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ENERGYAUSTRALIA YALLOURN EMISSIONS MONITORING PROGRAM - CLASS 3 INDICATORS REPORT

Prepared for	EnergyAustralia Yallourn Pty Ltd
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Executive Summary

HRL Technology Group (HRL) has prepared this document for EnergyAustralia Yallourn Pty Ltd (EAY) to report on the outcomes of an Emissions Monitoring Program for Class 3 Indicators (Class 3 Program) completed at Yallourn power station. As required by EPA Licence No. 10961 (EPA Licence) condition LI_DA4.4:

> *You must establish and implement a program for a 12-month period to monitor the discharge to air, at discharge point(s) A1, A2a and A2b, of all class 3 indicators listed in Schedule A of State Environment Protection Policy (Air Quality Management), as agreed in writing with EPA. The results of this program must be made available to EPA on request and must be published to the publicly accessible website required by condition LI_DA4.2 by 31 March 2022.*

A Class 3 monitoring program was developed following guidance from EPA Publication 440.1 *A guide to the sampling and analysis of air emissions and air quality* and EPA Publication 1322.9 *Licence Management.* The program scope of work was informed by outcomes of previous studies and historic analytical results (e.g. coal analysis data, stack test reports and fly ash analysis data) obtained from Yallourn power station, to identify which Class 3 Indicators should be excluded from the Class 3 Program. From that assessment, seven (7) Class 3 Indicators were excluded from the Class 3 Program, on the basis that they are not a component of brown coal from the Yallourn coal mine nor are they associated with the combustion of brown coal at Yallourn power station. On 21 January 2021, the EPA confirmed in writing that the proposed scope of work for the Class 3 Program was appropriate for the purpose of complying with the new condition LI_DA4.4.

Stack emission testing was conducted by a National Association of Testing Authorities (NATA) accredited third-party stack emission testing specialist (Ektimo Pty Ltd (Ektimo)) across all licenced air emission discharge points at Yallourn Power Station (A1, A2a, and A2b), in accordance with the approved Class 3 Program. The analytical results for most organic Class 3 Indicators were below the limit of detection for the applicable analytical measurement methods. For the few organic Class 3 Indicators that were detected (e.g. dioxins & furans, poly aromatic hydrocarbons (PAHs)) each of these were present at low concentrations.

Inorganic Class 3 Indicators that were detected are primarily associated with residual particulate matter emissions downstream of the Electrostatic Dust Precipitators (EDPs). These included arsenic, beryllium, cadmium and nickel, and respirable crystalline silica (as cristobalite), which were present above detection limits for some, but not all, of the stack tests conducted during the Class 3 Program. The Class 3 Program also utilised recent emission testing data for Class 3 metals from hazardous substances (metals) stack emission testing conducted in November and December 2020, and March to May 2021 at Yallourn power station. This testing was conducted by another third-party NATA accredited stack emission testing specialist (AECOM Australia Pty Ltd (AECOM)).

Of the 26 Class 3 Indicators listed in Schedule A of *State Environment Protection Policy (Air Quality Management)* (SEPP AQM) seven (7) Class 3 Indicators were detected i.e. found to be present in the flue gas at concentrations above the analytical limit of detection.

EAY engaged air dispersion modelling specialist Jacobs Group (Australia) Pty Limited (Jacobs) to prepare an independent air emissions assessment to assess the 'in-stack' measured Class 3 Indicator emissions from Yallourn power station against the current ground level air pollution assessment criteria (APAC) for Class 3 substances in Table 3 of EPA Publication 1961 *Guideline For Assessing and Minimising Air Pollution*. A memorandum summarising the Class 3 Program air emissions assessment undertaken by Jacobs for the Yallourn power station is attached as Appendix A.

Jacobs concluded that:

"The Calpuff results for the Class 3 indicators were maximum 1-hour, maximum 24-hour and annual average GLCs; these were maxima for all 20,000+ grid and discrete (sensitive) receptors. Comparisons with APAC were made for both incremental and cumulative results as fractions of the APAC (where provided by EPA, 2022 [EPA Publication 1961 Table 3]*). Where APAC were available, all the incremental results were less than 0.1% of APAC, except for chromium (VI) that was 2.3% of APAC, and nickel that was 6.5% of APAC;* [see Table 3].

The estimates for background concentrations for the Class 3 substances are provided in [see Table 3] – *the analysis was limited to substances with detectable concentrations. The YPS contributions plus background estimates were considered for each substance. The highest cumulative results, which include background concentrations, were for PAH (as Benzo[a]pyrene) and chromium (VI) and was 10% of APAC.*

Note the assessment for chromium was conservative – the highest of all the calculated in-stack emission rates was used in the modelling and assumed to be 100% chromium-(VI). Whereas, some of the chromium is expected to be in the less harmful chromium-(III) oxidation state; e.g. [see literature reference provided in Appendix A]."

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1 Introduction

Yallourn power station is subject to Victorian Environment Protection Authority (EPA) Operating Licence No. 10961 (EPA Licence). Licence condition LI_DA4.4 requires EnergyAustralia Yallourn Pty Ltd (EAY):

> *You must establish and implement a program for a 12-month period to monitor the discharge to air, at discharge point(s) A1, A2a and A2b, of all class 3 indicators listed in Schedule A of State Environment Protection Policy (Air Quality Management), as agreed in writing with EPA. The results of this program must be made available to EPA on request and must be published to the publicly accessible website required by condition LI_DA4.2 by 31 March 2022.*

HRL Technology Group (HRL) has prepared this document for EAY to report on the outcomes of the Class 3 Indicators monitoring program (Class 3 Program) completed at Yallourn power station.

2 Class 3 Program Methodology

EPA Publication 1322.9 *Licence Management* requires sampling and analysis to be conducted in accordance with EPA Publication 440.1 *Guide to Air Quality Sampling and Analysis*. The Class 3 Program developed to address Licence condition LI_DA4.4 was prepared following guidance from EPA Publication 440.1 and was informed by outcomes of previous studies and historic analytical results (e.g. coal analysis data, stack test reports and fly ash analysis data) from Yallourn power station.

The Class 3 Program proposed by EAY included conducing stack emission testing on all licenced air emission discharge points (A1 – Stage 1, A2a – Unit 3, and A2b – Unit 4) for all Class 3 Indicators except the following:

- asbestos
- ethylene oxide
- propylene oxide
- epichlorohydrin
- MDI (methylene diphenyl diisocyanate)
- TDI (toluene-2,4-diisocyanate and toluene-2,6-diisocyanate)
- phosgene

The Class 3 Program proposed that physical stack emission sampling would utilise the normal sampling location on each stack or flue which is utilised for routine annual Licence compliance monitoring. The Class 3 Program also proposed to include results for relevant Class 3 Indicators from Hazardous Substances (Metals) stack emission testing conducted recently at Yallourn power station. The relevant Class 3 Indicators from this prior testing included arsenic, beryllium, cadmium and nickel. This testing was undertaken in November and December 2020 and in March to May 2021 by a specialist sampling and testing service provider (AECOM).

EAY submitted the proposed Class 3 Program scope of work to the EPA on 16 September 2021. The EPA deemed the Class 3 Program scope of work was appropriate for complying with new condition LI_DA4.4 and provided written feedback to EAY on 21 January 2022.

EAY engaged a National Association of Testing Authorities (NATA) accredited specialist stack emission sampling and testing service provider, Ektimo Pty Ltd (Ektimo) to:

- Implement the physical sampling and testing aspects of the Class 3 Program using NATA accredited methods and laboratories, and
- Prepare reports for each sampling and testing campaign, to inform the assessment of Class 3 Indicator emissions to the atmosphere at the Yallourn power station.

The sampling and analysis methods and the NATA accreditation status each analyte in relation to the specified sampling or analysis method are summarised in Table 1.

Table 1: Selected sampling and analysis methods for Class 3 analytes

Parameter	Sampling Method	Analysis Method	Uncertainty*	NATA Accredited	
				Sampling	Analysis
Sampling points - Selection	AS 4323.1	NA	NA	✓	NA
Flow rate, temperature and velocity	ISO 10780	ISO 10780	8%, 2%, 7%	NA	✓
Moisture	USEPA Method 4	USEPA Method 4	8%	✓	✓
Molecular weight	NA	USEPA Method 3	not specified	NA	✓
Carbon dioxide and oxygen	USEPA Method 3A	USEPA Method 3A	13%	✓	✓
Vinyl chloride monomer (VCM)	USEPA Method 106	Ektimo 340	19%	✓	✓†
Cyanide	Ektimo 270	Envirolab in-house method Inorg-014	14%	✓	✓‡
Speciated volatile organic compounds	Ektimo 200	Ektimo 345b	not specified	✓	✓†
Speciated volatile organic compounds (VOCs)	Ektimo 344	Ektimo 344	19%	✓	✓†
Speciated volatile organic compounds (benzoyl chloride, alpha chlorinated toluenes)	Ektimo 344	Ektimo 344	not specified	✓	×
Total particulate matter	AS 4323.2	AS 4323.2	7%	✓	✓††
Particulate matter (PM_{10} and $PM_{2.5}$)	USEPA Method 201A	USEPA Method 201A	9%	✓	✓††
Total (gaseous and particulate) metals (Ag, As, Ba, Be, Cd, Co, Cr, Cu, Hg, Mn, Ni, P, Pb, Sb, Se, Tl, Zn)	USEPA Method 29	Envirolab in-house methods Metals-006, Metals-020, Metals-021 & Metals-022	15%	✓	✓‡
Hexavalent chromium	CARB 425	Envirolab in-house method Inorg-024	16%	✓	✓‡
Dioxins and furans (PCDDs and PCDFs)	USEPA Method 23A	NMI in-house method AUTL_MET_02	16%	✓	✓¶
Pentachlorophenol (PCP)	USEPA SW-846 0010	NMI in-house method NGCMS 11.27	16%	✓	✓¶
Polycyclic aromatic hydrocarbons (PAHs)	USEPA SW-846 0010	NMI in-house method NGCMS 11.27	21%	✓	✓¶
Crystalline silica	Isokinetic-In-stack-PM2.5 cyclone-water impingers	Envirolab in-house method DUST-004	not specified	×	✓‡
Radionuclides (210Pb, 226Ra, 228Ra, 228Th, 40K)	Isokinetic-water impingers	SGS in-house method based on ISO10703	not specified	×	✓§
Radionuclides (238U)	Isokinetic-water impingers	SGS in-house method MA1400	not specified	×	×§

Ektimo is NATA accredited for sampling all the Class 3 Indicator analytes selected for inclusion in the Class 3 Program except for respirable crystalline silica and radionuclides, neither of which are typically sampled from flue gas stacks in Australia. However, as both analytes are associated with particulate matter, Ektimo employed particulate matter sampling techniques for collecting samples from flue gas at Yallourn power station to enable analysis of respirable crystalline silica and radionuclides.

Ektimo noted in its reports that NATA accredited laboratories undertook the analysis of all samples for the relevant Class 3 Indicator analytes. However, due to the unusual requirement to test brown coal combustion flue gas emissions for the presence of three of the Class 3 Indicator analytes, respirable crystalline silica, alpha chlorinated toluenes and benzoyl chloride, and Radionuclide Uranium-238, the Laboratory NATA accreditations for the analysis methods, do not specifically include those analytes.

EAY also engaged an air dispersion modelling specialist Jacobs Group (Australia) Pty Limited (Jacobs) to undertake air dispersion modelling to estimate ground level concentrations (GLCs) resulting from the 'in-stack' measured Class 3 Indicator emissions from Yallourn power station and to assess the model estimated GLCs against the relevant standards (now listed in Table 3 of EPA Publication 1961 *Guideline For Assessing and Minimising Air Pollution*).

The overall Class 3 Program schedule is illustrated in Figure 1.

Figure 1: Emissions Monitoring Program – Class 3 Indicators Implementation Schedule

	2021										2022		
Activity	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
Development of Class 3 Indicators Program scope of work													
Receipt of EPA approval of Class 3 Indicators Program													
Regular Hazardous Substances (Metals) Testing Campaign (incl. Class 3 Indicator metals)	Unit 3 (A2a)	Stage 1 (A1)	Unit 4 (A2b)										
1st Campaign (Unit 3, Flue 1 & 2) for selected Class 3 Indicators									U3 (A2a)				
2nd Campaign (Unit 4, Flue 2) for Dioxins & Furans and PAHs										U4 (A2b)			
3rd Campaign (Stage 1, W1&2) for selected Class 3 Indicators excluding Class 3 metals												Stage 1 (U1 & U2) (A1)	
Receipt of analysis results & Jacobs air emissions assessment													
Report to EPA													
Publish on Website													

3 Class 3 Program Results Summary & Assessment

Table 2 summarises the maximum in-stack concentrations measured for the Class 3 Program. Of the 26 Class 3 Indicators listed in Schedule A of *State Environment Protection Policy (Air Quality Management)* (SEPP AQM) seven (7) Class 3 Indicators were detected i.e. found to be present in the flue gas at levels above the analytical limit of detection.

Table 2: Analytical results from the Emissions Monitoring Program - Class 3 Indicators

Class 3 Indicators	Included in Monitoring Program?	Maximum In-Stack Concentrations from 2021/22 testing campaigns (mg/m^3, Dry, STP)	Comment
Acrolein	Yes	BDL (<0.005)	
Acrylonitrile	Yes	BDL (<0.2)	
Alpha chlorinated toluenes and benzoyl chloride	Yes	BDL (<0.2)	
Arsenic and compounds	Yes	0.000556	
Asbestos	No	Not Tested	Unlikely in coal fired combustion emissions.
Benzene	Yes	BDL (<0.2)	
Beryllium and compounds	Yes	0.00025	
1,3-butadiene	Yes	BDL (<0.005)	
Cadmium and compounds	Yes	0.00283	
Chromium VI compounds	Yes	BDL (<0.004)	
1,2-dichloroethane (ethylene dichloride)	Yes	BDL (<0.2)	
Dioxins and Furans (as TCDD I-TEQs)	Yes	Lower Bound (Note 2) 6.4E-08 Middle Bound 6.4E-08 Upper Bound 6.4E-08	
Epichlorohydrin	No		Unlikely in coal fired combustion emissions.
Ethylene Oxide	No	Not Tested	Unlikely in coal fired combustion emissions. Also, unlikely given reactivity, mainly associated with polymer manufacture.
Hydrogen cyanide	Yes	<0.004	
MDI (Diphenylmethane diisocyanate)	No	Not Tested	Unlikely in coal fired combustion emissions. Also, unlikely given reactivity, mainly associated with foam manufacture.
Nickel and compounds	Yes	0.0415	
PAH (as BaP)	Yes	Lower Bound (Note 2) 0 Middle Bound 7.8E-06 Upper Bound 1.6E-05	
Pentachlorophenol	No	Not Tested	
Phosgene	No	Not Tested	Unlikely in coal fired combustion emissions. Not expected to be present at temperatures >200°C and requires specialised equipment.
Propylene oxide	No	Not Tested	Unlikely in coal fired combustion emissions. Also, unlikely given reactivity, mainly associated with polymer manufacture.

Class 3 Indicators	Included in Monitoring Program?	Maximum In-Stack Concentrations from 2021/22 testing campaigns (mg/m^3, Dry, STP)	Comment
Radionuclides	Yes	^{210}Pb <0.21 <0.17 ^{226}Ra <0.070 <0.087 ^{238}U <0.001 & <0.00005 mg/filter <0.001 & <0.00005 mg/filter ^{228}Th <0.040 <0.052 ^{228}Ra <0.21 <0.25 ^{40}K <0.81 <0.92	
Respirable crystalline silica (inhaled in the form of quartz or cristobalite) (measured as PM2.5)	Yes	BDL (<0.007) – alpha quartz and 0.041 - cristobalite	
TDI (toluene-2,4-diisobyanate and toluene-2,6-diisocyanate)	No	Not Tested	Unlikely in coal fired combustion emissions. Also, unlikely given reactivity, mainly associated with foam manufacture.
Trichloroethylene	Yes	BDL (<0.2)	
Vinyl chloride	Yes	BDL (<0.006)	

Notes:

1. BDL = Below Detection Limit
2. Dioxins & furans and PAHs consist of groups of similar compounds which are expressed as a total based on a reference compound i.e. 2,3,7,8-retrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) in the case of dioxins & furans and benzo[a]pyrene (BaP) in the case of PAHs. Since some of the individual compounds may not be detected, the following convention is used by Ektimo to report the analytical test results for these groups of compounds:
   Lower bound: those compounds whose concentrations are below their respective detection limits are set to zero.
   Middle bound: those compounds whose concentrations are below their respective detection limits are assumed to be present at half of the detection limit concentration.
   Upper bound: those compounds whose concentrations are below their respective detection limits are assumed to be present at the detection limit concentration.

3.1 Jacobs Air Yallourn Power Station Air Emissions Assessment

EnergyAustralia engaged Jacobs to undertake the air quality impact assessment component of the Class 3 Program. A memorandum summarising the Class 3 Program air emissions assessment undertaken by Jacobs for the Yallourn power station is attached as Appendix A.

Jacobs' scope of work and methodology for undertaking the air emissions assessment was to build upon previous Calpuff air dispersion modelling also undertaken by Jacobs in 2018 by incorporating results from emission testing conducted in 2021. The prior air dispersion modelling results were re-processed by Jacobs to determine ground level concentrations (GLCs) for each of the Class 3 Indicators found to be present in flue gas emissions from Yallourn power station. This data was based on the stack testing campaigns undertaken by Ektimo and AECOM on behalf of EAY in 2020/21. The 2016 and 2017 annual meteorological simulations used previously by Jacobs in 2018 were utilised for the current air dispersion modelling assessment.

For a conservative assessment, Jacobs utilised the maximum 'in-stack' emission concentration measurements for those Class 3 Indicators that were detected (from the Ektimo and AECOM stack testing campaigns) and only considered the GLC maxima from 20,000+ receptors (including from within the site boundary). The assessment included consideration of the background concentration values with the calculated Yallourn power station contributions ('cumulative assessment') to evaluate against APAC cumulative concentrations.

Using the risk assessment framework of EPA Publication 1961, Jacobs note that their assessment is consistent with a 'Level 2 assessment', because it has benchmarked model-predicted pollutant concentrations against relevant APAC to make a judgement about the resulting risks of air quality impact from all modelled Class 3 Indicators. Jacobs (2022) comment that "*Model-predicted GLCs for an air pollutant that exceed one or more APAC indicate that the tested activity has the potential to pose an unacceptable risk to human health or the environment (EPAV, 2022[1]).*"

Table 3 is from the Jacobs (2022) Yallourn power station air emissions assessment and summarises the incremental, background and cumulative[2] modelling results for the Class 3 indicators as maximum 1-hour, maximum 24-hour and annual average GLCs (these were maxima for all 20,000+ grid and discrete (sensitive) receptors). Comparisons with APAC were made as fractions expressed as a percentage of the APAC (where provided by EPA Publication 1961 Table 3).

Jacobs concluded that:

"The Calpuff results for the Class 3 indicators were maximum 1-hour, maximum 24-hour and annual average GLCs; these were maxima for all 20,000+ grid and discrete (sensitive) receptors. Comparisons with APAC were made for both incremental and cumulative results as fractions of the APAC (where provided by EPA, 2022 [EPA Publication 1961 Table 3]*). Where APAC were available, all the incremental results were less than 0.1% of APAC, except for chromium (VI) that was 2.3% of APAC, and nickel that was 6.5% of APAC;* [see Table 3].

The estimates for background concentrations for the Class 3 substances are provided in [see Table 3] – *the analysis was limited to substances with detectable concentrations. The YPS contributions plus background estimates were considered for each substance. The highest cumulative results, which include background concentrations, were for PAH (as Benzo[a]pyrene) and chromium (VI) and was 10% of APAC.*

Note the assessment for chromium was conservative – the highest of all the calculated in-stack emission rates was used in the modelling and assumed to be 100% chromium-(VI). Whereas, some of the chromium is expected to be in the less harmful chromium-(III) oxidation state; e.g. [see literature reference provided in Appendix A]."

[1] EPA Publication 1961 Section 6.3.1 Applying the APAC to model results: "*Exceedance of one or more APACs indicates that the activity has the potential to pose an unacceptable risk to human health or the environment.*"

[2] The incremental GLC at a location is due to emissions from the Yallourn power station only. The cumulative GLC = incremental GLC + background GLC.

Table 3: Yallourn power station incremental (standalone) GLC maxima for all receptors (Jacobs, 2022, see Appendix A)

#	Substance		Max 1h GLC ($\mu g/m^3$)	Max 24h GLC ($\mu g/m^3$)	Annual average GLC ($\mu g/m^3$)	Fraction APAC max 1h	Fraction APAC max 24h	Fraction APAC annual
	Dioxins and furans							
1	PCDD I-TEQ [total PCDD + PCDF], assessed as TCDD (conservative)	Incremental	2.1E-06	1.5E-07	7.7E-09	--	--	0.02%
		Background	--	< 1.3E-09	< 2.18E-09	--	--	--
		Cumulative	2.1E-06	1.5E-07	9.9E-9	--	--	0.02%
2	PAH as B(a)P	Incremental	1.4E-05	1.0E-06	5.3E-08	--	--	0.05%
		Background	0.00099	0.0004	1.0E-05	--	--	--
		Cumulative	0.0010	0.0004	1.01E-05	--	--	10%
	Metals							
3	Chromium (VI)	Incremental	0.031	0.0022	0.00012	2.4%	--	2.4%
		Background	--	0.0013	0.0004	--	--	--
		Cumulative	0.031	0.0035	0.00052	2.4%	--	10%
4	Nickel	Incremental	0.013	0.0009	4.7E-05	6.5%	--	0.05%
		Background	--	0.001	0.0006	--	--	--
		Cumulative	0.013	0.0019	0.00065	6.5%	--	0.72%

A double-dash indicates APAC not provided by EPA (2022) or no background data available.

4 References

Environment Protection Regulations 2021 (Vic) (EP Regulations)

EPA Publication 440.1 *Guide to Air Quality Sampling and Analysis*

EPA Publication 1322.9 *Licence Management*

EPA Publication 1961 *Guideline for Assessing and Minimising Air Pollution in Victoria*

EPA Licence No. 10961 EnergyAustralia Yallourn Pty Ltd

Memorandum: Jacobs-Energy Australia 29 March 2022 (see Appendix A)

The following Ektimo stack testing reports were referenced when preparing this report:

Ektimo Report No.	Report Title	Comment
R011879r	W3 Class 3 Indicators EPA Licence Condition LI_DA4.4 Report EnergyAustralia – Yallourn Pty Ltd	Yallourn Power Station, W3 (Stage 2), Unit 3, Flues 1 and 2
R012140	EnergyAustralia – Yallourn Pty Ltd W4 Reduced Class 3 Indicators EPA Licence condition LI_DA4.4 Report	Yallourn Power Station, W4 (Stage 2), Unit 4, Flues 2
R012276	EnergyAustralia – Yallourn Pty Ltd Stage 1 Reduced Class 3 Indicators EPA Licence condition LI_DA4.4	Yallourn Power Station, Stage 1 (Units 1 & 2)

The following AECOM stack testing report was referenced for the Class 3 Program results assessment:

AECOM Job No.	Report Title	Comment
605811732.7	EnergyAustralia, Yallourn Power Station, Emissions Testing Report, Hazardous Substances (Metals) testing, May 2021	Yallourn Power Station, Stage 1 (Units 1 & 2), Unit 3 (Flue 1) and Unit 4 (Flue 2)
605811732.6	EnergyAustralia, Yallourn Power Station, Emissions Testing Report, Hazardous Substances (Metals) testing, December 2020	Yallourn Power Station, Stage 1 (Units 1 & 2), Unit 3 (Flue 2) and Unit 4 (Flue 1)

Appendix A. Jacobs Memorandum: Yallourn Power Station Air Emissions Assessment Summary

Yallourn Power Station Air Emissions Assessment Summary

Date: 30 March 2022
Project name: Air Quality Modelling Update for Yallourn Power Station
Project no: IS416800
Company: Energy Australia:
Document no: IS416800-1-NN-MEM-001
Copies to: Clayton UTZ

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1. Introduction

The Environment Protection Authority Victoria (EPAV) completed a review into the Victorian brown coal-fired power station environmental licences and issued EnergyAustralia Yallourn with a revised environmental licence (licence number 10961) on 5th March, 2021. The revised licence included a new condition LI_DA4.4. LI_DA4.4:

- *You must establish and implement a program for a 12-month period to monitor the discharge to air, at discharge point(s) A1, A2a and A2b, of all class 3 indicators listed in Schedule A of State Environment Protection Policy (Air Quality Management), as agreed in writing with EPA. The results of this program must be made available to EPA on request and must be published to the publicly accessible website required by condition LI_DA4.2 by 31 March 2022.*

To comply with this new licence condition, EnergyAustralia is undertaking an assessment of Yallourn Power Station (YPS) operations and air emissions. EnergyAustralia requested Jacobs undertake the air quality impact assessment component, building on previous Calpuff air dispersion modelling undertaken in 2018 by Jacobs, and incorporating results from emission testing conducted in 2021 targeting Class 3 air quality indicators.

The Jacobs (2018) Calpuff results were re-processed to determine Ground Level Concentrations (GLCs) for each of the target substances. The potential for ambient air quality impact by the Class 3 substances was assessed by comparisons of model-predicted GLCs with the new EPAV (2022) Air Pollution Assessment Criteria (APAC), which superceded the 2001 design criteria set out in the State Environment Protection Policy (Air Quality Management) (Victoria Government, 2001).

1.1 Scope of works and method

The scope of works (and method) of this assessment is described by the main tasks listed in the following points:

- Review scope of works and assess emissions for substances identified in emissions reports provided by Energy Australia. A review was undertaken to determine whether background (non-YPS) levels for the substances could be established.
- Analyse YPS stack testing reports, using reports provided to Jacobs up to 18th March, 2022.
- Review and process the Jacobs (2018) Calpuff results based on the 2016 meteorological simulation.
- Review and process the Jacobs (2018) Calpuff results based on the 2017 meteorological simulation.
- Determination of Calpuff results and GLCs for the substances, and reporting; i.e., this report.

A conservative approach was taken for all steps in the assessment, where available; e.g., the stack test data used were always the maximum measurements obtained for a YPS flue or unit, where available, and extrapolated to each of the emission points to calculate a total YPS emission rate.

While this assessment was based on the previous Jacobs (2018) Calpuff modelling assessment, as far as practicable this assessment was undertaken in accordance with the new Guideline for Assessing and Minimising Air Pollution in Victoria (for air pollution managers and specialists) (EPAV, February 2022).

1.2 EPAV Guideline and APAC

The EPAV Guideline for Assessing and Minimising Air Pollution in Victoria provides a framework to assess and control risks associated with air pollution. eliminate or minimise risks to human health or the environment, so far as reasonably practicable; EPAV (2022) states that:

A focus of the Guideline is the so-called ‘general environmental duty’ to apply (air emissions) controls to eliminate or minimise risks to human health or the environment, so far as reasonably practicable. The Guideline outlines a risk management approach that involves a repeating cycle of four steps: (1) identifying hazards, (2) assessing risks, (3) implementing controls, and (4) checking controls (EPAV, 2022).

The Guideline presents risk-based air pollution assessment criteria (APAC) for the assessment and management of air emissions. The APAC supercede criteria set out in the State Environment Protection Policy (Air Quality Management) 2001 and the Protocol for Environmental Management: Mining and Extractive Industries 2007 (EPAV, 2022).

The Guideline states APAC are designed to be used within a broader air pollution management framework, so that risks can be minimised 'so far as reasonably practicable'.

1.3 Applying the APAC to model results

Model-predicted GLCs for an air pollutant that exceed one or more APAC indicate that the tested activity has the potential to pose an unacceptable risk to human health or the environment (EPAV, 2022).

The APAC are to be applied to modelled GLCs and reported for 'most impacted' locations at or beyond the boundaries of a site, and for any sensitive land uses – this assessment applied the APAC at more than 20,000 grid receptors and discrete receptors identified by Jacobs (2018) for the Latrobe Valley study area: 19,600 grid receptors and 1,114 discrete receptors.

(Where background data are available), results for each pollutant are to be presented as:

- incremental GLC at the location due to emissions from the site
- background GLC
- cumulative GLC (background plus incremental)

EPAV (2022) states that GLC percentiles are to be reported as:

- 99.9^{th} percentile for averaging times of an hour or less, and
- maxima for all averaging times greater than an hour.
- APAC with averaging times of >=24 hours apply (only) at discrete sensitive locations.

1.4 Conservative assessment

For this assessment only the maxima were tested by comparisons with the APAC; i.e., maximum 1-hour averages, maximum 24-hour averages, and annual averages. Only the GLC maxima from the 20,000+ receptors (including from within the site boundary) were used for the reporting of final results. Also, only the maxima from the stack testing were used. Combined, this approach is expected to have led to a conservative assessment being undertaken.

Estimates for Latrobe Valley background levels were found for most of the Class 3 indicators, these background levels were considered as part of the assessment ('cumulative assessment').

Using the risk assessment framework of the Guideline, this assessment is a 'Level 2 assessment', because it has benchmarked model-predicted pollutant concentrations against relevant APAC to make a judgement about the resulting risks of air quality impacts.

2. Calpuff results – Class 3 substances

The Calpuff results for the Class 3 indicators were maximum 1-hour, maximum 24-hour and annual average GLCs; these were maxima for all 20,000+ grid and discrete (sensitive) receptors. Comparisons with APAC were made for both incremental and cumulative results as fractions of the APAC (where provided by EPA, 2022). Where APAC were available, all the incremental results were less than 0.1% of APAC, except for chromium-6 that was 2.3% of APAC, and nickel that was 6.5% of APAC; see Table 2-1.

The estimates for background concentrations for the Class 3 substances are provided in Table 2-1 – the analysis was limited to substances with detectable concentrations. The YPS contributions plus background estimates were considered for each substance. The highest cumulative results, which include background concentrations, were for PAH (as Benzo[a]pyrene) and chromium (VI) and was 10% of APAC for both analytes.

Note the assessment for chromium was conservative – the highest of all the calculated in-stack emission rates was used in the modelling and assumed to be 100% chromium-(VI). Whereas, some of the chromium is expected to be in the less harmful chromium-(III) oxidation state; e.g., see Shah et al. (2012).

Table 2-1 YPS substances for assessment and APAC – maxima for all 20,000+ receptors

#	Substance		Max 1h GLC ($\mu g/m^3$)	Max 24h GLC ($\mu g/m^3$)	Annual average GLC ($\mu g/m^3$)	Fraction APAC max 1h	Fraction APAC max 24h	Fraction APAC annual
	Dioxins and furans							
1	PCDD I-TEQ [total PCDD + PCDF], assessed as TCDD (conservative)	Incremental	2.1E-06	1.5E-07	7.7E-09	--	--	0.02%
		Background	--	< 1.3E-09	< 2.18E-09	--	--	--
		Cumulative	2.1E-06	1.5E-07	9.9E-9	--	--	0.02%
2	PAH as B(a)P	Incremental	1.4E-05	1.0E-06	5.3E-08	--	--	0.05%
		Background	0.00099	0.0004	1.0E-05	--	--	--
		Cumulative	0.0010	0.0004	1.01E-05	--	--	10%
	Metals							
3	Chromium (VI)	Incremental	0.031	0.0022	0.00012	2.4%	--	2.4%
		Background	--	0.0013	0.0004	--	--	--
		Cumulative	0.031	0.0035	0.00052	2.4%	--	10%
4	Nickel	Incremental	0.013	0.0009	4.7E-05	6.5%	--	0.05%
		Background	--	0.001	0.0006	--	--	--
		Cumulative	0.013	0.0019	0.00065	6.5%	--	0.72%

A double-dash indicates APAC not provided by EPA (2022) or no background data available.

References

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