes from the one seam (the Lithgow seam).

A single conveyor from Springvale delivers coal from the colliery to either a storage area or directly to the main receiving bin, then on to the crushing plant, to the mill building for final sizing, then to the boiler bunkers for transfer to either of the Unit 1/ Unit 2 boilers. No further treatment or conditioning is undertaken before the coal is burnt.

Coal received from Springvale is sampled and analysed for calorific value, moisture and ash content. Daily samples are kept and from daily samples, a composite sample is taken and analysed as required under the

[4] EML Air Pty Ltd Report Number N92464 - Emission Testing Report Energy Australia NSW Pty Ltd (Mt Piper), Mt Piper Power Station (30 May 2014)
[5] EML Air Pty Ltd Report Number N92972 - Emission Testing Report Energy Australia NSW Pty Ltd, Mt Piper Power Station (18 August 2014)

EPL. The monthly coal sulfur content and SO_2 stack test results are shown in Figure 6 below. The sulfur content (%) has been stable between 0.7% and 0.9% between 2011 and 2015.

Table 17 displays the 2014 monthly coal analysis data for Mount Piper Power Station. The sulfur content of the coal was relatively consistent throughout all months of the year, ranging between 0.74% and 0.89%.

Figure 6: Mount Piper coal sulfur content and SO_2 stack test results (2011-2015).

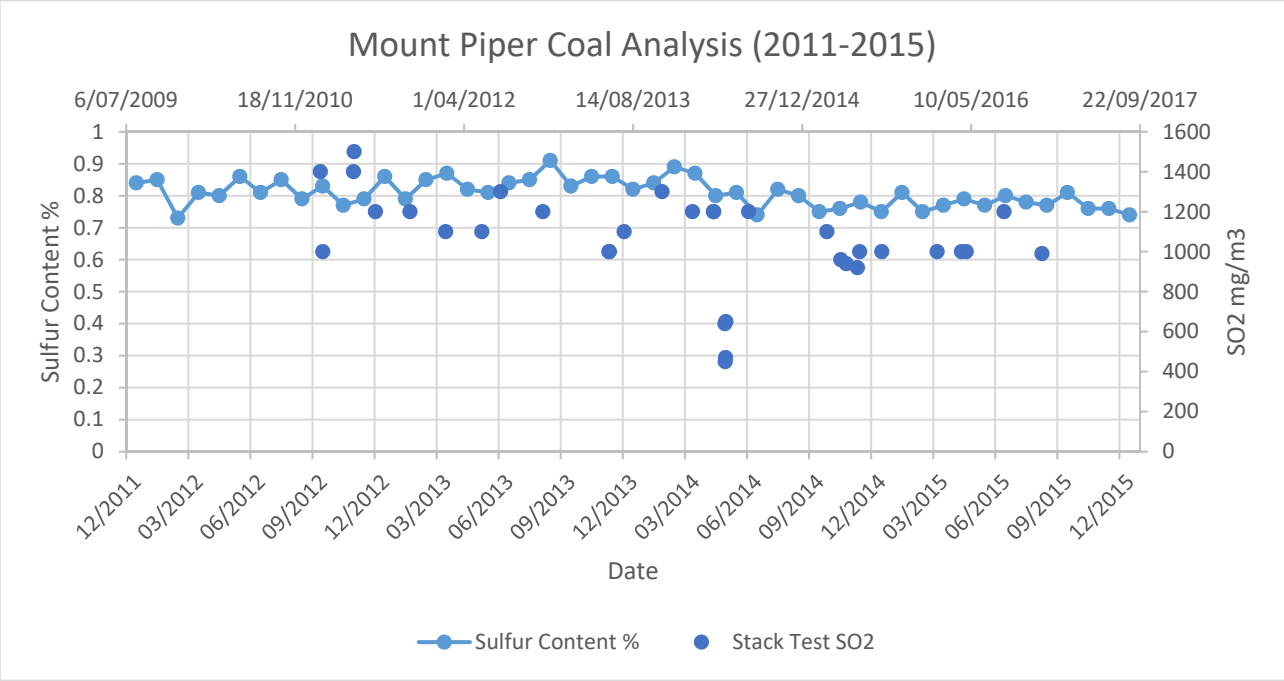


Table 17: 2014 monthly coal analysis data for Mount Piper power station. Sourced from data provided by Mount Piper, contained in excel workbook "2012-2017 monthly data as fired.xlsx".

	2014											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
PROXIMATE ANALYSIS												
Inherent Moisture %	1.9	2.3	2.4	**2.3**	2.5	2.3	2.3	2.3	2.1	2.1	2.2	2.4
Total Moisture %	0	0	0	**0**	0	0	0	0	0	0	0	0
Ash %	22.8	23.3	23.3	**23.8**	24.3	23.3	24.1	24.9	25.1	26.8	25.5	24
Volatile Matter %	28.8	28.1	28	**27.3**	27.3	28	27.8	27.6	27.4	27	27.5	27.7
Fixed Carbon %	46.5	46.3	46.3	**46.6**	45.9	46.4	45.8	45.2	45.4	44.1	44.8	45.9
Gross SE MJ/kg	0	0	0	**0**	0	0	0	0	0	0	0	0
Total Sulphur %	**0.63**	**0.66**	**0.64**	**0.59**	**0.59**	**0.55**	**0.6**	**0.58**	**0.54**	**0.54**	**0.56**	**0.55**
Phosphorous %	0	0	0	**0**	0	0	0	0	0	0	0	0
Chlorine %	0.04	0.01	0.02	**0.01**	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Ash Hemisphere T. deg C	1550	1550	1550	**1560**	1550	1550	1550	1550	1550	1550	1540	1550
Hardgrove Grind. Index	47	49	57	**56**	56	52	59	54	50	50	47	47
Calorific Value MJ/kg	26	25.6	25.64	**25.37**	25.12	25.57	25.3	25.04	24.98	24.35	24.74	25.38
Fluorine mg/kg	91	81	91	**120**	0	108	110	100	97	70	89	95
	0	0	0	**0**	0	0	0	0	0	0	0	0
ULTIMATE ANALYSIS	0	0	0	**0**	0	0	0	0	0	0	0	0
(DRY BASIS) DAF	0	0	0	**0**	0	0	0	0	0	0	0	0
Carbon %	83.8	83.8	83.6	**83.5**	84.1	83.7	83.8	83.6	83.2	83.1	83.1	83.4
Hydrogen %	5.39	5.41	5.45	**5.48**	5.5	5.42	5.43	5.48	5.47	5.57	5.42	5.49
Nitrogen %	1.94	1.95	1.95	**1.94**	2	1.89	1.88	1.89	1.88	1.92	1.94	1.91
Sulphur %	**0.84**	**0.89**	**0.87**	**0.8**	**0.81**	**0.74**	**0.82**	**0.8**	**0.75**	**0.76**	**0.78**	**0.75**
Oxygen %	8	8	8.2	**8.3**	7.6	8.3	8.1	8.2	8.7	8.7	8.8	8.4
Chlorine %	0	0	0	**0**	0	0	0	0	0	0	0	0
	0	0	0	**0**	0	0	0	0	0	0	0	0
ASH ANALYSIS	0	0	0	**0**	0	0	0	0	0	0	0	0
SiO2	68	67.7	66.7	**66.7**	67.8	67.1	67.4	67.4	67.4	66.8	66.5	67.1
Al2O3	26.7	26.6	26.5	**26.1**	25.9	26.4	26.9	26.5	27.1	27.5	27.3	26.2
Fe2O3	0.8	1	1	**1.1**	0.9	0.6	0.9	0.5	0.5	0.6	0.5	0.6
CaO	0.33	0.33	0.49	**0.34**	0.55	0.37	0.36	0.32	0.33	0.32	0.33	0.46
MgO	0.41	0.43	0.44	**0.43**	0.46	0.44	0.45	0.44	0.43	0.4	0.41	0.45
Na2O	0.2	0.21	0.23	**0.22**	0.18	0.13	0.15	0.12	0.14	0.13	0.11	0.16
K2O	2.57	2.56	2.54	**2.44**	2.62	2.6	2.61	2.56	2.47	2.31	2.42	2.74
TiO2	1.11	1.11	1.08	**1.06**	1.09	1.14	1.14	1.08	1.01	0.9	0.95	1.06
Mn3O4	0.005	0.005	0.005	**0.005**	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
SO3	**0.05**	**0.05**	**0.1**	**0.07**	**0.12**	**0.05**	**0.09**	**0.08**	**0.08**	**0.08**	**0.08**	**0.08**
P2O5	0.09	0.09	0.16	**0.1**	0.1	0.08	0.06	0.05	0.05	0.05	0.05	0.06

3.3.2 Formation of H_2SO_4 and SO_3

The formation of SO_3 will occur during the combustion of sulfur bearing fuels such as coal and heavy fuel oils. During the combustion of coal, virtually all sulfur gets oxidized to gaseous species such as SO_2 and SO_3, with SO_2 being the principal oxide. Virtually all SO_3 converts to H_2SO_4 as flue gas is cooled.

Literature and data suggests the typical conversion of SO_2 to SO_3 in coal-fired boilers, in the presence of fly ash, ranges between, 0.8 to 1.6% for bituminous and 0.05–0.1% for sub-bituminous coals[6]. Data comparing SO_2 and SO_3 concentrations at Mount Piper is presented in the following sub-section on SO_2 and SO_3 stack test results.

The chemistry of SO_3 and water to make sulfuric acid vapor is temperature dependent, that is, the amount of sulfuric acid molecules that are formed is related to the temperature of the exhaust. Therefore, the amount of manufactured and released sulfuric acid are dependent upon the flue gas temperature.

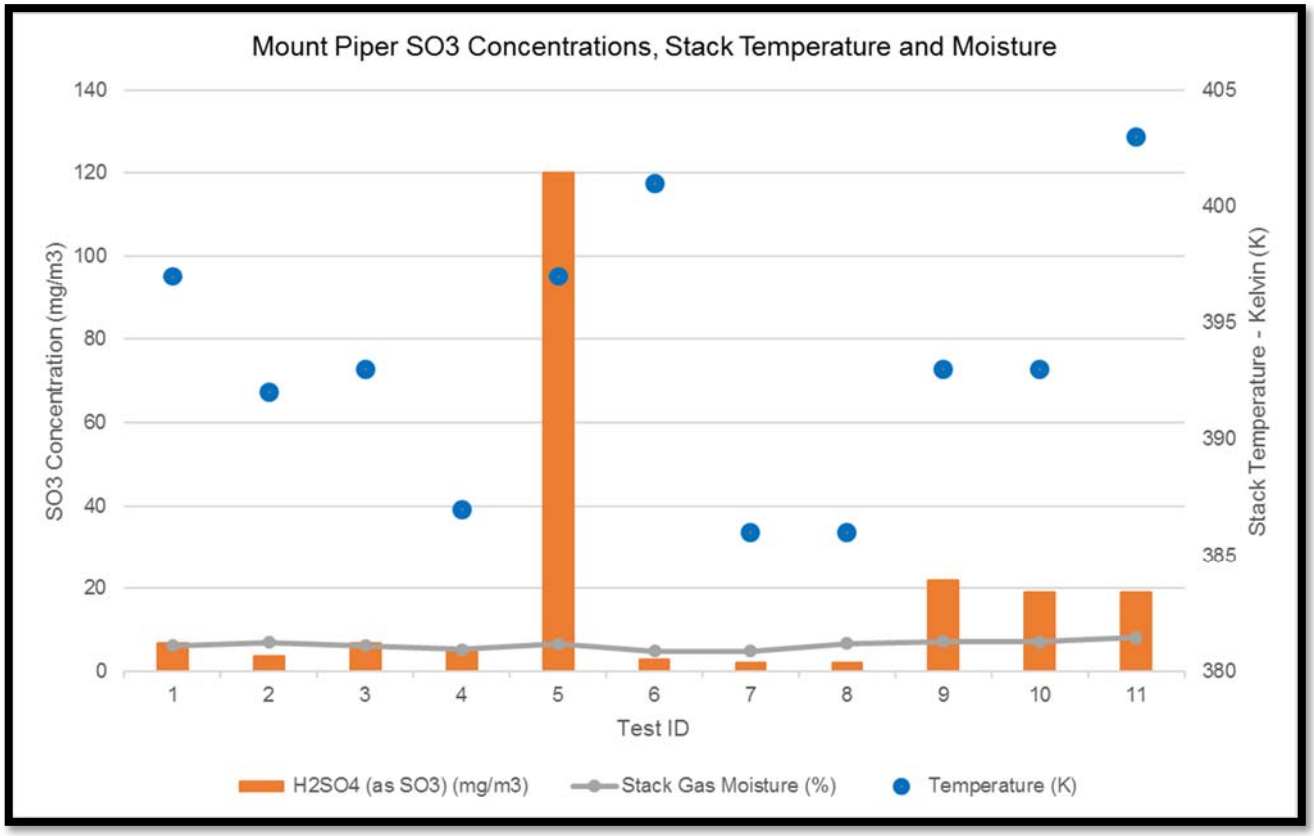
As shown in Table 18 and Figure 7, the measured stack temperature has been relatively consistent between 386 and 403 Kelvin (or 113 to 130 degrees Celsius). There appears to be no simple relationship between moisture content, temperature and the high H_2SO_4 concentration measured in April 2014.

Table 18: Summary of Mount Piper SO_3 results, stack temperature, moisture and boiler load.

Test ID	Date sampled	H_2SO_4 (as SO_3) (mg/m^3)	Temperature (K)	Stack Gas Moisture (%)	Boiler load (MW)
1	9-Feb-12	6.9	397	6.2	670
2	16-Feb-12	3.6	392	7.0	670
3	24-May-13	6.9	393	6.2	575
4	28-May-13	4.8	387	5.3	575
5	**10-Apr-14**	**120**	**397**	**6.6**	**680**
6	15-May-14	3	401	4.9	575
7	**22-Jul-14**	**2.2**	**386**	**4.9**	**575**
8	9-Jun-15	2	386	6.8	440
9	17-Jun-15	22	393	7.3	440
10	14-Apr-16	19	393	7.2	600
11	*28-Apr-16*	19	403	8.2	620

[6] Emissions of Sulfur Trioxide from Coal-Fired Power Plants – Technical Paper. R.K. Srivastava and C.A. Miller. Office of Research and Development, National Risk Management Research Laboratory, Air Pollution Prevention and Control Division, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina

Figure 7: Mount Piper SO_3 and stack temperature – data sourced from Table 18 above.



3.3.3 SO_2 and SO_3 Stack Test Results

Table 19, below, shows that Mount Piper SO_3 concentrations are typically 0.2% to 2.2% of the SO_2 concentration. The April 2014 value of 10% is inconsistent with other data from years 2012-2016.

Table 19: SO_3 concentrations compared with SO_2 - Mount Piper power station.

Year	H_2SO_4 (as SO_3) mg/m^3	SO_2 (mg/m^3)	SO_2/ SO_3
Feb-12	6.9	1100	0.6%
May-13	4.8	1100	0.4%
Apr-14	**120**	**1200**	**10.0%**
May-14	3	610	0.5%
Jul - 14	**2.2**	**1200**	**0.2%**
Jun-15	1.6	920	0.2%
Jun-15	22	1000	2.2%
Apr-16	19	1000	1.9%
Apr-16	19	1000	1.9%

Figure 8 compares the historical SO_2 and H_2SO_4 (SO_3) concentrations measured at Mount Piper between 2011-2016. As SO_2 is measured every 3 months, there are more data points than H_2SO_4. In Figure 8, the H_2SO_4 exceedance is indicated by the orange column, highlighted with a red box. The April 2014 result is appreciably higher, and inconsistent, with all other test results recorded between 2011 and 2016. The SO_2 concentrations measured during the same period are relatively consistent with average reported SO_2 concentrations – with the exception of some low measurements from May 2014.

Figure 9 is an excerpt from EML Air Report No. 92972 showing SO_2 concentration measured during the same time period the exceedance of H_2SO_4 occurred.

Figure 8: Mount Piper H_2SO_4 and SO_2 stack test results (2011-2016).

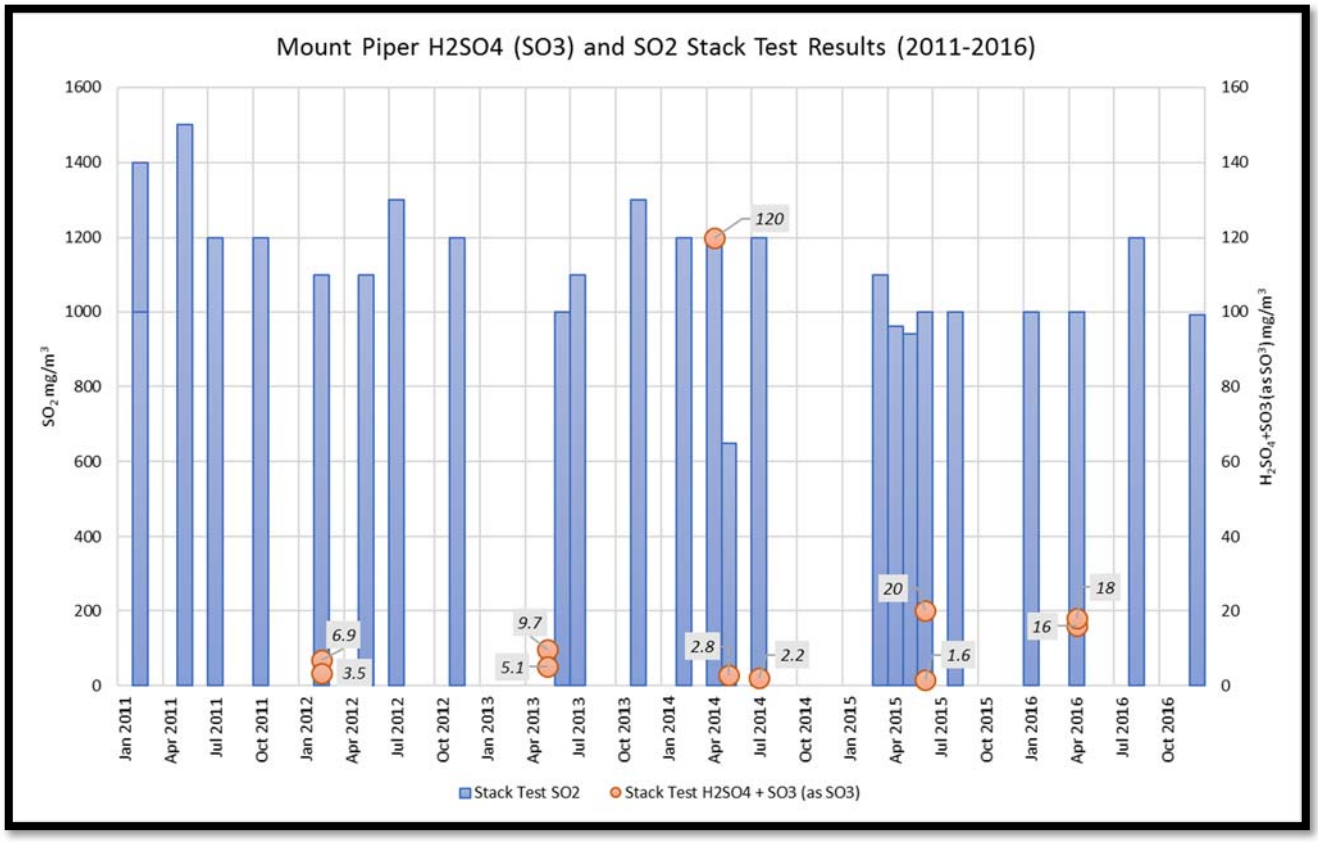


Figure 9: Excerpt from EML Air report # 92972 showing SO_2 concentration measured during the same time period sulfur trioxide was sampled.

Isokinetic	Results		
Sampling time	1230-1600		
	Concentration g/m³	O2 corrected g/m³	Mass Rate g/s
Sulfur trioxide [1]	0.12	0.12	46

Gases	Average			Minimum			Maximum		
Sampling time	1247-1347			1247-1347			1247-1347		
	Concentration g/m³	O2 corrected g/m³	Mass Rate g/s	Concentration g/m³	O2 corrected g/m³	Mass Rate g/s	Concentration g/m³	O2 corrected g/m³	Mass Rate g/s
Nitrogen oxides (as NO_2)	0.9	0.93	350	0.84	0.87	320	0.96	1	370
Sulfur dioxide	1.1	1.2	440	1.1	1.1	420	1.2	1.2	460
Carbon monoxide	0.015	0.016	5.9	0.0038	0.0039	1.4	0.11	0.12	43
	Concentration %			Concentration %			Concentration %		
Carbon dioxide	14.2			13.6			14.7		
Oxygen	7.5			7.3			7.8		

4) Compliance with Regulatory Reporting Requirements

To investigate if the power stations were compliant with regulatory reporting requirements for the period 2011-2016, EPA considered the following:

- Annual Returns - All NSW power stations are required to submit an Annual Return form including a statement of compliance with regulatory conditions.
- Published monitoring data - Each power station is required to publish monitoring data on the licensee's website. In accordance with the POEO Act (1997).
- Air emissions exceedance reports – Power station EPLs include requirements to report emissions found in exceedance of reporting limits.

4.1 Annual Returns

All NSW power stations are required to submit an Annual Return form including a statement of compliance with regulatory conditions. All power stations submitted and Annual Return to the EPA for all years reviewed – refer to Table 21.

For the period of review (2011-2016), Liddell reported six non-compliances related to air emissions, including failure to monitor volatile organic compounds due to oversight, an opacity exceedance due to operational failure, and failure to report an exceedance of its sulfur dioxide reporting limit within the timeframe specified in its EPL. Details are provided in Table 20.

No other power station reported non-compliances, relating to air emissions, in their Annual Returns for the review period.

Table 20: Liddell power station, reported non-compliances with EPL conditions - from Annual Returns (2011-2016).

AR no	Start date	End date	Condition number	Number of incidents	Summary of particulars
82431	1/07/2011	30/06/2012	R1.10.1	2	Exceeded smoke reporting limit of 20% opacity. Licensee required to provide report under this condition if there is an exceedance of the 20% opacity trigger value.
86566	1/07/2013	30/06/2014	M2.2	2	Monitoring of VOC concentrations on points 2 & 4 were not carried out after change in requirements due to an oversight. Minor opacity trigger exceedance due to mechanical fault in pulse cycling for bag cleaning.
86998	1/07/2014	1/09/2014	M2.2	1	No VOC monitoring was completed during the reporting period due to an oversight in the monitoring regime. The next monitoring event is scheduled for October 2014 and is to incorporate VOC monitoring.
90707	1/07/2015	30/06/2016	R4.1	1	Concentration limit exceedance of sulphur dioxide was not reported within 30 days as required.

Table 21 - List of Annual Returns received by the EPA for the period 2011-2016

A/P Name	License No	AR no	Status	Start date	End date	Received date
AGL Macquarie Pty Limited (Bayswater)	779	70267	Complete	1/02/2010	31/01/2011	4/04/2011
	779	81550	Complete	1/02/2011	31/01/2012	3/04/2012
	779	83596	Complete	1/02/2012	31/01/2013	28/03/2013
	779	85681	Complete	1/02/2013	31/01/2014	1/04/2014
	779	86997	Complete	1/02/2014	1/09/2014	7/11/2014
	779	87754	Complete	2/09/2014	31/01/2015	1/04/2015
	779	89839	Complete	1/02/2015	31/01/2016	31/03/2016
	779	91882	Complete	1/02/2016	31/01/2017	11/04/2017
AGL Macquarie Pty Limited (Liddell)	2122	80301	Complete	1/07/2010	30/06/2011	31/08/2011
	2122	82431	Complete	1/07/2011	30/06/2012	30/08/2012
	2122	84543	Complete	1/07/2012	30/06/2013	30/08/2013
	2122	86566	Complete	1/07/2013	30/06/2014	27/08/2014
	2122	86998	Complete	1/07/2014	1/09/2014	7/11/2014
	2122	88581	Complete	2/09/2014	30/06/2015	25/08/2015
	2122	90707	Complete	1/07/2015	30/06/2016	29/08/2016
ENERGYAUSTRALIA NSW PTY LTD (Mount Piper)	13007	81387	Complete	1/01/2011	31/12/2011	29/02/2012
	13007	83437	Complete	1/01/2012	31/12/2012	27/02/2013
	13007	84821	Complete	1/01/2013	1/09/2013	28/10/2013
	13007	85492	Complete	2/09/2013	31/12/2013	26/02/2014
	13007	87578	Complete	1/01/2014	31/12/2014	26/02/2015
	13007	89664	Complete	1/01/2015	31/12/2015	26/02/2016
	13007	91750	Complete	1/01/2016	31/12/2016	24/02/2017
ORIGIN ENERGY ERARING PTY LTD	1429	80336	Complete	1/07/2010	30/06/2011	1/09/2011
	1429	82433	Complete	1/07/2011	30/06/2012	30/08/2012
	1429	84450	Complete	1/07/2012	30/06/2013	26/08/2013
	1429	86650	Complete	1/07/2013	30/06/2014	1/09/2014
	1429	88651	Complete	1/07/2014	30/06/2015	28/08/2015
	1429	90762	Complete	1/07/2015	30/06/2016	30/08/2016
SUNSET POWER INTERNATIONAL PTY LTD	761	81385	Complete	1/01/2011	31/12/2011	29/02/2012
	761	82427	Complete	1/01/2012	30/06/2012	30/08/2012
	761	84515	Complete	1/07/2012	30/06/2013	30/08/2013
	761	86604	Complete	1/07/2013	30/06/2014	29/08/2014
	761	88588	Complete	1/07/2014	30/06/2015	26/08/2015
	761	89601	Complete	1/07/2015	17/12/2015	12/02/2016
	761	90664	Complete	18/12/2015	30/06/2016	25/08/2016

4.2 Published Monitoring Data

Section 66(6) of the Act obliges coal fired power stations to publish results of monitoring required by an EPL condition.

> *The holder of a licence subject to a condition referred to in subsection (1) (a) must, within 14 days of obtaining monitoring data as referred to in that subsection:*
>
> > *(a) if the holder maintains a website that relates to the business or activity the subject of the licence—make any of the monitoring data that relates to pollution, and the licensee's name, publicly and prominently available on that website in accordance with any requirements issued in writing by the EPA, or*
> >
> > *(b) if the holder does not maintain such a website—provide a copy of any of the monitoring data that relates to pollution, to any person who requests a copy of the data, at no charge and in accordance with any requirements issued in writing by the EPA.*

A review of reporting years 2015 and 2016 identified the following:

- Eraring and Vales Point power stations have published all requisite monitoring data.

- The review additionally confirmed that published data is consistent with stack test reports held by the EPA.

- Bayswater and Liddell power stations have published all requisite monitoring results.
  - Errors in data transcription, presentation and consistency were identified. Issues include; rounding of some data to zero; variable rounding from month to month; poor labelling of sampling dates and discharge points; and transposing of mean and maximum data.

- Mount Piper did not publish all requisite monitoring results[7] and some published data was in error:
  - Quarterly NOx and SO_2 data in Q4 2015 and Q1 & Q2 2016 was not published
  - Annual mercury data for 2015 and 2016 was not published
  - The published particle data in 2016 for generating Unit 1 was the result of a single total particle test of 2.2 mg/m^3 from Duct A. Published data should have included tests for all ducts associated with the licenced discharge point. A test result from Duct B of 5.8 mg/m^3 was not published. Additionally, a second test from duct A of 39 mg/m^3 was not published.
  - Test data for solid particles from generating Unit 2 was not published for 2016.
  - Annual test data for all other monitored pollutants from Units 1 and 2 was not published for 2016.

4.3 EPL Reporting Limits

In addition to concentration limits, some EPLs also include reporting limits. Table 22 summarises the reporting limits and monitoring requirements for each of the power stations.

Table 22: NSW power station Environment Protection Licence – Reporting Limits

EPL Reporting Limits			
	SO_2	NOx	Opacity
Bayswater	600 ppm (Boiler 1 Only)	Not Required	Not Required
Liddell	600 ppm	700 ppm	20% Opacity
Mount Piper	No Continuous Monitoring Requirements		
Eraring	600 ppm	Not Required	Not Required
Vales Point	600 ppm	Not Required	Not Required

To comply with EPL reporting limits, the licensee must continuously monitor emissions to air for each pollutant specified. Typically, data capture rates of 90% or above are recommended to demonstrate continuous monitoring is being achieved. The review found CEMS monitoring being conducted at each of the power stations is achieving high rates of data capture as per Table 23 over page.

[7] EPA sourced published monitoring data from Energy Australia's website page -https://www.energyaustralia.com.au/about-us/energy-generation/mt-piper-power-station/mt-piper-epa-reports. EPA was unable to access historical published data records from website, http://www.de.com.au/Environment/Environmental-Licences---Monitoring/Mt-Piper-Power-Station-Monitoring-Data/default.aspx

Table 23: CEMS data capture for each of the NSW power stations.

		Unit1	Unit 2	Unit 3	Unit 4	Average
Bayswater	NOX	98.8%	-	-	-	98.8%
	SO2	99.1%	-	-	-	99.1%
	Opacity	99.0%	100.0%	100.0%	100.0%	99.8%
Liddell	NOX	100.0%	101.5%	100.0%	99.3%	100.2%
	SO2	99.7%	99.9%	100.0%	100.0%	99.9%
	Opacity	100%	100%	100%	100%	100%
Eraring	NOX	97.3%	97.6%	99.2%	97.0%	97.8%
	SO2	96.5%	97.3%	99.1%	97.7%	97.7%
	Opacity	98.0%	91.5%	93.7%	87.0%	92.6%
Vales Point		**Unit5**		**Unit 6**		**Average**
	NOX	98.9%	-	99.3%	-	99.1%
	SO2	98.7%	-	98.5%	-	98.6%
		Unit5A	**Unit 5B**	**Unit 5C**	**Unit 5D**	**Average**
	Opacity	92.8%	97.8%	89.8%	73.4%	88.4%
		Unit6A	**Unit 6B**	**Unit 6C**	**Unit 6D**	**Average**
	Opacity	96.9%	83.7%	86.2%	85.9%	88.2%

Note: Values calculated by NSW EPA using CEMS data provided by the power stations and LBL workbooks. The calculations are based on the In-Service hours of operation for the boiler being sampled. NOx and SO_2 concentrations below 100ppm were excluded from the calculation.

4.4 EPL Reporting Limits - Non-Compliance reports

If a reporting limit is exceeded, the licensee must provide an exceedance report to the EPA within the timeframe specified in the EPL. The exceedance report must include the following information:

- details of the date and times of the exceedance
- the duration of the exceedance
- the reason(s) for the exceedance
- actions to be taken to address any future exceedance(s)

4.5 EPL Reporting Limits – Non-Compliances

EPA reviewed 5 consecutive years (2011-2016) of continuous emission monitoring (CEM) data to determine compliance with EPL reporting limits.

The review found multiple instances of CEM data values greater than EPL reporting limits. The review investigated all elevated results in an effort to establish the validity of the data. During the investigation, many of the results were determined to be uncharacteristic of the emission profile and boiler operation at the time the reading was recorded. Further analysis compared pollutant emission trends, boiler loads and maintenance data to inform the cause of the high readings.

The results of the enquiries found many of the elevated values were unlikely to be representative of in-stack pollutant concentrations at the time the measurement was recorded, and were therefore discounted from further review. The common causes of high CEM measurements included monitor faults, incorrect measurement unit conversion and maintenance/cleaning affecting the monitor sensors. All measurement values, that were not excluded, are considered to be a true value and have been treated as an exceedance of EPL reporting limit(s).

Table 24 below provides a summary of identified reporting limit exceedances.

Table 24 - Reporting limit exceedances identified by EPA for the review period 2011-2016.

Record of Exceedances	
Bayswater	No Exceedances
Liddell	SO_2 exceeded 600 ppm on 3 separate occasions between 2011 and 2016. Opacity exceeded 20% opacity on 17 separate days between 2011 and 2013, and 2 days between 2014-2016. Total of 19 exceedances.
Mount Piper	No Continuous Monitoring Requirements
Eraring	No Exceedances
Vales Point	No Exceedances

4.6 Liddell Reporting Limit Exceedances

Table 25 contains the summary of non-compliances reported, in Annual Returns, by Liddell Power Station.

Table 25: Summary of non-compliances self-reported by Liddell power station.

AR no	Start date	End date	Condition no	Number of incidents	Summary of particulars
82431	1/07/2011	30/06/2012	R1.10.1	2	Exceeded smoke reporting limit of 20% opacity. Licensee required to provide report under this condition if there is an exceedance of the 20% opacity trigger value.
86566	1/07/2013	30/06/2014	M2.2	1	Minor opacity trigger exceedance due to mechanical fault in pulse cycling for bag cleaning.
90707	1/07/2015	30/06/2016	R4.1	1	Concentration limit exceedance of sulphur dioxide was not reported within 30 days as required.

4.6.1 Liddell Reporting Limit Exceedances of SO_2

A review of the CEM data provided by Liddell Power Station indicates that the SO_2 reporting limit of 600 ppm was exceeded three times, as per Table 26. For the purposes of this review, figures highlighted in red are considered exceedances of the SO_2 reporting limit – in the absence of information to the contrary.

Table 26: Liddell - Summary of SO_2 Exceedances – Measured by CEMS

Liddell - Summary of SO_2 Exceedances – Measured by CEMS					
Date	Time	Unit	Generator Load (MW)	SO_2 Concentration (ppm)	Reporting Limit
2/09/2011	10.00	3	420.17	**671**	600
6/02/2016	23.00	4	219.69	**605**	600
6/02/2016	20.00	3	314.01	**614**	600

4.6.2 Liddell Reporting Limit Exceedances of Opacity

Liddell's continuous opacity monitors have recorded opacity values greater than 20% on 19 occasions over the 5-year period 2011-2016, as shown in Table 277.

Table 27 - Summary of opacity exceedances recorded by Liddell PS continuous opacity monitors.

Exceedance #	Date	Unit Number	Generator Load (MW)	Fan A Opacity (%)	Fan B Opacity (%)	Average Opacity (%)
1	14/07/2011	4	377	22.7	20.2	**21.4**
2	23/07/2011	2	302	31.4	18.9	**25.1**
3	24/07/2011	2	359	18.1	22.4	**20.2**
4	25/07/2011	2	357	18.5	23.0	**20.7**
5	6/09/2011	1	229	9.5	37.1	**23.3**
6	6/09/2011	2	251	33.8	7.9	**20.8**
7	25/11/2011	3	420	12.4	32.0	**22.2**
8	13/03/2012	2	344	76.8	0.4	**38.6**
9	14/03/2012	2	388	80.0	2.0	**41.0**
10	19/04/2012	2	454	68.9	10.9	**39.9**
11	15/05/2012	3	355	86.0	11.5	**48.7**
12	16/05/2012	1	388	92.1	6.1	**49.1**
13	16/05/2012	2	243	77.0	16.4	**46.7**
14	14/01/2013	4	404	6.7	36.9	**21.8**
15	31/01/2013	2	333	5.2	76.5	**40.8**
16	26/08/2013	1	464	7.8	42.4	**25.1**
17	5/12/2013	3	420	4.3	50.2	**27.2**
18	8/05/2014	1	446	9.9	66.4	**38.1**
19	5/06/2016	1	420	20.5	22.4	**21.4**

Note: The opacity monitoring data provided by Liddell is based on 1 hour averages. The averaging time for measuring opacity is not specified the licence. The Protection of the Environment Operations (Clean Air) Regulation specifies an averaging period of 6 minutes.

Since 2014 only 2 exceedances have been recorded by the opacity meters, as summarised in Table 28. Indicating significant improvement when compared to the number of exceedances recorded between 2011 – 2013.

Table 28 - Count of number of exceedances recorded at Liddell PS, tabulated by calendar year.

Review of Opacity Exceedances Liddell PS (2011-2016)					
Year	Unit1	Unit 2	Unit 3	Unit4	Number reported to EPA
	Number of Exceedances				
2011	1	4	1	1	7
2012	1	4	1	0	0
2013	1	1	1	1	1
2014	1	0	0	0	0
2015	0	0	0	0	0
2016	1	0	0	0	0
Total	5	9	3	2	8