`

REBUTTAL PROOF OF EVIDENCE
OF PROFESSOR JAMES BRIDGES

ASSESSMENT OF POSSIBLE IMPACTS OF THE PROPOSED PLANT ON THE HEALTH OF THE LOCAL COMMUNITY

DECC REFERENCE: DPI/A0665/11/10
LPA REFERENCE: 10/00691/DECC

ELECTRICITY ACT 1989 (SECTION 36)

TOWN AND COUNTRY PLANNING ACT 1990 (SECTION 90)

APPLICATION BY TATA CHEMICALS EUROPE LTD (FORMERLY BRUNNER MOND UK LTD) AND E.ON ENERGY FROM WASTE UK LTD FOR CONSENT TO CONSTRUCT AND OPERATE A 60MW ENERGY FROM WASTE GENERATING STATION AT LOSTOCK, NORTHWICH, CHESHIRE.

Professor Jim Bridges
Emeritus Professor of Toxicology and Environmental Health
Research for Sustainability
Guildford
Surrey
GU3 3AE

Contents

1 Rebuttal of the Proof of evidence by Dr van Steenis on Issues Relating to Health

Dr van Steenis Proof of Evidence is not Specific to Lostock Plant

1.1 The evidence provided by Dr van Steenis is generic rather than specific to the proposed plant in Lostock. Moreover, Dr van Steenis does not make any differentiation in his proof between hazardous waste, hospital wastes or municipal waste incineration.

1.2 Dr van Steenis quotes extensively Mr Ryan's submission to the UK parliamentary committee on his research into increases in infant deaths downwind of four incinerators in the UK. I note that:

a) This evidence has been presented at various public inquiries in the past few years in the UK, and to a House of Commons Select Committee, but has never been published in the scientific or medical literature;

b) It is not evident how it takes into account confounding factors such as socioeconomic and lifestyle considerations or how wards are selected or omitted;

c) Although the information has been available to various UK government departments for a number of years it has not influenced their views on the safety of modern incinerators. It has also not been cited as important material evidence in any Inspector's report following a Public Inquiry into a proposed incinerator.

d) The conclusions are very surprising bearing in mind the low ground level concentrations of the chemicals of potential concern that would be emitted from a modern plant and the many other more significant sources of exposure to these chemicals.

Evidence from a study of air pollution in Mexico City

1.3 Dr van Steenis quotes the MILARGO study as evidence in his proof (p.3 of Dr van Steenis Proof of Evidence). MILARGO stands for 'Megacity Initiative: Local and Global Research Observations' and consists of many field studies. A team of American scientists conducted source apportionment of fine organic aerosol in Mexico City during the MILARGO experiment in 2006 (Stone et al, 2008). This study does not mention

incinerators. The study concludes: *'Motor vehicles, including diesel and gasoline, consistently accounted for 49% of organic carbon in the urban area and 32% on the periphery. The daily contribution of biomass burning to organic carbon was highly variable, and ranged from 5-26% at the urban site and 7-39% at the peripheral site.'*

1.4 The study discusses the relative contribution of diesel engines, gasoline vehicles and smoking vehicles to organic carbon emissions. A smoking vehicle is defined as a high-emitting vehicle that releases visible amounts of smoke and/or produces more than 50 mg of elemental carbon (EC) per mile (Lough et al, 2007). According to Stone et al, (2008) non-smoky vehicles accounted for 41% (standard deviation 7%) of gasoline powered vehicle emissions of organic carbon on weekdays and 74% (standard deviation 8%) on weekends, whereas smoking vehicles accounted for the rest .

1.5 The study is focussed on wood smoke as the second major contribution to organic carbon aerosol above Mexico City, which originates from open biomass burning. Apart from open fires used for food preparation the study suggests that cottage industries, such as brick and tile making may be primary sources of biomass burning in the urban areas of Mexico City. This study, although very thorough and detailed is not at all relevant to the industrial and economic conditions of Lostock area.

1.6 Another study (Moffet et al, 2008), which researched particulate aerosols during the MILARGO campaign in 2006 concentrated on the northern part of Mexico City metropolitan area, which is a mixture of industrial and residential areas with roads with intensive traffic. These researchers took samples on the rooftop of one building. The authors acknowledged that the Government emissions inventory for the area indicate that metallurgical sources release a substantial fraction of the $PM_{2.5}$ and that incineration was not currently listed in the emission inventory for the area researched. The authors stated that Pb-Zn-Cl particles represented as much as 73% of the fine mode particles in the morning hours between 2-5 am but by 7am nitrate becomes a principal component of these particles.

Dr van Steenis states that incineration leads to increased suicide rates

1.7 Dr van Steenis quotes in particular research conducted by Dr Richard H Weisler, adjunct professor of psychiatry at the University of North Carolina at Chapel Hill School of Medicine as 'emissions from a new incinerator leading to suicide, brain cancers and violence'.

1.8 In Science Daily (Dec 28, 2004) Dr Weisler's research is described as a study of two US census tract block groups which contained a total of 1,561 residents who were living immediately downwind from a liquid asphalt terminal; an asphalt hot-mix plant which also contained a former N.C Department of Transportation solvent-contaminated clean-up site. The study of Dr Weisler concludes that exposure to hydrogen sulphide at the levels where the odour is apparent may be the cause of the higher incidence of suicides. It should be noted that there are very few similarities between the emissions from an asphalt plant and those from an incinerator. Indeed, incinerators do not emit hydrogen sulphide.

The proof of evidence of Dr van Steenis concentrates on emissions of particulate matter

1.9 The principal theme of Dr van Steenis' evidence is that because incinerators/ waste to energy plants emit fine and ultrafine particles they inevitably cause serious adverse health effects on those living in the surrounding neighbourhood. It is essential in examining the evidence for this contention to distinguish between:

a) the hazardous properties of fine and ultrafine particles

b) the contribution of a particular incinerator to the levels of primary particles in the local ambient air.

1.10 There is little dispute that exposure to high levels of airborne fine and ultrafine particles can have serious consequences for at least some susceptible members of the population. I have discussed the hazardous properties of fine and ultrafine particles in my main Proof of Evidence and in the Appendix to it.

1.11 However the key issue is whether the levels of fine and ultrafine particles that might be emitted from the stack of the proposed plant could cause adverse health effects on members of the local population.

1.12 In the discussion of levels of exposure it is important to distinguish between primary particles (i.e. those released at the top of the stack) and those that may be formed from the hot flue gases some distance away. Dr Van Steenis's evidence is concerned mainly with primary particles. He claims that he has access to two letters from the EA to the effect that the bag filters allow the majority of fine and ultrafine particles into '*the air you* breathe' (p2 of his evidence). I do not have access to these letters and Dr van Steenis has not furnished them but the statement is counter to the published literature on the effectiveness of bag filters in removing fine and ultrafine particles.

1.13 For example, Zeuthen et al (2007) measured combustion aerosols in a municipal waste incinerator, where they added PVC plastic, pressure-impregnated wood, shoes, salt (NaCI), batteries, and an automotive shredder waste to a base-load waste. The authors stated that the major part of the particles is removed from the flue gas by the flue gas cleaning. The average number is decreased, corresponding to an overall number-based penetration of 0.11%.

1.14 Jiang et al (2006) state that bag house filters remove particles very efficiently. Particles 0.4 and 1.0µm are not quite as well filtered as those of larger or smaller size. This is a feature of the collection efficiency of the fabric filter. Mr Othen describes in his rebuttal evidence the processes that apply to the collection of particles in bag filters.

1.15 Buonanno et al (2011) assessed the ultrafine particle emitted at the stack of the incineration plant in San Vittore de Lazio (Italy). Maximum values of $2.7x10^{7}$ and $2.0x10^{3}$ cm^{-3} were found for the number of particles before and after fabric filters. This shows a very high efficiency in particle removing by the fabric filter. The authors concluded that the resulting averaged number removal efficiency of the filter is greater than 99.99% with lower efficiency as the diameter decreases.

Dr van Steenis references are mainly outside the scope of this enquiry

1.16 Dr van Steenis places great store by the thoroughness of his research as demonstrated by a list of 360 references. However, of these references less than a dozen studies refer to modern incinerators. The remainder refer to such varied themes as vaccines,

pesticides, radioactivity, tobacco, dust mites and soy bean dust. He also lists papers on genetic engineering, microbial infections, landfill sites, the Gulf war, Chernobyl, overhead power lines, petroleum refining and a popcorn factory. All these issues are important in assessing certain aspects of environmental health in various countries and many of them are valuable in assessing public health but they are not all relevant to this Inquiry.

1.17 By way of example, a sample of Dr van Steenis' references is given below. It is hard to explain how the following references may help the Inquiry:

a) N244 in Dr van Steenis References:

Benn Cs, Balde A, George E, Kidd M, Whittle H, Lisse I, Aaby P (2002)'Effect of vitamin A supplementation on measles-specific antibody levels in Guinea-Bissau' *The Lancet*,359

b) N256 in Dr van Steenis References:

Marttila J, Hinkkanen A, Ziegler T, Vainionpaa R, Salmi A and Ilione J (2001)'Cell membrane-associated measles virus components inhibit antigen processing' *Virology*, 279, 422-428

c) N269 in Dr van Steenis References:

Schmidt RJ(2011)'Prenatal vitamins reduce the risk of autism by half, even more for some higher-risk cases' *Epidemiology*

d) N314 in Dr van Steenis References:

Hendryx M and Ahern MM(2009)'Mortality in Appalachian coal mining regions: the value of statistical life lost' Public Health Rep, 124

e) N328 in Dr van Steenis References:

Beavais SL, Jones SB, Brewer SK, and Little E (2000)' Physiological measures of neurotoxicity of diazinon and malathion to larval rainbow trout and their correlation with behavioural measures' *Environ Toxicology and Chemistry*, 19(7)

1.18 The list of the references given by Dr Van Steenis which are not relevant to the purpose of this Inquiry is very long. It is worth mentioning that the study in N328 (above) is about herbicides, which (if present in wastes) would be definitely destroyed by incineration.

1.19 Dr van Steenis' Proof does not specifically cite from his list of references in his Proof. Evidently, a number of references could not be used for the purpose of the proof. The small of number of references that relate to incineration are mainly studies, which were conducted on old plants or refer to hazardous/medical incinerators or remediation of contaminated sites. For example,

a) N28 in Dr van Steenis References:

Mao IF, Chen CN, Lin YC, Chen ML (2006)' Airborne particle $PM_{2.5/10}$

Mass distribution and particle–bound PAH concentrations near a medical waste incinerator' Elsevier. Medical waste is a subject of separate legislation. They deal with hazardous materials, including pathogens.

b) N114 in Dr van Steenis References

Cormier SA, Lomnicki S, Backes W, Dellinger B (2006) 'Origin and health impacts of emissions of toxic by-products and fine particles from combustion and thermal treatment of hazardous wastes and materials' *Environ Health Perspect*, **114, 810-817**.

On p. 810 in the abstract of this study starts as follows: *'High-temperature, controlled incineration and thermal treatment of contaminated soils, sediments and wastes at Superfund sites are often preferred methods of remediation of contaminated sites under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 and related legislation.'* The study goes on *'low or moderate temperature treatment has the potential to form more toxic by-products than does incineration'* (p.810).

1.20 There are also references in Dr van Steenis' list, which have conclusions that are the opposite of Dr van Steenis' main argument. For example:

a) N115 in Dr van Steenis References

Reiss MF, Sampaio C, Brantes A, Aniceto P, Melim M, Cardoso L, Gabriel, Simao F, Miguel JP(2007)' Human exposure to heavy metals in the vicinity of Portuguese solid waste incinerators – Part 1: Biomonitoring of Pb, Cd and Hg in blood of the general population' *Int J Hyg Environ Health*, 210, **439-446**

This study compared the metal levels in blood of people living around a modern incinerator with a population in a modern city. The highest levels of metals in blood were found to be in modern city dwellers. However, there was no evidence that the

incinerator made any significant contribution to the blood levels of metals in those living close to the incinerator. In a further paper the same lead author found that dioxin levels in blood were not at all determined by the emissions from the incinerator.

1.21 There is a discussion in Dr van Steenis' Proof (p3) about the CLARINET Report. CLARINET is a European research network aimed at contaminated land rehabilitation for environmental technologies. It was conducted by 16 European countries over two years. CLARINET does not consider incineration or ambient air quality in its scope. This is further clarified by examining the work of its human health effects Working Group. They cover twenty scenarios of different soil types, land uses and contaminants (Benzo(a)pyrene, cadmium, atrazine, benzene and trichloroethylene). There is no mention of particulates.

Conclusions

1.22 I conclude from the examination of the scientific evidence that he cites that the assertion by Dr van Steenis that the proposed plant would cause many deaths is without any valid foundation. None of his references to published scientific papers support his claim and there are many relevant papers relating to the performance of modern incinerators/ waste to energy plants that he chooses not to cite.

2 Rebuttal of the Proof of Evidence of Mrs Gamble

2.1 Mrs Gamble raises the issue of whether children are more susceptible than adults to certain of the chemicals of potential concern that may be emitted from the stack of the proposed plant and whether this has been taken into account in the health risk assessment.

2.2 It has been known for some time that children are more vulnerable to some chemicals. The critical questions from a public health viewpoint are a) what are the main sources of child exposure to these chemicals, b) are the relevant standards complied with and c) do these standards allow for an increased vulnerability. Mrs Gamble's concern appears to be based on a publication available on the internet arising from the PINCHE study.

2.3 PINCHE is the acronym for Policy Interpretation Network on Children's Health and Environment. This was a multi country, EU funded, literature based research study from 2002-2005. The participants selected a number of stressors (various chemicals and mixtures, noise, radon). The aim of the study was to examine whether children are more vulnerable than adults to each of these stressors. In common with all such literature based studies, the authors would have liked more data in order to quantify their risk estimates and most appropriate action measures. However, the extent of this uncertainty was not considered to be substantial enough to advocate a more precautionary approach.

2.4 The authors categorised each stressor according to priority for action into high, medium and low priorities. In regard to the chemicals of potential concern that may be emitted from the proposed plant the categorisation was as follows:

a) Low (chromium, nickel, sulphur dioxide)

b) Medium (arsenic, cadmium, dioxins, lead, polycyclic aromatic hydrocarbons,)

c) High (mercury, nitrogen dioxide, particulate matter).

d) The authors identify the main priority in Europe as a reduction in vehicle emissions.

2.5 The authors do not propose that the standards set at the time should be changed substantially to account for the greater vulnerability of children to some of these

chemicals. Instead their main concern is to argue for action to reduce levels of these chemicals where exceedences of the standard commonly occurred.

2.6 For the majority of these chemicals (arsenic, cadmium, chromium, dioxins, lead, nickel) airborne exposure was deemed to be generally minor in comparison with the exposure from food and/or water. For nitrogen dioxide, sulphur dioxide, particulate matter and in some situations mercury the most important route of exposure is through ambient and indoor air.

2.7 The study along with others has been available to air quality policy makers since before its completion. It would have been taken into account in setting subsequent air quality guidelines.

Conclusions

2.8 It is unquestionably the case that vulnerable groups, in particular, children, should be considered specifically in setting the standards for exposure to chemicals. It is evident from the published literature that in setting the standards for chemicals such as lead, mercury and dioxins the vulnerability of children was specifically considered. For $PM_{2.5}$, sulphur dioxide and nitrogen dioxide vulnerable groups including asthmatics were taken into account in setting the air quality standards.

References

Buonanno G, Stabile L, Avino P, Belluso E (2011)'Chemical, dimensional and morphological ultrafine particle characterization from a waste-to-energy plant' *Waste Management*, **31**, 2253-2262

Cormier SA, Lomnicki S, Backes W, Dellinger B(2006)'Origin and health impacts of emissions of toxic by-products and fine particles from combustion and thermal treatment of hazardous wastes and materials' *Environ Health Perspect*, **114**, 810-817

Jiang W, Cheung CS, Chan CK and Zhu C (2006)' The aerosol penetration through an electret fibrous filter' *Chinese Phys*, **15**, 1864-1870

Lough GC, Christenson CC, Schauer JJ, Tortorelli J, Beam E, -Lawson D, Clack NN and Gabele PA(2007)'Development of molecular marker source profiles for emissions from on-road gasoline and diesel vehicle fleets' *J Air Waste Management*, **57**(10):1190-1199

Moffet RC, Desyaterik Y, Hopkins RJ, Tivanski AV, Gilles MK, Molina LT, Abraham RG, Johnson K, Mugica V, Molina MJ, Laskin A and Prather KA(2008)' Characterization of aerosols containing Zn, Pb and Cl from an industrial region of Mexico City' *Environ Sci Technol,* **42**, 7091-7097

Reiss MF, Sampaio C, Brantes A, Aniceto P, Melim M, Cardoso L, Gabriel , Simao F, Miguel JP(2007)' Human exposure to heavy metals in the vicinity of Portuguese solid waste incinerators – Part 1: Biomonitoring of Pb, Cd and Hg in blood of the general population' *Int J Hyg Environ Health,* **210**, 439-446

Stone EA, Snyder DC, Sheesley RJ, Sullivan AP, Weber RJ and Schauer JJ (2008)' Source apportionment of fine organic aerosol in Mexico City during the MILAGRO experiment 2006' *Atmos Chem Phys,* 8:1249-1259

www.sciencedaily.com/releases/2004/12/04129182339.htm

Zeuthen JH, Pedersen A, Hansen J, Frandsen FJ and Livbjerg H (2007)'Combustion aerosols from municipal waste incineration –effect of fuel feedstock and plant operation' *Combus Sci and Tech*, 179, 2171-2198.