Alinta Cogeneration (Wagerup) Pty Ltd

Alinta Wagerup Units 1 – 2

STACK EMISSIONS MANAGEMENT PLAN

- WP03100-EV-PL-0006
- Rev 1
- October 2006

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1. Background

1.1 Introduction

Alinta Cogeneration (Wagerup) Pty Ltd (Alinta) proposes to develop two cogeneration units on the Alcoa World Alumina Australia (Alcoa) Wagerup Refinery site as part of its plan to continue delivering clean, reliable and competitively priced electricity to customers on the South West Interconnected System (SWIS). Each cogeneration unit is comprised of a gas turbine generator (GTG), which generates electricity, and a heat recovery steam generator (HRSG), which utilises hot exhaust gases from the GTG to produce high-pressure steam. By providing electricity to customers throughout the South West, as well as supplying steam for refinery purposes, cogeneration is an efficient use of a single fuel source.

In order to accommodate the timing of varying demands for the Alinta project, staged development of these facilities is required. Stage One of the development will involve the construction and operation of the GTGs for open-cycle peaking duty, producing electricity but not steam. Stage Two of the development will involve the construction of the HRSGs.

The timing of Stage One development is driven by Alinta's commitment to provide reserve capacity to the SWIS for the summer peak power demand period. This reserve capacity will ensure that an appropriate level of system security and reliability is maintained.

Stage Two of the development will meet Alcoa's increased steam demands should the Alcoa Wagerup Refinery expansion proceed. However, should the refinery expansion not proceed the cogeneration project will progress when required to meet base-load demand from contestable customers on the SWIS. As the Alcoa Wagerup Refinery has a finite demand for steam, under this scenario the steam supplied from the Alinta cogeneration facility will replace steam currently provided by Alcoa's existing boilers.

A transition phase will be required between Stage One and Stage Two operation. During this phase the operating hours of the GTGs will increase as the HRSGs and other Stage Two equipment is being designed, built and commissioned, but no steam will be produced.

As a part of the Project environmental impact assessment process, an air quality modelling assessment has been performed. The air quality modelling assessment has been documented in "Alinta Wagerup Cogeneration Project – Air Quality Assessment" (SKM 2006a) and "Alinta Wagerup Cogeneration Project – Air Quality Assessment: Supplementary Air Quality Modelling"(SKM 2006b) and summarised in the project Environmental Impact Statement (EIS) (SKM 2006c). Design emissions have been identified and assessed.

1.2 Purpose of Document

This Stack Emission Management Plan (SEMP) is provided in response to the Ministerial Conditions of approval for the Wagerup Cogeneration Project, which make specific reference to the need for the proponent to prepare a SEMP.

Condition 7 states the following:

> *7 Stack Emissions*
>
> *7-1 Prior to construction of the co-generation facility, the proponent shall prepare a Stack Emissions Management Plan, to:*
>
> - *ensure that best available practicable and efficient technologies are used to minimise total air emissions from the co-generation facility;*
>
> *to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.*
>
> *This Plan shall address:*
>
> *1) specific measures to minimise total air emissions from the co-generation facility to meet emission limits consistent with best practicable technology and current industry standards;*
>
> *2) stack testing during commissioning of both Stage 1 and Stage 2 to fully characterise all constituents listed in the plan, including minor emissions such as formaldehyde, acetaldehyde, toluene and benzene;*
>
> *3) on going monitoring of key air emissions identified in the stack testing required by point 2; and*
>
> *4) public reporting of air emissions and any complaints about air emissions.*

The contents of the remaining sections of this SEMP are as follows:

- **Section 2** provides objectives of the SEMP;
- **Section 3** lists relevant legislation;
- **Section 4** summarise emission sources and emissions of interest;
- **Section 5** discusses management of emissions;
- **Section 6** outlines the proposed stack emission testing program during both commissioning and operation; and
- **Section 7** outlines information required in a public monitoring report.

1.3 Limitations and Assumptions of Document

The detail in the SEMP is based on the requirements of the Ministerial Conditions of approval. Therefore, the following limitations should be noted:

- The monitoring of source emissions (i.e. stack emissions) is proposed. Ambient monitoring is not proposed on the basis that the predicted concentrations due to stack emissions are well within EPA guidelines. This is largely achieved by the proponent's use of technology consistent with EPA guidelines for low NO_x emissions turbines (EPA 2000).
- Similarly, the monitoring of fugitive emissions is not proposed.
- The frequency of monitoring proposed is done so on the prediction/expectation that the process and therefore emissions will be consistent or stable.
- Benchmarking of the process and emissions during the first year (12 months) of Stage Two operation is proposed. Should other significant changes be made to the proposal in future then consideration should be given to similar benchmarking activities at the completion of those works.

2. Objectives

The objectives of this management plan are to:

- Ensure that best available practicable and efficient technologies are used to minimise total air emissions from the co-generation facility;
- Ensure stack emissions from the co-generation facility are consistent with the assumptions and expectations detailed during the environmental impact assessment process; and
- Define the stack emission testing program to be undertaken during the commissioning and operation of the project.

In this context the following definitions apply:

- Commissioning refers to the period of time between start-up and full operation (including reliability and performance test runs). During the commissioning phase, the commissioning process will seek to demonstrate the proven performance of the installed project/works as compared to the design criteria and design intent specified for air quality outcomes.
- Operation refers to the period of time following the completion of the commissioning process in which the plant is in full operation.

3. Relevant Legislation

The following legislation, regulations and documents are applicable to the project:

- *Environmental Protection Act 1986;*
- *Environmental Protection Act Regulations 1987;*
- *National Environment Protection (Ambient Air Quality) Measure (Air NEPM);*
- *National Environment Protection (Air Toxics) Measure (Air Toxics NEPM); and*
- *Occupational Health and Safety Act 1984.*

The following reference documents are also applicable to the project:

- *Stationary Source Emissions – Method 1: Selection of Sampling Positions, Australian Standard AS 4323.1; and*
- *USEPA Test Method and Performance Specifications (various).*

4. Air quality emissions of interest

4.1 Emission Sources

Best available practicable and efficient technologies have been adopted within the project to ensure that air emissions are minimised.

The power generator of choice in this project, a dry low-NO_x combustion gas turbine, is generally a low emitter of exhaust pollutants particularly when compared to coal fired and oil fired power generation.

The Wagerup Cogeneration Project consists of two stages of development. Stage One will involve the construction and operation of the GTGs for open-cycle peaking duty, producing electricity but not steam. Stage Two of the development will involve the installation of Heat Recovery Steam Generators (HRSGs).

Estimated NO_x emission concentrations from Stage One and Stage Two are 30 and 42 ppmvd (at 15% O_2 as NO_2), respectively. These emissions levels are consistent with EPA guidance on maximum NO_x from gas turbines of 34 ppm (power station >10MW) (EPA, 2000). Higher emissions concentrations for the cogeneration plant with one unit fired are the result of duct firing to maintain steam production and do not reflect higher emissions from the gas turbine.

Stage One and Stage Two stack locations are shown in **Figure 1** and detailed in **Table 1**.

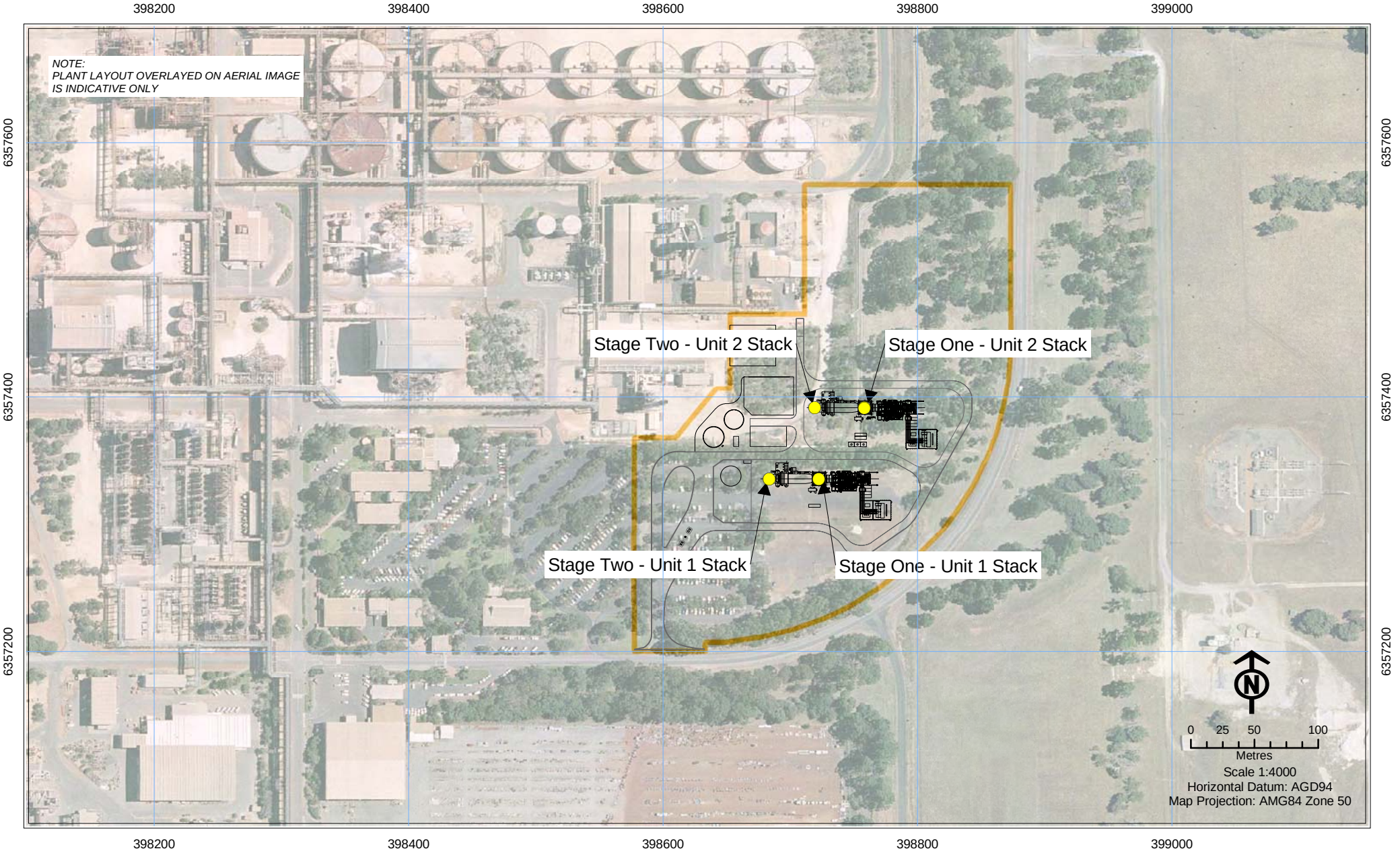
Table 1 List of stacks and location

Stack	Location (Easting, Northing)[1]
Stage One - Unit 1 stack	(398742, 6357332)
Stage One - Unit 2 stack	(398770, 6357386)
Stage Two - Unit 1 stack	(398742, 6357332)
Stage Two - Unit 2 stack	(398770, 6357386)

Note: 1) AMG, zone 50

Following the installation of Heat Recovery Steam Generators (HRSGs) in Stage Two, Alinta will be able to provide steam to Alcoa while selling base-load power to contestable customers on the SWIS. This is one of the most efficient, clean and reliable ways of making electricity. In essence, the benefit of cogeneration is that with one fuel input there are two outputs: electricity and steam. This results in high overall thermal efficiencies and comparatively low greenhouse emissions intensities attributable to electricity generation.

The main fuel to the gas turbines will be natural gas. Ultra-low sulphur content diesel will be used to ensure reliability of supply with maximum operation of 100 hours per unit per calendar year.



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Alinta Boundary

Wagerup Cogeneration Project
Stack Locations

Figure 1

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4.2 Emissions of Interest

The following "criteria pollutants" have been identified as being relevant to the operation of the cogeneration units (SKM 2006a):

- oxides of nitrogen (NO_X);
- carbon monoxide (CO);
- sulphur dioxide (SO_2); and
- particulate matter less than 10 μm in diameter(PM_{10}).

The key parameters relevant for ongoing monitoring are considered to be NO_x and CO.

Based on natural gas being the prime fuel source, and the minimal and intermittent use of ultra-low sulphur content diesel, the emission of SO_x and PM_{10} are expected to be very low. Monitoring of these two parameters will be undertaken initially to verify this expectation.

Other parameters of relevance to the operation of the cogeneration units are the minor emission of volatile organic compounds (VOCs), specifically:

- Aldehydes - acetaldehyde and formaldehyde; and
- Aromatic hydrocarbons - benzene, toluene and xylene.

Based on USEPA AP-42 emission factors, aldehyde and aromatic hydrocarbon emissions from gas turbines are estimated to be low. In addition, the health risk attributed to VOC emissions from the cogeneration plant assessed in the ERMP Response to Public Submissions (Alcoa, 2005) only accounts for an average 0.02% and 1.74% of the total acute hazard and chronic hazard respectively (averaged across 16 receptors).

The monitoring of these VOCs will be undertaken initially to verify this expectation.

5. Management of Emissions

5.1 Management Tasks

Specific measures adopted within the design and development of the project, to ensure that emissions are acceptable, are detailed in **Table 2**.

Table 2 Stack Emission Management Tasks

Ref	Task	Timing	Delegated Responsibility
Design Management			
SEMP 1.	Minimise NO_x emission from gas turbine combustion by using dry low NO_x burners.	Design	Design Manager
SEMP 2.	Design combustors to minimise generation of CO and particulate emissions.	Design	Design Manager
Operation Management			
SEMP 3.	Ensure the gas turbines and emissions controls are properly maintained and kept in good condition throughout operations.	Operation	Plant Manager
SEMP 4.	Manage burner conditions through temperature monitoring.	Operation	Plant Manager
SEMP 5	Minimise SO_x and particulate emissions by using natural gas as a main fuel with ultra-low sulphur content diesel as back up to ensure reliability of supply (with maximum operation using diesel to be limited to 100 hours per unit per calendar year).	Operation	Plant Manager
SEMP 6	Review the SEMP annually to ensure the plan/monitoring program is appropriate	Operation	Plant Manager
Commissioning and Operation Monitoring			
SEMP 7	Record operational data related to air pollutant emissions: ▪ Quarterly and annual quantity of fuel used; ▪ Quarterly and annual hours of operation; ▪ Quarterly total sulphur content of ultra-low S distillate; and Date and time of each occurrence, duration, and type of upset conditions which may effect stack emissions from the plant, in addition to date and time of any start up and shutdown.	Commissioning and Operation	Construction Manager and Plant Manager
SEMP 8	Equip the gas turbine exhaust stacks with permanent provisions to allow periodic collection of stack gas samples consistent with Australian Standards.	Commissioning and Operation	Construction Manager and Plant Manager
SEMP 9	Conduct stack testing during commissioning and operation periods as detailed in **Table 3** and **Table 4**.	Commissioning and Operation	Construction Manager and Plant Manager

Ref	Task	Timing	Delegated Responsibility
SEMP 10	Establish a complaints register and complaints procedure as appropriate. Details of 'who', 'what', 'when' and 'where' associated with a complaint, along with information on the action taken and response to the complaint (including feedback to the complainant) are to be reported.	Commissioning	Construction Manager
SEMP 11	Provide public reporting of air emissions and complaints (details in **Section 7)**.	Commissioning and Operation	Construction Manager and Plant Manager

6. Stack Emission Monitoring Program

The proposed Stack Emission Monitoring program is based on the requirements specified in the Ministerial Conditions (Condition 7) as mentioned in **Section 1.2**.

A phased approach to the monitoring regime is proposed on the basis that:

- During the commissioning phases of both Stage One and Stage Two it is necessary to verify the validity of the emission predictions established during the environmental impact assessment process.
- During operation in Stage One ongoing stack testing is impracticable given that the plant will be servicing occasional peak load demands. During this time, notice in advance of operation will be less than 24 hours and the duration of operation cannot be guaranteed.
- During the first year (12 months) of Stage Two operation it is necessary to verify that emission predictions and estimates have been achieved during normal operating conditions. The intent is to confirm via monitoring those parameters considered to be negligible through modelling and emission estimation. In addition, this will provide the opportunity to confirm the parameters that will require ongoing sampling and the frequency of their sampling, and to establish a benchmark for the ongoing comparison of emission sampling results.
- During ongoing operation in Stage Two (beyond the first 12 months) it will necessary to periodically verify that the emissions continue to meet benchmarked expectations.

The frequency of monitoring proposed is therefore:

- At least once during the commissioning period for Stage One and Stage Two. The sampling should be carried out during reliability and performance test run after competition of commissioning and prior to commercial operation;
- Quarterly sampling during the first 12 months of Stage Two operation; and
- Quarterly or Annual sampling during subsequent years of Stage Two operation (subject to the results obtained during the first year of Stage Two operation).

The proposed monitoring regimes during Stage One and Stage Two are detailed in **Table 3** and **Table 4** respectively.

Table 3 Stack monitoring program for Stage One

Phase	Parameter	Location	Frequency
Commissioning	NO_x (as NO_2) CO SO_x (as SO_2) PM_{10} Total VOC Acetaldehyde Formaldehyde Benzene Toluene Xylene Stack gas velocity, flow rate and temperature	Exhausts	At least once

Table 4 Stack monitoring program for Stage Two

Phase	Parameter	Location	Frequency
Commissioning	NO_x (as NO_2) CO SO_x (as SO_2) PM_{10} Total VOC Acetaldehyde Formaldehyde Benzene Toluene Xylene Stack gas velocity, flow rate and temperature	Exhausts	At least once
First 12 months	Same as commissioning	Exhausts	Quarterly
Post-first year operation	NO_x (as NO_2) CO Stack gas velocity, flow rate and temperature	Exhausts	Quarterly or Annual

Note: The proposed parameters to be monitored after the first year of operation are subject to the results of monitoring conducted during the first year of operation.

It is recommended that stack testing methods comply with USEPA Methods or DEC approved equivalents. Stack testing should only be undertaken by suitably qualified individuals and companies accredited for undertaking the test methods to be used.

Preferred test methods are shown in **Table 5**. The actual method used will be determined in conjunction with the stack testing company.

Table 5 Recommended methods for stack testing

Parameter	Test Method*
NO_x (as NO_2)	USEPA Method 20
SO_x (as SO_2)	USEPA Method 20
CO	USEPA Method 10B
PM_{10}	USEPA Method 201A
Formaldehyde Acetaldehyde	USEPA Method 0011
Total VOC Benzene Toluene Xylene	USEPA Method 18

7. Reporting

The Plant Manager/Environmental Manager will prepare an annual report detailing air emissions testing and any complaints about air emissions. The report will contain all pertinent data concerning the SEMP including (but not necessarily limited to):

Source description including:

- Operating data (production rate, fuel type and sulphur content, and fuel consumption);
- Start-up, shutdown or plant upset conditions along with the resulting mass emission during these periods; and
- Plant layout and location of emission discharge points.

Sampling and analytical methodologies including:

- Location, time and date of all tests, including a declaration by those undertaking the emissions testing that appropriate qualifications and accreditations are in place;
- Dimension sketch showing all sampling ports in relation to breeching and to upstream and downstream disturbances or obstruction of gas flow;
- Sketch of cross-sectional view of stack indicating transverse point locations and exact stack dimensions; and
- Sampling and analytical methods and applicable standard method references.

Test results and discussion including:

- Detailed tabulation of results including process operating conditions and flue gas conditions;
- Discussion of significance of results relative to operating parameters and emission regulations or design criteria;
- Discussion of any variations from normal sampling procedures or operating conditions which could have affected the results; and
- Description of any major maintenance performed on the air pollution control device(s) during the last period.

Complaints about air emissions including:

- Date and time of complaints;
- Outcomes of any investigations conducted in response to complaints; and
- Management action and response(s) to the complaints.

8. References

Alcoa World Alumina Australia (2005). *Wagerup Refinery Unit Three Environmental Review and Management Program – Response to Public Submissions*.

Australian Standards. *Stationary Source Emissions – Method 1: Selection of Sampling Positions"*, Australian Standard AS 4323.1.

Environmental Protection Authority (EPA) (2000). *Guidance Statement for Emissions of Oxides of Nitrogen from Gas Turbines,* Guidance for the Assessment of Environmental Factors No. 15, Perth, Western Australia, May 2000.

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