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Air Quality Assessment for the Relocation of the Vesuvius Refractory Manufacturing Plant to Port Kembla, NSW

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Executive Summary

This report is an Air Quality study of the Vesuvius production processes that will be relocated from the current manufacturing site at the northern Wollongong suburb of Bulli to the new location at the corner of Darcy Road and Gloucester Boulevard, Port Kembla, the site already having a property zoning of IN3 Heavy Industrial. This study is part of the Environmental Assessment process for the new plant location and its operations.

This report will essentially follow the format of the previous air assessment report for the client in its original intent to locate a new plant at Unanderra. While the plant operations will substantially be unchanged, this new report takes into account the different environment and surrounds of Port Kembla, where site specific meteorological and terrain conditions will affect the predictive dispersion of air emissions from the plant. Additionally the Port Kembla airshed impacts as predicted from the plant will also differ from those at Unanderra.

The new factory building will be constructed as a steel framed structure with a combination of precast concrete wall panels and *colorbond* clad walls and roof. Most of the existing manufacturing facilities at Bulli will be relocated in to the new building, with upgrades and replacement as required on some items of plant.

The focus of this report is to consider the factors the new plant at Port Kembla is required to meet in accordance with the following:

- The NSW Protection of the Environment Operations Act 1997, and its associated Regulations, in particular Part 4 - Emissions of Air Impurities from Activities and Plant of the POEO Act (Clean Air) Regulations 2002,
- NSW DECC – *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW.*
- NSW DECC – *Technical Notes: Assessment & Management of Odour from Stationary Sources in NSW*

The conclusions of this report are as summarised below:

- As per the previous report, the Vesuvius operations at Port Kembla will not be subject to an Environmental Protection Licence (EPL) as a 'scheduled' premise under the POEO Act, as it is a manufacturing process outside the criteria under the Scheduled Activity: *Ceramic Works & Crushing, Grinding & Separating Works.*
- As the proposed new plant at Port Kembla will not be a scheduled premise as described above, the NSW DECC will not be the regulatory authority as prescribed by the POEO Act. This function will revert to the Wollongong City Council who presently is the regulator under the Act for the plant at the existing Bulli site.

- The Air Quality Assessment process that included predictive dispersion modelling work in accordance with NSW DECC guidelines, found that any residual emissions of contaminants from plant processes are within prescribed limits, and hence will not detrimentally impact on nearby industrial and residential properties. The study investigated emissions of dust and organic compounds that may exhaust from plant processes. The investigation also examined plant processes for other prescribed compounds and found that there will be no emissions of fluorene, oxides of nitrogen or sulphur compounds from the site, as the plant process heating works will utilise natural gas and process oven temperatures are in the range of 250-300 deg.C., which are below temperatures that are to be prescribed for scheduled premises.

- The Air Quality Assessment determined that dust generated during manufacturing processes will be controlled through encapsulating plant where dust is present and exhausting this dust for treatment in high efficiency removal dust collectors[1].

- The relocated plant will not require additional pollution control systems to remove organic or odorous compounds from the plant process exhaust air. Predictive dispersion modelling work undertaken has indicated that emissions impact is well below prescribed limits. Based on the current plant operations at Bulli, there are no records of community complaints against the plant for odours or other air emissions, and it is expected that the relocation will result in similar outcomes at the new site in Port Kembla.

- This assessment has verified that the emissions from the existing plant are a minor contribution to the Air Emissions Inventory for the Illawarra 'airshed'. Within the Port Kembla precinct, the new Vesuvius plant would also make at best, a very minor contribution to the emissions from the industries around the Port. Given that this assessment is essentially of a plant being relocated, there is no net increase in the NSW Greater Metropolitan Region (GMR) emissions as tabulated by the NSW DECCW. This assessment will be maintained for the Vesuvius plant at Port Kembla given that the Company has indicated there will be no increase in production rates above the current levels that exist at its Bulli plant location.

[1] The current dust control processes on site use reverse air pulse dust collectors that provide a high level of particulate removal. The new plant at Unanderra will utilise the same plant during the relocation, and where required dust collectors will be updated.

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1.0 INTRODUCTION

The subject of this report examines the issues of contaminants in air that are generated by plant operations at the existing Vesuvius manufacturing facilities at Bulli, and that will be relocated to the new Port Kembla site. Currently, there are a number of separate operations on site where contaminating materials in the exhaust airstreams are collected and treated via dust collection units.

These are:

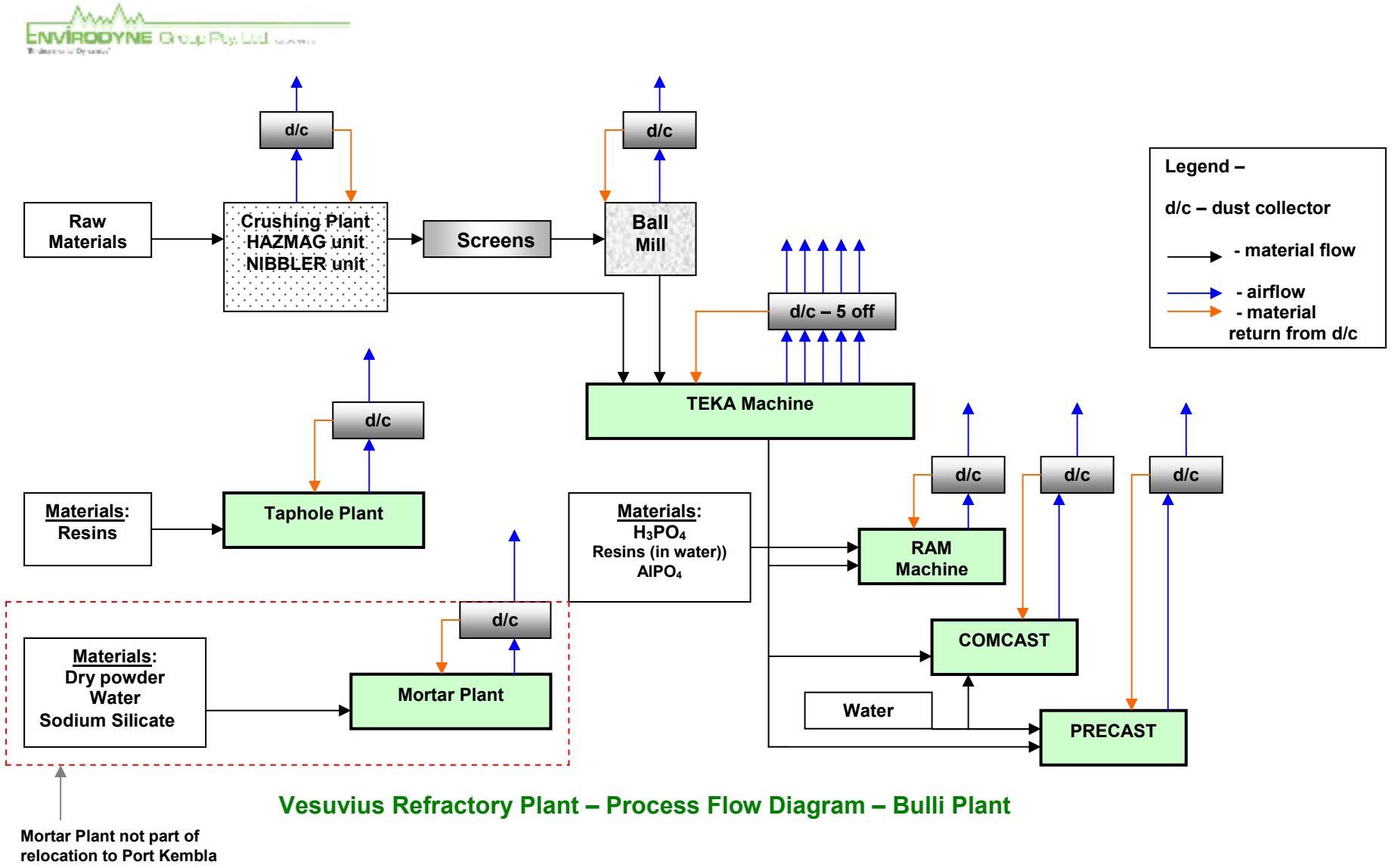
- Crushing and Screening of Raw Materials,
- Ball Mill processes where further size reduction and homogenisation of raw materials occur,
- TEKA operations where materials are prepared for downstream market products,
- RAM operations integrate TEKA product with phosphoric acid (H_3PO_4), phenolic resins (e.g; Hexamine) and Aluminium Orthophosphate ($AlPO_4$) into products that are either boxed or bagged to client requirements.
- COMCAST & PRECAST plants produce slab and associated products that are subject to oven curing to client requirements.
- TAPHOLE products utilise resins and Hexamine in the production of specific products used in client furnaces such as the control of liquefied metals.
- MORTAR products are produced using bagged dry powder, water and sodium silicate and packaged to client requirements.

Each operation is fitted with a discrete dust collection system to capture the contaminants in the airstream from each process, and return the product to the process.

In the relocation of the above manufacturing processes to the new site at Port Kembla, the mechanical ventilation and dust control systems are also to be relocated and where required due to practicalities and age of existing systems, replaced with upgraded systems for dust, fume and odour control.

Refer to Appendix 1 for technical information on the chemical products used in the various processes as described. This information is taken from Material Safety Data Sheets (MSDS) and other information as referenced, and is used in this report in the discussions concerning air pollution matters.

Refer to Diagram overleaf for the Process Flow Diagram for product produced by Vesuvius. *Note: the Mortar Plant is not part of the plant relocation to Port Kembla.*



Vesuvius Refractory Plant – Process Flow Diagram – Bulli Plant

2.0 STATUTORY & REGULATORY COMPLIANCE

The following statutory requirements are addressed in this report:

- Protection of Environment Operations Act 1997, and
- Part 4: Emissions of Air Impurities from Activities and Plant of the POEO Act (Clean Air) Regulations 2002
- Approved Methods for the Modelling and Assessment of Air Pollutants in NSW, and associated Technical Notes
- Technical Framework – Assessment and management of Odours from Stationary Sources in NSW
- The Environmental Planning and Assessment Act 1979 (as amended)

Ventilation requirements for the new plant are considered using AS 1668.2-200 – Part 2 *Ventilation Design for Indoor Air Contaminant Control*

2.1 'Non-Scheduled' Activities – Dust Emissions

Under the POEO Act, licenses are required for manufacturing processes that meet the conditions and activities as per Schedule 1 of the Act. Essentially the Vesuvius processes will be determined as 'scheduled activities' under the Act if outputs exceed 30,000 tonnes per annum of product if they comply in description with Item 6 of the Schedule. The works do not fit the description of Item 7 in terms of ceramics manufacture or the '*firing of refractory material*' The Vesuvius processes do not fire cast products at temperatures associated with conventional refractory products of 1,000-1,200 deg.C. Rather the CP process cures the castings in gas fired ovens at a temperature of 250 deg.C.

In associated documentation – Statement of Environmental Effects, stated total output will be 15,000 - 20,000 tonnes per annum. Hence the plant, under the terms of the POEO Act Regulations, would be classified as a 'non-scheduled' premise. The plant at Port Kembla would meet the conditions for Group C categorisation, where such plant and processes are to "…*operate on or after 1st September 2005 as a result of development consent granted pursuant to a development application made on or after 1st September 2005*."

Under the Group C categorisation, the plant operations are not to allow emissions of dust in excess of 100 mg/m^3 of exhaust air. The effective operation of dust collectors as currently used at Bulli, and planned for operation on the relocated plant at Port Kembla would ensure compliance with this emission limit, which would be verified as required under Part 4 of the POEO Act Regulations, Section 7.

2.2 Other Emissions

In Schedule 6 of the POEO Act Regulations – Part 4 – the Standards of Concentrations for 'non-scheduled' premises - lists prescribed compounds and their respective permitted emissions from processing plant. As discussed previously, test methods, averaging periods and reference conditions are specified in Schedule 7 for verifying plant performance. In terms of the materials used in the manufacture of refractory materials by Vesuvius, none of these materials are listed within Schedule 6 for dust or particulate matter emission control.

For air impurities not covered by the Regulations, the Act outlines general requirements for operating and maintaining plant, the handling of materials that may generate air pollution, as well as a general obligation that all practical means are taken to prevent or minimise air pollution. The POEO Act defines air pollution as follows:

- *Air pollution*: the emission into the air of any air impurity, and
- *Air impurity*: smoke, dust, cinders, solid particulate matter of any kind, gases, fumes, mists, odours and radioactive substances.

The POEO Act and Regulations require assessment of emissions that are the product of combustion from furnaces, boilers and ovens. These include oxides of nitrogen (NO_x) along with sulphur based compounds, carbon monoxide, etc.. The Vesuvius processes where heat is required is supplied by natural gas – a small boiler is used to provide hot water to a heating jacket on storage tanks in order to maintain viscosity conditions for stored resins, and for the heating of ovens for curing cast products – as previously discussed. Currently, the existing Vesuvius plant at Bulli has no licenses on these gas-fired operations, and as these are to be transferred to the new site at Port Kembla with minimal changes to their function, it is not expected that these operations would be licensed at the new plant.

2.3 Odour Emissions

As seen from the Process Flow Diagram (page 6), there are materials within the manufacturing process that are not generators of particulates emissions, but will be examined in this report for their potential to cause odour impact beyond plant boundaries. Odour impact is essentially a loss of amenity by the recipient due to odour presence that is objectionable, and while Clause 129 of the POEO Act relates to 'scheduled premises', provisions in Clauses 124-126 of the Act indicate clearly the onus is on the proprietors of the manufacturing process not to cause an offence, regardless if the premises are 'scheduled' or not. Hence, while the process must comply with emissions concentrations requirements, the issue of odour emissions must also be addressed in the pollution control plant from the manufacturing processes.

It most circumstances, the reduction in odour impact will ensure that concentrations of specific air impurities are well within specified limits, since the odour threshold will be substantially less at ground level concentrations[2], than Short Term Exposure Limits (STEL). *In this assessment GLC impacts will be investigated using the NSW DECCW prescribed maximum allowable concentrations. This approach is preferred instead of odour emissions values, as it will provide specific information that can be used in specifications for gas scrubbing or incineration equipment if required to remove these compounds.* Additionally, an assessment of emission concentrations will provide data on the impact on the local area in terms of cumulative air emissions as per DECCW databases for the Illawarra 'airshed'.

Air quality matters are an important input into the approval processes on planning and development. The introduction of 'integrated development assessment' processes in July 1998 resulted in planning approvals being linked to environmental performance requirements. Hence the assessment of environmental impact statements would now include consideration of the air quality issues surrounding a development.

The discussion on Air Quality Assessment issues at the Port Kembla site (in Section 4) will include these matters as referred to in the above legislative and regulatory requirements.

[2] *Ch.2 – Ground Level Concentrations Criteria – Technical Notes – NSW DECC – Assessment & Management of Odour from Stationary Sources*

3.0 PORT KEMBLA - SITE FEATURES

The Proposed Location Site for the Relocated Vesuvius Refractory Plant, Port Kembla

The Port Kembla site comprises Lots 101, 102 & 103 of DP839149 and is bordered by Darcy Road and Gloucester Boulevard, Port Kembla. The land is zoned IN3 Heavy Industrial, and offers no constraints for development to cater for Vesuvius operations.

The site and adjoining properties are essentially on flat terrain. The proposed factory building will have its axis in a general N-S orientation, with industrial manufacturing and associated heavy industry on the northern and western sides of the site. To the east of the site is North Beach separated from the site by Gloucester Boulevard itself.

Consequently, prevailing winds from the east will have some affect on the building air 'plume', resulting in some eddying and break up of laminar airflows around the Vesuvius building. A similar situation could occur with prevailing northerly winds.

Refer to Section 5.3 for discussions on the verified meteorological data used in predictive dispersion modelling work.

4.0 AIR QUALITY ASSESSMENT

The following is the air quality assessment for the proposed development at the Unanderra site for Vesuvius.

4.1 Level 1 Assessment - Odours

As discussed in Section 2.1, the relocated operations to Port Kembla would not be classified as 'scheduled premises' under the terms of the POEO Act Regulations. The control of dust emissions would meet the conditions for Group C categorisation as discussed in Section 2.1 (page 7) of this report.

To comply with provisions of the *Assessment and Management of Odour from Stationary Sources in NSW,* it is necessary at this proposal stage to conduct a Level 1 assessment of potential odour impact from the relocated plant at Port Kembla. Given that the plant in its current Bulli location has not been a cause of odour nuisance to the nearby residential properties, and that the manufacturing operations are essentially unchanged in their new site at Port Kembla, a Level 1 odour impact assessment is considered suitable at this stage of project development.

4.2 Air Impurities

The relocated plant is required to meet the conditions of toxicity and concentrations as per the POEO Regulations. Clause 20 of the Regulations lists the principal toxic air pollutants, of which none are used in the CP manufacturing operations. However, this section of the report discusses the various air impurities that will be in the ventilation airstream, and the approaches to be taken to comply with POEO requirements.

The emissions from the relocated manufacturing plant therefore must be controlled in accordance with Group C categorisation as discussed previously in Section 2 of this report.

4.2.1 Cement based Products

The cement based products manufactured by Vesuvius are castable products using high grade cement ingredients. These ingredients provide the necessary properties for exposure to high temperature applications.

Refer to the Appendices for properties of cement dust, based on the Materials Safety Data Sheets (MSDS) and NOHSC standards. The capture via exhaust ventilation and dust collection systems of residual product from manufacturing processes is to satisfy both OH&S issues as well as environmental pollution control. These dust collection systems are currently in use on all Vesuvius processes where cement dust is likely to be generated. Current systems used are of the reverse pulse jet bag-house (or dust collectors) type on individual process units that return collected materials to the manufacturing processes. Refer to Section 6.2 for further discussion on dust collectors.

The current performance of the dust collectors deployed on Vesuvius processes is not known at the time of writing this report. At the design stage, all dust collectors would be assessed as to their efficacy, performance and whether upgrades of the dust collectors on process items would be appropriate in the relocation, to ensure compliance with Group C categorisation – refer to discussions in Section 2.1.

4.2.2 Hexion Cascophen & Hexamine

These proprietary supplied products are phenolic resin products that are used in the manufacture of specific products foe refractory applications.

Hexion Cascophen is a proprietary product that is a blend of the following compounds:

- Glycols
- Phenols
- (methyl) Alcohols - methanol
- Formaldehyde

Hexamine (or Aminoform) has no listing in NOHSC[3] documentation as a product that may cause chronic exposure symptoms. Hexamine emissions can be characterised by an amine/ammonia type odour.

Refer to Appendices for summary of the MSDS and odour detection data for both products. *The organic materials within these proprietary products that are volatile organic compounds (VOCs) will be investigated as pollutants.*

These materials are used in processes under exhaust ventilation to ensure the exposure to plant personnel is controlled to OH&S standards. However, the risk of odour emissions and resultant impact on nearby properties must be assessed under the *NSW DECC - Assessment and Management of Odour from Stationary Sources* to ensure plant processes installed comply with Clauses 124-126 of the POEO Act.

4.2.3 Sodium Silicate (Water Glass)

This material is used in the manufacture of refractory materials because of its inherent properties as a binding agent with cements, its insulating properties and its overall use in minimising wear and erosion in high temperature applications.

Sodium silicate has been used in food preserving – e.g; eggs have been in the past sprayed with sodium silicate solution to prevent eggshell porosity and hence degradation.

[3] National Occupational Health & Safety Council

The physical properties of sodium silicate is classified as mildly hazardous under NOHSC guidelines, however in its liquid form and in its use in refractory products during manufacture, *it produces no vapour or odour emissions.* Refer to Appendices for summary of MSDS.

4.2.4 Aluminium Orthophosphate

Aluminium Orthophosphate ($AlPO_4$ - also known by the synonym: phosphate) is supplied to Vesuvius as a dry powder that is prepared in solution for addition into the RAM manufacturing process.

The handling and addition of this material to the process is done in controlled ventilated environments to ensure minimum risk of fugitive dust emissions. As discussed previously, these ventilated processes are exhausted to atmosphere via dust collectors.

Once in the liquid phase, *there is no dust associated with this material, and is not expected to have a residual odour*. The material is mildly hazardous under NOHSC guidelines, and there is no environmental/ecological information on this product.

Refer to Appendices for MSDS summary.

4.2.5 Phosphoric Acid

Phosphoric Acid (H_3PO_4) is a strong acid raw material used in the Vesuvius manufacture of RAM products. The acid is diluted before addition to the manufacturing process. Due to the nature of the Vesuvius manufacturing processes, *the risks of thermal decomposition of the material to possible air impurities is not possible*.

Phosphoric acid has explicit materials handling procedures due to its corrosive and toxicological properties. There is no available environmental/ecological information on phosphoric acid, although disposal instructions emphasise the observance of all federal state and local environmental regulations. In the addition to the manufacture of RAM products, *phosphoric acid does not produce a fume or odour component*.

Refer to Appendices for MSDS summary.

4.2.6 Compounds Examined through Dispersion Modelling

The following compounds will be subjected to dispersion modelling work to assess possible impact beyond the plant boundaries:

Dusts, Formaldehyde, Methanol, Phenol

The above organic compounds are usually referred to as Volatile Organic Compounds (VOCs). GLC values as prescribed in Clean Air regulations will be the assessment criteria.

5.0 PREDICTIVE DISPERSION MODELLING FOR PRESCRIBED POLLUTANTS

5.1 General

Computerised predictive dispersion modelling of residual emissions from the proposed new plant was conducted to predict if emissions exhausted from the Vesuvius plant would cause impact on nearby industrial, commercial and residential properties outside the plant boundary. The tools used for the conduct of this modelling were:

- AUSPLUME dispersion modelling software Version 6 as approved for use by NSW DECCW,
- Formatted and verified local meteorological data sourced from DECCW weather stations in the region,
- Inventory of residual emissions from the plant,
- Computerised terrain file for the plant site and area of likely impact.

5.2 Plant Emissions - Performance Criteria

The performance criteria for this study are based on the NSW DECCW Policy Document - *Assessment & Management of Odours from Stationary Sources, January (2001).*

Under the above Policy Statement, criteria for odour and ground level concentrations (GLC) assessments are for prescribed thresholds not to be exceeded at any location beyond the boundary of a facility. The policy is emphatic in not utilising the ground level concentrations or the odour performance criteria for environmental licence conditions. Compliance with these criteria is often difficult to measure, and their usefulness in licensing arrangements is minimal. In the case of known or measured point source emissions, the GLC and odour performance criteria outcomes may be used to prescribe emission conditions from point sources where appropriate.

In this study of the residual emissions from the new plant, the existing plant has been tested and the residual compound concentrations assessed. In the modelling work conducted, these test results from sampling were used and compared with GLC values. This provides:

- An assessment of the potential impact of residual emissions on surrounding properties,
- Provides real data that can be used in the assessment of cumulative emissions within the Illawarra 'airshed', taking into account that the plant at Port Kembla is essentially a relocation and hence not an additional emissions contributor to the Illawarra region.

- Use results of modelling determine if additional mitigation measures are required to exhaust airstreams to ensure compliance with statutory requirements.

In the modelling work GLC limits[4] will be used as prescribed by the NSW DECCW for dusts, formaldehyde, methanol and phenol, as these constitute the pollutants that may be emitted from the new plant.

Pollutant	Ground Level Concentration		Notes
	ppm	mg/m^3	
Dust		0.33	Based on general dust materials including cement dusts.
Formaldehyde	0.033	0.05	
Methanol	4.26	5.5	Values are based on consideration of odorous properties of the indicator (gas).
Phenol	0.0094	0.036	

Notes:
- ppm – parts per million (volume/volume)
- gas volumes expressed at 25 deg.C and an absolute pressure of 1 atmosphere(101.325 kPa)

Table 1
Ground Level Concentrations Criteria
(as per NSW DECCW Requirements under POEO Act)

These compounds are listed in the POEO Act Clean Air Regulations for scheduled premises. As discussed previously in Section 2, the new factory would not be classified as a scheduled premise, however as part of this modelling assessment to assess impacts of any residual emissions, the GLC criteria for emissions will be used as if the plant was scheduled.

Refer to Appendix 2 for Emissions Inventory Files for Modelling work.

[4] Table 2.1 – DECCW *Technical Notes to Policy – Assessment and Management of Odour from Stationary Sources in NSW.* Refer to Appendix 1 for **G**round **L**evel **C**oncentrations (GLC) definition.

Diagram 1
Topographic Map of Area used in Modelling

5.3 Meteorological Data Files

Verified meteorological files were obtained under licence from the NSW DECCW weather station at Wollongong. These files demonstrated prevailing winds for the site originate from a S-SW direction with a secondary effect from the NE. These were compared with known met data from the DECCW Kembla Grange weather station and found to be comparable in profile, as shown in the windrose below:

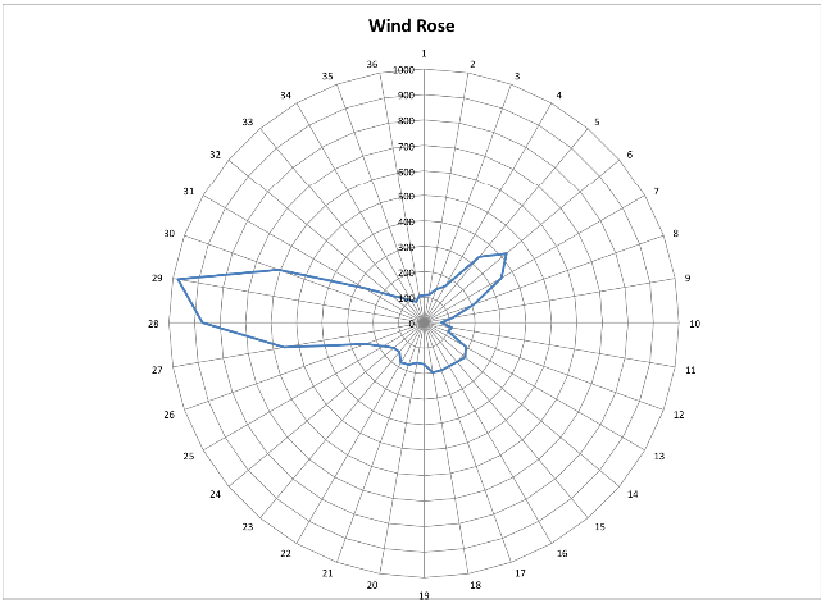


Diagram 2
Windrose for DECCW Wollongong weather station '06-'07

5.4 Terrain Files

A terrain file was developed representing the local topography around the new plant location in Port Kembla.

Further to descriptions given in Section 3, the land is essentially flat with the ocean to the east and rising ground approximately ½ km away (Military Road). The location is an industrial precinct, hence the new plant is surrounded by heavy industry and factory type operations. The nearest residential area is approximately some 500 metres approximately to the west and S-W. The Port Kembla Public School is located on Gloucester Boulevard approximately 700m to the south of the site.

The terrain file was developed by digitising a topographical map of the area. This digital data was then converted into the required terrain file, using the conversion utility within the AUSPLUME model software.

5.5 Modelling Results

The modelling results on the following pages (Diagrams 3-6) utilised the emissions data as summarised below in Table 2. Refer to Appendices for Emissions Inventory Files used in the modelling.

Plant	Exhaust Air Volume (m^3/sec)	Pollutant	Exhaust @ 15 m/sec Stack dia. (mms).	Exhaust @ 15 m/sec Max.Exhaust Concentration[5]	Ground Level Concentration (glc)[6]
Crushing Plant	2.87	dust	500	5 mg/m^3	330 µg/m^3
Ball Mill - 1st fan	0.7	dust	330	5 mg/m^3	330 µg/m^3
- 2nd fan	0.5				
TEKA Machine - mixer	0.35	dust	450	5 mg/m^3	330 µg/m^3
- bagger	0.65				
- skip	0.35				
- bag split	0.25				
- conveyor	0.65				
RAM Machine	0.65	dust	250	5 mg/m^3	330 µg/m^3
ComCast	0.25	dust	150	5 mg/m^3	330 µg/m^3
Precast	0.35	dust	180	5 mg/m^3	330 µg/m^3
Taphole Plant		dust	250	5 mg/m^3	330 µg/m^3
		resin -			
mixer	0.35	*formaldehyde*		0.0038 mg/m^3	0.05 mg/m^3
conveyor	0.25	*methanol*		2.6 mg/m^3	5.5 mg/m^3
		phenol		0.017 mg/m^3	0.036 mg/m^3

Table 2
Emissions Inventory Summary & GLC Criteria

Notes -
mg/m^3 is milligram/m^3 or 10^{-3} grams/m^3.
µg/m^3 is microgram/m^3 or 10^{-6} grams/m^3.
ppm & ppb are parts per million or billion as volume/volume at 25 deg.C and 1 atmosphere.

[5] The dust concentrations were derived from assuming an efficiency of 95% removal by the dust collector on the plant process, using the MSDS value of 100 mg/m^3 as the allowed extraction under exhaust ventilation of dust from manufacturing. Hence 5 mg/m^3 would be the worst case scenario for emissions after the dust collector. *Dust particulate capture would be based on utilising filter media for dust less than 2.5 micron ($PM_{2.5}$)*

[6] GLC values as per Table 2.1 NSW DECCW Technical Notes as referenced in Section 2.

Diagram 3
Predicted Dispersion of Dust from Plant
(Concentration in micrograms/m^3 99.5% average)

Diagram 4
Predicted Dispersion of Formaldehyde from Plant
(Concentrations in micrograms/m^3 – 99.5% average)

Diagram 5
Predicted Dispersion of Methanol from Plant
(Concentrations in micrograms/m^3, 99.5% average)

Diagram 6
Predicted Dispersion of Phenol from Plant
(Concentrations in micrograms/m^3 – 99.5% average)

5.6 Discussion of Modelling Inputs & Results

The conduct of the modelling work included the following inputs:

- Dust emissions were taken as particulate size of 2.5 microns or less ($PM_{2.5}$). This factor has been used due to the use of reverse pulse dust collectors where filter media will remove particulate matter larger than $PM_{2.5}$.

- Emissions are treated as not continuous over the plant operating hours of 0600-2200 Monday to Friday. Reference the data in Appendix 4 for plant utilisation, the data developed for the emissions inventories for dust and the various VOCs (methanol, phenol, formaldehyde).has taken into account the plant utilisation as advised by Vesuvius.

- *Note: All modelling was conducted at 1 hour averages, however to convert to 3 minute averages to compare results with GLC Criteria requirements under the POEO Act, a factor[7] of 1.6 can be applied to hourly results.* All modelling demonstrates a 99.5% average for emissions over the year, as required by DECCW guidelines.

Results of modelling work and findings are as follows:

- *Dust emissions from the new plant* – the modelling results in Diagram 3 show a worst case scenario of GLC values of 8 µg/m^3 at 1 hour averages approximately 100 m from the plant, with levels of 1 µgram/m^3 at some 700-800m from the plant boundary. All emissions fall within the industrial precinct. *These values are well below GLC criteria limits of 0.33 mg/m^3 required under statutory guidelines*.

- *Formaldehyde emissions from the new plant* – results in Diagram 4 indicate that the highest level of formaldehyde emissions from the plant will be 0.0008 µg/m^3 concentrations at ground level. *These levels are well below the GLC impact limit of 5 X 10^{-2} mg/m^3.* Note: these levels are likely to be below normal detectable levels of analysis of GC/MS laboratory analysis.

[7] Factors can be calculated from AUSPLUME file Help Notes, where an algorithm provides a factor of 1.6 for conversion from 1 hour to 3 minute averages for concentrations of pollutants.

- *Methanol emissions from the new plant* – results of the predictive modelling as shown in Diagram 5 indicate a similar scenario to the modelling outcomes for formaldehyde. *The highest level of methanol concentrations are 0.60 µg/m^3 in close proximity to the new plant, which are well below the GLC values of 5.5 mg/m^3*. Similarly, GC/MS analysers would be at their limits of sensitivity to identify these concentrations. There is minimal risk of emissions of methanol as an emission from process plant operations ever exceeding the GLC criteria at both 1 hour and 3 minute averages.

- *Phenol emissions from the new plant* – results of the predictive modelling as shown in Diagram 6 indicate concentrations of 0.004 µg/m^3 in close proximity to the new plant. Hence the modelling indicates that the GLC criteria limit of 0.036 mg/m^3 would not be reached at either the 1 hour or 3 minute averages for concentrations at locations outside the plant boundaries.

5.7 Cumulative Emissions & Contributions to the Illawarra 'Airshed'

Based on the measured emissions from the existing plant, the total contribution from the relocated CP plant to the Illawarra 'airshed' will be as tabled below. Refer to Appendix 3 for details of calculations.

Pollutants from Vesuvius Plant	Calculated Annual Emissions (kgs)	DECCW Data on Illawarra 'Airshed' Pollutants
Dust ($PM_{2.5}$)	**70**	**126 tonnes p.a.**
VOCs - Methanol Formaldehyde Phenol	**4**	**Total VOCs: 6,300 tonnes p.a.**

Table 3
Calculated Cumulative Emissions from Plant
& Comparison with DECC Air Emissions Inventory[8]

As can be seen above, the contributions that the Vesuvius plant makes to the Illawarra 'airshed' is minor. What also needs to be kept in the assessment is that this is a relocation of an existing plant which will likely involve upgrades to pollution control equipment due to the need to replace plant that has served its life. These upgrades, as part of the relocation to Port Kembla, are an opportunity to ensure that the relocated plant will match or exceed the performance obtained from the plant when operating at the Bulli site.

[8] Air Emissions Inventory for the NSW Greater Metropolitan Region (GMR): http://www.environment.nsw.gov.au/air/airinventory.htm

6.0 POLLUTION CONTROL MEASURES

6.1 General

Pollution control measures are to be based on the following, utilising the data obtained from modelling:

- Adequate ventilation rates to ensure negative pressure in and around the Vesuvius processes so that no fugitive emissions occur during handling, loading and production.
- The process airflow will be passed through dust collectors on each process line, with collected dust product returned to the process.
- Residual fumes and odours from the VOC compounds will not require any additional pollution control measures before exhaust to the atmosphere. *Note: currently no fume or odour control facilities operate on the Bulli plant, and the plant management have no records of odour complaints from the nearby residential community.*
- Exhaust to atmosphere from the ventilation/dust control and fume/odour systems will be via vertical stacks with minimum exit velocities of 15 metres/second to ensure proper dispersion into the building plume of process ventilation air as per NSW DECCW recommended practices for treated exhaust airstreams.

6.2 Dust Collectors

These appliances will be of the high efficient type, usually of the fabric type operating as a reverse jet (or pulse) bag-house collector. These are currently in use at the Vesuvius Bulli plant and provide an effective removal of particulate matter in the 5-15 micron size with an efficiency of 95%. Other high efficiency dust collectors such as wet collectors would obviously not be applicable as:

- The likely production of a cement solids forming in the system,
- The treatment and disposal of wastewater from the site is a major concern that favours the use of dry media dust collection systems.

Prior to the relocation to Port Kembla, all dust collectors would be evaluated as to their effective life and operational service, and whether it would be more practical to install new dust collectors in the relocation.

All collectors will be required to operate to the Group C categorisation of 100 mg/m^3 (as per Section 2) of particulate matter from processes.

- Diagram 7 -
Vesuvius Bulli Refractory Plant – TEKA Machine
Typical Arrangement for Dust Collectors at back end of Plant Process

5.3 Materials Handling

The current manufacturing practices require apertures into receival bins, etc., be under a negative pressure to ensure minimal fugitive dust emissions occur in and around processing plant. This is crucial in those work activities requiring personnel to load product to various processes. Where practical, large volume materials are handled in bulk systems that minimise physical handling by plant personnel.

The relocation of the plant to Port Kembla would be an opportunity to upgrade manufacturing practices where applicable within the plant to improve materials handling for both OH&S reasons as well as overall air quality.

5.4 Building Ventilation

Generally, building ventilation will be in accordance with AS 1668.2-2002 as described in Section 2. The design intent will be to ensure capture of all fugitive emissions as per OH&S standards and treat collected air via dust collectors and odour control devices – if required.

The overall building ventilation would be achieved through natural ventilation with air entry via wall openings (doors, wall vents, etc.,) and relieved to atmosphere via roof vents, ridge vents or similar.

6.0 CONCLUSIONS

The conclusions reached from this study on the Air Quality issues surrounding the relocation of the Vesuvius premises to Port Kembla are:

- The current manufacturing operations are classified as 'non scheduled' activities as defined by the POEO Act, and in their relocation there is no change in the operations or manufactured output volumes that would alter this classification.

- The relocated plant to Port Kembla will be required to meet conditions within the POEO Act and Regulations for emissions from 'non scheduled' premises, including fumes, pollutants and odours.

- The current plant located at Bulli has no history of odour impact on the surrounding residential properties, based on the lack of odour complaints.

- Modelling work undertaken using worst case scenarios has indicated that the plant emissions for dust and VOCs from the plant in its new location will comply with the provisions of the Clean Air regulations of the POEO Act. Impact levels beyond the plant boundaries are well within statutory guidelines.

- The relocated plant will not increase the levels of pollutants as tabled in DECCW Air Emissions Inventories for the NSW Greater Metropolitan Region. This assessment of emissions from the plant shows a very minor contribution to overall pollution levels.

- From a Due Diligence point of view to ensure compliance with the POEO Act, it would be appropriate to conduct sampling and analysis of exhaust airstreams from the various plant processes to verify dust collection efficacy and the levels of air impurities that may be present. This work should be conducted during commissioning work for the new plant and the results become required operating conditions for plant Standard Operating Procedures (SOPs).

APPENDIX 1

Material Safety Data Sheets – Summary Table
Products used in Vesuvius Production

Table 5 - Raw Materials used in Vesuvius Production – Summary of MSDS

Raw Material	CAS #	Hazards		TWA/TLV STEL	Odour Limit
		Toxicological	Environmental/Ecological		
Cement Dust	65997-15-1	❑ Mildly corrosive. ❑ Eye: short term irritation. Long term cornea inflammation ❑ Skin: short term irritation ❑ Inhalation: short term irritation, long term may lead to asthma, bronchial and other lung damage	❑ No available data on environmental or ecological hazards	TLV: 5 mg/m^3 TWA: 10 mg/m^3 Crystalline Silica: 0.2 mg/m^3 (ref: Portland Cement)	**No Statutory Limit**
Hexamine (product supplied by Swift & Co))	100-97-0	❑ No specific data with Worksafe or NOHSC on toxicological effects. ❑ Data indicates non irritating to eyes & skin. ❑ Data suggests inhalation should present no significant problems.	❑ No environmental data on environmental or ecological hazards ❑ Slight amine/ammonia odour	Not set	**No Statutory Limit**
Resinox (product supplied by Orica)		❑ NOHSC classified – potential carcinogen ❑ Contains formaldehyde, phenol specific STEL & TWA exposure limits	❑ Flammable ❑ Alcohol type odour ❑ Avoid discharge to waterways, ❑ Dispose through a licensed waste contractor	*Formaldehyde*: 8 hr TWA 1ppm 15min STEL 2ppm *Methanol:* 8hr TWA 200 ppm 15min STEL 250 ppm *Phenol:* 8hr TWA1ppm	*Formaldehyde*: 0.033 ppm (glc) *Methanol:* 4.26 ppm (glc) *Phenol:* 0.0094 ppm (glc)

Raw Materials	CAS#	Hazards		TWA/TLV STEL	Odour Limit
		Toxicological	Environmental/Ecological		
Hexion Cascophen (product supplied by Swift & Co)		❑ NOHSC classified – hazardous ❑ Contains formaldehyde, phenol specific STEL & TWA exposure limits	❑ Flammable ❑ Alcohol type odour ❑ Avoid discharge to waterways, ❑ Dispose through a licensed waste contractor	*Formaldehyde*: 8 hr TWA 1ppm 15min STEL 2ppm *Methanol:* 8hr TWA 200 ppm 15min STEL 250 ppm *Phenol:* 8hr TWA1ppm	*Formaldehyde*: 0.033 ppm (glc) *Methanol:* 4.26 ppm (glc) *Phenol:* 0.0094 ppm (glc)
Sodium Silicate	15859-24-2	❑ No toxicological or carcinogenic data from NOHSC ❑ Mild eye & skin irritant	❑ No environmental or ecological data available	Not set	odourless
Aluminium Orthophosphate	7784-30-7	❑ NOHSC classified – hazardous ❑ For eye & skin contact – can cause burns, water washing advised. ❑ Inhalation/Ingestion – wash out mouth with water and seek medical attention.	❑ No environmental and ecological data available	TWA 2 mg/m^3	odourless
Phosphoric Acid	7664-38-2	❑ NOHSC classified – hazardous ❑ Eye & skin contact will cause burns, immediate treatment and medical advice required. ❑ Ingestion requires washout of the mouth and immediate attention by medical professional	❑ No environmental or ecological data available	TWA 1 mg/m^3 STEL 3 mg/m^3 (NIOSH standards)	odourless

Description of Acronyms -

TWA – The **T**ime **W**eighted **A**verage airborne concentration over an eight-hour working day for a five-day working week over an entire working life.

STEL – **S**hort **T**erm **E**xposure **L**imit – the average airborne concentration over a 15 minute period which should not be exceeded at any time during a normal eight-hour day. According to current knowledge this concentration should not impair the health nor cause undue comfort to the majority of workers.

glc – **G**round **L**evel **C**oncentration are criteria guideline values for air impurities that fall to ground from the emissions from plants, and represent detectable limits for odour assessment. These can be used in design processes for 'scheduled' premises under the POEO Act with predictive dispersion modelling to determine limits of plant emissions and hence specifications for pollution control plant.

APPENDIX 2

Emissions Inventory Files

VESUVIUS EMISSIONS INVENTORY
DUST DISPERSION MODELLING

TERRAIN FILE: VESUV10B1.TER
METEOROLOGICAL FILE: WO2004.MET
INPUT FILE: VESUV10B1.CFG
OUTPUT FILE: VESUV10B1.TXT
CONCENTRATION FILE: VESUV10B1.DAT
FREQUENCY FILE: VESUV10B1F.FRQ
CALENDAR FILE: VESUV10B1.CAL
STATISTICAL FILE: VESUV10B1.STA

Building Corners coordinates: A(8305.6; 2755.6), B(8249.2; 2758.7),
C(8288.1; 2613.1), D(8233.5; 2617.2).
Building Base elevation = 7 m.
Building height = 15.7 m.

EMISSION RATE
g/s

Crushing Plant

CRUSH Stack Source 8263.7, 2756.1, 6 0.01435
h = 18.7 m t = 30 ^{o}C d = 0.50 m v = 15 m/s
Emission rate depends on time. From 6 to 14 it is 0.8*0.01435 = 0.01148 g/s.
From 14 to 22 it is 0.2*0.01435 = 0.00287 g/s. From 22 to 6 it is 0 g/s.
No gravitational settling or scavenging.

Ball Mill – 1st & 2nd Fans

BALL12 Stack Source 8282.3, 2750.9, 6 0.006
h = 18.7 m t = 30 ^{o}C d = 0.33 m v = 15 m/s
Emission rate depends on time. From 6 to 14 it is 0.006/3 = 0.002 g/s.
From 14 to 22 it is 0.006/3 = 0.002 g/s. From 22 to 6 it is 0.006/3 = 0.002 g/s.
No gravitational settling or scavenging.

TEKA Machine

TEKA Stack Source 8289.7, 2700.0, 6 0.01125
h = 18.7 m t = 30 ^{o}C d = 0.45 m v = 15 m/s
Emission rate depends on time. From 6 to 14 it is 0.7*0.01125 = 0.007875 g/s.
From 14 to 22 it is 0.3*0.01125 = 0.003375 g/s. From 22 to 6 it is 0 g/s.
No gravitational settling or scavenging.

RAM Machine

RAM Stack Source 8283.4, 2650.7, 6 0.00325
h = 18.7 m t = 30 ^{o}C d = 0.25 m v = 15 m/s
Emission rate depends on time. From 6 to 14 it is 0.8*0.00325 = 0.0026 g/s.
From 14 to 22 it is 0.2*0.00325 = 0.00065 g/s. From 22 to 6 it is 0 g/s.
No gravitational settling or scavenging.

ComCast

COMCAS Stack Source 8269, 2666.7, 7 0.00125
h = 18.7 m t = 30.0 ^{o}C d = 0.15 m v = 15 m/s
Emission rate depends on time. From 6 to 14 it is 0.8*0.00125 = 0.001 g/s.
From 14 to 22 it is 0.2*0.00125 = 0.00025 g/s. From 22 to 6 it is 0 g/s.
No gravitational settling or scavenging.

Precast

PRECAS Stack Source 8265.4, 2650.4, 7 0.00175
h = 18.7 m t = 30 ^{o}C d = 0.18 m v = 15 m/s
Emission rate depends on time. From 6 to 14 it is 1.0*0.00175 = 0.00175 g/s.
From 14 to 22 it is 0 g/s. From 22 to 6 it is 0 g/s.
No gravitational settling or scavenging.

Taphole Plant

TAPH1 Stack Source 8284.6, 2674.1, 6 0.00175
h = 18.7 m t = 30 ^{o}C d = 0.2 m v = 15 m/s
Emission rate depends on time. From 6 to 14 it is 0.8*0.00175 = 0.0014 g/s.
From 14 to 22 it is 0.2*0.00175 = 0.00035 g/s. From 22 to 6 it is 0 g/s.
No gravitational settling or scavenging.

Notes:

1. Meteorological data used are from 01/01/2004 to 31/12/2004.
2. Altogether 8,784 entries. 1.0 % represents 87.84 hours.
3. Averaging time = 1 hour.
4. Frequency analysis decision making level for dust >5 $\mu g/m^3$.
5. Roughness height at the wind vane site = 0.3 m.
6. Surface roughness height = 0.4 m.
7. Anemometer height = 10 m.
8. Horizontal dispersion curves for sources <100 m high – Sigma Theta.
9. Vertical dispersion curves for sources <100 m high – Pasquill-Gifford.
10. Horizontal dispersion curves for sources >100 m high – Briggs Rural.
11. Vertical dispersion curves for sources >100 m high – Briggs Rural.
12. Wind Profile Exponent: Irwin – Rural.

File Name: VESUV10B2.INV
Modified on: 24/11/2010

VESUVIUS EMISSIONS INVENTORY
FORMALDEHYDE DISPERSION MODELLING

RECEPTOR FILE: VESUV10B1.TER
METEOROLOGICAL FILE: WO2004.MET
INPUT FILE: VESUV10B2.CFG
OUTPUT FILE: VESUV10B2.TXT
CONCENTRATION FILE: VESUV10B2.DAT
FREQUENCY FILE: VESUV10B2F.FRQ
CALENDAR FILE: VESUV10B2.CAL
STATISTICAL FILE: VESUV10B2.STA

Building Corners coordinates: 1(8305.6; 2755.6), 2(8249.2; 2758.7),
3(8288.1; 2613.1), 4(8233.5; 2617.2).
Building Base elevation = 6 m.
Building height = 15.7 m.

EMISSION RATE
g/s

TAPHOLE Plant

TAPH1 Stack Source 8284.6, 2674.1, 6 0.00000133
h = 18.7 m t = 30 ^{o}C d = 0.25 m v = 15 m/s
Emission rate depends on time. From 6 to 14 it is 0.8*0.00000133 = 0.000001064 g/s.
From 14 to 22 it is 0.2*0.00000133 = 0.000000266 g/s. From 22 to 6 it is 0 g/s.
No gravitational settling or scavenging.

TAPH2 Stack Source 8289.6, 2674.1, 6 0.000001
h = 18.7 m t = 30 ^{o}C d = 0.15 m v = 15 m/s
Emission rate depends on time. From 6 to 14 it is 0.8*0.000001 = 0.0000008 g/s.
From 14 to 22 it is 0.2*0.000001 = 0.0000002 g/s. From 22 to 6 it is 0 g/s.
No gravitational settling or scavenging.

Notes:
1. Meteorological data used are from 01/01/2004 to 31/12/2004.
2. Altogether 8,784 entries. 1.0 % represents 87.84 hours.
3. Averaging time = 1 hour.
4. Frequency analysis decision making level for formaldehyde >0.0038 mg/m^3.
5. Roughness height at the wind vane site = 0.3 m.
6. Surface roughness height = 0.4 m.
7. Anemometer height = 10 m.
8. Horizontal dispersion curves for sources <100 m high – Sigma Theta.
9. Vertical dispersion curves for sources <100 m high – Pasquill-Gifford.
10. Horizontal dispersion curves for sources >100 m high – Briggs Rural.
11. Vertical dispersion curves for sources >100 m high – Briggs Rural.
12. Wind Profile Exponent: Irwin – Rural.

VESUVIUS EMISSIONS INVENTORY
METHANOL DISPERSION MODELLING

RECEPTOR FILE: VESUV10B1.TER
METEOROLOGICAL FILE: WO2004.MET
INPUT FILE: VESUV10B3.CFG
OUTPUT FILE: VESUV10B3.TXT
CONCENTRATION FILE: VESUV10B3.DAT
FREQUENCY FILE: VESUV10B3F.FRQ
CALENDAR FILE: VESUV10B3.CAL
STATISTICAL FILE: VESUV10B3.STA

Building Corners coordinates: 1(8305.6; 2755.6), 2(8249.2; 2758.7),
3(8288.1; 2613.1), 4(8233.5; 2617.2).
Building Base elevation = 6 m.
Building height = 15.7 m.

EMISSION RATE
g/s

TAPHOLE Plant

TAPH1 Stack Source 8284.6, 2674.1, 6 0.00091
h = 18.7 m t = 30 ^{o}C d = 0.15 m v = 15 m/s
Emission rate depends on time. From 6 to 14 it is 0.8*0.00091 = 0.000728 g/s.
From 14 to 22 it is 0.2*0.00091 = 0.000182. From 22 to 6 it is 0 g/s.
No gravitational settling or scavenging.

TAPH2 Stack Source 8289.6, 2674.1, 6 0.00065
h = 18.7 m t = 30 ^{o}C d = 0.15 m v = 15 m/s
Emission rate depends on time. From 6 to 14 it is 0.8*0.00065 = 0.00052 g/s.
From 14 to 22 it is 0.2*0.00065 = 0.00013. From 22 to 6 it is 0 g/s.
No gravitational settling or scavenging.

Notes:
13. Meteorological data used are from 01/01/2004 to 31/12/2004.
14. Altogether 8,784 entries. 1.0 % represents 87.84 hours.
15. Averaging time = 1 hour.
16. Frequency analysis decision making level for methanol >2.6 mg/m^3.
17. Roughness height at the wind vane site = 0.3 m.
18. Surface roughness height = 0.4 m.
19. Anemometer height = 10 m.
20. Horizontal dispersion curves for sources <100 m high – Sigma Theta.
21. Vertical dispersion curves for sources <100 m high – Pasquill-Gifford.
22. Horizontal dispersion curves for sources >100 m high – Briggs Rural.
23. Vertical dispersion curves for sources >100 m high – Briggs Rural.
24. Wind Profile Exponent: Irwin – Rural.

VESUVIUS EMISSIONS INVENTORY
PHENOL DISPERSION MODELLING

RECEPTOR FILE: VESUV10B1.TER
METEOROLOGICAL FILE: WO2004.MET
INPUT FILE: VESUV10B4.CFG
OUTPUT FILE: VESUV10B4.TXT
CONCENTRATION FILE: VESUV10B4.DAT
FREQUENCY FILE: VESUV10B4F.FRQ
CALENDAR FILE: VESUV10B4.CAL
STATISTICAL FILE: VESUV10B4.STA

Building Corners coordinates: 1(8305.6; 2755.6), 2(8249.2; 2754.7),
3(8288.1; 2613.1), 4(8233.5; 2617.2).
Building Base elevation = 6 m.
Building height = 15.7 m.

EMISSION RATE
g/s

TAPHOLE Plant

TAPH1 Stack Source 8284.6, 2674.1, 6 0.000006
h = 18.7 m t = 30 ^{o}C d = 0.45 m v = 15 m/s
Emission rate depends on time. From 6 to 24 it is 0.8*0.000006 = 0.0000048 g/s.
From 14 to 22 it is 0.2*0.000006 = 0.0000012 g/s. From 22 to 6 it is 0 g/s.
No gravitational settling or scavenging.

TAPH2 Stack Source 8289.6, 2674.1, 6 0.000004
h = 18.7 m t = 30 ^{o}C d = 0.15 m v = 15 m/s
Emission rate depends on time. From 6 to 24 it is 0.8*0.000004 = 0.0000032 g/s.
From 14 to 22 it is 0.2*0.000004 = 0.0000008 g/s. From 22 to 6 it is 0 g/s.
No gravitational settling or scavenging.

Notes:
25. Meteorological data used are from 01/01/2004 to 31/12/2004.
26. Altogether 8,784 entries. 1.0 % represents 87.84 hours.
27. Averaging time = 1 hour.
28. Frequency analysis decision making level for phenol >0.017 mg/m^3.
29. Roughness height at the wind vane site = 0.3 m.
30. Surface roughness height = 0.4 m.
31. Anemometer height = 10 m.
32. Horizontal dispersion curves for sources <100 m high – Sigma Theta.
33. Vertical dispersion curves for sources <100 m high – Pasquill-Gifford.
34. Horizontal dispersion curves for sources >100 m high – Briggs Rural.
35. Vertical dispersion curves for sources >100 m high – Briggs Rural.
36. Wind Profile Exponent: Irwin – Rural.

APPENDIX 2

Plant Utilisation

Table 6: Vesuvius – Plant Utilisation

	Max. annual production (T)	Typical thoughput (T/hr)	Max. annual hours of operation (hrs)	Estimated % production during shifts			Max. % of shift time generating dust/fumes		
				6 am to 2 pm	2 pm to 10 pm	10 pm to 6 am	6 am to 2 pm	2 pm to 10 pm	10 pm to 6 am
Ball Mill	1500	0.3	5000	33.33%	33.33%	33.33%	57%	57%	57%
TEKA/Batching Plant	15000	10	1500	70.00%	30.00%	0.00%	36%	15%	0%
ComCast	4000	4	1000	90.00%	10.00%	0.00%	31%	3%	0%
Taphole Clay	3000	1.4	2143	80.00%	20.00%	0.00%	59%	15%	0%
RAM	1000	4	250	80.00%	20.00%	0.00%	7%	2%	0%
PreCast	1000	1	1000	100.00%	0.00%	0.00%	34%	0%	0%
Crushing Plant	1000	3.75	267	80.00%	20.00%	0.00%	7%	2%	0%

Data supplied by Vesuvius 08/11/2010

Table 7: Emissions Based on Utilisation

Plant	Airflow Rate (m^3/sec)	Contaminant Type	Contaminant Emissions (ref. Emissions Inventory)[1] (grams per 8 hour shift)			Total Emissions (grams/day)	Plant Utilisation[2] (per annum)	Total Annual Emissions (grams)
			0600-1400	1400-2200	2200-0600			
Crushing Plant	**1.2**	**dust**	330.6	82.6	0	**413.2**	267 hours **(11 days)**	**4545**
Ball Mills	**2.87**		57.6	57.6	57.6	**172.8**	5000 hours **(208 days)**	**35942**
TEKA Plant	**2.25**		226.8	97.2	0	**324**	1500 hours **(63 days)**	**20412**
Comcast	**0.25**		28.8	7.2	0	**36**	1000 hours **(42 days)**	**1512**
Taphole Clay	**0.6**	**dust**	40.32	10.1	0	**50.4**	2143 hours **(89 days)**	**4486**
		VOCs -						
		Formaldehyde,	0.05	0.013	0	**0.063**		**5.6**
		Methanol,	35.9	8.98	0	**44.88**		**3994**
		Phenol	0.23	0.06	0	**0.29**		**26**
RAM	**0.65**	**dust**	75	18.7	0	**93.7**	250 hours **10.5 (days)**	**984**
Pre-Cast	**0.35**	**dust**	50.4	0	0	**50.4**	1000 hours **(42 days)**	**2117**

Total Dust Emissions per annum: 70 kgs
Total VOC Emissions per annum: 4 kgs

Notes:
Note 1: refer to Emissions Inventories (Appendix2, pages 33-37))
Note 2: refer to Table 6 (Appendix 3, page 39)