

VICTORIAN CIVIL AND ADMINISTRATIVE TRIBUNAL

Applications for Review:

P1816/2011, P1818/2011, P1820/2011 P1822/2011, P1829/2011,  
P1846/2011

Dual Gas Demonstration Project

Works Approval WA 67043

Expert Report

prepared by Dr Lynette Denison

October 2011

## Introduction

- 1 I am the Principal Scientist – Air Quality for the Environment Protection Authority Victoria (**EPA**) and I specialise in air pollution and related health effects.
- 2 On 1 September 2010, Dual Gas Pty Ltd (**Dual Gas**) lodged with the EPA an application for a works approval for its proposed Dual Gas Demonstration Project in Morwell (**Works Approval Application**).
- 3 On 20 May 2011, the EPA granted Dual Gas a works approval for the Dual Gas Demonstration Project (**DGDP**), subject to a number of conditions (**Works Approval**). In particular, the Works Approval is subject to the following condition:

*Before commencing construction, the occupier must submit to EPA for written approval a report that includes the plans and specifications of the works specified in condition 1.2, including details of sulphur dioxide reduction equipment that will reduce the emissions by at least 90% of uncontrolled emissions (based on the average sulphur level in the coal feedstock).*
- 4 The following applications have been lodged with the Victorian Civil and Administrative Tribunal seeking a review of the EPA's decision to grant the Works Approval:
  - (a) application by Dual Gas under s33(1)(b) of the *Environment Protection Act 1970* (**EP Act**) (**P1846/2011**);
  - (b) application by Dual Gas under s33(3) of the EP Act (**P1829/2011**);
  - (c) application by Environment Victoria Inc under s33B of the EP Act (**P1820/2011**);
  - (d) application by Locals Into Victoria's Environment Inc under s33B of the EP Act (**P1822/2011**);
  - (e) application by Martin Shield under s33B of the EP Act (**P1816/2011**);
  - (b) application by Doctors for the Environment Australia Inc under s33B of the EP Act (**P1818/2011**).
- 5 I have been requested by Corrs Chambers Westgarth to prepare an expert report for the VCAT proceedings.
- 6 Corrs Chambers Westgarth is acting on behalf of the EPA.

## Instructions

- 7 I have been requested to address the following matters in my expert report:

**Potential SO<sub>2</sub> Impacts**

  - (a) The health risks associated with SO<sub>2</sub>.
  - (b) The levels of SO<sub>2</sub> that pose a public health risk.
  - (c) The changing SO<sub>2</sub> regulatory requirements both locally and internationally.
  - (d) The current ambient concentrations of SO<sub>2</sub> and volumes of SO<sub>2</sub> emissions in the Latrobe Valley Air Quality Control Region.

- (e) The impact of modelled SO<sub>2</sub> emissions from the DGDP on air quality in the Latrobe Valley Air Quality Control Region.
- (f) The Department of Health request to invoke clause 30 of the SEPP (AQM).

#### **Potential Impacts of Oxides of Nitrogen**

- (a) The health risks associated with oxides of nitrogen.
- (b) Levels of oxides of nitrogen that pose a public health risk.
- (c) Whether modelled oxides of nitrogen emissions from the DGDP would adversely affect any beneficial use of the environment (by reference to the definition of beneficial use in the EP Act and the list of beneficial uses in Clause 9 of the SEPP (AQM))

#### **Potential Impacts of Particulates**

- (a) The health risks associated with fine particulates (**PM<sub>2.5</sub>**) and ultra-fine particles (**PM<sub>0.1</sub>**).
- (b) The levels of fine particulates (PM<sub>2.5</sub>) and ultrafine particles (PM<sub>0.1</sub>) that pose a public health risk.

## Summary of Opinions

- 8 There are potential health effects associated with the emissions of sulphur dioxide (SO<sub>2</sub>) from the DGDP. The inclusion of pollution control equipment to reduce SO<sub>2</sub> emissions will reduce these potential health effects.
- 9 The emissions of nitrogen dioxide (NO<sub>2</sub>) from DGDP and existing sources comply with the design criteria in SEPP (AQM) which have been established to protect the beneficial uses specified in the policy and the EP Act.
- 10 The emissions of particles (PM<sub>10</sub> and PM<sub>2.5</sub>) from the DGDP are low and do not pose a significant health risk to the community.

## Potential SO<sub>2</sub> Impacts

### **Health risks associated with SO<sub>2</sub>**

- 11 In recent years the health effects of SO<sub>2</sub> linked to ambient exposures have been well studied and reviewed by international agencies.
- 12 In summary, ambient levels of SO<sub>2</sub> are associated with increases in mortality (mainly respiratory causes), hospital admissions and emergency department attendances, exacerbation of asthma and reduction in lung function. SO<sub>2</sub> has also been linked with low birth weight which is a risk factor for developmental problems.
- 13 People with asthma and other existing respiratory disease, the elderly (>65 years) and children are groups within the population that are particularly sensitive to the effects of SO<sub>2</sub>.
- 14 Epidemiological studies conducted in Australia have shown that the effects observed in international studies are also observed here even though the levels of SO<sub>2</sub> are lower.

- 15 Epidemiological studies worldwide have found no evidence of a threshold below which health effects are not observed and this has led agencies such as the World Health Organisation (**WHO**) and United States Environmental Protection Agency (**USEPA**) to conclude that there is no safe level of exposure to SO<sub>2</sub> in particular for sensitive groups.
- 16 It is generally accepted that people with severe asthma cannot be protected from the health effects of SO<sub>2</sub> and will respond within minutes of exposure.

#### **The levels of SO<sub>2</sub> that pose a public health risk**

- 17 Victoria's legal framework for protecting air quality is provided by the EP Act, which provides for the development of State Environment Protection Policies (**SEPPs**). SEPPs establish a statutory policy framework for protecting the environment.
- 18 The following two SEPPs relate to air quality:
- (a) State Environment Protection Policy (Ambient Air Quality) (**SEPP (AAQ)**); and
  - (b) State Environment Protection Policy (Air Quality Management) (**SEPP (AQM)**).
- 19 The SEPP (AAQ) contains the air quality indicators, standards, goals and monitoring and reporting protocol of the National Environment Protection Measure for Ambient Air Quality which was made by the National Environment Protection Council in June 1998 (**AAQ NEPM**).
- 20 The SEPP (AAQ) establishes the following standards for SO<sub>2</sub>:
- (a) 0.2ppm averaged over a one hour period;
  - (b) 0.08ppm averaged over a 24 hour period; and
  - (c) 0.02ppm averaged over a one year period.
- 21 The standards contained in the SEPP (AAQ) apply to regional air quality and not to individual sources. All sources, stationary and diffuse, within a region must be managed so that their cumulative impact does not exceed these standards.
- 22 The SEPP (AQM) establishes the framework for the management of emissions to the air environment to ensure that the standards in the SEPP (AAQ) are met and that continuous improvement in air quality is achieved. The SEPP (AQM) establishes design criteria that apply to individual sources during the design stage of a new or modified source. The design criteria for individual pollutants are more stringent than the ambient air quality standards in the SEPP (AAQ) to enable multiple sources to exist within the airshed without leading to exceedances in the regional air quality standards.
- 23 The design criterion for SO<sub>2</sub> in Schedule A of the SEPP (AQM) is 0.17ppm (0.45 mg/m<sup>3</sup>).
- 24 These design criteria do not mean that all health risk is eliminated. They are the result of a weighted assessment of acceptable risk. Sitting behind this risk assessment is the recognition that any SO<sub>2</sub> released into the atmosphere may have an impact on human health and that, whatever the risk-weighted

'standard', it is preferable for the generation of SO<sub>2</sub> emissions to be reduced to the minimum possible level.

- 25 In addition to the vulnerable groups discussed in paragraph 13 above, recent studies have shown that people who have a low socioeconomic status (**SES**) form a group within the population that is particularly vulnerable to effects of air pollution, including SO<sub>2</sub>. This is largely due to the fact that people within these groups usually have poorer health status than people within higher SES groups. They also have poorer access to medical care. In addition they usually live in areas that are more polluted (e.g. near major roads or near industry) as property is generally cheaper in these areas.
- 26 There are several indices of social deprivation used to assess SES status in Australia. One commonly used is the SEIFA index. It is important to note that the Latrobe Valley Shire has the second lowest SEIFA index in Victoria. This indicates that the general population of the Latrobe Valley are likely to be a susceptible population to the effects of air pollution.

### **The changing SO<sub>2</sub> regulatory requirements both locally and internationally**

#### **International standards for SO<sub>2</sub>**

- 27 In recent years both the World Health Organisation and the USEPA have revised their air quality standards for SO<sub>2</sub>. Extensive reviews of the health effects of SO<sub>2</sub> were undertaken and led to these agencies significantly lowering the standards (USEPA, 2008b; WHO, 2006).
- 28 Since 2006, the WHO lowered the 24-hour SO<sub>2</sub> standard by a factor of approximately 6 to reflect the growing body of evidence about the health effects of SO<sub>2</sub>. The current guidelines established by WHO for SO<sub>2</sub> are:
- (a) 10 minute average 500µg/m<sup>3</sup> (0.175ppm)
  - (b) 24 hour average 20µg/m<sup>3</sup> (0.007ppm)
- 29 The previous 24-hour guideline established in 2000 was 0.04ppm (125µg/m<sup>3</sup>). It is important to note that the WHO guidelines are based solely on health evidence and do not have any consideration of achievability and costs of meeting this value. The European Union takes the WHO guidelines and conducts the cost-benefit analysis for the Member States of the EU to determine appropriate limit values (standards) that apply to regional air quality and limits for industrial processes. The current EU standards for SO<sub>2</sub> are:
- (a) 1 hour average 350µg/m<sup>3</sup> (0.122ppm)
  - (b) 24 hour average 125µg/m<sup>3</sup> (0.044ppm)
- 30 These standards are significantly more stringent than those currently in the AAQ NEPM and SEPP (AAQ).
- 31 The USEPA has recently revised its air quality standard for SO<sub>2</sub> reducing the standard from 100ppb. The current standard in the USA, again more stringent than that established in the SEPP (AAQ), is 1 hour average 0.075ppm.
- 32 Both the 24-hour and annual average standards were revoked as the USEPA considered that the most significant health effects associated with SO<sub>2</sub> were short-term peaks and by meeting the new 1-hour standard people would be

protected from the health effects associated with those longer averaging periods.

#### **Review of local standards**

- 33 Given that the evidence from these recent studies into the health effects of SO<sub>2</sub> (WHO, 2006; USEPA, 2008; NEPC, 2010) shows that there is no threshold for effect, no safe level of exposure, all air quality standards are based on some level of risk. The aim of regulatory frameworks and policy is to minimise these risks.
- 34 The AAQ NEPM has recently been reviewed by the National Environment Protection Council (NEPC) and recommendations have been made to NEPC Ministers that the current standards in the NEPM should be changed to reflect the current understanding of the health effects of the pollutants covered in the AAQ NEPM, including SO<sub>2</sub>. NEPC Ministers have accepted the report and recommendations from the NEPM review and the changes required to the AAQ NEPM to address these is being considered by the Standing Committee on Environment and Water Air Thematic Oversight Group. The process to vary the NEPM will commence within the next 6 months.

#### **The current ambient concentrations of SO<sub>2</sub> and volumes of SO<sub>2</sub> emissions in the Latrobe Valley Air Quality Control Region**

##### *Current ambient concentrations of SO<sub>2</sub> in the Latrobe Valley Air Quality Control Region*

- 35 Air quality in the Latrobe Valley is currently monitored by the EPA in Traralgon. Monitoring was conducted in Moe until 2009.
- 36 In addition to monitoring conducted by the EPA, the electricity generators network is required to conduct monitoring across the Valley to assess the impact of the emissions from the power stations on air quality in the region. Monitoring has been undertaken since the mid 1980s.
- 37 The results of the monitoring undertaken by the EPA show that in general the SO<sub>2</sub> levels meet the current air quality standards in SEPP (AAQ) (set out in paragraph 20 above) with only occasional exceedances of the 1-hour standard.
- 38 The monitoring conducted by the electricity generators network shows that there are exceedances of the SO<sub>2</sub> standards in SEPP (AAQ) in particular at Jeeralang Hill. It is important to note that the electricity generators network is established specifically to monitor the impact of the industry. The EPA's monitoring station at Traralgon is designed to measure a general representation of air quality across the region. It is not located to pick up the direct impact of the industry.
- 39 The modelling conducted for the Works Approval Application by HRL Technology indicates that the existing SO<sub>2</sub> levels in Morwell are higher than those monitored in Traralgon and Moe. The modelling was validated across the whole region against existing data from both the EPA monitoring stations and the electricity generators monitoring network.
- 40 The modelling was shown to predict levels of SO<sub>2</sub> in Traralgon and Moe that were consistent with levels measured by the EPA. The modelling also showed good correlation with the data from the electricity generators network.

- 41 The validation process indicates that the model accurately predicted ground level concentrations at these locations and therefore should provide a reliable estimate of predicted SO<sub>2</sub> concentrations at other locations.
- 42 To further investigate the levels SO<sub>2</sub> in Morwell, the EPA is in the process of establishing a monitoring site in Morwell East which will commence operation by the end of October 2011.

*Current volumes of SO<sub>2</sub> emissions in the Latrobe Valley Air Quality Control Region*

- 43 According to the 2009/10 National Pollutant Inventory data, there are 110 million kg/yr of SO<sub>2</sub> emitted into the Latrobe Valley Air Quality Control Region. Of this, 100 million kg/yr comes from electricity generation. When compared to the total emissions of SO<sub>2</sub> emitted in Victoria there is a disproportionate load emitted in the Latrobe Valley. The total amount of SO<sub>2</sub> emitted in Victoria is 210 million kg/yr of which 110 million kg/yr is emitted into the Latrobe Valley. In total 140 million kg/yr of SO<sub>2</sub> is emitted by electricity generators, 100 million kg of this is emitted in the Latrobe Valley.

**The impact of modelled SO<sub>2</sub> emissions from the DGDP on air quality in the Latrobe Valley Air Quality Control Region**

*Annual SO<sub>2</sub> emissions*

- 44 According to the Works Approval Application, the proposed 600MW plant would add an additional 13 million kg/yr of SO<sub>2</sub> into the Latrobe Valley Air Quality Control Region. This estimate is based on the emission rates provided in the Works Approval Application in g/min and assumes constant operation of the plant over a year.
- 45 The Works Approval requires installation of pollution control equipment for the removal of SO<sub>2</sub>.
- 46 If a scrubbing system was installed, 90% efficiency could be achieved in the removal of SO<sub>2</sub>. This would reduce the emissions of SO<sub>2</sub> from the DGDP from 13 million kg/yr to 1.3 million kg/yr.

*SO<sub>2</sub> modelling*

- 47 The EPA commissioned Dr Graeme Ross of CAMM to review the modelling conducted by HRL Technology for the Works Approval Application and to conduct additional air modelling.
- 48 Dr Ross has issued three reports:
- (a) External Review of Air Quality Modelling Assessment conducted by HRL, CAMM Report 55/10, January 2011 (**CAMM Report (January)**)
  - (b) External Review of Air Quality Modelling Assessment conducted by HRL, Additional Results, CAMM Report 1/11, February 2011 (**CAMM Report (February)**)
  - (c) External Review of Air Quality Modelling Assessment conducted by HRL, Further Results, CAMM Report 9/11, August 2011 (**CAMM Report (August)**)

### SO<sub>2</sub> modelling for the 600MW proposal

- 49 Dr Ross's modelling of the 600MW proposal predicted exceedances of the SO<sub>2</sub> design criterion with a maximum concentration of 0.54mg/m<sup>3</sup> compared with the design criterion of 0.45 mg/m<sup>3</sup> (p7 CAMM Report (January)). It is important to note that the design criteria in SEPP (AQM) apply at the point of predicted maximum impact wherever that may fall. It is incorrect to only apply them in population centres.
- 50 Further analysis conducted by Dr Ross predicted a maximum ground level concentration of 0.91 mg/m<sup>3</sup> which is approximately double the design criterion in SEPP (AQM) (p8 CAMM Report (January)).
- 51 I accept that the modelling undertaken by Dr Ross indicated that the maximum ground level concentration of SO<sub>2</sub>, which occurred 1 km south west of Loy Yang Power Station, was not significantly impacted by the addition of the Dual Gas Demonstration Plant and that the same is true at Morwell East, given the existing impacts of the Loy Yang Power Station and the Hazelwood and Energy Brix facilities. However, these marginal increases are in the context of the design criterion already being met or exceeded at these locations.
- 52 For the location predicted to have the maximum impact from the Dual Gas Demonstration Plant (which is just south of the proposed plant) the emissions from Dual Gas alone were estimated to be approximately 60% of the design criterion (p20 CAMM Report (January)).
- 53 In my opinion, the predicted increase in SO<sub>2</sub> levels due to the proposed 600MW plant would potentially lead to significant health effects in the exposed populations, in particular the sensitive groups within this population.
- 54 Given this, any reduction in SO<sub>2</sub> emissions from the DGDP would reduce the potential health effects.

### SO<sub>2</sub> modelling for the 300MW proposal

- 55 The Works Approval granted for a 300MW plant requires the installation of pollution control equipment for SO<sub>2</sub>. To assess the impact of these requirements the EPA requested Dr Ross to undertake further modelling. As well as assessment against the design criteria in SEPP (AQM), Dr Ross conducted modelling to enable an assessment against the standards in SEPP (AAQ).
- 56 Dr Ross conducted modelling for the 300MW plant with and without pollution control equipment and compared the results with the 600MW plant as proposed in the Works Approval Application (CAMM Report No. 9/11 (August 2011)). As with previous modelling the location where the maximum ground level is predicted to occur exceeds the design criterion due solely to existing sources. At this location neither the reduction in capacity of the DGDP nor the introduction of pollution control equipment impacts on the predicted concentration of SO<sub>2</sub>.
- 57 However, at other locations where the impact of the emissions from the DGDP is greater, the reduction in capacity leads to reductions in the predicted ground level concentrations (p17 CAMM Report (August)). In addition, the inclusion of pollution control equipment for SO<sub>2</sub> reduction leads to further reduction in the impact of emissions from the DGDP. This is particularly noticeable in Morwell

East and Jeeralang Hill (p17 CAMM Report (August)). These reductions in SO<sub>2</sub> levels will mitigate the potential health impacts of the DGDP.

- 58 The modelling was undertaken to assess the impact of the individual sources at a discrete receptor in Traralgon. Although clearly dominated by Loy Yang, the DGDP was the second highest contributor to the ground level concentrations at this location. The reduction from the proposed 600MW plant to the approved 300MW plant would reduce the impact from the DGDP by 50%. The further addition of pollution control equipment would reduce the impact by a further factor of 10 (p28 and 29 CAMM Report (August)).

### **The Department of Health request to invoke clause 30 of the SEPP (AQM)**

- 59 In September 2010, the EPA referred the Works Approval Application to the Department of Health (DH) for comment on any potential public health issues that might arise from the proposal. DH is a statutory referral body for works approvals applications under the EP Act. The preliminary response received from DH stated that they had no objections providing that the proposal complied with the requirements of SEPP (AQM).
- 60 In March 2011, the EPA referred to the DH additional information and modelling that had been provided to the EPA by Dual Gas in response to a Section 22 notice and the CAMM modelling commissioned by the EPA. On 29 April 2011, the DH wrote to the EPA formally responding to this additional information and raising concerns about the impact of SO<sub>2</sub> on the health of community in the Latrobe Valley. In particular, the DH was concerned about the existing levels of SO<sub>2</sub> in the Valley already exceeding the air quality standards in SEPP (AAQ) as well as the new evidence on the health effects of SO<sub>2</sub> that has shown health effects below the current standards.
- 61 With respect to existing SO<sub>2</sub> levels, the DH noted that the modelling done for the Works Approval Application indicated that the emissions in the Valley were approaching a 'ceiling' for this pollutant. They recommended that in considering the Works Approval Application the EPA should give consideration to Clauses 30 and 31 of SEPP (AQM).

#### **Clause 30**

- 62 Clause 30(1) of SEPP (AQM) provides that:
- (1) *For the purpose of improving or maintaining regional air quality within an Air Quality Control Region, the Authority may:*
    - (a) *require emission generators to reduce their emissions to a greater extent than required by clauses 18 and 19; and*
    - (b) *refuse to issue a works approval for a large new source of emissions unless emission reductions for other sources are able to offset the impacts of the proposed emissions.*
- 63 Clause 18 of the SEPP (AQM) requires that generators of emissions must "apply best practice to the management of their emissions...". A similar obligation applies to a generator of a new or substantially modified source of emissions under clause 19 of the SEPP (AQM).

- 64 As the proposed DGDP is located in the Latrobe Valley Air Quality Control Region, clause 30 applies.
- 65 Therefore, for the purpose of improving or maintaining regional air quality within the Latrobe Valley Air Quality Control Region, the EPA may require Dual Gas to reduce its emissions from the DGDP to a greater extent than would otherwise be required to comply with 'best practice'.

### **Clause 31**

- 66 Clause 31 of the SEPP (AQM) enables the EPA to develop Air Quality Improvement Plans for any Air Quality Control Region.
- 67 The purpose of Air Quality Improvement Plans is to protect the beneficial uses and identify actions that will enable the environmental quality objectives to be met as well as guiding, supporting and promoting continuous improvement in air quality to minimise the exposure of the community to air pollution.
- 68 Clause 31 falls outside the scope of this report.

## **Potential Impacts of Oxides of Nitrogen**

### **Health effects of NO<sub>2</sub>**

- 69 There is a large body of epidemiological evidence from overseas and Australian studies showing consistent and statistically-significant associations between adverse health effects and short-term exposure to NO<sub>2</sub> at levels below the current ambient air quality SEPP (AAQ) standards of 0.12 ppm (1-hour average).
- 70 In summary, ambient levels of NO<sub>2</sub> are associated with increases in mortality, hospital admissions and emergency department attendances (mainly for respiratory causes), reduction in lung function, exacerbation of asthma and other existing respiratory diseases.
- 71 The health effects associated with NO<sub>2</sub> are both short-term and chronic (long-term). The critical health outcomes identified in overseas and Australian studies for long-term exposure to NO<sub>2</sub> are mortality, respiratory morbidity and asthma incidence, and carcinogenic, cardiovascular, reproductive and developmental effects.
- 72 People with asthma and other existing cardiovascular and respiratory disease, the elderly (>65 years) and children are groups within the population that are particularly sensitive to the effects of NO<sub>2</sub>.
- 73 Epidemiological studies conducted in Australia have shown that the effects observed in international studies are also observed here even though the levels of NO<sub>2</sub> are lower. The observed effects in Australia appear to be greater than those observed in Europe and the US but similar to those observed in Canada.
- 74 Epidemiological studies worldwide have found no evidence of a threshold below which health effects are not observed and this has led agencies such as the World Health Organisation (WHO) and United States Environmental Protection Agency (USEPA) to conclude that there is no safe level of exposure to NO<sub>2</sub> in particular for sensitive groups.

- 75 **Levels of oxides of nitrogen that pose a public health risk**
- 76 The SEPP (AAQ) establishes the following standards for NO<sub>2</sub>:
- (a) 0.12ppm averaged over a one hour period;
  - (b) 0.03ppm averaged over a one year period.
- 77 As discussed in paragraphs 21 and 22 above, these standards apply to regional air quality and not to individual sources. All sources, stationary and diffuse, within a region must be managed so that their cumulative impact does not exceed these standards.
- 78 The design criteria for individual pollutants are more stringent than the ambient air quality standards in the SEPP (AAQ) to enable multiple sources to exist within the airshed without leading to exceedances in the regional air quality standards.
- 79 The design criterion for NO<sub>2</sub> in Schedule A of the SEPP (AQM) is 0.1ppm (0.19 mg/m<sup>3</sup>) 1 hour average.
- 80 However, there are potential health risks below these levels. In addition to the vulnerable groups discussed in paragraph 72 above, recent studies have shown that people who have a low socioeconomic status (**SES**) form a group within the population that is particularly vulnerable to effects of air pollution, including SO<sub>2</sub>. As previously discussed in paragraphs 25 and 26 above the Latrobe Valley Shire is a low SES community.

**Whether modelled oxides of nitrogen emissions from the DGDP would adversely affect any beneficial use of the environment (by reference to the definition of beneficial use in the EP Act and the list of beneficial uses in Clause 9 of the SEPP (AQM))**

- 81 The beneficial uses of the air environment to be protected through the SEPP (AQM) are:
- (a) Life, health and well-being of humans;
  - (b) Life, health and well-being of other forms of life, including the protection of ecosystems and biodiversity;
  - (c) Local amenity and aesthetic enjoyment;
  - (d) Visibility
  - (e) The useful life and aesthetic appearance of buildings, structures, property and materials, and
  - (f) Climate systems that are consistent with human development, the life, health and well-being of humans, and the protection of ecosystems and biodiversity.
- 82 With respect to oxides of nitrogen the key pollutant of concern is NO<sub>2</sub> which is known to impact on human health. Therefore, the key beneficial use to be protected is the life, health and well-being of humans.
- 83 The modelling undertaken by HRL Technology as part of the Works Approval Application and further work commissioned by the EPA (CMM Report

(January) ; CAMM Report (February); CAMM Report (August)) has shown that the predicted ground level concentrations of NO<sub>2</sub>, the oxide of nitrogen of concern with respect to human health, all meet the design criterion in SEPP (AQM).

- 84 Recent modelling conducted by Dr Ross to assess the impact of the 300MW plant against both the design criteria and the SEPP (AAQ) standards showed that both set of standards are easily met and that the emissions of NO<sub>2</sub> from the DGDP contribute a very small amount to the predicted ground level concentrations (CAMM Report (August)).
- 85 Given that health effects may be observed at very low levels, there may be a impact on human health in the exposed community. However, it is not possible to have a situation whereby there are no health effects related to these pollutants as this would mean zero emissions from all sources. The policy framework has been established to set an acceptable level of risk within the air quality objectives. This has been agreed that through consultative processes with all stakeholders in the establishment of the SEPPs.

## Potential Impacts of Particles

### The health risks associated with fine particles (PM<sub>2.5</sub>) and ultra-fine particles (PM<sub>0.1</sub>)

- 86 Unlike the other criteria pollutants, particles are a broad class of chemically and physically diverse substances. They exist as discrete particles spanning several orders of magnitude in size, 0.005 to 100µm. They are emitted from a wide range of sources including natural sources such as dusts and pollens. The biological effects of particles are determined by
- (a) the physical and chemical nature of the particles
  - (b) the physics of deposition and distribution in the respiratory tract
  - (c) the physiological events that occur in response to the presence of the particle.
- 87 In recent years a significant amount of research has focussed on the health effects of particles and an increasing body of literature reports associations between particles and adverse health effects.
- 88 In summary, particles (mainly PM<sub>10</sub> and PM<sub>2.5</sub>) have been associated with increases in mortality (mainly cardiovascular causes), increases in hospital admissions and emergency department attendances (both respiratory and cardiovascular causes), exacerbation of asthma and symptoms of existing respiratory and cardiovascular disease, reduction in lung function and low birth weights in retarded intrauterine growth in fetuses.
- 89 The effects are both acute and long-term (chronic). Exposure to particles is linked a significant number of years of life lost due to long-term exposures.
- 90 Studies investigating the health effects of ultrafine particles are limited in number and show conflicting results. Some studies have found greater effects with ultrafine particles than PM<sub>2.5</sub> or PM<sub>10</sub> while others show no difference in the observed effects.

- 91 The lack of evidence at this time as to the independent effect of ultrafine particles over PM<sub>2.5</sub> has led the USEPA and WHO to conclude that the existing evidence is inconclusive of an independent effect and is insufficient to establish air quality standards at this time.

**The levels of fine particulates (PM<sub>2.5</sub>) and ultrafine particles (PM<sub>0.1</sub>) that pose a public health risk**

- 92 The SEPP (AAQ) establishes the following standards for PM<sub>10</sub> and PM<sub>2.5</sub>:
- (a) PM<sub>10</sub> 50 µg/m<sup>3</sup> averaged over a 24 hour period;
  - (b) PM<sub>2.5</sub> 25 µg/m<sup>3</sup> averaged over a 24 hour period and 8 µg/m<sup>3</sup> averaged over a one year period.
- 93 The PM<sub>2.5</sub> standards are the most stringent in the world.
- 94 As discussed in paragraphs 21 and 22 above these standards in the SEPP (AAQ) apply to regional air quality and not to individual sources. All sources, stationary and diffuse, within a region must be managed so that their cumulative impact does not exceed these standards.
- 95 The design criteria for individual pollutants are more stringent than the ambient air quality standards in the SEPP (AAQ) to enable multiple sources to exist within the airshed without leading to exceedances in the regional air quality standards.
- 96 The design criteria for PM<sub>10</sub> and PM<sub>2.5</sub> in Schedule A of the SEPP (AQM) are 80µg/m<sup>3</sup> and 50 µg/m<sup>3</sup> 1 hour average respectively.
- 97 However, as with SO<sub>2</sub>, there are potential health risks below these levels. As previously discussed in paragraphs 25 and 26 above, the Latrobe Valley Shire is a low SES community. In addition to the vulnerable groups discussed in paragraph 72 above, recent studies have shown that people who have a low socioeconomic status (**SES**) form a group within the population that is particularly vulnerable to effects of air pollution.
- 98 The modelling conducted by HRL Technology as part of the Works Approval Application indicates that the predicted ground level concentrations easily meet both the design criteria (although this only takes into account existing industrial sources in the Latrobe Valley and not other sources, such as planned burning).
- 99 Modelling undertaken by Dr Ross confirms that the emissions from the industrial sources in the Latrobe Valley meet the design criteria and ambient air quality standards for PM<sub>2.5</sub> and PM<sub>10</sub> (CAMM Report (January); CAMM Report (February); CAMM Report (August)) and that the Dual Gas Demonstration Plant does not significantly contribute to the predicted levels of PM<sub>10</sub> and PM<sub>2.5</sub>.
- 100 Whilst EPA monitoring of PM<sub>10</sub> in the Latrobe Valley shows that there are exceedances of the standards each year, these exceedances are due to smoke from planned burning and bushfires as well as burning on private land. The DGDP will not add to these exceedances.

I declare that I have made all the inquiries that I believe are desirable and appropriate and that no matters of significance which I regard as relevant have to my knowledge been withheld from the Tribunal.

A handwritten signature in cursive script, appearing to read "L. J. Denison", written over a dotted horizontal line.

Dr Lynette Denison

Date: 13/10/11

# SCHEDULE 1

## Requirements under Practice Note No 2: Expert Evidence

- 1 This report is prepared by Dr Lynette Denison, 200 Victoria Street, Carlton, Victoria.
- 2 I have the following qualifications:
- (a) Bachelor of Science (Honours), University of Melbourne
  - (b) Ph.D. Chemistry, University of Melbourne
- 3 I am currently employed by the EPA as Principal Scientist – Air Quality. This role is a science policy position within the EPA.
- 4 My area of expertise is in air pollution and related health effects.
- 5 My experience includes:
- (a) I have been involved in the development of several State and National policies for air quality including the review of the State Environment Protection Policy (Air Quality Management) in 2001.
  - (b) I have represented Victoria in a number of national working groups through the National Environment Protection Council (**NEPC**) including the development of the National Environment Protection Measure [NEPM] (Ambient Air Quality), the variation to the NEPM to include standards for PM<sub>2.5</sub> and the current review of that NEPM, the development of the NEPM for Air Toxics, the Risk Assessment Taskforce and Risk Assessment Working Group (which I Chaired) and several other projects relating to air pollution and health.
  - (c) I also chaired the NEPC working group to develop a methodology to prioritise air toxics in Australia and was a member of the Environment Protection and Heritage Council (**EPHC**) working group developing a methodology for the setting of air quality standards in Australia.
  - (d) I have also been involved in a number of international projects on environmental issues primarily relating to risk assessment, air quality and health and the development of air quality policy and standards in these countries. I presented a course on Environmental Health Risk Assessment on behalf of the World Health Organisation to the Ministry of Health in Mozambique.
  - (e) I have been involved in a number of epidemiological studies investigating the impact of air pollution on health in both Victoria and nationally.
- 6 My expertise to make this report is I have 16 years experience working in the field of air quality and health and in the development of policies at both the State and National level for air quality. During that time I have attended several international conferences on air quality and health and have been actively involved in research in this area. I have been an invited speaker at several of these conferences. I am a member of the International Society for Environmental Epidemiology and the Clean Air Society of Australia and New Zealand.

- 7 The instructions that define the scope of my report are set out in paragraph 7 of this report.
- 8 The facts, matters and assumptions on which this report is based are:
- (a) The information provided in the Works Approval Application and subsequent information provided in response to the Section 22 notices, information contained in the CAMM reports commissioned by EPA, National Pollutant Inventory data for the 2009/2010 reporting year, International reviews of the health effects of SO<sub>2</sub>, NO<sub>2</sub> and particles conducted by WHO (2006), USEPA (2008, 2009 and NEC, 2010).
  - (b) My understanding of the policy framework in Australia and Victoria for air quality. This is based on my involvement in the development of the SEPP (AAQ) and SEPP (AQM) and subsequent implementation of these policies as well as my involvement in the development of the AAQ NEPM and subsequent reviews.
- 9 I have been instructed to consider the documents and other materials listed below in preparing this report:
- (a) VCAT Practice Note 2 – Expert Evidence;
  - (b) Works Approval Application for the Dual Gas Demonstration Project dated 1 September 2010
  - (c) Response from the Department of Health to the Works Approval Application dated 28/9/10 and 29/4/11
  - (d) External Review of Air Quality Modelling Assessment conducted by HRL, CAMM Report 55/10, January 2011
  - (e) External Review of Air Quality Modelling Assessment conducted by HRL, Additional Results, CAMM Report 1/11, February 2011
  - (f) External Review of Air Quality Modelling Assessment conducted by HRL, Further Results, CAMM Report 9/11, August 2011
  - (g) EPA Assessment Report for the Works Approval Application for the Dual Gas Demonstration Project
  - (h) Doctors for the Environment VCAT application (P1818/2011)
- 10 I have used the literature and other material listed below in preparing this report:
- (a) WHO Air Quality Guidelines, Global Update (2006)
  - (b) USEPA (2008), Integrated Scientific Assessment, Oxides of Nitrogen
  - (c) USEPA (2008), Integrated Scientific Assessment, Sulfur Dioxide
  - (d) USEPA (2009), Integrated Scientific Assessment, Particulate Matter
  - (e) All documents listed in paragraph 9 above.
  - (f) State Environment Protection Policy (Air Quality Management) 2001
  - (g) State Environment Protection Policy (Ambient Air Quality) 2001
  - (h) Ambient Air Quality NEPM 1998

- (i) Ambient Air Quality NEPM Review, Discussion Paper Air Quality Standards, 2010
- (j) Ambient Air Quality NEPM, Review Report, October 2011, Report to NEPC.
- (k) National Pollutant Inventory data for the 2009/2010 reporting year, Department of Sustainability Environment, Water Population and Communities

11 A summary of my opinions is contained in paragraphs 8, 9 and 10 of this report.

12 This report is complete and, to the best of my knowledge and endeavours, is accurate.

