

Prepared for:

Transpacific Refiners Pty Ltd
11 Kyle Street, Rutherford, NSW



Operational Air and Noise Validation Report, Transpacific Refiners 11 Kyle Street, Rutherford, NSW

ENSR Australia Pty Ltd (ENSR)

10 December 2008

Document No.: N4079505_RPT_10Dec08.doc

Distribution

Operational Air and Noise Validation Report, Transpacific Refiners
11 Kyle Street, Rutherford, NSW

10 December 2008

Copies	Recipient	Copies	Recipient
1	Mr Ken Telfer Environmental Specialist NSW Transpacific Industries Pty LTD 11 Kyle Street Rutherford NSW 2320	1	ENSR File Copy

© ENSR Australia Pty Ltd (ENSR)

- * This document was prepared for the sole use of the party identified on the cover sheet, and that party is the only intended beneficiary of ENSR Australia Pty Ltd (ENSR) work.
- * No other party should rely on the document without the prior written consent of ENSR, and ENSR undertakes no duty to, nor accepts any responsibility to, any third party who may rely upon this document.
- * All rights reserved. No section or element of this document may be removed from this document, extracted, reproduced, electronically stored or transmitted in any form without the prior written permission of ENSR

By

ENSR Australia Pty Ltd (ENSR)

ABN: 34 060 204 702

17 Warabrook Boulevard Warabrook NSW 2304

PO Box 73 Hunter Region MC NSW 2310


Ph: +61 2 4911 4900 Fax: +61 2 4911 4999

for: 
Ross Thompson
 Project Environmental Scientist


David Rollings
 Associate Chemical Engineer

Technical Peer Reviewer:

Date:

	11/12/08
Graham Taylor Senior Principal / National Air Quality Service Line Leader	

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Operational Air and Noise Validation Report,

December 2008

Transpacific Refiners

N4079505_RPT_10Dec08.doc

Commercial in Confidence

"This page has been left blank intentionally"

Contents

1.0	INTRODUCTION	1
1.1	Applicable Guidelines	2
1.2	ENSR Experience and Qualifications	2
2.0	PROCESS DESCRIPTION.....	3
3.0	AIR QUALITY IMPACT ASSESSMENT.....	5
3.1	Impact Assessment Background	5
3.2	Methodology	5
3.2.1	Dispersion Modelling	5
3.2.2	Model Inputs	6
3.2.3	Meteorology.....	6
3.2.4	Terrain Effects	7
3.2.5	Building Wake Effects.....	7
3.2.6	Modelling Scenarios	8
3.2.7	Source Characteristics	8
3.2.8	Emissions Inventory	10
3.3	Assessment Criteria	12
3.4	Existing Environment.....	13
3.5	Sensitive Receptors.....	14
3.6	Modelling Results	15
3.7	Assessment of Impacts.....	19
3.8	Source Emissions Monitoring Program.....	22
4.0	NOISE COMPLIANCE DATA REVIEW.....	24
5.0	AIR AND NOISE ASSESSMENT CONCLUSIONS.....	29
6.0	REFERENCES	31

List of Tables

Body Report

Table 1: Summary of CALPUFF Input Parameters	6
Table 2: Source Characteristics	9
Table 3: Relevant Air Quality Impact Assessment Criteria.....	13
Table 4: Summary Data of Ambient Air Monitoring Station	14
Table 5: Sensitive Receptor Locations.....	14
Table 6: Dispersion Modelling Results –Oxides of Nitrogen and Sulphur Dioxide ($\mu\text{g}/\text{m}^3$).....	16
Table 7: Dispersion Modelling Results - TSP, PM_{10} and Carbon Monoxide ($\mu\text{g}/\text{m}^3$)	17
Table 8: Dispersion Modelling Results for Total VOC's, PAH's, H_2S , and H_2SO_4 ($\mu\text{g}/\text{m}^3$)	18
Table 9: Recommended Future Emissions Source Monitoring Program.....	22
Table 10: Acoustic Monitoring Results – TPR Refinery Boundary Fence.....	24
Table 11: Acoustic Monitoring Results – Remote Receptors	25

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

List of Figures

Figures Section

- Figure 1: Site Location and Sensitive Receptor Location
- Figure 2: Site Plan
- Figure 3: Plant Flow Diagram
- Figure 4: CALMET Windrose – Original Air Impact Assessment
- Figure 5: 2004 Windrose – Meteorological Station 8 km west
- Figure 6: CALMET Mixing Heights
- Figure 7: 1 Hour Average Oxides of Nitrogen Isopleth
- Figure 8: Annual Average Oxides of Nitrogen Isopleth
- Figure 9: 1 Hour Average Sulphur Dioxide Isopleth
- Figure 10: 24 Hour Average Sulphur Dioxide Isopleth
- Figure 11: Annual Average Sulphur Dioxide Isopleth
- Figure 12: Annual Average TSP Isopleth
- Figure 13: 24 Hour Average PM₁₀ Isopleth
- Figure 14: Annual Average PM₁₀ Isopleth
- Figure 15: 1 Hour Average Carbon Monoxide Isopleth
- Figure 16: 8 Hour Average Carbon Monoxide Isopleth
- Figure 17: 1 Hour Average Total VOCs Isopleth
- Figure 18: 1 Hour Average Benzene Isopleth
- Figure 19: 1 Hour Average PAH Isopleth
- Figure 20: 1 Hour Average H₂SO₄ Isopleth
- Figure 21: 1 Hour Average H₂S 99th Percentile Isopleth

List of Appendices

- Appendix A CALPUFF Input Files
- Appendix B BPIP Output File
- Appendix C Emissions Inventory
- Appendix D Stack Emission Reports

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

1.0 Introduction

ENSR Australia Pty Limited (ENSR) was commissioned by Transpacific Refiners (TPR) to perform a Post Commissioning Air and Noise Validation Report of the operations at the Oil Refinery (OR) plant Rutherford, NSW (refer **Figure 1**).

This report is based on the identified requirements outlined by Department of Environment and Climate Change (DECC) as communicated to TPR in Environmental Protection License (EPL) 12555 Condition U1 as follows:

- *Be prepared by a suitably qualified and experienced person(s) (refer Section 1.2);*
- *Assess whether the facility is complying with the noise criteria specified in condition L6 of this licence (refer Section 4);*
- *Identify what additional measures could be implemented to ensure compliance with the noise limits should non-compliances be identified (refer Section 4);*
- *Include a revised Air Quality Impact Assessment of air quality impacts from the project 'as constructed' that is consistent with the limits in the project approval, and includes actual measured emissions (Section 3 contains all Air Quality Impact Assessment information with specific source emissions data contained within Section 3.2.7, Section 3.2.8 and Appendix D);*
- *Confirm conclusions made in the documents (refer Sections 3.1 and 3.7 for discussion and comparison of ENSR Assessment of Impacts against PAE predicted impacts):*
 - *"Air Quality Impact Assessment – Hydrogenation Plant (Rutherford, NSW" prepared by Transpacific Industries Pty Ltd and dated 2 May 2006; and*
 - *"Report Air Impact Assessment Alternate Hydrogenation Plant (Rutherford NSW)" prepared by Pacific Air and Environment and dated 7 July 2006;*
 - *and any subsequent air quality impact assessment prepared for the facility 'as constructed'.*
- *Include a complete source emissions monitoring program for the facility to validate compliance with the Protection of the Environment Operations (Clean Air) Amendment (Industrial and Commercial Activities and Plant) Regulation 2005 ("the Regulation") and to validate the emissions inventory contained within the document "Air Quality Impact Assessment – Hydrogenation Plant (Rutherford NSW)" prepared by Transpacific Industries Pty Ltd and dated 2 May 2006 or any subsequent emissions inventory prepared for the facility 'as constructed'. A copy of the results and recommendations of the source emissions monitoring program must be included in the Report (refer Section 3.2.8 (Emissions Inventory) for summary of emissions results for 2008 and Section 3.8 for recommended sampling program for 2009).*
- *Identify what additional measures could be implemented to ensure compliance with the Regulation and licence conditions should any non-compliance be detected (refer Section 3.7 for details of mitigation program already underway); and*
- *Provide details of any complaints received relating to air quality generated by the project and action taken to respond to those complaints (refer Section 3.7).*

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

One scenario was examined to determine compliance with Condition U1. This scenario assumes the facility under current load conditions.

1.1 Applicable Guidelines

The air quality impact assessment criteria referenced in this report were sourced from the following documents:

- Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (NSW DECC, 2005).
- Industrial Noise Policy, (NSW EPA, 2000)

1.2 ENSR Experience and Qualifications

Originally established in 1973, HLA-Envirosciences Pty Limited merged with ENSR in June 2007. ENSR Australia Pty Ltd (ENSR) is the Australian arm of ENSR, a leading worldwide environmental firm, serving industrial clients and government agencies with 2,500 employees from 90 global offices. ENSR serves clients from nine locations throughout Australia, providing comprehensive consulting, engineering, remediation, environmental, health and safety (EHS) management solutions. ENSR is the recipient of numerous industry, client EHS, business achievement and organizational innovation awards. ENSR is part of the AECOM family of companies.

AECOM (NYSE: ACM) is a global provider of professional technical and management support services to a broad range of markets, including transportation, facilities, environmental and energy. With more than 31,000 employees around the world, AECOM is a leader in all of the key markets that it serves. AECOM provides a blend of global reach, local knowledge, innovation and technical excellence in delivering solutions that enhance and sustain the world's built, natural and social environments. AECOM serves clients in more than 60 countries and had revenue of more than \$4 billion for the 12-month period ended June 30, 2007.

ENSR's air quality service line has over 10 years' experience in Australia with atmospheric dispersion modelling and air quality impact assessment for a range of industrial situations. In addition to the dispersion modelling aspects of the impact assessments, ENSR also manages the collection of data from a variety of sources necessary for completing assessments to regulatory authority standards.

ENSR has performed dispersion modelling for a variety of clients including the BHP Billiton Olympic Dam Copper and Uranium Mine Feasibility Study and EIS in South Australia. ENSR has also completed projects for Onesteel, Unomedical (a recent high profile impact assessment for a medical steriliser in Mona Vale), a variety of mine sites in the Hunter Valley and various other industrial impact assessments which has gives ENSR a sound working knowledge of Australian environmental legislation

2.0 Process Description

TPR operates an Oil Refinery which, whilst being the first plant of its kind in Australia for processing recycled lubricant base oils (RLBOs), the technology is well established in the petrochemical and food manufacturing industries. The RLBO feedstock for refining is sourced from recovered used oils that have undergone preliminary offsite treatment by oil recyclers to remove water and other impurities. The facility is designed to process RLBO at a typical rate of 3.8 tonnes per hour. The RLBO feedstock has a sulfur content of 0.75%, with the final product having a sulfur content of 0.06%.

Broadly speaking, the refining process involves hydrogenation of the feedstock i.e. the addition of hydrogen to unsaturated hydrocarbon molecules. Hydrogenation is performed by contacting the RLBO feed with a catalyst (identified as C12-4-02, C49-1, G72D, FFS MBI or C11-9-02) where the RLBO's carbon bonds are saturated with hydrogen at elevated temperature and pressure (350 - 450°C and 25 bar) resulting in stable saturated hydrocarbons.

The aim of the hydrogenation process is to improve the oils colour and remove trace impurities (such as nitrogen, sulfur and metals) from the RLBO feedstock. Products of the process include light end gases (recovered and used as fuel), light end liquids (recovered for use as industrial solvents), water (recovered for treatment) and refinery-grade lube base oil. Approximately 90% of the feedstock oil is recovered for re-sale into the lube base oil market.

From an air quality perspective, the process can be divided into the following process areas for discussion:

- Hydrogen Reformer Burner.
- Steam Generation Facility.
- Hydrogenation Process.
- Startup and shutdown emissions.
- Sour water, feed and product storage emission control.

Hydrogen (which is required for the hydrogenation process) is produced in the Hydrogen Reformer Burner (HRB). The HRB is situated in the northwest corner of the plant adjacent to the steam boilers and consist of a natural gas reforming unit which feeds hydrogen through to the main plant. All air emissions produced by the HRB are emitted through the HRB stack (DECC Point 20). Emissions from this stack are expected to consist of non-odorous products of combustion and reforming byproducts e.g. NO_x, CO, CO₂ etc. Due to the temperature of the stack (estimated at 900°C), no odorous emissions were expected from this source.

Steam required for the HRB process is generated by two natural gas boilers (with capacities of 3.0 MW and 0.2 MW) which produce steam as required for the HRB. This method of steam supply removes the need for hydrogen storage and allows the TPR facility to have Hydrogen on demand. Pollutant emissions from the 3.0 MW and 0.2 MW boilers are expected to contain products of combustion and are discharged into the atmosphere through two exhaust stacks (DECC Point 2 and 3 respectively).

Prior to hydrogenation, a combined natural gas and process off-gas fired heater (FH) is used to increase the temperature of the RLBO to approximately 400°C. The off-gases produced from the hydrogenation process that are burnt in the FH are expected to consist of pollutants such as methane, ethane, propane and hydrogen sulfide (H₂S). As a consequence of the combustion of the process off-gases, significant amounts of sulfur dioxide (SO₂) and sulfur trioxide (SO₃) gases (known as SO_x gases) are expected to be emitted from the FH.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

The FH exhaust is captured and emitted through a wet SO_x scrubber system which promotes the conversion of the SO_x gas to soluble sodium salts. The soluble sodium salts are then removed in a liquid effluent stream and transferred to a sour water tank for disposal. The scrubbed gas stream passes through a demister and is then discharged through the FH stack (DECC Point 19) via an extraction fan. This source has the potential to generate odorous emissions if the scrubber is not operating effectively.

Once the oil is at an appropriate temperature (after the FH), the oil is contacted with the hydrogenation catalyst along with the hydrogen from the Hydrogen plant. Following the hydrogenation reaction, the RLBO is sent to a high and low pressure separator and a vacuum stripper after which it is sent to storage tanks for dispatch or further refining in the flashpoint correction column (if needed depending on the product). The off-gases produced prior to the flashpoint correction column and product storage are captured by a vacuum stripper and pumped back to the fired heater for combustion. Emissions from the Flashpoint correction column vacuum pump and the product storage tanks are vented through a light end scrubber (discussed further below)

The flare (DECC Point 4) operates during start-up and shut-down operations and during upset events (typically only operates for a duration of are between 2 and 4 hours until the process can be safely shut down and sealed). After the commissioning and testing period, the flare is expected to operate a maximum of once per month. The flare operates with a permanent natural gas pilot flame with a flow rate of 0.83 Nm³/h which was used in this assessment. The emissions from this source are expected to consist of low levels of products of combustion. As the typical process air emitted during startup consist of Hydrogen (process pipes are filled with hydrogen prior to startup to flush the pipes prior to startup), significant gaseous pollutant emissions during startup are not expected.

Volatile Organic Compound (VOC) emissions from light end liquid storage tanks occur as a result of both standing and working losses. Standing losses refers to the expulsion of vapour from a tank through vapour expansion and contraction, which are the results of changes in temperature and barometric pressure. This loss occurs without any liquid level change in the tank. The combined loss from filling and emptying is called working loss. The working losses are a result of an increase in the liquid level in the tank. As the liquid level increases, the pressure inside the tank exceeds the relief pressure and vapours are expelled from the tank. The working loss during emptying occurs when air drawn into the tank during liquid removal becomes saturated with organic vapour and expands, thus exceeding the capacity of the vapour space (USEPA, 1995a). Emissions from working loss are controlled by a Light End (LE) scrubber (DECC Point 5).

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

3.0 Air Quality Impact Assessment

An air quality impact assessment has been undertaken for the TPR OR “as built” and operating as of November 2008. Emission sources characteristics and emission concentrations have been listed in **Section 3.2.7** and **Section 3.2.8** respectively along with emission limits imposed by the process Environmental Protection Licence which in turn were sourced from project approvals. Air pollutant emission rates listed in **Section 3.2.8** have been sourced from actual measurements as shown in **Appendix D**, which includes excerpts of stack emissions reports for the facility.

3.1 Impact Assessment Background

The OR operated by TPR was originally assessed by Pacific Air and Environment as part of the Environmental Impact Assessment prepared in 2006. Two reports were prepared for the EIS as defined in dot point 5 of **Section 1**. Based on the expected emissions from the facility, the findings of the PAE reports were that no air pollutants would exceed the assessment criteria beyond the facility boundary. This assessment was based primarily on theoretical data as stack testing data on this type of plant was not available at the time of writing the PAE report.

Various recommendations were made by the PAE reports relating to air quality. The recommendations all related to post commissioning testing, further assessment and plant modification should exceedences be identified.

An assessment against these findings has been made along with the general assessment reported in **Section 3.7** of this report.

3.2 Methodology

3.2.1 Dispersion Modelling

The CALPUFF model was used to predict the Ground Level Concentrations (GLCs) for all parameters. CALPUFF was chosen to provide consistency with the original Environmental Assessment (EA) modelling. CALPUFF is a three dimensional Gaussian puff model developed by the US Environmental Protection Agency (EPA) for use in situations where the basic Gaussian plume models are not effective. Situations where Gaussian plume models typically do not work well are areas with complex meteorological or topographical conditions, such as coastal areas with re-circulating sea breezes.

The air dispersion modeling conducted for this assessment utilised The Air Pollution Model (TAPM) and CALMET/CALPUFF models. The CALMET and CALPUFF models substantially overcome the basic limitations of the steady-state Gaussian plume models. CALMET, the meteorological pre-processor for the dispersion model CALPUFF, calculates three-dimensional meteorological data based upon observed ground and upper level meteorological data, as well as modelled data generated by TAPM. CALPUFF then calculates the dispersion of plumes within this three-dimensional meteorological field.

Although the Rutherford area does not have very complex terrain close to the TPR facility the CALPUFF model is used in this modelling scenario to provide consistency with the original EA.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Input parameters used for the CALPUFF dispersion modelling is summarised in **Table 1**.

Table 1: Summary of CALPUFF Input Parameters

Parameter	Input
CALPUFF Version	Version 5.8 (US EPA approved version)
Modelling Domain	30 km x 30 km
CALPUFF Modelling Grid Resolution	0.25 km
Number of Receptors	22
Terrain Data	Incorporated into CALMET
Building Wake Data	Entered via BPIP
Dispersion Algorithm	PG (rural ISC curves) & MP Coeff. (Urban)
Hours Modelled	8760 hours (364 days)
Meteorological Data Period	Jan 2004 – Dec 2004

All dispersion modelling was undertaken in accordance with guidelines published by NSW Department of Environment and Climate Change (DECC, 2005a). The document prescribes calculation modes to account for terrain effects, building wake effects, horizontal and vertical dispersion curves, buoyancy effects, surface roughness, plume rise, wind speed categories and wind profile exponents.

3.2.2 Model Inputs

The CALPUFF model requires six main categories of data to determine the dispersion of pollutants:

- Meteorology.
- Terrain effects.
- Building wake effects.
- Modelling scenarios.
- Source characteristics.
- Emissions inventory.

The above inputs are addressed separately in the following sections. Modelling input files are contained in **Appendix A**.

3.2.3 Meteorology

No on-site weather data are available for 2004, however local conditions have been modelled by CALMET using files supplied by Pacific Air and Environment (PAE) from the Air Impact Assessment (July 2006). The meteorological outputs were compared to a privately run meteorological station located at Kurri Kurri, 8 km south from the TPR site.

Wind rose diagrams for the study site, taken from CALMET are shown in **Figure 4**. Note that the wind rose data are extracted from a model and therefore represent an estimate of the local conditions. The modelled data was compared to measured wind data collected at the privately run meteorological station located at Kurri Kurri. The data was used to create a comparative wind rose diagram study (refer **Figure 5**).

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Figure 4 shows that in the early morning (00:00 to 06:00 hours) winds are light and dominated by north westerly winds. Later in the morning, winds are still predominantly light and from the northwest. Wind speeds later in the morning are typically higher than those experienced earlier in the day. By afternoon, winds are stronger and occur from both the southeast and the northwest, representing both common synoptic scale influences and the sea breeze effect. During the late evening (18:00 to 24:00 hours) the winds can blow from all directions, but typically this period is dominated by south easterly or north westerly winds depending on the time of year. Overall, the wind roses indicate that light winds are common and that impacts from the site may be expected to extend mainly to the southeast, although local terrain effects on the flow field may alter the plume path as the plume travels and disperses.

Figure 5 shows a similar overall trend for the year with light wind from the southeast and northwest axis dominating. However late evening and early morning wind roses are dominated by southeast wind. This trend is not reflected in **Figure 4**.

The estimated wind speed for the year at the site is 2 m/s. Wind speeds up to 6 m/s are relatively common, with light winds (up to 2 m/s), occurring approximately 48% of the time. The measured average wind speed was 1.8 m/s at the nearby meteorological station

Mixing height is the depth of the atmospheric surface layer beneath an elevated temperature inversion. It is an important parameter within air pollution meteorology. Vertical diffusion or mixing of a plume is generally considered to be limited by the mixing height, as the air above this layer tends to be stable, with restricted vertical motions. A series of internal algorithms within CALMET are used to calculate mixing heights for the subject site.

The diurnal variation of mixing height is summarised in **Figure 6** with the diurnal cycle being clearly evident. At night, mixing height is normally relatively low and after sunrise it typically increases to between 500 m and 2,000 m in response to convective mixing that result from solar heating of the earth's surface.

3.2.4 Terrain Effects

The domain for CALMET covered a 30 km x 30 km area, with the southwest corner at 344.504 Easting and 6364.741 Northing (Map Grid of Australia (MGA) grid coordinates). This consisted of 121 x 121 grid points, with a 0.25 km resolution along both the x and y axes. Terrain for this area was derived from 9-second DEM data sourced from GeoScience Australia. Land use data were sourced from the 1996-97 Land Use Data of Australia, Version 2, National Land and Water Resources Audit. Geographic Information Systems (GIS) methods were used to calculate average terrain height and dominant land use for each grid cell.

3.2.5 Building Wake Effects

The dispersion of air pollutants around the OR is likely to be affected by aerodynamic wakes generated by winds having to flow around the buildings or stacks. Wake effects result in the decrease of pollutants with distance downwind where the plume approaches the ground. This may result in higher ground level pollutant concentrations closer to the source of emission.

Building wake effects were considered in this assessment by including the dimensions of the OR and surrounding buildings in the model. The Building Profile Input Program (BPIP) program was used to enter building dimensions to allow concessions for wake effects in the calculation of GLC's.

The BPIP output data used by the model are shown as part of the CALPUFF input file in **Appendix B**

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

3.2.6 Modelling Scenarios

One scenario was considered in the dispersion modelling. All TPR components were assumed to be operating at full capacity. This assumption is an overestimate as downtime for maintenance and breakdowns are not incorporated within the scenario. Despite this overestimation, the assumption is considered conservative and would result in a worst case estimation of GLCs. The scenario assumptions are as follows:

3.2.7 Source Characteristics

A summary of the parameters of the stack sources included in the dispersion modelling are provided in **Table 2** with all data used for the summary data presented in **Appendix C**.

It is noted from **Table 2** there are some significant differences between the as constructed and measured source characteristics compared to PAE AQIA (2006). Exit temperature of all stack sources have been measured to be lower than PAE AQIA (2006). The difference of the Flare exit temperature is due to measurements carried out during pilot light operation (not during flaring). With the exception of the Reformer Burner, measured exit velocities were less than PAE AQIA (2006). Normalised flow rate was similar for all stack sources.

Table 2: Source Characteristics

Source	Data Source	Stack Diameter ¹ (m)	Stack Height (m)	Exit Temperature (°C)	Exit Velocity ² (m/s)	Moisture Content (%)	Flow Rate (Am ³ /s)*	Flow Rate (Nm ³ /s)**
3MW Boiler DECC Point 2	ENSR measured Inventory Data ¹	0.65	8	172.3	3.60	9.65	1.19	0.67
	PAE Emission Inventory Data ²	0.3	12	300	27.9	NA	1.97	0.94
0.2MW Boiler DECC Point 3	ENSR measured Inventory Data	0.16	10	237.3	9.68	11.13	0.29	0.14
	PAE Emission Inventory Data	0.12	10	300	20.9	NA	0.24	0.11
Fired Heater DECC Point 19	ENSR measured Inventory Data	0.4	16	97.1	5.57	11.48	0.70	0.44
	PAE Emission Inventory Data	0.2	16	320	26.9	NA	0.85	0.39
Reformer Burner DECC Point 20	ENSR measured Inventory Data	0.34	14	797.1	13.50	16.27	1.25	0.30
	PAE Emission Inventory Data	0.6	6	918	2	NA	0.57	0.13
Light End Scrubber DECC Point 5 ³	ENSR measured Inventory Data	0.2	8	19.5	2.40	2.60	0.09	0.09
	PAE Emission Inventory Data	NA	NA	NA	NA	NA	NA	NA
Flare DECC Point 4	ENSR measured Inventory Data	0.95	16	89.7	3.87	1.97	2.73	2.00
	PAE Emission Inventory Data	0.445	16	1000	10	NA	1.56	0.33

¹ ENSR Stack Emission Reports **Appendix D**.

² Pacific Air and Environment (PAE) Air Impact Assessment Alternate Hydrogenation Plant (2006),

³ Methodology used in PAE AQIA not compatible with as built OR.

* Measured at stack conditions

** Normalised 0°C, 1 Atmosphere

NA data not available

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

3.2.8 Emissions Inventory

Emission concentrations for all sources at TPR were obtained from ENSR stack emission testing reports. Excerpts of the stack reports are shown in **Appendix D** and a summary of the results shown in **Table 3**

VOC results were modelled as total VOC. The GLC's extracted from the modelling assumed a maximum Benzene percentage of 50%, which was applied to the concentration contour and the discrete sensitive receptor results. Benzene was chosen as it represented the worst of the VOC emission (Air Toxic) and the highest relative component.

Table 3: Source Emission Inventory

Source	Pollutant	Emission Rate		Corrected Emission Concentration ¹		Regulatory Emission Concentration Limit
		g/s		mg/Nm ^{3*}		
		ENSR ¹	PAE ²	ENSR ¹	PAE ²	mg/Nm ^{3*}
3MW Boiler (DECC Point 2)	Total Oxides of Nitrogen (NOx)	0.013585	0.33	20.20	350	350
	Sulfur Dioxide (SO ₂ as SO ₃)	0.000673	0.00054	1.00	1	NA
	Carbon Monoxide (CO)	0.265638	0.087	395.00	92	NA
	Total VOC	0.000538	0.0057	0.80	6	10
	Total Particulate (TP)	0.007823	0.047	11.63	50	10
	Fine Particulate (PM ₁₀)	0.005010	0.047	7.45	50	NA
	Hydrogen Sulfide (H ₂ S)	0.001345	0	2.00	0	NA
	Sulfuric Acid Mist (H ₂ SO ₄)	0.000135	NA	0.20	NA	NA
	Polycyclic Aromatic Hydrocarbons (PAH)	0.000125	NA	0.19	NA	NA
0.2MW Boiler (DECC Point 3)	Total Oxides of Nitrogen (NOx)	0.006665	0.039	46.50	350	350
	Sulfur Dioxide (SO ₂ as SO ₃)	0.001555	0.000078	10.85	1	NA
	Carbon Monoxide (CO)	0.020667	0.013	140.00	111	NA
	Total VOC	0.001441	0.00082	10.05	7	10
	Total Particulate (TP)	0.001104	0.0056	7.70	50	10
	Fine Particulate (PM ₁₀)	0.000072	0.0056	0.50	50	NA
	Hydrogen Sulfide (H ₂ S)	0.001111	0	7.75	0	NA
	Sulfuric Acid Mist (H ₂ SO ₄)	0.000315	NA	2.20	NA	NA
	Polycyclic Aromatic Hydrocarbons (PAH)	0.000005	NA	0.04	NA	NA
Fired	Total Oxides of Nitrogen (NOx)	0.095091	0.14	215.50	350	350

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Source	Pollutant	Emission Rate		Corrected Emission Concentration ¹		Regulatory Emission Concentration Limit
		g/s		mg/Nm ^{3*}		
		ENSR ¹	PAE ²	ENSR ¹	PAE ²	mg/Nm ^{3*}
Heaters (DECC Point 19)	Sulfur Dioxide (SO ₂ as SO ₃)	0.006112	1.4	14.05	3709	1360
	Carbon Monoxide (CO)	0.274050	0.032	630.00	82	100
	Total VOC	0.001457	0.0021	3.35	5	10
	Total Particulate (TP)	0.040963	0.02	94.17	50	10
	Fine Particulate (PM ₁₀)	0.000044	0.02	0.10	50	NA
	Hydrogen Sulfide (H ₂ S)	0.006373	0.12	14.65	299	5
	Sulfuric Acid Mist (H ₂ SO ₄)	0.006279	NA	14.43	NA	NA
	Polycyclic Aromatic Hydrocarbons (PAH)	0.000005	NA	0.01	NA	NA
Reformer Burner (DECC Point 20)	Total Oxides of Nitrogen (NO _x)	0.016346	0.045	55.10	350	350
	Sulfur Dioxide (SO ₂ as SO ₃)	0.007847	0.00009	26.45	1	NA
	Carbon Monoxide (CO)	0.000979	0.014	3.30	111	NA
	Total VOC	0.001157	0.0009	3.90	7	10
	Total Particulate (TP)	0.001647	0.0065	5.55	50	10
	Fine Particulate (PM ₁₀)	0.000030	0.0065	0.10	50	NA
	Hydrogen Sulfide (H ₂ S)	0.003723	0	12.55	0	NA
	Sulfuric Acid Mist (H ₂ SO ₄)	0.002106	NA	7.10	NA	NA
	Polycyclic Aromatic Hydrocarbons (PAH)	0.000002	NA	0.01	NA	NA
Light End Scrubber (DECC Point 5) ³	Total Oxides of Nitrogen (NO _x)	NA	NA	NA	NA	NA
	Sulfur Dioxide (SO ₂ as SO ₃)	0.001152	NA	12.80	NA	1360
	Carbon Monoxide (CO)	0.001836	NA	20.40	NA	100
	Total VOC	0.179070	NA	1989.67	NA	10
	Total Particulate (TP)	0.000423	NA	4.70	NA	10
	Fine Particulate (PM ₁₀)	0.000423	NA	4.70	NA	NA
	Hydrogen Sulfide (H ₂ S)	0.055161	NA	612.90	NA	5
	Sulfuric Acid Mist (H ₂ SO ₄)	0.000342	NA	3.80	NA	NA
	Polycyclic Aromatic Hydrocarbons (PAH)	0.000019	NA	0.22	NA	NA
Flare (DECC Point 4)	Total Oxides of Nitrogen (NO _x)	0.024400	0.66	12.20	1972	NA
	Sulfur Dioxide (SO ₂ as SO ₃)	0.023000	0	11.50	0	NA
	Carbon Monoxide (CO)	0.031400	3.6	15.70	10731	NA

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Source	Pollutant	Emission Rate		Corrected Emission Concentration ¹		Regulatory Emission Concentration Limit
		g/s		mg/Nm ^{3*}		
		ENSR ¹	PAE ²	ENSR ¹	PAE ²	mg/Nm ^{3*}
	Total VOC	0.000200	0.61	0.10	1827	NA
	Total Particulate (TP)	0.006200	0.13	3.10	398	NA
	Fine Particulate (PM ₁₀)	0.006200	0.13	3.10	398	NA
	Hydrogen Sulfide (H ₂ S)	NA	NA	NA	NA	NA
	Sulfuric Acid Mist (H ₂ SO ₄)	0.004600	NA	2.30	NA	NA
	Polycyclic Aromatic Hydrocarbons (PAH)	0.000012	NA	0.01	NA	NA

¹ ENSR Stack Emission Reports Appendix C.

² Pacific Air and Environment (PAE) Air Impact Assessment Alternate Hydrogenation Plant (2006).

³ Methodology used in PAE AQIA not compatible with as built OR.

* Normalised 0°C 1 Atmosphere.

From **Table 2** broad trends for the different pollutants are outlined below:

- NO_x – One order of magnitude smaller than PAE AQIA.
- SO₂ – One order of magnitude larger than PAE AQIA. Less than regulatory emission concentration limit.
- CO – One order of magnitude larger than PAE AQIA. Less than regulatory emission concentration limit.
- Total VOC – With the exception of the LE Scrubber similar to PAE AQIA.
- TP – With the exception of the Fired Heaters lower than PAE AQIA.
- PM₁₀ – One order of magnitude smaller than PAE AQIA.
- H₂S – Higher than PAE AQIA, in particular the LE Scrubber.
- H₂SO₄ – small amounts measured, not modelled in PAE AQIA.
- PAH – small amounts measured, not modelled in PAE AQIA.

3.3 Assessment Criteria

Table 3 presents the GLC assessment criteria specified in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (NSW DEC, 2005).

Table 3: Relevant Air Quality Impact Assessment Criteria

Air Quality Indicator	($\mu\text{g}/\text{m}^3$)	Averaging Period
Oxides of Nitrogen	246	1 hour
	62	Annual
Sulphur dioxide	570	1 hour
	228	24 hours
	60	Annual
Particulate matter (as TSP)	90	Annual
Particulate matter (as PM_{10})	50	24 hours
	30	Annual
Carbon monoxide	30,000	1 hour
	10,000	8 hours
Total VOC's (as Benzene)	29	1 hour
PAH's (as benzo[a]pyrene)	0.4	1 hour
Sulphuric acid	18	1 hour
Hydrogen Sulfide	2.76	1 Hour 99 th percentile Nose Response Time

3.4 Existing Environment

Air quality in Rutherford is dominated by motor vehicle emissions from the New England Highway and major industry situated within the Rutherford Industrial estate. In addition, the air quality is influenced by regional sources such as coal mines and power stations which contribute pollutants which move down the valley. The air emissions of prime concern in NSW are summarised in Table 7.1 of the NSW DECC Approved Method for the Modelling and Assessment of Air Pollutants in NSW (2005), with levels of these air emissions approaching or exceeding the national standards prescribed in the National Environment Protection Measure for Ambient Air Quality on occasion. Air emission levels in Rutherford, however, are generally acceptable, with the exception of particulates which are elevated (NSW State of the Environment 2006, DECC).

Data on the existing environment in the region surrounding TPR Rutherford has been monitored by the DECC Beresfield monitoring station. The station is located at Francis Greenway High School which is situated in a residential area approximately 15km south east from the assessment site and is at an elevation of 14 meters. The station measures O_3 , CO, NO_2 , NO_x , SO_2 , fine particles (by nephelometry and $\text{PM}_{2.5}$ & PM_{10} using a tapered element oscillating microbalance). The CO, NO_x , SO_2 and PM_{10} monitored data has been used as background data for the assessment. This data represents the closest DECC monitoring station data available and is considered indicative of current background concentrations for the area and is consistent with the meteorological year selected for the study. No background monitoring data was able to be sourced for TSP, H_2SO_4 , H_2S , and PAHs.

A summary of the key statistics of the last full year of data (2006) for the parameters monitored at the monitoring site is shown in **Table 4**.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 4: Summary Data of Ambient Air Monitoring Station

Pollutant	Averaging Period	Year 2006 ug/m ³	Criteria ug/m ³
NO ₂	Annual average	28	246
	1 hour maximum	103	62
PM ₁₀	Annual average	21	30
	24 hour maximum	52	50
CO	1 hour maximum	3625	30,000
	8 hour maximum	2750	10,000
SO ₂	1 hour maximum	117	570
	24 hour maximum	29	228
	Annual average	5	60

3.5 Sensitive Receptors

Sensitive receptors are defined by NSW DECC as “A location where people are likely to work or reside this may include a dwelling, school, hospital, office or public recreational area. An air quality impact assessment should also consider the location of known or likely future sensitive receptors.” On this basis, representative receptors were placed at various locations surrounding the TPR facility to supplement the arbitrary receptor grid developed for the modelling domain.

A summary of the approximate receptor locations is shown below in **Table 5** and the location of the receptors shown in **Figure 1**.

Table 5: Sensitive Receptor Locations

Receptor Number	Easting	Northing	Receptor Description	Receptor Type
1	359810	6380106	500m East of Kyle Road and New England Highway Intersection	Commercial
2	360241	6379147	Boundary of golf course and industrial estate	Sporting
3	360134	6378983	Boundary of golf course and industrial estate	Sporting
4	360115	6378743	Boundary of golf course and industrial estate	Sporting
5	359822	6378743	Boundary of golf course and industrial estate	Sporting
6	359608	6378819	Boundary of golf course and industrial estate	Sporting
7	359814	6380102	500m East of Kyle Road and New England Highway Intersection	Industrial
8	359285	6380087	Near Kyle Road and New England Highway Intersection	Industrial
9	359266	6379626	Near Kyle Road and Gardiner intersection	Industrial
10	359372	6379611	Near Kyle Road and Gardiner intersection	Industrial
11	359441	6379596	Near Kyle Road and Gardiner intersection	Industrial

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Receptor Number	Easting	Northing	Receptor Description	Receptor Type
12	359479	6379592	Near Kyle Road and Gardiner intersection	Industrial
13	359536	6379588	Near Kyle Road and Gardiner intersection	Industrial
14	359631	6379615	Near Kyle Road and Gardiner intersection	Industrial
15	359734	6379741	Western End Racecourse Road	Industrial
16	359696	6379908	Kyle Road Near TPR	Industrial
17	359624	6379939	Kyle Road Near TPR	Industrial
18	359475	6379939	Kyle Road Near TPR	Industrial
19	359281	6379969	Kyle Road Near TPR	Industrial
20	359239	6379874	Kyle Road Near TPR	Industrial
21	359186	6379733	Kyle Road Near TPR	Industrial
22	359171	6379642	Kyle Road Near TPR	Industrial

3.6 Modelling Results

Results of the dispersion modelling of the operational scenario are shown in **Table 6**, **Table 7**, and **Table 8**. With the exception of H₂S (1 Hour 99th percentile) the tables list the 100th percentile predicted GLC for each modelled air emission at each sensitive receptor. The predicted GLC isopleths of each modelled air emission have been prepared for the modelling domain and are shown in **Figures 7 to 21**.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 6: Dispersion Modelling Results –Oxides of Nitrogen and Sulphur Dioxide ($\mu\text{g}/\text{m}^3$)

Receptor Number	Oxides of Nitrogen		Sulphur Dioxide		
	1 Hour	Annual	1 Hour	24 Hour	Annual
1	15.5 (118.5)	0.1 (27.7)	1.7 (119)	0.2 (28.8)	0 (4.8)
2	14.5 (117.4)	0.3 (27.9)	3.2 (120.5)	0.4 (29)	0.1 (4.8)
3	16.7 (119.7)	0.2 (27.8)	3.5 (120.8)	0.3 (28.9)	0 (4.8)
4	10.8 (113.7)	0.1 (27.8)	2.3 (119.6)	0.2 (28.8)	0 (4.8)
5	9.5 (112.4)	0.1 (27.7)	2.2 (119.5)	0.2 (28.8)	0 (4.8)
6	8.5 (111.5)	0.1 (27.7)	1.9 (119.2)	0.2 (28.8)	0 (4.8)
7	16 (119)	0.1 (27.7)	1.9 (119.2)	0.2 (28.8)	0 (4.8)
8	27.7 (130.7)	0.3 (28)	6 (123.3)	0.6 (29.2)	0.1 (4.8)
9	49.4 (152.4)	0.8 (28.4)	9.3 (126.5)	1 (29.6)	0.2 (4.9)
10	46.5 (149.5)	0.8 (28.4)	8.8 (126)	1.2 (29.8)	0.2 (4.9)
11	37.4 (140.3)	0.8 (28.5)	7.7 (125)	1.5 (30.1)	0.2 (5)
12	46.2 (149.2)	0.8 (28.5)	10.8 (128.1)	1.3 (29.9)	0.2 (5)
13	40.6 (143.5)	0.9 (28.5)	9.3 (126.6)	1.2 (29.8)	0.2 (5)
14	42 (145)	0.9 (28.6)	9.6 (126.9)	1.2 (29.8)	0.2 (5)
15	31.2 (134.2)	0.6 (28.2)	7.4 (124.7)	1.1 (29.7)	0.1 (4.9)
16	27.8 (130.8)	0.3 (27.9)	5.3 (122.6)	0.6 (29.2)	0.1 (4.8)
17	26.7 (129.7)	0.2 (27.9)	5.9 (123.1)	0.5 (29.1)	0 (4.8)
18	32.9 (135.9)	0.3 (27.9)	3.6 (120.9)	0.5 (29.1)	0.1 (4.8)
19	43.1 (146)	0.7 (28.3)	5.5 (122.7)	1.6 (30.2)	0.1 (4.9)
20	71.5 (174.4)	2.8 (30.5)	15.8 (133.1)	5.2 (33.8)	0.6 (5.4)
21	49.4 (152.4)	1.1 (28.8)	6.2 (123.5)	1.4 (30)	0.2 (5)
22	58 (161)	0.6 (28.2)	9.8 (127)	0.9 (29.5)	0.1 (4.9)
Criteria	246	62	570	228	60

Note: cumulative data in brackets

Table 7: Dispersion Modelling Results - TSP, PM₁₀ and Carbon Monoxide (µg/m³)

Receptor Number	TSP ¹	PM ₁₀		Carbon Monoxide	
	Annual	24 Hour	Annual	1 Hour	8 hour
1	0 (53)	0.1 (52.1)	0.01 (21.17)	76.5 (3701.5)	11.7 (2761.7)
2	0.1 (53)	0.1 (52.1)	0.02 (21.19)	59.1 (3684.1)	14.3 (2764.3)
3	0.1 (53)	0.1 (52.1)	0.01 (21.18)	71.2 (3696.2)	10.3 (2760.3)
4	0 (53)	0.1 (52.1)	0.01 (21.18)	44.8 (3669.8)	10.2 (2760.2)
5	0 (53)	0.1 (52.1)	0.01 (21.17)	34.8 (3659.8)	7.8 (2757.8)
6	0 (53)	0 (52)	0.01 (21.17)	31.2 (3656.2)	5.9 (2755.9)
7	0 (53)	0.1 (52.1)	0.01 (21.17)	76.9 (3701.9)	11.7 (2761.7)
8	0.1 (53)	0.2 (52.2)	0.02 (21.19)	125 (3750)	26.2 (2776.2)
9	0.3 (53.2)	0.4 (52.4)	0.06 (21.23)	259.1 (3884.1)	53.8 (2803.8)
10	0.3 (53.2)	0.4 (52.4)	0.07 (21.23)	211.2 (3836.2)	47.5 (2797.5)
11	0.3 (53.2)	0.5 (52.5)	0.07 (21.23)	167.7 (3792.7)	44.6 (2794.6)
12	0.3 (53.2)	0.4 (52.4)	0.07 (21.23)	190.7 (3815.7)	35.5 (2785.5)
13	0.3 (53.3)	0.4 (52.4)	0.07 (21.24)	182.8 (3807.8)	33.9 (2783.9)
14	0.3 (53.3)	0.3 (52.3)	0.07 (21.24)	164.5 (3789.5)	39 (2789)
15	0.2 (53.1)	0.3 (52.3)	0.04 (21.21)	121.5 (3746.5)	34.3 (2784.3)
16	0.1 (53)	0.2 (52.2)	0.02 (21.19)	133.4 (3758.4)	30.4 (2780.4)
17	0.1 (53)	0.2 (52.2)	0.02 (21.18)	135.7 (3760.7)	27.4 (2777.4)
18	0.1 (53)	0.2 (52.2)	0.02 (21.18)	138.4 (3763.4)	22.7 (2772.7)
19	0.3 (53.2)	0.5 (52.5)	0.04 (21.2)	162.3 (3787.3)	59.3 (2809.3)
20	1.1 (54)	2 (54)	0.22 (21.38)	355.4 (3980.4)	216.8 (2966.8)
21	0.5 (53.4)	0.6 (52.6)	0.08 (21.25)	204.2 (3829.2)	80.7 (2830.7)
22	0.2 (53.2)	0.3 (52.3)	0.05 (21.21)	259.9 (3884.9)	34.8 (2784.8)
Criteria	90	50	30	30000	10000

Note cumulative data in brackets

¹TSP assumed to be 40% of PM₁₀ annual

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 8: Dispersion Modelling Results for Total VOC's, PAH's, H₂S, and H₂SO₄ (µg/m³)

Receptor Number	Benzene	PAH	H ₂ S	H ₂ SO ₄
	1 Hour	1 Hour	99 th Percentile 1 Hour	1 Hour
1	28.6	0.02	6.1	1.0
2	15.0	0.02	8.1	1.2
3	16.6	0.02	6.9	1.3
4	9.5	0.01	5.3	0.9
5	8.3	0.01	3.7	0.8
6	9.0	0.01	3.5	0.7
7	30.8	0.02	6.1	1.0
8	38.7	0.03	13.5	2.3
9	127.6	0.09	40.2	3.6
10	110.0	0.06	43.2	3.4
11	60.0	0.05	32.2	2.8
12	54.3	0.06	28.8	3.9
13	58.3	0.05	25.6	3.3
14	43.5	0.05	23.4	3.5
15	32.9	0.04	21.1	2.7
16	48.3	0.04	14.4	2.1
17	53.0	0.04	14.6	1.9
18	87.9	0.03	26.2	2.2
19	99.8	0.04	30.5	2.8
20	160.9	0.16	92.5	5.8
21	292.6	0.06	57.1	3.2
22	138.2	0.08	29.2	4.3
Criteria	29	0.4	2.76	18

Note: No background data was assumed for Benzene, PAH, H₂S and H₂SO₄, hence no cumulative values were calculated.

Bold entries denote exceedance of criteria.

3.7 Assessment of Impacts

Based on the result of the dispersion modelling, most air pollutant concentrations were below their respective assessment criteria (NO_2 , SO_2 , CO , TSP, PAH and H_2SO_4). Three pollutants however exceeded their impact assessment criteria (PM_{10} (24 hour average), VOC (proportion modelled as Benzene) and Hydrogen Sulfide). Discussion of these exceedences are as follows:

- PM_{10} 24 hour average concentration was predicted to be a maximum of $2 \mu\text{g}/\text{m}^3$ for all sensitive receptors surrounding the OR. This predicted concentration complied with the assessment criteria when considered in isolation from the ambient environment. The reason for the exceedence of the assessment criteria when considered cumulatively is that the background particulate concentration is already elevated above the assessment criteria. It is considered unlikely that this worst case concentration would impact on the nearby receptors given that the worst case predicted concentration occurred at a industrial receptor.
- H_2S concentrations are predicted to exceed the assessment criteria well beyond the boundary of the OR and are predicted to potentially impact on the residential area of Rutherford approximately 1.5 km to the east of the site.
- Benzene concentrations are predicted to exceed the assessment criteria beyond the boundary of the facility and extend across some of the neighbouring industrial facilities at concentrations in excess of the criteria. The exceedence contour is not predicted to reach any residential properties surrounding the OR.

The findings of this report differ substantially to the findings of the report discussed in **Section 3.1** (report prepared by PAE for the TPR EIS). The PAE report predicted no exceedences beyond the property boundary whereby the modelling undertaken by this report clearly predicted exceedences for both H_2S and Benzene beyond the property boundary. The differences in the two reports are due to the emissions from the LES, which was not expected to receive such an elevated concentration of H_2S , and hence emit elevated concentrations resulting in DECC criteria exceedences. The presence of the H_2S is also thought to have impacted on the efficiency of the LES to remove light end hydrocarbons (such as Benzene). All other air pollutants modelled are predicted to comply with the assessment criteria as predicted by the PAE report.

Subsequent to the modelling discussed above, TPR have undertaken to redirect emissions from the FPCC vent from the LES to the fired heater. Thus increasing the energy efficiency of the fired heater and reducing the load of the LES to within its design capacity. All FPCC vent process air that used to be vented through the LES are now in the process of being redirected to the off-gas burning system which vents to the SO_x scrubber. This redirection is a positive efficiency measure for the overall process and is expected to result in the elimination of the most significant VOC and H_2S emission sources on the facility. This is expected to result in a significant lowering of the pollutant emission rates and surrounding predicted ground level pollutant concentrations. As the redirecting of the FPCC vent gases is only likely to add 0.5% to the existing SO_x scrubber load (perscomms TPR), the emissions from this source are not expected to be significantly increased.

A detailed description of the LES modification process from initial measurement stage is provided as follows:

Stage 1: The condition in which the unit was when the initial measurements were taken.

- The system was commissioned as supplied by OEM, FFS Refiners from South Africa.
- The make up supply to the LES, was fresh water supplied from mains at 100l/h.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

- Average circulation temp was 40 – 50°C.
- The pH had a tendency to reduce to approximately 4 pH units showing that some reactions are causing the water to turn acidic.
- Additional measurements were performed and it was discovered that the hydrogenation process was more efficient than initially envisaged and was removing more sulphur than anticipated. It showed that 0.5% of the sulphur removed by the entire system was being removed in the second stage high vacuum, high temp, flash point correction unit, which was not the original intention.
- This had the effect of the scrubbing system having to cope with higher load levels of H₂S.
- Some process and plant modifications were made to combat the higher loads of H₂S.
- The volatiles measured were attributed to the high temperatures in the VRU which drove off the light hydrocarbon cut.

Stage 2: This investigation concluded the LE Scrubber needed to run cooler, typically less than 30°C with a higher purge rate. During a shutdown period in October the following improvements were made to the LE Scrubbing process:

- A link between the SO_x Scrubber and the LE Scrubber was installed, to allow the run down of the SO_x Scrubber through the LE Scrubber.
- The link supplies pH controlled water from the SO_x Scrubber unit as a scrubbing medium for the LE Scrubber, removing the low pH operation.
- The caustic is also believed to be able to assist in the scrubbing efficiency of the unit.
- Increase the flow purge rate to 300 L/h compared to 100 L/h. This should promote a more effective clearance within the unit of the accumulated VOC's.
- Hydrogen peroxide was included as a dosing stream to act as an oxidizing agent to further assist in the neutralizing of the gas components.
- The hydrogen peroxide was dosed at 1% per volume into the circulation line after laboratory trials were performed into the efficiency of its neutralizing effects on H₂S and odour.
- A cooler was installed on the run down stream to reduce to operating temp of the LE Scrubber with the aim of reducing the volatile emissions of the unit.
- Results of the modifications will require further assessment to identify the level of improvement.

After the modifications in house testing has determined that TPR had achieved a significant improvement. The H₂S scrubbing efficiency was measured at around 95%. This would have been adequate for the expected loading of sulphur, however with currently loads compliance will not be achieved. The temperature of the LE Scrubber continues to operate above 35°C.

Stage 3: Considering the above findings, TPR has embarked on the last stage to continue to improve the LE scrubbing process:

- The main source of H₂S and VOC's entering the LE Scrubber was identified to be the outlet of the FPCC vacuum pump system.
- It is believed that the limit of the scrubbing system's efficiency has been reached.
- An alternative approach will be investigated as follows:

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

- The vent gas from the FPCC vacuum pump is similar to that in the existing Off Gas system as in the hydrogenation process
- The vent gas from the FPCC vacuum system has a calorific value which can be used to off set Natural Gas consumption and improve the efficiency of the Fired Heater
- Re-direct the vent gas of the FPCC vacuum pump in the same system used for consuming fuel gas produced from the upstream hydrogenation process.
- The vent gas will be burnt by the oil heater and the combustion oxidized flue gas components will be scrubbed by the existing SO_x Scrubber.
- The linked outlet of the FPCC vacuum system to the fuel gas system will then be burnt and scrubbed.
- This would represent a 0.5% increase of the SO_x Scrubbers' current sulphur load which can be regarded as feasible.
- The VOC component would only be a small part and would be combusted as per normal combustible gas to a burner.
- The LE Scrubber will then be free to deal with only the recovery load bay vapours, the breathing vent vapours from the process and storage tanks. These changes will lead to a significant reduction in load for the LE Scrubber, and it is believed these changes will lead to compliance.

TPR plan to implement these above changes by the end of the current year. Potential challenges include the following:

- Converting the discharge system of the FPCC vacuum to a pressure vessel system, this would require pressure vessel certification.
- The logic and control of the vacuum system would also need to link into the cause and effect control system to coincide with the fired heater operation as well as the flare.
- A full Hazard and Operability Study (HAZOP) of the above modifications to the process would need to be completed.

TPR envisages that the result of these changes will eliminate the VOC scrubber as the dominate odour source and consequently diminish the odour profile of the site below scenario 3.

These process alterations are the result of a TPR in-house investigation which will improve the overall energy efficiency of the process and are best communicated as a staged approach. The resulting outcome will also ensure that emissions can be controlled to a degree that allows compliance with the DECC criteria as well as general best practice. Currently TPR is in "stage 2" and on the cusp of completing "stage 3".

The implications of this modification to the pollutant ground level concentrations have yet to be determined. However it is expected that following modification to the emission control system additional testing and modelling would be undertaken to demonstrate compliance with the impact assessment criteria outlined in **Section 5**.

No odour complaints were passed on to ENSR by TPR for the period since operation commenced. Hence no odour complaints have been discussed or actions undertaken specifically relating to odour complaints.

3.8 Source Emissions Monitoring Program

As required by Condition U1 of the EPL, a complete source emissions monitoring program is required to ensure compliance of the TPR OR in the future. Based on observations and results from the facility, a monitoring program has been developed to ensure compliance with DECC emissions criteria. The monitoring program has been summarised into current and recommended future monitoring in **Table 9**. Results of the current monitoring program have been summarised as part of the impact assessment in **Section 3.2.7** and **Section 3.2.8** with excerpts from the monitoring reports included as **Appendix D**.

Note that the monitoring program below is aimed at addressing emission points only. There are intermediate licence points required by DECC which are not directly emitted to atmosphere i.e. DECC sampling points 1 and 18 vent through DECC sampling point 19. As the focus of this monitoring program is to confirm emissions to air, the intermediate sampling points have not been addressed.

Table 9: Recommended Future Emissions Source Monitoring Program

Emission Source	Pollutant	Existing Testing Frequency	Recommended Testing Frequency
3MW Boiler DECC Point 2 & 0.2MW Boiler DECC Point 3 & Reformer Burner DECC Point 20	Stack Parameters ¹ Carbon monoxide Hydrogen Sulfide Nitrogen Oxides ² Odour PAH Solid Particles Sulfuric Acid Mist & Sulfur Trioxide (as SO ₃) Sulfur Dioxide VOC	Special Frequency 1 ³	Extend Special Frequency 1 for 6 months
Flare DECC Point 4	Smoke Emissions Volumetric Flow Rate	Special Frequency 2 ⁴ Special Frequency 1 ³	Extend Special Frequency 1 for 6 months
Light End Scrubber DECC Point 5	Stack Parameters ¹ PAH VOC	Special Frequency 1	Extend Special Frequency 1 for 6 months
Fired Heater DECC Point 19	Stack Parameters ¹ Carbon monoxide Formaldehyde Hydrogen Sulfide Methane Nitrogen Oxides ² Odour PAH Solid Particles Sulfuric Acid Mist & Sulfur Trioxide (as SO ₃) Sulfur Dioxide VOC	Special Frequency 1 ³	Extend Special Frequency 1 for 6 months

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

¹ Stack parameters include gas density, moisture, molecular weight of stack gas, oxygen, temperature, velocity and volumetric flow rate

² NO_x reported as Equivalent NO₂

³ Frequency corresponds to quarterly for the first year after commissioning after which the frequency could be reviewed.

⁴ During Flare Operation

⁵ Odour excluded as it needs to be determined whether odour emission improve following the modification to the LES which is suspected to have been influencing the reformer odour results.

During the development of this monitoring program, it was advised that the LES would be modified and the process lines containing the H₂S and VOC's transported to the Fired heater (after which the flue gases are scrubbed by the SO_x scrubber). As a result the recommended source monitoring for the LES has been eliminated.

Following the completion of the testing outlined above at the end of 2009, a brief report should be prepared which outlined compliance of the emissions with limits imposed by DECC. If compliance can be demonstrated, a reduction in frequency of the monitoring is recommended.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

4.0 Noise Compliance Data Review

Attended noise measurements were conducted using a calibrated Bruel & Kjaer Type 2260 Precision Sound Analyser during representative periods of the night time period from 10.30 pm, Monday 27 to 4.30 am, Tuesday 28 October 2008. This instrument has Class 1 characteristics as defined in AS IEC 61672.1-2004 "Electroacoustics - Sound Level Meters". Calibration of the instrument was confirmed with a Bruel & Kjaer Calibrator Type 4231 prior to and at the completion of measuring. Each attended measurement was conducted over a 15-minute duration at or near to the locations specified by EPL 12555 Section L6.

Permission to access private properties was not obtained prior to the monitoring. Measurements were therefore taken from the nearest publicly accessible road. Results of the noise monitoring have been summarised in **Table 10** and **Table 11** along with noted acoustic influences noted during the monitoring period. Note that all locations were highly influenced by the New England Highway, residential activities (including music) and crickets. The only readings which were not highly influenced by these parameters were those locations at the refineries boundary.

Table 10 Acoustic Monitoring Results – TPR Refinery Boundary Fence

Location	Description	L _{A1}	L _{A1} Criteria	L _{Aeq}	L _{Aeq} Criteria	L ₉₀	Acoustic Influences
North Refinery	1 m from perimeter of refinery fence.	62	-	61	-	61	Constant machinery from refinery
East Refinery	1 m from perimeter of refinery fence.	58	-	57	-	58	Constant machinery from refinery and birds
South Refinery	1 m from perimeter of refinery fence.	59	-	58	-	58	Constant machinery from refinery
West Refinery	1 m from perimeter of refinery fence.	65	-	65	-	65	Constant machinery from refinery and the expulsion of compressed gasses

"-" denotes no criteria applicable for this location.

Note that the refinery fence is an internal fence within the TPR facility. The noise levels were measured within the facility, hence the reason for no criteria established for this location. There is a buffer around the internal fence which would result in noise reduction before it reaches the property boundary.

Table 11 Acoustic Monitoring Results – Remote Receptors

Location	Description	L _{A1}	L _{A1} Criteria	LA _{eq}	LA _{eq} Criteria	L ₉₀	Acoustic Influences
A	Outside of receiver location	57	49	50	35	43	Traffic on the New England Highway, crickets, frogs
B	Outside of receiver location	50	49	43	37	38	Traffic on the New England Highway, crickets, frogs and dogs barking
O	Outside of receiver location	59	49	48	35	34	Traffic on the New England Highway, crickets, and dogs barking
P	Outside of receiver location	48	49	48	35	37	Traffic on the New England Highway, crickets, and frogs
K	Adjacent to residence	51	49	43	35	37	Traffic on the New England Highway and crickets
L	Adjacent to residence	50	49	41	35	38	Traffic on the New England Highway, crickets, and dogs barking
M	Adjacent to residence	51	49	43	35	38	Trucks and traffic on the New England Highway, crickets, and frogs
J	Adjacent to residence	47	49	42	35	39	Dominated mainly by traffic on the New England Highway, distant music, a mechanical hum from the industrial estate, crickets and frogs
I	Adjacent to residence	48	49	44	35	43	Traffic on the New England Highway, distant music, a mechanical hum from the industrial estate, crickets and frogs
H	Adjacent to residence	NA	49	NA	35	NA	Traffic on the New England Highway, truck alarms, a mechanical hum from the industrial estate, crickets and frogs
G	Adjacent to residence	52	49	42	35	37	Traffic on the New England Highway, truck alarms, a mechanical hum from the industrial estate, crickets and loud bangs from the industrial estate
F	Adjacent to boundary	49	49	40	35	35	Trains, loud sirens, machinery hum from the industrial estate and

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Location	Description	L _{A1}	L _{A1} Criteria	L _{Aeq}	L _{Aeq} Criteria	L ₉₀	Acoustic Influences
	fence						crickets
E	Adjacent to boundary fence	43	49	41	35	40	Trains, loud sirens, machinery hum from the industrial estate, crickets and the wind blowing through the trees
D	Highway by the properties entrance	59	49	50	35	38	Traffic on the New England Highway, a mechanical hum from the industrial estate, crickets and frogs
C	Highway by the properties entrance	62	49	52	35	41	Traffic on the New England Highway, crickets and frogs
N	Highway by the properties entrance	64	49	51	35	36	Traffic on the New England Highway, a mechanical hum from the industrial estate, trains, crickets and dogs barking

* The measured noise levels of the EPL locations presented in this table are not attributed to activities within the site, rather ambient noise sources such as road traffic, trains and natural fauna and other industrial sources.

All L_{Aeq} results and all L_{A1} results (with the exception of monitoring locations E, F, I and J) were found to be above the criteria supplied by EPL 12555 (refer Condition L6). Observations did however indicate that no discernable noise from the site was identified at any of the remote monitoring locations during the monitoring period. In addition to this, the noise recorded at each of the monitoring locations was dominated by traffic (particularly the New England Highway), other industrial premises, passing trains, crickets, frogs and barking dogs.

Taking the acoustic influences noted above into account, the Industrial Noise Policy provides guidance on how to assess elevated noise levels. Specifically it states that:

In certain circumstances other noise descriptors may be more appropriate for measurement/assessment or compliance purposes, depending on the characteristics of the noise source. For example, where the noise emissions from the source of interest are constant (e.g fan noise) and the ambient noise level has a degree of variability (for example, due to traffic), the L_{A90} descriptor may adequately describe the noise source and be much easier to measure/assess. In these cases, it may be preferable to replace the L_{Aeq} descriptor.

Given the nature of the noise from the OR i.e. consistent stack blower noise with significant traffic noise surrounding the site, the measured L₉₀ data is considered appropriate for comparison with the criteria instead of the L_{Aeq} data, the assessment has been modified to use the L₉₀ data in place of the L_{Aeq}.

As noted above, the majority of the noise measurements result in non-compliance with the criteria listed in the EPL when the L₉₀ data is used in place of the L_{Aeq} data.

Despite the non-compliances noted above however, it is ENSR's observations both from working on the plant and from undertaking noise measurements that the TPR facility is not a major noise contributor to the Rutherford area. The facility noise was not discernable at the remote receptors and is not believed to be exceeding its limits.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Despite the belief that TPR are in compliance, as noted in Condition U1, DECC requires that if non-compliances are noted then ENSR need to identify additional measures which could be implemented to ensure compliance with the EPL. ENSR recommends the following actions:

- 1 Given the significant acoustic influences noted around the Rutherford area, it is recommended that the noise measurements be undertaken again without the influence of TPR i.e. during a scheduled shutdown period when no schedule maintenance could influence the results. The aim of this is to establish the contribution of the TPR plant to the background noise.
- 2 Should the results of the measurements prove to be inconclusive, it is recommended that noise levels at major plant activities be measured and converted to sound power levels and added to a noise model to allow predictions of actual noise. This would allow verifiable predictions to be made at the property boundary and beyond.
- 3 In the event that the two activities outlined above do not result in demonstration of compliance, TPR would investigate other methods to reduce noise emissions from their facility.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

"This page has been left blank intentionally"

5.0 Air and Noise Assessment Conclusions

An Operational Air and Noise Validation assessment was undertaken by ENSR for TPR's OR plant at Rutherford, NSW. Impacts of the plant on the local air quality were modelled using the CALPUFF dispersion model. The results from current operations indicate that for some pollutants (H₂S and Benzene) there is the potential for air quality impacts at surrounding sensitive receptors.

Subsequent process alterations have been instigated by TPR which will improve the overall efficiency of the facility and eliminate the largest source of VOCs and H₂S. This modification is scheduled for completion within 2008. Thus it has not been tested or commissioned, but is expected to result in a significant decrease in predicted GLC pollutant concentrations beyond the boundary of TPR.

Validation will be via advancing the next round of scheduled quarterly testing to coincide with the completion of commissioning of the process alterations. In the event that TPR does not achieve success with reaching acceptable emission levels, having completed Stage 3 of the LES, TPR will immediately embark on developing a Stage 4.

Analysis of noise data around the TPR facility indicates that whilst noise measurements result in technical non-compliance with the assessment criteria, noise from the facility was not discernable at remote receptors by ENSR field staff. Recommendations for additional work have been suggested which are expected to demonstrate that TPR complies with the assessment criteria.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

"This page has been left blank intentionally"

6.0 References

The Department of Environment and Conservation (DEC), 2005, Approved Methods for the Modelling and Assessment of Air Pollutants in NSW

Air Quality Impact Assessment – Hydrogenation Plant (Rutherford, NSW) prepared by Pacific Air and Environment for Transpacific Industries Pty Ltd and dated 2 May 2006; and

Report Air Impact Assessment Alternate Hydrogenation Plant (Rutherford NSW) prepared by Pacific Air and Environment for Transpacific Industries Pty Ltd and dated 7 July 2006;

Air Impact Assessment for Alternate Hydrogen Plant Comparission of 2221 and 2221a reports (Rutherford, NSW) prepared by Pacific Air and Environment for Transpacific Industries Pty Ltd and dated 26 February 2006; and

"This page has been left blank intentionally"

Figures



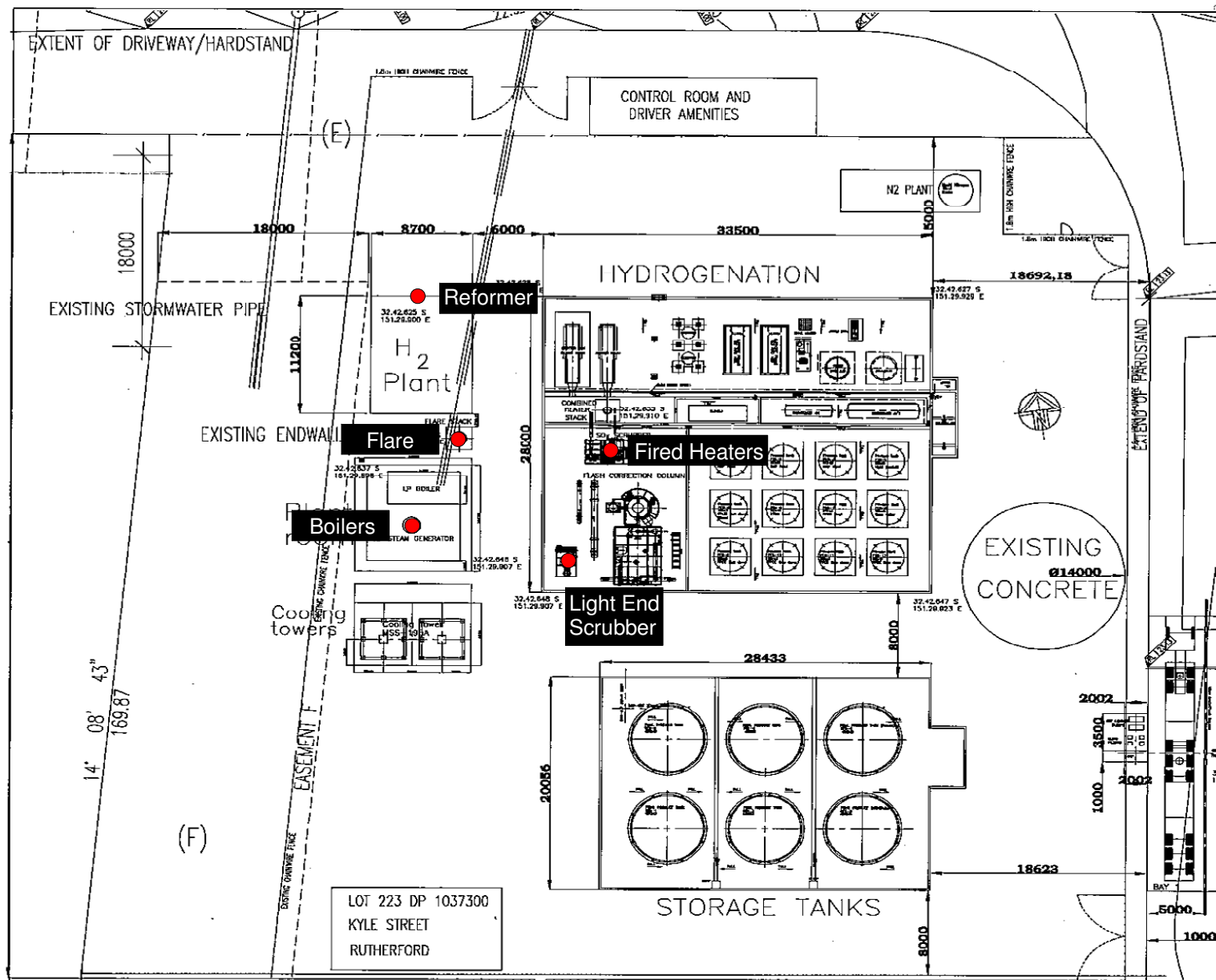
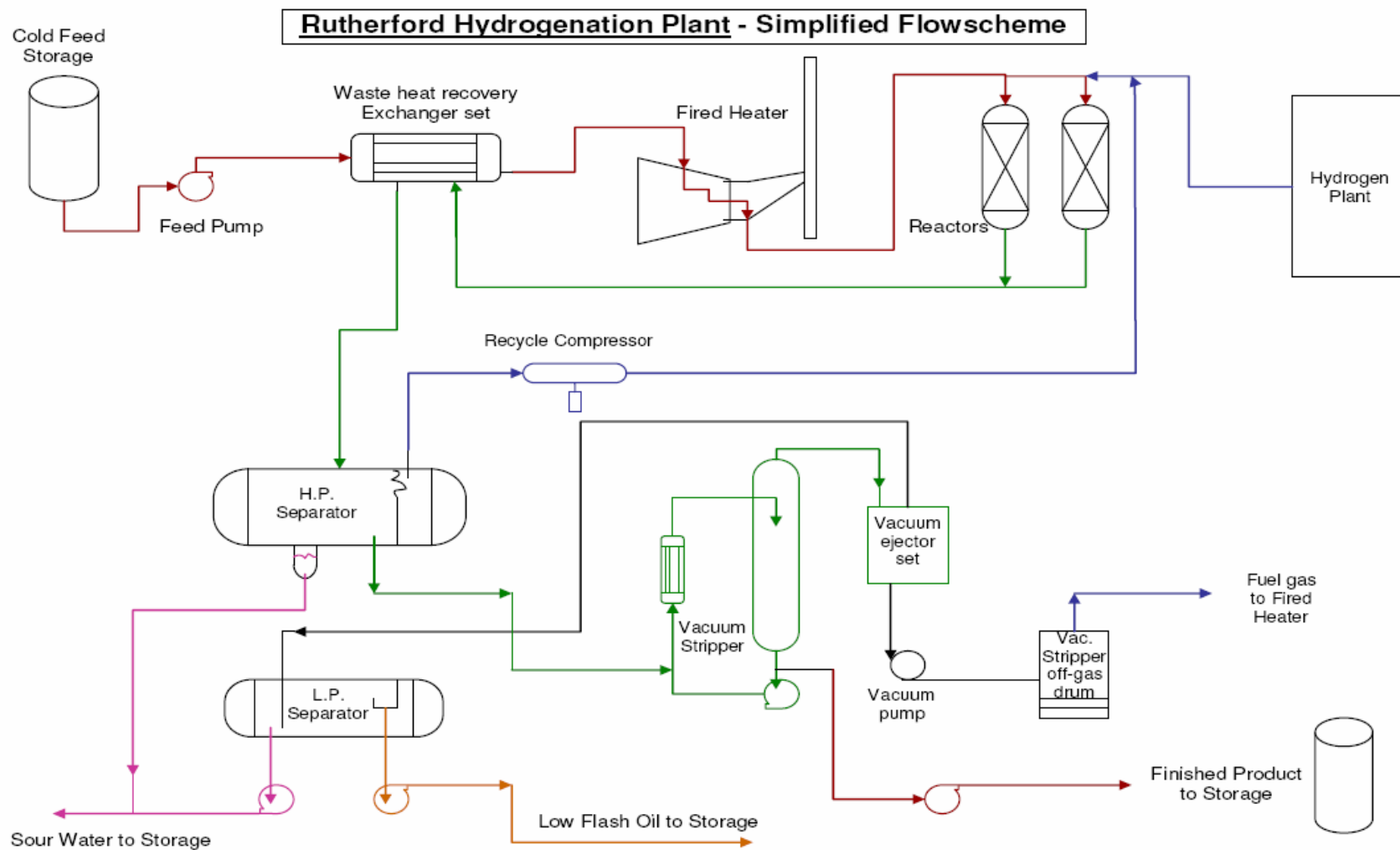
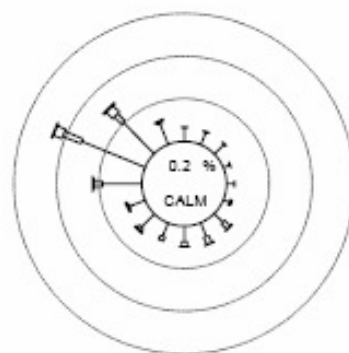


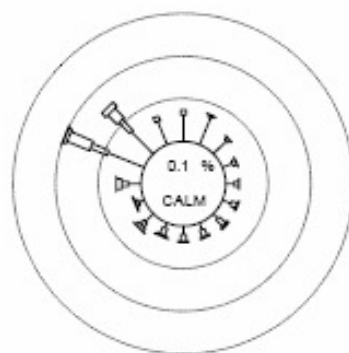
Figure 2 Site Plan
Transpacific Refiners Pty Ltd
Operational Air and Noise Validation Report
Rutherford, NSW





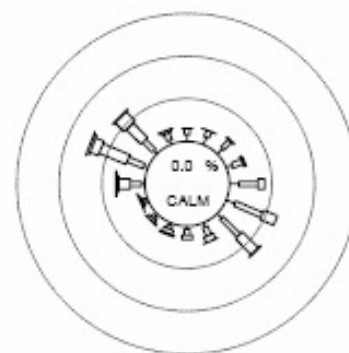
No. of Records :- 2196

0:01 - 6:00



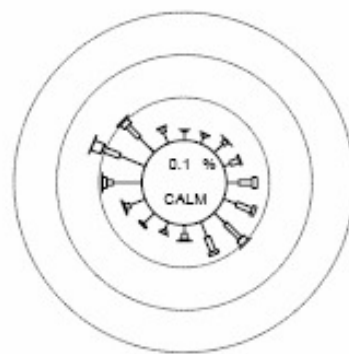
No. of Records :- 2196

6:01 - 12:00



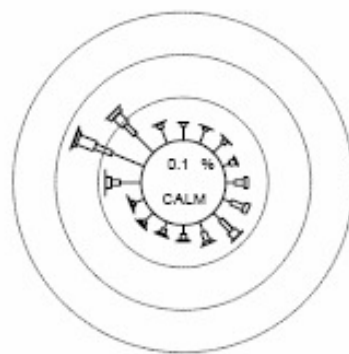
No. of Records :- 2196

12:01 - 18:00



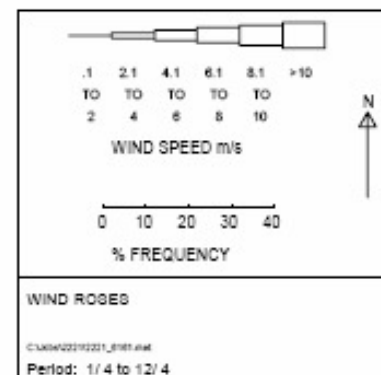
No. of Records :- 2196

18:01 - 24:00



No. of Records :- 8784

ALL HOURS



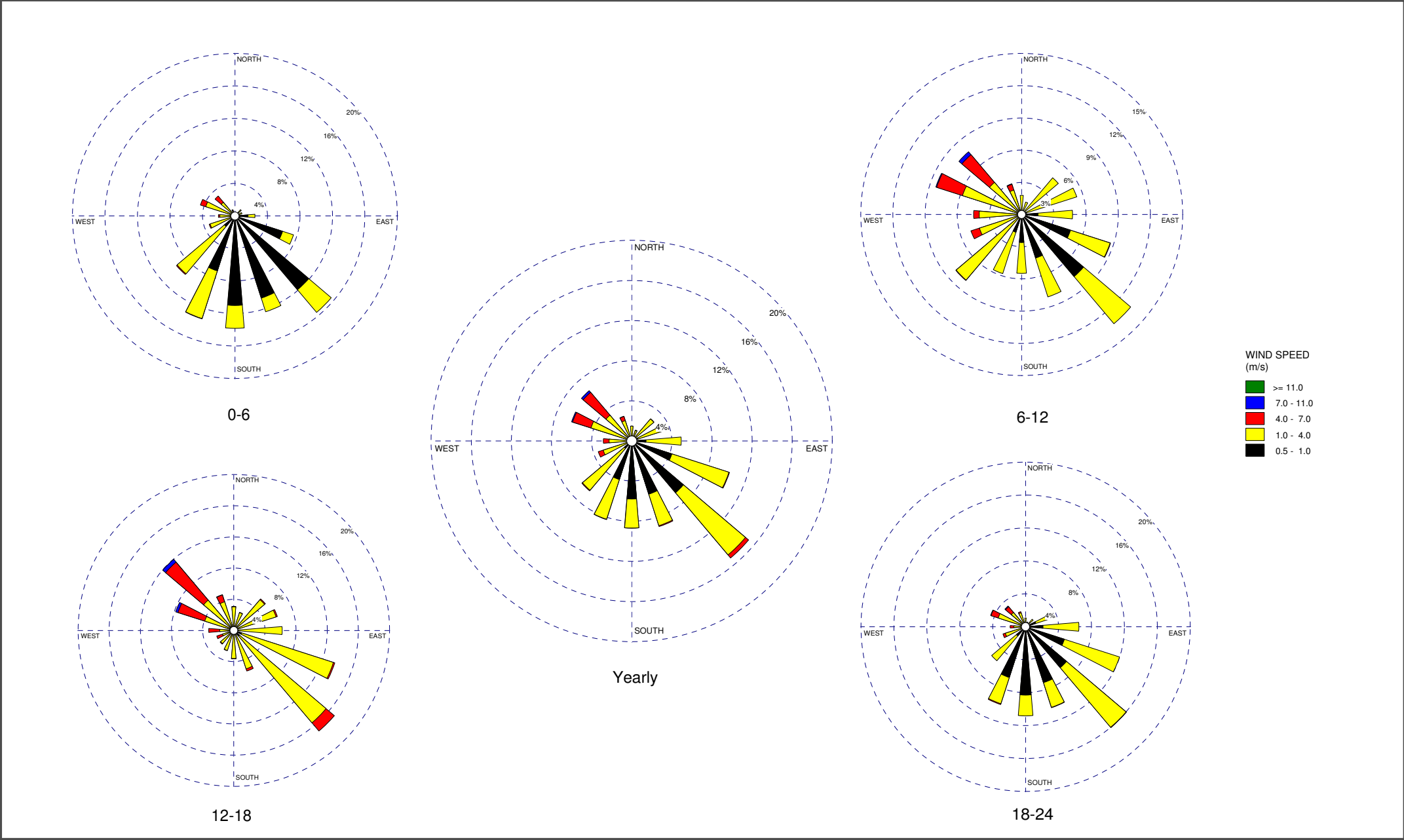


Figure 5 2004 Windrose - Meterological Station 8 km West Transpacific Refiners Pty Ltd
Comprehensive Odour Audit Report
Rutherford NSW

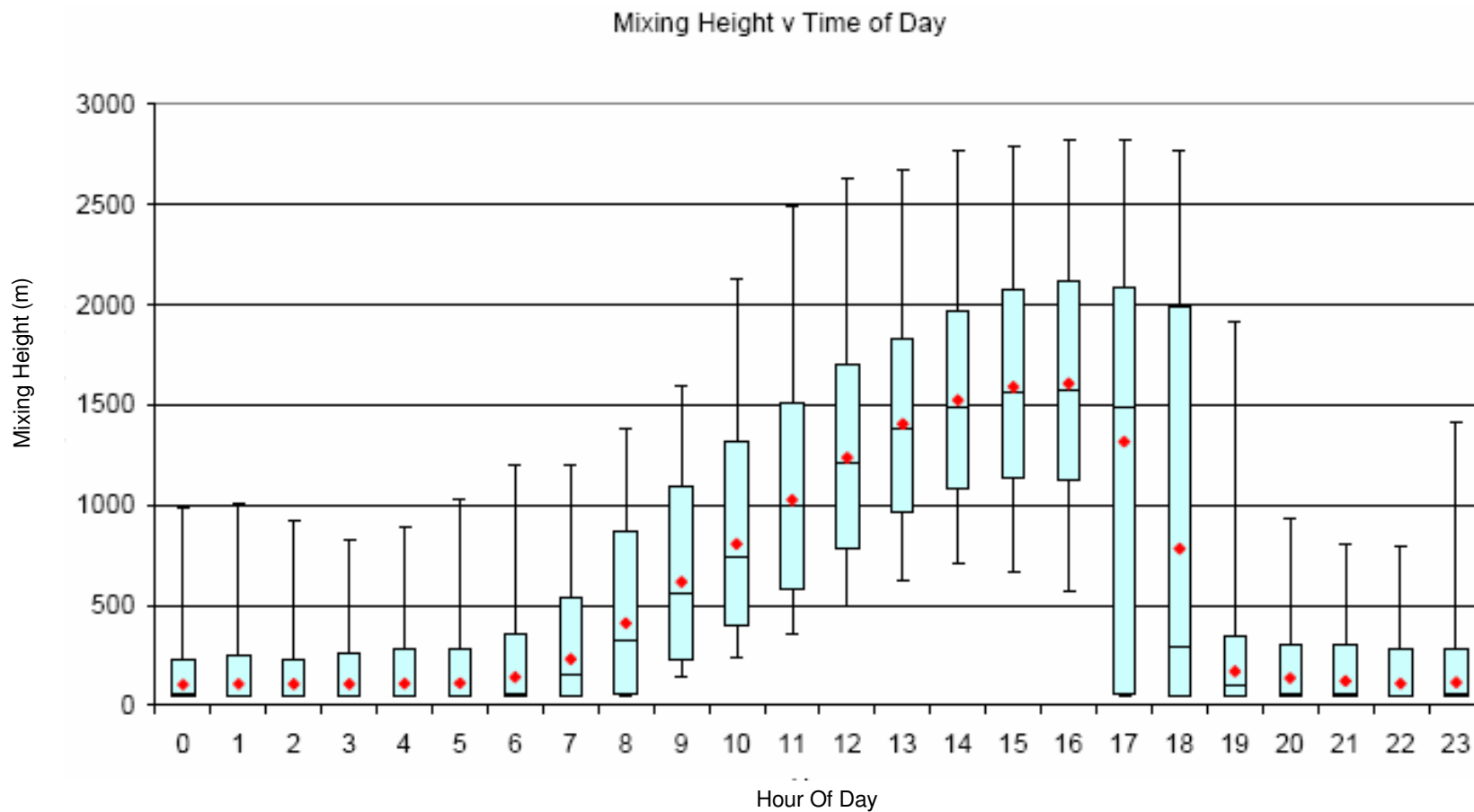


Figure 6 CALMET Mixing Heights
Transpacific Refiners Pty Ltd
Comprehensive Odour Audit Report
Rutherford NSW





Figure 8 Annual Average Oxides of Nitrogen Isopleth
Transpacific Refiners PTY Ltd
Operational Air and Noise Validation Report
Rutherford, NSW



Figure 9 1 Hour Average Sulphur Dioxide Isopleth
Transpacific Refiners PTY Ltd
Operational Air and Noise Validation Report
Rutherford, NSW



Figure 10 24 Hour Average Sulphur Dioxide Isopleth
Transpacific Refiners PTY Ltd
Operational Air and Noise Validation Report
Rutherford, NSW















Figure 17 1 Hour Average Total VOCs Isopleth
Transpacific Refiners PTY Ltd
Operational Air and Noise Validation Report
Rutherford, NSW



Figure 18 1 Hour Average Benzene Isopleth
Transpacific Refiners PTY Ltd
Operational Air and Noise Validation Report
Rutherford, NSW







"This page has been left blank intentionally"

Appendix A

CALPUFF Input Files

TPR Waste Oil Recycling Facility
Air Modelling
Gaseous Pollutants

----- Run title (3 lines) -----

CALPUFF MODEL CONTROL FILE

INPUT GROUP: 0 -- Input and Output File Names

Default Name	Type	File Name
CALMET.DAT	input	! METDAT =M:\TPI\CALMET.DAT !
or		
ISCMET.DAT	input	* ISCDAT = *
or		
PLMMET.DAT	input	* PLMDAT = *
or		
PROFILE.DAT	input	* PRFDAT = *
SURFACE.DAT	input	* SFCDAT = *
RESTARTB.DAT	input	* RSTARTB= *

CALPUFF.LST	output	! PUFLST =M:\TPRAIR\TPRAIR.LST !
CONC.DAT	output	! CONDAT =M:\TPRAIR\CONCAIR.DAT !
DFLX.DAT	output	! DFDAT =M:\TPRAIR\DFLXAIR.DAT !
WFLX.DAT	output	* WFDAT = *

VISB.DAT	output	* VISDAT = *
TK2D.DAT	output	* T2DDAT = *
RHO2D.DAT	output	* RHODAT = *
RESTARTE.DAT	output	* RSTARTE= *

Emission Files

PTEMARB.DAT	input	* PTDAT = *
VOLEMARB.DAT	input	* VOLDAT = *
BAEMARB.DAT	input	* ARDAT = *
LNEMARB.DAT	input	* LNDAT = *

Other Files

OZONE.DAT	input	* OZDAT = *
VD.DAT	input	* VDDAT = *
CHEM.DAT	input	* CHEMDAT= *
H2O2.DAT	input	* H2O2DAT= *
HILL.DAT	input	* HILDAT= *
HILLRCT.DAT	input	* RCTDAT= *
COASTLN.DAT	input	* CSTDAT= *
FLUXBDY.DAT	input	* BDYDAT= *
BCON.DAT	input	* BCNDAT= *
DEBUG.DAT	output	* DEBUG = *
MASSFLX.DAT	output	* FLXDAT= *
MASSBAL.DAT	output	* BALDAT= *
FOG.DAT	output	* FOGDAT= *

All file names will be converted to lower case if LCFILES = T
Otherwise, if LCFILES = F, file names will be converted to UPPER CASE
T = lower case ! LCFILES = F !
F = UPPER CASE

NOTE: (1) file/path names can be up to 70 characters in length

Provision for multiple input files

```

                                TPRAIR.INP
Number of CALMET.DAT files for run (NMETDAT)
                                Default: 1      ! NMETDAT = 1  !

Number of PTEMARB.DAT files for run (NPTDAT)
                                Default: 0      ! NPTDAT = 0  !

Number of BAEMARB.DAT files for run (NARDAT)
                                Default: 0      ! NARDAT = 0  !

Number of VOLEMARB.DAT files for run (NVOLDAT)
                                Default: 0      ! NVOLDAT = 0  !

```

!END!

----- Subgroup (0a) -----

The following CALMET.DAT filenames are processed in sequence if NMETDAT>1

Default Name	Type	File Name
none	input	* METDAT= * *END*

----- INPUT GROUP: 1 -- General run control parameters -----

Option to run all periods found
in the met. file (METRUN) Default: 0 ! METRUN = 0 !

METRUN = 0 - Run period explicitly defined below
METRUN = 1 - Run all periods in met. file

Starting date: Year (IBYR) -- No default ! IBYR = 2004 !
(used only if Month (IBMO) -- No default ! IBMO = 1 !
METRUN = 0) Day (IBDY) -- No default ! IBDY = 1 !
Hour (IBHR) -- No default ! IBHR = 0 !

Base time zone (XBTZ) -- No default ! XBTZ = -10.0 !
PST = 8., MST = 7.
CST = 6., EST = 5.

Length of run (hours) (IRLG) -- No default ! IRLG = 8760 !

Number of chemical species (NSPEC)
Default: 5 ! NSPEC = 9 !

Number of chemical species
to be emitted (NSE) Default: 3 ! NSE = 9 !

Flag to stop run after
SETUP phase (ITEST) Default: 2 ! ITEST = 2 !
(Used to allow checking
of the model inputs, files, etc.)

ITEST = 1 - STOPS program after SETUP phase
ITEST = 2 - Continues with execution of program
after SETUP

Restart Configuration:

Control flag (MRESTART) Default: 0 ! MRESTART = 0 !

0 = Do not read or write a restart file
1 = Read a restart file at the beginning of
the run

TPRAIR.INP

2 = Write a restart file during run
 3 = Read a restart file at beginning of run
 and write a restart file during run

Number of periods in Restart
 output cycle (NRESPD) Default: 0 ! NRESPD = 0 !

0 = File written only at last period
 >0 = File updated every NRESPD periods

Meteorological Data Format (METFM)
 Default: 1 ! METFM = 1 !

METFM = 1 - CALMET binary file (CALMET.MET)
 METFM = 2 - ISC ASCII file (ISCMET.MET)
 METFM = 3 - AUSPLUME ASCII file (PLMMET.MET)
 METFM = 4 - CTDM plus tower file (PROFILE.DAT) and
 surface parameters file (SURFACE.DAT)
 METFM = 5 - AERMET tower file (PROFILE.DAT) and
 surface parameters file (SURFACE.DAT)

Meteorological Profile Data Format (MPRFFM)
 (used only for METFM = 1, 2, 3)
 Default: 1 ! MPRFFM = 1 !

MPRFFM = 1 - CTDM plus tower file (PROFILE.DAT)
 MPRFFM = 2 - AERMET tower file (PROFILE.DAT)

PG sigma-y is adjusted by the factor (AVET/PGTIME)**0.2
 Averaging Time (minutes) (AVET) Default: 60.0 ! AVET = 60. !

PG Averaging Time (minutes) (PGTIME)
 Default: 60.0 ! PGTIME = 60. !

!END!

INPUT GROUP: 2 -- Technical options

Vertical distribution used in the
 near field (MGAUSS) Default: 1 ! MGAUSS = 1 !
 0 = uniform
 1 = Gaussian

Terrain adjustment method
 (MCTADJ) Default: 3 ! MCTADJ = 2 !
 0 = no adjustment
 1 = ISC-type of terrain adjustment
 2 = simple, CALPUFF-type of terrain
 adjustment
 3 = partial plume path adjustment

Subgrid-scale complex terrain
 flag (MCTSG) Default: 0 ! MCTSG = 0 !
 0 = not modeled
 1 = modeled

Near-field puffs modeled as
 elongated slugs? (MSLUG) Default: 0 ! MSLUG = 0 !
 0 = no
 1 = yes (slug model used)

Transitional plume rise modeled?

```

                                TPRAIR.INP
(MTRANS)                        Default: 1      ! MTRANS = 1  !
    0 = no (i.e., final rise only)
    1 = yes (i.e., transitional rise computed)

Stack tip downwash? (MTIP)      Default: 1      ! MTIP = 1  !
    0 = no (i.e., no stack tip downwash)
    1 = yes (i.e., use stack tip downwash)

Method used to simulate building
downwash? (MBDW)                Default: 1      ! MBDW = 1  !
    1 = ISC method
    2 = PRIME method

Vertical wind shear modeled above
stack top? (MSHEAR)             Default: 0      ! MSHEAR = 0  !
    0 = no (i.e., vertical wind shear not modeled)
    1 = yes (i.e., vertical wind shear modeled)

Puff splitting allowed? (MSPLIT) Default: 0      ! MSPLIT = 1  !
    0 = no (i.e., puffs not split)
    1 = yes (i.e., puffs are split)

Chemical mechanism flag (MCHEM)  Default: 1      ! MCHEM = 0  !
    0 = chemical transformation not
        modeled
    1 = transformation rates computed
        internally (MESOPUFF II scheme)
    2 = user-specified transformation
        rates used
    3 = transformation rates computed
        internally (RIVAD/ARM3 scheme)
    4 = secondary organic aerosol formation
        computed (MESOPUFF II scheme for OH)

Aqueous phase transformation flag (MAQCHEM)
(Used only if MCHEM = 1, or 3)  Default: 0      ! MAQCHEM = 0  !
    0 = aqueous phase transformation
        not modeled
    1 = transformation rates adjusted
        for aqueous phase reactions

Wet removal modeled ? (MWET)    Default: 1      ! MWET = 0  !
    0 = no
    1 = yes

Dry deposition modeled ? (MDRY)  Default: 1      ! MDRY = 1  !
    0 = no
    1 = yes
    (dry deposition method specified
     for each species in Input Group 3)

Gravitational settling (plume tilt)
modeled ? (MTILT)               Default: 0      ! MTILT = 0  !
    0 = no
    1 = yes
    (puff center falls at the gravitational
     settling velocity for 1 particle species)

Restrictions:
    - MDRY = 1
    - NSPEC = 1 (must be particle species as well)
    - sg = 0 GEOMETRIC STANDARD DEVIATION in Group 8 is
               set to zero for a single particle diameter

Method used to compute dispersion
coefficients (MDISP)             Default: 3      ! MDISP = 3  !

```

TPRAIR.INP

- 1 = dispersion coefficients computed from measured values of turbulence, sigma v, sigma w
- 2 = dispersion coefficients from internally calculated sigma v, sigma w using micrometeorological variables (u*, w*, L, etc.)
- 3 = PG dispersion coefficients for RURAL areas (computed using the ISCST multi-segment approximation) and MP coefficients in urban areas
- 4 = same as 3 except PG coefficients computed using the MESOPUFF II eqns.
- 5 = CTDM sigmas used for stable and neutral conditions. For unstable conditions, sigmas are computed as in MDISP = 3, described above. MDISP = 5 assumes that measured values are read

Sigma-v/sigma-theta, sigma-w measurements used? (MTURBVW)
 (Used only if MDISP = 1 or 5) Default: 3 ! MTURBVW = 3 !

- 1 = use sigma-v or sigma-theta measurements from PROFILE.DAT to compute sigma-y (valid for METFM = 1, 2, 3, 4, 5)
- 2 = use sigma-w measurements from PROFILE.DAT to compute sigma-z (valid for METFM = 1, 2, 3, 4, 5)
- 3 = use both sigma-(v/theta) and sigma-w from PROFILE.DAT to compute sigma-y and sigma-z (valid for METFM = 1, 2, 3, 4, 5)
- 4 = use sigma-theta measurements from PLMMET.DAT to compute sigma-y (valid only if METFM = 3)

Back-up method used to compute dispersion when measured turbulence data are missing (MDISP2) Default: 3 ! MDISP2 = 3 !
 (used only if MDISP = 1 or 5)

- 2 = dispersion coefficients from internally calculated sigma v, sigma w using micrometeorological variables (u*, w*, L, etc.)
- 3 = PG dispersion coefficients for RURAL areas (computed using the ISCST multi-segment approximation) and MP coefficients in urban areas
- 4 = same as 3 except PG coefficients computed using the MESOPUFF II eqns.

[DIAGNOSTIC FEATURE]
 Method used for Lagrangian timescale for Sigma-y
 (used only if MDISP=1,2 or MDISP2=1,2)
 (MTAULY) Default: 0 ! MTAULY = 0 !

- 0 = Draxler default 617.284 (s)
- 1 = Computed as Lag. Length / (.75 q) -- after SCIPUFF
- 10 < Direct user input (s) -- e.g., 306.9

[DIAGNOSTIC FEATURE]
 Method used for Advective-Decay timescale for Turbulence
 (used only if MDISP=2 or MDISP2=2)
 (MTAUADV) Default: 0 ! MTAUADV = 0 !

- 0 = No turbulence advection
- 1 = Computed (OPTION NOT IMPLEMENTED)
- 10 < Direct user input (s) -- e.g., 300

Method used to compute turbulence sigma-v & sigma-w using micrometeorological variables
 (Used only if MDISP = 2 or MDISP2 = 2)
 (MCTURB) Default: 1 ! MCTURB = 1 !

- 1 = Standard CALPUFF subroutines
- 2 = AERMOD subroutines

TPRAIR.INP

PG sigma-y,z adj. for roughness? Default: 0 ! MROUGH = 0 !
(MROUGH)
0 = no
1 = yes

Partial plume penetration of Default: 1 ! MPARTL = 1 !
elevated inversion?
(MPARTL)
0 = no
1 = yes

Strength of temperature inversion Default: 0 ! MTINV = 0 !
provided in PROFILE.DAT extended records?
(MTINV)
0 = no (computed from measured/default gradients)
1 = yes

PDF used for dispersion under convective conditions? Default: 0 ! MPDF = 0 !
(MPDF)
0 = no
1 = yes

Sub-Grid TIBL module used for shore line? Default: 0 ! MSGTIBL = 0 !
(MSGTIBL)
0 = no
1 = yes

Boundary conditions (concentration) modeled? Default: 0 ! MBCON = 0 !
(MBCON)
0 = no
1 = yes, using formatted BCON.DAT file
2 = yes, using unformatted CONC.DAT file

Note: MBCON > 0 requires that the last species modeled be 'BCON'. Mass is placed in species BCON when generating boundary condition puffs so that clean air entering the modeling domain can be simulated in the same way as polluted air. Specify zero emission of species BCON for all regular sources.

Individual source contributions saved? Default: 0 ! MSOURCE = 0 !
(MSOURCE)
0 = no
1 = yes

Analyses of fogging and icing impacts due to emissions from arrays of mechanically-forced cooling towers can be performed using CALPUFF in conjunction with a cooling tower emissions processor (CTEMISS) and its associated postprocessors. Hourly emissions of water vapor and temperature from each cooling tower cell are computed for the current cell configuration and ambient conditions by CTEMISS. CALPUFF models the dispersion of these emissions and provides cloud information in a specialized format for further analysis. Output to FOG.DAT is provided in either 'plume mode' or 'receptor mode' format.

Configure for FOG Model output? Default: 0 ! MFOG = 0 !
(MFOG)
0 = no
1 = yes - report results in PLUME Mode format
2 = yes - report results in RECEPTOR Mode format

TPRAIR.INP

Test options specified to see if
they conform to regulatory
values? (MREG)

Default: 1 ! MREG = 0 !

0 = NO checks are made
1 = Technical options must conform to USEPA

Long Range Transport (LRT) guidance

METFM 1 or 2
AVET 60. (min)
PGTIME 60. (min)
MGAUSS 1
MCTADJ 3
MTRANS 1
MTIP 1
MCHEM 1 or 3 (if modeling SOx, NOx)
MWET 1
MDRY 1
MDISP 2 or 3
MPDF 0 if MDISP=3
1 if MDISP=2
MROUGH 0
MPARTL 1
SYTDEP 550. (m)
MHFTSZ 0
SVMIN 0.5 (m/s)

!END!

INPUT GROUP: 3a, 3b -- Species list

Subgroup (3a)

The following species are modeled:

! CSPEC = NOX ! !END!
! CSPEC = SO2 ! !END!
! CSPEC = CO ! !END!
! CSPEC = VOC-T ! !END!
! CSPEC = PM10 ! !END!
! CSPEC = TSP0D ! !END!
! CSPEC = H2SO4 ! !END!
! CSPEC = H2S ! !END!
! CSPEC = PAH ! !END!

GROUP	SPECIES	MODELED	EMITTED	Dry DEPOSITED	OUTPUT
NUMBER	NAME	(0=NO, 1=YES)	(0=NO, 1=YES)	(0=NO, 1=COMPUTED-GAS 2=COMPUTED-PARTICLE 3=USER-SPECIFIED)	1=1st 2=2nd 3=
(0=NONE, (Limit: 12 CGRUP, characters CGRUP, in length) etc.)					
!	NOX =	1,	1,	0,	0 !
!	SO2 =	1,	1,	0,	0 !
!	CO =	1,	1,	0,	0 !

```

                                TPRAIR.INP
!      VOC-T   =           1,           1,           0,           0   !
!      PM10    =           1,           1,           0,           0   !
!      TSP0D   =           1,           1,           2,           0   !
!      H2SO4   =           1,           1,           0,           0   !
!      H2S     =           1,           1,           0,           0   !
!      PAH     =           1,           1,           0,           0   !

```

!END!

Note: The last species in (3a) must be 'BCON' when using the boundary condition option (MBCON > 0). Species BCON should typically be modeled as inert (no chem transformation or removal).

----- Subgroup (3b) -----

The following names are used for Species-Groups in which results for certain species are combined (added) prior to output. The CGRUP name will be used as the species name in output files. Use this feature to model specific particle-size distributions by treating each size-range as a separate species. Order must be consistent with 3(a) above.

----- INPUT GROUP: 4 -- Map Projection and Grid control parameters -----

Projection for all (X,Y):

Map projection
(PMAP)

Default: UTM ! PMAP = UTM !

UTM : Universal Transverse Mercator
TTM : Tangential Transverse Mercator
LCC : Lambert Conformal Conic
PS : Polar Stereographic
EM : Equatorial Mercator
LAZA : Lambert Azimuthal Equal Area

False Easting and Northing (km) at the projection origin
(Used only if PMAP= TTM, LCC, or LAZA)

(FEAST) Default=0.0 ! FEAST = 0.000 !
(FNORTH) Default=0.0 ! FNORTH = 0.000 !

UTM zone (1 to 60)

(Used only if PMAP=UTM)

(IUTMZN) No Default ! IUTMZN = 56 !

Hemisphere for UTM projection?

(Used only if PMAP=UTM)

(UTMHEM) Default: N ! UTMHEM = S !

N : Northern hemisphere projection
S : Southern hemisphere projection

Latitude and Longitude (decimal degrees) of projection origin
(Used only if PMAP= TTM, LCC, PS, EM, or LAZA)

(RLAT0) No Default ! RLAT0 = 0N !
(RLON0) No Default ! RLON0 = 0E !

TTM : RLON0 identifies central (true N/S) meridian of projection
RLAT0 selected for convenience

TPRAIR.INP

LCC : RLON0 identifies central (true N/S) meridian of projection
 RLAT0 selected for convenience

PS : RLON0 identifies central (grid N/S) meridian of projection
 RLAT0 selected for convenience

EM : RLON0 identifies central meridian of projection
 RLAT0 is REPLACED by 0.0N (Equator)

LAZA: RLON0 identifies longitude of tangent-point of mapping plane
 RLAT0 identifies latitude of tangent-point of mapping plane

Matching parallel(s) of latitude (decimal degrees) for projection
 (Used only if PMAP= LCC or PS)

(XLAT1) No Default ! XLAT1 = 0N !
 (XLAT2) No Default ! XLAT2 = 0N !

XLAT2 LCC : Projection cone slices through Earth's surface at XLAT1 and
 PS : Projection plane slices through Earth at XLAT1
 (XLAT2 is not used)

 Note: Latitudes and longitudes should be positive, and include a
 letter N,S,E, or W indicating north or south latitude, and
 east or west longitude. For example,
 35.9 N Latitude = 35.9N
 118.7 E Longitude = 118.7E

Datum-region

The Datum-Region for the coordinates is identified by a character string. Many mapping products currently available use the model of the Earth known as the world Geodetic System 1984 (WGS-84). Other local models may be in use, and their selection in CALMET will make its output consistent with local mapping products. The list of Datum-Regions with official transformation parameters is provided by the National Imagery and Mapping Agency (NIMA).

NIMA Datum - Regions(Examples)

WGS-84	WGS-84 Reference Ellipsoid and Geoid, Global coverage (WGS84)
NAS-C	NORTH AMERICAN 1927 Clarke 1866 Spheroid, MEAN FOR CONUS (NAD27)
NAR-C	NORTH AMERICAN 1983 GRS 80 Spheroid, MEAN FOR CONUS (NAD83)
NWS-84	NWS 6370KM Radius, Sphere
ESR-S	ESRI REFERENCE 6371KM Radius, Sphere

Datum-region for output coordinates
 (DATUM) Default: WGS-84 ! DATUM = WGS-G !

METEOROLOGICAL Grid:

Rectangular grid defined for projection PMAP,
 with X the Easting and Y the Northing coordinate

No. X grid cells (NX)	No default	! NX = 121 !
No. Y grid cells (NY)	No default	! NY = 121 !
No. vertical layers (NZ)	No default	! NZ = 7 !
Grid spacing (DGRIDKM)	No default	! DGRIDKM = .25 !
	Units: km	

Cell face heights
 (ZFACE(nz+1)) No defaults
 Units: m

! ZFACE = .0, 20.0, 80.0, 120.0, 280.0, 720.0, 1280.0, 2720.0 !

TPRAIR.INP

Reference Coordinates
of SOUTHWEST corner of
grid cell(1, 1):

X coordinate (XORIGKM)	No default	! XORIGKM = 344.504 !
Y coordinate (YORIGKM)	No default	! YORIGKM = 6364.741 !
Units: km		

COMPUTATIONAL Grid:

The computational grid is identical to or a subset of the MET. grid.
The lower left (LL) corner of the computational grid is at grid point
(IBCOMP, JBCOMP) of the MET. grid. The upper right (UR) corner of the
computational grid is at grid point (IECOMP, JECOMP) of the MET. grid.
The grid spacing of the computational grid is the same as the MET. grid.

X index of LL corner (IBCOMP) (1 <= IBCOMP <= NX)	No default	! IBCOMP = 48 !
Y index of LL corner (JBCOMP) (1 <= JBCOMP <= NY)	No default	! JBCOMP = 48 !
X index of UR corner (IECOMP) (1 <= IECOMP <= NX)	No default	! IECOMP = 71 !
Y index of UR corner (JECOMP) (1 <= JECOMP <= NY)	No default	! JECOMP = 71 !

SAMPLING Grid (GRIDDED RECEPTORS):

The lower left (LL) corner of the sampling grid is at grid point
(IBSAMP, JBSAMP) of the MET. grid. The upper right (UR) corner of the
sampling grid is at grid point (IESAMP, JESAMP) of the MET. grid.
The sampling grid must be identical to or a subset of the computational
grid. It may be a nested grid inside the computational grid.
The grid spacing of the sampling grid is DGRIDKM/MESHDN.

Logical flag indicating if gridded receptors are used (LSAMP) (T=yes, F=no)	Default: T	! LSAMP = T !
X index of LL corner (IBSAMP) (IBCOMP <= IBSAMP <= IECOMP)	No default	! IBSAMP = 51 !
Y index of LL corner (JBSAMP) (JBCOMP <= JBSAMP <= JECOMP)	No default	! JBSAMP = 51 !
X index of UR corner (IESAMP) (IBCOMP <= IESAMP <= IECOMP)	No default	! IESAMP = 68 !
Y index of UR corner (JESAMP) (JBCOMP <= JESAMP <= JECOMP)	No default	! JESAMP = 68 !
Nesting factor of the sampling grid (MESHDN) (MESHDN is an integer >= 1)	Default: 1	! MESHDN = 2 !

!END!

TPRAIR.INP

INPUT GROUP: 5 -- Output Options

FILE	DEFAULT VALUE	VALUE THIS RUN
Concentrations (ICON)	1	! ICON = 1 !
Dry Fluxes (IDRY)	1	! IDRY = 1 !
Wet Fluxes (IWET)	1	! IWET = 0 !
2D Temperature (IT2D)	0	! IT2D = 0 !
2D Density (IRHO)	0	! IRHO = 0 !
Relative Humidity (IVIS) (relative humidity file is required for visibility analysis)	1	! IVIS = 0 !
Use data compression option in output file? (LCOMPRS)	Default: T	! LCOMPRS = T !

*

0 = Do not create file, 1 = create file

QA PLOT FILE OUTPUT OPTION:

Create a standard series of output files (e.g.
locations of sources, receptors, grids ...)
suitable for plotting?

(IQAPLOT) Default: 1 ! IQAPLOT = 1 !
0 = no
1 = yes

DIAGNOSTIC MASS FLUX OUTPUT OPTIONS:

Mass flux across specified boundaries
for selected species reported hourly?

(IMFLX) Default: 0 ! IMFLX = 0 !
0 = no
1 = yes (FLUXBDY.DAT and MASSFLX.DAT filenames
are specified in Input Group 0)

Mass balance for each species
reported hourly?

(IMBAL) Default: 0 ! IMBAL = 0 !
0 = no
1 = yes (MASSBAL.DAT filename is
specified in Input Group 0)

LINE PRINTER OUTPUT OPTIONS:

Print concentrations (ICPRT) Default: 0 ! ICPRT = 1 !
Print dry fluxes (IDPRT) Default: 0 ! IDPRT = 1 !
Print wet fluxes (IWPRT) Default: 0 ! IWPRT = 0 !
(0 = Do not print, 1 = Print)

Concentration print interval
(ICFRQ) in hours Default: 1 ! ICFRQ = 1 !
Dry flux print interval
(IDFRQ) in hours Default: 1 ! IDFRQ = 1 !
Wet flux print interval
(IWFRQ) in hours Default: 1 ! IWFRQ = 1 !

Units for Line Printer Output
(IPRTU) Default: 1 ! IPRTU = 3 !

for
Concentration
1 = g/m**3
for
Deposition
g/m**2/s
Page 11

		TPRAIR.INP
2 =	mg/m**3	mg/m**2/s
3 =	ug/m**3	ug/m**2/s
4 =	ng/m**3	ng/m**2/s
5 =	Odour Units	

Messages tracking progress of run
written to the screen ?

(IMESG) Default: 2 ! IMESG = 2 !
0 = no
1 = yes (advection step, puff ID)
2 = yes (YYYYJJJHH, # old puffs, # emitted puffs)

SPECIES (or GROUP for combined species) LIST FOR OUTPUT OPTIONS

WET FLUXES -----		----- CONCENTRATIONS -----		----- DRY FLUXES -----		-----
SPECIES		-- MASS FLUX --				
SPECIES	/GROUP	PRINTED?	SAVED ON DISK?	PRINTED?	SAVED ON DISK?	PRINTED?
SAVED ON DISK?	SAVED ON DISK?	SAVED ON DISK?	SAVED ON DISK?	SAVED ON DISK?	SAVED ON DISK?	SAVED ON DISK?
!	NOX =	1,	1,	0,	0,	0,
0,		0 !				
!	SO2 =	1,	1,	0,	0,	0,
0,		0 !				
!	CO =	1,	1,	0,	0,	0,
0,		0 !				
!	VOC-T =	1,	1,	0,	0,	0,
0,		0 !				
!	PM10 =	1,	1,	0,	0,	0,
0,		0 !				
!	TSP0D =	1,	1,	1,	1,	0,
0,		0 !				
!	H2SO4 =	1,	1,	0,	0,	0,
0,		0 !				
!	H2S =	1,	1,	0,	0,	0,
0,		0 !				
!	PAH =	1,	1,	0,	0,	0,
0,		0 !				

Note: Species BCON (for MBCON > 0) does not need to be saved on disk.

OPTIONS FOR PRINTING "DEBUG" QUANTITIES (much output)

Logical for debug output (LDEBUG)	Default: F	! LDEBUG = F !
First puff to track (IPFDEB)	Default: 1	! IPFDEB = 1 !
Number of puffs to track (NPFDEB)	Default: 1	! NPFDEB = 1 !
Met. period to start output (NN1)	Default: 1	! NN1 = 1 !
Met. period to end output (NN2)	Default: 10	! NN2 = 10 !

!END!

Subgroup (6a)

Number of terrain features (NHILL) Default: 0 ! NHILL = 0 !

Number of special complex terrain
receptors (NCTREC) Default: 0 ! NCTREC = 0 !

Terrain and CTSR Receptor data for
CTSG hills input in CTDM format ?
(MHILL) No Default ! MHILL = 2 !
1 = Hill and Receptor data created
by CTDM processors & read from
HILL.DAT and HILLRCT.DAT files
2 = Hill data created by OPTHILL &
input below in Subgroup (6b);
Receptor data in Subgroup (6c)

Factor to convert horizontal dimensions Default: 1.0 ! XHILL2M = 1.0 !
to meters (MHILL=1)

Factor to convert vertical dimensions Default: 1.0 ! ZHILL2M = 1.0 !
to meters (MHILL=1)

X-origin of CTDM system relative to No Default ! XCTDMKM = 0 !
CALPUFF coordinate system, in Kilometers (MHILL=1)

Y-origin of CTDM system relative to No Default ! YCTDMKM = 0 !
CALPUFF coordinate system, in Kilometers (MHILL=1)

! END !

Subgroup (6b)

1 **
HILL information

HILL SCALE 1 NO. (m)	XC SCALE 2 (km)	YC AMAX1 (km)	THETAH AMAX2 (deg.) (m)	ZGRID (m)	RELIEF (m)	EXPO 1 (m)	EXPO 2 (m)
----	----	----	-----	-----	-----	-----	-----
-----	-----	-----	-----				

Subgroup (6c)

COMPLEX TERRAIN RECEPTOR INFORMATION

XRCT (km)	YRCT (km)	ZRCT (m)	XHH
-----	-----	-----	----

1

Description of Complex Terrain Variables:
 XC, YC = Coordinates of center of hill
 THETAH = Orientation of major axis of hill (clockwise from
 North)
 ZGRID = Height of the 0 of the grid above mean sea
 level

TPRAIR.INP

RELIEF = Height of the crest of the hill above the grid elevation
 EXPO 1 = Hill-shape exponent for the major axis
 EXPO 2 = Hill-shape exponent for the major axis
 SCALE 1 = Horizontal length scale along the major axis
 SCALE 2 = Horizontal length scale along the minor axis
 AMAX = Maximum allowed axis length for the major axis
 BMAX = Maximum allowed axis length for the major axis

XRCT, YRCT = Coordinates of the complex terrain receptors
 ZRCT = Height of the ground (MSL) at the complex terrain Receptor
 XHH = Hill number associated with each complex terrain receptor
 (NOTE: MUST BE ENTERED AS A REAL NUMBER)

**

NOTE: DATA for each hill and CTSG receptor are treated as a separate input subgroup and therefore must end with an input group terminator.

INPUT GROUP: 7 -- Chemical parameters for dry deposition of gases

SPECIES RESISTANCE NAME	DIFFUSIVITY HENRY'S LAW COEFFICIENT (cm**2/s) (dimensionless)	ALPHA STAR	REACTIVITY	MESOPHYLL (s/cm)
-----	-----	-----	-----	

!END!

INPUT GROUP: 8 -- Size parameters for dry deposition of particles

For SINGLE SPECIES, the mean and standard deviation are used to compute a deposition velocity for NINT (see group 9) size-ranges, and these are then averaged to obtain a mean deposition velocity.

For GROUPED SPECIES, the size distribution should be explicitly specified (by the 'species' in the group), and the standard deviation for each should be entered as 0. The model will then use the deposition velocity for the stated mean diameter.

SPECIES NAME	GEOMETRIC MASS MEAN DIAMETER (microns)	GEOMETRIC STANDARD DEVIATION (microns)
-----	-----	-----
! TSP0D =	2.5,	.0 !

!END!

INPUT GROUP: 9 -- Miscellaneous dry deposition parameters

Reference cuticle resistance (s/cm)
 (RCUTR) Default: 30 ! RCUTR = 30.0 !
 Reference ground resistance (s/cm)

```

                                TPRAIR.INP
(RGR)                        Default: 10      !   RGR = 10.0 !
Reference pollutant reactivity
(REACTR)                    Default: 8        ! REACTR = 8.0 !

Number of particle-size intervals used to
evaluate effective particle deposition velocity
(NINT)                      Default: 9        !   NINT = 9   !

Vegetation state in unirrigated areas
(IVEG)                      Default: 1        !   IVEG = 1   !
    IVEG=1 for active and unstressed vegetation
    IVEG=2 for active and stressed vegetation
    IVEG=3 for inactive vegetation

```

!END!

INPUT GROUP: 10 -- Wet Deposition Parameters

```

                                Scavenging Coefficient -- Units: (sec)**(-1)

Pollutant      Liquid Precip.      Frozen Precip.
-----

```

!END!

INPUT GROUP: 11 -- Chemistry Parameters

```

Ozone data input option (MOZ)      Default: 1          ! MOZ = 0   !
(Used only if MCHEM = 1, 3, or 4)
    0 = use a monthly background ozone value
    1 = read hourly ozone concentrations from
        the OZONE.DAT data file

```

```

Monthly ozone concentrations
(Used only if MCHEM = 1, 3, or 4 and
MOZ = 0 or MOZ = 1 and all hourly O3 data missing)
(BCKO3) in ppb                      Default: 12*80.
!   BCKO3 = 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00,
80.00, 80.00, 80.00 !

```

```

Monthly ammonia concentrations
(Used only if MCHEM = 1, or 3)
(BCKNH3) in ppb                      Default: 12*10.
!   BCKNH3 = 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00,
10.00, 10.00, 10.00 !

```

```

Nighttime SO2 loss rate (RNITE1)
in percent/hour                      Default: 0.2          ! RNITE1 = .2 !

```

```

Nighttime NOx loss rate (RNITE2)
in percent/hour                      Default: 2.0          ! RNITE2 = 2.0 !

```

```

Nighttime HNO3 formation rate (RNITE3)
in percent/hour                      Default: 2.0          ! RNITE3 = 2.0 !

```

```

H2O2 data input option (MH2O2)      Default: 1          ! MH2O2 = 1   !
(Used only if MAQCHEM = 1)

```

TPRAIR.INP

0 = use a monthly background H2O2 value
1 = read hourly H2O2 concentrations from
the H2O2.DAT data file

Monthly H2O2 concentrations

(Used only if MQACHEM = 1 and

MH2O2 = 0 or MH2O2 = 1 and all hourly H2O2 data missing)

(BCKH2O2) in ppb

Default: 12*1.

! BCKH2O2 = 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00 !

--- Data for SECONDARY ORGANIC AEROSOL (SOA) Option
(used only if MCHEM = 4)

The SOA module uses monthly values of:

Fine particulate concentration in ug/m³ (BCKPMF)

Organic fraction of fine particulate (OFRAC)

VOC / NOX ratio (after reaction) (VCNX)

to characterize the air mass when computing
the formation of SOA from VOC emissions.

Typical values for several distinct air mass types are:

Month	1	2	3	4	5	6	7	8	9	10	11	12
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Clean Continental												
BCKPMF	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
OFRAC	.15	.15	.20	.20	.20	.20	.20	.20	.20	.20	.20	.15
VCNX	50.	50.	50.	50.	50.	50.	50.	50.	50.	50.	50.	50.
Clean Marine (surface)												
BCKPMF	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5
OFRAC	.25	.25	.30	.30	.30	.30	.30	.30	.30	.30	.30	.25
VCNX	50.	50.	50.	50.	50.	50.	50.	50.	50.	50.	50.	50.
Urban - low biogenic (controls present)												
BCKPMF	30.	30.	30.	30.	30.	30.	30.	30.	30.	30.	30.	30.
OFRAC	.20	.20	.25	.25	.25	.25	.25	.25	.20	.20	.20	.20
VCNX	4.	4.	4.	4.	4.	4.	4.	4.	4.	4.	4.	4.
Urban - high biogenic (controls present)												
BCKPMF	60.	60.	60.	60.	60.	60.	60.	60.	60.	60.	60.	60.
OFRAC	.25	.25	.30	.30	.30	.55	.55	.55	.35	.35	.35	.25
VCNX	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.
Regional Plume												
BCKPMF	20.	20.	20.	20.	20.	20.	20.	20.	20.	20.	20.	20.
OFRAC	.20	.20	.25	.35	.25	.40	.40	.40	.30	.30	.30	.20
VCNX	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.
Urban - no controls present												
BCKPMF	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.
OFRAC	.30	.30	.35	.35	.35	.55	.55	.55	.35	.35	.35	.30
VCNX	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.

Default: Clean Continental

! BCKPMF = 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00 !

! OFRAC = 0.15, 0.15, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.15 !

! VCNX = 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00 !

!END!

INPUT GROUP: 12 -- Misc. Dispersion and Computational Parameters

```

Horizontal size of puff (m) beyond which
time-dependent dispersion equations (Heffter)
are used to determine sigma-y and
sigma-z (SYTDEP)                                Default: 550.    ! SYTDEP =
5.5E02 !

Switch for using Heffter equation for sigma z
as above (0 = Not use Heffter; 1 = use Heffter
(MHFTSZ)                                Default: 0      ! MHFTSZ = 0
!

Stability class used to determine plume
growth rates for puffs above the boundary
layer (JSUP)                                Default: 5      ! JSUP = 5  !

Vertical dispersion constant for stable
conditions (k1 in Eqn. 2.7-3) (CONK1)        Default: 0.01   ! CONK1 = .01 !

Vertical dispersion constant for neutral/
unstable conditions (k2 in Eqn. 2.7-4)
(CONK2)                                Default: 0.1    ! CONK2 = .1 !

Factor for determining Transition-point from
Schulman-Scire to Huber-Snyder Building Downwash
scheme (SS used for Hs < Hb + TBD * HL)
(TBD)                                Default: 0.5    ! TBD = .5 !
    TBD < 0    ==> always use Huber-Snyder
    TBD = 1.5 ==> always use Schulman-Scire
    TBD = 0.5 ==> ISC Transition-point

Range of land use categories for which
urban dispersion is assumed
(IURB1, IURB2)                                Default: 10     ! IURB1 = 10  !
                                           19         ! IURB2 = 19  !

Site characterization parameters for single-point Met data files -----
(needed for METFM = 2,3,4,5)

Land use category for modeling domain
(ILANDUIN)                                Default: 20     ! ILANDUIN = 20
!

Roughness length (m) for modeling domain
(Z0IN)                                Default: 0.25   ! Z0IN = .25 !

Leaf area index for modeling domain
(XLAIIN)                                Default: 3.0    ! XLAIIN = 3.0 !

Elevation above sea level (m)
(ELEVIN)                                Default: 0.0    ! ELEVIN = .0 !

Latitude (degrees) for met location
(XLATIN)                                Default: -999.  ! XLATIN =
-999.0 !

Longitude (degrees) for met location
(XLONIN)                                Default: -999.  ! XLONIN =
-999.0 !

```

Specialized information for interpreting single-point Met data files -----

Anemometer height (m) (Used only if METFM = 2,3)

```

                                TPRAIR.INP
!      (ANEMHT)                                Default: 10.      ! ANEMHT = 10.0

!      Form of lateral turbulence data in PROFILE.DAT file
!      (Used only if METFM = 4,5 or MTURBVW = 1 or 3)
!      (ISIGMAV)                                Default: 1      ! ISIGMAV = 1
!
!      0 = read sigma-theta
!      1 = read sigma-v
!
!      Choice of mixing heights (Used only if METFM = 4)
!      (IMIXCTDM)                                Default: 0      ! IMIXCTDM = 0
!
!      0 = read PREDICTED mixing heights
!      1 = read OBSERVED mixing heights
!
!      Maximum length of a slug (met. grid units)
!      (MXMLEN)                                Default: 1.0    ! MXMLEN = 1.0 !
!
!      Maximum travel distance of a puff/slug (in
!      grid units) during one sampling step
!      (XSAMLEN)                                Default: 1.0    ! XSAMLEN = 3.0
!
!      Maximum Number of slugs/puffs release from
!      one source during one time step
!      (MXNEW)                                Default: 99     ! MXNEW = 60
!
!      Maximum Number of sampling steps for
!      one puff/slug during one time step
!      (MXSAM)                                Default: 99     ! MXSAM = 60
!
!      Number of iterations used when computing
!      the transport wind for a sampling step
!      that includes gradual rise (for CALMET
!      and PROFILE winds)
!      (NCOUNT)                                Default: 2      ! NCOUNT = 2
!
!      Minimum sigma y for a new puff/slug (m)
!      (SYMIN)                                Default: 1.0    ! SYMIN = 1.0 !
!
!      Minimum sigma z for a new puff/slug (m)
!      (SZMIN)                                Default: 1.0    ! SZMIN = 1.0 !
!
!      Default minimum turbulence velocities sigma-v and sigma-w
!      for each stability class over land and over water (m/s)
!      (SVMIN(12) and SWMIN(12))

```

	LAND						WATER				
Stab Class :	A	B	C	D	E	F	A	B	C	D	E
Default SVMIN :	.50,	.50,	.50,	.50,	.50,	.50,	.37,	.37,	.37,	.37,	.37,
Default SWMIN :	.20,	.12,	.08,	.06,	.03,	.016,	.20,	.12,	.08,	.06,	.03,
! SVMIN =	0.500,	0.500,	0.500,	0.500,	0.500,	0.500,	0.370,	0.370,	0.370,	0.370,	0.370,
! SWMIN =	0.200,	0.120,	0.080,	0.060,	0.030,	0.016,	0.200,	0.120,	0.080,	0.060,	0.016,

Divergence criterion for dw/dz across puff


```

                                TPRAIR.INP
used to initiate adjustment for horizontal
convergence (1/s)
Partial adjustment starts at CDIV(1), and
full adjustment is reached at CDIV(2)
(CDIV(2))                                Default: 0.0,0.0 ! CDIV = .0,
.0 !

Minimum wind speed (m/s) allowed for
non-calm conditions. Also used as minimum
speed returned when using power-law
extrapolation toward surface
(WSCALM)                                Default: 0.5 ! WSCALM = .5 !

Maximum mixing height (m)
(XMAXZI)                                Default: 3000. ! XMAXZI =
3000.0 !

Minimum mixing height (m)
(XMINZI)                                Default: 50. ! XMINZI = 50.0
!

Default wind speed classes --
5 upper bounds (m/s) are entered;
the 6th class has no upper limit
(WSCAT(5))                                Default :
ISC RURAL : 1.54, 3.09, 5.14, 8.23, 10.8
(10.8+)

                                wind Speed Class : 1      2      3      4      5
                                                ---  ---  ---  ---  ---
                                ! WSCAT = 1.54, 3.09, 5.14, 8.23, 10.80 !

Default wind speed profile power-law
exponents for stabilities 1-6
(PLX0(6))                                Default : ISC RURAL values
ISC RURAL : .07, .07, .10, .15, .35, .55
ISC URBAN : .15, .15, .20, .25, .30, .30

                                stability Class : A      B      C      D      E
F
                                ---  ---  ---  ---  ---
                                ! PLX0 = 0.07, 0.07, 0.10, 0.15, 0.35,
0.55 !

Default potential temperature gradient
for stable classes E, F (degK/m)
(PTG0(2))                                Default: 0.020, 0.035
                                ! PTG0 = 0.020, 0.035 !

Default plume path coefficients for
each stability class (used when option
for partial plume height terrain adjustment
is selected -- MCTADJ=3)
(PPC(6))                                stability Class : A      B      C      D      E
F
                                Default PPC : .50, .50, .50, .50, .35,
.35
                                ---  ---  ---  ---  ---
                                ! PPC = 0.50, 0.50, 0.50, 0.50, 0.35,
0.35 !

slug-to-puff transition criterion factor
equal to sigma-y/length of slug
(SL2PF)                                Default: 10. ! SL2PF = 10.0 !

Puff-splitting control variables -----

```

TPRAIR.INP

VERTICAL SPLIT

Number of puffs that result every time a puff
is split - nsplit=2 means that 1 puff splits
into 2

(NSPLIT) Default: 3 ! NSPLIT = 3 !

Time(s) of a day when split puffs are eligible to
be split once again; this is typically set once
per day, around sunset before nocturnal shear develops.
24 values: 0 is midnight (00:00) and 23 is 11 PM (23:00)

0=do not re-split 1=eligible for re-split
(IRESPLIT(24)) Default: Hour 17 = 1

! IRESPLIT = 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0 !

Split is allowed only if last hour's mixing
height (m) exceeds a minimum value

(ZISPLIT) Default: 100. ! ZISPLIT = 100.0

!

Split is allowed only if ratio of last hour's
mixing ht to the maximum mixing ht experienced
by the puff is less than a maximum value (this
postpones a split until a nocturnal layer develops)
(ROLDMAX) Default: 0.25

! ROLDMAX = 0.25

!

HORIZONTAL SPLIT

Number of puffs that result every time a puff
is split - nsplith=5 means that 1 puff splits
into 5

(NSPLITH) Default: 5 ! NSPLITH = 5 !

Minimum sigma-y (Grid Cells Units) of puff
before it may be split

(SYSPLITH) Default: 1.0 ! SYSPLITH = 1.0

!

Minimum puff elongation rate (SYSPLITH/hr) due to
wind shear, before it may be split

(SHSPLITH) Default: 2. ! SHSPLITH = 2.0

!

Minimum concentration (g/m³) of each
species in puff before it may be split
Enter array of NSPEC values; if a single value is
entered, it will be used for ALL species

(CNSPLITH) Default: 1.0E-07 ! CNSPLITH =

1.0E-07 !

Integration control variables -----

Fractional convergence criterion for numerical SLUG
sampling integration

(EPSSLUG) Default: 1.0e-04 ! EPSSLUG =

1.0E-04 !

Fractional convergence criterion for numerical AREA
source integration

(EPSAREA) Default: 1.0e-06 ! EPSAREA =

1.0E-06 !

Trajectory step-length (m) used for numerical rise

TPRAIR.INP

integration
(DSRISE)

Default: 1.0 ! DSRISE = 1.0 !

Boundary Condition (BC) Puff control variables -----

Minimum height (m) to which BC puffs are mixed as they are emitted
(MBCON=2 ONLY). Actual height is reset to the current mixing height
at the release point if greater than this minimum.
(HTMINBC)

Default: 500. ! HTMINBC = 500.0

!

Search radius (km) about a receptor for sampling nearest BC puff.
BC puffs are typically emitted with a spacing of one grid cell
length, so the search radius should be greater than DGRIDKM.
(RSAMPBC)

Default: 10. ! RSAMPBC = 10.0

!

Near-Surface depletion adjustment to concentration profile used when
sampling BC puffs?
(MDEPBC)

Default: 1 ! MDEPBC = 1 !

0 = Concentration is NOT adjusted for depletion
1 = Adjust Concentration for depletion

!END!

INPUT GROUPS: 13a, 13b, 13c, 13d -- Point source parameters

Subgroup (13a)

Number of point sources with
parameters provided below

(NPT1) No default ! NPT1 = 6 !

Units used for point source
emissions below

(IPTU) Default: 1 ! IPTU = 1 !

1 = g/s
2 = kg/hr
3 = lb/hr
4 = tons/yr
5 = Odour Unit * m**3/s (vol. flux of odour compound)
6 = Odour Unit * m**3/min
7 = metric tons/yr

Number of source-species
combinations with variable
emissions scaling factors
provided below in (13d)

(NSPT1) Default: 0 ! NSPT1 = 0 !

Number of point sources with
variable emission parameters
provided in external file

(NPT2) No default ! NPT2 = 0 !

(If NPT2 > 0, these point
source emissions are read from
the file: PTEMARB.DAT)

!END!

Subgroup (13b)

a

TPRAIR.INP
POINT SOURCE: CONSTANT DATA

b

Source Emission No. Rates	X Coordinate (km)	Y Coordinate (km)	Stack Height (m)	Base Elevation (m)	Stack Diameter (m)	Exit Vel. (m/s)	Exit Temp. (deg. K)	Bldg. Dwash
------------------------------------	-------------------------	-------------------------	------------------------	--------------------------	--------------------------	-----------------------	---------------------------	----------------

```

-----
1 ! SRCNAM = 3MWBL !
1 ! X = 359.258, 6379.799, 8.0, 19.3, .65, 3.6, 445.4,
1.0,1.3585E-02, 6.73E-04, 2.6564E-01,
5.38E-04, 5.01E-03, 7.8234E-03, 1.35E-04, 1.345E-03, 1.25E-04 !
1 ! ZPLTFM = .0 !
1 ! FMFAC = 1.0 ! !END!
2 ! SRCNAM = 02MWBL !
2 ! X = 359.261, 6379.799, 10.0, 19.3, .16, 9.68, 510.5,
1.0,6.665E-03, 1.555E-03, 2.0667E-02,
1.441E-03, 7.2E-05, 1.1037E-03, 3.1533E-04, 1.111E-03, 5.47E-06 !
2 ! ZPLTFM = .0 !
2 ! FMFAC = 1.0 ! !END!
3 ! SRCNAM = HEATER !
3 ! X = 359.277, 6379.806, 16.0, 19.3, .4, 5.57, 370.2,
1.0,9.5091E-02, 6.112E-03, 2.7405E-01,
1.457E-03, 4.4E-05, 4.0963E-02, 6.279E-03, 6.373E-03, 5.0E-06 !
3 ! ZPLTFM = .0 !
3 ! FMFAC = 1.0 ! !END!
4 ! SRCNAM = REFORM !
4 ! X = 359.26, 6379.816, 14.0, 19.3, .34, 13.5, 1070.2,
1.0,1.6346E-02, 7.847E-03, 9.79E-04,
1.157E-03, 3.0E-05, 1.647E-03, 2.106E-03, 3.723E-03, 2.0E-06 !
4 ! ZPLTFM = .0 !
4 ! FMFAC = 1.0 ! !END!
5 ! SRCNAM = FLARE !
5 ! X = 359.263, 6379.805, 16.0, 19.3, .95, 3.87, 362.9,
1.0,2.44E-02, 2.3E-02, 3.14E-02,
2.0E-04, 6.2E-03, 6.2E-03, 4.6E-03, 0.0E00, 1.2E-05 !
5 ! ZPLTFM = .0 !
5 ! FMFAC = 1.0 ! !END!
6 ! SRCNAM = LESCRO !
6 ! X = 359.268, 6379.787, 8.0, 19.3, .2, 2.4, 292.7, 1.0,
0.0E00, 1.152E-03, 1.836E-03,
1.7907E-01, 4.23E-04, 4.23E-04, 3.42E-04, 5.5161E-02, 1.9E-05 !
6 ! ZPLTFM = .0 !
6 ! FMFAC = 1.0 ! !END!
-----

```

a

Data for each source are treated as a separate input subgroup and therefore must end with an input group terminator.

SRCNAM is a 12-character name for a source
(No default)

X is an array holding the source data listed by the column headings
(No default)

SIGYZI is an array holding the initial sigma-y and sigma-z (m)
(Default: 0.,0.)

ZPLTFM is the platform height (m) for sources influenced by an isolated structure that has a significant open area between the surface and the bulk of the structure, such as an offshore oil platform. The Base Elevation is that of the surface (ground or ocean), and the Stack Height is the release height above the Base (not above the platform). Building heights entered in Subgroup 13c must be those of the buildings on the platform, measured from

TPRAIR.INP

the platform deck. ZPLTFM is used only with MBDW=1 (ISC downwash method) for sources with building downwash. (Default: 0.0)

FMFAC is a vertical momentum flux factor (0. or 1.0) used to represent the effect of rain-caps or other physical configurations that reduce momentum rise associated with the actual exit velocity. (Default: 1.0 -- full momentum used)

b

0. = No building downwash modeled

1. = Downwash modeled for buildings resting on the surface

2. = Downwash modeled for buildings raised above the surface (ZPLTFM > 0.)

NOTE: must be entered as a REAL number (i.e., with decimal point)

c

An emission rate must be entered for every pollutant modeled. Enter emission rate of zero for secondary pollutants that are modeled, but not emitted. Units are specified by IPTU (e.g. 1 for g/s).

Subgroup (13c)

BUILDING DIMENSION DATA FOR SOURCES SUBJECT TO DOWNWASH

Source

No.

Effective building height, width, length and X/Y offset (in meters) every 10 degrees. LENGTH, XBADJ, and YBADJ are only needed for MBDW=2 (PRIME downwash option)

a

```

-----
1  ! SRCNAM  =  3MWBL  !
1  ! HEIGHT  =  7.0,   7.0,   7.0,   7.0,   7.0,   7.0,
    16.0,   16.0,   16.0,   16.0,   16.0,   16.0,
    16.0,   16.0,   16.0,   16.0,   16.0,   14.0,
    14.0,   14.0,   14.0,   7.0,   7.0,   7.0,
    16.0,   16.0,   16.0,   16.0,   16.0,   16.0,
    16.0,   16.0,   16.0,   16.0,   16.0,   7.0!
1  ! WIDTH   =  9.19,  11.0,  12.5,  13.75,  14.5,  14.5,
    22.0,  21.0,  19.0,  18.0,  19.5,  21.0,
    22.5,  25.5,  26.5,  26.75,  26.38,  39.0,
    40.62,  42.88,  44.0,  13.75,  14.5,  14.5,
    22.0,  21.0,  19.0,  17.5,  20.0,  21.0,
    22.5,  25.5,  26.5,  27.0,  26.38,  10.0!
1  ! LENGTH  =  12.0,  12.5,  13.5,  14.5,  14.0,  13.5,
    21.0,  19.37,  17.0,  16.12,  18.75,  26.25,
    22.25,  26.0,  24.5,  22.5,  19.5,  24.0,
    17.5,  22.5,  28.5,  14.0,  14.0,  13.75,
    21.0,  19.37,  17.0,  16.12,  18.75,  26.25,
    22.25,  26.0,  24.5,  22.0,  19.5,  13.0!
1  ! XBADJ   =  -9.5,  -10.0,  -10.5,  -10.5,  -9.5,  -8.75,
    16.75,  20.25,  23.0,  24.13,  22.5,  25.75,
    17.25,  29.5,  30.0,  30.0,  29.0,  -77.0,
    -73.5,  -74.0,  -73.0,  -4.0,  -4.5,  -4.75,
    -38.0,  -39.63,  -40.0,  -40.25,  -41.25,  -52.0,
    -39.5,  -55.5,  -54.5,  -52.5,  -48.5,  -10.0!
1  ! YBADJ   =  -.16,  -.75,  -1.25,  -1.87,  -2.75,  -2.75,
    -17.0,  -12.0,  -6.5,  -1.0,  4.75,  -18.0,
    15.25,  -3.75,  3.75,  11.12,  18.06,  4.5,
    -5.87,  -17.06,  -27.75,  1.87,  2.25,  2.75,
    17.0,  12.0,  6.5,  .75,  -5.0,  18.0,
    -15.25,  3.75,  -3.75,  -11.25,  -18.06,  .0!
!END!
2  ! SRCNAM  =  02MWBL  !
2  ! HEIGHT  =  7.0,   7.0,   7.0,   7.0,   7.0,   7.0,
    16.0,   16.0,   16.0,   16.0,   16.0,   16.0,
    16.0,   16.0,   16.0,   16.0,   16.0,   14.0,

```

```

TPRAIR.INP
14.0, 14.0, 7.0, 7.0, 7.0, 7.0,
16.0, 16.0, 16.0, 16.0, 16.0, 16.0,
16.0, 16.0, 16.0, 16.0, 16.0, 7.0!
2 ! WIDTH = 9.19, 11.0, 12.5, 13.75, 14.5, 14.5,
22.0, 21.0, 19.0, 18.0, 19.5, 21.5,
22.5, 22.5, 26.5, 26.75, 26.38, 39.0,
40.62, 42.88, 12.5, 13.75, 14.5, 14.5,
22.0, 21.0, 19.0, 17.5, 20.0, 21.5,
22.5, 22.5, 26.5, 27.0, 26.38, 10.0!
2 ! LENGTH = 12.0, 12.5, 13.5, 14.5, 14.0, 13.5,
21.0, 19.37, 17.0, 16.12, 18.75, 20.75,
22.25, 22.5, 24.5, 22.5, 19.5, 24.0,
17.5, 22.5, 13.5, 14.0, 14.0, 13.75,
21.0, 19.37, 17.0, 16.12, 18.75, 20.75,
22.25, 22.5, 24.5, 22.0, 19.5, 13.0!
2 ! XBADJ = -10.0, -11.0, -12.0, -12.0, -12.0, -11.25,
14.0, 17.25, 20.0, 21.13, 19.63, 17.5,
15.0, 12.0, 28.5, 29.0, 28.5, -77.0,
-73.0, -73.0, -2.0, -2.0, -2.5, -2.25,
-35.0, -36.63, -37.0, -37.25, -38.38, -38.25,
-37.25, -34.5, -53.0, -51.5, -48.0, -10.0!
2 ! YBADJ = 2.78, 2.13, 1.25, .62, -.75, -1.25,
-16.0, -11.5, -6.5, -1.5, 3.75, 8.75,
13.25, 17.75, 1.0, 8.37, 15.06, 1.5,
-8.81, -19.94, -1.25, -.37, .75, 1.25,
16.0, 11.5, 6.5, 1.25, -3.5, -8.75,
-13.25, -17.75, -1.25, -8.25, -15.06, 3.0!
!END!
3 ! SRCNAM = HEATER !
3 ! HEIGHT = 16.0, 16.0, 16.0, 16.0, 16.0, 16.0,
16.0, 16.0, 16.0, 16.0, 16.0, 16.0,
16.0, 16.0, 16.0, 16.0, 16.0, 16.0,
16.0, 16.0, 16.0, 16.0, 16.0, 16.0,
16.0, 16.0, 16.0, 16.0, 16.0, 16.0!
3 ! WIDTH = 16.06, 18.75, 20.75, 22.25, 23.0, 23.0,
22.0, 21.0, 19.0, 18.0, 19.5, 21.5,
22.5, 22.5, 22.25, 21.25, 19.37, 17.0,
16.06, 18.63, 20.75, 22.0, 23.0, 23.0,
22.0, 21.0, 19.0, 17.5, 20.0, 21.5,
22.5, 22.5, 22.25, 21.0, 19.37, 17.0!
3 ! LENGTH = 18.0, 20.0, 21.5, 22.5, 23.0, 22.25,
21.0, 19.37, 17.0, 16.12, 18.75, 20.75,
22.25, 22.5, 23.0, 22.5, 21.0, 19.0,
17.5, 19.5, 21.5, 22.5, 22.5, 22.25,
21.0, 19.37, 17.0, 16.12, 18.75, 20.75,
22.25, 22.5, 23.0, 22.0, 21.0, 19.0!
3 ! XBADJ = -20.0, -18.5, -16.5, -13.5, -10.5, -7.0,
-3.5, .25, 4.0, 6.63, 7.0, 7.25,
7.25, 7.0, 6.0, 5.5, 5.0, 4.0,
2.5, -1.5, -5.5, -9.0, -12.0, -15.25,
-17.75, -19.63, -21.0, -22.75, -25.75, -28.0,
-29.5, -29.5, -29.0, -28.0, -26.0, -23.0!
3 ! YBADJ = -14.66, -16.38, -17.63, -18.13, -18.5, -18.0,
-17.0, -15.5, -13.5, -11.0, -8.25, -5.25,
-2.25, .75, 4.13, 7.12, 9.94, 12.5,
14.66, 16.31, 17.37, 18.25, 18.5, 18.0,
17.0, 15.5, 13.5, 11.25, 8.5, 5.25,
2.25, -1.25, -4.13, -7.25, -9.94, -12.5!
!END!
4 ! SRCNAM = REFORM !
4 ! HEIGHT = 7.0, 7.0, 7.0, 14.0, .0, .0,
.0, .0, .0, 16.0, 16.0, 16.0,
16.0, 16.0, 16.0, 16.0, 16.0, 14.0,
14.0, 14.0, 14.0, 14.0, .0, .0,
.0, .0, .0, .0, 16.0, 16.0,
16.0, 16.0, 16.0, 16.0, 16.0, 7.0!
4 ! WIDTH = 9.19, 11.0, 12.5, 43.75, .0, .0,

```

```

TPRAIR.INP
.0, .0, .0, 18.0, 19.5, 21.5,
22.5, 22.5, 22.25, 40.25, 34.75, 39.0,
40.62, 42.88, 44.0, 43.75, .0, .0,
.0, .0, .0, .0, 20.0, 21.5,
22.5, 22.5, 22.25, 27.0, 26.38, 10.0!
4 ! LENGTH = 12.0, 12.5, 13.5, 33.0, .0, .0,
.0, .0, .0, 16.12, 18.75, 20.75,
22.25, 22.5, 23.0, 47.0, 47.0, 24.0,
17.5, 22.5, 28.5, 32.5, .0, .0,
.0, .0, .0, .0, 18.75, 20.75,
22.25, 22.5, 23.0, 22.0, 19.5, 13.0!
4 ! XBADJ = -25.5, -25.5, -25.0, 22.5, .0, .0,
.0, .0, .0, 24.88, 26.13, 26.5,
26.0, 25.0, 22.5, 20.0, 17.0, -61.0,
-57.5, -58.0, -58.0, -55.5, .0, .0,
.0, .0, .0, .0, -44.87, -47.25,
-48.25, -47.5, -45.5, -66.5, -64.0, -26.0!
4 ! YBADJ = -.97, -4.37, -7.75, 28.63, .0, .0,
.0, .0, .0, -17.0, -11.25, -4.75,
1.75, 8.25, 14.38, 10.38, 17.5, 2.5,
-5.06, -13.44, -21.5, -28.87, .0, .0,
.0, .0, .0, .0, 11.0, 4.75,
-1.75, -8.25, -14.38, -3.75, -13.31, 2.0!
!END!
5 ! SRCNAM = FLARE !
5 ! HEIGHT = 7.0, 7.0, 7.0, 7.0, 7.0, 7.0,
7.0, 16.0, 16.0, 16.0, 16.0, 16.0,
16.0, 16.0, 16.0, 16.0, 16.0, 16.0,
14.0, 14.0, 14.0, 7.0, 7.0, 7.0,
7.0, 16.0, 16.0, 16.0, 16.0, 16.0,
16.0, 16.0, 16.0, 16.0, 16.0, 16.0!
5 ! WIDTH = 9.19, 11.0, 12.5, 13.75, 14.5, 14.5,
14.5, 21.0, 19.0, 18.0, 19.5, 21.5,
22.5, 22.5, 22.25, 40.25, 34.75, 28.0,
40.62, 42.88, 44.0, 13.75, 14.5, 14.5,
14.5, 21.0, 19.0, 17.5, 20.0, 21.5,
22.5, 22.5, 22.25, 27.0, 26.38, 25.0!
5 ! LENGTH = 12.0, 12.5, 13.5, 14.5, 14.0, 13.5,
12.75, 19.37, 17.0, 16.12, 18.75, 20.75,
22.25, 22.5, 23.0, 47.0, 47.0, 46.0,
17.5, 22.5, 28.5, 14.0, 14.0, 13.75,
12.75, 19.37, 17.0, 16.12, 18.75, 20.75,
22.25, 22.5, 23.0, 22.0, 19.5, 16.0!
5 ! XBADJ = -16.5, -17.5, -18.0, -18.0, -17.0, -16.0,
-14.5, 14.25, 18.0, 20.19, 19.87, 18.75,
17.25, 15.5, 12.5, 9.5, 6.5, 3.0,
-67.0, -66.5, -65.0, 4.0, 3.0, 2.5,
1.75, -33.63, -35.0, -36.31, -38.63, -39.5,
-39.5, -38.0, -35.5, -56.5, -53.5, -49.0!
5 ! YBADJ = 3.72, 1.87, .0, -1.87, -3.75, -5.25,
-7.25, -17.0, -12.5, -7.5, -2.75, 2.25,
7.25, 12.25, 16.88, 11.12, 16.25, 21.0,
-9.75, -19.69, -29.0, 1.87, 3.75, 5.75,
7.25, 17.0, 12.5, 7.75, 2.5, -2.75,
-7.75, -12.25, -16.88, -4.5, -12.06, -19.5!
!END!
6 ! SRCNAM = LESCRO !
6 ! HEIGHT = 16.0, .0, 16.0, 16.0, 16.0, 16.0,
16.0, 16.0, 16.0, 16.0, 16.0, 16.0,
16.0, 16.0, 16.0, 16.0, 16.0, 16.0,
16.0, .0, 16.0, 16.0, 16.0, 16.0,
16.0, 16.0, 16.0, 16.0, 16.0, 16.0,
16.0, 16.0, 16.0, 16.0, 16.0, 16.0!
6 ! WIDTH = 23.44, .0, 20.75, 22.25, 23.0, 23.0,
22.0, 21.0, 19.0, 18.0, 19.5, 21.0,
22.5, 22.5, 26.5, 26.75, 26.38, 25.0,
23.44, .0, 20.75, 22.0, 23.0, 23.0,
22.0, 21.0, 19.0, 17.5, 20.0, 21.0,

```

```

                                TPRAIR.INP
6      ! LENGTH = 22.5, 22.5, 26.5, 27.0, 26.38, 25.0!
                14.5, .0, 21.5, 22.5, 23.0, 22.25,
                21.0, 19.37, 17.0, 16.12, 18.75, 26.25,
                22.25, 22.5, 24.5, 22.5, 19.5, 16.0,
                14.0, .0, 21.5, 22.5, 22.5, 22.25,
                21.0, 19.37, 17.0, 16.12, 18.75, 26.25,
                22.25, 22.5, 24.5, 22.0, 19.5, 16.0!
6      ! XBADJ = -30.5, .0, 2.0, 4.5, 6.5, 8.75,
                10.5, 11.87, 13.0, 12.69, 10.0, 12.5,
                3.75, .5, 17.5, 18.0, 18.5, 18.0,
                16.0, .0, -23.5, -27.0, -29.0, -31.0,
                -31.5, -31.38, -30.0, -28.81, -28.75, -38.75,
                -26.0, -23.0, -42.0, -40.5, -38.0, -34.0!
6      ! YBADJ = -18.78, .0, -17.37, -14.88, -12.0, -8.5,
                -5.0, -1.0, 2.5, 6.0, 9.75, -15.5,
                15.75, 18.25, -.5, 4.88, 9.69, 14.5,
                18.78, .0, 17.37, 15.0, 12.0, 9.0,
                5.0, 1.0, -2.5, -6.25, -10.0, 15.0,
                -15.75, -18.25, .5, -4.75, -9.81, -14.5!
!END!

```

a
Building height, width, length, and X/Y offset from the source are treated as a separate input subgroup for each source and therefore must end with an input group terminator. The X/Y offset is the position, relative to the stack, of the center of the upwind face of the projected building, with the x-axis pointing along the flow direction.

----- Subgroup (13d) -----

a
POINT SOURCE: VARIABLE EMISSIONS DATA

Use this subgroup to describe temporal variations in the emission rates given in 13b. Factors entered multiply the rates in 13b. Skip sources here that have constant emissions. For more elaborate variation in source parameters, use PTMARB.DAT and NPT2 > 0.

IVARY determines the type of variation, and is source-specific:
(IVARY) Default: 0

0 =	Constant
1 =	Diurnal cycle (24 scaling factors: hours 1-24)
2 =	Monthly cycle (12 scaling factors: months 1-12)
3 =	Hour & Season (4 groups of 24 hourly scaling factors, where first group is DEC-JAN-FEB)
4 =	Speed & Stab. (6 groups of 6 scaling factors, where first group is Stability Class A, and the speed classes have upper bounds (m/s) defined in Group 12)
5 =	Temperature (12 scaling factors, where temperature classes have upper bounds (C) of: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 50+)

a
Data for each species are treated as a separate input subgroup and therefore must end with an input group terminator.

TPRAIR.INP

INPUT GROUPS: 14a, 14b, 14c, 14d -- Area source parameters

Subgroup (14a)

Number of polygon area sources with parameters specified below (NAR1) No default ! NAR1 = 0 !

Units used for area source emissions below (IARU) Default: 1 ! IARU = 1 !

- 1 = g/m**2/s
- 2 = kg/m**2/hr
- 3 = lb/m**2/hr
- 4 = tons/m**2/yr
- 5 = Odour Unit * m/s (vol. flux/m**2 of odour compound)
- 6 = Odour Unit * m/min
- 7 = metric tons/m**2/yr

Number of source-species combinations with variable emissions scaling factors provided below in (14d) (NSAR1) Default: 0 ! NSAR1 = 0 !

Number of buoyant polygon area sources with variable location and emission parameters (NAR2) No default ! NAR2 = 0 !
(If NAR2 > 0, ALL parameter data for these sources are read from the file: BAEMARB.DAT)

!END!

Subgroup (14b)

AREA SOURCE: CONSTANT DATA^a

Source No.	Effect. Height (m)	Base Elevation (m)	Initial Sigma z (m)	Emission Rates ^b
-----	-----	-----	-----	-----

^a Data for each source are treated as a separate input subgroup and therefore must end with an input group terminator.

^b An emission rate must be entered for every pollutant modeled. Enter emission rate of zero for secondary pollutants that are modeled, but not emitted. Units are specified by IARU (e.g. 1 for g/m**2/s).

Subgroup (14c)

COORDINATES (km) FOR EACH VERTEX(4) OF EACH POLYGON

Source No.	Ordered list of x followed by list of y, grouped by source ^a
-----	-----

a
Data for each source are treated as a separate input subgroup
and therefore must end with an input group terminator.

Subgroup (14d)

AREA SOURCE: VARIABLE EMISSIONS DATA^a

Use this subgroup to describe temporal variations in the emission rates given in 14b. Factors entered multiply the rates in 14b. Skip sources here that have constant emissions. For more elaborate variation in source parameters, use BAEMARB.DAT and NAR2 > 0.

IVARY determines the type of variation, and is source-specific:
(IVARY) Default: 0

0 =	Constant
1 =	Diurnal cycle (24 scaling factors: hours 1-24)
2 =	Monthly cycle (12 scaling factors: months 1-12)
3 =	Hour & Season (4 groups of 24 hourly scaling factors, where first group is DEC-JAN-FEB)
4 =	Speed & Stab. (6 groups of 6 scaling factors, where first group is Stability Class A, and the speed classes have upper bounds (m/s) defined in Group 12)
5 =	Temperature (12 scaling factors, where temperature classes have upper bounds (C) of: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 50+)

a
Data for each species are treated as a separate input subgroup
and therefore must end with an input group terminator.

INPUT GROUPS: 15a, 15b, 15c -- Line source parameters

Subgroup (15a)

Number of buoyant line sources
with variable location and emission
parameters (NLN2) No default ! NLN2 = 0 !

(If NLN2 > 0, ALL parameter data for
these sources are read from the file: LNEARB.DAT)

Number of buoyant line sources (NLINES) No default ! NLINES = 0

!

Units used for line source
emissions below (ILNU) Default: 1 ! ILNU = 1 !

- | | |
|-----|---|
| 1 = | g/s |
| 2 = | kg/hr |
| 3 = | lb/hr |
| 4 = | tons/yr |
| 5 = | Odour Unit * m**3/s (vol. flux of odour compound) |

```

                                TPRAIR.INP
6 =      Odour Unit * m**3/min
7 =      metric tons/yr

Number of source-species
combinations with variable
emissions scaling factors
provided below in (15c)          (NSLN1) Default: 0 ! NSLN1 = 0 !

Maximum number of segments used to model
each line (MXNSEG)                Default: 7 ! MXNSEG = 7
!

The following variables are required only if NLINES > 0. They are
used in the buoyant line source plume rise calculations.

!      Number of distances at which          Default: 6 ! NLRISE = 6
!      transitional rise is computed

Average building length (XL)        No default ! XL = .0 !
(in meters)

Average building height (HBL)       No default ! HBL = .0 !
(in meters)

Average building width (WBL)        No default ! WBL = .0 !
(in meters)

Average line source width (WML)     No default ! WML = .0 !
(in meters)

Average separation between buildings (DXL) No default ! DXL = .0 !
(in meters)

!      Average buoyancy parameter (FPRIMEL)  No default ! FPRIMEL = .0
(in m**4/s**3)

!END!

```

Subgroup (15b)

BUOYANT LINE SOURCE: CONSTANT DATA

Source Emission No. Rates	a					
	Beg. X	Beg. Y	End. X	End. Y	Release	Base
	Coordinate	Coordinate	Coordinate	Coordinate	Height	Elevation
	(km)	(km)	(km)	(km)	(m)	(m)
-----	-----	-----	-----	-----	-----	-----

a
Data for each source are treated as a separate input subgroup
and therefore must end with an input group terminator.

b
An emission rate must be entered for every pollutant modeled.
Enter emission rate of zero for secondary pollutants that are
modeled, but not emitted. Units are specified by ILNTU
(e.g. 1 for g/s).

Subgroup (15c)

a

BUOYANT LINE SOURCE: VARIABLE EMISSIONS DATA

Use this subgroup to describe temporal variations in the emission rates given in 15b. Factors entered multiply the rates in 15b. Skip sources here that have constant emissions.

IVARY determines the type of variation, and is source-specific:
(IVARY) Default: 0

0 =	Constant
1 =	Diurnal cycle (24 scaling factors: hours 1-24)
2 =	Monthly cycle (12 scaling factors: months 1-12)
3 =	Hour & Season (4 groups of 24 hourly scaling factors, where first group is DEC-JAN-FEB)
4 =	Speed & Stab. (6 groups of 6 scaling factors, where first group is Stability Class A, and the speed classes have upper bounds (m/s) defined in Group 12)
5 =	Temperature (12 scaling factors, where temperature classes have upper bounds (C) of: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 50+)

a
Data for each species are treated as a separate input subgroup and therefore must end with an input group terminator.

INPUT GROUPS: 16a, 16b, 16c -- volume source parameters

Subgroup (16a)

Number of volume sources with parameters provided in 16b,c (NVL1) No default ! NVL1 = 0 !

Units used for volume source emissions below in 16b (IVLU) Default: 1 ! IVLU = 1 !

1 =	g/s
2 =	kg/hr
3 =	lb/hr
4 =	tons/yr
5 =	Odour Unit * m**3/s (vol. flux of odour compound)
6 =	Odour Unit * m**3/min
7 =	metric tons/yr

Number of source-species combinations with variable emissions scaling factors provided below in (16c) (NSVL1) Default: 0 ! NSVL1 = 0 !

Number of volume sources with variable location and emission parameters (NVL2) No default ! NVL2 = 0 !

(If NVL2 > 0, ALL parameter data for
these sources are read from the VOLEMARB.DAT file(s))

!END!

Subgroup (16b)

a

VOLUME SOURCE: CONSTANT DATA

X Coordinate (km)	Y Coordinate (km)	Effect. Height (m)	Base Elevation (m)	Initial Sigma y (m)	Initial Sigma z (m)	b Emission Rates
-----	-----	-----	-----	-----	-----	-----

a
Data for each source are treated as a separate input subgroup
and therefore must end with an input group terminator.

b
An emission rate must be entered for every pollutant modeled.
Enter emission rate of zero for secondary pollutants that are
modeled, but not emitted. Units are specified by IVLU
(e.g. 1 for g/s).

Subgroup (16c)

a

VOLUME SOURCE: VARIABLE EMISSIONS DATA

Use this subgroup to describe temporal variations in the emission
rates given in 16b. Factors entered multiply the rates in 16b.
Skip sources here that have constant emissions. For more elaborate
variation in source parameters, use VOLEMARB.DAT and NVL2 > 0.

IVARY determines the type of variation, and is source-specific:
(IVARY) Default: 0

0 =	Constant	
1 =	Diurnal cycle (24 scaling factors: hours 1-24)	
2 =	Monthly cycle (12 scaling factors: months 1-12)	
3 =	Hour & Season (4 groups of 24 hourly scaling factors, where first group is DEC-JAN-FEB)	
4 =	Speed & Stab. (6 groups of 6 scaling factors, where first group is Stability Class A, and the speed classes have upper bounds (m/s) defined in Group 12)	
5 =	Temperature (12 scaling factors, where temperature classes have upper bounds (C) of: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 50+)	

a
Data for each species are treated as a separate input subgroup
and therefore must end with an input group terminator.

INPUT GROUPS: 17a & 17b -- Non-gridded (discrete) receptor information

 Subgroup (17a)

Number of non-gridded receptors (NREC) No default ! NREC = 22 !

!END!

 Subgroup (17b)

a
 NON-GRIDDED (DISCRETE) RECEPTOR DATA

Receptor No.		X Coordinate (km)	Y Coordinate (km)	Ground Elevation (m)	Height Above Ground (m)	b
1	! X =	359.81,	6380.106202,	18.900,	0.000!	!END!
2	! X =	360.241,	6379.146736,	17.800,	0.000!	!END!
3	! X =	360.134,	6378.983018,	16.800,	0.000!	!END!
4	! X =	360.115,	6378.788841,	16.800,	0.000!	!END!
5	! X =	359.822,	6378.743152,	16.900,	0.000!	!END!
6	! X =	359.608,	6378.8193,	17.700,	0.000!	!END!
7	! X =	359.814,	6380.102394,	18.900,	0.000!	!END!
8	! X =	359.285,	6380.087165,	19.400,	0.000!	!END!
9	! X =	359.266,	6379.626469,	18.300,	0.000!	!END!
10	! X =	359.372,	6379.61124,	18.300,	0.000!	!END!
11	! X =	359.441,	6379.59601,	18.300,	0.000!	!END!
12	! X =	359.479,	6379.592203,	18.300,	0.000!	!END!
13	! X =	359.536,	6379.588395,	18.300,	0.000!	!END!
14	! X =	359.631,	6379.615047,	18.300,	0.000!	!END!
15	! X =	359.734,	6379.740691,	18.300,	0.000!	!END!
16	! X =	359.696,	6379.908217,	18.700,	0.000!	!END!
17	! X =	359.624,	6379.938676,	18.700,	0.000!	!END!
18	! X =	359.475,	6379.938676,	19.300,	0.000!	!END!
19	! X =	359.281,	6379.969135,	19.300,	0.000!	!END!
20	! X =	359.239,	6379.87395,	19.600,	0.000!	!END!
21	! X =	359.186,	6379.733076,	18.700,	0.000!	!END!
22	! X =	359.171,	6379.641699,	18.700,	0.000!	!END!

 a

Data for each receptor are treated as a separate input subgroup and therefore must end with an input group terminator.

b

Receptor height above ground is optional. If no value is entered, the receptor is placed on the ground.

"This page has been left blank intentionally"

Appendix B

BPIP Output File

=====

BPIP PROCESSING INFORMATION:

=====

PRELIMINARY* GEP STACK HEIGHT RESULTS TABLE
(Output Units: meters)

Stack Name	Stack Height	Stack-Building Base Elevation Differences	GEP** EQN1	Preliminary* GEP Stack Height Value
3MW	8.00	0.00	40.00	65.00
02MW	10.00	0.00	40.00	65.00
FIRHT	16.00	0.00	40.00	65.00
HydR	14.00	0.00	40.00	65.00
LESC	5.00	0.00	40.00	65.00
FLARE	16.00	0.00	40.00	65.00

* Results are based on Determinants 1 & 2 on pages 1 & 2 of the GEP Technical Support Document. Determinant 3 may be investigated for additional stack height credit. Final values result after Determinant 3 has been taken into consideration.

** Results were derived from Equation 1 on page 6 of GEP Technical Support Document. Values have been adjusted for any stack-building base elevation differences.

Note: Criteria for determining stack heights for modeling emission limitations for a source can be found in Table 3.1 of the GEP Technical Support Document.

BPIP output is in meters

SO BUILDHGT	3MW	7.00	7.00	7.00	7.00	7.00	7.00
SO BUILDHGT	3MW	16.00	16.00	16.00	16.00	16.00	16.00
SO BUILDHGT	3MW	16.00	16.00	16.00	16.00	16.00	14.00
SO BUILDHGT	3MW	14.00	14.00	14.00	7.00	7.00	7.00
SO BUILDHGT	3MW	16.00	16.00	16.00	16.00	16.00	16.00
SO BUILDHGT	3MW	16.00	16.00	16.00	16.00	16.00	7.00
SO BUILDWID	3MW	9.19	11.00	12.50	13.75	14.50	14.50
SO BUILDWID	3MW	22.00	21.00	19.00	18.00	19.50	21.00
SO BUILDWID	3MW	22.50	25.50	26.50	26.75	26.38	39.00
SO BUILDWID	3MW	40.62	42.88	44.00	13.75	14.50	14.50
SO BUILDWID	3MW	22.00	21.00	19.00	17.50	20.00	21.00
SO BUILDWID	3MW	22.50	25.50	26.50	27.00	26.38	10.00
SO BUILDLEN	3MW	12.00	12.50	13.50	14.50	14.00	13.50
SO BUILDLEN	3MW	21.00	19.37	17.00	16.12	18.75	26.25
SO BUILDLEN	3MW	22.25	26.00	24.50	22.50	19.50	24.00
SO BUILDLEN	3MW	17.50	22.50	28.50	14.00	14.00	13.75
SO BUILDLEN	3MW	21.00	19.37	17.00	16.12	18.75	26.25
SO BUILDLEN	3MW	22.25	26.00	24.50	22.00	19.50	13.00
SO XBADJ	3MW	-9.50	-10.00	-10.50	-10.50	-9.50	-8.75
SO XBADJ	3MW	16.75	20.25	23.00	24.13	22.50	25.75
SO XBADJ	3MW	17.25	29.50	30.00	30.00	29.00	-77.00
SO XBADJ	3MW	-73.50	-74.00	-73.00	-4.00	-4.50	-4.75
SO XBADJ	3MW	-38.00	-39.63	-40.00	-40.25	-41.25	-52.00
SO XBADJ	3MW	-39.50	-55.50	-54.50	-52.50	-48.50	-10.00
SO YBADJ	3MW	-0.16	-0.75	-1.25	-1.87	-2.75	-2.75
SO YBADJ	3MW	-17.00	-12.00	-6.50	-1.00	4.75	-18.00
SO YBADJ	3MW	15.25	-3.75	3.75	11.12	18.06	4.50

			~BPIP.OUT					
SO	YBADJ	3MW	-5.87	-17.06	-27.75	1.87	2.25	2.75
SO	YBADJ	3MW	17.00	12.00	6.50	0.75	-5.00	18.00
SO	YBADJ	3MW	-15.25	3.75	-3.75	-11.25	-18.06	0.00
SO	BUILDHGT	02MW	7.00	7.00	7.00	7.00	7.00	7.00
SO	BUILDHGT	02MW	16.00	16.00	16.00	16.00	16.00	16.00
SO	BUILDHGT	02MW	16.00	16.00	16.00	16.00	16.00	14.00
SO	BUILDHGT	02MW	14.00	14.00	7.00	7.00	7.00	7.00
SO	BUILDHGT	02MW	16.00	16.00	16.00	16.00	16.00	16.00
SO	BUILDHGT	02MW	16.00	16.00	16.00	16.00	16.00	7.00
SO	BUILDWID	02MW	9.19	11.00	12.50	13.75	14.50	14.50
SO	BUILDWID	02MW	22.00	21.00	19.00	18.00	19.50	21.50
SO	BUILDWID	02MW	22.50	22.50	26.50	26.75	26.38	39.00
SO	BUILDWID	02MW	40.62	42.88	12.50	13.75	14.50	14.50
SO	BUILDWID	02MW	22.00	21.00	19.00	17.50	20.00	21.50
SO	BUILDWID	02MW	22.50	22.50	26.50	27.00	26.38	10.00
SO	BUILDLN	02MW	12.00	12.50	13.50	14.50	14.00	13.50
SO	BUILDLN	02MW	21.00	19.37	17.00	16.12	18.75	20.75
SO	BUILDLN	02MW	22.25	22.50	24.50	22.50	19.50	24.00
SO	BUILDLN	02MW	17.50	22.50	13.50	14.00	14.00	13.75
SO	BUILDLN	02MW	21.00	19.37	17.00	16.12	18.75	20.75
SO	BUILDLN	02MW	22.25	22.50	24.50	22.00	19.50	13.00
SO	XBADJ	02MW	-10.00	-11.00	-12.00	-12.00	-12.00	-11.25
SO	XBADJ	02MW	14.00	17.25	20.00	21.13	19.63	17.50
SO	XBADJ	02MW	15.00	12.00	28.50	29.00	28.50	-77.00
SO	XBADJ	02MW	-73.00	-73.00	-2.00	-2.00	-2.50	-2.25
SO	XBADJ	02MW	-35.00	-36.63	-37.00	-37.25	-38.38	-38.25
SO	XBADJ	02MW	-37.25	-34.50	-53.00	-51.50	-48.00	-10.00
SO	YBADJ	02MW	2.78	2.13	1.25	0.62	-0.75	-1.25
SO	YBADJ	02MW	-16.00	-11.50	-6.50	-1.50	3.75	8.75
SO	YBADJ	02MW	13.25	17.75	1.00	8.37	15.06	1.50
SO	YBADJ	02MW	-8.81	-19.94	-1.25	-0.37	0.75	1.25
SO	YBADJ	02MW	16.00	11.50	6.50	1.25	-3.50	-8.75
SO	YBADJ	02MW	-13.25	-17.75	-1.25	-8.25	-15.06	3.00
SO	BUILDHGT	FIRHT	16.00	16.00	16.00	16.00	16.00	16.00
SO	BUILDHGT	FIRHT	16.00	16.00	16.00	16.00	16.00	16.00
SO	BUILDHGT	FIRHT	16.00	16.00	16.00	16.00	16.00	16.00
SO	BUILDHGT	FIRHT	16.00	16.00	16.00	16.00	16.00	16.00
SO	BUILDHGT	FIRHT	16.00	16.00	16.00	16.00	16.00	16.00
SO	BUILDHGT	FIRHT	16.00	16.00	16.00	16.00	16.00	16.00
SO	BUILDWID	FIRHT	16.06	18.75	20.75	22.25	23.00	23.00
SO	BUILDWID	FIRHT	22.00	21.00	19.00	18.00	19.50	21.50
SO	BUILDWID	FIRHT	22.50	22.50	22.25	21.25	19.37	17.00
SO	BUILDWID	FIRHT	16.06	18.63	20.75	22.00	23.00	23.00
SO	BUILDWID	FIRHT	22.00	21.00	19.00	17.50	20.00	21.50
SO	BUILDWID	FIRHT	22.50	22.50	22.25	21.00	19.37	17.00
SO	BUILDLN	FIRHT	18.00	20.00	21.50	22.50	23.00	22.25
SO	BUILDLN	FIRHT	21.00	19.37	17.00	16.12	18.75	20.75
SO	BUILDLN	FIRHT	22.25	22.50	23.00	22.50	21.00	19.00
SO	BUILDLN	FIRHT	17.50	19.50	21.50	22.50	22.50	22.25
SO	BUILDLN	FIRHT	21.00	19.37	17.00	16.12	18.75	20.75
SO	BUILDLN	FIRHT	22.25	22.50	23.00	22.00	21.00	19.00
SO	XBADJ	FIRHT	-20.00	-18.50	-16.50	-13.50	-10.50	-7.00
SO	XBADJ	FIRHT	-3.50	0.25	4.00	6.63	7.00	7.25
SO	XBADJ	FIRHT	7.25	7.00	6.00	5.50	5.00	4.00
SO	XBADJ	FIRHT	2.50	-1.50	-5.50	-9.00	-12.00	-15.25
SO	XBADJ	FIRHT	-17.75	-19.63	-21.00	-22.75	-25.75	-28.00
SO	XBADJ	FIRHT	-29.50	-29.50	-29.00	-28.00	-26.00	-23.00
SO	YBADJ	FIRHT	-14.66	-16.38	-17.63	-18.13	-18.50	-18.00
SO	YBADJ	FIRHT	-17.00	-15.50	-13.50	-11.00	-8.25	-5.25
SO	YBADJ	FIRHT	-2.25	0.75	4.13	7.12	9.94	12.50
SO	YBADJ	FIRHT	14.66	16.31	17.37	18.25	18.50	18.00
SO	YBADJ	FIRHT	17.00	15.50	13.50	11.25	8.50	5.25
SO	YBADJ	FIRHT	2.25	-1.25	-4.13	-7.25	-9.94	-12.50

~BPIP.OUT

SO	BUILDHGT	HydR	7.00	7.00	7.00	14.00	0.00	0.00
SO	BUILDHGT	HydR	0.00	0.00	0.00	16.00	16.00	16.00
SO	BUILDHGT	HydR	16.00	16.00	16.00	16.00	16.00	14.00
SO	BUILDHGT	HydR	14.00	14.00	14.00	14.00	0.00	0.00
SO	BUILDHGT	HydR	0.00	0.00	0.00	0.00	16.00	16.00
SO	BUILDHGT	HydR	16.00	16.00	16.00	16.00	16.00	7.00
SO	BUILDWID	HydR	9.19	11.00	12.50	43.75	0.00	0.00
SO	BUILDWID	HydR	0.00	0.00	0.00	18.00	19.50	21.50
SO	BUILDWID	HydR	22.50	22.50	22.25	40.25	34.75	39.00
SO	BUILDWID	HydR	40.62	42.88	44.00	43.75	0.00	0.00
SO	BUILDWID	HydR	0.00	0.00	0.00	0.00	20.00	21.50
SO	BUILDWID	HydR	22.50	22.50	22.25	27.00	26.38	10.00
SO	BUILDLN	HydR	12.00	12.50	13.50	33.00	0.00	0.00
SO	BUILDLN	HydR	0.00	0.00	0.00	16.12	18.75	20.75
SO	BUILDLN	HydR	22.25	22.50	23.00	47.00	47.00	24.00
SO	BUILDLN	HydR	17.50	22.50	28.50	32.50	0.00	0.00
SO	BUILDLN	HydR	0.00	0.00	0.00	0.00	18.75	20.75
SO	BUILDLN	HydR	22.25	22.50	23.00	22.00	19.50	13.00
SO	XBADJ	HydR	-25.50	-25.50	-25.00	22.50	0.00	0.00
SO	XBADJ	HydR	0.00	0.00	0.00	24.88	26.13	26.50
SO	XBADJ	HydR	26.00	25.00	22.50	20.00	17.00	-61.00
SO	XBADJ	HydR	-57.50	-58.00	-58.00	-55.50	0.00	0.00
SO	XBADJ	HydR	0.00	0.00	0.00	0.00	-44.87	-47.25
SO	XBADJ	HydR	-48.25	-47.50	-45.50	-66.50	-64.00	-26.00
SO	YBADJ	HydR	-0.97	-4.37	-7.75	28.63	0.00	0.00
SO	YBADJ	HydR	0.00	0.00	0.00	-17.00	-11.25	-4.75
SO	YBADJ	HydR	1.75	8.25	14.38	10.38	17.50	2.50
SO	YBADJ	HydR	-5.06	-13.44	-21.50	-28.87	0.00	0.00
SO	YBADJ	HydR	0.00	0.00	0.00	0.00	11.00	4.75
SO	YBADJ	HydR	-1.75	-8.25	-14.38	-3.75	-13.31	2.00

SO	BUILDHGT	LESC	16.00	0.00	16.00	16.00	16.00	16.00
SO	BUILDHGT	LESC	16.00	16.00	16.00	16.00	16.00	16.00
SO	BUILDHGT	LESC	16.00	16.00	16.00	16.00	16.00	16.00
SO	BUILDHGT	LESC	16.00	0.00	16.00	16.00	16.00	16.00
SO	BUILDHGT	LESC	16.00	16.00	16.00	16.00	16.00	16.00
SO	BUILDHGT	LESC	16.00	16.00	16.00	16.00	16.00	16.00
SO	BUILDWID	LESC	23.44	0.00	20.75	22.25	23.00	23.00
SO	BUILDWID	LESC	22.00	21.00	19.00	18.00	19.50	21.00
SO	BUILDWID	LESC	22.50	22.50	26.50	26.75	26.38	25.00
SO	BUILDWID	LESC	23.44	0.00	20.75	22.00	23.00	23.00
SO	BUILDWID	LESC	22.00	21.00	19.00	17.50	20.00	21.00
SO	BUILDWID	LESC	22.50	22.50	26.50	27.00	26.38	25.00
SO	BUILDLN	LESC	14.50	0.00	21.50	22.50	23.00	22.25
SO	BUILDLN	LESC	21.00	19.37	17.00	16.12	18.75	26.25
SO	BUILDLN	LESC	22.25	22.50	24.50	22.50	19.50	16.00
SO	BUILDLN	LESC	14.00	0.00	21.50	22.50	22.50	22.25
SO	BUILDLN	LESC	21.00	19.37	17.00	16.12	18.75	26.25
SO	BUILDLN	LESC	22.25	22.50	24.50	22.00	19.50	16.00
SO	XBADJ	LESC	-30.50	0.00	2.00	4.50	6.50	8.75
SO	XBADJ	LESC	10.50	11.87	13.00	12.69	10.00	12.50
SO	XBADJ	LESC	3.75	0.50	17.50	18.00	18.50	18.00
SO	XBADJ	LESC	16.00	0.00	-23.50	-27.00	-29.00	-31.00
SO	XBADJ	LESC	-31.50	-31.38	-30.00	-28.81	-28.75	-38.75
SO	XBADJ	LESC	-26.00	-23.00	-42.00	-40.50	-38.00	-34.00
SO	YBADJ	LESC	-18.78	0.00	-17.37	-14.88	-12.00	-8.50
SO	YBADJ	LESC	-5.00	-1.00	2.50	6.00	9.75	-15.50
SO	YBADJ	LESC	15.75	18.25	-0.50	4.88	9.69	14.50
SO	YBADJ	LESC	18.78	0.00	17.37	15.00	12.00	9.00
SO	YBADJ	LESC	5.00	1.00	-2.50	-6.25	-10.00	15.00
SO	YBADJ	LESC	-15.75	-18.25	0.50	-4.75	-9.81	-14.50

SO	BUILDHGT	FLARE	7.00	7.00	7.00	7.00	7.00	7.00
SO	BUILDHGT	FLARE	7.00	16.00	16.00	16.00	16.00	16.00
SO	BUILDHGT	FLARE	16.00	16.00	16.00	16.00	16.00	16.00

			~BPIP.OUT				
SO BUILDHGT	FLARE	14.00	14.00	14.00	7.00	7.00	7.00
SO BUILDHGT	FLARE	7.00	16.00	16.00	16.00	16.00	16.00
SO BUILDHGT	FLARE	16.00	16.00	16.00	16.00	16.00	16.00
SO BUILDWID	FLARE	9.19	11.00	12.50	13.75	14.50	14.50
SO BUILDWID	FLARE	14.50	21.00	19.00	18.00	19.50	21.50
SO BUILDWID	FLARE	22.50	22.50	22.25	40.25	34.75	28.00
SO BUILDWID	FLARE	40.62	42.88	44.00	13.75	14.50	14.50
SO BUILDWID	FLARE	14.50	21.00	19.00	17.50	20.00	21.50
SO BUILDWID	FLARE	22.50	22.50	22.25	27.00	26.38	25.00
SO BUILDLEN	FLARE	12.00	12.50	13.50	14.50	14.00	13.50
SO BUILDLEN	FLARE	12.75	19.37	17.00	16.12	18.75	20.75
SO BUILDLEN	FLARE	22.25	22.50	23.00	47.00	47.00	46.00
SO BUILDLEN	FLARE	17.50	22.50	28.50	14.00	14.00	13.75
SO BUILDLEN	FLARE	12.75	19.37	17.00	16.12	18.75	20.75
SO BUILDLEN	FLARE	22.25	22.50	23.00	22.00	19.50	16.00
SO XBADJ	FLARE	-16.50	-17.50	-18.00	-18.00	-17.00	-16.00
SO XBADJ	FLARE	-14.50	14.25	18.00	20.19	19.87	18.75
SO XBADJ	FLARE	17.25	15.50	12.50	9.50	6.50	3.00
SO XBADJ	FLARE	-67.00	-66.50	-65.00	4.00	3.00	2.50
SO XBADJ	FLARE	1.75	-33.63	-35.00	-36.31	-38.63	-39.50
SO XBADJ	FLARE	-39.50	-38.00	-35.50	-56.50	-53.50	-49.00
SO YBADJ	FLARE	3.72	1.87	0.00	-1.87	-3.75	-5.25
SO YBADJ	FLARE	-7.25	-17.00	-12.50	-7.50	-2.75	2.25
SO YBADJ	FLARE	7.25	12.25	16.88	11.12	16.25	21.00
SO YBADJ	FLARE	-9.75	-19.69	-29.00	1.87	3.75	5.75
SO YBADJ	FLARE	7.25	17.00	12.50	7.75	2.50	-2.75
SO YBADJ	FLARE	-7.75	-12.25	-16.88	-4.50	-12.06	-19.50

Appendix C

Emissions Inventory

Emission Inventory

Source	Month	Year	Pollutants ¹	Stack Diameter ²	Stack Height	Exit Temp	Exit Velocity	Flow Rate	Flow Rate
				(m)	(m)	(°C)	(m/s)*	(Am ³ /s)*	(Nm ³ /s)**
3MW Boiler (DECC Point 2)	March	2008	10	0.65	8	180.3	4.2	1.40	0.80
	March	2008	2, 5, 6, 8			180.3	4.30	1.40	0.80
	July	2008	5, 6			162.4	2.96	0.98	0.53
	August	2008	5			166.1	2.94	0.98	0.56
Average Stack Characteristics				0.65	8	172.3	3.60	1.19	0.67
PAE Emission Inventory Data				0.3	12	300	27.9	1.97	0.94
0.2MW Boiler (DECC Point 3)	March	2008	9	0.16	10	242.5	10.00	0.30	0.10
	March	2008	2, 5, 8			227.5	10.00	0.30	0.20
	August	2008	5			241.9	9.05	0.28	0.13
Average Stack Characteristics				0.16	10	237.3	9.68	0.29	0.14
PAE Emission Inventory Data				0.12	10	300	20.9	0.24	0.11
Fired Heater (DECC Point 19)	March	2008	9	0.4	16	112.0	5.60	0.70	0.40
	March	2008	2, 5, 8			110.4	5.60	0.70	0.35
	July	2008	2, 5, 8			86.8	6.60	0.83	0.60
	August	2008	2, 5, 8			79.0	4.48	0.56	0.39
Average Stack Characteristics				0.4	16	97.1	5.57	0.70	0.44
PAE Emission Inventory Data				0.2	16	320	26.9	0.85	0.39
Reformer Burner (DECC Point 20)	March	2008	9	0.34	14	772.9	12.80	1.20	0.30
	March	2008	2, 5, 8			770.3	12.80	1.20	0.30
	August	2008	2, 5, 8, 9			848.0	14.90	1.35	0.29
Average Stack Characteristics				0.34	14	797.1	13.50	1.25	0.30
PAE Emission Inventory Data				0.6	6	918	2	0.57	0.13
Light End Scrubber (DECC Point 5)	March	2008	2, 8, 9	0.2	8	20.4	2.40	0.10	0.10
	March	2008	5, 6			19.9	2.40	0.10	0.10
	August	2008	9			18.2	2.40	0.08	0.07
Average Stack Characteristics				0.2	8	19.5	2.40	0.09	0.09
PAE Emission Inventory Data				NA	NA	NA	NA	NA	NA
Flare (DECC Point 4)	March	2008	2, 8, 9	0.95	16	71.7	3.70	2.60	2.00
	March	2008	5, 6			87.9	3.80	2.70	2.00
	August	2008	Flow rate only			109.5	4.10	2.90	2.00
Average Stack Characteristics				0.95	16	89.7	3.87	2.73	2.00
PAE Emission Inventory Data				0.445	16	1000	10	1.56	0.33

Pacific Air and Environment (PAE) *Measured at stack conditions. **Normalised 0°C 1 atmosphere. ¹ 1 = NO_x, 2 = SO₂, 3 = CO, 4 = VOC, 5 = TP, 6 = PM₁₀, 7 = H₂S, 8 = H₂SO₄, 9 = PAH, 10 = Hazardous Substances (Metals). ² Stack Diameter at sampling plane

Appendix D

Stack Emission Reports

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Prepared for:

Transpacific Refineries Pty. Ltd.

11 Kyle Street

Rutherford NSW 2320

Transpacific Refiners Pty. Ltd. Emission Testing (Re-Test) Report 2008

ENSR Australia Pty Ltd (ENSR)



NATA ACCREDITATION No. 2778 (14391)

Accredited for compliance with ISO/IEC 17025

This document is issued in accordance with NATA's accreditation requirements.

This document may not be reproduced except in full.

ENSR Australia Pty Ltd (ENSR)

24 September 2008

Document No.: N4079510_Retest_Rpt_Sep08.doc

Distribution

Transpacific Refiners Pty. Ltd. Emission Testing (Re-Test) Report 2008

September 2008

Copies	Recipient	Copies	Recipient
1	Ken Telfer Transpacific Refiners Pty. Ltd. 11 Kyle Street Rutherford NSW 2320	1	ENSR File Copy

© ENSR Australia Pty Ltd (ENSR)

- * This document was prepared for the sole use of the party identified on the cover sheet, and that party is the only intended beneficiary of ENSR Australia Pty Ltd (ENSR) work.
- * No other party should rely on the document without the prior written consent of ENSR, and ENSR undertakes no duty to, nor accepts any responsibility to, any third party who may rely upon this document.
- * All rights reserved. No section or element of this document may be removed from this document, extracted, reproduced, electronically stored or transmitted in any form without the prior written permission of ENSR

By

ENSR Australia Pty Ltd (ENSR)

ABN: 34 060 204 702

17 Warabrook Boulevard Warabrook NSW 2304

PO Box 73 Hunter Region MC NSW 2310

Ph: +61 2 4911 4900 Fax: +61 2 4911 4999



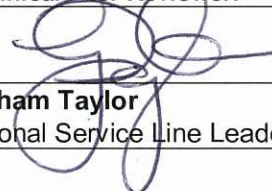
Christopher Burns
Emission Scientist



Chad Whitburn
Senior Environmental Scientist

Technical Peer Reviewer:

Date:

	24/9/08
Graham Taylor National Service Line Leader	

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Contents

1.0	INTRODUCTION.....	1
2.0	SAMPLING PLANE REQUIREMENTS.....	3
3.0	METHODOLOGY.....	5
3.1	NATA Accredited Methods	5
3.2	Deviations from NATA Accredited Test Procedures	6
4.0	SAMPLING LOCATION	7
4.1	Sampling Location Summary.....	7
5.0	EQUIPMENT CALIBRATION.....	9
6.0	RESULTS	11
7.0	REFERENCES.....	17

List of Tables

Body Report

Table 1: Criteria for Selection of Sampling Planes (AS 4323.1-1995)	3
Table 2: ENSR NATA Endorsed Methods.....	5
Table 3: Sampling Location Summary	7
Table 4: Emission Testing Results Summary for DECC Points 1, 18 and 19; July 2008	11
Table 5: Emission Testing Results Summary for DECC Points 2, 4 and 5; July 2008	11
Table 6: Fired Heater DECC Point 19 Total Particulate, Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃), Sulfur Dioxide (SO ₂ as SO ₃) Results, 22 July 2008	12
Table 7: SS Heater DECC Point 1 Total Particulate, Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃), Sulfur Dioxide (SO ₂ as SO ₃) Results 22 July 2008	13
Table 8: Thermal Oil Heater DECC Point 18 Total Particulate, Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃), Sulfur Dioxide (SO ₂ as SO ₃) Results 22 July 2008	14
Table 9: 3MW Boiler DECC Point 2 Fine Particulate (PM ₁₀) and Total Particulate Results, 23 July 2008.....	15
Table 10: Light End Scrubber DECC Point 5 Volatile Organic Compounds Results 22 July 2008	16

List of Appendices

Appendix A Field Sheets
Appendix B Analytical Laboratory Results
Appendix C Raw and Calculated Gas Data

“This page has been left blank intentionally”

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

September 2008

ii

Transpacific Refiners Pty. Ltd. Emission Testing (Re-
Test) Report 2008

Commercial in Confidence

N4079510_Retest_Rpt_Sep08.doc

1.0 Introduction

ENSR was appointed by Transpacific Refiners Pty. Ltd. to conduct a series of measurements to determine stack gas emissions from the oil refinery in Rutherford NSW. Emission testing is a compliance requirement of Environmental Protection Licence conditions (EPL No 12555).

Testing was conducted during July 2008 to investigate emission concentrations from following points for the following parameters:

SS Heater (DECC Point 1), Thermal Oil Heater (DECC Point 18) and Fired Heater (DECC Point 19):

- Total Particulate (TP);
- Sulfuric Acid Mist (H_2SO_4 as SO_3); and
- Sulfur Dioxide (SO_2 as SO_3).

3MW Boiler (DECC Point 2):

- Total Particulate (TP); and
- Fine Particulate (PM_{10}).

Flare Stack (DECC Point 4):

- Total Oxides of Nitrogen (NO_x as Equivalent NO_2);
- Nitrogen Oxide (NO);
- Oxides of Nitrogen (NO_x);
- Nitrogen Dioxide (NO_2); and
- Carbon Monoxide (CO).

Light End Scrubber (DECC Point 5):

- Volatile Organic Compounds (VOCs); and
- Hydrogen Sulfide (H_2S); and
- Carbon Monoxide (CO).

Laboratory analysis was conducted by the following laboratories, which hold NATA accreditation for the specified tests:

- Australian Laboratory Services (ALS), accreditation number 825, laboratory report number EN0801373 for analysis of:
 - Total Particulate (TP);
 - Fine Particulate (PM_{10});
 - Sulfuric Acid Mist (H_2SO_4 as SO_3);
 - Sulfur Dioxide (SO_2 as SO_3);
 - Volatile Organic Compounds (VOCs); and
 - Hydrogen Sulfide (H_2S).

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

"This page has been left blank intentionally"

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

September 2008

2

Transpacific Refiners Pty. Ltd. Emission Testing (Re-
Test) Report 2008

Commercial in Confidence

N4079510_Retest_Rpt_Sep08.doc

2.0 Sampling Plane requirements

The criteria for sampling planes are specified in AS 4323.1-1995.

Table 1: Criteria for Selection of Sampling Planes (AS 4323.1-1995)

Type of flow disturbance	Minimum distance upstream from disturbance, diameters (D)	Minimum distance downstream from disturbance, diameters (D)
Bend, connection, junction, direction change	>2D	>6D
Louvre, butterfly damper (partially closed or closed)	>3D	>6D
Axial fan	>3D	>8D (see Note)
Centrifugal fan	>3D	>6D

NOTE: The plane should be selected as far as practicable from a fan. Flow straighteners may be required to ensure the position chosen meets the check criteria listed in Items (a) to (f) below.

- The gas flow is basically in the same direction at all points along each sampling traverse.*
- The gas velocity at all sampling points is greater than 3 m/s.*
- The gas flow profile at the sampling plane shall be steady, evenly distributed and not have a cyclonic component which exceeds an angle of 15° to the duct axis, when measured near the periphery of a circular sampling plane.*
- The temperature difference between adjacent points of the survey along each sampling traverse is less than 10% of the absolute temperature, and the temperature at any point differs by less than 10% from the mean.*
- The ratio of the highest to lowest pitot pressure difference shall not exceed 9:1 and the ratio of highest to lowest gas velocities shall not exceed 3:1. For isokinetic testing with the use of impingers, the gas velocity ratio across the sampling plane should not exceed 1.6:1.*
- The gas temperature at the sampling plane should preferably be above the dewpoint.*

DECC Points 1, 2, 4 and 5 did not meet the criteria stated above in regards to the minimum distances of the sampling planes from disturbances. To compensate for this, correction factors were applied for sampling at these points. In addition to this all of the DECC points met the criteria stated above, from a-f, apart from DECC Point 5 which did not satisfy criteria 'b'.

“This page has been left blank intentionally”

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

September 2008

4

Transpacific Refiners Pty. Ltd. Emission Testing (Re-
Test) Report 2008

Commercial in Confidence

N4079510_Retest_Rpt_Sep08.doc

3.0 Methodology

3.1 NATA Accredited Methods

The following methods are accredited with the National Association of Testing Authorities (NATA) (accreditation number 2778 (14391)) and are approved for the sampling and analysis of gases. Specific details of the methods are available on request.

All sampling and analysis is conducted according to the methods in **Table 2**.

Table 2: ENSR NATA Endorsed Methods

NSW DECC Approved Methods	USEPA Methods	Method Title
NSW DECC TM1 (AS4323.1)	USEPA (2000) Method 1	Selection of sampling positions
NSW DECC TM-15 (AS4323.2)	USEPA (2000) Method 5 under approved circumstances	Determination of total particulate matter – isokinetic manual sampling – gravimetric method
NSW DECC TM-2	USEPA (2000) Method 2 or 2C or USEPA (1999) Method 2F or 2G or 2H (as appropriate)	Determination of stack gas velocity and volumetric flow rate (type s pitot tube)
NSW DECC TM-3	USEPA (2000) Method 8	Determination of sulfuric acid mist or sulfur trioxide emissions from stationary sources
NSW DECC TM-4	USEPA (2000) Method 6 or 6A or 6B	Determination of sulfur dioxide emissions from stationary sources
NSW DECC TM-22	USEPA (2000) Method 4	Determination of moisture content in stack gases
NSW DECC TM-23	USEPA (2000) Method 3	Gas analysis for the determination of dry molecular weight
NSW DECC TM-34	USEPA (2000) Method 18	Volatile organic compounds
NSW DECC OM-5	USEPA (1997) Method 201 or 201A (as appropriate)	Determination of PM ₁₀ emissions

All parameters are reported adjusted to 0°C at 1 atmosphere and dry gas.

3.2 Deviations from NATA Accredited Test Procedures

The following tests were conducted that are not covered under the terms of our NATA accreditation:

- NSW DECC TM-5 USEPA Method 11.
- NSW DECC TM-11 USEPA Method 7E Oxides of Nitrogen, Instrumental Method.
- NSW DECC TM-32 USEPA Method 10 Carbon Monoxide.
- NSW DECC Special Method 1 USEPA Method 323 Formaldehyde.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

4.0 Sampling Location

4.1 Sampling Location Summary

Table 3 provides a summary of the locations sampled by ENSR during July 2008.

Table 3: Sampling Location Summary

Discharge Description	SS Heater DECC Point 1	3.0 MW Boiler DECC Point 2	Flare DECC Point 4
Duct Shape	Circular	Circular	Circular
Construction Material	Metal	Metal	Metal
Duct Diameter (mm)	240	650	950
Minimum No. Sampling Points	4	8	12
Sampling Ports	2	2	2
Min. Points/Traverse	2	4	6
Disturbance	Yes	Yes	Yes
Distance from Upstream Disturbance	~4D	~3D	~4D
Type of Disturbance	Change in Diameter	Boiler Entry	Junction
Distance from Downstream Disturbance	~4D	~15D	~5D
Type of Disturbance	Bend	Stack Exit	Stack Exit
Ideal Sampling Location	No	No	No
Correction Factors Applied	Yes	Yes	Yes
Total No. Points Sampled	8	12	16
Points/Traverse	4	6	8
Sampling Performed to Standard*	Yes ²	Yes ²	Yes ²

*AS 4323.1 Stationary source emissions Method 1 – Selection of sampling positions

¹ AS 4323.1 Section 4.1

² AS 4323.1 Section 4.2

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Discharge Description	Light End Scrubber DECC Point 5	TO Fired Heater DECC Point 18	Fired Heater DECC Point 19
Duct Shape	Circular	Circular	Circular
Construction Material	Metal	Metal	Metal
Duct Diameter (mm)	165	380	400
Minimum No. Sampling Points	4	8	8
Sampling Ports	2	2	2
Min. Points/Traverse	2	4	4
Disturbance	Yes	No	No
Distance from Upstream Disturbance	~3D	~10D	~12D
Type of Disturbance	Change in Diameter	Bend	Bend
Distance from Downstream Disturbance	~2D	~5D	~25D
Type of Disturbance	Stack Exit	Bend	Stack Exit
Ideal Sampling Location	No	Yes	Yes
Correction Factors Applied	Yes	No	No
Total No. Points Sampled	8	8	8
Points/Traverse	4	4	4
Sampling Performed to Standard*	Yes ²	Yes ¹	Yes ¹

*AS 4323.1 Stationary source emissions Method 1 – Selection of sampling positions

¹ AS 4323.1 Section 4.1

² AS 4323.1 Section 4.2

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

5.0 Equipment Calibration

ENSR has a calibration schedule to ensure the emission testing equipment is maintained in good order and with known calibration. Equipment used in this project was calibrated according to the procedures and frequency identified in the ENSR calibration schedule. Details of the schedule and the calibration calculations are available on request.

"This page has been left blank intentionally"

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

September 2008

10

Transpacific Refiners Pty. Ltd. Emission Testing (Re-
Test) Report 2008

Commercial in Confidence

N4079510_Retest_Rpt_Sep08.doc

6.0 Results

A summary of air emission test results of the Re-Test carried out on 22 and 23 July 2008 is shown in **Tables 5 - 6**. Detailed results along with gas stream properties during the testing periods can be found in **Tables 7-10**. Speciated Volatile Organic Compound results are presented in **Tables 11**.

Emission concentrations are converted to standard conditions of 0°C, dry gas and 1 atmosphere pressure for comparison with regulatory limits outlined in the Transpacific Refiners Pty. Ltd. Environmental Protection Licence (EPL) number 12555.

Field sheets and final calculations are attached as **Appendix A**. Laboratory reports can be referred to in **Appendix B**. **Appendix C** contains raw and calculated gas data relating to Oxides of Nitrogen, Nitrogen Oxide, Nitrogen Dioxide and Carbon Monoxide.

Table 4: Emission Testing Results Summary for DECC Points 1, 18 and 19; July 2008

Parameter	SS Heater DECC Point 1	Thermal Oil Heater DECC Point 18	Fired Heater DECC Point 19
Total Particulate (TP) (mg/m ³)	17	2.7	59
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) (mg/m ³)	4	<2.5	3.8
Sulfur Dioxide (SO ₂ as SO ₃) (mg/m ³)	<13	<12	<13

Table 5: Emission Testing Results Summary for DECC Points 2, 4 and 5; July 2008

Parameter	3MW Boiler DECC Point 2	Flare Stack DECC Point 4	Light End Scrubber DECC Point 5
Fine Particulate (PM ₁₀) (mg/m ³)	11*	NA	NA
Total Particulate (TP) (mg/m ³)	5.8*	NA	NA
Total Volatile Organic Compounds (VOC) (mg/m ³)	NA	NA	507.6
Hydrogen Sulfide (H ₂ S) (mg/m ³)	NA	NA	612.9
Oxides of Nitrogen (NO _x) as Equivalent NO ₂ (mg/m ³)	NA	18.6	NA
Nitrogen Oxide (NO) (mg/m ³)	NA	12.0	NA
Oxides of Nitrogen (NO _x) (mg/m ³)	NA	12.2	NA
Nitrogen Dioxide (NO ₂) (mg/m ³)	NA	0.2	NA
Carbon Monoxide (CO) (mg/m ³)	NA	15.7	20.4

Note* The fine Particulate (PM₁₀) result was slightly higher than the Total Particulate (TP) result for DECC Point 2. This can be attributed to the high moisture content in the stack (11.1%) and the adverse effect it can have on the PM₁₀ cyclone head.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 6: Fired Heater DECC Point 19 Total Particulate, Sulfuric Acid Mist (H₂SO₄ as SO₃), Sulfur Dioxide (SO₂ as SO₃) Results, 22 July 2008

Sampling Conditions:			
Stack internal diameter at test location	400	mm	
Stack gas temperature (average)	86.8	°C	360.0 K
Stack pressure (average)	1022.7	hPa	
Stack gas velocity (average, stack conditions)	6.6	m/s	
Stack gas flowrate (stack conditions)	0.83	m ³ /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	0.6	m ³ /s	
Total Particulate Testing			
Test Period	12:19	-	13:22
Total Particulate Mass	46.1	mg	
Gas Volume Sampled	0.7849	m ³	
Total Particulate Emission* ¹	59	mg/m ³	
Total Particulate Mass Emission Rate* ²	36	mg/s	
Regulatory Limit	10	mg/m ³	
Sulfuric Acid Mist (H₂SO₄ as SO₃) Testing			
Test Period	12:19	-	13:22
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Mass	3	mg	
Gas Volume Sampled	0.7849	m ³	
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Emission* ¹	3.8	mg/m ³	
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Mass Emission Rate* ²	2.3	mg/s	
Regulatory Limit	100	mg/m ³	
Sulfur Dioxide (SO₂ as SO₃) Testing			
Test Period	12:19	-	13:22
Sulfur Dioxide (SO ₂ as SO ₃) Mass	<10	mg	
Gas Volume Sampled	0.7849	m ³	
Sulfur Dioxide (SO ₂ as SO ₃) Emission* ¹	<13	mg/m ³	
Sulfur Dioxide (SO ₂ as SO ₃) Mass Emission Rate* ²	<7.9	mg/s	
Regulatory Limit	1360	mg/m ³	
Moisture Content (%)	4.8		
Gas Density (dry at 1 atmosphere)	1.31	kg/m³	
Dry Molecular Weight	29.35	g/g-mole	

Notes *1 Emission concentration at Standard conditions of (0°C, 1 atm, dry gas)

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 7: SS Heater DECC Point 1 Total Particulate, Sulfuric Acid Mist (H₂SO₄ as SO₃), Sulfur Dioxide (SO₂ as SO₃) Results 22 July 2008

Sampling Conditions:			
Stack internal diameter at test location	240	mm	
Stack gas temperature (average)	39.7	°C	312.9 K
Stack pressure (average)	1022.8	hPa	
Stack gas velocity (average, stack conditions)	3.55	m/s	
Stack gas flowrate (stack conditions)	0.16	m ³ /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	0.13	m ³ /s	
Total Particulate Testing			
Test Period	12:19	-	13:22
Total Particulate Mass	12.7	mg	
Gas Volume Sampled	0.7579	m ³	
Total Particulate Emission* ¹	17	mg/m ³	
Total Particulate Mass Emission Rate* ²	2.2	mg/s	
Regulatory Limit	NA		
Sulfuric Acid Mist (H₂SO₄ as SO₃) Testing			
Test Period	12:19	-	13:22
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Mass	3	mg	
Gas Volume Sampled	0.7579	m ³	
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Emission* ¹	4	mg/m ³	
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Mass Emission Rate* ²	0.53	mg/s	
Regulatory Limit	NA		
Sulfur Dioxide (SO₂ as SO₃) Testing			
Test Period	12:19	-	13:22
Sulfur Dioxide (SO ₂ as SO ₃) Mass	<10	mg	
Gas Volume Sampled	0.7579	m ³	
Sulfur Dioxide (SO ₂ as SO ₃) Emission* ¹	<13	mg/m ³	
Sulfur Dioxide (SO ₂ as SO ₃) Mass Emission Rate* ²	<1.7	mg/s	
Regulatory Limit	NA		
Moisture Content (%)	7.0		
Gas Density (dry at 1 atmosphere)	1.30	kg/m³	
Dry Molecular Weight	29.08	g/g-mole	

Notes *1 Emission concentration at Standard conditions of (0°C, 1 atm, dry gas)

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 8: Thermal Oil Heater DECC Point 18 Total Particulate, Sulfuric Acid Mist (H₂SO₄ as SO₃), Sulfur Dioxide (SO₂ as SO₃) Results 22 July 2008

Sampling Conditions:		
Stack internal diameter at test location	380	mm
Stack gas temperature (average)	139.1 °C	412.3 K
Stack pressure (average)	1022.8	hPa
Stack gas velocity (average, stack conditions)	2.89	m/s
Stack gas flowrate (stack conditions)	0.33	m ³ /s
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	0.2	m ³ /s
Total Particulate Testing		
Test Period	12:19 -	13:22
Total Particulate Mass	2.2	mg
Gas Volume Sampled	0.8061	m ³
Total Particulate Emission* ¹	2.7	mg/m ³
Total Particulate Mass Emission Rate* ²	0.54	mg/s
Regulatory Limit	NA	
Sulfuric Acid Mist (H₂SO₄ as SO₃) Testing		
Test Period	12:19 -	13:22
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Mass	<2	mg
Gas Volume Sampled	0.8061	m ³
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Emission* ¹	<2.5	mg/m ³
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Mass Emission Rate* ²	<0.5	mg/s
Regulatory Limit	NA	
Sulfur Dioxide (SO₂ as SO₃) Testing		
Test Period	12:19 -	13:22
Sulfur Dioxide (SO ₂ as SO ₃) Mass	<10	mg
Gas Volume Sampled	0.8061	m ³
Sulfur Dioxide (SO ₂ as SO ₃) Emission* ¹	<12	mg/m ³
Sulfur Dioxide (SO ₂ as SO ₃) Mass Emission Rate* ²	<2.4	mg/s
Regulatory Limit	NA	
Moisture Content (%)	8.9	
Gas Density (dry at 1 atmosphere)	1.33	kg/m³
Dry Molecular Weight	29.67	g/g-mole

Notes *1 Emission concentration at Standard conditions of (0°C, 1 atm, dry gas)

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 9: 3MW Boiler DECC Point 2 Fine Particulate (PM₁₀) and Total Particulate Results, 23 July 2008

Sampling Conditions:			
Stack internal diameter at test location	650	mm	
Stack gas temperature (average)	162.4	°C	435.6 K
Stack pressure (average)	1026.7	hPa	
Stack gas velocity (average, stack conditions)	2.96	m/s	
Stack gas flowrate (stack conditions)	0.98	m ³ /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	0.53	m ³ /s	
Fine Particulate (PM₁₀) Testing			
Test Period	9:43	-	10:45
Fine Particulate (PM ₁₀) Mass	4.2	mg	
Gas Volume Sampled	0.3983	m ³	
Fine Particulate (PM ₁₀) Emission* ¹	11	mg/m ³	
Fine Particulate (PM ₁₀) Mass Emission Rate* ²	5.5	mg/s	
Regulatory Limit	NA		
Total Particulate Testing			
Test Period	9:43	-	10:45
Total Particulate Mass	4.6	mg	
Gas Volume Sampled	0.7993	m ³	
Total Particulate Emission* ¹	5.8	mg/m ³	
Total Particulate Mass Emission Rate* ²	3.2	mg/s	
Regulatory Limit	10	mg/m ³	
Moisture Content (%)	11.1		
Gas Density (dry at 1 atmosphere)	1.32	kg/m³	
Dry Molecular Weight	29.47	g/g-mole	

Notes *1 Emission concentration at Standard conditions of (0°C, 1 atm, dry gas)

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 10: Light End Scrubber DECC Point 5 Volatile Organic Compounds Results 22 July 2008

Analyte	Sample µg	Blank µg	Sample Blank Corrected µg	(mg/m ³)	mg/s
Acetone	181.0	<0.5	180.8	31	3.1
1,1-dichloroethane	<0.5	<0.5	<0.5	<0.085	<0.0085
2-Butanone	15.5	<0.5	15.3	2.6	0.26
Chloroform	<0.5	<0.5	<0.5	<0.085	<0.0085
Benzene	876.0	<0.5	875.8	150	15
1-heptene	1370.0	<0.5	1369.8	230	23
n-heptane	470.0	<0.5	469.8	80	8
Trichloroethene	<0.5	<0.5	<0.5	<0.085	<0.0085
MIBK	<0.5	<0.5	<0.5	<0.085	<0.0085
Toluene	79.9	<0.5	79.7	14	1.4
2-hexanone	<0.5	<0.5	<0.5	<0.085	<0.0085
Chlorobenzene	<0.5	<0.5	<0.5	<0.085	<0.0085
Ethyl Benzene	<0.5	<0.5	<0.5	<0.085	<0.0085
m- & p-xylene	<1	<1	<1	<0.17	<0.017
o-xylene	<0.5	<0.5	<0.5	<0.085	<0.0085
Styrene	<0.5	<0.5	<0.5	<0.085	<0.0085
Cyclohexanone	<0.5	<0.5	<0.5	<0.085	<0.0085
Isopropylbenzene	<0.5	<0.5	<0.5	<0.085	<0.0085
2-chlorotoluene	<0.5	<0.5	<0.5	<0.085	<0.0085
4-chlorotoluene	<0.5	<0.5	<0.5	<0.085	<0.0085
1,3,5-trimethylbenzene	<0.5	<0.5	<0.5	<0.085	<0.0085
n-decane	<0.5	<0.5	<0.5	<0.085	<0.0085
1,2,4-trimethylbenzene	<0.5	<0.5	<0.5	<0.085	<0.0085
1,3-dichlorobenzene	<0.5	<0.5	<0.5	<0.085	<0.0085
1,4-dichlorobenzene	<0.5	<0.5	<0.5	<0.085	<0.0085
1,2-dichlorobenzene	<0.5	<0.5	<0.5	<0.085	<0.0085
n-butylbenzene	<0.5	<0.5	<0.5	<0.085	<0.0085
Hexachlorobutadiene	<0.5	<0.5	<0.5	<0.085	<0.0085
Total	2992.4		2991.2	507.6	50.76

Note: Where the blank has returned a less than value, the analysed value has been corrected for half of that blank value. ie a blank value of <0.5 has had 0.25 subtracted from the analysed value.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

7.0 References

New South Wales Department of Environment and Climate Change – Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales January 2007.

New South Wales Department of Environment and Climate Change – Protection of the Environment Operations (Clean Air) Regulation 2002.

New South Wales Department of Environment and Climate Change – Section 55 Protection of the Environment Operations Act 1997 – Environment Protection Licence 12555.

Prepared for:

Transpacific Industries Pty. Ltd.

11 Kyle Street

Rutherford NSW 2320

Transpacific Industries Pty. Ltd. Emissions Testing Report 2008

ENSR Australia Pty Ltd (ENSR)



NATA ACCREDITATION No. 2778 (14391)

Accredited for compliance with ISO/IEC 17025

This document is issued in accordance with NATA's accreditation requirements.

This document may not be reproduced except in full.

ENSR Australia Pty Ltd (ENSR)

30 May 2008

Document No.: N4079510_Rpt_May08

Distribution

Transpacific Industries Pty. Ltd. Emissions Testing Report 2008
11 Kyle Street
Rutherford NSW 2320


30 May 2008

Copies	Recipient	Copies	Recipient
1	John Bennet 11 Kyle Street Rutherford NSW 2320	1	ENSR Australia Pty Ltd (ENSR) File copy

© ENSR Australia Pty Ltd (ENSR)

- * This document was prepared for the sole use of the party identified on the cover sheet, and that party is the only intended beneficiary of ENSR Australia Pty Ltd (ENSR) work.
- * No other party should rely on the document without the prior written consent of ENSR, and ENSR undertakes no duty to, nor accepts any responsibility to, any third party who may rely upon this document.
- * All rights reserved. No section or element of this document may be removed from this document, extracted, reproduced, electronically stored or transmitted in any form without the prior written permission of ENSR.

By
ENSR Australia Pty Ltd (ENSR)
 ABN: 34 060 204 702
 17 Warabrook Boulevard Warabrook NSW 2304
 PO Box 73 Hunter Region MC NSW 2310
 Ph: +61 2 4911 4900 Fax: +61 2 4911 4999


 Christopher Burns
 Emissions Scientist


 Chad Whitburn
 Senior Environmental Scientist
 NATA Signatory

Technical Peer Reviewer:

Date:


 Greg Schumacher
 Hunter Region Operations Manager

12/6/08

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Contents

1.0	INTRODUCTION	1
2.0	SAMPLING PLANE REQUIREMENTS	3
3.0	METHODOLOGY	4
3.1	NATA Accredited Methods	4
3.2	Deviations from NATA Accredited Test Procedures	5
4.0	SAMPLING LOCATION	6
4.1	Sampling Location Summary	6
5.0	EQUIPMENT CALIBRATION.....	8
6.0	RESULTS.....	9
7.0	REFERENCES	47

List of Tables

Table 1:	Criteria for Selection of Sampling Planes (AS 4323.1-1995)	3
Table 2:	ENSR NATA Endorsed Methods.....	4
Table 3:	Sampling Location Summary	6
Table 4:	Sampling Location Summary (continued).....	7
Table 5:	Emission Testing Results Summary for DECC Points 1, 4, and 18, March 2008	9
Table 6:	Emission Testing Results Summary for DECC Points 2, 3, and 20, March 2008	10
Table 7:	Emission Testing Results Summary for DECC Points 5 and 19, March 2008	11
Table 8:	0.2MW Boiler DECC Point 3 Polycyclic Aromatic Hydrocarbons Results, 6 March 2008	12
Table 9:	0.2MW Boiler DECC Point 3 Total Particulate, Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) and Sulfur Dioxide (SO ₂ as SO ₃) Results, 4 March 2008.....	13
Table 10:	3MW Boiler DECC Point 2 Polycyclic Aromatic Hydrocarbon Results, 5 March 2008.....	14
Table 11:	3MW Boiler DECC Point 2 Fine Particulate (PM ₁₀), Total Particulate, Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) and Sulfur Dioxide (SO ₂ as SO ₃) Results, 5 March 2008.....	15
Table 12:	SS Heater DECC Point 1 Hazardous Substances (Metals) Results, 5 March 2008.....	16
Table 13:	SS Heater DECC Point 1 Polycyclic Aromatic Hydrocarbons, Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃), Sulfur Dioxide (SO ₂ as SO ₃) and Total Particulate Results, 4 March 2008.....	17
Table 14:	TO Heater DECC Point 18 Polycyclic Aromatic Hydrocarbons, Hazardous Substances (Metals) Results, 7 March 2008.....	18
Table 15:	TO Heater DECC Point 18 Total Particulate, Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) and Sulfur Dioxide (SO ₂ as SO ₃) Results, 7 March 2008	19
Table 16:	Flare DECC Point 4 Polycyclic Aromatic Hydrocarbons, Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) and Sulfur Dioxide (SO ₂ as SO ₃) Results, 27 March 2008.....	20
Table 17:	Flare DECC Point 4 Fine Particulate (PM ₁₀) and Total Particulate Results, 26 March 2008	21
Table 18:	Light End Scrubber DECC Point 5 Polycyclic Aromatic Hydrocarbons, Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) and Sulfur Dioxide (SO ₂ as SO ₃) Results, 26 March 2008.....	22
Table 19:	Light End Scrubber DECC Point 5 Fine Particulate (PM ₁₀) and Total Particulate Results, 26 March 2008	23

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 20:	Fired Heaters DECC Point 19 Polycyclic Aromatic Hydrocarbons, Hazardous Substances (Metals) Results, 28 March 2008	24
Table 21:	Fired Heaters DECC Point 19 Total Particulate, Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) and Sulfur Dioxide (SO ₂ as SO ₃) Results, 28 March 2008	25
Table 22:	Reformer DECC Point 20 Polycyclic Aromatic Hydrocarbons Results, 27 March 2008	26
Table 23:	Reformer DECC Point 20 Total Particulate, Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) and Sulfur Dioxide (SO ₂ as SO ₃) Results, 27 March 2008	27
Table 24:	SS Heater DECC Point 1 Hazardous Substances (Metals) Elemental Analysis Results, March 2008	28
Table 25:	TO Heater DECC Point 18 Hazardous Substances (Metals) Elemental Analysis Results, 7 March 2008	29
Table 26:	Fired Heaters DECC Point 19 Hazardous Substances (Metals) Elemental Analysis Results, 28 March 2008	30
Table 27:	0.2MW Boiler DECC Point 3 Volatile Organic Compounds Results, 7 March 2008	31
Table 28:	3MW Boiler DECC Point 2 Volatile Organic Compounds Results, 6 March 2008	32
Table 29:	Flare DECC Point 4 Volatile Organic Compounds Results, 27 March 2008	33
Table 30:	Light End Scrubber DECC Point 5 Volatile Organic Compounds Results, 26 March 2008	34
Table 31:	Fired Heaters DECC Point 19 Volatile Organic Compounds Results, 28 March 2008	35
Table 32:	Reformer DECC Point 20 Volatile Organic Compound Results, 27 March 2008	36
Table 33:	SS Heater DECC Point 1 Volatile Organic Compounds Results, 6 March 2008	37
Table 34:	TO Heater DECC Point 18 Volatile Organic Compounds Results, 10 March 2008	38
Table 35:	0.2MW Boiler DECC Point 3 Speciated Polycyclic Aromatic Hydrocarbons (PAH) Results, 6 March 2008	39
Table 36:	3MW Boiler DECC Point 2 Speciated Polycyclic Aromatic Hydrocarbons Results, 5 March 2008	40
Table 37:	TO Heater DECC Point 18 Speciated Polycyclic Aromatic Hydrocarbons Results, 7 March 2008	41
Table 38:	SS Heater DECC Point 1 Speciated Polycyclic Aromatic Hydrocarbons Results, 4 March 2008	42
Table 39:	Flare DECC Point 4 Speciated Polycyclic Aromatic Hydrocarbons Results, 26 March 2008	43
Table 40:	Light End Scrubber DECC Point 5 Speciated Polycyclic Aromatic Hydrocarbons Results, 26 March 2008	44
Table 41:	Fired Heaters DECC Point 19 Speciated Polycyclic Aromatic Hydrocarbons Results, 28 March 2008	45
Table 42:	Reformer DECC Point 20 Speciated Polycyclic Aromatic Hydrocarbons Results, 27 March 2008	46

List of Appendices

Appendix A Field Data Sheets
 Appendix B Laboratory Analytical Results
 Appendix C Raw and Calculated Gas Data
 Appendix D Client Satisfaction Form

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

1.0 Introduction

ENSR Australia Pty Ltd (ENSR) was appointed by Transpacific Industries Pty. Ltd. to conduct a series of measurements to determine stack gas emissions from the oil refinery in Rutherford NSW. Emission testing was a compliance requirement of Environmental Protection Licence conditions (EPL No 12555). Testing was conducted during March 2008 to investigate emission concentrations for the following parameters:

- Total Particulate (TP);
- Fine Particulate (PM₁₀);
- Sulfuric Acid Mist (H₂SO₄ as SO₃);
- Sulfur Dioxide (SO₂ as SO₃);
- Hazardous Substances (Metals);
- Volatile Organic Compounds (VOCs);
- Polycyclic Aromatic Hydrocarbons (PAH);
- Hydrogen Sulfide (H₂S);
- Formaldehyde;
- Total Oxides of Nitrogen (NO_x as Equivalent NO₂);
- Carbon Monoxide (CO);
- Carbon Dioxide (CO₂);
- Oxygen (O₂);
- Methane (CH₄); and
- Odour.

Laboratory analysis was conducted by the following laboratories, which hold NATA accreditation for the specified tests:

- Australian Laboratory Services (ALS), accreditation number 825, laboratory report numbers EN0800490 and EN0800645 for analysis of:
 - Total Particulate (TP);
 - Fine Particulate (PM₁₀);
 - Sulfuric Acid Mist (H₂SO₄ as SO₃);
 - Sulfur Dioxide (SO₂ as SO₃);
 - Volatile Organic Compounds (VOCs);
 - Hydrogen Sulfide (H₂S); and
 - Formaldehyde.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

- National Measurement Institute (NMI), NATA accreditation number 198, performed the following analysis detailed in report ORG08_015, ORG08_021 and ORG08_027:
 - Polycyclic Aromatic Hydrocarbons (PAH).
- SGS Environmental, NATA accreditation number 2562 (4354), performed the following analysis detailed in report number 59439 and 60014:
 - Hazardous Substances (Metals).
- The Odour Unit, not NATA accredited, performed the following analysis detailed in report SYD20080327_024.
 - Odour.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

2.0 Sampling Plane requirements

The criteria for sampling planes are specified in AS 4323.1-1995.

Table 1: Criteria for Selection of Sampling Planes (AS 4323.1-1995)

Type of flow disturbance	Minimum distance upstream from disturbance, diameters (D)	Minimum distance downstream from disturbance, diameters (D)
Bend, connection, junction, direction change	>2D	>6D
Louvre, butterfly damper (partially closed or closed)	>3D	>6D
Axial fan	>3D	>8D (see Note)
Centrifugal fan	>3D	>6D

NOTE: The plane should be selected as far as practicable from a fan. Flow straighteners may be required to ensure the position chosen meets the check criteria listed in Items (a) to (f) below.

- The gas flow is basically in the same direction at all points along each sampling traverse.*
- The gas velocity at all sampling points is greater than 3 m/s.*
- The gas flow profile at the sampling plane shall be steady, evenly distributed and not have a cyclonic component which exceeds an angle of 15° to the duct axis, when measured near the periphery of a circular sampling plane.*
- The temperature difference between adjacent points of the survey along each sampling traverse is less than 10% of the absolute temperature, and the temperature at any point differs by less than 10% from the mean.*
- The ratio of the highest to lowest pitot pressure difference shall not exceed 9:1 and the ratio of highest to lowest gas velocities shall not exceed 3:1. For isokinetic testing with the use of impingers, the gas velocity ratio across the sampling plane should not exceed 1.6:1.*
- The gas temperature at the sampling plane should preferably be above the dewpoint.*

All of the DECC points sampled met all the criteria stated above, with the exception of DECC Point 5 which did not satisfy criteria 'b'.

3.0 Methodology

3.1 NATA Accredited Methods

The following methods are accredited with the National Association of Testing Authorities (NATA) (accreditation number 2778) and are approved for the sampling and analysis of gases. Specific details of the methods are available on request.

All sampling and analysis is conducted according to the methods in **Table 2**.

Table 2: ENSR NATA Endorsed Methods

NSW DECC Approved Methods	USEPA Methods	Method Title
NSW DECC TM1 (AS4323.1)	USEPA (2000) Method 1	Selection of sampling positions
NSW DECC TM-15 (AS4323.2)	USEPA (2000) Method 5 under approved circumstances	Determination of total particulate matter – isokinetic manual sampling – gravimetric method
NSW DECC TM-2	USEPA (2000) Method 2 or 2C or USEPA (1999) Method 2F or 2G or 2H (as appropriate)	Determination of stack gas velocity and volumetric flow rate (type s pitot tube)
NSW DECC TM-3	USEPA (2000) Method 8	Determination of sulfuric acid mist or sulfur trioxide emissions from stationary sources
NSW DECC TM-4	USEPA (2000) Method 6 or 6A or 6B	Determination of sulfur dioxide emissions from stationary sources
NSW DECC TM-22	USEPA (2000) Method 4	Determination of moisture content in stack gases
NSW DECC TM-23	USEPA (2000) Method 3	Gas analysis for the determination of dry molecular weight
NSW DECC TM-34	USEPA (2000) Method 18	Volatile organic compounds
NSW DECC TM-12,13 and 14	USEPA (2000) Method 29	Determination of metal emissions from stationary sources
NSW DECC OM-5	USEPA (1997) Method 201 or 201A (as appropriate)	Determination of PM ₁₀ emissions
NSW DECC OM-6	California EPA Air Resources Board (1997) Method 429	Determination of Polycyclic Aromatic Hydrocarbons (PAHs)

All parameters are reported adjusted to 0°C at 1 atmosphere and dry gas.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

3.2 Deviations from NATA Accredited Test Procedures

The following tests were conducted that are not covered under the terms of our NATA accreditation:

- NSW DECC OM – 7 AS 4323.3 – 2001.
- NSW DECC TM-5 USEPA Method 11.
- NSW DECC TM-11 USEPA Method 7E Oxides of Nitrogen, Instrumental Method.
- NSW DECC TM-32 USEPA Method 10 Carbon Monoxide.
- NSW DECC TM-24 USEPA Method 3A Carbon Dioxide.
- NSW DECC TM-25 USEPA Method 3A Oxygen.
- NSW DECC Special Method 1 USEPA Method 323 Formaldehyde.
- NSW DECC TM-34 USEPA Method 25B Methane.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

4.0 Sampling Location

4.1 Sampling Location Summary

Tables 3 and 4 provide a summary of the locations sampled by ENSR during March 2008.

Table 3: Sampling Location Summary

Discharge Description	SS Heater DECC Point 1	3.0 MW Boiler DECC Point 2	0.2 MW Boiler DECC Point 3	Flare DECC Point 4
Duct Shape	Circular	Circular	Circular	Circular
Construction Material	Metal	Metal	Metal	Metal
Duct Diameter (mm)	240	650	160	950
Minimum No. Sampling Points	4	8	4	12
Sampling Ports	2	2	2	2
Min. Points/Traverse	2	4	2	6
Disturbance	Yes	Yes	No	Yes
Distance from Upstream Disturbance	4D	3D	10D	4D
Type of Disturbance	Change in Diameter	Boiler Entry	Bend	Junction
Distance from Downstream Disturbance	4D	15D	30D	5D
Type of Disturbance	Bend	Stack Exit	Stack Exit	Stack Exit
Ideal Sampling Location	No	No	Yes	No
Correction Factors Applied	Yes	Yes	No	Yes
Total No. Points Sampled	8	12	4	16
Points/Traverse	4	6	2	8
Sampling Performed to Standard*	Yes ²	Yes ²	Yes ¹	Yes ²

*AS 4323.1 Stationary source emissions Method 1 – Selection of sampling positions

¹ AS 4323.1 Section 4.1

² AS 4323.1 Section 4.2

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

5.0 Equipment Calibration

ENSR has a calibration schedule to ensure the emission testing equipment is maintained in good order and with known calibration. Equipment used in this project was calibrated according to the procedures and frequency identified in the ENSR calibration schedule. Details of the schedule and the calibration calculations are available on request.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

6.0 Results

A summary of air emission test results for each stack is shown in **Tables 5 - 7**. Detailed results along with gas stream properties during the testing periods can be found in **Tables 8 - 23**. Elemental Hazardous Substances (Metals) results are presented in **Tables 14 - 26**. Speciated Volatile Organic Compound results are displayed in **Tables 27 - 34**. Speciated Polycyclic Aromatic Hydrocarbon results can be found in **Tables 35 - 42**.

Emission concentrations are converted to standard conditions of 0°C, dry gas and 1 atmosphere pressure for comparison with regulatory limits outlined in the Transpacific Industries Pty. Ltd. licence (NSW EPL number 12555).

Field sheets and final calculations are attached as **Appendix A**. Laboratory reports can be referred to in **Appendix B**. **Appendix C** contains raw and calculated gas data relating to Oxides of Nitrogen, Carbon Dioxide, Carbon Monoxide, Oxygen and Methane.

Table 5: Emission Testing Results Summary for DECC Points 1, 4, and 18, March 2008

Parameter	SS Heater DECC Point 1	Flare DECC Point 4	TO Heater DECC Point 18	Regulatory Limit
Fine Particulate (PM ₁₀) (mg/m ³)	<0.1	3.1	2.3	NA
Total Particulate (TP) (mg/m ³)	16.2	2.5	7.0	NA
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) (mg/m ³)	3.1	<2.3	<0.2	NA
Sulfur Dioxide (SO ₂ as SO ₃) (mg/m ³)	<10.4	<11.5	<1.1	NA
Total Volatile Organic Compounds (VOC) (mg/m ³)	2.2	0.1	<0.1	NA
Polycyclic Aromatic Hydrocarbons (PAH) (µg/m ³)	4750	6.1	18.3	NA
Hazardous Substances (Metals) (mg/m ³)	<0.1	NA	<0.1	NA
Hydrogen Sulfide (H ₂ S) (mg/m ³)	<1.9	NA	<2.0	NA
Total Oxides of Nitrogen (NO _x) as Equivalent NO ₂ (mg/m ³)	430	NA	68.3	NA
Nitrogen Oxide (NO) (mg/m ³)	278	NA	40.1	NA
Total Oxides of Nitrogen (NO _x) (mg/m ³)	282	NA	46.9	NA
Nitrogen Dioxide (NO ₂) (mg/m ³)	3.6	NA	6.8	NA
Carbon Monoxide (CO) (mg/m ³)	1.4	NA	29.9	NA
Oxygen (O ₂) (%)	4.6	NA	10.3	NA
Carbon Dioxide (CO ₂) (%)	6.1	NA	4.4	NA
Methane (CH ₄) (mg/m ³)	<0.7	NA	<0.7	NA
Odour (ou)	5220	NA	4145	NA
Formaldehyde (mg/m ³)	0.6	NA	0.8	NA

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 6: Emission Testing Results Summary for DECC Points 2, 3, and 20, March 2008

Parameter	3MW Boiler DECC Point 2	0.2MW Boiler DECC Point 3	Reformer DECC Point 20	Regulatory Limit
Fine Particulate (PM ₁₀) (mg/m ³)	3.9	0.5	<0.1	NA
Total Particulate (TP) (mg/m ³)	0.6	9.3	4.6	10
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) (mg/m ³)	<0.2	<1.9	<3.2	NA
Sulfur Dioxide (SO ₂ as SO ₃) (mg/m ³)	<1.0	<9.7	<15.9	NA
Total Volatile Organic Compounds (VOC) (mg/m ³)	0.8	<0.1	<0.2	10
Polycyclic Aromatic Hydrocarbons (PAH) (μg/m ³)	186	38.2	7.3	NA
Hydrogen Sulfide (H ₂ S) (mg/m ³)	<2	<1.9	<2.1	NA
Total Oxides of Nitrogen (NO _x) as Equivalent NO ₂ (mg/m ³)	30.0	64.4	136	350
Nitrogen Oxide (NO) (mg/m ³)	18.4	33.5	87.2	NA
Total Oxides of Nitrogen (NO _x) (mg/m ³)	20.2	46.5	90.3	NA
Nitrogen Dioxide (NO ₂) (mg/m ³)	1.8	13.0	3.1	NA
Carbon Monoxide (CO) (mg/m ³)	395	140	0.3	NA
Oxygen (O ₂) (%)	12.4	8.8	6.0	NA
Carbon Dioxide (CO ₂) (%)	3.8	6.9	9.4	NA
Odour (ou)	2675	3695	11200	NA

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 4: Sampling Location Summary (continued)

Discharge Description	Light End Scrubber DECC Point 5	TO Fired Heater DECC Point 18	Fired Heaters DECC Point 19	Reformer DECC Point 20
Duct Shape	Circular	Circular	Circular	Circular
Construction Material	Metal	Metal	Metal	Metal
Duct Diameter (mm)	165	380	400	340
Minimum No. Sampling Points	4	8	8	4
Sampling Ports	2	2	2	2
Min. Points/Traverse	2	4	4	2
Disturbance	Yes	No	No	Yes
Distance from Upstream Disturbance	3D	10D	12D	6D
Type of Disturbance	Change in Diameter	Bend	Bend	Junction
Distance from Downstream Disturbance	2D	5D	25D	6D
Type of Disturbance	Stack Exit	Bend	Stack Exit	Stack Exit
Ideal Sampling Location	No	Yes	Yes	Yes
Correction Factors Applied	Yes	No	No	No
Total No. Points Sampled	8	8	8	4
Points/Traverse	4	4	4	2
Sampling Performed to Standard*	Yes ²	Yes ²	Yes ¹	Yes ¹

*AS 4323.1 Stationary source emissions Method 1 – Selection of sampling positions

¹ AS 4323.1 Section 4.1

² AS 4323.1 Section 4.2

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 7: Emission Testing Results Summary for DECC Points 5 and 19, March 2008

Parameter	Light End Scrubber DECC Point 5	Regulatory Limit	Fired Heaters DECC Point 19	Regulatory Limit
Fine Particulate (PM ₁₀) (mg/m ³)	4.7	NA	<0.1	NA
Total Particulate (TP) (mg/m ³)	4.6	NA	33.5	10
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) (mg/m ³)	3.8	NA	37.1	100
Sulfur Dioxide (SO ₂ as SO ₃) (mg/m ³)	<12.8	NA	<16.1	1360
Total Volatile Organic Compounds (VOC) (mg/m ³)	1290	20	5.9	10
Polycyclic Aromatic Hydrocarbons (PAH) (µg/m ³)	215	NA	11.8	NA
Hazardous Substances (Metals) (mg/m ³)	NA	NA	<0.1	NA
Hydrogen Sulfide (H ₂ S) (mg/m ³)	NA	NA	27.4	5
Total Oxides of Nitrogen (NO _x as Equivalent NO ₂) (mg/m ³)	NA	NA	173.7	NA
Nitrogen Oxide (NO) (mg/m ³)	NA	NA	107.7	NA
Total Oxides of Nitrogen (NO _x) (mg/m ³)	NA	NA	116.2	NA
Nitrogen Dioxide (NO ₂) (mg/m ³)	NA	NA	8.6	NA
Carbon Monoxide (CO) (mg/m ³)	NA	NA	1250	100
Oxygen (O ₂) (%)	NA	NA	5.0	NA
Carbon Dioxide (CO ₂) (%)	NA	NA	6.9	NA
Methane (CH ₄) (mg/m ³)	NA	NA	2.9	NA
Odour (ou)	NA	NA	6220	NA
Formaldehyde (mg/m ³)	NA	NA	1.9	NA

Due to high temperatures, high moisture contents and DECC Point 3 being fitted with 50mm ports, PM₁₀ sampling was unable to be undertaken on several stacks. In these cases, a laser particle sizing analysis was performed on the total particulate sample and the PM₁₀ concentration subsequently calculated from these results. Stacks falling into this category are DECC Points 1, 3, 18, 19 and 20.

Table 8: 0.2MW Boiler DECC Point 3 Polycyclic Aromatic Hydrocarbons Results, 6 March 2008

Sampling Conditions:			
Stack internal diameter at test location	160	mm	
Stack gas temperature (average)	242.5	°C	515.7 K
Stack pressure (average)	1017.73	hPa	
Stack gas velocity (average, stack conditions)	10.0	m/s	
Stack gas flowrate (stack conditions)	0.3	m ³ /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	0.1	m ³ /s	
Polycyclic Aromatic Hydrocarbons Testing			
Test Period	12:00	-	13:20
Polycyclic Aromatic Hydrocarbons Mass	41.230	µg	
Gas Volume Sampled	1.0790	m ³	
Polycyclic Aromatic Hydrocarbons Emission* ¹	38.207	µg/m ³	
Polycyclic Aromatic Hydrocarbons Mass Emission Rate* ²	5.70	µg/s	
Regulatory Limit	NA		
Moisture Content (%)			
	10.8		
Gas Density (dry at 1 atmosphere)			
	1.32	kg/m ³	
Dry Molecular Weight			
	29.46	g/g-mole	

Notes *1 Emission concentration at Standard conditions of (0°C, 1 atm, dry gas)

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 9: 0.2MW Boiler DECC Point 3 Total Particulate, Sulfuric Acid Mist (H₂SO₄ as SO₃) and Sulfur Dioxide (SO₂ as SO₃) Results, 4 March 2008

Sampling Conditions:			
Stack internal diameter at test location	160	mm	
Stack gas temperature (average)	227.5	°C	500.7 K
Stack pressure (average)	1017.73	hPa	
Stack gas velocity (average, stack conditions)	10.0	m/s	
Stack gas flowrate (stack conditions)	0.3	m ³ /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	0.2	m ³ /s	
Total Particulate Testing			
Test Period	12:47	-	14:07
Total Particulate Mass	9.600	mg	
Gas Volume Sampled	1.0331	m ³	
Total Particulate Emission* ¹	9.293	mg/m ³	
Total Particulate Mass Emission Rate* ²	1.43	mg/s	
Regulatory Limit	10	mg/m ³	
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Testing			
Test Period	12:47	-	14:07
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Mass	<2	mg	
Gas Volume Sampled	1.0331	m ³	
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Emission* ¹	<1.93597	mg/m ³	
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Mass Emission Rate* ²	<0.3	mg/s	
Regulatory Limit	NA		
Sulfur Dioxide (SO ₂ as SO ₃) Testing			
Test Period	12:47	-	14:07
Sulfur Dioxide (SO ₂ as SO ₃) Mass	<10	mg	
Gas Volume Sampled	1.0331	m ³	
Sulfur Dioxide (SO ₂ as SO ₃) Emission* ¹	<9.67984	mg/m ³	
Sulfur Dioxide (SO ₂ as SO ₃) Mass Emission Rate* ²	<1.49	mg/s	
Regulatory Limit	NA		
Moisture Content (%)			
Gas Density (dry at 1 atmosphere)	11.0		
Dry Molecular Weight			
	1.32	kg/m ³	
	29.44	g/g-mole	

Notes *1 Emission concentration at Standard conditions of (0°C, 1 atm, dry gas)

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 10: 3MW Boiler DECC Point 2 Polycyclic Aromatic Hydrocarbon Results, 5 March 2008

Sampling Conditions:			
Stack internal diameter at test location	650	mm	
Stack gas temperature (average)	180.3	°C	453.5 K
Stack pressure (average)	1015.90	hPa	
Stack gas velocity (average, stack conditions)	4.3	m/s	
Stack gas flowrate (stack conditions)	1.4	m ³ /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	0.8	m ³ /s	
Polycyclic Aromatic Hydrocarbons Testing			
Test Period	14:15	-	15:20
Polycyclic Aromatic Hydrocarbons Mass	117.710	µg	
Gas Volume Sampled	0.6238	m ³	
Polycyclic Aromatic Hydrocarbons Emission ^{*1}	186.023	µg/m ³	
Polycyclic Aromatic Hydrocarbons Mass Emission Rate ^{*2}	143.08	µg/s	
Regulatory Limit	NA		
Moisture Content (%)			
	9.7		
Gas Density (dry at 1 atmosphere)			
	1.33	kg/m ³	
Dry Molecular Weight			
	29.68	g/g-mole	

Notes *1 Emission concentration at Standard conditions of (0°C, 1 atm, dry gas)

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 11: 3MW Boiler DECC Point 2 Fine Particulate (PM₁₀), Total Particulate, Sulfuric Acid Mist (H₂SO₄ as SO₃) and Sulfur Dioxide (SO₂ as SO₃) Results, 5 March 2008

Sampling Conditions:			
Stack internal diameter at test location	650	Mm	
Stack gas temperature (average)	180.3	oC	453.5 K
Stack pressure (average)	1015.90	hPa	
Stack gas velocity (average, stack conditions)	4.2	m/s	
Stack gas flowrate (stack conditions)	1.4	m ³ /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	0.8	m ³ /s	
Fine Particulate (PM ₁₀) Testing			
Test Period	14:15	-	15:20
Fine Particulate (PM ₁₀) Mass	2.000	Mg	
Gas Volume Sampled	0.5189	m ³	
Fine Particulate (PM ₁₀) Emission*1	3.855	mg/m ³	
Fine Particulate (PM ₁₀) Mass Emission Rate*2	2.98	mg/s	
Regulatory Limit	NA		
Total Particulate Testing			
Test Period	14:15	-	15:20
Total Particulate Mass	0.600	Mg	
Gas Volume Sampled	0.9607	m ³	
Total Particulate Emission*1	0.625	mg/m ³	
Total Particulate Mass Emission Rate*2	0.49	mg/s	
Regulatory Limit	10	mg/m ³	
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Testing			
Test Period	14:15	-	15:20
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Mass	<0.2	Mg	
Gas Volume Sampled	0.9607	m ³	
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Emission*1	<0.20818	mg/m ³	
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Mass Emission Rate*2	<0.16	mg/s	
Regulatory Limit	100	mg/m ³	
Sulfur Dioxide (SO ₂ as SO ₃) Testing			
Test Period	14:15	-	15:20
Sulfur Dioxide (SO ₂ as SO ₃) Mass	<1	Mg	
Gas Volume Sampled	0.9607	m ³	
Sulfur Dioxide (SO ₂ as SO ₃) Emission*1	<1.04089	mg/m ³	
Sulfur Dioxide (SO ₂ as SO ₃) Mass Emission Rate*2	<0.82	mg/s	
Regulatory Limit	NA		
Moisture Content (%)			
	9.2		
Gas Density (dry at 1 atmosphere)			
	1.33	kg/m ³	
Dry Molecular Weight			
	29.68	g/g-mole	

Notes *1 Emission concentration at Standard conditions of (0°C, 1 atm, dry gas)

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 12: SS Heater DECC Point 1 Hazardous Substances (Metals) Results, 5 March 2008

Sampling Conditions:			
Stack internal diameter at test location	240	mm	
Stack gas temperature (average)	54.7	°C	327.9 K
Stack pressure (average)	1015.78	hPa	
Stack gas velocity (average, stack conditions)	4.4	m/s	
Stack gas flowrate (stack conditions)	0.2	m ³ /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	0.1	m ³ /s	
Hazardous Substances (Metals) Testing			
Test Period	9:30	-	10:52
Hazardous Substances (Metals) Mass	0.030	mg	
Gas Volume Sampled	1.1862	m ³	
Hazardous Substances (Metals) Emission ^{*1}	0.026	mg/m ³	
Hazardous Substances (Metals) Mass Emission Rate ^{*2}	0.004	mg/s	
Regulatory Limit	NA		
Moisture Content (%)	16.3		
Gas Density (dry at 1 atmosphere)	1.33	kg/m ³	
Dry Molecular Weight	29.83	g/g-mole	

Notes *1 Emission concentration at Standard conditions of (0°C, 1 atm, dry gas)

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Table 13: SS Heater DECC Point 1 Polycyclic Aromatic Hydrocarbons, Sulfuric Acid Mist (H₂SO₄ as SO₃), Sulfur Dioxide (SO₂ as SO₃) and Total Particulate Results, 4 March 2008

Sampling Conditions:			
Stack internal diameter at test location	240	mm	
Stack gas temperature (average)	58.6	oC	331.8 K
Stack pressure (average)	1017.71	hPa	
Stack gas velocity (average, stack conditions)	5.0	m/s	
Stack gas flowrate (stack conditions)	0.2	m ³ /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	0.2	m ³ /s	
Polycyclic Aromatic Hydrocarbons Testing			
Test Period	14:47	-	15:55
Polycyclic Aromatic Hydrocarbons Mass	3790.300	g	
Gas Volume Sampled	0.7972	m ³	
Polycyclic Aromatic Hydrocarbons Emission*1	4754.281	g/m ³	
Polycyclic Aromatic Hydrocarbons Mass Emission Rate*2	754.08	g/s	
Regulatory Limit	NA		
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Testing			
Test Period	14:47	-	15:55
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Mass	3.000	mg	
Gas Volume Sampled	0.9589	m ³	
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Emission*1	3.129	mg/m ³	
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Mass Emission Rate*2	0.56	mg/s	
Regulatory Limit	NA		
Sulfur Dioxide (SO ₂ as SO ₃) Testing			
Test Period	14:47	-	15:55
Sulfur Dioxide (SO ₂ as SO ₃) Mass	<10	mg	
Gas Volume Sampled	0.9589	m ³	
Sulfur Dioxide (SO ₂ as SO ₃) Emission*1	<10.42877	mg/m ³	
Sulfur Dioxide (SO ₂ as SO ₃) Mass Emission Rate*2	<1.87	mg/s	
Regulatory Limit	NA		
Total Particulate Testing			
Test Period	14:47	-	15:55
Total Particulate Mass	15.500	mg	
Gas Volume Sampled	0.9589	m ³	
Total Particulate Emission*1	16.165	mg/m ³	
Total Particulate Mass Emission Rate*2	2.90	mg/s	
Regulatory Limit	NA		
Moisture Content (%)			
Gas Density (dry at 1 atmosphere)	8.0		
Dry Molecular Weight			
	1.33	kg/m ³	
	29.83	g/g-mole	

Notes *1 Emission concentration at Standard conditions of (0°C, 1 atm, dry gas)

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 14: TO Heater DECC Point 18 Polycyclic Aromatic Hydrocarbons, Hazardous Substances (Metals) Results, 7 March 2008

Sampling Conditions:					
Stack internal diameter at test location	380	mm			
Stack gas temperature (average)	210.4	°C	483.6	K	
Stack pressure (average)	1017.80	hPa			
Stack gas velocity (average, stack conditions)	3.1	m/s			
Stack gas flowrate (stack conditions)	0.4	m ³ /s			
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	0.2	m ³ /s			
Polycyclic Aromatic Hydrocarbons Testing					
Test Period	12:24	-	15:09		
Polycyclic Aromatic Hydrocarbons Mass	21.590	µg			
Gas Volume Sampled	1.1793	m ³			
Polycyclic Aromatic Hydrocarbons Emission* ¹	18.304	µg/m ³			
Polycyclic Aromatic Hydrocarbons Mass Emission Rate* ²	3.30	µg/s			
Regulatory Limit	NA				
Hazardous Substances (Metals) Testing					
Test Period	12:24	-	15:09		
Hazardous Substances (Metals) Mass	0.010	mg			
Gas Volume Sampled	1.1686	m ³			
Hazardous Substances (Metals) Emission* ¹	0.010	mg/m ³			
Hazardous Substances (Metals) Mass Emission Rate* ²	0.002	mg/s			
Regulatory Limit	NA				
Moisture Content (%)		10.3			
Gas Density (dry at 1 atmosphere)		1.31	kg/m ³		
Dry Molecular Weight		29.40	g/g-mole		

Notes *1 Emission concentration at Standard conditions of (0°C, 1 atm, dry gas)

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 15: TO Heater DECC Point 18 Total Particulate, Sulfuric Acid Mist (H₂SO₄ as SO₃) and Sulfur Dioxide (SO₂ as SO₃) Results, 7 March 2008

Sampling Conditions:			
Stack internal diameter at test location	380	mm	
Stack gas temperature (average)	206.7	°C	479.9 K
Stack pressure (average)	1017.80	hPa	
Stack gas velocity (average, stack conditions)	3.1	m/s	
Stack gas flowrate (stack conditions)	0.4	m ³ /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	0.2	m ³ /s	
Total Particulate Testing			
Test Period	10:16	-	11:40
Total Particulate Mass	6.8	mg	
Gas Volume Sampled	0.9737	m ³	
Total Particulate Emission* ¹	6.984	mg/m ³	
Total Particulate Mass Emission Rate* ²	1.21	mg/s	
Regulatory Limit	NA		
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Testing			
Test Period	10:16	-	11:40
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Mass	<0.2	mg	
Gas Volume Sampled	0.9405	m ³	
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Emission* ¹	<0.21265	mg/m ³	
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Mass Emission Rate* ²	<0.04	mg/s	
Regulatory Limit	NA		
Sulfur Dioxide (SO ₂ as SO ₃) Testing			
Test Period	10:16	-	11:40
Sulfur Dioxide (SO ₂ as SO ₃) Mass	<1	mg	
Gas Volume Sampled	0.9405	m ³	
Sulfur Dioxide (SO ₂ as SO ₃) Emission* ¹	<1.06323	mg/m ³	
Sulfur Dioxide (SO ₂ as SO ₃) Mass Emission Rate* ²	<0.19	mg/s	
Regulatory Limit	NA		
Moisture Content (%)		14.1	
Gas Density (dry at 1 atmosphere)		1.31	kg/m ³
Dry Molecular Weight		29.38	g/g-mole

Notes *1 Emission concentration at Standard conditions of (0°C, 1 atm, dry gas)

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 16: Flare DECC Point 4 Polycyclic Aromatic Hydrocarbons, Sulfuric Acid Mist (H₂SO₄ as SO₃) and Sulfur Dioxide (SO₂ as SO₃) Results, 27 March 2008

Sampling Conditions:			
Stack internal diameter at test location	950	mm	
Stack gas temperature (average)	71.7	°C	344.9 K
Stack pressure (average)	1009.00	hPa	
Stack gas velocity (average, stack conditions)	3.7	m/s	
Stack gas flowrate (stack conditions)	2.6	m ³ /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	2.0	m ³ /s	
Polycyclic Aromatic Hydrocarbons Testing			
Test Period	9:06	-	10:28
Polycyclic Aromatic Hydrocarbons Mass	6.560	µg	
Gas Volume Sampled	1.0809	m ³	
Polycyclic Aromatic Hydrocarbons Emission* ¹	6.064	µg/m ³	
Polycyclic Aromatic Hydrocarbons Mass Emission Rate* ²	12.35	µg/s	
Regulatory Limit	NA		
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Testing			
Test Period	9:06	-	10:28
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Mass	<2	mg	
Gas Volume Sampled	0.8720	m ³	
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Emission* ¹	<2.29367	mg/m ³	
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Mass Emission Rate* ²	<4.61	mg/s	
Regulatory Limit	NA		
Sulfur Dioxide (SO ₂ as SO ₃) Testing			
Test Period	9:06	-	10:28
Sulfur Dioxide (SO ₂ as SO ₃) Mass	<10	mg	
Gas Volume Sampled	0.8720	m ³	
Sulfur Dioxide (SO ₂ as SO ₃) Emission* ¹	<11.46834	mg/m ³	
Sulfur Dioxide (SO ₂ as SO ₃) Mass Emission Rate* ²	<23.03	mg/s	
Regulatory Limit	NA		
Moisture Content (%)			
	1.6		
Gas Density (dry at 1 atmosphere)			
	1.29	kg/m ³	
Dry Molecular Weight			
	28.86	g/g-mole	

Notes *1 Emission concentration at Standard conditions of (0°C, 1 atm, dry gas)

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 17: Flare DECC Point 4 Fine Particulate (PM₁₀) and Total Particulate Results, 26 March 2008

Sampling Conditions:			
Stack internal diameter at test location	950	mm	
Stack gas temperature (average)	87.9	°C	361.1 K
Stack pressure (average)	1007.95	hPa	
Stack gas velocity (average, stack conditions)	3.8	m/s	
Stack gas flowrate (stack conditions)	2.7	m ³ /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	2.0	m ³ /s	
Fine Particulate (PM ₁₀) Testing			
Test Period	15:21	-	16:42
Fine Particulate (PM ₁₀) Mass	3.0	mg	
Gas Volume Sampled	0.9706	m ³	
Fine Particulate (PM ₁₀) Emission* ¹	3.091	mg/m ³	
Fine Particulate (PM ₁₀) Mass Emission Rate* ²	6.09	mg/s	
Regulatory Limit	NA		
Total Particulate Testing			
Test Period	15:21	-	16:42
Total Particulate Mass	3.8	mg	
Gas Volume Sampled	1.5058	m ³	
Total Particulate Emission* ¹	2.524	mg/m ³	
Total Particulate Mass Emission Rate* ²	4.99	mg/s	
Regulatory Limit	NA		
Moisture Content (%)			
	2.3		
Gas Density (dry at 1 atmosphere)			
	1.29	kg/m ³	
Dry Molecular Weight			
	28.86	g/g-mole	

Notes *1 Emission concentration at Standard conditions of (0°C, 1 atm, dry gas)

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Table 18: Light End Scrubber DECC Point 5 Polycyclic Aromatic Hydrocarbons, Sulfuric Acid Mist (H₂SO₄ as SO₃) and Sulfur Dioxide (SO₂ as SO₃) Results, 26 March 2008

Sampling Conditions:			
Stack internal diameter at test location	200	mm	
Stack gas temperature (average)	20.4	°C	293.6 K
Stack pressure (average)	1008.00	hPa	
Stack gas velocity (average, stack conditions)	2.4	m/s	
Stack gas flowrate (stack conditions)	0.1	m ³ /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	0.1	m ³ /s	
Polycyclic Aromatic Hydrocarbons Testing			
Test Period	11:15	-	12:52
Polycyclic Aromatic Hydrocarbons Mass	206.470	µg	
Gas Volume Sampled	0.9572	m ³	
Polycyclic Aromatic Hydrocarbons Emission* ¹	215.687	µg/m ³	
Polycyclic Aromatic Hydrocarbons Mass Emission Rate* ²	14.58	µg/s	
Regulatory Limit	NA		
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Testing			
Test Period	11:15	-	12:52
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Mass	3.000	mg	
Gas Volume Sampled	0.7795	m ³	
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Emission* ¹	3.849	mg/m ³	
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Mass Emission Rate* ²	0.26	mg/s	
Regulatory Limit	NA		
Sulfur Dioxide (SO ₂ as SO ₃) Testing			
Test Period	11:15	-	12:52
Sulfur Dioxide (SO ₂ as SO ₃) Mass	<10	mg	
Gas Volume Sampled	0.7795	m ³	
Sulfur Dioxide (SO ₂ as SO ₃) Emission* ¹	<12.82864	mg/m ³	
Sulfur Dioxide (SO ₂ as SO ₃) Mass Emission Rate* ²	<0.85	mg/s	
Regulatory Limit	NA		
Moisture Content (%)			
	3.1		
Gas Density (dry at 1 atmosphere)			
	1.28	kg/m ³	
Dry Molecular Weight			
	28.65	g/g-mole	

Notes *1 Emission concentration at Standard conditions of (0°C, 1 atm, dry gas)

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 19: Light End Scrubber DECC Point 5 Fine Particulate (PM₁₀) and Total Particulate Results, 26 March 2008

Sampling Conditions:			
Stack internal diameter at test location	200	mm	
Stack gas temperature (average)	19.9	°C	293.1 K
Stack pressure (average)	1008.00	hPa	
Stack gas velocity (average, stack conditions)	2.4	m/s	
Stack gas flowrate (stack conditions)	0.1	m ³ /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	0.1	m ³ /s	
Fine Particulate (PM₁₀) Testing			
Test Period	9:35	-	10:32
Fine Particulate (PM ₁₀) Mass	3.0	mg	
Gas Volume Sampled	0.6412	m ³	
Fine Particulate (PM ₁₀) Emission* ¹	4.679	mg/m ³	
Fine Particulate (PM ₁₀) Mass Emission Rate* ²	0.32	mg/s	
Regulatory Limit	NA		
Total Particulate Testing			
Test Period	9:35	-	10:32
Total Particulate Mass	3.900	mg	
Gas Volume Sampled	0.8557	m ³	
Total Particulate Emission* ¹	4.558	mg/m ³	
Total Particulate Mass Emission Rate* ²	0.31	mg/s	
Regulatory Limit	NA		
Moisture Content (%)	2.9		
Gas Density (dry at 1 atmosphere)	1.28	kg/m³	
Dry Molecular Weight	28.65	g/g-mole	

Notes *1 Emission concentration at Standard conditions of (0°C, 1 atm, dry gas)

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 20: Fired Heaters DECC Point 19 Polycyclic Aromatic Hydrocarbons, Hazardous Substances (Metals) Results, 28 March 2008

Sampling Conditions:			
Stack internal diameter at test location	400	mm	
Stack gas temperature (average)	112.0	°C	385.2 K
Stack pressure (average)	1010.71	hPa	
Stack gas velocity (average, stack conditions)	5.6	m/s	
Stack gas flowrate (stack conditions)	0.7	m ³ /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	0.4	m ³ /s	
Polycyclic Aromatic Hydrocarbons Testing			
Test Period	12:18	-	13:39
Polycyclic Aromatic Hydrocarbons Mass	12.340	µg	
Gas Volume Sampled	1.0436	m ³	
Polycyclic Aromatic Hydrocarbons Emission* ¹	11.824	µg/m ³	
Polycyclic Aromatic Hydrocarbons Mass Emission Rate* ²	5.01	µg/s	
Regulatory Limit	NA		
Hazardous Substances (Metals) Testing			
Test Period	12:18	-	13:39
Hazardous Substances (Metals) Mass	0.040	mg	
Gas Volume Sampled	1.1813	m ³	
Hazardous Substances (Metals) Emission* ¹	0.032	mg/m ³	
Hazardous Substances (Metals) Mass Emission Rate* ²	0.01	mg/s	
Regulatory Limit	NA		
Moisture Content (%)			
Gas Density (dry at 1 atmosphere)	1.32	kg/m ³	
Dry Molecular Weight			
	29.59	g/g-mole	

Notes *1 Emission concentration at Standard conditions of (0°C, 1 atm, dry gas)

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Table 21: Fired Heaters DECC Point 19 Total Particulate, Sulfuric Acid Mist (H₂SO₄ as SO₃) and Sulfur Dioxide (SO₂ as SO₃) Results, 28 March 2008

Sampling Conditions:			
Stack internal diameter at test location	400	mm	
Stack gas temperature (average)	110.4	°C	383.6 K
Stack pressure (average)	1010.71	hPa	
Stack gas velocity (average, stack conditions)	5.6	m/s	
Stack gas flowrate (stack conditions)	0.7	m ³ /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	0.4	m ³ /s	
Total Particulate Testing			
Test Period	9:02	-	9:43
Total Particulate Mass	26.5	mg	
Gas Volume Sampled	0.7903	m ³	
Total Particulate Emission* ¹	33.530	mg/m ³	
Total Particulate Mass Emission Rate* ²	14.37	mg/s	
Regulatory Limit	10	mg/m ³	
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Testing			
Test Period	9:02	-	9:43
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Mass	23.0	mg	
Gas Volume Sampled	0.6194	m ³	
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Emission* ¹	37.132	mg/m ³	
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Mass Emission Rate* ²	15.60	mg/s	
Regulatory Limit	100	mg/m ³	
Sulfur Dioxide (SO ₂ as SO ₃) Testing			
Test Period	9:02	-	9:43
Sulfur Dioxide (SO ₂ as SO ₃) Mass	<10	mg	
Gas Volume Sampled	0.6194	m ³	
Sulfur Dioxide (SO ₂ as SO ₃) Emission* ¹	<16.14431	mg/m ³	
Sulfur Dioxide (SO ₂ as SO ₃) Mass Emission Rate* ²	<6.78	mg/s	
Regulatory Limit	1360	mg/m ³	
Moisture Content (%)			
	14.3		
Gas Density (dry at 1 atmosphere)			
	1.32	kg/m ³	
Dry Molecular Weight			
	29.59	g/g-mole	

Notes *1 Emission concentration at Standard conditions of (0°C, 1 atm, dry gas)

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 22: Reformer DECC Point 20 Polycyclic Aromatic Hydrocarbons Results, 27 March 2008

Sampling Conditions:			
Stack internal diameter at test location	340	mm	
Stack gas temperature (average)	772.9	°C	1046.1 K
Stack pressure (average)	1008.80	hPa	
Stack gas velocity (average, stack conditions)	12.8	m/s	
Stack gas flowrate (stack conditions)	1.2	m ³ /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	0.3	m ³ /s	
Polycyclic Aromatic Hydrocarbons Testing			
Test Period	16:17	-	17:17
Polycyclic Aromatic Hydrocarbons Mass	5.580	µg	
Gas Volume Sampled	0.7682	m ³	
Polycyclic Aromatic Hydrocarbons Emission ^{*1}	7.265	µg/m ³	
Polycyclic Aromatic Hydrocarbons Mass Emission Rate ^{*2}	1.82	µg/s	
Regulatory Limit	NA		
Moisture Content (%)			
Gas Density (dry at 1 atmosphere)	1.32	kg/m ³	
Dry Molecular Weight			
	29.59	g/g-mole	

Notes *1 Emission concentration at Standard conditions of (0°C, 1 atm, dry gas)

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 23: Reformer DECC Point 20 Total Particulate, Sulfuric Acid Mist (H₂SO₄ as SO₃) and Sulfur Dioxide (SO₂ as SO₃) Results, 27 March 2008

Sampling Conditions:			
Stack internal diameter at test location	340	mm	
Stack gas temperature (average)	770.3	°C	1043.5 K
Stack pressure (average)	1008.80	hPa	
Stack gas velocity (average, stack conditions)	12.8	m/s	
Stack gas flowrate (stack conditions)	1.2	m ³ /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	0.3	m ³ /s	
Total Particulate Testing			
Test Period	13:25	-	14:26
Total Particulate Mass	3.0	mg	
Gas Volume Sampled	0.6480	m ³	
Total Particulate Emission* ¹	4.630	mg/m ³	
Total Particulate Mass Emission Rate* ²	1.16	mg/s	
Regulatory Limit	10	mg/m ³	
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Testing			
Test Period	13:25	-	14:26
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Mass	<2	mg	
Gas Volume Sampled	0.6286	m ³	
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Emission* ¹	<3.18189	mg/m ³	
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Mass Emission Rate* ²	<0.8	mg/s	
Regulatory Limit	NA		
Sulfur Dioxide (SO ₂ as SO ₃) Testing			
Test Period	13:25	-	14:26
Sulfur Dioxide (SO ₂ as SO ₃) Mass	<10	mg	
Gas Volume Sampled	0.6286	m ³	
Sulfur Dioxide (SO ₂ as SO ₃) Emission* ¹	<15.90	mg/m ³	
Sulfur Dioxide (SO ₂ as SO ₃) Mass Emission Rate* ²	<4	mg/s	
Regulatory Limit	NA		
Moisture Content (%)			
	17.3		
Gas Density (dry at 1 atmosphere)			
	1.32	kg/m ³	
Dry Molecular Weight			
	29.59	g/g-mole	

Notes *1 Emission concentration at Standard conditions of (0°C, 1 atm, dry gas)

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 24: SS Heater DECC Point 1 Hazardous Substances (Metals) Elemental Analysis Results, March 2008

Sample	Total Particulate Metals (mg)	Total Particulate Metals (mg/m ³)	Total Gaseous Metals (mg)	Total Gaseous Metals (mg/m ³)	Total Oxidisable Mercury (mg)	Total Oxidisable Mercury (mg/m ³)	Total (mg)	Total (mg/m ³)	Mass Emission Rate (mg/s)
Antimony	0.0034	0.0029	<0.02	<0.0169			0.0034	0.0029	0.0003
Arsenic	<0.015	<0.0126	<0.015	<0.0126			<0.015	<0.0126	<0.0013
Beryllium	<0.00012	<0.0001	<0.00012	<0.0001			<0.00012	<0.0001	<0
Cadmium	0.0009	0.0008	0.0009	0.0007			0.0018	0.0015	0.0002
Chromium	0.0015	0.0013	<0.0006	<0.0005			0.0015	0.0013	0.0001
Cobalt	0.0008	0.0007	<0.0015	<0.0013			0.0008	0.0007	0.0001
Copper	0.0005	0.0004	<0.0006	<0.0005			0.0005	0.0004	0.0000
Lead	0.0034	0.0029	<0.015	<0.0126			0.0034	0.0029	0.0003
Magnesium	NA	NA	NA	NA			NA	NA	NA
Manganese	0.0068	0.0057	0.0087	0.0073			0.0155	0.0130	0.0013
Mercury	<0.00005	<0.00004	<0.00005	<0.00004	<0.00005	<0.00004	<0.00005	<0.00004	<0
Nickel	0.0007	0.0006	0.0000	NA			0.0007	0.0006	0.0001
Selenium	<0.02	<0.0169	<0.02	<0.0169			<0.02	<0.0169	<0.0017
Tin	<0.04	<0.0337	<0.04	<0.0337			<0.04	<0.0337	<0.0034
Thallium	0.0028	0.0024	<0.01	<0.0084			0.0028	0.0024	0.0002
Vanadium	<0.02	<0.0169	<0.02	<0.0169			<0.02	<0.0169	<0.0017
Zinc	NA	NA	NA	NA			NA	NA	NA
Total Hazardous Metals*	0.0208	0.0177	0.0096	0.0080	<0.00005	<0.00004	0.0304	0.0257	0.0026
Total Metals	0.0208	0.0177	0.0096	0.0080			0.0304	0.0257	0.0026

* Total does not include Magnesium and Zinc as they are classed non-hazardous

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 25: TO Heater DECC Point 18 Hazardous Substances (Metals) Elemental Analysis Results, 7 March 2008

Sample	Total Particulate Metals (mg)	Total Particulate Metals (mg/m ³)	Total Gaseous Metals (mg)	Total Gaseous Metals (mg/m ³)	Total Oxidisable Mercury (mg)	Total Oxidisable Mercury (mg/m ³)	Total (mg)	Total (mg/m ³)	Mass Emission Rate (mg/s)
Antimony	0.0025	0.0021	<0.02	<0.0171			0.0025	0.0021	0.0004
Arsenic	<0.015	<0.0128	<0.015	<0.0128			<0.015	<0.0128	<0.0026
Beryllium	<0.00012	<0.0001	<0.00012	<0.0001			<0.00012	<0.0001	<0
Cadmium	0.0021	0.0018	0.0006	0.0005			0.0027	0.0023	0.0005
Chromium	0.0015	0.0013	0.0002	0.0002			0.0017	0.0015	0.0003
Cobalt	<0.0015	<0.0013	<0.0015	<0.0013			<0.0015	<0.0013	<0.0003
Copper	0.0005	0.0004	0.0001	NA			0.0006	0.0004	0.0001
Lead	<0.015	<0.0128	<0.015	<0.0128			<0.015	<0.0128	<0.0026
Magnesium	NA	NA	NA	NA			NA	NA	NA
Manganese	0.0018	0.0015	0.0010	0.0008			0.0028	0.0023	0.0005
Mercury	<0.00005	<0.00004	<0.00005	<0.00004	<0.00005	<0.00004	<0.00005	<0.00004	<0
Nickel	0.0007	0.0006	0.0001	0.0001			0.0008	0.0007	0.0001
Selenium	<0.02	<0.0171	<0.02	<0.0171			<0.02	<0.0171	<0.0034
Tin	<0.04	<0.0342	<0.04	<0.0342			<0.04	<0.0342	<0.0068
Thallium	0.0010	0.0009	<0.01	<0.0086			0.0010	0.0009	0.0002
Vanadium	<0.02	<0.0171	<0.02	<0.0171			<0.02	<0.0171	<0.0034
Zinc	NA	NA	NA	NA			NA	NA	NA
Total Hazardous Metals*	0.0101	0.0086	0.0018	0.0016	<0.00005	<0.00004	0.0119	0.0102	0.0021
Total Metals	0.0101	0.0086	0.0018	0.0016			0.0119	0.0102	0.0021

* Total does not include Magnesium and Zinc as they are classed non-hazardous

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 26: Fired Heaters DECC Point 19 Hazardous Substances (Metals) Elemental Analysis Results, 28 March 2008

Sample	Total Particulate Metals (mg)	Total Particulate Metals (mg/m ³)	Total Gaseous Metals (mg)	Total Gaseous Metals (mg/m ³)	Total Oxidisable Mercury (mg)	Total Oxidisable Mercury (mg/m ³)	Total (mg)	Total (mg/m ³)	Mass Emission Rate (mg/s)
Antimony	<0.02	<0.0169	<0.02	<0.0169			<0.02	<0.0169	<0.0068
Arsenic	<0.015	<0.0127	<0.015	<0.0127			<0.015	<0.0127	<0.0051
Beryllium	<0.00012	<0.0001	<0.00012	<0.0001			<0.00012	<0.0001	<0
Cadmium	0.0023	0.0019	0.0024	0.002			0.0047	0.0039	0.0016
Chromium	0.0055	0.0047	0.0059	0.005			0.0114	0.0097	0.0039
Cobalt	0.0002	0.0001	<0.0015	<0.0013			0.0002	0.0001	0.0000
Copper	0.0033	0.0028	0.0049	0.0042			0.0082	0.0070	0.0028
Lead	0.0032	0.0027	<0.015	<0.0127			0.0032	0.0027	0.0011
Magnesium	NA	NA	NA	NA			NA	NA	NA
Manganese	0.0013	0.0011	0.0022	0.0018			0.0035	0.0029	0.0012
Mercury	<0.00005	<0.00004	<0.00005	<0.00004	<0.00005	<0.00004	<0.00005	<0.00004	<0
Nickel	0.0027	0.0023	0.0035	0.003			0.0062	0.0053	0.0021
Selenium	<0.02	<0.0169	<0.02	<0.0169			<0.02	<0.0169	<0.0068
Tin	<0.04	<0.0339	<0.04	<0.0339			<0.04	<0.0339	<0.0136
Thallium	<0.01	<0.0085	<0.01	<0.0085			<0.01	<0.0085	<0.0034
Vanadium	<0.02	<0.0169	<0.02	<0.0169			<0.02	<0.0169	<0.0068
Zinc	NA	NA	NA	NA			NA	NA	NA
Total Hazardous Metals*	0.0185	0.0156	0.0189	0.0160	<0.00005	<0.00004	0.0373	0.0316	0.0127
Total Metals	0.0185	0.0156	0.0189	0.0160			0.0373	0.0316	0.0127

* Total does not include Magnesium and Zinc as they are classed non-hazardous

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 27: 0.2MW Boiler DECC Point 3 Volatile Organic Compounds Results, 7 March 2008

Analyte	Sample μg	Blank μg	Sample Blank Corrected μg	(mg/m^3)	mg/s
Acetone	<0.5	<0.5	<0.5	<0.097	<0.01
1,1-dichloroethane	<0.5	<0.5	<0.5	<0.097	<0.01
2-Butanone	<0.5	<0.5	<0.5	<0.097	<0.01
Chloroform	<0.5	<0.5	<0.5	<0.097	<0.01
Benzene	<0.5	<0.5	<0.5	<0.097	<0.01
1-heptene	<0.5	<0.5	<0.5	<0.097	<0.01
n-heptane	<0.5	<0.5	<0.5	<0.097	<0.01
Trichloroethene	<0.5	<0.5	<0.5	<0.097	<0.01
MIBK	<0.5	<0.5	<0.5	<0.097	<0.01
Toluene	<0.5	<0.5	<0.5	<0.097	<0.01
2-hexanone	<0.5	<0.5	<0.5	<0.097	<0.01
Chlorobenzene	<0.5	<0.5	<0.5	<0.097	<0.01
Ethyl Benzene	<0.5	<0.5	<0.5	<0.097	<0.01
m- & p-xylene	<1	<1	<1	<0.195	<0.02
o-xylene	<0.5	<0.5	<0.5	<0.097	<0.01
Styrene	<0.5	<0.5	<0.5	<0.097	<0.01
Cyclohexanone	<0.5	<0.5	<0.5	<0.097	<0.01
Isopropylbenzene	<0.5	<0.5	<0.5	<0.097	<0.01
2-chlorotoluene	<0.5	<0.5	<0.5	<0.097	<0.01
4-chlorotoluene	<0.5	<0.5	<0.5	<0.097	<0.01
1,3,5-trimethylbenzene	<0.5	<0.5	<0.5	<0.097	<0.01
n-decane	<0.5	<0.5	<0.5	<0.097	<0.01
1,2,4-trimethylbenzene	<0.5	<0.5	<0.5	<0.097	<0.01
1,3-dichlorobenzene	<0.5	<0.5	<0.5	<0.097	<0.01
1,4-dichlorobenzene	<0.5	<0.5	<0.5	<0.097	<0.01
1,2-dichlorobenzene	<0.5	<0.5	<0.5	<0.097	<0.01
n-butylbenzene	<0.5	<0.5	<0.5	<0.097	<0.01
Hexachlorobutadiene	<0.5	<0.5	<0.5	<0.097	<0.01
Total	<1		<1	<0.195	<0.02

Note: Where the blank has returned a less than value, the analysed value has been corrected for half of that blank value
ie. a blank value of <0.5 has had 0.25 subtracted from the analysed value

Table 28: 3MW Boiler DECC Point 2 Volatile Organic Compounds Results, 6 March 2008

Analyte	Sample μg	Blank μg	Sample Blank Corrected μg	(mg/m^3)	mg/s
Acetone	<0.5	<0.5	<0.5	<0.1	<0.08
1,1-dichloroethane	<0.5	<0.5	<0.5	<0.1	<0.08
2-Butanone	<0.5	<0.5	<0.5	<0.1	<0.08
Chloroform	<0.5	<0.5	<0.5	<0.1	<0.08
Benzene	3.8	<0.5	3.6	0.718	0.574
1-heptene	<0.5	<0.5	<0.5	<0.1	<0.08
n-heptane	<0.5	<0.5	<0.5	<0.1	<0.08
Trichloroethene	<0.5	<0.5	<0.5	<0.1	<0.08
MIBK	<0.5	<0.5	<0.5	<0.1	<0.08
Toluene	0.8	<0.5	0.6	0.120	0.096
2-hexanone	<0.5	<0.5	<0.5	<0.1	<0.08
Chlorobenzene	<0.5	<0.5	<0.5	<0.1	<0.08
Ethyl Benzene	<0.5	<0.5	<0.5	<0.1	<0.08
m- & p-xylene	<1	<1	<1	<0.199	<0.159
o-xylene	<0.5	<0.5	<0.5	<0.1	<0.08
Styrene	<0.5	<0.5	<0.5	<0.1	<0.08
Cyclohexanone	<0.5	<0.5	<0.5	<0.1	<0.08
Isopropylbenzene	<0.5	<0.5	<0.5	<0.1	<0.08
2-chlorotoluene	<0.5	<0.5	<0.5	<0.1	<0.08
4-chlorotoluene	<0.5	<0.5	<0.5	<0.1	<0.08
1,3,5-trimethylbenzene	<0.5	<0.5	<0.5	<0.1	<0.08
n-decane	<0.5	<0.5	<0.5	<0.1	<0.08
1,2,4-trimethylbenzene	<0.5	<0.5	<0.5	<0.1	<0.08
1,3-dichlorobenzene	<0.5	<0.5	<0.5	<0.1	<0.08
1,4-dichlorobenzene	<0.5	<0.5	<0.5	<0.1	<0.08
1,2-dichlorobenzene	<0.5	<0.5	<0.5	<0.1	<0.08
n-butylbenzene	<0.5	<0.5	<0.5	<0.1	<0.08
Hexachlorobutadiene	<0.5	<0.5	<0.5	<0.1	<0.08
Total	4.6		4.2	0.838	0.670

Note: Where the blank has returned a less than value, the analysed value has been corrected for half of that blank value
ie. a blank value of <0.5 has had 0.25 subtracted from the analysed value

Table 29: Flare DECC Point 4 Volatile Organic Compounds Results, 27 March 2008

Analyte	Sample µg	Blank µg	Sample Blank Corrected µg	(mg/m ³)	mg/s
Acetone	<0.5	<0.5	<0.5	<0.087	<0.174
1,1-dichloroethane	<0.5	<0.5	<0.5	<0.087	<0.174
2-Butanone	<0.5	<0.5	<0.5	<0.087	<0.174
Chloroform	<0.5	<0.5	<0.5	<0.087	<0.174
Benzene	<0.5	<0.5	<0.5	<0.087	<0.174
1-heptene	<0.5	<0.5	<0.5	<0.087	<0.174
n-heptane	<0.5	<0.5	<0.5	<0.087	<0.174
Trichloroethene	<0.5	<0.5	<0.5	<0.087	<0.174
MIBK	<0.5	<0.5	<0.5	<0.087	<0.174
Toluene	0.6	<0.5	0.4	0.070	0.14
2-hexanone	<0.5	<0.5	<0.5	<0.087	<0.174
Chlorobenzene	<0.5	<0.5	<0.5	<0.087	<0.174
Ethyl Benzene	<0.5	<0.5	<0.5	<0.087	<0.174
m- & p-xylene	<1	<1	<1	<0.175	<0.35
o-xylene	<0.5	<0.5	<0.5	<0.087	<0.174
Styrene	<0.5	<0.5	<0.5	<0.087	<0.174
Cyclohexanone	<0.5	<0.5	<0.5	<0.087	<0.174
Isopropylbenzene	<0.5	<0.5	<0.5	<0.087	<0.174
2-chlorotoluene	<0.5	<0.5	<0.5	<0.087	<0.174
4-chlorotoluene	<0.5	<0.5	<0.5	<0.087	<0.174
1,3,5-trimethylbenzene	<0.5	<0.5	<0.5	<0.087	<0.174
n-decane	<0.5	<0.5	<0.5	<0.087	<0.174
1,2,4-trimethylbenzene	<0.5	<0.5	<0.5	<0.087	<0.174
1,3-dichlorobenzene	<0.5	<0.5	<0.5	<0.087	<0.174
1,4-dichlorobenzene	<0.5	<0.5	<0.5	<0.087	<0.174
1,2-dichlorobenzene	<0.5	<0.5	<0.5	<0.087	<0.174
n-butylbenzene	<0.5	<0.5	<0.5	<0.087	<0.174
Hexachlorobutadiene	<0.5	<0.5	<0.5	<0.087	<0.174
Total	0.6		0.4	0.070	0.140

Note: Where the blank has returned a less than value, the analysed value has been corrected for half of that blank value
ie. a blank value of <0.5 has had 0.25 subtracted from the analysed value

Table 30: Light End Scrubber DECC Point 5 Volatile Organic Compounds Results, 26 March 2008

Analyte	Sample µg	Blank µg	Sample Blank Corrected µg	(mg/m ³)	mg/s
Acetone	107.3	<0.5	107.1	19.195	1.92
1,1-dichloroethane	<0.5	<0.5	<0.5	<0.09	<0.009
2-Butanone	<0.5	<0.5	<0.5	<0.09	<0.009
Chloroform	1.6	<0.5	1.4	0.251	0.025
Benzene	2250.0	<0.5	2249.8	403.227	40.323
1-heptene	431.0	<0.5	430.8	77.211	7.721
n-heptane	2930.0	<0.5	2929.8	525.101	52.51
Trichloroethene	<0.5	<0.5	<0.5	<0.09	<0.009
MIBK	1.2	<0.5	1.0	0.179	0.018
Toluene	1320.0	<0.5	1319.8	236.545	23.655
2-hexanone	32.0	<0.5	31.8	5.699	0.57
Chlorobenzene	0.6	<0.5	0.4	0.072	0.007
Ethyl Benzene	41.8	<0.5	41.6	7.456	0.746
m- & p-xylene	37.4	<1	36.9	6.614	0.661
o-xylene	33.6	<0.5	33.4	5.986	0.599
Styrene	1.2	<0.5	1.0	0.179	0.018
Cyclohexanone	3.5	<0.5	3.3	0.591	0.059
Isopropylbenzene	<0.5	<0.5	<0.5	<0.09	<0.009
2-chlorotoluene	<0.5	<0.5	<0.5	<0.09	<0.009
4-chlorotoluene	<0.5	<0.5	<0.5	<0.09	<0.009
1,3,5-trimethylbenzene	<0.5	<0.5	<0.5	<0.09	<0.009
n-decane	5.6	<0.5	5.4	0.968	0.097
1,2,4-trimethylbenzene	0.7	<0.5	0.5	0.090	0.009
1,3-dichlorobenzene	<0.5	<0.5	<0.5	<0.09	<0.009
1,4-dichlorobenzene	<0.5	<0.5	<0.5	<0.09	<0.009
1,2-dichlorobenzene	<0.5	<0.5	<0.5	<0.09	<0.009
n-butylbenzene	<0.5	<0.5	<0.5	<0.09	<0.009
Hexachlorobutadiene	<0.5	<0.5	<0.5	<0.09	<0.009
Total	7197.5		7194	1289.4	128.9

Note: Where the blank has returned a less than value, the analysed value has been corrected for half of that blank value
ie. a blank value of <0.5 has had 0.25 subtracted from the analysed value

Table 31: Fired Heaters DECC Point 19 Volatile Organic Compounds Results, 28 March 2008

Analyte	Sample µg	Blank µg	Sample Blank Corrected µg	(mg/m ³)	mg/s
Acetone	<0.5	<0.5	<0.5	<0.099	<0.04
1,1-dichloroethane	<0.5	<0.5	<0.5	<0.099	<0.04
2-Butanone	<0.5	<0.5	<0.5	<0.099	<0.04
Chloroform	<0.5	<0.5	<0.5	<0.099	<0.04
Benzene	8.8	<0.5	8.6	1.697	0.679
1-heptene	<0.5	<0.5	<0.5	<0.099	<0.04
n-heptane	4.3	<0.5	4.1	0.809	0.324
Trichloroethene	<0.5	<0.5	<0.5	<0.099	<0.04
MIBK	<0.5	<0.5	<0.5	<0.099	<0.04
Toluene	14.5	<0.5	14.3	2.822	1.129
2-hexanone	<0.5	<0.5	<0.5	<0.099	<0.04
Chlorobenzene	<0.5	<0.5	<0.5	<0.099	<0.04
Ethyl Benzene	1.1	<0.5	0.9	0.178	0.071
m- & p-xylene	1.2	<1	0.7	0.138	0.055
o-xylene	1.4	<0.5	1.2	0.237	0.095
Styrene	<0.5	<0.5	<0.5	<0.099	<0.04
Cyclohexanone	<0.5	<0.5	<0.5	<0.099	<0.04
Isopropylbenzene	<0.5	<0.5	<0.5	<0.099	<0.04
2-chlorotoluene	<0.5	<0.5	<0.5	<0.099	<0.04
4-chlorotoluene	<0.5	<0.5	<0.5	<0.099	<0.04
1,3,5-trimethylbenzene	<0.5	<0.5	<0.5	<0.099	<0.04
n-decane	<0.5	<0.5	<0.5	<0.099	<0.04
1,2,4-trimethylbenzene	<0.5	<0.5	<0.5	<0.099	<0.04
1,3-dichlorobenzene	<0.5	<0.5	<0.5	<0.099	<0.04
1,4-dichlorobenzene	<0.5	<0.5	<0.5	<0.099	<0.04
1,2-dichlorobenzene	<0.5	<0.5	<0.5	<0.099	<0.04
n-butylbenzene	<0.5	<0.5	<0.5	<0.099	<0.04
Hexachlorobutadiene	<0.5	<0.5	<0.5	<0.099	<0.04
Total	31.3		29.8	5.9	2.4

Note: Where the blank has returned a less than value, the analysed value has been corrected for half of that blank value
ie. a blank value of <0.5 has had 0.25 subtracted from the analysed value

Table 32: Reformer DECC Point 20 Volatile Organic Compound Results, 27 March 2008

Analyte	Sample µg	Blank µg	Sample Blank Corrected µg	(mg/m ³)	mg/s
Acetone	<0.5	<0.5	<0.5	<0.105	<0.032
1,1-dichloroethane	<0.5	<0.5	<0.5	<0.105	<0.032
2-Butanone	<0.5	<0.5	<0.5	<0.105	<0.032
Chloroform	<0.5	<0.5	<0.5	<0.105	<0.032
Benzene	<0.5	<0.5	<0.5	<0.105	<0.032
1-heptene	<0.5	<0.5	<0.5	<0.105	<0.032
n-heptane	<0.5	<0.5	<0.5	<0.105	<0.032
Trichloroethene	<0.5	<0.5	<0.5	<0.105	<0.032
MIBK	<0.5	<0.5	<0.5	<0.105	<0.032
Toluene	<0.5	<0.5	<0.5	<0.105	<0.032
2-hexanone	<0.5	<0.5	<0.5	<0.105	<0.032
Chlorobenzene	<0.5	<0.5	<0.5	<0.105	<0.032
Ethyl Benzene	<0.5	<0.5	<0.5	<0.105	<0.032
m- & p-xylene	<1	<1	<1	<0.209	<0.063
o-xylene	<0.5	<0.5	<0.5	<0.105	<0.032
Styrene	<0.5	<0.5	<0.5	<0.105	<0.032
Cyclohexanone	<0.5	<0.5	<0.5	<0.105	<0.032
Isopropylbenzene	<0.5	<0.5	<0.5	<0.105	<0.032
2-chlorotoluene	<0.5	<0.5	<0.5	<0.105	<0.032
4-chlorotoluene	<0.5	<0.5	<0.5	<0.105	<0.032
1,3,5-trimethylbenzene	<0.5	<0.5	<0.5	<0.105	<0.032
n-decane	<0.5	<0.5	<0.5	<0.105	<0.032
1,2,4-trimethylbenzene	<0.5	<0.5	<0.5	<0.105	<0.032
1,3-dichlorobenzene	<0.5	<0.5	<0.5	<0.105	<0.032
1,4-dichlorobenzene	<0.5	<0.5	<0.5	<0.105	<0.032
1,2-dichlorobenzene	<0.5	<0.5	<0.5	<0.105	<0.032
n-butylbenzene	<0.5	<0.5	<0.5	<0.105	<0.032
Hexachlorobutadiene	<0.5	<0.5	<0.5	<0.105	<0.032
Total	<1		<1	<0.209	<0.063

Note: Where the blank has returned a less than value, the analysed value has been corrected for half of that blank value
ie. a blank value of <0.5 has had 0.25 subtracted from the analysed value

Table 33: SS Heater DECC Point 1 Volatile Organic Compounds Results, 6 March 2008

Analyte	Sample µg	Blank µg	Sample Blank Corrected µg	(mg/m ³)	mg/s
Acetone	<0.5	<0.5	<0.5	<0.102	<0.01
1,1-dichloroethane	<0.5	<0.5	<0.5	<0.102	<0.01
2-Butanone	<0.5	<0.5	<0.5	<0.102	<0.01
Chloroform	<0.5	<0.5	<0.5	<0.102	<0.01
Benzene	<0.5	<0.5	<0.5	<0.102	<0.01
1-heptene	<0.5	<0.5	<0.5	<0.102	<0.01
n-heptane	<0.5	<0.5	<0.5	<0.102	<0.01
Trichloroethene	<0.5	<0.5	<0.5	<0.102	<0.01
MIBK	<0.5	<0.5	<0.5	<0.102	<0.01
Toluene	<0.5	<0.5	<0.5	<0.102	<0.01
2-hexanone	<0.5	<0.5	<0.5	<0.102	<0.01
Chlorobenzene	<0.5	<0.5	<0.5	<0.102	<0.01
Ethyl Benzene	<0.5	<0.5	<0.5	<0.102	<0.01
m- & p-xylene	<1	<1	<1	<0.204	<0.02
o-xylene	<0.5	<0.5	<0.5	<0.102	<0.01
Styrene	<0.5	<0.5	<0.5	<0.102	<0.01
Cyclohexanone	<0.5	<0.5	<0.5	<0.102	<0.01
Isopropylbenzene	<0.5	<0.5	<0.5	<0.102	<0.01
2-chlorotoluene	<0.5	<0.5	<0.5	<0.102	<0.01
4-chlorotoluene	<0.5	<0.5	<0.5	<0.102	<0.01
1,3,5-trimethylbenzene	<0.5	<0.5	<0.5	<0.102	<0.01
n-decane	<0.5	<0.5	<0.5	<0.102	<0.01
1,2,4-trimethylbenzene	<0.5	<0.5	<0.5	<0.102	<0.01
1,3-dichlorobenzene	<0.5	<0.5	<0.5	<0.102	<0.01
1,4-dichlorobenzene	<0.5	<0.5	<0.5	<0.102	<0.01
1,2-dichlorobenzene	<0.5	<0.5	<0.5	<0.102	<0.01
n-butylbenzene	<0.5	<0.5	<0.5	<0.102	<0.01
Hexachlorobutadiene	<0.5	<0.5	<0.5	<0.102	<0.01
Total	<1		<1	<0.204	<0.02

Note: Where the blank has returned a less than value, the analysed value has been corrected for half of that blank value
ie. a blank value of <0.5 has had 0.25 subtracted from the analysed value

Table 34: TO Heater DECC Point 18 Volatile Organic Compounds Results, 10 March 2008

Analyte	Sample µg	Blank µg	Sample Blank Corrected µg	(mg/m ³)	mg/s
Acetone	<0.5	<0.5	<0.5	<0.098	<0.02
1,1-dichloroethane	<0.5	<0.5	<0.5	<0.098	<0.02
2-Butanone	<0.5	<0.5	<0.5	<0.098	<0.02
Chloroform	<0.5	<0.5	<0.5	<0.098	<0.02
Benzene	<0.5	<0.5	<0.5	<0.098	<0.02
1-heptene	<0.5	<0.5	<0.5	<0.098	<0.02
n-heptane	<0.5	<0.5	<0.5	<0.098	<0.02
Trichloroethene	<0.5	<0.5	<0.5	<0.098	<0.02
MIBK	<0.5	<0.5	<0.5	<0.098	<0.02
Toluene	11.4	<0.5	11.2	2.204	0.441
2-hexanone	<0.5	<0.5	<0.5	<0.098	<0.02
Chlorobenzene	<0.5	<0.5	<0.5	<0.098	<0.02
Ethyl Benzene	<0.5	<0.5	<0.5	<0.098	<0.02
m- & p-xylene	<1	<1	<1	<0.197	<0.039
o-xylene	<0.5	<0.5	<0.5	<0.098	<0.02
Styrene	<0.5	<0.5	<0.5	<0.098	<0.02
Cyclohexanone	<0.5	<0.5	<0.5	<0.098	<0.02
Isopropylbenzene	<0.5	<0.5	<0.5	<0.098	<0.02
2-chlorotoluene	<0.5	<0.5	<0.5	<0.098	<0.02
4-chlorotoluene	<0.5	<0.5	<0.5	<0.098	<0.02
1,3,5-trimethylbenzene	<0.5	<0.5	<0.5	<0.098	<0.02
n-decane	<0.5	<0.5	<0.5	<0.098	<0.02
1,2,4-trimethylbenzene	<0.5	<0.5	<0.5	<0.098	<0.02
1,3-dichlorobenzene	<0.5	<0.5	<0.5	<0.098	<0.02
1,4-dichlorobenzene	<0.5	<0.5	<0.5	<0.098	<0.02
1,2-dichlorobenzene	<0.5	<0.5	<0.5	<0.098	<0.02
n-butylbenzene	<0.5	<0.5	<0.5	<0.098	<0.02
Hexachlorobutadiene	<0.5	<0.5	<0.5	<0.098	<0.02
Total	11.4		11.2	2.204	0.441

Note: Where the blank has returned a less than value, the analysed value has been corrected for half of that blank value
ie. a blank value of <0.5 has had 0.25 subtracted from the analysed value

Table 35: 0.2MW Boiler DECC Point 3 Speciated Polycyclic Aromatic Hydrocarbons (PAH) Results, 6 March 2008

	Sample Result			Emission		Mass Emission Rate
	(ng)	(µg)	(mg)	(µg/m ³)	(mg/m ³)	(µg/s)
Naphthalene	13000	13.000	0.01300	12.048	0.012048	1.20
2 - Methyl naphthalene	320	0.320	0.00032	0.297	0.000297	0.03
Acenaphthylene	340	0.340	0.00034	0.315	0.000315	0.03
Acenaphthene	95	0.095	0.00010	0.088	0.000088	0.01
Fluorene	850	0.850	0.00085	0.788	0.000788	0.08
Phenanthrene	17000	17.000	0.01700	15.755	0.015755	1.58
Anthracene	34	0.034	0.00003	0.032	0.000032	0.00
Fluoranthene	4500	4.500	0.00450	4.170	0.004170	0.42
Pyrene	4700	4.700	0.00470	4.356	0.004356	0.44
Benz(a)anthracene	<20	<0.02	<0.00002	<0.019	<0.000019	<0.01
Chrysene	87	0.087	0.00009	0.081	0.000081	0.01
Benzo(b)fluoranthene	49	0.049	0.00005	0.045	0.000045	<0.01
Benzo(k)fluoranthene	36	0.036	0.00004	0.033	0.000033	<0.01
Benzo(e)pyrene	56	0.056	0.00006	0.052	0.000052	0.01
Benzo(a)pyrene	<20	<0.02	<0.00002	<0.019	<0.000019	<0.01
Perylene	<20	<0.02	<0.00002	<0.019	<0.000019	<0.01
Indeno(123:cd)pyrene	<20	<0.02	<0.00002	<0.019	<0.000019	<0.01
Dibenzo(ah)anthracene	<20	<0.02	<0.00002	<0.019	<0.000019	<0.01
Benzo(ghi)perylene	160	0.160	0.00016	0.148	0.000148	0.01
Sum of reported PAH's	41227	41.227	0.04123	38.208	0.038208	3.8

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 36: 3MW Boiler DECC Point 2 Speciated Polycyclic Aromatic Hydrocarbons Results, 5 March 2008

	Sample Result			Emission		Mass Emission Rate	
	(ng)	(µg)	(mg)	(µg/m ³)	(mg/m ³)	(µg/s)	(mg/s)
Naphthalene	55000	55.000	0.05500	105.102	0.105102	84.08	0.0841
2 - Methyl naphthalene	2100	2.100	0.00210	4.013	0.004013	3.21	0.0032
Acenaphthylene	5900	5.900	0.00590	11.275	0.011275	9.02	0.009
Acenaphthene	650	0.650	0.00065	1.242	0.001242	0.99	0.001
Fluorene	1400	1.400	0.00140	2.675	0.002675	2.14	0.0021
Phenanthrene	12000	12.000	0.01200	22.931	0.022931	18.34	0.0183
Anthracene	270	0.270	0.00027	0.516	0.000516	0.41	0.0004
Fluoranthene	12000	12.000	0.01200	22.931	0.022931	18.34	0.0183
Pyrene	19000	19.000	0.01900	36.308	0.036308	29.05	0.029
Benz(a)anthracene	70	0.070	0.00007	0.134	0.000134	0.11	0.0001
Chrysene	710	0.710	0.00071	1.357	0.001357	1.09	0.0011
Benzo(b)fluoranthene	260	0.260	0.00026	0.497	0.000497	0.40	0.0004
Benzo(k)fluoranthene	290	0.290	0.00029	0.554	0.000554	0.44	0.0004
Benzo(e)pyrene	860	0.860	0.00086	1.643	0.001643	1.31	0.0013
Benzo(a)pyrene	240	0.240	0.00024	0.459	0.000459	0.37	0.0004
Perylene	43	0.043	0.00004	0.082	0.000082	0.07	0.0001
Indeno(123:cd)pyrene	870	0.870	0.00087	1.663	0.001663	1.33	0.0013
Dibenzo(ah)anthracene	44	0.044	0.00004	0.084	0.000084	0.07	0.0001
Benzo(ghi)perylene	6000	6.000	0.00600	11.466	0.011466	9.17	0.0092
Sum of reported PAH's	117707	117.707	0.11771	224.932	0.224932	179.9	0.1798

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 37: TO Heater DECC Point 18 Speciated Polycyclic Aromatic Hydrocarbons Results, 7 March 2008

	Sample Result			Emission		Mass Emission Rate
	(ng)	(µg)	(mg)	(µg/m ³)	(mg/m ³)	(µg/s)
Naphthalene	10000	10.000	0.01000	8.479	0.008479	1.70
2 - Methyl naphthalene	2200	2.200	0.00220	1.865	0.001865	0.37
Acenaphthylene	370	0.370	0.00037	0.314	0.000314	0.06
Acenaphthene	160	0.160	0.00016	0.136	0.000136	0.03
Fluorene	240	0.240	0.00024	0.204	0.000204	0.04
Phenanthrene	3900	3.900	0.00390	3.307	0.003307	0.66
Anthracene	83	0.083	0.00008	0.070	0.000070	0.01
Fluoranthene	3100	3.100	0.00310	2.629	0.002629	0.53
Pyrene	790	0.790	0.00079	0.670	0.000670	0.13
Benz(a)anthracene	<20	<0.02	<0.00002	<0.017	<0.000017	<0.01
Chrysene	220	0.220	0.00022	0.187	0.000187	0.04
Benzo(b)fluoranthene	65	0.065	0.00007	0.055	0.000055	0.01
Benzo(k)fluoranthene	38	0.038	0.00004	0.032	0.000032	0.01
Benzo(e)pyrene	62	0.062	0.00006	0.053	0.000053	0.01
Benzo(a)pyrene	<20	<0.02	<0.00002	<0.017	<0.000017	<0.01
Perylene	<20	<0.02	<0.00002	<0.017	<0.000017	<0.01
Indeno(123:cd)pyrene	58	0.058	0.00006	0.049	0.000049	0.01
Dibenzo(ah)anthracene	<20	<0.02	<0.00002	<0.017	<0.000017	<0.01
Benzo(ghi)perylene	300	0.300	0.00030	0.254	0.000254	0.05
Sum of reported PAH's	21586	21.586	0.02159	18.304	0.018304	3.7

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 38: SS Heater DECC Point 1 Speciated Polycyclic Aromatic Hydrocarbons Results, 4 March 2008

	Sample Result			Emission		Mass Emission Rate	
	(ng)	(µg)	(mg)	(µg/m ³)	(mg/m ³)	(µg/s)	(mg/s)
Naphthalene	2000000	2000.000	2.00000	2508.657	2.508657	501.73	0.5017
2 - Methyl naphthalene	38000	38.000	0.03800	47.664	0.047664	9.53	0.0095
Acenaphthylene	600000	600.000	0.60000	752.597	0.752597	150.52	0.1505
Acenaphthene	4400	4.400	0.00440	5.519	0.005519	1.10	0.0011
Fluorene	55000	55.000	0.05500	68.988	0.068988	13.80	0.0138
Phenanthrene	310000	310.000	0.31000	388.842	0.388842	77.77	0.0778
Anthracene	6800	6.800	0.00680	8.529	0.008529	1.71	0.0017
Fluoranthene	170000	170.000	0.17000	213.236	0.213236	42.65	0.0426
Pyrene	430000	430.000	0.43000	539.361	0.539361	107.87	0.1079
Benz(a)anthracene	1100	1.100	0.00110	1.380	0.001380	0.28	0.0003
Chrysene	3600	3.600	0.00360	4.516	0.004516	0.90	0.0009
Benzo(b)fluoranthene	6200	6.200	0.00620	7.777	0.007777	1.56	0.0016
Benzo(k)fluoranthene	4300	4.300	0.00430	5.394	0.005394	1.08	0.0011
Benzo(e)pyrene	22000	22.000	0.02200	27.595	0.027595	5.52	0.0055
Benzo(a)pyrene	15000	15.000	0.01500	18.815	0.018815	3.76	0.0038
Perylene	2100	2.100	0.00210	2.634	0.002634	0.53	0.0005
Indeno(123:cd)pyrene	22000	22.000	0.02200	27.595	0.027595	5.52	0.0055
Dibenzo(ah)anthracene	7800	7.800	0.00780	9.784	0.009784	1.96	0.002
Benzo(ghi)perylene	92000	92.000	0.09200	115.398	0.115398	23.08	0.0231
Sum of reported PAH's	3790300	3790.300	3.79030	4754.281	4.754281	950.9	0.9509

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 39: Flare DECC Point 4 Speciated Polycyclic Aromatic Hydrocarbons Results, 26 March 2008

	Sample Result			Emission		Mass Emission Rate
	(ng)	(µg)	(mg)	(µg/m ³)	(mg/m ³)	(µg/s)
Naphthalene	3200	3.200	0.00320	2.960	0.002960	5.92
2 - Methylnapthalene	430	0.430	0.00043	0.398	0.000398	0.80
Acenaphthylene	43	0.043	0.00004	0.040	0.000040	0.08
Acenaphthene	91	0.091	0.00009	0.084	0.000084	0.17
Fluorene	210	0.210	0.00021	0.194	0.000194	0.39
Phenanthrene	1500	1.500	0.00150	1.388	0.001388	2.78
Anthracene	23	0.023	0.00002	0.021	0.000021	0.04
Fluoranthene	590	0.590	0.00059	0.546	0.000546	1.09
Pyrene	400	0.400	0.00040	0.370	0.000370	0.74
Benz(a)anthracene	<20	<0.02	<0.00002	<0.019	<0.000019	<0.04
Chrysene	68	0.068	0.00007	0.063	0.000063	0.13
Benzo(b)fluoranthene	<20	<0.02	<0.00002	<0.019	<0.000019	<0.04
Benzo(k)fluoranthene	<20	<0.02	<0.00002	<0.019	<0.000019	<0.04
Benzo(e)pyrene	<20	<0.02	<0.00002	<0.019	<0.000019	<0.04
Benzo(a)pyrene	<20	<0.02	<0.00002	<0.019	<0.000019	<0.04
Perylene	<20	<0.02	<0.00002	<0.019	<0.000019	<0.04
Indeno(123:cd)pyrene	<25	<0.025	<0.000025	<0.023	<0.000023	<0.05
Dibenzo(ah)anthracene	<20	<0.02	<0.00002	<0.019	<0.000019	<0.04
Benzo(ghi)perylene	<25	<0.025	<0.000025	<0.023	<0.000023	<0.05
Sum of reported PAH's	6555	6.555	0.00656	6.064	0.006064	12.1

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

**Table 40: Light End Scrubber DECC Point 5 Speciated Polycyclic Aromatic Hydrocarbons
Results, 26 March 2008**

	Sample Result			Emission		Mass Emission Rate
	(ng)	(µg)	(mg)	(µg/m ³)	(mg/m ³)	(µg/s)
Naphthalene	180000	180.000	0.18000	188.040	0.188040	8.650
2 - Methyl naphthalene	8600	8.600	0.00860	8.984	0.008984	0.413
Acenaphthylene	110	0.110	0.00011	0.115	0.000115	0.005
Acenaphthene	400	0.400	0.00040	0.418	0.000418	0.019
Fluorene	1300	1.300	0.00130	1.358	0.001358	0.063
Phenanthrene	8800	8.800	0.00880	9.193	0.009193	0.423
Anthracene	57	0.057	0.00006	0.060	0.000060	0.003
Fluoranthene	2700	2.700	0.00270	2.821	0.002821	0.130
Pyrene	4300	4.300	0.00430	4.492	0.004492	0.207
Benzo(a)anthracene	<20	<0.02	<0.00002	<0.021	<0.000021	<0.001
Chrysene	130	0.130	0.00013	0.136	0.000136	0.006
Benzo(b)fluoranthene	40	0.040	0.00004	0.042	0.000042	0.002
Benzo(k)fluoranthene	28	0.028	0.00003	0.029	0.000029	0.001
Benzo(e)pyrene	<20	<0.02	<0.00002	<0.021	<0.000021	<0.001
Benzo(a)pyrene	<20	<0.02	<0.00002	<0.021	<0.000021	<0.001
Perylene	<20	<0.02	<0.00002	<0.021	<0.000021	<0.001
Indeno(123:cd)pyrene	<25	<0.025	<0.000025	<0.026	<0.000026	<0.0012
Dibenzo(ah)anthracene	<20	<0.02	<0.00002	<0.021	<0.000021	<0.001
Benzo(ghi)perylene	<25	<0.025	<0.000025	<0.026	<0.000026	<0.0012
Sum of reported PAH's	206465	206.465	0.20647	215.688	0.215688	9.9

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 41: Fired Heaters DECC Point 19 Speciated Polycyclic Aromatic Hydrocarbons Results, 28 March 2008

	Sample Result			Emission		Mass Emission Rate
	(ng)	(µg)	(mg)	(µg/m ³)	(mg/m ³)	(µg/s)
Naphthalene	4400	4.400	0.00440	4.216	0.004216	1.69
2 - Methyl naphthalene	140	0.140	0.00014	0.134	0.000134	0.05
Acenaphthylene	570	0.570	0.00057	0.546	0.000546	0.22
Acenaphthene	190	0.190	0.00019	0.182	0.000182	0.07
Fluorene	260	0.260	0.00026	0.249	0.000249	0.10
Phenanthrene	2400	2.400	0.00240	2.300	0.002300	0.92
Anthracene	31	0.031	0.00003	0.030	0.000030	0.01
Fluoranthene	2700	2.700	0.00270	2.587	0.002587	1.03
Pyrene	1300	1.300	0.00130	1.246	0.001246	0.50
Benzo(a)anthracene	<20	<0.02	<0.00002	<0.019	<0.000019	<0.01
Chrysene	230	0.230	0.00023	0.220	0.000220	0.09
Benzo(b)fluoranthene	87	0.087	0.00009	0.083	0.000083	0.03
Benzo(k)fluoranthene	31	0.031	0.00003	0.030	0.000030	0.01
Benzo(e)pyrene	<20	<0.02	<0.00002	<0.019	<0.000019	<0.01
Benzo(a)pyrene	<20	<0.02	<0.00002	<0.019	<0.000019	<0.01
Perylene	<20	<0.02	<0.00002	<0.019	<0.000019	<0.01
Indeno(123:cd)pyrene	<20	<0.02	<0.00002	<0.019	<0.000019	<0.01
Dibenzo(ah)anthracene	<30	<0.03	<0.00003	<0.029	<0.000029	<0.01
Benzo(ghi)perylene	<20	<0.02	<0.00002	<0.019	<0.000019	<0.01
Sum of reported PAH's	12339	12.339	0.01234	11.823	0.011823	4.7

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

Table 42: Reformer DECC Point 20 Speciated Polycyclic Aromatic Hydrocarbons Results, 27 March 2008

	Sample Result			Emission		Mass Emission Rate
	(ng)	(µg)	(mg)	(µg/m ³)	(mg/m ³)	(µg/s)
Naphthalene	3200	3.200	0.00320	4.165	0.004165	1.25
2 - Methylnapthalene	310	0.310	0.00031	0.404	0.000404	0.12
Acenaphthylene	50	0.050	0.00005	0.065	0.000065	0.02
Acenaphthene	53	0.053	0.00005	0.069	0.000069	0.02
Fluorene	150	0.150	0.00015	0.195	0.000195	0.06
Phenanthrene	1300	1.300	0.00130	1.692	0.001692	0.51
Anthracene	<20	<0.02	<0.00002	<0.026	<0.000026	<0.01
Fluoranthene	350	0.350	0.00035	0.456	0.000456	0.14
Pyrene	120	0.120	0.00012	0.156	0.000156	0.05
Benzo(a)anthracene	<20	<0.02	<0.00002	<0.026	<0.000026	<0.01
Chrysene	25	0.025	0.00003	0.033	0.000033	0.01
Benzo(b)fluoranthene	23	0.023	0.00002	0.030	0.000030	0.01
Benzo(k)fluoranthene	<20	<0.02	<0.00002	<0.026	<0.000026	<0.01
Benzo(e)pyrene	<20	<0.02	<0.00002	<0.026	<0.000026	<0.01
Benzo(a)pyrene	<20	<0.02	<0.00002	<0.026	<0.000026	<0.01
Perylene	<20	<0.02	<0.00002	<0.026	<0.000026	<0.01
Indeno(123:cd)pyrene	<20	<0.02	<0.00002	<0.026	<0.000026	<0.01
Dibenzo(ah)anthracene	<30	<0.03	<0.00003	<0.039	<0.000039	<0.01
Benzo(ghi)perylene	<20	<0.02	<0.00002	<0.026	<0.000026	<0.01
Sum of reported PAH's	5581	5.581	0.00558	7.265	0.007265	2.2

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

7.0 References

New South Wales Department of Environment and Climate Change – Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales January 2007.

New South Wales Department of Environment and Climate Change – Protection of the Environment Operations (Clean Air) Regulation 2002.

New South Wales Department of Environment and Climate Change – Section 55 Protection of the Environment Operations Act 1997 – Environment Protection Licence 12555.

Use or disclosure of data contained on this sheet is subject to the restriction on the distribution page of this document.

"This page has been left blank intentionally"

"This page has been left blank intentionally"

Worldwide Locations

Australia	+61-2-8484-8999
Azerbaijan	+994 12 4975881
Belgium	+32-3-540-95-86
Bolivia	+591-3-354-8564
Brazil	+55-21-3526-8160
China	+86-20-8130-3737
England	+44 1928-726006
France	+33(0)1 48 42 59 53
Germany	+49-631-341-13-62
Ireland	+353 1631 9356
Italy	+39-02-3180 77 1
Japan	+813-3541 5926
Malaysia	+603-7725-0380
Netherlands	+31 10 2120 744
Philippines	+632 910 6226
Scotland	+44 (0) 1224-624624
Singapore	+65 6295 5752
Thailand	+662 642 6161
Turkey	+90-312-428-3667
United States	+1 978-589-3200
Venezuela	+58-212-762-63 39

Australian Locations

Adelaide
 Brisbane
 Canberra
 Darwin
 Mackay
 Melbourne
 Newcastle
 Sydney
 Singleton

www.ensr.com.au