



Environmental
Defenders
Office
Western Australia (Inc)

Suite 4, Woods Building
544 Hay Street, Perth WA 6000
Ph (08) 9221 3030, FX (08) 9221 3070
Country WA 1800 175 542
www.edowa.org.au
edowa@edowa.org.au

7 April 2015

Vince Puiccio
Community Alliance for Positive Solutions Inc.
PO Box 69
YARLOOP
WA 6218

By Email: caps6218@yahoo.com

Dear Vince,

Further to our meeting, I set out below at section 2 of this document, a consolidated summary of submissions for your presentation to the Department of Health (**DoH**) scheduled for 23 April 2015. These submissions are supported by examination of key evidentiary scientific findings which highlight a clear causative link between the Alcoa Wagerup Alumina Refinery (**Refinery**) emissions and the surrounding community health complaints. I have extracted this summary of submissions from a more detailed discussion of the issues at section 3 of this document. All statements are referenced to supporting evidence current as at 26 March 2015.

1. Introduction to submissions

As far back as 11 October 2011, Mr John Hyde, Parliamentary Secretary to the then Minister for Health stated “*both the DoH and the Government readily accept that there has been health issues with the refinery and this has never been questioned*”. This position is in keeping with the growing body of global scientific studies and findings evidencing all manner of health impacts associated with alumina refinery emissions and related airborne volatile organic compounds, and yet still there is dispute and denial over the both short and long term health impacts of the Refinery emissions.

Economic burden of health impacts caused by Refinery outweighs economic benefits

The Doctors for the Environment Australia (**DEA**) in their submissions on the proposed variation to the Ambient Air Quality NEPM, Oct 2014, stated ‘*as a wealthy country with good governance and good science there is no reason we should continue to tolerate an increasing health burden from air pollution*’. The bottom line is that we should, and do know better.

It is not, as Professor Tarun Weeramanthri, Executive Director of Public Health and Clinical Services Division of DoH states in his letter of 31 October 2014, “*both sustainable and in the interests of the West Australian public*’ for the Refinery to expand its program. On 23 June 2005, the Medical Practitioner’s Forum made statements in their submissions to the Minister for Health,

Bob Kucera, in response to the proposed Wagerup Alumina Refinery Unit Three Expansion that:

this is an issue of ethics (in terms of social justice) of a decision that could lead to the local community carrying most of the burden of potential health and social costs so that Alcoa and the State can gain economic benefits. On this basis we consider the risk of further compromising the health and social functioning of the local community to be too high; and the trade-off of this risk against the broader economic benefits to be unjust.¹

It is also well documented that the economic burden associated with Refinery pollution can be directly linked to the costs to the Western Australian health system for hospital admissions and visits to the doctor, medication costs, costs to businesses for reduced productivity and absenteeism, and costs to individuals experiencing mild or severe health effects (BDA Group 2013).² The Executive Director's statement falls well short of the economic truth under factual scrutiny. The health costs of air pollution in Australia are estimated to be in the order of \$11.1 billion to \$24.3 billion annually, solely as a result of mortality (Begg et al. 2007; Access Economics 2008).³

See further section 3(5.11) of this document for discussion on economic burden of Refinery.

The agencies are erroneously basing approval decisions upon incomplete and misleading data Alcoa and the relevant government regulatory agencies (**Agencies**) justify continued expansion of the Refinery's production through reliance upon outdated (from almost a decade ago) and selectively sourced scientific health studies. No studies appear to have been undertaken or relied upon by the Department of Environment Regulation (**DER**) or DoH regarding this issue since 2006. There also appears to be a blind acceptance by Agencies of Alcoa's misleading and incomplete Refinery data. Alcoa can be shown to have provided misleading information in connection with its application in 2012 for extension to commencement date for the expansion. Alcoa selectively presented information, failed to present relevant information or answered different questions from that which were actually posed in order to make it appear the projected impacts of the proposal would not become any worse since the original grant of approval. This is in keeping with the findings of the Medical Practitioner's Forum submissions to Health Minister Bob Kucera in 2005⁴ – see further section 3(5.8) of this document. Alcoa appear to be perpetuating their poor international reputation for lack of integrity and social responsibility. In 2003 they were even found guilty of falsifying their dust level recordings from the Refinery.⁵

Most concerningly, Alcoa's current air quality monitoring program fails to adequately monitor for well-accepted carcinogens such as acetaldehyde, crotonaldehyde and benzene, as well as

¹ Medical Practitioner's Forum submissions to Health Minister Bob Kucera in response to proposed Wagerup Refinery Unit Three Expansion, 23 June 2005

² Draft Variation to the National Environment Protection (Ambient Air Quality) Measure Impact Statement Prepared for the National Environment Protection Council, July 2014, section 3.3 Costs associated with airborne PM in Australia, p 13.

³ Ibid.

⁴ See n1.

⁵ Dr Geoff Pain submissions to Senate Community Affairs References Committee, Parliament House, Canberra, 'Inquiry into workplace exposure to toxic dust', p 2.

particulate matter pollutants of <2.5 µg (see further section 3(3,4) below). How then can the Agencies approve expansion or licence conditions without relevant data for determination of consequent health impacts.

Claims there is no ‘causative link’ between Refinery and health impacts cannot be maintained

Still further to these concerns, the wealth of available scientific and medical research on this subject from recent years overwhelmingly supports the finding of a causative link between many of the permitted Volatile Organic Compounds (VOCs) emitted by Alcoa and their associated health impacts (see 3(1-4) below). The Department of Environment and Conservation 2006 Winter Study found a correlation between emissions and community complaints. This study was peer reviewed by Dr Ronald Calhoun and colleagues at the Arizona State University and National Oceanic & Atmospheric Administration (NOAA USA) and the Royal Metrological Society. All concurred with the findings. Such documents are on public record. It is embarrassing for the DoH to continue restatement of their position that there *‘is no causal link between health emissions and the Wagerup refinery’*. Beyond reasonable doubt the Refinery, with approval of the Agencies, is knowingly and recklessly poisoning people. First and foremost, this is a human rights issue. Complaints to date have been largely marginalised, silenced and discredited by Alcoa and the Agencies. With time and ever improving scientific knowledge, data recording systems and technology, complaints and potential compensation claims are likely to intensify - not go away.

This document sets out the Community Alliance for Positive Solutions (CAPS) submissions supported by examination of key evidentiary scientific findings. These findings evidence the causative link between the Refinery emissions and Community health complaints as well as identifying recommendations at section 3(5).

2. Summary of Submissions

1. There has been significant recent advancement in our understanding of the health risks associated with exposure to ambient particulate matter and adsorbed VOCs.
2. Secondary particulate matter emissions do not behave as previously assumed and their effects on human health are likely far greater than currently known.
3. There is confirmation of causal links between toxic air pollution and consequent impacts on human health.
4. Previous measurements of airborne VOCs are gross underestimates and current monitoring of Refinery emissions and compliance with current health guidelines is not adequate.
5. Recommendations – there needs to be:
 - 5.1 more stringent air quality standards for WA and a national threshold value for exposure to PM₁₀ and PM_{2.5};
 - 5.2 an enforceable air quality limit value for the Refinery in keeping with proposed national threshold and WA standards;
 - 5.3 a cap on Refinery production;

- 5.4 academic consensus regarding the method of sampling techniques used to measure emissions and their impacts;
- 5.5 unbiased independent senior academic toxicologists advising the Agencies, particularly in regard to the risk of chemical synergies developing as pollutants adsorbed onto Particulate Matter (**PM**) and the impact of this on human health;
- 5.6 further studies progressing and developing upon findings of the CRC Care Final Report;
- 5.7 a further, more comprehensive and reliable base line study of the health of the Communities taking into account statistics associated with Refinery workers;
- 5.8 an independent third party contracted to ensure reliable air monitoring is undertaken in the surrounding Communities;
- 5.9 more stringent regulation of Alcoa by Agencies to ensure implementation of their undertakings:
- 5.10 an increased buffer zone between the Refinery and community is essential; and
- 5.11 State consideration and assessment of true ‘economic’ impact of Refinery operations in light of Community impact upon our health system.

3. Detailed Submissions

1. **There have been significant advancements in our understanding of the health risks associated with exposure to ambient particulate matter and adsorbed compounds**

- 1.1 Since the introduction of the Air NEPM in 1998, there have been significant advancements in understanding the health and environmental effects of exposure to ambient PM.⁶
- 1.2 There have also been significant improvements in PM monitoring methods.⁷
- 1.3 Since 2003, publications highlighting the severe and adverse health effects of PM have appeared on the global stage.⁸ These impacts are diverse in scope, severity and duration. Premature mortality, aggravation of cardiovascular disease and aggravation of respiratory disease such as asthma, changes to lung tissue structure and function, cancer, reproductive and developmental effects and changes in the function of the nervous system have all been linked to PM exposure.⁹
- 1.4 Rapid and constant scientific advances in these fields mean that historic scientific and medical reports become outdated quickly and cannot be credibly relied upon by Alcoa or Agencies in stating, *‘there is no causative link between the Refinery emissions*

⁶ Environmental Health Standing Committee (enHealth) of the Australian Health Protection Principal committee, Mr Jim Dodds, 4 October 2013 p vii; National Environment Protection Council (NEPC), Commonwealth of Australia, *Draft Variation to the National Environment Protection (Ambient Air Quality) Measure Impact Statement* (July 2014) Department of the Environment, Canberra.

⁷ Ibid.

⁸ USEPA. *Integrated Science Assessment for Particulate Matter* (Final Report). US Environmental Protection Agency, Washington, DC, EPA/600/R-08/139F, 2009; WHO Regional Office for Europe 2013.

⁹ National Environment Protection Council (NEPC), Commonwealth of Australia, *Draft Variation to the National Environment Protection (Ambient Air Quality) Measure Impact Statement* (July 2014) Department of the Environment, Canberra, p x.

and the health complaints of the Communities'. The DoH must make decisions which reflect current understanding in this field or be held publicly accountable.

2. New scientific findings regarding Secondary Particulate Matter indicate particulate emissions do not behave as previously assumed and their effects on human health are likely far greater than currently known

- 2.1 PM can be classified as either primary or secondary based on its chemical and physical origin. Primary particles are emitted directly from an (industrial) source. Secondary particles form in the atmosphere through adsorption of 'secondary particulate precursors'¹⁰.
- 2.2 Examples of secondary particulate precursors include nitrogen oxides, sulphur dioxide, ammonia and other gases which are also emitted from the Refinery smoke stacks but were not previously monitored by Aloca.¹¹
- 2.3 The main gaseous precursors include VOCs.¹² Following emission, these gaseous precursors may travel some distance from their source before chemical reactions involving inorganic or organic gas-phase components occur to form harmful/measurable/secondary PM.¹³
- 2.4 Previous analyses have focussed on and quantified only primary PM. However, studies now show secondary particles can contribute significantly to PM concentrations and PM-associated adverse health effects.¹⁴
- 2.5 Further, secondary PM is more frequently of a smaller size class (fine PM_{2.5}, or of an airborne diameter of less than 2.5µm). These particles have a much larger spatial range; they travel further due to their smaller size and mass.¹⁵
- 2.6 As far back as 2003, the World Health Organisation published statements that:

*fine particles (commonly measured as PM_{2.5}) are strongly associated with mortality and other endpoints such as hospitalization for cardio-pulmonary disease.*¹⁶

- 2.7 Certain pollutants can become concentrated on airborne particles and consequently alter the surface chemistry of dust particles (adsorption).¹⁷

¹⁰ European Environment Agency. *Emissions of primary PM_{2.5} and PM₁₀ particulate matter (CSI 003/APE 009)* - Assessment (published Jun 2014) available online at <http://www.eea.europa.eu/data-and-maps/indicators/emissions-of-primary-particles-and-5/assessment-3>. Accessed March 2015

¹¹ Ibid.

¹² Ibid.

¹³ Ibid ix.

¹⁴ Ibid.

¹⁵ <http://cfpub.epa.gov/eroe/index.cfm?fuseaction=detail.viewPDF&ch=46&lShowInd=0&subtop=341&lv=list.IstByChapter&r=219687>; World Health Organisation Regional Office for Europe, *Health Aspects of Air Pollution with Particulate Matter, Ozone and Nitrogen Dioxide - Report on a WHO Working Group held in Bonn, Germany, EUR/03/5042688* (13 – 15 January 2003) [p 21].

¹⁶ World Health Organisation Regional Office for Europe, *Health Aspects of Air Pollution with Particulate Matter, Ozone and Nitrogen Dioxide - Report on a WHO Working Group held in Bonn, Germany, EUR/03/5042688* (13 – 15 January 2003) [5.2].

¹⁷ Anita D'Angelo et al., CRC Care Pty Ltd, *Final Report: Adsorbed Organic Species on Respirable Alumina Particles* (2009)

- a. Adsorption is defined by the International Union of Pure and Applied Chemistry (IUPAC) as:

*an increase in the concentration of a dissolved substance at the interface of a condensed and a liquid phase due to the operation of surface force. Adsorption can also occur at the interface of a condensed and a gaseous phase.*¹⁸

- b. It is now known the concentration of toxic components on particulate emissions may exceed those in the gas phase.¹⁹
- c. The results of the experiments conducted under controlled laboratory conditions clearly indicated the organic compounds studied were absorbed onto γ -alumina.²⁰

2.8 The adverse effects of Refinery emissions on human and animal health and possibly plant life may be far greater than is currently acknowledged.²¹

- a. Studies on the types and concentrations of organic species adsorbed onto particles are important in determining the causal link between alumina refinery emissions, dust pollution and health problems.²²
- b. Peer reviewed literature shows the emissions from many industries' organic species adsorbed on respirable particles affect human health.²³
- c. The CRC study found that:
- n-hexane, 1-hexene, benzene, toluene, o-, m- and p-xylene, trans-2-hexenal, 2-butanone, acetophenone, benzaldehyde, propionaldehyde, benzyl alcohol, and acetaldehyde and acetone were adsorbed and retained by γ -alumina for up to 120 minutes;²⁴
 - the compounds identified above are harmful if inhaled into the lung;²⁵
 - benzaldehyde, acetaldehyde, propionaldehyde, acetone and benzyl alcohol were converted into other, more toxic products when absorbed on γ -alumina;²⁶
 - the CRC study further states:

*it would be reasonable to expect that under the influence of environmental stimuli such as UV radiation and elevated temperatures a host of reaction products including mixed condensation products could be produced*²⁷

¹⁸ Ibid 3 citing A D McNaught and A Wilkinson. IUPAC Compendium of Chemical Terminology, Royal Society of Chemistry, Cambridge, UK.

¹⁹ Ibid 1 citing K F Ho et al. 'Emissions of gas- and particle-phase polycyclic aromatic hydrocarbons (PAHs) in the Shing Mun Tunnel, Hong Kong' (2009) 43:40 *Atmospheric Environment* 6343-6351

²⁰ Ibid x.

²¹ Ibid

²² Ibid ix.

²³ Ibid 1 citing Mazzarella et al, 'Effects of diesel exhaust particles on human lung epithelial cells: An in vitro study' (2007) 101 *Respiratory Medicine* 1155-1162

²⁴ Ibid.

²⁵ Ibid.

²⁶ Ibid.

This statement indicates further effects due to chemical and physical processes not quantified in the CRC study should be expected in out-of-laboratory circumstances.

3. There is a clear causal link between air pollution and impacts to human health²⁸

In light of the substantial body of scientific evidence, there now exists high scientific certainty that Refinery emissions containing VOCs have significant negative health impacts upon persons exposed to them.

3.1 Exposure to Refinery emissions is directly linked to cardiopulmonary and lung cancer mortality:

- a. VOCs from refinery stacks adsorbed by air-borne particulates transfer into the human body upon encountering water in the eyes, skin, nose and extended airways, and other fluids of the human body.²⁹
- b. Airborne PM has long been associated with asthma, bronchitis, chronic cough, respiratory illness and lung cancer.³⁰
- c. Numerous studies have shown an increase in cardiovascular disease, decreased lung function, lung cancer and cardiopulmonary mortality associated with air pollution PM.³¹
- d. Exposure to PM less than 2.5 µm showed an increase of 6% and 8% in cardiopulmonary and lung cancer mortality respectively. This was observed for each 10 µm/m³ increase in PM after taking into account lifestyle effects such as weight and cigarette smoking.³²
- e. VOCs contained in Refinery emissions are known carcinogens (see further 3.5 - 3.9 below).

3.2 Exposure to Refinery emissions is directly linked to general respiratory illness:

- a. Many of the compounds in the Refinery emissions, including PM are harmful if inhaled into the lung.³³

²⁷ Ibid.

²⁸ See primarily findings of DEC partnered study with CRC Care Pty Ltd which studied the character of alumina dust to both develop methodology for identifying organic compounds adsorbed on alumina dust and to determine the concentrations of compounds adsorbed on alumina dust - CRC Care Final Report: Adsorbed Organic Species on Respirable Alumina Particles, D'Angelo et al. 2009 (**CRC Care Report 2009**).

²⁹ Comments CRCCARE – Final Report 11010506 (2009) Adsorbed Organic Species on Respirable Alumina Particles by Dr Geoff N. Pain Ph.D, B.Sc (Hons.), Consultant Scientist' undated

³⁰ CRC Care Final Report: Adsorbed Organic Species on Respirable Alumina Particles, D'Angelo et al. 2009 citing Arden Pope III *et al* 2002; Kelly 2003; Bai *et al* 2007.

³¹ Ibid citing Arden res III *et al* 2002; Kelly 2003; Bai *et al* 2007.

³² CRC Care Final Report: Adsorbed Organic Species on Respirable Alumina Particles, D'Angelo et al. 2009 citing Arden Pope III *et al*, (2002).

³³ Ibid.

- b. Scientific literature suggests a strong association between respirable size PM with adsorbed organic compounds and respiratory disease.³⁴
- c. The smaller the particulate, the greater the surface area and greater the interaction with lung alveoli.³⁵

3.3 Exposure to Refinery emissions, mortality and cardiovascular disease:

- a. There is a substantial body of scientific evidence supports the conclusions that long-term and short-term exposure to PM are causally associated with mortality and cardiovascular disease.³⁶ Specifically, the relative risk of death due to ischaemic heart disease as a result of moving from PM_{2.5} of 5 µg/m³ up to 10 µg/m³ was 1.2 while a further increase from 10 µg/m³ to 15 µg/m³ gave a relative risk of 1.12.³⁷ That is over a 30% increase from 5 µg/m³ to 15 µg/m³.
- b. Increasing evidence that long-term and short-term exposure to PM at levels below current standards is associated with adverse health effects A recent Canadian study provides evidence of an association between long term exposure to PM and mortality at levels below those generally experienced in Australia.³⁸
- c. 2014 submissions by DEA state that there is in fact ‘no safe level of PM_{2.5}.³⁹

3.4 Refinery emissions and Multiple Chemical Sensitivity (MCS):

- a. Alumina particles are likely to adsorb carcinogenic VOCs and promote reactions generating other carcinogens. Many of the VOCs emitted by the Refinery are also known sensitizers which can prime the body producing an allergic reaction to tiny subsequent exposures. This complaint is known as Chemical Hypersensitivity or MCS. As a general rule, sensitizers are carcinogens also.⁴⁰
- b. It seems from the following extract from the Standing Committee on Environment and Public Affairs: Alcoa Refinery at Wagerup Inquiry in October 2004 that Alcoa and the medical profession are both well aware that a notable number of Refinery workers are reporting MCS and that Alcoa has

³⁴ Ibid.

³⁵ Ibid citing Bai *et al* 2007.

³⁶ Recent report by the World Health Organization, Review of evidence on health aspects of air pollution – cited by Environmental Health Standing Committee (enHealth) of the Australian Health Protection Principal committee, Mr Jim Dodds, 4 October 2013.

³⁷ Submission on the proposed variation to the Ambient Air Quality NEPM, Oct 2014, Doctors for the Environment Australia [2]

³⁸ Recent report by the World Health Organization, Review of evidence on health aspects of air pollution – cited by Environmental Health Standing Committee (enHealth) of the Australian Health Protection Principal committee, Mr Jim Dodds, 4 October 2013.

³⁹ Above n 34. { = Submission on the proposed variation to the Ambient Air Quality NEPM, Oct 2014, Doctors for the Environment Australia [2]}

⁴⁰ Comments CRCCARE – Final Report 11010506 (2009) Adsorbed Organic Species on Respirable Alumina Particles by Dr Geoff N. Pain Ph.D, B.Sc (Hons.), Consultant Scientist’ undated.

even made efforts to identify workers starting to suffer MCS symptoms and remove them from the Refinery.⁴¹

- c. Professor Holman as representative of the Wagerup Medical Practitioner's Forum reported to the Committee at 4.317 of the Report:

one of the recommendations is designed to emphasise the importance of the early identification of workers who appear to be starting to suffer some of the symptoms that have been seen, which progress to the point whereby some people would call it multiple chemical sensitivity syndrome.

Holman notes:

*when those symptoms begin to appear, Alcoa now takes a much more proactive response. It aims to find an alternative place for the affected worker to continue to be employed by Alcoa if possible. If necessary, Alcoa tries to assist the worker to find alternative employment elsewhere.*⁴²

3.5 Exposure to alumina and cancer:

- a. Uncontaminated alumina is hazardous in its own right.⁴³
- b. In 1968 studies found aluminium oxide showed evidence of atypical cellular proliferation and squamous cell atypia. The authors concluded that aluminium compounds induce a specific proliferative response of the respiratory epithelium (Kobayashi).⁴⁴ A similar study in 1991 found γ -alumina was highly fibrogenic and had carcinogenic potential.⁴⁵
- c. Accumulation has been confirmed by several animal studies:
- Further, exposure of rabbits to low level, (0.56 mg/m³) alumina dust for eight hours per day, five days per week, for five months, caused Aluminium to continuously increase in various organs with brain aluminium levels increasing to 247%, lung 15800%, kidney 165%, heart 70% and bone 122%.⁴⁶
 - A study of ten horses living near an alumina plant indicated a cluster of granulomatous enteritis. Ulceration was evident on the buccal, oesophageal,

⁴¹ Report of the Standing Committee on Environment and Public Affairs in relation to the Alcoa Refinery at Wagerup Inquiry, Report 11, Oct 2004, Chapter 4: Public Health, see p113

⁴² Ibid.

⁴³ Comments CRCCARE – Final Report 11010506 (2009) Adsorbed Organic Species on Respirable Alumina Particles by Dr Geoff N. Pain Ph.D, B.Sc (Hons.), Consultant Scientist' undated.

⁴⁴ Kobayashi N, Ide G, Katsuki H, Yamane Y 1968 Gann, Vol. 59, pages 433-436 Effect Of Aluminium Compound On The Development Of Experimental Lung Tumor In Mice as cited in Comments CRCCARE – Final Report 11010506 (2009) Adsorbed Organic Species on Respirable Alumina Particles by Dr Geoff N. Pain Ph.D, B.Sc (Hons.), Consultant Scientist' undated.

⁴⁵ Comments CRCCARE – Final Report 11010506 (2009) Adsorbed Organic Species on Respirable Alumina Particles by Dr Geoff N. Pain Ph.D, B.Sc (Hons.), Consultant Scientist' undated citing Rollin 1991.

⁴⁶ Ibid.

gastric, small and large intestinal mucosae.⁴⁷ Alumina has an accumulative effect in the lungs. A study sponsored by the alumina industry found a clearance half-time, due to dissolution of the retained, inhaled deposit, is approximately 2000 days or 5.5 years. Consequently, under conditions of continuous intake, aluminium will accumulate in the body.⁴⁸

3.6 Exposure to acetaldehyde and cancer:

- a. Acetaldehyde has been shown to dissolve into the saliva and be a local carcinogen in the human upper digestive tract.⁴⁹
- b. Bittersohl (1974) reported a fivefold higher than expected incidence of cancer among 200 German factory workers exposed to 1 - 7 mg/m³ acetaldehyde as well as to other aldehydes. The workers had squamous-cell cancers of the mouth.⁵⁰
- c. Acetaldehyde is reasonably anticipated to be a human carcinogen based on sufficient evidence of carcinogenicity in experimental animals.⁵¹
 - Acetaldehyde induces squamous cell carcinomas and adenocarcinomas in rats and laryngeal cancer in hamsters.
- d. Acetaldehyde is listed as a carcinogen by the State of California under Proposition 65, *California's Safe Drinking Water and Toxic Enforcement Act of 1986*.⁵²
- e. Acetaldehyde associated with alcohol consumption is regarded as 'carcinogenic to humans', with sufficient evidence available for the oesophagus, head and neck as sites of carcinogenicity.
- f. It self-condenses to paraldehyde and metaldehyde (snail poison).⁵³

⁴⁷ Fogarty et al, Cluster of Equine Granulomatous Enteritis Cases: The Link With Aluminium, cited in Comments CRCCARE – Final Report 11010506 (2009) Adsorbed Organic Species on Respirable Alumina Particles by Dr Geoff N. Pain Ph.D, B.Sc (Hons.), Consultant Scientist' undated.

⁴⁸ Priest Nicholas D. and O'Donnell Thomas V. eds. 1997 Managing Health in the Aluminium Industry, the proceedings of the International Conference on Managing Health Issues in the Aluminium Industry held in Montreal, Canada, October 26 – 29, Middlesex University Press London, England, chapter 10 cited in Comments CRCCARE – Final Report 11010506 (2009) Adsorbed Organic Species on Respirable Alumina Particles by Dr Geoff N. Pain Ph.D, B.Sc (Hons.), Consultant Scientist' undated.

⁴⁹ Salaspuro Ville J., Hietala Jaana M., Marvola Martti L. and Salaspuro Mikko P. 2006 Eliminating Carcinogenic Acetaldehyde By Cysteine From Saliva During Smoking Cancer Epidemiol Biomarkers Prev 15(1):146–9, as cited in Comments CRCCARE – Final Report 11010506 (2009) Adsorbed Organic Species on Respirable Alumina Particles by Dr Geoff N. Pain Ph.D, B.Sc (Hons.), Consultant Scientist' undated.

⁵⁰ Comments CRCCARE – Final Report 11010506 (2009) Adsorbed Organic Species on Respirable Alumina Particles by Dr Geoff N. Pain Ph.D, B.Sc (Hons.), Consultant Scientist' undated.

⁵¹ IARC Acetaldehyde International Agency for Research on Cancer Tenth Report on Carcinogens, as cited in Comments CRCCARE – Final Report 11010506 (2009) Adsorbed Organic Species on Respirable Alumina Particles by Dr Geoff N. Pain Ph.D, B.Sc (Hons.), Consultant Scientist' undated.

⁵² Comments CRCCARE – Final Report 11010506 (2009) Adsorbed Organic Species on Respirable Alumina Particles by Dr Geoff N. Pain Ph.D, B.Sc (Hons.), Consultant Scientist' undated.

⁵³ Ibid.

- g. National Institute for Occupational Health and Safety (**NIOSH**) recommends occupational exposure to acetaldehyde be limited to the lowest feasible concentration.⁵⁴
- h. American Conference of Governmental Industrial Hygienists (**ACGIH**) recommends a ceiling of 25 ppm (45 mg/cubic metre).⁵⁵
- i. The WA Government described a level of 210 ppb as “acceptable” ground level concentration [K481]. This is 42 times the Office of Environmental Health Hazard Assessment Reference Exposure Level (**OEHHA REL**).⁵⁶
- j. The Liquor burner at the Refinery emitted 4.0 mg/m³ (444 times the OEHHA REL) of acetaldehyde which translates to 120 gm/hr assuming 30,000 m³ per hour flow.⁵⁷
- k. Acetaldehyde is also present in causticisation vent emissions at 16 mg/m³ (4000 times the OEHHA REL) and the Refinery mill vent showed 14 mg/m³.⁵⁸
- l. Further work on characterizing Alcoa worker and community exposure to acetaldehyde is clearly required.⁵⁹

3.7 Exposure to crotonaldehyde and cancer - there is no safe exposure to crotonaldehyde:

- a. Sources of release of Crotonaldehyde - Butenal (2-Butenal) at the Refinery include the Green Liquor (35A) Vent 76 mg/m³ and Slurry Storage Tanks (25A) 48 mg/m³.⁶⁰
- b. The CRC Care Report 2009 demonstrated alumina converts acetaldehyde to crotonaldehyde.⁶¹
- c. Crotonaldehyde is described as geno toxic, mutagenic, and carcinogenic⁶² and it forms exocyclic 1, N2-propanodeoxyguanosine adducts as the main DNA adducts.⁶³
- d. It is a severe lachrymator (like tear gas causes tears to flow from the eyes).⁶⁴
- e. There is no “safe” level of crotonaldehyde.⁶⁵

⁵⁴ NIOSH NTP National Toxicology Program 10th and 11th Annual reports on Carcinogens: Acetaldehyde, as cited in Comments CRCCARE – Final Report 11010506 (2009) Adsorbed Organic Species on Respirable Alumina Particles by Dr Geoff N. Pain Ph.D, B.Sc (Hons.), Consultant Scientist’ undated.

⁵⁵ Ibid.

⁵⁶ Ibid.

⁵⁷ Ibid.

⁵⁸ Ibid.

⁵⁹ Ibid.

⁶⁰ Ibid.

⁶¹ Ibid.

⁶² Chung, F. L., Tanaka, T., and Hecht, S. S. Induction of liver tumors in F344 rats by crotonaldehyde. *Cancer Res.*, 46: 1285–1289, 1986.

⁶³ Comments CRCCARE – Final Report 11010506 (2009) Adsorbed Organic Species on Respirable Alumina Particles by Dr Geoff N. Pain Ph.D, B.Sc (Hons.), Consultant Scientist’ undated citing Wilson 1991, Hecht 2001.

⁶⁴ Ibid.

⁶⁵ Ibid.

3.8 Exposure to toluene and cancer:

- a. There is much evidence that toluene produces oral cancers in test animals.⁶⁶
- b. Toluene is continually released in large quantities from the red mud waste areas as well as Liquor Burners⁶⁷.
- c. Toluene shows an impactful geno toxic effect in cells of the human buccal mucosa.⁶⁸ The incidence of nuclear abnormalities was significantly higher in the exposed group when compared to the control group. A positive relationship between the incidence of micronuclei and the toluene concentration in the environment was found.⁶⁹
- d. In a study of spray-painters exposed to toluene, isobutylacetate and dust histological examination showed in no case a normal nasal mucosa.⁷⁰
- e. In human studies⁷¹ using seven non-smoking healthy volunteers, the number of micronuclei (MN) was determined in exfoliated buccal mucosa cells before and after rinsing the mouth with an aqueous 10 ppm solution of 2-trans-hexenal during three consecutive days. All individuals showed at least a doubling of the MN frequency during one of the next four days. An increase of the mean group MN frequency was observed on the fourth day, becoming significant between the sixth and the seventh day.⁷²
- f. The Liquor burner at the Kwinana Refinery emitted 5.9 mg/m³ of toluene.⁷³
- g. Toluene was found in Wagerup Residue Areas at a concentration of 98 mg/m³.⁷⁴

3.9 Exposure to Benzene and cancer - there is no safe threshold for exposure to benzene:

- a. As early as the 1920s scientists have known that Benzene causes cancer.⁷⁵

⁶⁶ Ibid.

⁶⁷ Ibid.

⁶⁸ González-Yebra AL, Kornhauser C, Barbosa-Sabanero G, Pérez-Luque EL, Wrobel K, Wrobel K. *Int Arch Occup Environ Health*. 2009 Feb;82(3):373-80. Epub 2008 Jul 3. Exposure to organic solvents and cytogenetic damage in exfoliated cells of the buccal mucosa from shoe workers, as cited in Comments CRCCARE – Final Report 11010506 (2009) Adsorbed Organic Species on Respirable Alumina Particles by Dr Geoff N. Pain Ph.D, B.Sc (Hons.), Consultant Scientist' undated.

⁶⁹ Comments CRCCARE – Final Report 11010506 (2009) Adsorbed Organic Species on Respirable Alumina Particles by Dr Geoff N. Pain Ph.D, B.Sc (Hons.), Consultant Scientist' undated.

⁷⁰ Hellquist H et al *Acta Otolaryngol*. 1983 96(5-6):495-500. Nasal symptoms and histopathology in a group of spray-painters, as cited in Comments CRCCARE – Final Report 11010506 (2009) Adsorbed Organic Species on Respirable Alumina Particles by Dr Geoff N. Pain Ph.D, B.Sc (Hons.), Consultant Scientist' undated.

⁷¹ Dittberner U, Schmetzer B, Gölzer P, Eisenbrand G and Zankl H, 1997 Genotoxic effects of 2-trans-hexenal in human buccal mucosa cells in vivo *Mutation Research/Genetic Toxicology and Environmental Mutagenesis* Volume 390, Issues 1-2, 24 April, Pages 161-165.

⁷² Comments CRCCARE – Final Report 11010506 (2009) Adsorbed Organic Species on Respirable Alumina Particles by Dr Geoff N. Pain Ph.D, B.Sc (Hons.), Consultant Scientist' undated.

⁷³ Ibid.

⁷⁴ Ibid.

⁷⁵ Ibid.

- b. It was not until some twenty years later that officials instituted 100ppm as the “permissible” exposure level, which was lowered to 10ppm in 1978, and 1 ppm 1990. As a renowned benzene researcher⁷⁶ noted, the evolution of what was considered a permissible level of benzene was not driven by dramatic improvements in scientific knowledge regarding the mechanisms by which benzene caused cancer, but rather was the result of a continued struggle for health by unions, workers, physicians, and scientists against powerful economic interests. The debate regarding a permissible exposure level for benzene exposure continues with mounting evidence that there is no safe threshold for this carcinogen.⁷⁷
- c. Benzene was measured by Alcoa at Kwinana in the range of 35 to 50 mg/cubic metre (over 800 times the REL), giving emission rate above the USEPA reportable limit. Actual flow of LB feed was closer to 50,000 cubic metres per hour at 74 degrees C.⁷⁸

3.10 There is a considerable weight of medical opinion that there is a medical problem in the Communities as a direct result of the close proximity of the existing Refinery:

- a. Medical Practitioner’s Forum held in June 2005 reached the conclusion that, in their collective professional opinions, the history of workers at the Refinery showed that some workers had suffered acute and chronic adverse health consequences as the result of their employment.⁷⁹
- b. They stated further:

*The available evidence indicates that some of the neighbouring community members, including the people of the township of Yarloop, in our professional opinion, have suffered acute and chronic adverse health consequences as a result of the close proximity of the existing refinery.*⁸⁰

- c. The Wagerup Medical Practitioner’s Forum 2001 Perth concluded- “*there needs to be a focus on getting affected people out of the exposure situation*”.⁸¹ The forum supported exposure reduction either via planned buffer zone or via reduction of emissions.

3.11 ‘Wagerup and Surrounds Community Health Study’, June 2008 findings showed significantly elevated rates for most symptoms potentially related to chemical exposure with incidence of asthma being almost double the state average:

⁷⁶ Infante PM, Distasio MV. 1988 Occupational benzene exposure: preventable deaths. Lancet 1399–1400. [PubMed: 2898076].

⁷⁷ Comments CRCCARE – Final Report 11010506 (2009) Adsorbed Organic Species on Respirable Alumina Particles by Dr Geoff N. Pain Ph.D, B.Sc (Hons.), Consultant Scientist’ undated.

⁷⁸ Ibid.

⁷⁹ Medical Practitioner’s Forum submissions to Health Minister Bob Kucera in response to proposed Wagerup Refinery Unit Three Expansion, 23 June 2005.

⁸⁰ Ibid.

⁸¹ Conclusions from Wagerup Medical Practitioners’ Forum 2001 Perth.

- a. For symptoms potentially related to chemical exposure, elevated rates were found for most symptoms for residents of Hamel/Wagerup/Yarloop and also for residents of Cookernup.⁸²
- b. Higher reporting of headache was 2.5 times the state average;⁸³ breathing difficulties were 3-4 times the state average for males, more for workers; sore or irritated eyes, skin irritation or eczema being almost double the state average,⁸⁴ cough or sore throat being nearly 3 times state average,⁸⁵ fatigue after sleep being up to 50% on state average,⁸⁶ and nosebleed was reported at 2.9% in Hamel, 2.7% in Waroona and 2.2% in Cookernup against the state average of 0.7%.⁸⁷
- c. The Survey indicated those surveyed indicated 22.7% complained of stuffy nose against WA figure of 13%. Complaints of weakness were 12.6% against WA figures of 5.4%; complaints of dizziness (weak or dizzy up to 2-4 times state average)⁸⁸ and nausea 6.4% against 1.9% in WA which is more than 5 times the state average.⁸⁹
- d. These are compelling figures even after adjustment for various factors. They strongly indicate the health of residents in this area is suffering and that further survey and research is required immediately.
- e. These survey results are significant when taking into account the study was conducted without taking into account residents who had left the area or the circumstances surrounding the deaths of many others.
- f. This is in keeping with Geoff Pain's comments regarding symptoms relating to Formaldehyde and similar compounds emitted from the Refinery.⁹⁰

4. Previous measurements of airborne VOCs are gross underestimates and current monitoring of Refinery emissions and compliance with current health guidelines is not adequate

4.1 All previous measurements of airborne VOCs emitted into the Community are gross underestimates and the *'real dose received by those affected workers and residents is very much higher than previously admitted by Alcoa and the WA Health Department'*⁹¹

⁸² Wagerup and Surrounds Community Health Study, June 2008.

⁸³ Ibid p38.

⁸⁴ Ibid p44.

⁸⁵ Ibid p45.

⁸⁶ Ibid p46.

⁸⁷ Ibid

⁸⁸ Ibid, p47.

⁸⁹ Ibid.

⁹⁰ Ibid.

⁹¹ Comments CRCCARE – Final Report 11010506 (2009) Adsorbed Organic Species on Respirable Alumina Particles by Dr Geoff N. Pain Ph.D, B.Sc (Hons.), Consultant Scientist' undated

- a. In 1998 a study found measurements performed in WA at mine sites, including Alcoa sites prior to 1998 were likely to have underestimated dust loads by a factor of 2.4 to 3.4.⁹²
- b. the CRC Care Report 2009 modelled its findings on dust particles of 50 µm diameter where the dust from stacks and red mud waste is more likely to be closer to 1 µm diameter which is approximately 50 times that of the particles studied.⁹³
- c. Dr Geoff Pain states - “the smaller the particles, the larger the surface area, the greater the dose delivered”.⁹⁴ To date, the size of PM in relation to levels of VOC has not adequately been studied.
- d. This means the carcinogenic load delivered to the workers and residents surrounding the Refinery will be significantly larger than previously thought.⁹⁵
- e. Evidence arising from earlier investigation and assessment clearly indicates geography and topography of the area of Yarloop was never a suitable site for the Refinery. As a result of the unique topography and adjacent scarp of the region, a clearly defined ‘airshed’ or body of contaminated air becomes ‘contained’, creating a blanket of trapped pollution in the air space directly above the Communities. The unique behaviour of this ‘airshed’ of pollution has not adequately been considered by either Alcoa or the State in the approval of VOC levels for the Refinery.⁹⁶

4.2 As stated previously at 3.3(c) above, there is no safe level of PM_{2.5} and this has been known for decades.⁹⁷

- a. The recent advances in the understanding of the health impacts of PM have been extensively reviewed and summarised in a number of key documents, including:
 - Air quality guidelines – global update 2005. Particulate matter, ozone, nitrogen dioxide and sulfur dioxide (WHO Regional Office for Europe 2006);⁹⁸
 - Integrated Science Assessment for Particulate Matter (USEPA 2009);⁹⁹

⁹² Terry K W et al 1998 Minerals and Energy Research Institute of Western Australia (MERIWA) Report No 195 Characterisation of inhaled dusts on mine site as cited in Comments CRCCARE – Final Report 11010506 (2009) Adsorbed Organic Species on Respirable Alumina Particles by Dr Geoff N. Pain Ph.D, B.Sc (Hons.), Consultant Scientist’ undated.

⁹³ Comments CRCCARE – Final Report 11010506 (2009) Adsorbed Organic Species on Respirable Alumina Particles by Dr Geoff N. Pain Ph.D, B.Sc (Hons.), Consultant Scientist’ undated, p1.

⁹⁴ Comments CRCCARE – Final Report 11010506 (2009) Adsorbed Organic Species on Respirable Alumina Particles by Dr Geoff N. Pain Ph.D, B.Sc (Hons.), Consultant Scientist’ undated.

⁹⁵ Ibid.

⁹⁶ Medical Practitioner’s Forum submissions to Health Minister Bob Kucera in response to proposed Wagerup Refinery Unit Three Expansion, 23 June 2005.

⁹⁷ Australian Air Quality Group submission No. 144 Inquiry into Performance of the NSW EPA.

⁹⁸ Draft Variation to the National Environment Protection (Ambient Air Quality) Measure Impact Statement Prepared for the National Environment Protection Council, July 2014, Effects and monetary costs of airborne particulate matter, p 10.

⁹⁹ Ibid..

- Long-term exposure to air pollution: effect on mortality (COMEAP 2009);¹⁰⁰
 - The mortality effects of long-term exposure to particulate air pollution in the United Kingdom (COMEAP 2010);¹⁰¹
 - Review of evidence on health aspects of air pollution (REVIHAAP) project (WHO Regional Office for Europe 2013)¹⁰²
- b. The effects observed in relation to PM_{2.5} from a large study conducted in Australia and New Zealand (EPHC 2010) are consistent with the effects reported in the international literature.¹⁰³
 - c. These studies use a number of different methods to investigate the health effects of PM, namely:
 - population-based epidemiological studies;
 - clinical studies in humans; and
 - toxicological studies in animals and in vitro.¹⁰⁴
 - d. In 2009, the USEPA concluded the evidence was suggestive of a causal relationship (USEPA 2009).¹⁰⁵
 - e. These studies again state there is no safe level of PM_{2.5}¹⁰⁶. There is a strong association of both long-term and short-term exposure to PM_{2.5} with hospitalisation for respiratory and cardiovascular disease¹⁰⁷ and mortality as well as reproductive, developmental effects and cancer.¹⁰⁸
 - f. It was found across the globe that the potential of PM for causing health effects is directly linked to their size.¹⁰⁹ Although biological effects of inhaled PM depend upon physical and chemical properties adsorbed upon the PM, by the sites of deposition and by the mechanisms of action of chemicals, the size of PM has been shown to be the most significant factor relating to occurrence of illness and disease.¹¹⁰
 - g. The smaller the particulate, the greater the surface area and greater the interaction of the PM with lung alveoli.¹¹¹

¹⁰⁰ Ibid.

¹⁰¹ Ibid.

¹⁰² Ibid.

¹⁰³ Ibid.

¹⁰⁴ Ibid.

¹⁰⁵ Ibid.

¹⁰⁶ Submission on the proposed variation to the Ambient Air Quality NEPM, Oct 2014, Doctors for the Environment Australia citing Crouse, Peters et al. 2012.

¹⁰⁷ CRC Care Final Report: Adsorbed Organic Species on Respirable Alumina Particles, D'Angelo et al. 2009

¹⁰⁸ Draft Variation to the National Environment Protection (Ambient Air Quality) Measure Impact Statement Prepared for the National Environment Protection Council, July 2014, Effects and monetary costs of airborne particulate matter, p 10.

¹⁰⁹ Harrison et al. 2010, cited in Draft Variation to the National Environment Protection (Ambient Air Quality) Measure Impact Statement Prepared for the National Environment Protection Council, July 2014, Effects and monetary costs of airborne particulate matter, p 9.

¹¹⁰ Ibid.

¹¹¹ CRC Care Final Report: Adsorbed Organic Species on Respirable Alumina Particles, D'Angelo et al. 2009 citing Bai *et al* 2007.

- h. With normal nasal breathing larger particles with an aerodynamic diameter between 10 µm and 100 µm are deposited in the extrathoracic part (nose, mouth and throat) of the respiratory tract.¹¹² These are then usually easily eliminated by the body through expiration or by ingestion. Most of the particles in the 5–10 µm range are deposited in the proximity of the larynx and enter the thoracic region.¹¹³
- i. However, particles with a diameter of less than 2.5 µm penetrate deep into the human respiratory system¹¹⁴ and whatever chemicals the particles have adsorbed are carried directly into the blood stream.¹¹⁵
- j. Even studies published in 1993¹¹⁶ and 1996¹¹⁷ provide strong evidence that premature mortality is more closely linked to PM_{2.5} than particles between 2.5 and 10 microns.¹¹⁸
- k. In 2012 COAG agreed a review of the AAQ NEPM particulate standards would be prioritised because of this strong evidence that exposure to PM had adverse effects on human health and because there was a lack of evidence for a concentration threshold below which health effects do not occur.¹¹⁹
- l. This means current levels of PM experienced in Australian cities even where these are below the current standards and goals are causing adverse health impacts.¹²⁰
- m. PM_{2.5} is the size fraction with the greatest health impact so should be a strong focus of regulatory measures.¹²¹
- n. In the situation of there being no safe level of exposure, the regulatory system should ensure the levels are as low as can be achieved, and not simply below a given standard¹²² which according to the NEPM annual PM_{2.5} standard is currently set at 8 µg/m³.
- o. Lack of study and monitoring of PM_{2.5} at the Refinery likely contributes to Alcoa and the State's gross underestimate of Community exposure to VOCs.

¹¹² Draft Variation to the National Environment Protection (Ambient Air Quality) Measure Impact Statement Prepared for the National Environment Protection Council, July 2014, executive summary, Effects and monetary costs of airborne particulate matter, p 9.

¹¹³ Draft Variation to the National Environment Protection (Ambient Air Quality) Measure Impact Statement Prepared for the National Environment Protection Council, July 2014, Effects and monetary costs of airborne particulate matter, p 9.

¹¹⁴ Ibid.

¹¹⁵ CRC Care Final Report: Adsorbed Organic Species on Respirable Alumina Particles, D'Angelo et al. 2009

¹¹⁶ Dockery DW, Pope CA, 3rd, Xu X, Spengler JD, Ware JH, Fay ME, et al. An association between air pollution and mortality in six U.S. cities. *N Engl J Med.* 1993;329(24):1753-9.

¹¹⁷ Schwartz J, Dockery D, Neas L. Is daily mortality associated specifically with fine particles? *J Air Waste Manag Assoc.* 1996;46:927-39.

¹¹⁸ Australian Air Quality Group submission No. 144 Inquiry into Performance of the NSW EPA.

¹¹⁹ Draft Variation to the National Environment Protection (Ambient Air Quality) Measure Impact Statement Prepared for the National Environment Protection Council, July 2014, executive summary pvii.

¹²⁰ Ibid.

¹²¹ Comments CRCCARE – Final Report 11010506 (2009) Adsorbed Organic Species on Respirable Alumina Particles by Dr Geoff N. Pain Ph.D, B.Sc (Hons.), Consultant Scientist' undated.

¹²² Submission on the proposed variation to the Ambient Air Quality NEPM, Oct 2014, Doctors for the Environment Australia.

- 4.3 Current health guidelines are based upon the effects of individual chemical components without regard for reactions occurring between chemicals and for this reason are of little or no use in regulation of Refinery emissions:
- a. The National Exposure Standards 1995 (**NES 1995**) and Environmental Standards are largely based on size, quantity and type of substrate of industrial emissions released into the atmosphere. They are expressed with little or no consideration of organic and/or inorganic species that may be adsorbed and *react* on the surface of airborne particles.¹²³ For this reason, the NES 1995 is of little or no use in regulation of the Refinery emissions.¹²⁴
 - b. Further reform is required to set accurate and appropriate National Exposure Standards and health guidelines applicable to the Alumina industry.
 - c. This ineffective regulatory framework contributes to the gross underestimate of current Refinery VOC emission monitoring and regulation.
- 4.4 To date, monitoring of the Refinery is inadequate in capturing the true emission airborne organic species causatively linked to health hazards in the surrounding Communities:
- a. Typically alumina refinery emission levels such as stack emissions levels are measured separately as either gaseous or PM concentrations. This exercise does not consider the probability that the emissions may consist of a combination of both components, whereby these organics may be adsorbed onto the PM.¹²⁵
 - b. So even though stack emission levels are shown to be within recommended limits (Environment and Public Affairs Committee 2004; Coffey *et al* 2005), those limits and monitoring of actual emission levels are currently inadequate.¹²⁶
 - c. The following organic species occur in the Refinery stack emissions: γ -alumina, toluene, benzene, isomers of xylene, acetaldehyde, acetone and benzaldehyde and PM sizes ranging from less than 2.5 μ m and less than 10 μ m (Coffey *et al* 2005)¹²⁷ and require further study and regular monitoring.¹²⁸
 - d. Professor Holman, Chair of the Wagerup Medical Practitioner's Forum made statement at the Alcoa Refinery Wagerup Inquiry in evidence taken 18 August 2003 which supports these findings. Holman stated there was a lack of consideration by Alcoa for the risk of chemical synergies developing as pollutants which may be hazardous to human health.¹²⁹

¹²³ CRC Care Final Report: Adsorbed Organic Species on Respirable Alumina Particles, D'Angelo et al. 2009

¹²⁴ Ibid.

¹²⁵ Ibid.

¹²⁶ Ibid.

¹²⁷ Ibid.

¹²⁸ The 2002 Refinery air emissions inventory monitoring program list these compounds to be present in stack emissions as stated in CRC Care Final Report: Adsorbed Organic Species on Respirable Alumina Particles, D'Angelo et al. 2009.

¹²⁹ Standing Committee on Environment and Public Affairs, Alcoa Refinery at Wagerup, transcript of evidence taken at Perth 18 August 2003.

- e. Further, the researchers of the CRC Care Report 2009 did not study acrolein (2-propenal) known to be emitted by the refineries (Oxalate furnace and precipitation area). Likewise they did not study Methacrolein (2-methyl-2-propenal), 2-methylpropanal, 2-methylpropenal, 4-methylhexanal or 2,4-Hexadienal which are also emitted by the refineries.¹³⁰ So at present very little is known about the reactivity of these highly reactive organic species in the presence of other known VOCs.
- f. Further study and monitoring is urgently required and the lack of knowledge to date in this area of science contributes to the gross underestimate and current monitoring of Refinery emissions.

4.5 Time weighted average (**TWA**) Refinery emission evaluations are not accurate for evaluation of community exposure.

- a. Data present in the 2002 Wagerup Refinery Air Emissions Inventory is evaluated against a TWA which is defined as the amount a worker can be exposed to daily without adverse effects (Department of Education, Employment and Workplace Relations 1995).¹³¹
- b. These TWAs are for exposure over an eight hour and five day week and cannot be accurately used for evaluation of community exposure.¹³²
- c. This means Alcoa cannot rely upon these Refinery emission evaluations to credibly assess safe Community exposure. This error has contributed to a gross underestimate of Refinery VOC emissions.

4.6 Prediction of VOC emissions is further challenged by impacts of climate change and projected increase in population:

- a. In WA, according to the Bureau of Statistics, there is a projected increase in PM₁₀ and also PM_{2.5} between 2011 and 2036 despite controls on emissions from several sectors. This increase is due to projected population and industry growth. The projected growth in emissions will make it more difficult to achieve sustained improvements in air quality due to increased transport demand, domestic emissions and energy use.¹³³
- b. Further, hot summers are likely to become more 'typical' in Australia's future, leading to a higher pollution episodes where emission of VOCs increase at higher temperatures.¹³⁴

¹³⁰ Comments CRCCARE – Final Report 11010506 (2009) Adsorbed Organic Species on Respirable Alumina Particles by Dr Geoff N. Pain Ph.D, B.Sc (Hons.), Consultant Scientist' undated.

¹³¹ CRC Care Final Report: Adsorbed Organic Species on Respirable Alumina Particles, D'Angelo et al. 2009.

¹³² Ibid.

¹³³ Draft Variation to the National Environment Protection (Ambient Air Quality) Measure Impact Statement Prepared for the National Environment Protection Council, July 2014, Statement of the problem and case for government intervention, p 55.

¹³⁴ Draft Variation to the National Environment Protection (Ambient Air Quality) Measure Impact Statement Prepared for the National Environment Protection Council, July 2014, 3.2.2 PM – climate interactions, p 12 citing AQEG (2012), Fine Particulate Matter (PM2.5) in the United Kingdom, report of the Air Quality Expert Group,

- c. Neither Alcoa, nor the State have factored impacts of climate change into projected Refinery production and emissions and contribute to gross underestimates of projected Refinery pollution.

5. Recommendations- there needs to be:

- 5.1 More stringent air quality standards for Western Australia and threshold for exposure to PM₁₀ and PM_{2.5}:
 - a. The absence of a threshold for the health effects of fine particles has prompted support for more stringent air quality standards and for the adoption of an exposure reduction approach to reduce general exposures to fine particle concentrations.¹³⁵
 - b. Given the clear evidence that long and short-term exposure to PM causes adverse health effects, enHealth of the Australian Health Protection Principal Committee strongly supports the proposal to introduce compliance standards for annual average and 24 hour average PM_{2.5} concentrations. In light of the increasing evidence that short-term exposure to PM₁₀ is independently associated with health effects, enHealth also supports a 24hr compliance standard for PM₁₀.¹³⁶
 - c. PM_{2.5} is the size fraction with the greatest health impact so should be a strong focus of reduction and regulatory measures.¹³⁷
 - d. Even though the 8 µg/m³ value for Australia is lower than most countries, as Australia starts from a lower natural background, and do not have cross border air pollution problems from neighbouring countries, Australia may be experiencing a similar amount of national anthropogenic particulate pollution which should still be continually monitored and reduced.¹³⁸

- 5.2 An enforceable air quality limit value for the Refinery in keeping with the WA threshold:
 - a. An air quality limit value (24hr compliance standard) imposed upon the Refinery to guarantee equity for vulnerable exposed Communities. The current situation at the Refinery is cause for international concern and Agency embarrassment. This will become more so the case as time goes by and scientific research and resources improve and increase;

published by the Department for Environment, Food and Rural Affairs, London, UK.

¹³⁵ Draft Variation to the National Environment Protection (Ambient Air Quality) Measure Impact Statement Prepared for the National Environment Protection Council, July 2014, Statement of the problem and case for government intervention, p 54.

¹³⁶ Environmental Health Standing Committee (enHealth) of the Australian Health Protection Principal committee, Mr Jim Dodds, 4 October 2013.

¹³⁷ Comments CRCCARE – Final Report 11010506 (2009) Adsorbed Organic Species on Respirable Alumina Particles by Dr Geoff N. Pain Ph.D, B.Sc (Hons.), Consultant Scientist' undated.

¹³⁸ Ibid.

- b. The main regulatory strategy should be to continuously reduce exposure; however there should also be an air quality limit value as a backstop to guarantee equity for vulnerable exposed communities across Australia.¹³⁹

5.3 Development and approval of appropriate and standardised laboratory sampling techniques by senior academic in the field:

- a. Scientists currently assessing air quality samples emitted from the Refinery are using a variety of air sampling techniques and expressing their results differently. This is causing confusion and leading to erroneous assumptions.¹⁴⁰
- b. For instance, one laboratory may be taking measurements using a particular technique and another laboratory may be using a different technique. This leads to variance in results. Oftentimes information regarding laboratory techniques is not published or available. This can lead to important differences in results and conclusions.¹⁴¹
- c. Professor Holman states in his transcript of evidence taken in 2003 that:

I have seen an example in which a particular laboratory measured a range of substances in air samples. One of the substances required a different technique than the one employed to be measured properly. However, because the substance was part of a battery and not the principal focus of the analysis - which, from memory, was heavy metals such as nickel and lead - the technique was used in a catch-all way for most of the chemicals. The one chemical that should have been measured in a different way was tested along with the batch, so to speak. We were initially not told that that result should be ignored. It should not even have been reported because it was not measured using the correct technique. That alerted me to the problems that can occur when different measurement techniques are used incorrectly, and even correctly.¹⁴²

5.4 A cap on Refinery production:

- a. Given there is a general lack of consensus as to which combination of emissions has caused health problems in Refinery workers and Community to date, a limit on production is an appropriate control measure in addition to specific emission limits.¹⁴³
- b. This is an issue of ethics (in terms of social justice) of a decision that could lead to the local community carrying most of the burden of potential health and social costs so that Alcoa and the State can gain economic benefits. On this basis we consider the risk of further compromising the health and social functioning of

¹³⁹ Submission on the proposed variation to the Ambient Air Quality NEPM, Oct 2014, Doctors for the Environment Australia.

¹⁴⁰ Standing Committee on Environment and Public Affairs, Alcoa Refinery at Wagerup, transcript of evidence taken at Perth 18 August 2003.

¹⁴¹ Ibid.

¹⁴² Ibid.

¹⁴³ Ibid.

the local community to be too high; and the trade-off of this risk against the broader economic benefits to be unjust.¹⁴⁴

5.5 Senior academic toxicologists advising the Agencies from an independent position, particularly in regard to the risk of chemical synergies developing as pollutants adsorbed onto PM and the impact of this on human health:

- a. Professor Holman, as representative of the Wagerup Medical Practitioner's Forum reported to the Standing Committee on Environment and Public Affairs in relation to the Alcoa Refinery at Wagerup Inquiry in 2004 stated that he:

*would prefer senior academic toxicologists to be advising the Government from a more independent position on some of these areas.*¹⁴⁵

- b. Holman also reported a deficiency in independent toxicologists in WA and a lack of consideration by Alcoa for the risk of chemical synergies developing as pollutants which may be hazardous to human health.¹⁴⁶
- c. Professor Holman stated in evidence 18 August 2003 to the Standing Committee on Environment and Public Affairs investigating health complaints associated with the Refinery, that regulatory allowances should be made for the 'chemical cocktails' being produced as a result of the Refinery emissions. Holman stated that at the very least a pragmatic approach should be taken by the Government - such as reducing production and emissions. At that time it was:

*as though every chemical was considered in isolation by Alcoa and the State and true impacts of the Refinery emissions were not being adequately assessed, monitored or regulated.*¹⁴⁷

- d. Further long-term research, including in-source and ambient toxicological studies are necessary.¹⁴⁸
- e. PM_{2.5} is the size fraction with the greatest health impact so should be a strong focus of scientific study.¹⁴⁹

5.6 Further studies progressing and developing upon findings of the CRC Care Final Report:

¹⁴⁴ Medical Practitioner's Forum submissions to Health Minister Bob Kucera in response to proposed Wagerup Refinery Unit Three Expansion, 23 June 2005

¹⁴⁵ Report of the Standing Committee on Environment and Public Affairs in relation to the Alcoa Refinery at Wagerup Inquiry, Report 11, Oct 2004, Chapter 4: Public Health, see p113 at 4.335.

¹⁴⁶ Standing Committee on Environment and Public Affairs, Alcoa Refinery at Wagerup, transcript of evidence taken at Perth 18 August 2003.

¹⁴⁷ Ibid.

¹⁴⁸ CRC Care Final Report: Adsorbed Organic Species on Respirable Alumina Particles, D'Angelo et al. 2009.

¹⁴⁹ Comments CRCCARE – Final Report 11010506 (2009) Adsorbed Organic Species on Respirable Alumina Particles by Dr Geoff N. Pain Ph.D, B.Sc (Hons.), Consultant Scientist' undated.

- a. The CRC Care Final Report study was conducting using size fraction 38-52 μm rather than 10 μm . With the development of new techniques, the study findings recommend similar work be undertaken using the 10 μm size fraction.¹⁵⁰
- b. The CRC Care Final Report, although persuasive in its findings regarding health impacts of Refinery emissions, is incomplete. As previously stated above at 3.4, the researchers of the CRC Care Report 2009 did not study acrolein (2-propenal) known to be emitted by the refineries (Oxalate furnace and precipitation area). This is a light sensitive and extremely dangerous material to transport and use in the laboratory. Likewise they did not study Methacrolein (2-methyl-2-propenal), 2-methylpropanal, 2-methylpropenal, 4-methylhexanal or 2,4-Hexadienal which are also emitted by the refineries.¹⁵¹
- c. As stated at 4.4 above, further work on characterizing Alcoa worker and community exposure to acetaldehyde is clearly required.¹⁵²

5.7 A more comprehensive and reliable base line study of the health of the Communities taking into account statistics associated with Refinery workers:

- a. The Wagerup and Surrounds Community Health Study, June 2008, Telethon Institute for Child Health Research reports on a survey which was taken to create a health and well-being baseline for the affected Communities. This survey was required pursuant to the Deed of Undertaking Expansion of Wagerup Alumina Refinery, 28 March 2007 between the state of WA and Alcoa of Australia Ltd.
- b. There are several flaws in the survey, namely, the report fails to garner adequate participation rates and fails to identify which respondents were also former or current Alcoa workers. Whether a respondent was also a former or current Alcoa worker has a strong bearing on the expected cooperation level for the survey.¹⁵³
- c. The results from this study alone (for instance where Cookenup has more than double the risk of cancer than the state average)¹⁵⁴ should trigger alarm bells instigating immediate further detailed assessment in this area.
- d. Figures relating to difficulty concentrating or remembering were double the state average.¹⁵⁵ As alumina is well documented as a neurotoxin, these figures are unsurprising.

5.8 An independent third party contracted to ensure reliable air monitoring is undertaken in the surrounding Communities:

¹⁵⁰ CRC Care Final Report: Adsorbed Organic Species on Respirable Alumina Particles, D'Angelo et al. 2009.

¹⁵¹ Comments CRCCARE – Final Report 11010506 (2009) Adsorbed Organic Species on Respirable Alumina Particles by Dr Geoff N. Pain Ph.D, B.Sc (Hons.), Consultant Scientist' undated.

¹⁵² Ibid.

¹⁵³ Wagerup and Surrounds Community Health Study, June 2008, Telethon Institute for Child Health Research, p16-18.

¹⁵⁴ Ibid p30.

¹⁵⁵ Ibid p42.

- a. There is real cause for concern regarding Alcoa's integrity and reliability in air monitoring – see generally Alcoa's record to date (both internationally and locally), in particular, incidence in 2003 where Alcoa were even found guilty of falsifying their dust level recordings from the Refinery.¹⁵⁶
- b. There is insufficient duration or consistency of improved performance by Alcoa to create confidence that Alcoa has accepted ownership of the emissions problem.¹⁵⁷
- c. Alcoa operate on the basis of provision of incomplete, misleading or evasive data or tactics:
 - When Alcoa's response has been to measure exposure, or, more accurately, to measure an aspect of exposure such as 'odour', 'noise' or levels of particular air pollutants, the measurement has been used by Alcoa to advocate for refinery activity as though measurement itself were an intervention to reduce adverse health consequences.¹⁵⁸
 - In the cycle of community agitation, followed by engineering measures to reduce emissions, Alcoa has used the engineering changes to justify an increase in production without evidence of improved health outcomes.¹⁵⁹
 - Any initiative to address new illness among workers and the community has been taken by workers and the community, rather than by Alcoa.¹⁶⁰
- d. Systemic failure by Alcoa to meet obligations in accordance with agreed undertakings:
 - the State of WA and Alcoa of Australia Ltd, Deed of Undertaking Expansion of Wagerup Alumina Refinery, SSO, 28 March 2007 required Alcoa to address EPA recommendations as set out in EPA Bulletin 1215 for community health, air quality and land management issues – not done.
 - Alcoa was required to implement the Air Quality Study – Winter 2006 Study¹⁶¹ in accordance with timetables set out in Schedule 1 of the Undertaking.¹⁶² This was not done.
 - Alcoa was prohibited from implementing any material change to the Winter 2006 Study, whether in scope, nature or otherwise likely to affect

¹⁵⁶ Dr Geoff Pain submissions to Senate Community Affairs References Committee, Parliament House, Canberra, 'Inquiry into workplace exposure to toxic dust', p 2.

¹⁵⁷ Medical Practitioner's Forum submissions to Health Minister Bob Kucera in response to proposed Wagerup Refinery Unit Three Expansion, 23 June 2005.

¹⁵⁸ Ibid.

¹⁵⁹ Ibid.

¹⁶⁰ Ibid.

¹⁶¹ State of WA and Alcoa of Australia Ltd, Deed of Undertaking Expansion of Wagerup Alumina Refinery, SSO, 28 March 2007, section 4.1(a).

¹⁶² Ibid section 4.1(b).

the timetable for completing the study or objectives of the Winter 2006 Study¹⁶³ – not complied with.

- Alcoa was required to report on maintenance and inspection of Air Quality Equipment used and include a copy of the results of that testing in the report¹⁶⁴ – this was not done.
- Follow-up surveys were to be undertaken at the expense of Alcoa on the dates set out in paragraph 2.3 of Schedule 2 of the Undertaking¹⁶⁵ - not adhered to.

e. Illogical and unreasonable statements made by Alcoa and supported by State:

- The State claims that even with an expansion from 2.5 million to 4.7 million tonnes per annum there will be no increase in impact on Communities from emissions from the Refinery. This is simply impossible.¹⁶⁶ The *Legislative Council Standing Committee Inquiry Report on the Alcoa Refinery at Wagerup (2004)*¹⁶⁷ states nitrogen oxides will increase from 1005 to 1974 tonnes per annum (tpa), SO₂ will increase from 70 to 113 tpa, VOCs will increase from 78 to 93 tpa and PM emissions will increase from 60 to 65 tpa. It is yet to be demonstrated how an increase in all emissions will not result in an increased impact upon residents. See also Dr. Geoff Pain's extensive submissions to Senate Community Affairs References Committee, Parliament House, Canberra, 'Inquiry into workplace exposure to toxic dust' on disparity of Alcoa's recording of increase of emissions over the last decade and a half.
- As a result of the above mentioned expansion proposal, there will be an increase in VOCs. Alcoa has only conducted odour modelling based on calculated odour emissions derived from individual VOC odour characteristics not actual odour unit measurement of emissions. Alcoa has also failed to account for VOC behaviour upon adsorption on PM and resultant odour characteristics. This omission is glaring.
- The 2004 Inquiry Report¹⁶⁸ states the DoH considered a Health Impact Assessment (**HIA**) was required in order to assess the extent of the short term health amenity problem within the Communities. Alcoa agreed to undertake the HIA but only after the proposal was approved. It is illogical, unreasonable and irresponsible for the State to approve a proposed expansion before potential health impacts have been assessed.

¹⁶³ Ibid, section 4.1(d).

¹⁶⁴ Ibid section 4.3(a).

¹⁶⁵ Ibid section 5.1(b)(i).

¹⁶⁶ Alcoa Wagerup - Community Health Issues Statement by Hon Paul Llewlynn (SW).

¹⁶⁷ Legislative Council Standing Committee on Environment and Public Affairs, 2004. Report of the Standing Committee on Environment and Public Affairs in Relation to the Alcoa Refinery at Wagerup Inquiry (2004).

¹⁶⁸ Ibid.

- Further, Alcoa state that as the ‘causative agents’ for the short term health impacts ‘remain unknown’, it is impossible to establish whether the proposal will result in short term health impacts. Here, Alcoa and the State rely on Alcoa’s failure to fully investigate the impacts of their Refinery in order to justify a sizeable production increase. This reasoning is clearly flawed and borders on the unethical.
- The State claims that Alcoa on average will reduce emissions of toxic chemicals but this is not the case. As submitted above, Alcoa’s systemic failure to address the issues of accurate assessment of concentrated compounds resulting from adsorption on PM of emissions, Alcoa’s failure to produce reliable and standardised testing, monitoring and reporting, amongst other systemic failures by Alcoa and the State has resulted in unreliable and incredulous conclusions which require complete re-assessment.

5.9 Stronger regulation of Alcoa by Agencies to ensure implementation of their undertaking and consequences for Agencies that fail to, in good conscience, enforce the law:

- a. There needs to be regulatory consequences for Agencies that fall under the influence of large industrial emitters, lose sight of the public interest and fail to enforce compliance with appropriate and respectful air quality values.
- b. It is a weakness of the current system that there are no consequences for state regulatory agencies that fail to meet the air quality standards.¹⁶⁹

5.10 An increased buffer zone between the Refinery and residential community is essential:

- a. The geography and topography of the area surrounding the Refinery was never suitable for the placement of an aluminium refinery.
- b. There needs to be a focus on getting affected people out of the exposure situation.
- c. There needs to be State and Alcoa accountability for the affected residents of Area B who in the past, under the ‘buy-back program’ sold to Alcoa at unaffected value and took large financial losses just to get away, after years of suffering the effects of industrial noise, dust and toxic emissions from the Refinery.

5.11 an independent economic analysis and assessment of true ‘economic’ impact of Refinery operations:

- a. As touched upon at the introduction of this document, the economic burden associated with Refinery pollution can be directly linked to the costs to the WA health system for hospital admissions and visits to the doctor, medication costs,

¹⁶⁹ Submission on the proposed variation to the Ambient Air Quality NEPM, Oct 2014, Doctors for the Environment Australia.

costs to businesses for reduced productivity and absenteeism, and costs to individuals experiencing mild or severe health effects (BDA Group 2013).¹⁷⁰

- b. The health costs of air pollution in Australia are estimated to be in the order of \$11.1 billion to \$24.3 billion annually, solely as a result of mortality (Begg et al. 2007; Access Economics 2008).¹⁷¹
- c. Alcoa and the State clearly fail to conceive of the long term impacts of their short term economic gain. Alcoa submissions to 2014 Air NEPM Review were that:

while it agrees the lowest values of various standards for air quality are options for consideration, it does not agree the lowest values selected are economically achievable in Australia at the present time and therefore do not support adoption of the lowest values proposed.

Alcoa's view is that the only viable option would be to aim for an objective of 'no deterioration in existing levels of air quality'.¹⁷² This is impossible where an expansion of production has been approved and is unacceptable in light of consideration and assessment of true 'economic' impact of the Refinery.

- d. This is a case for government intervention where market failures are present, that is, in the absence of government intervention, the free market does not allocate goods and services in a way that maximises welfare for all of society. Therefore, government intervention to address the market failure is required to improve the efficiency of resource allocation.¹⁷³
- 7.1 Further government involvement is required to address the potential future health impacts and costs of industry emitted airborne PM, particularly where we know the potential health benefits of reducing population exposure to PM – and the associated monetary savings for society are larger than for other air pollutants. This indeed where the range of cost-effective abatement policies and actions available for PM is larger than that for other pollutants.¹⁷⁴

Conclusion

The weight of scientific evidence in support of the existence of a causal link between the Refinery and adverse community health impacts is difficult for the DoH to continue to ignore or trivialise. Professor Weeremanthri stated in his letter to Mr John Harris on 31 October 2014 when referring to the health survey of surrounding residents in 2008 that:

¹⁷⁰ Draft Variation to the National Environment Protection (Ambient Air Quality) Measure Impact Statement Prepared for the National Environment Protection Council, July 2014, section 3.3 Costs associated with airborne PM in Australia, p 13.

¹⁷¹ Ibid.

¹⁷² Alcoa submissions to 2014 Air NEPM Review.

¹⁷³ Draft Variation to the National Environment Protection (Ambient Air Quality) Measure Impact Statement Prepared for the National Environment Protection Council, July 2014, Statement of the problem and case for government intervention, p 54.

¹⁷⁴ Draft Variation to the National Environment Protection (Ambient Air Quality) Measure Impact Statement Prepared for the National Environment Protection Council, July 2014, executive summary pvii.

the survey results...did not exclude the possibility of idiosyncratic responses, where a small number of individuals might be subjected to ongoing health issues. Whilst very uncommon, responses of this nature are an accepted medical fact, and it would appear that you may well be one of these individuals...I am unable to see how I can assist you further or provide any assurance to you that there will not be further ongoing health impacts....When results are considered, they will be based on the majority of the population rather than addressing ongoing individual reactions such as those that you describe.

It is clear from these off-hand statements, presented on behalf of the DoH by Professor Weeremanthri, that the DoH may need to reflect a little longer upon the conclusions which they appear to draw from the evidence available to them. The DoH also appear to be making unsubstantiated claims regarding ‘accepted medical fact’ in a field which is experiencing rapid discovery and in direct contradiction to the findings of the DEA and 2005 Wagerup Medical Practitioner’s Forum. That Professor Weeremanthri is ‘unable to see how *he* can assist..further’ is a sad indictment of an agency which has tied itself too closely to industry and is willing to make the ultimate sacrifice – that of conscience.