Technical Advice Air – NO_x licence variation application

Reference	DOC21/1063665 - 4
Purpose	Licence variation application by Delta Electricity for Vales Point Power Station (VPPS) for a further 5 year exemption from the Protection of the Environment Operations (Clean Air) Regulation 2021 Group 5 NOx emission limits.

TA-Air's Position

Technical Advice Air (TA-Air) has reviewed the information submitted by the Licensee for the Licence Variation. TA-Air has reviewed:

- Licence Variation Application for NO_x emission limits, *prepared by Delta Electricity, dated 8 October 2021* (The Cover Letter)
- Vales Point Power Station Air Quality Assessment for Group Exemption Extension, *prepared by Katestone Environment Pty Ltd., dated 8 October 2021* (The AQA)
- NO_x Pollution Reduction Study, Vales Point – Evaluation of Potential NO_x Emission Controls, *prepared by Jacobs Group (Australia) Pty., Ltd., dated 6 October 2021* (The NO_x PRS)
- Memorandum, Sulfur Oxide (SO_x) emissions and reduction options for Vales Point Power Station, *prepared by Jacobs Group (Australia) Pty., Ltd., dated 30 September 2021* (The Memorandum).
- Revised NO_x Emission Limits for Vales Point Power Station, *prepared by Katestone Environment Pty Ltd., dated 26 November 2021* (The Revised NO_x Emission Limits report).

TA-Air considers that the information provided by Delta Electricity (the Licensee) addresses the majority of the specific assessment requirements provided by the EPA in document referenced (DOC20/1061527-4) and included as **Attachment A**. Detailed review comments regarding the submitted information are included in **Attachment B**.

The Environment Protection Licence (EPL) for VPPS has the following NOx emission limits:

- 100th percentile 1-hr average NO_x concentration limit: 1,500 mg/Nm^3.
- 99th percentile 1-hr average NO_x concentration limit: 1,100 mg/Nm^3.

After a review of current CEMS data indicating comfortable compliance with existing EPL emission limits and at the request of the EPA, the Licensee has proposed the following lower EPL NOx emission limits would apply until 1 January 2027:

- 100th percentile 1-hr average NO_x concentration limit: 980 mg/Nm^3.
- 99th percentile 1-hr average NO_x concentration limit: 850 mg/Nm^3.

1. VPPS have implemented combustion efficiency measures to reduce NO_x emissions

The following are some of the controls and actions that have been implemented to manage NO_x emissions from the premises:

- VPPS undertaken works on combustion optimisation, which is indicated has led to a reduction in NO_x emissions. For instance, air flows to the furnace were modified to ensure a lower peak flame temperature is achieved, thereby reducing NOx formation.
- In 2018, Centennial completed the construction and operation of a screening plant at its Mandalong mine. This action has reduced contaminants present in the coal supply to Vales Point. Contaminants in coal can result in feeder blockages, which cause mill trips, temporarily disturbing the fuel supply to the boiler. Such disruptions cause short term fluctuations in NO_x emissions while

the control system adjusts to the change. With fewer feeder trips occurring, NO_x emissions are stable for longer periods of time.

- In July 2021, the burner tips for Unit 6 were changed, which resulted in improved unit efficiency leading to a reduction in NO_x emissions.
- The Distributed Control System (DCS) on Unit 5 was upgraded in 2018 and the DCS on Unit 6 was upgraded in 2021. The new DCS systems allow further optimisation of air flow dynamics and smarter soot-blowing techniques to limit burner tilt positions, which reduces NO_x formation.

Overall, CEMS data analysis shows that the average NO_x emissions from VPPS have decreased in the past ten years.

Notwithstanding the above, the Licensee has not commissioned any post-combustion engineering controls and the decrease in NO_x emissions observed in the CEMS data is also likely to be linked to reduced generation levels.

2. Reduced NO_x limits reflect proper and efficient operation

The reduced NO_x concentration limits are based on the analysis of CEMS data from 2018 to 2021, including monitoring data representative of operations following the installation of the new burner tips for Unit 6 (July -October 2021).

Further, it is specified that Unit 6 performance is expected to be similar to that of Unit 5, for which emissions have remained below 800 mg/m^3 for the majority of time. It should be noted that CEMS data analysis from Unit 5 shows that since 2017, the percentage of time in a single year when emissions were above 800mg/Nm^3 is 0.4 - 0.8 %. As such, it is considered that the reduced limits are anticipated to be reflective of the previous and the expected plant performance.

3. Air dispersion modelling shows compliance with 2021 Ambient Air Quality NEPM NO_2 standard

<u>99th percentile NO_x concentration limit of 850 mg/Nm^3</u>

The maximum predicted 1-hr average cumulative NO_2 concentration at any of the identified sensitive receptors, for the VPPS operating at 850mg/Nm^3 for all hours of the year is 147.2 µg/m^3. The annual average NO_2 is 4.7 µg/m^3. This concentration is below the NSW EPA criterion of 62 µg/m^3 and the AAQ NEPM standard of 31 µg/m^3.

These results comply with the 2021 variation to the AAQ NEPM standard for NO_2 (1 hour: 164 µg/m^3; annual: 31 µg/m^3). The 2021 variation to the AAQ NEPM standards for NO_2 is stricter that the current NSW EPA 1-hr and annual average NO_2 criteria (246 µg/m^3 and 62 µg/m^3 respectively).

<u>100th percentile NOx concentration limit of 980 mg/Nm^3</u>

The maximum predicted 1-hr average cumulative NO_2 concentration at any of the identified sensitive receptor for the VPPS operating at 980mg/Nm^3 for all hours of the year is 171.1 µg/m^3. This predicted concentration complies with the current NSW EPA criterion of 246 µg/m^3. However, it exceeds the new NEPM NO_2 standard of 164 µg/m^3. Compliance with the current NSW EPA and 2021 NEPM NO_2 standard is predicted at all other identified sensitive receptors.

The licensee has undertaken an analysis of meteorological conditions for the hour during which this exceedance is predicted. It is likely that the model has not correctly characterised meteorological conditions during this hour and has assumed poor dispersion conditions close to the ground during this hour. Additionally, during this hour the NO_x mass emission rate was low (relative to the highest modelled emission rate).

The annual average NO_2 is 15.1 µg/m3, which is below the NSW EPA criterion of 62 µg/m^3 and the AAQ NEPM standard of 31 µg/m^3.

4. Air dispersion modelling represents worst case impacts

The air dispersion modelling to demonstrate that the reduced NO_X emission limits comply with the new NO_2 NEPM standards has assumed a constant emission concentration of 850mg/Nm^3 and 980 mg/Nm^3 for all hours of the year. However, the CEMS data recorded between July to October 2021, considered to be representative of the anticipated operations, shows concentrations for this period averaged around 550-650 mg/m^3.

The maximum predicted 1-hr NO_2 concentration at the identified sensitive receptors, for the modelling scenario based on recorded variable emissions data between 2018 and 2020 (i.e. representative of the plant's performance/operations) is 119.2 µg/m^3, which is below the NSW EPA criterion and the 2021 NEPM standard.

The dispersion modelling predicts peak impacts occur between 10am and 3pm. During these hours of the day, VPPS is typically operating at lower loads. Therefore, the likelihood of operating at high loads (as assumed for this modelling scenario) that may result in NO_x emissions close to the 100th limit 980 mg/m^3 is low. The recorded average loads for 2021 are at their lowest between 11:00 and 15:00.

5. At the request of the EPA, the licensee has proposed complimentary actions

The analysis of CEMS data from January 2018 to October 2021 shows that there have been 3 instances when recorded concentrations were above the proposed 100th NO_x concentration limit. At the request of the EPA, the Licensee has also proposed to develop a Trigger Action and Response Plan (TARP) aimed to improve the response to abnormal combustion conditions that might lead to a NO_x concentration limit exceedance. Therefore, suggesting the risk of such occurrences can be minimised.

At the request of the EPA, it has also been proposed to undertake additional ambient air quality monitoring at a location in the vicinity of Wyee Point . This location has been selected as it is considered to be representative of the maximum predicted ground level concentrations.

6. VPPS contribution to regional air quality is minimal

At the request of the EPA, Environment, Energy and Science (EES) has undertaken regional modelling to study the impact of changes to the current 99th percentile NO_x concentration limit. The study incorporated three modelling scenarios to determine the difference (i.e. change) in predicted air pollutant concentrations across the Great Metropolitan Region (GMR) between:

- The current 99th percentile limit (base case) and the reduced 99th percentile NO_x concentration limit (850 mg/m^3).
- The current 99th percentile limit (base case) and Group 5 NO_x concentration limit (800 mg/m^3).

Results and conclusions presented suggest that reducing NO_x concentration limits to meet Group 5 limits is unlikely to result in noticeable changes to regional impacts. A discussion on the results of the EES regional modelling is included as **Attachment C**.

7. The feasibility evaluation of additional NO_x and SO_x emission control measures has not been assessed from an engineering perspective

A feasibility analysis to assess additional mitigation measures that could be implemented at the premises has been undertaken by the Licensee as part of the License application. The analysis is focused on:

- The potential for a specific technology (i.e. control) to achieve NO_x levels at or below Group 5 and Group 6 NO_x emissions limits.
- Capital and operating expenditure.
- The potential savings in Load Base Licensing (LBL) fees that can be achieved from the implementations of specific controls.

It is noted, however, that this analysis has not included the evaluation of the implementation of additional controls from an engineering perspective. Nor has it included information regarding the anticipated implementation timeframe in the context of the expected plant life.

8. Predicted ground level SO_2 concentrations are above the NSW EPA criteria

The maximum predicted cumulative 1-hr SO_2 concentration at a sensitive receptor for the modelling scenario representative of current operations (i.e. reflective of emissions between 2018-2020) is 572.4 µg/m^3, which is above the NSW EPA SO_2 criterion (570 µg/m^3). VPPS contribution on the day the exceedance is predicted is 121.1 µg/m^3. Further, it is also indicated that there are 2 additional exceedances

predicted within the modelling domain. These exceedances are predicted in areas which are likely to include sensitive receptors.

Notwithstanding the above, it is acknowledged that the AQA indicates that:

- The analysis of results and contour plots suggest that maximum cumulative results are driven by background levels and the contribution from other power stations. It should be noted that the contributions from other power stations are likely over-stated in the modelling due to the assumptions made in the preparation of the AQA.
- Predicted modelling results at Dora Creek are close to the NSW EPA assessment criterion (570 µg/m^3). However, the maximum 1-hr SO_2 concentration recorded between 2018-2020 at a monitoring station near Dora Creek is 188.1 µg/m^3.
- A comparison between the measured and predicted concentration at the Wyee AQMS, shows that model is consistently over-predicting SO_2 concentrations at this monitoring location. As such, it is stated that "*It would appear likely that these highest concentrations will have been over-predicted by as much as 50%".*

In light of the above, TA-Air considers that further analysis and investigations should be undertaken by the Licensee to investigate the potential impacts due to SO_x emissions. If required, this is to include identification of control strategies to reduce SO_x emissions from the premises and/or revised SO_2 emission limits that reflect the proper and efficient operation of Unit 5 and 6. This could be undertaken through conditions of the licence or another avenue that the region considers appropriate.

Recommendations

TA-Air recommends that.

- Vales Point Power Station retains the Group 2 designation for NO_x, conditional upon inclusion of recommended conditions as provided in **Attachment D**.
- The Environment Protection Licence is varied to update the 100th percentile 1-hr average NO_x concentration limit to 980 mg/Nm^3.
- The Environment Protection Licence is varied to update the 99th percentile 1-hr average NO_x concentration limit to 850 mg/Nm^3.

Contact and Approval

Contact Officer	Position	Phone number
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Approving Officer	**Position**	**Date**
Janelle Pickup	A/Unit head Technical Advice - Air	03/12/2021

Attachments

Tab	Title
A	Assessment Requirements
B	TA-Air detailed comments on submitted information
C	Environment, Energy and Science (EES) regional modelling
D	Recommended conditions

Background

Vales Point Power Station, located at Mannering Park, NSW (the premises) is owned and operated by Sunset Power International and trades as Delta Electricity (the Licensee). The station was commissioned in 1978 and has an installed generating capacity of 1320 Mega Watts (MW). The premises operate under Environment Protection Licence (EPL) 761.

The Licensee has made an application to the EPA, to vary condition L3.9 of the EPL to state that Boilers 5 and 6 are taken to belong to Group 2 until 1 January 2027. The Licensee has previously submitted licence variation applications to the EPA regarding the inclusion (or extension of dates) of statements as per Cl 35 (2) of the *Protection of the Environment Operations (Clean Air) Regulation 2010* (the Clean Air Regulation). The variations include:

a. An application made in 2010.
b. An Application made in 2015.

In support of the most recent licence variation application, Delta submitted the "*Vales Point Power Station – EPL 761 Licence Variation Application Extension of Group 5 NO_x Emission Limit Exemption*" report (DOC20/1061527).

The EPA advised the Licensee that further information was required, including but not limited to a contemporary Air Quality Impact Assessment. Detailed information can be found in document referenced (DOC20/1061527-4).

The Licensee made an enquiry to the EPA (DOC21/163879) seeking the EPA's input on specific questions and assessment requirements for the licence variation. The EPA's response letter (DOC21/163879-2) detailed the specific information requirements to assist the EPA in determining the variation application. This advice includes a review and comments on the response provided by the Licensee.

In early October 2021, the Licensee submitted a package of information prepared to respond to the EPA's specific Assessment Requirements in relation to the NO_x Variation Application for Vales Point Power Station.

Following an initial review of this information, the EPA requested that the Licensee further investigate air emissions monitoring data and assess whether lower NO_x emissions limits representative of proper and efficient operation of the plant could be achieved. In the case new limits were to be proposed, impacts in the local air quality were also to be assessed.

Attachment A – Assessment and other information requirements in relation to the Variation Application for Vales Point Power Station

1) Assessment objective

The objective of the assessment is to compile sufficient, robust and transparent information that the EPA considers necessary and relevant to the environment protection licence variation application (Variation Application) submitted by Sunset Power International Pty Ltd trading as Delta Electricity (Licensee), in respect of the Vales Point power station.

2) Legislation, policy and assessment methods

a) The assessment must be undertaken in accordance with, and demonstrate compliance with, the following:
   i) The *Protection of the Environment Operations Act;*
   ii) The *Protection of the Environment Operations (Clean Air) Regulation;*
   iii) The *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW;*
   iv) The *Approved Methods for the Sampling and Analysis of Air Pollutants in NSW;*
   v) The *Tiered Procedure for Estimating Ground-Level Ozone Impacts from Stationary Sources.*

b) All assessment methods used must be robustly justified. Particular emphasis must be given to the justification of any adopted methods that differ from current published EPA policy, or where there is no current EPA published method.

3) Data and references

a) The assessment must reference and analyse reasonably available data and information, including but not limited to the following:
   i) Government and industry ambient air quality monitoring data;
   ii) Government and industry meteorology data;
   iii) The *Air Emissions Inventory for the Greater Metropolitan Region of NSW;*
   iv) Industry emission monitoring data;
   v) *Vales Point Power Station (Delta Electricity) NO_x Pollution Reduction Study (PRS) Final Report (2017);*
   vi) European Commission JRC Science for Policy Report - *Best Available Techniques (BAT) Reference Document for Large Combustion Plants*, Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control).
   vii) *Commission Implementing Decision (EU) 2017/1442 of 31 July 2017 establishing best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for large combustion plants*.

b) The assessment must demonstrate that all reasonable efforts have been taken to ensure the quality, integrity and representativeness of the data and information used in the assessment.

4) Project description, need and justification

a) The assessment must include:
   i) A detailed description of the proposal including interactions with other existing, approved or proposed projects – both on the premises and on other premises.
   ii) The strategic need and justification for the proposed variation having regard for relevant matters, including but not limited to:
      (a) analysis of feasible alternatives to the proposal, and
      (b) energy security and reliability in NSW.

5) Assessment of feasible mitigation measures

a) Provide a detailed description of existing air pollution emission controls and management measures used in conjunction with coal fired boilers at the premises.

b) Benchmark existing Vales Point Power Station air pollution controls, emission performance and emission limits against coal fired power stations in NSW and other jurisdictions (both Australia and internationally). The benchmarking must have regard for plant vintage, boiler configuration and technology and receiving environment.

c) Provide a detailed feasibility evaluation of additional NO_x and SO_x emission control measures that are not currently used at the premises. For the purpose of this requirement, feasibility is taken to be what is technically possible to be implemented at the premises from an engineering perspective.

   i) Detail the additional analysis that has been conducted to update, expand and extend the analysis of potential controls identified in the document titled: *Vales Point Power Station (Delta Electricity) NO_x Pollution Reduction Study (PRS) Final Report (2017)*; required by Condition U1 of the EPL No. 761.

   ii) As a minimum, consideration must be given to the following NO_x emissions controls:

      (1) Combustion optimisation

      (2) Low NO_x Burners

      (3) Selective non-catalytic reduction (SNCR)

      (4) Selective Catalytic reduction (SCR)

      (5) Other potential options beyond operational changes

   iii) As a minimum, consideration must be given to the following SO_x emissions controls:

      (1) Dry flue gas desulfurisation

      (2) Wet scrubbing

      (3) Semi-dry scrubbers

      (4) Sorbent injection

      (5) Use of lower sulfur fuels

d) Based on the evaluation in item 5c (above), identify feasible measures that could be implemented to reduce NO_x and SO_x emissions at the premises.

e) For each mitigation measure evaluated in item 5c (above) that is determined not to be feasible for implementation, detailed justification with supporting evidence on why these measures are not feasible for implementation must be provided.

6) Air Quality Impact Assessment (AQIA)

The AQIA must be undertaken in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (The Approved Methods) and address as a minimum the following:

a) Describe and analyse the receiving environment in detail using contemporary datasets. The proposal must be contextualised within the receiving environment (i.e. local, regional and inter-regional). The description must include, but need not be limited to:

   i) meteorology and climate;

   ii) ambient air quality

   iii) topography;

   iv) surrounding land-use; and

   v) receptors.

b) Assess the risk and potential impacts associated with point source emissions from the proposal. The assessment of risk relates to environmental harm, risk to human health and amenity.

c) The assessment of impacts must be conducted on the local and regional/inter-regional (including the Greater Metropolitan Region) receiving environment.

d) Any assumptions made during the preparation of the AQIA must be accompanied by a detailed description, supporting evidence and must be robustly justified.

Assessment of impacts on local air quality:

The assessment of impacts on local air quality must include, but need not be limited to:

e) Detailed review and analysis of current and historic NO_x, SO_x and particle emissions from the premises. Analysis must draw on at least 10 years of available data.

f) Detailed review and analysis of current and historic ambient NO_2, SO_2 and particle concentrations within the local receiving environment. Analysis must draw on at least 10 years of available data.

g) Quantification of the incremental (power station only) ground level concentrations for NO_2, SO_2 and particles.

h) Dispersion modelling scenarios, including but not limited to:

   i) emissions representative of "current normal" operations;

   ii) emissions at existing licence limits (i.e. NO_x 1,500 mg/m^3; SO_2 1,700 mg/m^3; particles 50 mg/m^3);

   iii) emissions representative of Group 5 and Group 6 limits for NO_x (i.e. 800 mg/m^3 and 500 mg/m^3);

   iv) emissions representative of feasible mitigation measures identified in item 5d (above).

i) The methodology used to account for chemical transformation (NO to NO_2 conversion) must be based on contemporary and representative data and undertaken in accordance with the Approved Methods or as otherwise agreed by the EPA.

j) Quantification of cumulative impacts for NO_2, SO_2 and particles accounting for:

   i) other existing power stations;

   ii) other significant existing emission sources;

   iii) any currently approved developments which would be significant emission sources, and

   iv) background air quality.

Assessment of impacts on regional air quality

The assessment of impacts on regional and inter-regional air quality must include, but is not be limited to:

k) Detailed review and analysis of current and historic ambient NO_2, SO_2 and particle concentrations within the regional and inter-regional receiving environment. Analysis must draw on at least 10 years of available data.

l) Modelling of ground level ozone, NO_2 and secondary particle impacts on the regional and inter-regional receiving environment, including the Greater Metropolitan Region.

   i) Evaluation of impacts based on the current plant configuration and operating regime.

   ii) Evaluation of additional emission abatement, representative of:

      (1) NO_x emission controls capable of achieving an emission concentration limit of 800 mg/m^3;

      (2) NO_x emission controls capable of achieving an emission concentration limit of 500 mg/m^3;

      (3) SO_x emission controls capable of achieving 50% and 90% control efficiency;

      (4) abatement scenarios otherwise agreed to by the EPA based on feasible control options identified in 5d (above).

m) A detailed quantitative photochemical assessment, evaluating the impacts on ambient ozone and nitrogen dioxide due to Vales Point Power Station based on the modelling scenarios listed in item (l) above.

   i) The photochemical assessment must follow the Level 2 detailed procedure set out in the EPA's *Tiered Procedure for Estimating Ground-Level Ozone Impacts from Stationary Sources*.

n) A detailed quantitative assessment of secondary particle formation due to Vales Point Power Station operations based on the modelling scenarios listed in point (l) above. The secondary particle assessment must also present results for:

   i) Secondary particle concentrations due to NO_x emissions from the premises;

   ii) Secondary particle concentrations due to SO_x emissions from the premises;

   iii) Total secondary particle concentrations due to emission from the premises;

   iv) Population weighted annual average $PM_{2.5}$ concentrations for each local government area in the study domain;

   v) Population weighted annual average $PM_{2.5}$ concentration aggregated across the study domain.

o) Results and conclusions of the secondary particle and photochemical pollution assessments must be validated and put in context of findings from comparable published chemical transport model and particle characterisation studies.

p) The regional air quality impact assessment must undergo independent expert peer review prior to submitting the assessment to the EPA.

   i) The independent expert peer reviewer must be approved in writing by the EPA prior to the review being undertaken

   ii) The independent review must be submitted to the EPA with the final assessment.

7) Assessment of practical control measures

a) Based on items 2-6 (above), and factoring any additional relevant considerations, nominate practical measures that can be implemented to mitigate air pollution impacts from the premises. Practicability may have regard for factors including, but not limited to:

   i) Air quality and health impacts

   ii) Expected plant life

   iii) Plant efficiency

   iv) Energy security and reliability in NSW

   v) Cost

   vi) Implementation timeframe

   vii) Technical and engineering constraints`

   The discussion and conclusions about practicability must be supported by detailed analysis and robust evidence.

b) Characterise the expected emission performance during routine operation with the practical measures nominated in item 7a (above).

c) Propose an emission limit associated with proper and efficient operation of the practical measures nominated in item 7a (above).

d) Recommend additional detailed investigations required prior to implementation of the practical measures nominated in 7a (above), and a timeframe for completing those investigations.

e) Propose an emissions monitoring and reporting framework suitable for robustly demonstrating that practical mitigation measures are operating in a proper and efficient manner.

Attachment B – TA-Air detailed comments on information provided to address the Assessment Requirements in relation to the NO_x Variation Application for Vales Point Power Station

TA-Air has reviewed:

- Licence Variation Application for NO_x emission limits, *prepared by Delta Electricity, dated 8 October 2021* (The Cover Letter)
- Vales Point Power Station Air Quality Assessment for Group Exemption Extension, *prepared by Katestone Environment Pty Ltd., dated 8 October 2021* (The AQA)
- NO_x Pollution Reduction Study, Vales Point – Evaluation of Potential NO_x Emission Controls, *prepared by Jacobs Group (Australia) Pty., Ltd., dated 6 October 202* (The NO_x PRS)
- Memorandum, Sulfur Oxide (SO_x) emissions and reduction options for Vales Point Power Station, *prepared by Jacobs Group (Australia) Pty., Ltd., dated 30 September 2021* (The Memorandum)
- Revised NO_x Emission Limits for Vales Point Power Station, *prepared by Katestone Environment Pty Ltd., dated 26 November 2021* (The Revised NO_x Emission Limits report).

TA-Air provides the following comments on the adequacy of the information provided to address each of the information requirements.

4) Variation Application description, need and justification

The cover letter indicates that the Licensee seeks to vary Environment Protection Licence condition (EPL) L3.8 to extend the exemption of Group 5 standards of concentration under Protection of the Environment Operations (Clean Air) Regulation 2021 (the clean air regulation) for NO_x emissions from Vales Point Power Station (VPPS) for a further 5 years.

The cover letter indicates that the Australian Energy Market Operator (AEMO) recently published its *2021 Electricity Statement of Opportunities* (ESOO). The purpose of the ESOO is to provide technical and market data that informs the decision-making processes of market participants, new investors, and jurisdictional bodies as they assess opportunities in the National Electricity Market. It incorporates a reliability assessment against the reliability standard, including AEMO's reliability forecasts.

It is further discussed in the cover letter that in the ESOO, AEMO modelled the early closure of Vales Point (the anticipated closure date is in 2029) and found that an unplanned closure of Vales Point would pose substantial risk to consumers.

The cover letter concludes that "*the requirement for additional NO_x controls would present an unnecessary financial burden on Vales Point's viability. Early closure of the station would present a significant challenge to energy security, which is unwarranted given the power station will comply with the existing EPL limits for itself and similar plants at Bayswater and Mt. Piper*."

Recommendation: Adequately addressed

5) Benchmarking and Evaluation of Potential Emission Control or Mitigation Measures

Requirement a)

The information provided in the NO_x PRS specifies that operators monitor the combustion to ensure the NO_x and CO levels are kept within the required limits. It is also specified that operational improvements may permit VPPS to reach a NO_x limit of 800 mg/Nm³ on a near continuous basis. Unit 5 emissions were below 800 mg/Nm³ for 99.6% of the time throughout 2017-2021, with a maximum of 1,245 mg/Nm^3 (furnace 5A, 2020). Following the removal of wide range tips, Unit 6 is achieving similar NO_x emission and maximum emission levels as Unit 5.

Regarding existing controls and mitigation measures to reduce SO_2 emissions from the existing operations, it is indicated in the memorandum that the key mitigation of SO_x emission at VPPS is the sourcing and combustion of low sulfur containing coals from local mines. It is further indicated that coal supplied to VPPS can be predominately classified as low sulfur coal.

Notwithstanding the above, it is noted that section 4 in the Revised NO_x Emission Limits report specifies that the following are some of the actions undertaken by the Licensee to reduce NO_x emissions from the premises:

- VPPS undertaken works on combustion optimisation, which is indicated has led to a reduction in NO_x emissions. For instance, air flows to the furnace were modified to ensure a lower peak flame temperature is achieved, thereby reducing NOx formation.

- In 2018, Centennial completed the construction and operation of a screening plant at its Mandalong mine. This action has reduced contaminants present in the coal supply to Vales Point. Contaminants in coal can result in feeder blockages, which cause mill trips, temporarily disturbing the fuel supply to the boiler. Such disruptions cause short term fluctuations in NO_x emissions while the control system adjusts to the change. With fewer feeder trips occurring, NO_x emissions are stable for longer periods of time.
- In July 2021 the burner tips for Unit 6 were changed, which resulted in improved unit efficiency leading to a reduction in NO_x emissions.
- The Distributed Control System (DCS) on Unit 5 was upgraded in 2018 and the DCS on Unit 6 was upgraded in 2021. The new DCS systems allow further optimisation of air flow dynamics and smarter soot-blowing techniques to limit burner tilt positions, which reduces NO_x formation

Requirement b)

The NO_x PRS includes a literature review of emissions limits and international best practice measures to minimise NO_x emission from coal fired electricity generation. The review focuses on the Unites States, Canada, Europe, and Asia.

Table 7-3 in the NO_x PRS shows a "benchmarking" summary between VPPS and power stations in Australia, USA and China. The report indicates that VPPS NO_x emissions are low to moderate when compared with other Australian power stations. It is also noted that the report states that *"The USA and China have much lower NO_x emissions per utility, commensurate with lower emissions standards. This has been required due to the higher concentration of power plants and other emitters in a smaller airshed resulting in a higher pollutant load and poor ambient air quality*".

The information provided by the Licensee does not include a detailed benchmarking analysis to compare VPPS SO_x emissions, limits and/or controls against other national or international power stations.

Requirement c), e)

NO_x:

Section 8 in the NO_x PRS includes the analysis of the identified NO_X control options. The report includes the analysis of both operational improvements (e.g. combustion optimisation) as well as specific control technologies to minimise NO_X emissions.

A feasibility assessment considering cost, emission performance and technology is presented in Section 9 of this report. Section 9.2 specifies that the following 5 options have been identified to achieve emission limits of at least 800 mg/m³ with two potentially achieving 500 mg/m³ or less.

- Burner optimisation for NO_x control using air staging.
- Low NO_x burners.
- Selective non-catalytic reduction (SNCR).
- Selective Catalytic reduction (SCR).
- Neural Networks technology (continuous combustion optimisation software).

Notwithstanding the above, it should be noted that the report states that "*Technical feasibility at this stage considers only the potential for the technology to achieve the various NO_x levels. For the post-combustion controls, additional assessment would be needed to see if these could be implemented at Vales Point with respect to integrating with existing plant."* Therefore, suggesting that the implementation of these controls has not been evaluated from an engineering perspective.

Further, the same report concludes that with the exception of combustion optimisation, all of the other identified options are cost prohibitive. As such, it is stated that these controls are not considered feasible primarily due to the total estimated costs for retrofitting far outweighing the saving in LBL (Load Base Licensing) fees that can be achieved.

SO_x:

Regarding the feasibility analysis of existing controls and mitigation measures to reduce SO_x emissions the memorandum identifies the following mitigation measures/controls:

- Firing coals containing low sulfur

- Reducing the sulfur content in the fuel prior to its combustion by washing
- Removing sulfur oxides from the combustion gases. Post combustion controls such as wet or dry flue gas desulfurisation and seawater desulfurisation).

Table 7.1 shows a summary of the expected capital and operating expenditure for the identified post combustion controls. It is concluded that the evaluated post combustion SO_x control measure options are not considered feasible primarily due to the total estimated costs for retrofitting these technologies far outweighing the saving in LBL (Load Base Licensing) fees that can be achieved.

Based on the information provided in the memorandum, it is unclear whether the implementation of the post combustion controls has been evaluated from an engineering perspective.

Requirements d)

Both the NO_x emissions control report and the memorandum include detailed discussions regarding the feasibility of the implementation of the identified controls and operating mitigation measures. The following are the key identified NO_x and SO_x emission reduction measures:

I. NO_X
   - Combustion optimisation.
   - Cofiring of up to 3% biomass with lower calorific value.

II. SO_X
   - Sourcing and combustion of low sulfur containing coals from local mines.

Further, the list below presents a summary of the considerations included in the information provided by the Licensee when determining that the identified control technologies are not feasible:

- Based on the remaining time to the forecast closure date (2029) and the capital and operating expenditure analysis, the implementation of post combustion controls is cost prohibited. The total estimated costs for retrofitting these technologies far outweighing the saving in LBL (Load Base Licensing) fees that can be achieved.
- It is predicted to be a decrease in the NO_x mass emissions from VPPS from present to the predicted closure in 2029, due to the forecast reducing generation from the station.
- Emissions from VPPS are unlikely to increase significantly in the future; in reality NO_x emission from VPPS should have reduced in 2021 with the change of the burner tips in Boiler 6.

Recommendation: Broadly addressed. The analysis does not include the evaluation of the implementation of the identified controls from an engineering perspective. However, this information can be requested via a Pollution Reduction Study as included in Attachment D.

6) Air Quality Impact Assessment (AQIA)

Assessment of impacts on local air quality

Requirements a), b), c), d)

Section 3.2 of the AQA includes general information regarding the existing environment in the vicinity of VPPS. The information includes details regarding the Air Quality Monitoring Stations (AQMS) operated by the Licensee (e.g. Wyee) and by the department of Planning, Industry and Environment (DPIE). Further, it is noted that the analysis of ambient air quality data and meteorological conditions are included in Section 5.

Appendix A in the AQA include a discussion regarding the land uses in the vicinity of the VPPS. Table 18 of the AQA exhibits a list of the 10 identified sensitive receptors. It is stated that *"the receptors have been selected to be representative of worst-case exposure in each local area/direction"*. It is noted that the 10 identified sensitive receptors are located within an approximate 7 kilometres radius from VPPS.

Detailed discussions regarding the approach (i.e. assumptions) to undertake Meteorological and Dispersion Modelling is included in Section 3 and Appendix A of the AQA. Modelling results and the corresponding analysis is presented in Section 7 of the same report.

Requirement e)

Section 6 of the AQA presents a summary of emissions monitoring data for boiler 5 and boiler 6. Stack testing results (between 2010-2020) are presented as well as a summary of statistics of the NO_x and SO_2 concentrations (between 2013-2021) recorded via the Continuous Emissions Monitoring System (CEMS). Detailed discussion of the findings and conclusions drawn from the data analysis is included in the AQA, with an overall summary presented in the paragraphs below.

The AQA specifies that the results from the stack testing show that concentrations of all of the measured air pollutants were below the corresponding EPL limits. It is also indicated that the pollutants with a significant measured concentration, when compared against the EPL limits, are NO_2, SO_2 and $PM_{2.5}$.

The conclusions of the statistical analysis for the CEMS data indicate that the annual average of the NO_x concentrations have decreased over the past 10 years. It is also indicated that since 2015, the recorded 1-hour average NO_x concentrations in both boilers have not exceeded the EPL 100th percentile limit of 1,500 mg/Nm³. Further, since 2013 in Boiler 5 and 2017 in Boiler 6, the 1-hour average concentration of NO_x complied with the 99th percentile limit of 1,100 mg/Nm³.

The Revised NO_x Emission Limits report includes further analysis of the NO_x CEMS data. The analysis for Unit 6 between July and October of 2021 (consider to be representative of likely future emissions) shows that this change resulted in lower NO_x emissions.

It is also clarified that the performance of unit 6 is anticipated to be similar to that of Unit 5, for which emissions have remained below 800 mg/m^3 for the majority of time. It should be noted that CEMS data analysis from Unit 5 shows that since 2017, the percentage of time in a single year when emissions were above 800mg/Nm^3 is 0.4 - 0.8 %. As such, the Revised NO_x Emission Limits report states "*The upgrade significantly improved unit efficiency, reducing coal requirements per unit of electricity generated, with corresponding reductions in the amount of combustion air and mass emission of NO_x*".

Measured SO_2 concentrations for boilers 5 and 6 complied with the EPL limit of 1,700 mg/Nm^3 throughout the period (2013 - 2021). Concentrations measured in boilers 5 and 6 comply with the 99th percentile EPL limit of 1,400 mg/Nm^3. The number of hours measured SO_2 concentrations have been above the 99th limit for boilers 5 and 6 is 1 and 4 hours respectively.

Requirement f)

Section 5.1 and Section 5.2 present the analysis of measured NO_2, SO_2 and $PM_{2.5}$ concentrations at the Wyee and Wyong AQMS between 2013 and 2020. Amongst other things, the analysis includes:

- The measured annual average for each of these pollutants.
- The measured peak hourly concentrations for NO_2, SO_2 as well as the peak daily SO_2 and $PM_{2.5}$ concentrations.
- Seasonal wind roses.
- NO, NO_2, SO_2 and $PM_{2.5}$ pollution roses and polar, polar annulus and ThielSen plots.

Detailed discussion of the findings and conclusions drawn from the data analysis is included in the AQA, with an overall summary below:

i. Wyee
    a. Measured concentrations have been below the short-term and annual NSW EPA air quality criteria for NO_2 and SO_2. For $PM_{2.5}$, exceedances of both the annual and 24-hour average criteria were measured in 2019, likely a result of the extensive bushfires that occurred in this year.
    b. Prevailing winds are mainly from the west, with frequent winds from the south all year round. In spring and summer, winds from the northeast are also relatively common.
    c. Significant NO_2 contributions are measured at the Wyee AQMS during winds from the east and northeast (downwind from the VPPS and Colongra power stations). These winds are common in spring and summer.
    d. Measured SO_2 average concentrations are highest when the monitor is downwind of either Eraring or VPPS.
    e. Concentrations of $PM_{2.5}$ tend not to differ much with wind direction.

ii. Wyong

a. Measured concentrations have been below the short-term and annual NSW EPA air quality criteria for NO_2 and SO_2. There are, however, $PM_{2.5}$ exceedances of both the annual and 24-hour average criteria in 2019, likely a result of the extensive bushfires that occurred in this year.
b. Winds are mainly from the north and northwest, with winds from the southeast also being reasonably frequent year-round.
c. The highest SO_2 concentrations occur during winds form the northeast (downwind from VPPS).
d. It is likely that NO_2 emissions from traffic from the M1 Pacific Motorway road dominate concentrations measured at the Wyong AQMS.
e. There are few distinct sources contributing to measured concentrations of $PM_{2.5}$. Concentrations and contributions seem to depend more on wind direction than anything else.

Requirement h)

Combined the AQA and the Revised NO_x Emission Limits report include the following modelling scenarios:

- *Scenario 1:* Modelling scenario representative of '*current operations'*. This modelling scenario is based upon the analysis of stack testing and continuous emission monitoring data between 2018-2020.
- *Scenario 2:* This modelling scenario uses recorded emissions data between 2018-2020 and replaces any concentrations above 800 mg/m³ with the Group 5 standard of concentration for NO_x (800 mg/m³).
- *Scenario 3:* This modelling scenario uses recorded emissions data between 2018-2020 and replaces any concentrations above 500 mg/m³ with the Group 6 standard of concentration for NO_x (500 mg/m³).
- *Scenario 4:* Modelling scenario representative of a constant emissions rate based on the proposed 99th percentile 1-hr NO_x concentration limit (850 mg/m³)
- *Scenario 5:* Modelling scenario representative of a constant emissions rate based on the proposed 100th percentile 1-hr NO_x concentration limit (980 mg/m³)

It should be noted that modelling scenarios 1 - 3 use a variable emissions file based on the CEMS recorded data between 2018-2020. Conversely, modelling scenarios 4 and 5 assume a constant emission rate for every hour of the day.

The Revised NO_x Emission Limits report specifies that modelling at the reduced limits every hour of the year (i.e. at a constant emission rate) is considered "*extreme"* as the CEMS data "*shows that such conditions rarely occur in practice"*. It is stated that *"In reality, the electricity grid has highly variable demand for coal-fired power and consequently, VPPS tends to operate at peak load during the early morning and evening, times that are of low risk for elevated ground-level air pollutant concentration".*

Requirement i)

Information regarding the methodology to account for NO_x to NO_2 transformation is presented in Section 3.8 of the AQA. It is specified that for the assessment of annual mean ground-level NO_2 concentrations a 100% transformation was assumed.

Predicted 1-hr NO_2 concentrations are estimated by using NO_2/NO_x ratios of both 20% and 40%. They are also estimated by using the Ozone Limiting Method (OLM).

The AQA states that "*the single, fixed ratio (of 0.2) is likely to under-estimate NO_2 concentrations at low NO_x concentrations and over-estimate NO_2 concentrations at high NO_x concentrations*." Nonetheless, it is indicated that an analysis of measured NO_2 and NO_x concentrations recorded at the Wyee and Wyong AQMS shows that a ratio of 0.2 is an appropriate factor to apply to modelled power station NO_x contributions when assessing peak 1-hour concentrations.

Requirement g), j)

Air dispersion modelling results include incremental ground level concentrations (VPPS contribution only) and cumulative ground level concentrations (background levels, VPPS, Eraring and Colongra power stations combined).

Detailed discussion regarding the adopted background concentrations is provided in Section 3.7.3. It is indicated that the measured data from Wyong AQMS is used as the primary source of background data. Further, the AQA clarifies that since this AQMS is downwind from the power stations (during winds direction between 0-60 degrees), recorded data during hours with these wind conditions were replaced with data from the Beresfield AQMS.

The assessment of cumulative impacts that account for the operation of the proposed Newcastle Power Project (NPP) and Hunter Power Project (HPP) are not included in the cumulative results. It is indicated that an initial analysis (see Section 7.1.3 in the AQA) shows that the predicted contributions from these sources in the vicinity of the VPPS are small, therefore suggesting that these sources were not modelled for all of the modelling scenarios.

The results are presented at the identified 10 sensitive receptors and as contour plots. It should be noted that the AQA states that *"in most cases, concentrations at specific receptors have been interpolated from the grid of maximum concentrations for each pollutant and averaging period".*

The maximum predicted 1 hour and annual average concentrations at a sensitive receptor are provided in Table 1 and Table 2 respectively.

***NO_2 Results*:**

Table 1: Maximum predicted 1-hr average NO_2 concentration at the sensitive receptors:

	Max. Incremental 1-hr (µg/m^3)	Max. Cumulative 1-hr (µg/m^3)	NSW EPA Criterion (µg/m^3)	NEPM Standard (µg/m^3)	Number of predicted additional exceedances
Current operations (Emissions 2018-2020)	104.0 (R3)	119.2 (R3)	246	164	0
Reduced 99th limit (850 mg/m^3)	141.2 (R3)	147.2 (R3)	246	164	0
Proposed 100th limit (980 mg/m^3)	162.8 (R3)	171.7 (R3)	246	164	1

1-hr NO_2 results presented in this table are based on a NO_2/NO_x conversion ratio of 20%.

Table 2: Annual average NO_2 predicted concentration at the sensitive receptors

	Incremental Annual (µg/m^3)	Cumulative Annual (µg/m^3)	NSW EPA Criterion (µg/m^3)	NEPM Standard (µg/m^3)	Number of predicted additional exceedances
Current operations (Emissions 2018-2020)	2.80 (R2)	13.3 (R2)	62	31	0
Reduced 99th limit (850 mg/m^3)	4.0 (R2)	4.7 (R2)	62	31	0
Proposed 100th limit (980 mg/m^3)	14.5 (R2)	15.1 (R2)	62	31	0

Annual NO_2 results presented in this table are based on a NO_2/NO_x conversion ratio of 100%.

Results for modelling scenarios representative of current operations (i.e. emissions representative of operations between 2018-2020 from CEMS data) and the reduced 99th percentile NO_x concentration limit show compliance with the NEPM standards.

Results for the modelling scenario representative of the reduced 100th percentile NO_x concentration limit indicate that there is one additional exceedance predicted at R3. Based on information provided to the EPA via email[1], it has been confirmed that this result is an interpolated value from the maximum predicted concentration at each grid point in the modelling domain. Only one of the predicted concentrations at grid points surrounding R3 location is higher than the NEPM standard. Therefore, it is concluded that the results at this receptor are "driven" by this concentration, which is predicted at the 13th hour of 7 October 2019.

Following on the above, it is also acknowledged that the Revised NO_x Emission Limits report includes an analysis to investigate the predicted high concentrations during the 13th hour of 7 October 2019. The following is concluded in the report:

- Figure 3 shows that the exceedance is predicted when the NO_x mass emission rate was low (relative to the highest modelled emission rate), "*which is not what would be expected*". .
- The analysis of meteorological conditions during hour 13 and the following hour are very similar, "*Therefore, the meteorological conditions at the time of maximum concentration do not seem to explain why the model has predicted such a dramatically high concentration in this one hour*".
- Based on the comparison of meteorological conditions from TAPM and two weather stations, "*It would seem likely that TAPM has under-predicted wind speeds close to ground level on the day in question and has incorrectly assumed the surface boundary layer to be unstable, which would result in considerably higher ground-level concentrations being predicted than would occur in reality*"

Further, the same report states that "*this is a time when the load at VPPS tends to be relatively low, due to the high prevalence of solar power".* As such, it is clarified that the average loads are at the lowest between 11:00 and 15:00, therefore, it is concluded that "*pollutant mass emissions at these times can be expected to typically be considerably lower than has been assumed in the high load continuous operations scenario modelling requested by NSW EPA.*

***SO_2 Results*:**

Table 3: Maximum predicted SO_2 concentrations at sensitive receptors*: *Current operations (Emissions 2018-2020)

	Max Incremental.	Maximum Cumulative	VPPS contribution to Max. cumulative	NSW EPA Criterion	NEPM Standard (Proposed 2025)
1-hr (µg/m³)	525.2 (R2)	572.4 (R8)	121.1 (R8)	570.0	286.0 (214)
24-hr (µg/m³)	88.1 (R2)	93.7 (R2)	54.2 (R2)	228.0	57.0
Annual (µg/m³)	2.8 (R2)	3.6 (R5)	1.1 (R2)	60.0	-

1-hr SO_2 results for the modelling scenario representative of current operations (i.e. emissions representative of operations between 2018-2020) show a marginal exceedance of the NSW EPA SO_2 criterion at receptor R8. VPPS contribution on the day the exceedance is predicted is 121.1 µg/m³.

In addition to the predicted exceedance of the NSW EPA SO_2 criterion at receptor R8 (representative of the area near Lake Munmorah), it is indicated that the contours of the cumulative (background, VPPS, Eraring and Colongra) 1-hr SO_2 concentrations show 4 additional areas of exceedances in the modelling domain. These are:

- One located primarily over water to the east of Wyee Point, containing no sensitive receptors.
- One running east to west to the west of the coal storage area at VPPS, containing no sensitive receptors.

[1] *Katestone (2021) RE: FW: [Sensitive] Questions, email from Ricky Gellatly (Katestone) to Janelle Pickup (EPA), 30 November 2021.*

- One to the northwest of Doyalson, which includes two or three residential properties along Wyee Road.
- One to the southeast of VPPS that includes a number of properties within the westernmost portion of Lake Munmorah.

The analysis of results and contour plots seem to suggest that maximum cumulative results are driven by background levels and other power stations contributions. It is acknowledged, however, that the AQA clarifies that the contributions from other power stations are likely over-stated in the modelling due to the use of conservative assumptions. For instance, it is noted that the AQA indicates that whilst predicted 1-hr SO_2 concentrations at Dora creek are close to the NSW EPA assessment criterion (570 µg/m^3), the maximum 1-hr SO_2 concentration recorded between 2018-2020 at a monitoring station at this location is 188.1 µg/m^3.

Based on a comparison between the measured and predicted concentration at the Wyee AQMS, it is concluded in the AQA that the model is consistently over-predicting SO_2 concentrations at this monitoring location. As such, it is stated that "*It would appear likely that these highest concentrations will have been over-predicted by as much as 50%".*

Recommendation: Broadly addressed. Further analysis and investigations should be undertaken by the Licensee to investigate the potential impacts due to SOx emissions. If f required, this is to include identification of control strategies to reduce SOx emissions from the premises and/or revised SO_2 emission limits that reflect the proper and efficient operation of Unit 5 and 6.

Assessment of impacts on regional air quality

Requirement K)

The information provided regarding the analysis of ambient air quality data for NO_2, SO_2 and $PM_{2.5}$ concentrations is presented in Section 5.1 and Section 5.2 of the AQA. As indicated under Section *Requirement f)* in this Attachment, the analysis of ambient air quality was undertaken for measured concentrations at the Wyee and Wyong AQMS between 2013 and 2020.

Requirements l), m), n), o), p)

It is indicated that a literature review was undertaken to assess the potential for significant regional ozone formation, secondary particulate formation, and inter-regional transport of air pollutants. A list of the studies covered in the literature review is presented in Table 19 of the AQA.

The AQA includes a summary of findings and conclusions from the studies included in the literature review. Sections below present a summary of the type of information presented in the AQA:

Secondary Particles

Section 4.3 of the AQA includes a summary of findings and conclusions from the literature review regarding secondary particles. The summary presented in this section includes broad information regarding the estimated contribution from power stations to the total $PM_{2.5}$ concentrations in the region. It also presents conclusion from studies undertaken to estimate the secondary particles from biogenic and anthropogenic emissions, including power stations.

Further, this section presents broad information from a study that exhibits the estimated the population-weighted mean concentration due to the operation of power stations in the Greater Metropolitan Region of Sydney.

Photochemical

The summary of findings and conclusions from the literature review used to address the photochemical assessment requirements is presented in Section 4.3 of the AQA. The information provided in this section includes a broad summary of findings to describe the estimated contribution from power stations to the overall ozone concentrations in the Greater Metropolitan Region (GMR). Further, it is noted that some of the findings are presented relate to the suggested focus for policy makers to manage the ozone concentrations in the GMR.

As such, the AQA concludes:

- "*many of these studies adopted a worst-case modelling approach, assuming power stations to be operating at full load continuously throughout the year. [...] As such, the studies are likely to overstate the contribution of power station emissions to ozone and secondary particle formation*".
- *"It can, therefore, be expected that measures to reduce NOx and SO2 emissions at VPPS would not have discernible impact on secondary particulate concentrations across the NSW Greater Metropolitan Region, with any resultant change likely to fall well within the uncertainty bounds of the instruments used for the measurements".*
- *"To summarise the findings on ozone, it is clear that power stations rarely make up a significant portion of peak short-term concentrations".*
- *"emissions controls at VPPS in isolation are highly unlikely to have a discernible effect on ozone concentrations across the NSW Greater Metropolitan Region".*

Notwithstanding the above, the following should be considered:

- The AQA does not include a detailed comparison and subsequent analysis of the emissions profile (and other assumptions) used in the studies included in the literature review and the historical emissions performance from VPPS.
- No information is provided to robustly and transparently demonstrate that the findings and conclusions from the studies included in the literature review are representative of the proposed limits.
- There is uncertainty regarding the assumptions made to estimate the contribution from VPPS to secondary particles and ozone concentrations in the GMR. As such, VPPS' contribution in isolation is still unknown.
- The information provided does not present the requested:
    - Population weighted annual average $PM_{2.5}$ concentrations for each local government area in the study domain.
    - Population weighted annual average $PM_{2.5}$ concentration aggregated across the study domain.

Recommendation: Not adequately addressed. However, it should be noted that the Environment, Energy and Science (EES) team has undertaken a regional modelling exercise to assess the change in predicted ground level concentrations between the current 99th NO_x emission limit (1,100 mg/m^3) and the reduced 99th NO_x emission limit (850 mg/m^3) and Group 5 limit (800 mg/m^3). The results of this modelling are provided in Attachment C.

7) Assessment of practical control measures

Requirement a)

As previously indicated the feasibility assessment focused on:

- The potential for a specific technology (i.e. control) to achieve NO_x levels at or below Group 5 and Group 6 NO_x emissions limits.
- Capital and operating expenditure.
- The potential savings in Load Base Licensing (LBL) fees that can be achieved from the implementations of specific controls.

The conclusion of this analysis clarifies that based on the remaining time to the forecast closure date (2029) and the capital and operating expenditure analysis, with the exception of combustion optimisation, all of the other identified options are cost prohibitive. As such, it is indicated that these controls are not considered feasible primarily due to the total estimated costs for retrofitting far outweighing the saving in LBL (Load Base Licensing) fees that can be achieved.

Requirements b), c)

Whilst no specific control technologies are being proposed by the Licensee, it is acknowledged that the information provided confirms that new burner tips were installed in Unit 6 during the first semester of 2021. The Revised NO_x Emission Limits report states. "*The upgrade significantly improved unit efficiency, reducing coal requirements per unit of electricity generated, with corresponding reductions in the amount of combustion air and mass emission of NO_x*".

The above is further discussed in the context of the analysis of the CEMS data for Unit 6 (July - October 2021), which is expected to be representative of likely future emissions. This analysis shows that the burner tips change resulted in considerably lower NO_x emissions. It is also clarified that the performance of unit 6 is anticipated to be similar to that of Unit 5, for which emissions have remained below 800 mg/m^3 for the majority of time. It should be noted that CEMS data analysis from Unit 5 shows that since 2017, the percentage of time in a single year when emissions were above 800mg/Nm^3 is 0.4 - 0.8 %

The conclusions in the information provided by the Licensee maintain that emissions from VPPS are unlikely to increase significantly in the future. It is anticipated that NO_x mass emissions from VPPS will reduce from present due to the forecast reducing generation from the station.

At the request of the EPA, the Licensee has proposed the following new limits. It is indicated that the reduced limits are anticipated to be *operationally achievable under the normal range of operating conditions that represent the proper and efficient operation of Unit 5 and Unit 6*.

- 1-hr NO_x concentration limit (100th percentile): 980 mg/m^3.
- 1-hr NO_x concentration limit (99th percentile): 850 mg/m^3.

The Revised NO_x Emission Limits report also specifies that the analysis shows that between July to October 2021 recorded concentrations averaged around 550-650 mg/Nm^3. Therefore, it is indicated that VPPS will operate with NO_x emission concentrations below the reduced limits.

Requirements d), e)

Trigger Action and Response Plan (TARP)

The Revised NO_x Emission Limits report clarifies that the CEMS data analysis for Unit 5 and Unit 6 shows that since 2018 there have been 3 occasions when recorded concentrations were above the reduced 100th percentile 1-hr NO_x limit (980 mg/m^3).

In light of the above, The EPA requested the Licensee to develop a TARP aimed to improve the response to abnormal combustion conditions that might lead to a NO_x concentration limit exceedance. Therefore, suggesting this can help reduce the risk of such occurrences.

It should be noted that it is clarified that the development of the TARP will require time to identify an appropriate triggering threshold and operating conditions that might lead to a possible exceedance. Therefore, the development of the TARP can be undertaken as part of a Pollution Reduction Program.

At the request of the EPA, the Licensee has proposed that current Condition R1.9(c) of Environment Protection License (EPL 761) be modified to:

> *include the requirement for Delta Electricity to include in the Annual Air Emission Monitoring Report details of ambient air quality and meteorological conditions at the time of any NO_x concentration limit exceedances, to establish whether ambient Air NEPM standards were achieved on these occasions in the vicinity of VPPS*.

Additional ambient air quality

Section 5.1 and Section 5.2 in the AQA present the analysis of measured NO_2, SO_2 and $PM_{2.5}$ concentrations at the Wyee and Wyong air quality monitoring stations (AQMS) between 2013 and 2020. Detailed discussion of the findings and conclusions drawn from the data analysis is included in the AQA. It is noted that the analysis concludes that the measured concentrations at both stations have been below the short-term (246 µg/m^3) and annual (62 µg/m^3) NSW EPA air quality criteria for NO_2.

It should be noted that the analysis of air dispersion modelling results suggests that the location of the existing AQMS maintained and operated by the licensee may not capture the peak ground level concentrations to the south-west and north from the premises.

At the EPA's request, the Licensee proposes to install a new air quality monitoring station in the vicinity of Wyee Point (North from the premises) to continuously measure ambient concentrations of SO_2, NO, NO_2 and $PM_{2.5}$, as well as wind speed and direction.

Attachment C: Environment, Energy and Science (EES) regional air quality modelling

TA-Air has reviewed:

- Vales Point Power Station photochemical modelling for EPA, Application for Group 5 exemption, *prepared by Environment, Energy and Science, Department of Planning, Industry and Environment* (The report).

TA-Air's comments

Emissions from power stations affect air quality in the local and downwind areas as the plumes can be dispersed widely. In the presence of sunlight, NO_x can undergo complex non-linear chemical reactions to produce ozone and secondary organic aerosols. NO_x can also react with NH_3 and SO_2 to form secondary inorganic aerosols.

Modelling approach:

The coupled Conformal Cubic Atmospheric Model (CCAM) and Chemical Transport Model (CTM CCAM–CTM modelling system) was used to generate spatial and temporal concentrations of air pollutants of interest. The photochemical air quality model used for the study was CCAM-CTM, developed by CSIRO. The model was run for one calendar year from 1 January to 31 December 2013. It was assumed that the emissions from the premises occurred at a constant emission rate for every hour of the modelling year.

The following are the 3 modelling scenarios included in the study:

- Base case scenario: Representative of current 99th percentile NO_x concentrations limit (1,100 mg/m^3).
- Scenario 1 (S1): Representative of the proposed 99th percentile NO_x concentrations limit (850 mg/m^3).
- Scenario 2 (S2): Representative of Group 5 NO_x concentrations limit (800 mg/m^3).

Results and conclusions

Three modelling scenarios were run to study the impact of change in emissions. One modelling scenario was taken to be the base case and the additional two are representative of the proposed emission limits. The difference in predicted air pollutant concentrations across the modelling domain was used to assess the impact of the proposed NOx emission limits.

Table 1: Summary of statistics of predicted annual average concentration over domain grid.

			Min	Mean	1st quartile	Median	3rd quartile	Max
Base case - S1	Annual average (µg/m^3)	NO	0.01	0.18	0.05	0.09	0.17	9.76
		NO_2	0.19	1.10	0.59	0.84	1.31	9.41
		O_3	- 8.17	- 0.64	- 0.96	- 0.41	- 0.08	0.66
		$PM_{2.5}$	- 0.00	0.00	0.00	0.00	0.00	0.01
	Annual average of daily max (µg/m^3)	NO	-	1.39	0.36	0.76	1.41	76.65
		NO_2	0.43	4.80	2.46	3.81	6.15	31.98
		O_3	- 4.92	0.47	- 0.06	0.43	1.07	2.46
		$PM_{2.5}$	- 0.02	0.00	- 0.04	0.00	0.01	0.03
Base case – S2	Annual average (µg/m^3)	NO	0.01	0.21	0.06	0.11	0.21	11.63
		NO_2	0.23	1.32	0.72	1.00	1.58	11.48
		O_3	- 9.97	- 0.77	- 1.16	- 0.49	- 0.09	0.81
		$PM_{2.5}$	- 0.00	0.00	0.00	0.00	0.00	0.02
	Annual Average of daily max (µg/m^3)	NO	-	1.66	0.43	0.91	1.68	91.44
		NO_2	0.51	5.74	2.93	4.55	7.30	38.95
		O_3	- 6.21	0.58	- 0.08	0.52	1.32	3.00
		$PM_{2.5}$	- 0.03	0.00	- 0.00	0.00	0.01	0.04

Table above has converted NO, NO_2 and O_3 concentrations from Table 6 in the report from ppb to µg/m^3 at 0 C.

Based on the analysis of results, the report concludes that

- Distribution patterns for predicted NO_x, O_3 and $PM_{2.5}$ concentrations from the base case scenario (in isolation) are consistent with results from previous studies.
    - Elevated NO and NO_2 concentrations occur in areas of the Upper Hunter, the Central Coast and Sydney. Areas where emissions from power stations and mobile sources are dominant.
    - Elevated high ozone concentrations mostly occur in north west and western Sydney, where the NO_x-limited photochemical regime frequently takes place during summertime
    - The ozone pattern is a consistent representation of interaction between NO_x, VOC emissions and meteorology in urban settings, with various anthropogenic sources such as the GMR.
    - Elevated $PM_{2.5}$ concentrations are predicted in the Upper Hunter and Sydney regions, where wood heating and mining activities contribute to elevated $PM_{2.5}$ concentrations. Especially during wintertime.
- Negative concentrations in the summary of statistics Table indicate that the base case values are less than predicted concentrations for S1 or S2.
- The results show that the change in NO_x emission limits for the base case scenario (1,100 mg/m^3) and S1 (850 mg/m^3) or S2 (800 mg/m^3) resulted in a decrease of annual average and annual average of daily maximum NO and NO_2 in the GMR. However,
    - The changes in NO, NO, O_3 and $PM_{2.5}$ concentrations (annual average and annual average of daily maximum) from base case to S1 or S2 scenario are small or below the detection limit.
    - Predicted changes in $PM_{2.5}$ annual average and annual average of daily maximum over the GMR domain show negligible difference.
- Emissions from point sources, such as power stations in the Central Coast and the Lower Hunter, do not contribute to elevated particle concentrations.

Results and conclusions for the regional modelling presented above suggest that reducing NO_x concentration limits to meet Group 5 limits is unlikely to result in noticeable changes to regional impacts.

Attachment D: Proposed Conditions

TA -Air recommends the following Conditions:

Monitoring Conditions

Location of monitoring:

EPA Identification	Type of Monitoring	Type of Discharge Point	Location Description
XX	Meteorological weather monitoring Ambient air quality monitoring		Meteorological weather and ambient air monitoring station at Wyee Point

Air Monitoring Requirements

MX.1 For each monitoring/discharge point or utilisation area specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency, specified opposite in the other columns:

MX.2 Air monitoring requirements

Point XX

Pollutant	Unit of measure	Frequency	Sampling Method
Nitrogen dioxide	parts per hundred million	Continuous	AM-12
$PM_{2.5}$	micrograms per cubic metre	Continuous	AM-22
Sulfur dioxide	parts per hundred million	Continuous	AM-20

Note: The sitting of the ambient air monitoring station must be in accordance with AM-1

MX.3 The Licensee must maintain and calibrate the monitoring station in accordance with the reference test methods and manufacturer's specifications. Records of the calibration and maintenance must be made available to EPA upon request.

MX.4 The Licensee must develop and implement a quality assurance/quality control procedure for the data collected from the ambient air monitoring station. Outcomes from the procedure must be made available to EPA upon request

MX.5 For ambient air monitoring of pollutants, the recording of results and their reporting in the Annual Return must include "averaging periods" as follows

a) nitrogen dioxide: averaging periods of one hour and annual;

b) PM2.5: averaging periods of 24 hour and annual; and

c) sulfur dioxide: averaging periods of one hour, 24 hour and annual.

Meteorological monitoring

MX.1 The meteorological weather station must be maintained to be capable of continuously monitoring the parameters specified in condition M2.2.

MX.2 For each monitoring point specified in the table below the licensee must monitor (by sampling and obtaining results by analysis) the parameters specified in Column 1. The licensee must use the sampling method, units of measure, averaging period and sample at the frequency, specified opposite in the other columns. The table showing monitoring parameters and corresponding requirements can be found in the Meteorological Monitoring Station section below

Parameter	Units of Measure	Frequency	Averaging Period	Sampling Method
Air temperature at 2 metres	degrees Celsius	Continuous	1 hour	AM-4
Air temperature at 10 metres	degrees Celsius	Continuous	1 hour	AM-4
Wind direction at 10 metres	Degrees	Continuous	15 minute	AM-2 & AM-4
Wind speed at 10 metres	m/s (metres per second)	Continuous	15 minute	AM-2 & AM-4
Sigma theta	Degrees	Continuous	15 minute	AM-2 & AM-4
Rainfall	mm	Continuous	15 minute	AM-4
Relative humidity	%	Continuous	1 hour	AM-4

Note 1 – The weather monitoring instrumentation installed and operated at the site must be have a stall speed or lower limit of measure for measuring wind speed less than 0.2 m/s.

MX.3 The Licensee must maintain and calibrate the meteorological monitoring station in accordance with the reference test methods and manufacturer's specifications. Records of the calibration and maintenance must be made available to EPA upon request.

MX.4 The Licensee must develop and implement a quality assurance/quality control procedure for the data collected from the meteorological monitoring station. Outcomes from the procedure must be made available to EPA upon request

Special Conditions:

NO_x emission control engineering feasibility study

U1.1 Provide a detailed feasibility evaluation study of NO_x emission control measures that are not currently used at the premises. For the purpose of this requirement, feasibility is taken to be what is technically possible to be implemented at the premises from an engineering perspective. As a minimum, consideration must be given to the following NO_x emissions controls:

a) Low NO_x Burners

b) Selective non-catalytic reduction (SNCR)

c) Selective Catalytic reduction (SCR)

d) Neural Networks technology (continuous combustion optimisation software)

U1.2 Based on the evaluation, identify practical measures that could be implemented to reduce NO_x emissions at the premises. Practicability may have regard for factors including, but not limited to:

a) Air quality impacts

b) Expected plant life and implementation timeframe

c) Plant efficiency

d) Cost

e) Technical and engineering constraints

Trigger, Action and Response Plan

U1.1 - The licensee must engage a suitably qualified and independent consultant to prepare a Trigger, Action and Response Plan (TARP) that:

a) minimises the risk of any NO_x concentration limit exceedances at the premises.
b) continually improves the licensee's response to occasional and/or abnormal combustion conditions that may lead to a NO_x concentration limit exceedance.
c) provide recommendations for implementation at the premises.
d) is used in combination with the Continuous Emissions Monitoring System CEMS

U1.2 As a minimum the Trigger, Action and Response Plan must include the following parts:

a) Describe 'normal' operating conditions. A range of metrics should be included to identify if the unit is operating in a proper and efficient manner. Such metrics may include:
    I. Boiler load (upper and lower bounds which are considered within 'normal' operating range).
    II. Stability of the units.
    III. Process inputs (fuel type, fuel usage rate, temperatures, flow rates).
b) Describe proactive measures that are implemented to minimise the risk of any NO_x concentration limit exceedances at the premises
c) Specify:
    I. Parameters that can be monitored and recorded for the purposes of ensuring the units are operating in a way to minimise the risk of any NO_x concentration limit exceedances at the premises.
    II. Clear, measurable and auditable thresholds / alarm / trigger levels that once exceeded require the Licensee to undertake investigative works and/or corrective actions.
    III. Clear 'threshold' levels that once exceeded require the Licensee to notify the EPA and/or the community must also be identified
d) Provide a detailed description of the measures or actions to be taken once thresholds / alarms are triggered.
e) Specify and describe clear reporting requirements used for describing the process operating conditions at the time thresholds / alarms are triggered. Similar information must be provided to describe the investigation and reactive measures / actions to follow.
f) Identify:
    I. persons responsible for undertaking actions,
    II. methods for tracking the effectiveness of the applied reactive measures

U1.3 Detailed description of quality assurance and quality control procedures used for collecting, verifying, and reporting data.

U1.4 The Trigger, Action and Response Plan should be informed by results and conclusions of the following documents:

- Vales Point Power Station Air Quality Assessment for Group Exemption Extension, *prepared by Katestone Environment Pty Ltd., dated 8 October 2021*.
- NO_x Pollution Reduction Study, Vales Point – Evaluation of Potential NO_x Emission Controls, *prepared by Jacobs Group (Australia) Pty., Ltd., dated 6 October 2021.*
- Revised NO_x Emission Limits for Vales Point Power Station, *prepared by Katestone Environment Pty Ltd., dated 26 November 2021*

SO_x emissions reduction investigation:

U1.1 – A pollution Reduction Study report must be prepared by the Licensee to address the following items:

1) Provide a detailed feasibility evaluation of SO_x emission control measures that are not currently used at the premises. For the purpose of this requirement, feasibility is taken to be what is technically possible to be implemented at the premises from an engineering perspective.

   a) As a minimum, consideration must be given to the following SO_x emissions controls:
      i) Dry flue gas desulfurisation
      ii) Wet scrubbing
      iii) Semi-dry scrubbers
      iv) Sorbent injection

   b) Based on the evaluation, identify feasible measures that could be implemented to reduce SO_x emissions at the premises.

2) Undertake Continuous Emissions Monitoring System CEMS data analysis to investigate, identify and propose SO_x emissions limits reflective of:
   a) The proper and efficient operation of the plant.
   b) Previous and expected plant performance.
3) The licensee must engage a suitably qualified and independent consultant to prepare an Air Quality Impact Assessment (AQIA).
   a) The AQIA must be undertaken in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (The Approved Methods).
   b) The AQIA must include as a minimum modelling scenarios representative of the proposed SO_x concentrations limits being emitted every hour of the modelling period.
   c) The AQIA must present the incremental (power station only) ground level concentrations for SO_2.
   d) The AQIA must present cumulative impacts for SO_2 accounting for:
      i) other significant existing emission sources (including other existing power stations);
      ii) any currently approved developments which would be significant emission sources, and
      iii) background air quality.
   e) Any assumptions made during the preparation of the AQIA must be accompanied by a detailed description, supporting evidence and must be robustly justified.
4) Based on the results and conclusions in the AQIA, nominate practical measures that can be implemented to mitigate air pollution impacts from the premises. Practicability may have regard for factors including, but not limited to:
      i. Air quality impacts
      ii. Expected plant life and implementation timeframe
      iii. Plant efficiency
      iv. Cost
      v. Technical and engineering constraints

U1.2 The AQIA should be informed by results and conclusions of the following documents:

- Vales Point Power Station Air Quality Assessment for Group Exemption Extension, *prepared by Katestone Environment Pty Ltd., dated 8 October 2021*.
- Memorandum, Sulfur Oxide (SO_x) emissions and reduction options for Vales Point Power Station, *prepared by Jacobs Group (Australia) Pty., Ltd., dated 30 September 2021.*

- Revised NO_x Emission Limits for Vales Point Power Station, *prepared by Katestone Environment Pty Ltd., dated 26 November 2021*.