Hunter Power Project - Additional Information

Response to RFI 2: Air Quality Assessment Addendum

15 September 2021

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1. Introduction

Snowy Hydro Limited (Snow Hydro) propose to develop an open cycle gas fired power station near Kurri Kurri, NSW (the Proposal). The Proposal involves the construction and operation of a power station, electrical switchyard and associated supporting infrastructure. The Proposal will operate as a "peak load" generation facility supplying electricity at short notice when there is a requirement in the National Electricity Market (NEM).

The Environmental Impact Statement (EIS) for the Hunter Power Project (Kurri Kurri Power Station) (the Proposal) was placed on public exhibition by the Department of Planning, Industry and Environment (DPIE) from 13 May 2021 to 9 June 2021.

During the exhibition period, submissions on the Proposal were received from the public and government agencies including the Environment Protection Authority (EPA). In response to the submissions, Jacobs prepared a Submissions Report (Jacobs, 2021a) and revised Air Quality Impact Assessment (AQIA) for the Proposal (Jacobs, 2021b).

Post the response to submissions, the EPA sought additional information (via letter on 3 September 2021) on four items relating to the revised AQIA:

1. Cumulative impact concentrations.
2. Criteria for nitrogen dioxide and sulfur dioxide.
3. Validation of emissions.
4. Background data and results at 25°C.

This Addendum addresses the EPA's request for addition information as per the Department of Planning, Industry and Environment's Request for Information (RFI 2).

2. Additional information

2.1 Cumulative Impact Concentrations

The EPA letter of 3 September 2021 stated:

> *The EPA recommends the proponent provide the results in a clear format that enables understanding of the potential impacts. The proponent should refer to Table 11.3 of the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW and provide a refined assessment for identified receptors which evaluates the cumulative impacts from both the highest backgrounds and the highest increments that includes:*
>
> - *Time/date*
> - *Project (only) increment*
> - *The adopted background*
> - *Cumulative (total) impact.*
>
> *The EPA recommends the proponent address issues 2 and 7 as they work to address this issue.*

Section 11.2 of the "Approved Methods for the Modelling and Assessment of Air Pollutants in NSW" (EPA, 2016) (the Approved Methods) outlines the approach for dealing with elevated background levels, that is, where background levels already approach or exceed criteria without the contribution of a proposed development. Two approaches are provided in the Approved Methods:

- Level 1 assessment – maximum impact
- Level 2 contemporaneous impact and background

The different levels of assessment mean that a Level 2 assessment is not required if it can be shown that a Level 1 assessment demonstrates that adverse impacts will not occur.

The model results have been re-formatted to improve the understanding of potential impacts and consideration has been given the appropriate level of assessment (Level 1 or 2). In addition, the background levels have been re-calculated from volumetric to mass concentrations at 0°C, and the relevant amended NEPM standards have been included for comparison.

2.1.1 Carbon Monoxide (CO)

A Level 1 assessment has been carried out for carbon monoxide (CO) and the results are provided in **Table 2-1**. The results show a low risk of the Proposal causing adverse impacts with respect to CO as the cumulative concentrations at all modelled 9600 ground-level locations, including the 16 sensitive receptors, would be well below all EPA assessment criteria.

Table 2-1 Model results for carbon monoxide at any location

Averaging time	Concentration in mg/m^3			
	Maximum background level	Maximum Proposal increment at any ground-level location	Maximum cumulative concentration at any ground-level location	EPA assessment criteria
Natural gas				
15-minute	1.7	0.1	1.8	100
1-hour	1.5	0.06	1.56	30

Averaging time	Concentration in mg/m^3			
	Maximum background level	Maximum Proposal increment at any ground-level location	Maximum cumulative concentration at any ground-level location	EPA assessment criteria
8-hour	1.1	0.01	1.11	10
Diesel				
15-minute	1.7	0.5	2.2	100
1-hour	1.5	0.3	1.8	30
8-hour	1.1	0.04	1.14	10

2.1.2 Nitrogen Dioxide (NO_2)

A Level 1 assessment has been carried out for nitrogen dioxide (NO_2) and the results are provided in **Table 2-2**. The results show that the maximum cumulative NO_2 concentrations at all ground-level locations, including sensitive receptors, would not exceed the EPA assessment criteria. These results have been determined from combining maximum background levels with maximum Proposal increments at the potentially most affected ground-level location. This situation is highly unlikely to occur given that the Proposal would only be operating for approximately 2 percent of the time. Therefore the results are conservative estimates of the potential NO_2 impacts.

Table 2-2 Model results for nitrogen dioxide at any location

Averaging time	Concentration in µg/m^3					
	Maximum background level	Maximum Proposal increment[1] at any ground-level location	Maximum cumulative concentration at any ground-level location	EPA assessment criteria	Varied NEPM	
					2021	2025
Natural gas						
1-hour	82	51	133	246	164	164
Annual	17.6	0.2	17.8	62	31	31
Diesel						
1-hour	82	86	168	246	164	164
Annual	17.6	0.4	18.0	62	31	31

[1] Maximum 1-hour average Proposal increments calculated on the assumption that 20% of the NO_x is NO_2 at the point of maximum ground-level concentration. This is supported by the DPIE monitoring data which showed that maximum NO_x concentrations are associated with NO_2 to NO_x ratios of no more than 20%. Jacobs (2021) estimated the percentage to be closer to 10% by OLM. Annual average Proposal increments calculated assuming 100% of the NO_x is NO_2.

Further investigation of the modelled NO_2 has been carried out to make a comparison with the recent amendments to the Ambient Air Quality NEPM. It should be noted that the Proposal AQIA (Jacobs, 2021) was prepared in accordance with the Approved Methods which does not refer to the Ambient Air Quality NEPM. In addition, it is understood that the Proposal is not required to be assessed against the Ambient Air Quality NEPM as the purpose of the Ambient Air Quality NEPM is to provide "a national framework for monitoring and reporting on exposure to common ambient air pollutants", and is not intended for the assessment of individual projects.

Notwithstanding the above, a comparison of the modelled NO_2 concentrations against the recently amended Ambient Air Quality NEPM Standards has been made as per the EPA's request.

Table 2-3 shows the model results for NO_2, specifically for the most affected sensitive receptor location. The modelling shows that the amended NEPM Standards would not be exceeded at any sensitive receptor due to the operation of the Proposal. Compliance with the amended NEPM Standards is therefore anticipated. Again, these results are based on the assumption the Proposal is operating continuously. In reality the Proposal would only be operating approximately 2 percent of the time so maximum cumulative concentrations would be expected to be lower than presented below, especially in the case of the annual averaging time.

Table 2-3 Model results for nitrogen dioxide at the most affected sensitive location

Averaging time	Concentration in µg/m^3					
	Maximum background level	Maximum Proposal increment[1] at any sensitive receptor	Maximum cumulative concentration at any sensitive receptor	EPA assessment criteria	Varied NEPM	
					2021	2025
Natural gas						
1-hour	82	12	94	246	164	164
Annual	17.6	0.2	17.8	62	31	31
Diesel						
1-hour	82	17	99	246	164	164
Annual	17.6	0.3	17.9	62	31	31

[1] Maximum 1-hour average Proposal increments calculated on the assumption that 20% of the NO_x is NO_2 at the point of maximum ground-level concentration. This is supported by the DPIE monitoring data which showed that maximum NO_x concentrations are associated with NO_2 to NO_x ratios of no more than 20%. Jacobs (2021) estimated the percentage to be closer to 10% by OLM. Annual average Proposal increments calculated assuming 100% of the NO_x is NO_2.

2.1.3 Sulfur Dioxide (SO_2)

A Level 1 assessment has been carried out for sulfur dioxide (SO_2) and the results are provided in **Table 2-4**. The results show that the maximum cumulative SO_2 concentrations at all ground-level locations, including sensitive receptors, would not exceed the EPA assessment criteria. These results have been determined from combining maximum background levels with maximum Proposal increments at the potentially most affected ground-level location. This situation is highly unlikely to occur given that the Proposal would only be operating approximately 2 percent of the time. Therefore the results are conservative estimates of the potential SO_2 impacts, especially for the longer averaging time periods.

Table 2-4 Model results for sulfur dioxide at any location

Averaging time	Concentration in µg/m^3					
	Maximum background level	Maximum Proposal increment at any ground-level location	Maximum cumulative concentration at any ground-level location	EPA assessment criteria	Varied NEPM	
					2021	2025
Natural gas						
10-minute	239	37	276	712	-	-
1-hour	200	20	220	570	286	214
24-hour	20.5	1.1	21.6	228	57	57
Annual	4.6	0.02	4.62	60	-	-
Diesel						
10-minute	239	6	245	712	-	-
1-hour	200	3	203	570	286	214
24-hour	20.5	0.1	20.7	228	57	57
Annual	4.6	0.003	4.6	60	-	-

The recent amendments to the Ambient Air Quality NEPM indicate that the Standard for 1-hour average SO_2 will be revised from 286 µg/m^3 in 2021 to 214 µg/m^3 in 2025. A comparison of the modelled SO_2concentrations against the recently amended Ambient Air Quality NEPM Standards has been made as per the EPA's request.

Table 2-5 shows the model results for SO_2, specifically for sensitive receptor locations. The modelling shows that the amended NEPM Standards would not be exceeded at any sensitive receptor due to the operation of the Proposal. Compliance with the amended NEPM Standards is therefore anticipated. Again, these results are based on the assumption that the Proposal is operating continuously, while it is expected to operate for approximately 2 percent of the time.

Table 2-5 Model results for sulfur dioxide at the most affected sensitive location

Averaging time	Concentration in µg/m^3					
	Maximum background level	Maximum Proposal increment at any sensitive receptor	Maximum cumulative concentration at any sensitive receptor	EPA assessment criteria	Varied NEPM	
					2021	2025
Natural gas						
10-minute	239	9	248	712	-	-
1-hour	200	5	205	570	286	214
24-hour	20.5	0.3	20.8	228	57	57
Annual	4.6	0.01	4.61	60	-	-
Diesel						
10-minute	239	1.2	240.2	712	-	-
1-hour	200	0.6	200.6	570	286	214
24-hour	20.5	0.04	20.54	228	57	57
Annual	4.6	0.002	4.602	60	-	-

2.1.4 Particulate Matter (as $PM_{2.5}$)

Figure 6-10 of the AQIA (Jacobs, 2021) provided the concurrent modelled and measured $PM_{2.5}$ concentrations at the most affected sensitive receptor for the worst-case Proposal operation (i.e. diesel). This information represented a Level 2 assessment and has now been presented in a tabular format, consistent with Table 11.3 of the Approved Methods.

Table 2-6 shows the model results for 24-hour average $PM_{2.5}$, ranked by background levels. The Proposal increment is presented for the most affected sensitive receptor for each day of the model year. From these results it can be seen that there is one day in the year when the Proposal has the potential to cause an exceedance of the EPA assessment criterion (25 µg/m^3). This outcome is clearly the result of an elevated background level, 24.9 µg/m^3, combined with a relatively small contribution from the Proposal, 0.4 µg/m^3. By this same approach it can be demonstrated that the Proposal would not cause an exceedance of the 2025 NEPM Standard, but clearly the outcome is influenced by background levels rather than contributions from the Proposal.

Table 2-6 Model results for $PM_{2.5}$ at sensitive locations, ranked by background levels

Date	Concentration in µg/m³					
	Background level	Proposal increment[1] at most affected sensitive receptor	Total concentration at most affected sensitive receptor	EPA assessment criteria	Varied NEPM	
					2021	2025
Diesel (worst case)						
22/11/2018	24.9	0.4	25.3	25	25	20
20/03/2018	17.7	0.1	17.8	25	25	20
6/11/2018	17.4	0.2	17.6	25	25	20
15/07/2018	17.1	0.2	17.3	25	25	20
9/04/2018	16.9	0.1	17.0	25	25	20
22/06/2018	16.9	0.3	17.2	25	25	20
19/03/2018	16.8	0.3	17.1	25	25	20
27/07/2018	16.7	0.3	17.0	25	25	20
31/12/2018	16.4	0.0	16.4	25	25	20
29/07/2018	16.3	0.1	16.4	25	25	20

[1] *Results for diesel fuelled (worst-case).*

Table 2-7 shows the model results for 24-hour average $PM_{2.5}$, ranked by Proposal increment. These results do not highlight any days when the Proposal would cause an exceedance of the EPA assessment criterion (25 µg/m³). Compliance with the amended NEPM Standard in 2025 is also demonstrated.

Table 2-7 Model results for $PM_{2.5}$ at sensitive locations, ranked by Proposal increment

Date	Concentration in µg/m³					
	Background level	Proposal increment[1] at most affected sensitive receptor	Total concentration at most affected sensitive receptor	EPA assessment criteria	Varied NEPM	
					2021	2025
Diesel (worst case)						
1/05/2018	5.5	0.6	6.1	25	25	20
6/05/2018	11.1	0.6	11.7	25	25	20
25/06/2018	14.9	0.6	15.5	25	25	20
27/05/2018	13.1	0.5	13.6	25	25	20
10/11/2018	5.4	0.5	5.9	25	25	20
11/05/2018	3.2	0.5	3.7	25	25	20
9/05/2018	11.2	0.5	11.7	25	25	20
2/08/2018	10.2	0.5	10.7	25	25	20
22/07/2018	14.9	0.5	15.4	25	25	20
23/08/2018	13.0	0.5	13.5	25	25	20

[1] *Results for diesel fuelled (worst-case).*

A Level 1 assessment has been carried out for annual average $PM_{2.5}$ and results are provided in **Table 2-8**. The results show that the Proposal increments would be very low and would not cause of an exceedance of the EPA assessment criterion. Again, the $PM_{2.5}$ outcomes are clearly influenced by background levels rather than contributions from the Proposal.

Table 2-8 Model results for $PM_{2.5}$ at any location

Averaging time	Concentration in µg/m^3					
	Maximum background level	Maximum Proposal increment at any ground-level location	Maximum cumulative concentration at any ground-level location	EPA assessment criteria	Varied NEPM	
					2021	2025
Natural gas						
Annual	8.6	0.02	8.62	8	8	7
Diesel						
Annual	8.6	0.05	8.65	8	8	7

2.2 Criteria for Nitrogen Dioxide and Sulfur Dioxide

The EPA letter of 3 September 2021 stated:

> *The EPA recommends as the proponent works to address issue 1, the new NEPM standards for NO_2 and SO_2 be considered.*

The AQIA was prepared in accordance with the Approved Methods. The Approved Methods does not refer to the Ambient Air Quality NEPM. In addition, it is understood that the Proposal is not required to be assessed against the Ambient Air Quality NEPM as the purpose of the Ambient Air Quality NEPM is to provide "a national framework for monitoring and reporting on exposure to common ambient air pollutants", and is not intended for the assessment of individual projects. Notwithstanding the above, an assessment of the predicted nitrogen dioxide (NO_2) and sulfur dioxide (SO_2) concentrations against the recently amended Ambient Air Quality NEPM Standards has been made as per the EPA's request. This information is presented in Section 2.1

2.3 Validation of Emissions

The EPA letter of 3 September 2021 stated:

> *The EPA recommends the proponent provide all the information used to model impacts for all pollutants. This includes but is not limited to the methodology used to determine the emission parameters and predicted impacts, including any emission factors and assumptions for pollutants not provided by equipment manufacturers. Specifically, the proponent should provide clarity on the assessment approach of principal toxic air pollutants.*

Emissions of volatile organic compounds (VOCs) were calculated using factors from the National Pollutant Inventory (NPI) Emission Estimation Technique Manual for Combustion Engines (NPI, 2008). **Table 2-9** shows the emission factors and calculated mass emission rates for the natural gas and diesel fuelled scenarios.

Table 2-9 Calculated emissions of volatile organic compounds

Substance	Natural gas fuel case	Diesel fuel case**
Emission factors (kg/kWh) from NPI (2008)*		
Acrolein	9.91E-09	No data
Formaldehyde	1.10E-06	4.33E-07
Polycyclic aromatic hydrocarbons as B(a)P	No data	6.19E-08
Combined mass emission rate from the power station (g/s)		
Acrolein	0.002	-
Formaldehyde	0.230	0.070
Polycyclic aromatic hydrocarbons as B(a)P	-	0.010

** Uncontrolled emission factors for natural gas. Water injection emission factors for diesel.*

*** Correction factor applied to the mass emission rates when operating on diesel as it is expected that the turbines will have a lower electrical output than gas in this scenario.*

Modelling of the speciated VOC emissions above was then carried out by the methodology outlined by Jacobs (2021), with results presented in Section 6.6 of Jacobs (2021). The modelling showed that the 99.9th percentile Proposal contributions in the order of 1% or less of the respective EPA assessment criteria, that is, a large margin of compliance. It was therefore concluded that the Proposal would not cause adverse impacts with respect to these key VOCs.

2.4 Background Data and Results at 25°C

The EPA letter of 3 September 2021 stated:

> *The EPA recommends as the proponent works to address issue 1, background air quality data converted at 0 C is used for accuracy in comparison against criteria.*

Background air quality data has been recalculated to mass concentrations at 0°C. This information is presented in Section 2.1.

3. References

EPA (2016) "Approved Methods for the Modelling and Assessment of Air Pollutants in NSW". Environment Protection Authority.

Jacobs (2021a) "Hunter Power Project – Response to Submissions. Rev 1, dated 4 August 2021.

Jacobs (2021b) "Hunter Power Project – Response to Submissions. Air Quality Impact Assessment - Revised". Rev 1, dated 30 July 2021.

NPI (2008) "National Pollutant Inventory Emission Estimation Technique Manual for Combustion Engines". Version 3.0, June 2008. Published by the Australian Government Department of Environment, Water, Heritage and the Arts.