27 October 2009

10-8328 Independent Review AQ Mt Piper FINAL 20091027.doc

Attention: **Dinuka McKenzie**

Dear Dinuka

Independent Expert Review
Mt Piper Power Station Extension
Air Quality Impact Assessment

1 Introduction

Heggies Pty Ltd (Heggies) has been requested by the NSW Government Department of Planning - Major Infrastructure Assessments (the Department) to undertake an independent expert review of the Concept Approval Air Quality Impact Assessment for the proposed Mt Piper Power Station Project (the Project).

The independent expert review panel consisted of Dr Peter Manins (CSIRO Fellow), Mr Scott Fishwick (Heggies) and Dr Martin Doyle (Heggies).

1.1 Reports of Reference

The documents which have been examined as part of this independent expert review were:

- Chapter 9- Air Quality – Mt Piper Power Station Extension Environmental Assessment, Main Report – dated September 2009, prepared for Delta Electricity by SKM.
- Appendix E - Air Quality Assessment for the proposed Mt Piper Power Station Extension –dated September 2009, prepared for Delta Electricity by SKM.

2 Review Summary

The findings of the review have indicated that several issues need to be addressed prior to Concept Plan Approval or Project Approval being granted for either fuel option. The review has raised issues regarding:

1. Selection of the representative meteorological year;
2. The use of surface (10 m) winds up to 300 m in complex terrain;
3. The use of one surface meteorological dataset in the centre of a 25 km modelling domain to reflect meteorological conditions across the domain;
4. Absence of CALMET output validation using available meteorological data in the modelling domain;
5. The use of emissions data in dispersion modelling;

HEGGIES PTY LTD
ABN 29 001 584 612
2 Lincoln Street Lane Cove NSW 2066 Australia
PO Box 176 Lane Cove NSW 1595 Australia
Telephone 61 2 9427 8100 Facsimile 61 2 9427 8200
Email sydney@heggies.com Website www.heggies.com

6. An absence of commentary on start up / shut down scenarios and implications for short term peak pollutant concentrations;
7. An absence of a quantitative assessment of ground level VOC concentrations resulting from the Project;
8. A lack of sensitive receptor location identification and subsequent lack of model outputs at the locations;
9. A lack of short–term peak SO_2 concentration plots within the assessment;
10. The use of a conservative 30% NO_X to NO_2 ratio when concentrations are approaching the criterion levels;
11. A lack of contour plot presentation for the full cumulative modelling assessment results; and
12. The assessment of coal handling, transport and storage.

The following sections provide further detail around these issues.

3 Local Air Quality Impact Assessment (Chapter 9 and Appendix E)

Following a review of Chapter 9, Appendix E and associated documents, a number of areas requiring clarification or further investigation have been identified.

3.1 Meteorology

3.1.1 Representative Meteorological Year Selection

Section 5.1 on Page 13 of Appendix E describes the choice of the representative meteorological year to be used in both meteorological and dispersion modelling for the Project. Table 4 on Page 14 compares five years of meteorological data from the Mt Piper Power Station meteorological monitoring station. Variation exists in the percentage of data capture, mean wind speed and percentage of calms across the five years. The year 2001 was selected for development of the meteorological wind field to be used in dispersion modelling.

The use of 2001 as a representative meteorological year is questioned after examination of Table 4. 2001 shows the highest mean wind speed (2.5 m/s) and the lowest percentage of calm wind conditions (4.9%) of the five years presented. The average wind speed for the 2001 to 2004 period is 2.4 m/s and average percentage of calms is 7.7%. The year 2005 can be excluded due to the low (41%) data capture.

Recommendation:

It is considered that the use of 2003 meteorology (2.4 m/s average wind speed and 7.0% calm winds) would characterise a more representative meteorological year. It is acknowledged that data capture was 96% in 2003, although supplementation of the dataset could be performed using TAPM (and verified), prior to being used in CALMET to generate a gridded meteorological wind field.

3.1.2 Meteorological Data Assimilation

The CSIRO model TAPM has been used to generate surface and upper air meteorological input datasets for use within CALMET, the meteorological processor for CALPUFF. Hourly observational data for wind speed and direction recorded at Mt Piper weather station was assimilated into TAPM to align the predictions with actual conditions.

Surface observational data from the Mt Piper weather station was given a horizontal radius of influence of 5 km through the lowest 8 model levels about the Mt Piper meteorological station. While not specified within Table 5 of Appendix E, it is assumed based on the default TAPM configuration that the first 8 model levels would cover the region between the surface and 300 m above ground level. Clarification is sought behind the reasoning of this assumption given that observations were recorded at 10 m and the surrounding terrain is quite complex.

Following meteorological modelling with TAPM, surface and upper air datasets were extracted at the location of the Mount Piper weather station. Actual meteorological conditions for a range of parameters recorded during 2001 were substituted into the TAPM-generated surface dataset where applicable. Due to a lack of upper air sounding data for the region surrounding the Mount Piper power station, the TAPM-generated upper air dataset was retained in completion.

The TAPM-generated upper air dataset and the fusion of actual observations/TAPM-generated surface dataset were then used as inputs within CALMET. CALMET was configured for a modelling domain of 25km x 25km with a grid resolution of 0.5 km.

The approach described above raises the following concerns

1. CALMET is a diagnostic meteorological model and as such is dependant on the meteorological, terrain and landuse input datasets to accurately generate a three-dimensional meteorological field for use in CALPUFF. Using a single surface and upper air meteorological column located at the centre of a modelling domain to generate meteorological conditions across an entire domain, particularly one with such complex terrain, is considered highly questionable. The rationale behind this decision is sought.

   Furthermore, no information on the key observation dataset integration parameters used in the configuration of CALMET has been provided within this assessment, including TERRAD, R1 and R2 and RMAX1, RMAX2 and RMAX3. The inclusion of appropriate values for these parameters is critical to the performance of CALMET in simulating the meteorology across the domain. Clarification on the parameters used in the CALMET modelling is sought.

   There is of course the potential that the CALMET-generated meteorological field has performed well in simulating the meteorological conditions across the modelling domain. However, no validation of the CALMET generated fields is provided within the assessment for this evaluation to be made. Validation of surface wind directions and speeds at a number of locations about the domain should have been performed to provide confidence in the modelled meteorological wind fields.

   Whilst it is acknowledged that there are no continuous Bureau of Meteorology meteorological observation stations within the modelling domain, there are several mining operations in the area which routinely collect meteorological data. Such operations known to Heggies include Angus Place, Springvale, Pinedale, Ivanhoe and Baal Bone mines. Should this data be obtainable by the proponent, it would provide a means of validation of the performance of the CALMET diagnostic model.

2. Furthermore, given the large number of meteorological observations in the domain, it is questioned why these have not been sourced and used within CALMET modelling, to allow greater 'nudging' of the wind field to observed conditions.

Recommendation:

1. Provide further information within the assessment as to the parameters used in CALMET modelling.
2. Provide the rationale as to why 10 m winds have been used up to 300 m in an area of complex terrain.

3. Assess the availability of meteorological data within the modelling domain and include within TAPM/CALMET as surface observations. Using Mt Piper data only does not reflect the spatial variability of surface energy and upper air data across the modelling domain. Validation of CALMET outputs at one of these surface meteorological stations should be undertaken to provide confidence in CALMET outputs.

3.2 Model Selection and Performance

3.2.1 CALPUFF Pollution Model Use

Justification for the use of the CALPUFF dispersion model is provided on Page 13 of Appendix E. It is stated that AUSPLUME is not appropriate due to the steady state assumptions contained within the model equations. It is correctly noted that such assumptions will not be valid when considering the complicated terrain surrounding the Mt Piper Power Station. This argument is considered to be an appropriate justification for the use of a model other than AUSPLUME.

However, the assumption that non-steady state conditions are likely for the study area is not justification alone for the implementation of CALPUFF. This places too much credence on the ability of CALMET to accurately simulate the likely variations in meteorological conditions across the selected modelling domain. Rather, as indicated previously, the performance of CALMET in simulating non-steady state conditions across the selected domain should have been conducted to show that CALPUFF is suitable for implementation in this instance.

Further, justification relating to the use of CALPUFF in simulating emissions from the 250 m high Mount Piper A (existing) and B (USC Option) stacks should be provided. Hurley and Luhar (2005) have shown that CALPUFF predictions of maximum concentrations from a tall stack vary between an under prediction of 40% to an under prediction of 9% in the near-field depending on the meteorological dataset used. A degree of variability between monitoring data and modelling predictions is highlighted within Table 14 of Appendix E, in particular under-prediction at the nearby Blackman's Flat monitoring station, which may be attributable to the selection of model or performance of meteorological parameters. A more suitable option for modelling emission sources of this nature may have been TAPM in pollution mode.

Recommendation:

1. As recommended previously, CALMET outputs should be validated against existing meteorological data available within the modelling domain.
2. Provide further justification for using CALPUFF in this instance.

4 Emissions

4.1.1 Emission Rates

Section 6 on Page 23 of Appendix E outlines the emissions data used in dispersion modelling. It is not clear from where data for either Mount Piper or Wallerawang have been sourced for this assessment.

Recommendation:

It is requested that the proponent provide a more detailed explanation of the emissions data used including, but not limited to:

- The data source (NPI, AP-42, CEMS, Licence conditions etc.)
- whether the variation in coal sulfur and ash content has been addressed for both the existing and upgrade scenarios. An assessment of the potential sulfur and ash content in fuel for a scenario in e.g. 5 years time is recommended.

4.1.2 Start up / Shut down

Section 6 on Page 23 of Appendix E describes that in the interests of conservatism, in particular for predicting long-term concentrations, the assumption has been made that the power station is operating continuously at full load.

Recommendation:

It is requested that some comment or analysis be provided on the differences between emissions during this continuous full load operation when compared to a start up / shut down scenario. This may have ramifications for predictions of the short-term concentration peaks, especially 10-minute SO_2 concentrations.

4.1.3 Volatile Organic Compounds

It is queried as to why emissions of Volatile Organic Compounds have not been quantitatively assessed for both the coal and gas-fired options. It is acknowledged that emissions of VOCs may not have a significant impact upon the surrounding area, but given the significant number of other species modelled, and the inclusion of VOCs as having a stack emission limit at Mt Piper Power Station (Table 2, Page 11), it is recommended that for the sake of completeness, VOC emissions are quantitatively assessed within this study.

Recommendation:

Provide a quantitative assessment of VOC impacts for both the coal and gas fired options.

4.2 Impact Assessment

4.2.1 Selection of Appropriate Sensitive Receptor Locations

The reviewers could not locate a section within either Chapter 9 or Appendix E which discusses the locations of potential sensitive receptors surrounding the Mt Piper Power Station. Section 5.4 on Page 18 of Appendix E discusses the locations of air quality monitoring stations at Blackmans Flat and Wallerawang and these station locations have been taken forward as receptor locations in the modelling assessment. Table 13 on Page 31 of Appendix E contains a summary of the dispersion model results for these monitoring locations.

Figure 1 on Page 65 of Appendix E includes the locations of two townships, Portland and Cullen Bullen, within the modelling domain. Figures 11 through 17 (Pages 75 to 81 of Appendix E) present contoured dispersion modelling results which also include the locations of these townships.

It is therefore confusing as to why no modelling results for these townships have been presented within the assessment, as has been provided for the monitoring stations at Blackmans Flat and Wallerawang. Currently, the assessment is suitable only as a model validation exercise and not as a means to identify the air quality impacts on the surrounding community.

Section 9 of the DECC Approved Methods outlines the requirements of an Air Quality Impact Assessment report, which includes the identification of all sensitive receptors (e.g. nearest residences) and the provision of dispersion modelling results at these identified receptors. This has not been provided for the Mt Piper Power Station Extension Air Quality Assessment.

Recommendation:

It is strongly recommended that sensitive receptor locations within the modelling domain are identified and used as discrete receptors within the modelling assessment. Results at each receptor should be presented clearly in both Chapter 9 and Appendix E to enable members of the community to assess the potential impact of the Mt Piper Power Station Extension in a meaningful way.

4.2.2 SO_2 Assessment – Impact Assessment Criteria

Table 3 on Page 12 of Appendix E outlines the impact assessment criteria adopted for this assessment. This includes four criteria for SO_2 (10-minute, 1-hour, 24-hours and annual average). Table 13 on Page 31 provides comparison of several model scenarios and comparison with all criteria outlined in Table 3. However, no contour plots of 10-minute SO_2 concentrations are provided in the Figures. Application of the VEPA (1996) empirical relationship can be applied to the 1-hour averages/maxima to produce these plots.

Recommendation:

Given the apparent high maximum GLC in the model domain identified for 10-minute average SO_2 concentrations, it would be appropriate to show the spatial distribution of concentrations within the domain.

4.2.3 Transformation of NOx to NO_2

Transformation of NOx to NO_2 has been discussed on Page 39 of Appendix E. The assessment has assumed that across the modelling domain, 30% of emitted NOx will be transformed to NO_2 by the time the plume reaches ground level. The conservative nature of the 30% is justified by quoting a study by Holmes Air Sciences (2005) which identified that the percentage of NO_2 in NOx was between 21% and 26% after examination of local monitoring data.

The maximum ground level concentration of NO_2 (1-hour average) within the modelling domain is predicted to be 365 $\mu g/m^3$ for a cumulative assessment of Mt Piper A, Mt Piper B, Wallerawang and the USC option. Many of the other scenarios show maximum 1-hour NO_2 concentrations approaching or exceeding the criterion of 246 $\mu g/m^3$.

Recommendation:

It is considered that the use of a 30% conversion factor across the modelling domain is not suitable, and that methods contained within the DECC Approved Methods should be examined (Method 2: Ozone Limiting Method and Method 3: Janssen Method). Alternatively the use of a chemical transformation model should be investigated.

4.2.4 Model Performance Assessment

Section 9.2 on Page 37 of Appendix E provides an assessment of model performance with modelled SO_2 concentrations compared with measured concentrations. Although this assessment provides an indication of the performance of the model in predicting maximum concentrations, more information regarding the model performance in prediction of a range of percentiles would be desirable to enable a greater understanding of the model predictions.

Recommendation:

Please provide a figure which identifies the range of pollutant percentiles modeled versus those monitored.

4.2.5 Presentation

Contour Plot Presentation

Table 13 on Page 31 of Appendix E presents air quality predictions for eight scenarios, Figures 11 through 17 show contour plots for six modelling scenarios:

- Mt Piper A only
- Mt Piper A plus Wallerawang (existing)
- Mt Piper B (USC) only
- Mt Piper CCGT only
- Mt Piper A plus Mt Piper B (USC)
- Mt Piper A plus CCGT

A suitable justification for not providing model outputs as contour plots for Mt Piper A plus Wallerawang plus either Mt Piper B (USC) or Mt Piper B (CCGT) cannot be found within either Appendix E or Chapter 9.

Recommendation:

It is considered that the contour plot of most interest and importance, viz a full cumulative assessment showing the impact of all three emissions sources (2 existing and one proposed upgrade), should be provided within the assessment and should cover all (yet to be identified) sensitive receptors in the region.

Furthermore, the absence of a scale on the contour plots makes the spatial interpretation of modelling results difficult.

Results Presentation

Table 13 on Page 31 of Appendix E contains a summary of the dispersion model results for a range of pollutants, averaging times and model scenarios. Several figures are presented in fixed point notation and several in scientific notation.

Recommendation:

It is requested that for clarity, a consistent format is used, preferably fixed point notation as it allows easier comparison with the criteria for those not familiar with the use of scientific notation.

5 Inter-regional Air Quality Impact Assessment

Section 9.6 on Page 44 of Appendix E details the findings of the inter-regional transport study conducted for the Mt Piper Power Station Expansion. The assessment indicates that the proposed expansion (either option) is unlikely to cause additional exceedances of the NO_2 or O_3 criteria, although some areas are predicted to experience increases in hourly O_3 of up to 15 ppb.

Review of this section yielded no comment for further action by the proponent. This section is considered to be appropriate for determining the potential inter-regional air quality impacts resulting from the Project.

6 Aviation Hazard Assessment

Section 9.7 on Page 50 of Appendix E provides an Aviation Hazard Assessment, required by the Civil Aviation Safety Authority (CASA) to be conducted for facilities where the vertical velocity of exhaust plumes exceeds 4.3 m/s at an aerodrome Obstacle Limitation Surface (OLS) or at 110 m above ground anywhere else.

As discussed in the assessment, the results of the assessment will be used by CASA to identify a restricted flight area. Due to the nature of the extension (upgrade to existing operations) it has been noted that CASA are highly likely to already have flight restrictions in place to take into account the Mt Piper (and Wallerawang) Power Station flight hazards. Proposed extension options are unlikely to change the existing restricted area.

7 General Comments

Given the importance of PM_{10} to the general public of the region, it seems necessary to attempt some kind of cumulative impact assessment, rather than just present the increment to PM_{10} due to the coal-fired Power Station proposal. There are probably past studies that could be called upon to provide guidance on suitable background levels for the days of high increments from the proposal. Resolution of this point is likely to be important for the residents of Blackmans Flat.

The impacts of coal handling, transport and storage prior to combustion have not been assessed. However, given that approximately 14,000 tonnes of coal will be combusted each day by the coal-fired option it is considered that this will involve significant on-site handling. Although this may not impact upon the surrounding area, this should be confirmed by either examination of existing particulate monitoring data surrounding a similar existing facility, or through a dispersion modelling exercise.

No comment on the potential for acid deposition due to the proposed upgrade has been included within the assessment.

Section 7 on Page 27 of Appendix E describes the emission control technologies which can be used to minimise air quality impacts from the proposed facility. It is noted however that none of the discussed technologies have been assumed to be in place in the modelling assessment, in the interests of conservatism. Although it understood that this assessment is for Concept Approval, further discussion of mitigation technologies *likely* to be used at Mt Piper would be required prior to Project Approval. Due to the proximity of Mt Piper A, B and Wallerawang to one another and the seemingly significant impacts due to Wallerawang when Mt Piper A and B are operational, it is recommended that an investigation is conducted which examines the costs and benefits of applying mitigation at Wallerawang. It is considered that there may be significant emissions reduction trade-offs which would be of benefit to the local community.

It is recommended that the air quality monitoring station at Portland is re-instated should the proposal for expansion be accepted given the large predicted cumulative impacts, especially of SO_2 within the vicinity.

8 Concept Plan Conditions of Approval

Prior to Project approval for either the coal or gas fuelled option at Mt Piper, further assessment with regard to air quality is recommended to be undertaken. It is considered that the recommendations provided below may be included within the Concept Plan instrument.

1. The Proponent should identify all sensitive receptors surrounding the Project Site and provide dispersion modelling results for all receptors. This is important is allowing the community to identify the potential impacts of any upgrade.

2. The Proponent must provide assurances through a detailed cumulative dispersion modelling exercise that the impact of the Project will not result in significantly degraded air quality at any identified sensitive receptor. An existing and future operations scenario should be provided to allow community understanding of the absolute impact of each option. Cumulative results should be provided as contour plots to allow community understanding of the potential impacts.
3. The Proponent must address all potential emissions of pollutants from either option in the cumulative assessment. Results should be provided as contour plots and in tabular form for all pollutants and averaging times to allow community understanding of the potential impacts.
4. The Proponent must undertake a dispersion modelling exercise of the coal handling, transport and storage proposed for the coal-fired Project option. Include in this a cumulative assessment of PM_{10} concentrations resulting from Project operation and surrounding sources.
5. Should dispersion modelling predict that either additional exceedances of air quality criteria are forecast, or significant increases in pollutant levels are expected at certain identified sensitive receptor locations, a detailed air quality monitoring strategy/plan should be formulated.

I trust this meets with your immediate requirements,

Yours sincerely

Martin Doyle
Senior Consultant