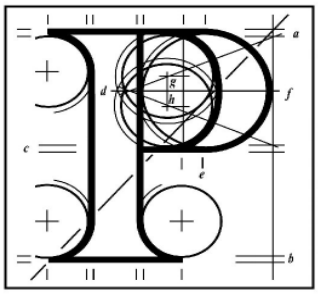
An Bord Pleanála



Waste to Energy Facility
at Ringskiddy
County Cork

Appendices
Reports by advisors

WASTE TO ENERGY FACILITY
RINGASKIDDY
CO. CORK

AIR QUALITY AND CLIMATE

prepared by

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for

An Bord Pleanala

1 Introduction

1.1 This report provides an evaluation of the air quality and climate impact assessments presented by Indaver Ltd in support of a proposed Waste to Energy facility at Ringaskiddy, Co Cork. Its purpose is to provide guidance and clarification on these issues for An Bord Pleanala.

1.2 The report has been compiled following a review of the EIS of the proposed development, review of submissions made to An Bord Pleanala, attendance at presentations made at the Oral Hearing into the proposed development and questioning at the Oral Hearing of the environmental expert who prepared the air quality assessment presented in the EIS.

1.3 The following issues are examined: the air quality assessment methodology employed in the EIS, the air quality model and modelling techniques employed, the predicted ambient concentrations of air pollutants expected to be emitted from the proposed facility, and the evaluation of greenhouse gas emissions.

2 Air Quality Assessment Methodology

2.1 The air quality assessment methodology employed is appropriate for a study of this type. It employs the essential steps of pollutant identification, baseline measurements, dispersion modelling and ambient air quality prediction. The principal aim of the assessment is to predict the total ambient concentrations of air pollutants that will occur when the proposed facility is operating, and to compare these with regulatory limit values. It also provides data input for an analysis of the health effects of dioxins emitted from the proposed facility.

2.2 The assessment employs a largely conservative approach intended to ensure that data limitations do not lead to potential underestimates in ambient concentrations. The main element of this conservatism is the use of maximum

emission rates and volume flows from the proposed Waste-to-Energy plant in atmospheric dispersion modelling.

2.3 Typical emissions expected during operation of the plant are not quantified or used in atmospheric dispersion modelling. The environmental assessment is only carried out for the maximum licenced emission rates, as set out in the EU Directive on incineration (Council Directive 2000/76/EC). Consequently, the EIS does not seek to quantify the expected impact of emissions from the facility as distinct from the maximum impact due to the highest emission rates allowed.

2.4 The air pollutants considered are those for which emission rates are restricted in the EU Directive on waste incineration (Council Directive 2000/76/EC). Only emissions from the stack of the proposed facility are considered. Submissions to the board expressed concern that neither fugitive emissions nor emissions of ultrafine particulates are considered in the air quality assessment.

2.5 Because no assessment of the fugitive emissions associated with the waste transport, transfer and processing activities of the proposed facility has been made it is not possible to determine whether they are negligible or significant. The mix of operations proposed for the facility and the physical separation of the Waste Transfer Station from the Main Process Building has the potential to give rise to fugitive emissions, especially of particulate matter, during unloading, loading and movement of waste and residual material. Cllr Egan reported to the oral hearing that procedures for the assessment of fugitive emissions are available under IPPC licensing procedures.

2.6 The health effects of ultrafine particulates are associated with their number concentration rather than their mass concentration. Consequently, the appropriate units of concentration to use are the number of particles in a cubic metre of air, and they are not well represented by PM_{10} or $PM_{2.5}$. These quantify the mass of particulate in a cubic metre of air, and cannot distinguish between many very small particles and fewer particles of larger diameter. There does not exist an accepted assessment methodology for ultrafine particulate emission from Waste to Energy facilities or other sources.

2.7 Ultrafine particulate matter comprises solid and liquid particles with a diameter less than 1 μm. Because of their small size, these particles do not make a large contribution to the overall mass of particulate matter in the atmosphere, even when they are large in number. Neither the emission nor the ambient concentration of ultrafine particulates is regulated by EU directives, or any other regulations, except in that they make a small contribution to the mass concentrations of PM_{10} and $PM_{2.5}$. Despite the lack of regulation, the health impacts of ultrafine particulate matter have received increased attention in recent years, and this was referred to in numerous public submissions as well as expert opinions presented at the oral hearing, including that of Professor Vyvyan Howard. There is limited information on the rates at which ultrafine particulates are emitted from waste incineration facilities, but these are likely to be a function of many variables including the input waste, emissions control technology and the operating condition of the incinerator, and cannot be reliably modelled. However, even if the emission rates were quantified, as there is no reference limit values (for emission rates or the

resulting ambient concentrations) to form a basis for comparison, it would not be possible to evaluate the significance of the identified impact.

2.8 Secondary particulates are small dispersed liquids and solids that are formed from gaseous pollutants such as the oxides of nitrogen and sulphur emitted from the proposed facility. Secondary particulates were not considered in the air quality assessment, but this was justified by the observation that their formation takes some time, and consequently will only occur far away from the source and will not affect local environmental conditions. However, a complete assessment of the air quality impacts of the proposed facility should, at least, have identified that emissions from the source would include ultrafine particulates and give rise to secondary particulate formation in the ultrafine range. This issue consistently come to the fore when considering the merits of proposals to develop waste incineration facilities, and the applicant's considerable experience in this field implies that they are certainly aware of its importance. However, an examination of the EIS shows that it fails to address the matter in any meaningful way.

2.9 In his evidence to the oral hearing, Alan Watson observed that the EIS does not make an assessment of emissions of persistent organic pollutants, except to note that Council Directive 1996/61/EC requires member states to give priority consideration to alternatives which avoid their formation and release. It is clear that the incineration of waste is not one such alternative.

2.10 Dispersion models such as AERMOD only predict the increase in pollutant concentrations due to emissions from the source or sources considered. To obtain total ambient concentration values the increment in concentrations due to process emissions must be added to a background concentration, normally quantified using baseline monitoring results. Accordingly, the baseline survey should be designed to obtain air quality data in which the level of temporal and spatial detail is compatible with that of the model output with which they are to be combined.

2.11 The baseline air quality survey reported in the EIS took place over the periods November 2006 to February 2007 and April to July 2008. Sampling of NO_2, NO_X, PM_{10}, $PM_{2.5}$, benzene, SO_2, heavy metals, HCl, HF and PCDDs/PCDFs took place at an on-site locations shown in Figure 9.1 of the EIS. The results of the baseline survey show that despite the considerable industrial development in the Ringaskiddy area, the location of the proposed facility currently enjoys good air quality, with ambient concentrations similar to those found in many rural parts of Ireland and lower than in many urban areas. The data presented suggest that the existing concentrations of nearly all the pollutants surveyed are less than 25% of their limit values.

2.12 The extent of the baseline survey was criticised at the oral hearing as being too limited in duration and spatial coverage. It is certainly the case that given the previous planning history of the site and the time available to the proposers of the new facility, a more extensive monitoring database could have been prepared for the EIS. The duration of PM_{10} and $PM_{2.5}$ monitoring received particular criticism as it was confined to periods of three months and one

month respectively. This is insufficient to determine the seasonal variations in concentrations that affect the annual average concentration. All PM_{10} measurements took place in Winter. It was noted at the oral hearing that Summer PM_{10} measurements in 2001 were much higher than those presented in the EIS. It is unacceptable that the limited monitoring data presented in the EIS means that it is impossible to determine whether the different concentrations identified in the 2001 and 2006/7 monitoring campaigns are a reflect long- or short-term factors. The spatial extent of the baseline survey is also limited and the EIS does not attempt to characterise existing air quality in areas such as Cobh and Monkstown which will be impacted by emissions from the proposed facility, albeit to a lesser extent than locations closer to the proposed source.

2.13 It was also observed that the concentrations of some metals identified in the baseline survey were lower than previously measured in 2001. It is not clear whether this difference is due to different local activity during the two sampling periods or different analytical techniques.

2.14 The primary purpose of the baseline survey presented in the EIS is to identify values for the background concentrations that need to be added to the additional (modelled) concentrations that will arise due to emissions from the proposed facility. With the exception of Cadmium, the maximum emission rates for particulate matter and metals allowed by the EU Directive on incineration (Council Directive 2000/76/EC) are low, and the effect of process emissions on ambient concentrations is generally small, mitigating the significance of a short baseline survey. This issue is addressed further in section 4 of this report.

2.15 A number of submissions to the board and at the oral hearing addressed the environmental impact, and associated health impacts, of emissions that may arise during an accident at the facility, including fire. The EIS does not assess the likely environmental effects of different accident scenarios.

3 Air Quality Modelling

3.1 The air quality assessment presented in the EIS was performed using two different atmospheric dispersion models: AERMOD and CALPUFF. The primary assessment was carried out using the USEPA-approved air dispersion model AERMOD which is formulated for the analysis of emissions from industrial sources in flat and complex terrain. It is an appropriate choice of model for the proposed facility and superior in a number of ways to the ISC model used previously at the same location. Additional modelling was performed using the CALPUFF dispersion model, which is approved by the USEPA for use in complex meteorological zones, in response to concerns about the appropriateness of the meteorological data available for input to AERMOD and their ability to represent conditions in Cork Harbour. CALPUFF was run to evaluate the results from AERMOD and the conclusions reached with regard to ambient air quality standards.

3.2 AERMOD and CALPUFF are both used to calculate the ambient concentrations of air pollutants resulting from emissions from the elevated stack source of the proposed facility. The accuracy of these calculations depends on the quality of input data on emissions, meteorological conditions and surrounding terrain.

3.3 In this application, the expected emissions from the Waste-to-Energy facility were not modelled. Instead, the maximum emission rates allowed under the EU Directive on Incineration were used, along with infrequently occurring abnormal emission rates. The use of maximum rather than average or typical emission rates is a conservative approach that ensures that the modelling results remain valid so long as the terms of the EU Incineration Directive are not breached. The treatment of abnormal emissions is more subjective, as it relies on information provided by the facility's process design engineers on the expected magnitude and frequency of these emissions based on past experience with similar facilities elsewhere. This clearly leaves considerable scope for uncertainty, which is compounded by the need to include these emissions in an arbitrary way within the modelling protocol (one day per calendar month was modelled using abnormal emission rates). The EIS claims that pessimistic and conservative assumptions were used throughout this process, but confirmation of this would require regular stack emissions monitoring at a more frequent rate than required by the EU Incineration Directive.

3.4 AERMOD employs data on meteorological conditions and surrounding terrain to determine the rate of plume dispersion downwind of a source. The model's representation of the plume is an approximation that is intended to capture the average dispersion of the plume expected under these conditions. CALPUFF has the capacity to model the transport of pollutants from the source in a more detailed way, taking into account spatial variations in windspeed, direction and turbulence in the modelled area. In the application of CALPUFF to the proposed facility, a horizontal resolution of 1000 metres was used to resolve the terrain and meteorological variations, with inner and outer receptor grids at 100m and 1000m grid resolution, respectively.

3.5 AERMOD was used to calculate pollutant concentrations using two sets of meteorological data. The main analyses were performed using 5 years of meteorological data (2003-2007) measured at Cork Airport. Results for 2006 are presented in the EIS and it is stated that these are the highest of the 5 years considered. Although Cork Airport is located reasonably close to the location of the proposed facility, concerns were expressed in numerous submissions to the board that the elevation and terrain around Cork Airport are very different to conditions in Cork Harbour, and meteorological data collected at the Airport will lead to unreliable and unconservative predictions of pollutant concentrations.

3.6 These concerns are partially addressed in the EIS through additional AERMOD modeling using local meteorological data (wind speed, wind direction, temperature and relative humidity) collected over a two year period at the site of the proposed facility. Wind roses comparing the Airport and local wind conditions were requested and presented at the oral hearing. In general good agreement is displayed by the two datasets, with more frequent westerly winds (and less frequent south-westerly winds) being observed in the local data. In a presentation to the oral hearing, the air quality modeler, Dr Porter, presented additional results obtained by employing the local (on-site) meteorological data collected throughout 2007 within AERMOD. Some important meteorological parameters, including cloud cover, were not collected on-site and for these the Airport data was still employed. A limited comparison of the resulting concentrations with those calculated using exclusively Cork Airport data was presented, showing that the inclusion of the available local data lead to a slight reduction in modeled concentrations.

3.7 Although wind and other meteorological conditions at Cork Airport do differ from those in the harbour, the plume modeled by AERMOD is emitted from an elevated source and its centerline lies at an altitude greater than 100m. Meteorological differences between the two locations will be reduced at this altitude.

3.8 Additional AERMOD modeling using five years of meteorological data collected at Roche's Point prior to the closure of the station there in 1991 was also presented by Dr Porter. Good agreement was observed with the results of the AERMOD modeling performed using Cork Airport data, even though a different set of 5 years were employed. The location of Roche's point at the mouth of Cork harbour means that meteorological conditions there could also be expected to be different to those at Ringaskiddy.

3.9 The meteorological input data required by CALPUFF is more detailed than that required by AERMOD as it must reflect the variation in meteorological conditions throughout the model domain. This includes differences in meteorological conditions such as wind direction and turbulence, but also the manner in which these depend on terrain conditions including land use and surface roughness. These data are calculated using a separate programme, CALMET, which can make use of all available sources of information about meteorological conditions in the area. For the CALPUFF modeling of emissions from the proposed facility, meteorological data from Cork Airport and the on-site meteorological station as well as data from the Marine Institute

M3 and M5 buoys were employed. These data are used along with a primary estimation of the wind field calculated by the MM5 Mesoscale Model which provided hourly values of wind speed, wind direction, temperature and pressure over 18 vertical levels at a horizontal resolution of 12 km.

3.10 Because the preparation of the input data required by CALPUFF is more complex and therefore leaves more scope for error or misinterpretation, the USEPA normally only approves its use in situations where the standard regulatory model (in this case AERMOD) is not appropriate, for instance due to very complex terrain or meteorological conditions. In the EIS, CALPUFF is only used to validate the results obtained with AERMOD and to provide additional confidence in its results. This is an appropriate application of the CALPUFF model. The comparison shows good agreement between the statistical results obtained with the two models, with the CALPUFF concentrations being 10-30% lower than the AERMOD concentrations. This difference should not be interpreted as suggesting a degree of conservatism in either model, but as a realistic reflection of the limited accuracy that can be achieved in air quality modeling. The availability of results from two distinct models provides additional confidence in the air quality assessment.

3.11 Gaussian dispersion models like AERMOD do not perform adequately during periods of low wind speed (< 1 m/s), which can coincide with the greatest impact of source emissions on air quality. The CALPUFF model, however, is able to model pollutant transport and dispersion under these conditions, as well as the associated occurrences of inversion break-up and shoreline fumigation. The provision of results obtained using both models mitigates concerns about model accuracy in these circumstances.

4 Predicted Ambient Concentrations

4.1 The results of the AERMOD modelling of maximum emissions are presented in Table 9.7 of the EIS. These quantify the expected impact of the proposed facility on air quality in the local area. At the worst-case receptor, the following increases in annual average concentrations are predicted, amongst others: an increase in the NO_2 concentration of 8.0 $\mu g/m^3$, an increase in the total NO_x concentration of 3.0 $\mu g/m^3$, an increase in the SO_2 concentration of 0.76 $\mu g/m^3$, an increase in the PM_{10} and $PM_{2.5}$ concentrations of 0.23 $\mu g/m^3$, an increase in the CO concentration of 54 $\mu g/m^3$, an increase in the concentration of Total Organic Compounds of 0.5 $\mu g/m^3$ and an increase in Cadmium concentration of 0.027 $\mu g/m^3$. In addition, predictions of key short term concentration statistics are provided for some pollutants where corresponding limit values exist. These include predicted increases of 68.5 $\mu g/m^3$ in the 99.8^{th} percentile hourly NO_2 concentration, of 84.2 $\mu g/m^3$ in the 99.7^{th} percentile hourly SO_2 concentration, and of 1.2 $\mu g/m^3$ in the 90^{th} percentile 24-hour average PM_{10} concentration. These are the expected increases under maximum emissions; the increases under typical emissions will be less, with the increases under abnormal emissions being greater.

4.2 The predicted increases under maximum emissions can be compared with the predicted impacts of two other Waste-to-Energy facilities planned in Ireland at Carranstown, Co. Meath and Poolbeg, Dublin. Although the model predictions are presented in different forms in the EISs of these projects, inspection of the data shows that the concentration increases at the proposed facility are expected to be two to three times greater than those predicted at Carranstown, and similar to (for hourly average concentrations) or somewhat lower than (for annual average concentrations) those predicted at Poolbeg.

4.3 The predicted increases in concentrations are added to background concentrations determined from the baseline survey and assessments of other sources nearby (including site traffic) to predict the total pollutant concentrations expected during the operation of the proposed facility. In Table 9.7 of the EIS these are compared with the corresponding ambient air quality standards ('limit values'), and these data are illustrated graphically in Figure 4 or Dr Porter's brief of evidence to the oral hearing. The presented results indicate that, with the exception of Cadmium, the predicted total ambient concentrations are all less than 50% of their corresponding limit values. The predicted annual average concentration of Cadmium is predicted to reach approximately 75% of its limit value. Taking into account the conservative emissions values used, this provides an acceptable margin of safety to cover errors that might arise due to the representation of the meteorological, topographic and dispersion conditions in the modelled domain.

4.4 Submissions to the oral hearing correctly pointed out that for many air pollutants, including some to be emitted from the proposed facility, adverse health effects occur at concentrations lower that those set down as limit values. Most limit values are set with a view to improving air quality in zones where the air quality is poor. They are less relevant in areas such Ringaskiddy which currently enjoy good air quality.

4.5 The impact of emissions on local ambient concentrations is strongly dependent on stack height. This is especially the case for the highest hourly average concentrations which are predicted to occur close to the site boundary during periods of strong convective turbulence. AERMOD output was used to identify the required stack height needed to achieve the desired margin between the predicted concentrations and their limit values. The resulting design height of 85m is 50% greater than previously proposed for the same location to take into account the increased emission volume flow and mass emission rates and to reduce building downwash effects due to the taller and bulkier buildings now proposed.

4.6 Considerable concern was expressed in submissions to the Board about the frequent occurrence of calm conditions and thermal inversions in the Cork Harbour area, and the likelihood of these conditions preventing adequate dispersion of pollutants. During these conditions, the plume of pollutants formed by emissions from the stack remains at an elevated height, and pollutants are not dispersed down to ground level. Instead the plume remains relatively narrow as the pollutants are transported down wind, and concentrations within the plume can be high. Should an area of elevated

ground, such as a hill, lie in the path of the plume, then the potential exists for plume impaction, causing high ground level concentrations at the elevated location.

4.7 AERMOD and CALPUFF model the movement of the plume in complex terrain in different ways. The key parameter, however, is the height of the centreline of the plume relative to the height of the hill on which impaction occurs. The plume centreline height is the sum of the physical stack height and the additional rise of the pollutants ('plume rise') that occurs shortly after leaving the stack. Plume rise depends in turn on the volume and temperature of the gases emitted from the stack. In Table 10 of his brief of evidence presented at the oral hearing, Dr Porter identifies a number of hills in the vicinity of the proposed facility and further afield. Neither AERMOD nor CALPUFF predict elevated concentrations at any of these locations. Table 12 of the same brief of evidence identifies the highest hourly concentrations predicted (for a normalised emission rate of 1 m/s) during periods of strong convective turbulence and during stable inversions. The concentrations during strong convective turbulence are the highest. While some of the highest concentrations during stable inversions occur at hill locations (such as Cobh Hill), the concentrations are lower than those observed during convective turbulence. This suggests that the plume rise modelled by AERMOD and CALPUFF is sufficient to ensure that the centreline of the plume lies above the height of the hills surrounding Cork Harbour, preventing plume impaction. During calm conditions, the plume rise will lie in the range 80–150m, indicating a plume centreline height in the range 170-240m O.D.

4.8 As ground level concentrations on the hills surrounding Cork Harbour are likely to be sensitive to the actual height of the plume, stack discharges from the proposed facility should be strongly regulated and monitored. While reductions in the volume of waste processed will lead to reductions in mass emissions rates, which will tend to reduce ambient concentration impacts, they will also reduce plume rise and lower the centreline of the plume, which will tend to increase ambient concentrations. The relationship between emission rates and pollutant concentrations is therefore complex and nonlinear, and it is possible that a reduction in waste processing may lead to increased ground level pollutant concentrations in some circumstances. This leads to the important observation that the air quality assessment presented in the EIS is only valid for the emissions characteristics, including stack height, considered in that assessment, and that it should not be assumed that small changes in any of these characteristics will only lead to small changes in the predicted ambient concentrations.

4.9 The air quality assessment described in the EIS includes cumulative assessment of the combined effect of emissions from the proposed facility and other IPPC licenced facilities nearby. Few details are provided in the EIS, but it is stated that the assessment follows a methodology outlined by the USEPA and that the pollutants of concern were NO_2, SO_2 and dioxins. The modelling results from the cumulative assessment were incorporated into the background concentrations for these pollutants, as presented in Table 9.5 of the EIS. The data indicates that the effects of the other the sources in the locality are small,

but the information provided in the EIS to limited reach a firm conclusion in this regard.

4.10 The air quality modelling results are employed in an assessment of dioxin intake by the Maximum at Risk Individual (MARI) living close to the proposed facility. The RISC Human PCCD/F Intake Model used for this assessment requires data on existing and future dioxin and furan levels in the soil and air in the vicinity of the proposed facility. Data on the existing levels in the soil were obtained from limited soil sampling and analysis, and data on the existing levels in the air were obtained from the baseline air quality survey. Future conditions were determined using output from the AERMOD air quality modelling, including deposition modelling, assuming that dioxin emissions were at their maximum allowable concentration in the stack gases and that the proposed facility was operating continuously at full capacity. Using these data, the Total Weekly Intake (TWI) of the MARI is predicted to increase by 12%, but still remain 36% below the EU limit value for TWI. The predicted 12% increase in TWI can be compared with the 4.4% and 5.1% increases predicted, using the same methodology, for the Waste-to-Energy facilities at Carranstown, Co.Meath and Poolbeg, Dublin, respectively. In these cases, the TWI of the MARI was predicted to reach 44% (Carranstown) and 88% (Poolbeg) of the EU limit value.

5 Assessment of Greenhouse Gas Emissions

5.1 The EIS presents an assessment of the impact of the proposed facility on greenhouse gas (GHG) emissions and climate. The assessment follows an IPCC protocol for evaluating GHG emissions. The methodology seeks to determine the net change in greenhouse gas emissions due to emissions from the proposed facility or landfill, taking into account the avoidance of emissions due to the energy produced.

5.2 Considerable uncertainties exist in the primary input data necessary for these evaluations. These include the mix of waste material, gas capture rates from landfill and the methods of electricity generation likely to be displaced by the Waste to Energy facility.

5.3 When operational, the proposed facility will export electricity to the grid for use elsewhere. Taking this energy recovery into account, the contribution of the proposed facility to total GHG emissions in Ireland is determined to be equal to 0.014% of total national emissions in 2013.

5.4 The EIS makes a brief mention of the energy savings associated with the recycling of ferrous materials at the proposed facility. However, it was observed at the oral hearing that the climate assessment does not examine the effect that the presence of the facility will have on the development of recycling and other waste treatment processes that have a lower climate impact than either landfilling or incineration. There is a need for a wider study on how climate impacts can be reduced by wider policy choices on waste management.

5.5 Alternative waste management and disposal methods exist which will result in lower greenhouse gas emissions than the proposed incinerator. The proposed facility does not contain any realistic plan to develop combined heat and power which is an essential feature of energy efficient thermal treatment facilities.

6 Conclusions

6.1 Thermal waste treatment processes such as that proposed for the Waste-to-Energy facility at Ringaskiddy give rise to emissions of harmful pollutants. For this reason, the emission rates from such facilities are closely regulated by the EU Directive on Waste Incineration (2000/76/EC). The proposed emissions from the Waste-to-Energy are fully compliant with this directive. These include abnormal emissions which may occur with limited frequency due to transient operation of the facility. It is important that the monitoring of stack emissions is capable of identifying the timing and magnitude of all instances when abnormal emissions arise.

6.2 Some important classes of pollutants are not considered in the EIS. These are fugitive dust emissions, ultrafine particulates, secondary particulates, POPs and ozone. These will have impacts that are additional to the impacts quantified in the EIS. Otherwise, the emissions data employed in the air quality assessment are conservative, being the maximum allowed under the EU directive on waste incineration.

6.3 The baseline air quality survey used to determine background concentrations in the vicinity of the plant employed limited sampling periods, sometimes restricted to a single season. This reduces confidence in the background concentrations employed in the air quality assessment. The baseline survey suggests that the area currently enjoys very good air quality.

6.4 An appropriate air quality assessment methodology was employed to determine the impact of stack emissions on ambient concentrations in the vicinity of the stack. Two air quality models were used in this assessment. The AERMOD model employed as the main modeling tool is appropriate and recommended for this kind of application. The CALPUFF model complements the AERMOD modeling by providing an alternative treatment of meteorological and topographical features. The agreement between the results obtained with these two models provides increased confidence in the methodology employed, although this agreement is partly attributable to the use of similar inputs to both models.

6.5 The main air quality assessment, conducted with the AERMOD model, used meteorological data collected at Cork Airport. While the meteorological conditions in Cork Harbour are known to be different to those at the airport, the differences will be less at the altitude at which plume formation and dispersion occurs. The air quality assessment includes other atmospheric modeling results, including the use of meteorological data collected on site and at Roche's Point, and the use of the more complex CALPUFF model,

which all show good agreement with the results obtained using AERMOD with Cork Airport data.

6.6 The expected impact on air quality is quantified in the EIS as the predicted increase in the concentrations of pollutants regulated under the EU Directive on Waste Incineration (2000/76/EC). The results presented show that the increases in concentrations will be greater than those predicted for the Waste-to-Energy facility at Carranstown, Co. Meath, but similar to or less than those predicted for the Waste-to-Energy facility at Poolbeg, Dublin. The increased ambient concentrations at the site will reduce the capacity of the receiving environment to accommodate other future activities in the vicinity.

6.7 The air quality assessment concludes that emissions from the proposed facility, even at maximum operation, will not lead to exceedences of air quality limit values. This conclusion is appropriate based on the results presented in the EIS. The margin between the predicted concentrations and the limit values is large and any inaccuracies resulting from inadequacies in the input meteorological data or background concentrations are not likely to materially affect the above conclusion. These results indicate that the design stack height of 85m is large enough to prevent the ground level pollutant concentrations exceeding their limit values.

6.8 Some pollutants emitted from the proposed facility are known to have negative impacts, including health impacts, at concentrations below their limit values. It is therefore not correct to assume (as is done in the EIS and in evidence presented on behalf of the applicant to the oral hearing) that because ambient concentrations are predicted to remain below their limit values, no adverse health effects will be caused by emissions from the facility.

6.9 The air quality modeling results are employed in an analysis of dioxin intake by individuals living close to the proposed facility. This analysis shows that a small increase in dioxin intake is expected, but that TWI levels will remain at or below two-thirds of the EU guideline value for human health protection. The analysis suffers from a lack of certainty on actual dioxin emission rates from waste incineration facilities generally.

6.10 Net greenhouse gas emissions from the proposed facility are not high, and are likely to be similar to those from landfill. The EIS does not address the effect that the presence of the facility will have on the development of recycling and other waste treatment processes that have a lower climate impact.

Professor Brian Broderick

10th July 2009

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Report following review of presentations and attendance at some of the Health Modules of Ringaskiddy Mixed Waste Incinerator Oral Hearings May/June 2009
Dr. Dan Murphy M.B, F.F.O.M.

1. Introduction

This report covers;
the various presentations to the oral hearing on the proposed mixed waste incinerator at Ringaskiddy, including the initial Environmental Impact Statement, the presentations by various experts on behalf of the objectors and some of the principles underlying the decision-making process with regard to health problems raised by projects such as this.

2. Summary and Conclusions

2.1 The fundamental problem requiring resolution in coming to a decision on human health aspects of this enquiry is whether the protective limit values given by, among others, the European Union, the World Health Organisation and the Irish Environmental Protection Agency are adequate in themselves or whether a full Health Impact Assessment, as proposed by Dr Staines can, or should, be demanded of the applicants.

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2.2 Given that the limit values proposed are set by international groups of experts it does not seem reasonable to debate these with each new project. Care must be taken however to ensure that the engineering controls proposed are not in any way upset by operational or meteorological variations which mean that these limit values might not in fact be met. Despite the uneasiness with the thoroughness of the assessment process which arose during the hearing, my overall conclusion is that rejecting the proposal, purely on the grounds of potential health effects due to pollutants, would not turn out to be scientifically supportable.
2.3 When other “health effects” such as accidents and flooding are taken into account on a broader analysis rejection might be justified but that is not my area of expertise.
2.4 Finally there is the issue of “total health”, (WHO definition). It is possible that, were a population psychological study to be carried out in the Cork Harbour area, the threat of the possible effects of the proposed project could be found to be having a profound effect.

3. Human Health Section of EIS

3.1 This section of the EIS was produced by Employment Health Advisers Ltd. of Cork and was presented by Dr Martin Hogan of that organisation. This document was criticised by Dr Anthony Staines and I will deal with that under Dr Staines’ presentation.
3.2 Early in the EHA presentation the point is made that the methodology of Health Impact Assessment is not possible in a situation such as this due to the difficulty in

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obtaining the necessary baseline health data for a defined geographical study area in Ireland. It does suggest that the national tumour Registry is an exception in this respect but points out that national cancer data is "quite reliable when one examines it on a national basis but much less so for a defined geographical area".
3.3 At this point the EHA document recommends not dealing with health effects which are not directly affected by emissions. It goes on to state "not alone is this approach consistent with planning law it is more practical and accurate than other approaches". In advising An Bord Pleanala I initially presumed that this was, in fact the case. Nonetheless it is a pity that some of the issues brought to light by objectors such as Professor Colin Bradley and other general practitioners in the area are ignored in projects

because of the concentration of the law solely on the control of chemical emissions. The EHA document suggests that "the vast majority of possible detrimental effects to human health are related to emissions". To some extent this begs the question. Health Impact Assessment proponents, such as Dr Anthony Staines might well reply "how do you know unless you have asked the questions".

3.4 The EHA document goes on to describe some characteristics of the local population both demographically and geographically. In his criticism of this document Dr Anthony Staines is probably justified in his general view that accurate numbers of vulnerable groups, such as children and older people, are not identified, located, and compared with similar proportions in the overall population.

3.5 The EHA document then goes on to point out that the proposed incinerator will comply with the emission limits in the incinerator directive.

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3.6 It now goes on to look at epidemiological evidence concerning the health effects of incineration. Dr Staines criticises this section of the document by suggesting that it does not look directly at the epidemiological evidence, particularly that evidence published since the 2003 report of the Irish Health Research Board and the 2004 report of the UK Department of the Environment Food and Rural Affairs. Dr Staines suggests that the Environmental Health Advisers Ltd. (EHA) contribution is over reliant on "secondary sources". This criticism is probably justified as regards epidemiological studies published since 2004. Personally I have no quibble with the use of secondary sources like this provided they are literature reviews from reliable sources.

3.7 The EHA document quotes an interesting few lines from the Department of the Environment Heritage and Local Government on its website "Race against Waste" under the heading "Irish Government Position". This encapsulates one of the core issues in the present hearing. That is "what determines whether the chemical does harm is the amount or dose to which we are exposed". Likewise he quotes from the WHO statement on incineration "incineration of waste is a hygienic method of reducing its volume and weight which also reduces its potential to pollute".

3.8 The EHA document goes on to point out that directive 2000/76/EC enforces stringent operating conditions and is based on the best advice of the WHO.

3.9 The document then discusses some of the specifics about Dioxins and PM10 and PM2.5. Pointing out the proposed operating procedure means that these, and other pollutants, would be kept well within the mandatory values (to a large extent this section actually refers to data already dealt with in other parts of the EIS).

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3.10 The EHA document now goes on to look at some specific epidemiological studies covering respiratory problems, reproductive problems and cancer. I will not comment further on these aspects of the document except to say that the conclusions drawn are that incineration has not been found to be associated with any of these disease outcomes.

3.11 It now goes on to quote various criticisms, in UK government documents, concerning the "Fourth report Of the British Society for Ecological Medicine: The Health Effects of Waste Incinerators".

3.12 Unfortunately, and a point raised by Dr Anthony Staines in his presentation, the EHA document states "there has been nothing published in subsequent literature which would significantly change this position". It would have helped matters greatly if a full bibliography of published, high quality, studies since the time of publication of the UK DEFRA report (2004) was appended to this document. However the WHO document referred to by Dr Staines in his comments goes some way towards bridging this gap[1].

4. Dr Anthony Staines

4.1 Dr. Staines clearly underlined his obvious competency in the area of environmental

epidemiology, Health Impact Assessment and indeed environmental medicine generally. He was specifically asked by the objectors to provide a critique of the health assessment in the EIS submitted with the planning application.

4.2 He found the population description inadequate, it should be pointed out however that the population description, such as it is, is contained in chapter 7 of the EIS and not in that part of the document specifically contributed by EHA. Reading this it appears to

me to give a reasonable summary of the characteristics of vulnerable sections of the population. The only significant item I noticed from the tables reproduced from the CSO is that the area has a higher number of women in the reproductive age group than the national average.

4.3 He disagrees with the EHA point of view that there is not enough data available to place human health at the core of the analysis. He feels that the analysis of the environmental modelling is not satisfactory either.

4.4 He also criticises the degree of consultation with the HSE. (I suspect he may not have been shown the document submitted by the HSE Southern area environmental health department)?

4.5 I have already outlined in the previous section Dr Staines' justified criticism of the literature review. He goes on to criticise the elements of the EHA report on dioxins, particulate matter and other air quality issues. He is also critical of quotations from the health research board report which were not attributed and describes these as plagiarism. Overall he feels that the report does not contribute to "answering the questions posed". I must report that I have great sympathy with Dr Staines' criticisms based on his own training and obvious competency.

4.6 The question at issue is, did the EHA report address matters as required by law in an EIS? A simple reading of the EHA report is certainly capable of giving a reader some idea of the health issues at stake.

4.5 Dr Staines when he says "I believe that it is both appropriate, necessary, and arguably, required by EU legislation, to properly assess the potential health impact of the operation of large industrial facilities" is giving his own view on the above question. He

also goes on to suggest that even without the legal obligation might there not be a moral one?

4.6 In his argument in favour of a full Health Impact Assessment he suggests that broader assessment is required looking at all kinds of potential health effects on the population affected by the project. He gives an excellent short summary of what the Health Impact Assessment (HIA) might look like. (Guidelines on HIA are also available from the Irish Institute of public health medicine and WHO2-3).

4.7 He concluded by saying and that the HSE does not have the capacity to monitor population health in situations such as the presently proposed project and finishes by suggesting that this project should have had a proper assessment and that the EIS "falls far short of any reasonable estimate of what is required".

4.8 Following his presentation Dr. Staines was questioned on a number of issues. At the end of his answers to Mr. Noonan he said "I do not think, if the intention of the Board is to

ensure there will be no impact on human health in the Ringaskiddy area or in the Cork Harbour area, that reliance on EU directives would achieve that". A final question to be answered is whether the use of an HIA, is legally demanded as part of an EIS?

4.9 When in Dr Staines was questioned by Mr Slattery one of the most significant criticisms he made, which may well be sustainable, was that the human health section of the EIS did not give a full bibliography of all relevant epidemiological studies in the

intervening period (since 2002 or since 2004 depending on whether one is relying on the Irish Health Research Board report or the UK Department Of the Environment Food and Rural Affairs), and that such an analysis should have reviewed the full text of each of these papers.

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4.10 This criticism might well have been modified if the human health section of the EIS had referred to one piece of information, which was revealed by Dr Staines in his presentation, the report of the WHO workshop on Health and waste management in 2007[4].

5. Dr. Gavin ten Tuscher

5.1 Dr ten Tuscher is a paediatrician who has developed a special expertise in paediatric toxicology and in the specialised area of epidemiology applied to toxicology.

It is clear from Dr ten Tuschur's presentation that dioxin (that is the group of chemicals normally generically referred to as "dioxin") is an extremely toxic substance. This means that it can cause severe effects, over a prolonged period of time (given its persistence in the environment and its half life in the human body). To do this however it must be absorbed and the sufficient dose to cause these effects must be absorbed.

5.2 Dr ten Tuscher criticises European limit values as being "over liberal" but does not propose any alternate values.

5.3 His paper does stress that his present worry would focus on the dioxins now filtered out rather than on dioxins reaching the ambient air (see page 3 of his written text). He gives an excellent scientific summary of the possible effects of dioxin. These include;

1. Birth defects.
2. Miscarriages and premature births.
3. Infant deaths.
4. Blood defects in young children.

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5. Immune defects in young children.
6. Thyroid malfunctioning in young children.
7. Liver problems in young children.
8. Respiratory problems in young children (it should be noticed that he also refers to the toxic effects of "fine-particulate air pollution" at this point, as well as dioxin).
9. Psychological and neurological defects in children due to dioxin exposure.
10. Psychosexual developments in young children (based on "childhood play behaviour")**.**
11. Dental health problems in young children.
12. The delay in breast development at puberty in females.

5.4 He also mentions an often quoted French epidemiology study near a French municipal solid waste incinerator with high dioxin emissions and possible excesses of non-Hodgkin's lymphoma. (This was one of the studies covered in the DEFRA report in 2004). He also moves on to quote a number of accidents, dating from 1993 to 2009 concerning accidents at incinerators.

5.5 In his conclusion Dr ten Tuscher claims that the excess in dioxin and PCB exposures, caused by this incinerator, will cause an unacceptable increase in their intake by the local population especially foetuses and toddlers (but gives no figures on likely doses). He criticises European commission limits as being too liberal and points out that they have been drastically reduced over the years.

5.6 The two questions remaining in the light of this presentation are;

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- Has he produced a credible indication of the actual toxicological effects on the

infant population specifically due to excess PCBs and dioxins produced during all operations of this incinerator?
• Has he given a reasonably credible reason to doubt all European Commission specified limit values?
In my view he has not.

6. Statement on Particulate Emissions and Health by Professor C. Vyvyan Howard

6.1 This presentation concentrates largely on the health effects of particular matter particularly ultra fine particulates (UFP). In the summary he points out and that epidemiology has shown links between ambient particulate matter exposure and adverse health outcomes. The heart of his thesis is that UFPs are “only usually measured for research purposes and are effectively outside regulatory control". In the remainder of his paper, when discussing epidemiological effects from particular matter he seems to alternate between the usually measured PM10 and PM2.5 and UFPs. The difference between these descriptions is hard to follow at times.

6.2 Likewise in paragraph 1.4 of the summary he states "Indaver appears to ignore, however, the very significant contribution made to particulate burdens by SOx and, especially, NOx emissions”.

6.3 Most importantly in paragraph 1.5 of the introduction he introduces his personal view on the interpretation of the "precautionary principle". He says about this principle "I consider that the evidence of risk of harm to human health and the environment is

sufficiently high for the precautionary approach to be taken towards the permitting of new incineration capacity at least until there is much better information from the biomarker studies recommended by the World Health Organisation and the (Irish) Health Research Board”.

6.4 He now proceeds to a detailed description of the nature of UFPs. With regard to UFPs he remarks "however, at present we know relatively little about their detailed structure, or their chemical and physical properties".

It is clear and that Professor Howard is a world expert in the particular field of how UFPs can affect human tissues. He also considers that UFPs may be the main contributor to the acute cardiovascular effects which have been found when epidemiologists study the effects of PM10.

6.5 Professor Howard points out that the core of his theory about the effects of UFPs is based on the fact that, for a given mass. UFPs have a far greater surface area.

In describing the effects of UFPs he points out (3.5), their behaviour when they have penetrated the lung alveoli, "once they penetrate the epithelium and enter the bloodstream, UFPs may be transported around the body and potentially be absorbed into cells - a process called endocytosis".

6.6 He concludes the final part of this section of his paper (3.11) by saying "medical science has been rather slow to fully recognize and explore the serious problems which particulate emissions cause". Here again it may seem confusing to some that he talks about the scientific findings relating to "fine particles", interspersed with the scientific work on "ultra fine particles".

6.7 With regard to section 4 of his presentation I have no comment as Professor Howard presumably has some expertise in the dynamics of particle behaviour as well as his foundation expertise of histopathology and his training and experience in experimental toxicology. In this section he discusses various aspects of particle dynamics including filter technology and the nature of the incinerator process which he feels will produce "ultra fine particulate aerosols". He also discusses the chemical coatings of particles in

some detail. Another interesting area of the future which he discusses is the fate of "nanotechnology wastes".

6.8 He finishes with a section 5 wherein he gives his interpretation of the "precautionary principle" and suggests that the present project should not proceed in the light of the evidence he has presented.

7. Comment on Toxicological Presentations

7.1 When discussing the area of toxicology later on in this advisory report I will outline the fact that toxicology usually looks at the potential damage which toxins can cause and the likely doses which will cause these effects. There are many toxicologists (sometimes described as "Regulatory Toxicologists"), who would also have some expertise in environmental pollution, deposition rates etc.

7.2 Dr ten Tuschers paper certainly shows health effects and biological changes but there seems to be no certainty as to where these came from. While Professor Howard refers to the American studies which showed increases in cardiovascular disease with increasing

levels of particular matter I am not satisfied that he has linked his findings on ultra fine particles to a possible excess of cardiovascular disease as a result of this project.

8. Evidence Presented by Local General Practitioners

8.1 Dr George Fitzgerald, a general practitioner from Cobh, outlines the fact that the Cork Harbour population already have an excess risk of cancer compared to the rest of the Irish population. He also pointed to the possible risk to foetuses and young children. Like his other general practice colleagues he pointed out the mental distress being caused to the population by the negative perception of the health hazards of this development. The remainder of his presentation covered health and safety rather than human health issues.

8.2 Dr Harry Kelleher, also from Cobh, underlined the effects of dioxins and referred to the possibility of accidents in such a proposed development.

8.3 Dr Paul Macdonald, also from Cobh, queried whether the applicants "would have enough trained personnel to carry out the necessary work to meet the highest standards of safety possible"? He also referred to a possible rise in cancer and congenital conditions. Like his colleagues he referred to the possibility of accidents.

8.4 Dr Declan Pender, also from Cobh, suggested that the proposed site "breaks many of the world health Organisation criteria with regard to the siting of incinerators, i.e. too little distance from the captive population, too few access roads and emergency vehicles cannot reach the site within the designated time span".

8.5 Professor Colin Bradley is Professor of General Practice in University College Cork. In his verbal contribution he explained that he was representing his patients in Cobh. The were already worried about the toxic dump, very close to them, on the island of Haulbowline following the closure of the steel plant. Cobh already suffers from high cancer rates. Many of them were extremely worried about having a toxic waste incinerator so nearby. Many of his patients suffered hearing loss and lung diseases from the industries which previously existed in the area. He felt that the health of the population he serves is already compromised due to social deprivation. People were already "worried sick" and the kind of consultation which the HRB report had recommended in 2003 had not, in his view, taken place. He observed that very tiny amounts of the toxins named in the inventory could be extremely poisonous. He concluded his talk by mentioning the possibility of accidents, both on the way to the plant and in the plant itself.

9. British Society for Ecological Medicine

9.1 The full title of this report is "The Health Effects of Waste Incinerators: Fourth

Report of the British Society for Ecological Medicine, Second Edition, June 2008 ". Because of its length I will not attempt to summarise the whole of this report here. The first half of the report discusses the possible toxicological effects of the emissions from incinerators and "other combustion sources". It has been revised from previous editions and now points out, in particular, the danger from fine particulates.

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9.2 It then moves on to look at the poisonous effects of heavy metals, nitrogen oxides and ozone. It then discusses the effects of various organic toxicants but especially dioxins. It then moves on to discuss the epidemiological studies (already found wanting in the DEFRA report) which they feel point to major cancer risks.

9.3 Later it goes on to suggest that both Alzheimer's disease and Parkinson's disease may be related to pollutants and points out that an increase in violence and crime has also been related to the increase in heavy metal contamination. It also discusses the somewhat controversial area of "the chemically sensitive".

9.4 The second part of the report looks at the precautionary principle, alternative waste technologies and some of the more advanced new waste technologies. It also suggests that monitoring procedures are not robust. It goes on to challenge the present approaches to risk assessment.

9.5 One of the most significant critiques of the BSEM document was produced by ENVIROS consulting. In its final conclusion it states

“The report falls down badly in its understanding of incineration processes. It fails to consider the significance of incineration as a source of the substances of concern. It does not consider the possible significance of the dose of pollutants that could result from incinerators. It does not fairly consider the adverse effects that could be associated with alternatives to incineration. It relies on inaccurate and outdated material. In view of these shortcomings, the report’s conclusions with regard to the health effects of incineration are not reliable”[5].

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9.6 My own general conclusion on this report is that, despite attempting some critique of the technical aspects of incineration it mainly relies on the "they emit toxic substances and in general are very bad for you" argument.

10. Environmental Health Department, HSE, Southern Region

10.1 There seems to have been only consultation with the "Southern area environmental health department" of the Health Services Executive. The environmental health officers involved in this report have assessed the project from the point of view of existing legislation covering process control and emissions.

10.2 It appears there has been no input from, or consultation with, specialists in public health medicine at national or local level.

11. The European Commission Directorate-General for the Environment (DG Environment) and Dioxins

11.1 This is the European commission body responsible for environmental matters, including research, initiation of legislation and overall policing of European environmental legislation. In it’s “Compilation of EU Dioxin Exposure and Health Data Summary Report (1999)”[6]. I have noted the following quotes;

11.2 “The most important route for human exposure to dioxins is food consumption, contributing 95-98% of total exposure”. (In other words in a proper risk assessment of the

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impact of dioxin on a section of the population it is necessary to follow the food intake link in the chain of exposure/absorption).

11.3 " 'At risk' individuals have been defined as those people consuming higher than average amounts of fatty foods, particularly fatty fish and fish products, but also meats and dairy products. Such high level consumers (95 or 97.5 percentile) have been exposed to around 3.1 pg I-TEQ/kg bw/day in the Netherlands and 1.7-2.6 pg ITEQ/ kg bw/day in the United Kingdom."
Given the date of this report (1999) it would appear that up to this point in time anyway, background consumption of PCB was relatively higher in the Netherlands.

12. Dioxin Risks and Proposed Facility

12.1 Chapter 9 of the EIS indicates that any increases in background dioxin levels would be 5% or less. Here one of the basic principles in toxicology can also be applied in exposure levels. "Only the dose makes the poison" (Paracelsus). In this case any increase is miniscule in an already minuscule background exposure. What this means for potentially exposed populations is that studies such as those carried out by Dr ten Tuscher in fairly heavily exposed populations in the Netherlands in the dying years of the 20th century could never be reproduced even in the event of this facility going ahead. Any health impacts from this facility might be in the kind of indirect effects indicated by Dr Anthony Staines and Professor Colin Bradley.

13. Two Points of View

This situation faces us with two possible technical approaches in assessing the health of the potentially exposed population.

13.1 The acceptance of internationally recognized emission standards arrived at to protect such exposed populations and the application of these standards in all cases, (including taking appropriate action whenever these standards are changed or are clearly about to change) and constant monitoring of their application.

13.2 The carrying out of professional procedures (such as Health Impact Assessments) in each and every case.

14. Acceptance of Recognized Standards

14.1 Returning now to the classical risk analysis involving analysis of chemical pollution and possible poisoning we must look at the question of internationally recognized standards. Acceptance of standards recognized by international committees with appropriate expertise has the following advantages;

14.2 Argument and debate is resolved before the implementation of the particular project provided the appropriate standards are adhered to.

14.3 Debate as to who has particular professional expertise and opinion in assessment is resolved by the use of appropriate experts at international level. (Provided their names and reputations are known and respected).

14.4 The disadvantages are firstly. when limits have been set there will always be some doubt as to whether they have "passed their sell by date".

14.5 Secondly while every effort will be made to secure the best experts, in appropriate fields, there will always be some scientific opinion which challenges their competence or whether they are working in appropriate fields.

14.6 In environmental health, when compared to occupational health, there always remains a question of population vulnerability. The approach by the regulatory toxicologists setting limit values is to set them low enough to protect the most vulnerable in the population. Following this hearing I would now inclined to the view that a more thorough health impact assessment would have been preferable on the characteristics of the target population and perhaps on some of the substances not covered in the incineration directive.

15. Health Assessments in Each Case

15.1 Carrying out Health Impact Assessments in each individual case has some advantages;
15.2 The exposed population, in each case, will feel that the professional expertise is focusing on their specific problem.
15.3 There would be no problem of a "sell by date" as it could be presumed that toxicological and epidemiological information would be updated in each case.
15.4 The stakeholders would have one particular scientific expert whose expertise and reputation could be agreed at the start of the project.
15.5 There are obvious disadvantages to such a procedure, firstly it is unlikely that any single scientist would share all the expertise required (toxicologists and

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epidemiologists certainly come from different backgrounds and, ideally, work in teams).
15.6 Even one such expert would need to look at internationally derived limit values and apply the most appropriate ones to the particular case under study.
15.7 With regard to planning laws and policies there would have to be some limit as regards size and scale of the project. Otherwise huge sums would have to be spent on assessing something as small as, for example, a small metal fabrication facility.
15.8 The economic costs thrown up by this need could be used by objectors to block virtually all industrial planning projects.
15.9 "Health Impact Assessment Guidance" published in 2006 by the Institute of Public Health in Ireland (available online at http://www.publichealth.ie/files/file/Health_Impact_Assessment_Guidance.pdf)[7] States, in section 2.4, "There is considerable overlap between HIA and other policy assessments, in particular Environmental Impact Assessment".
15.10 The setting up of a "core group" as recommended in section 3.2.1 of this guidance, would seem an unlikely possibility in planning situations such as the present hearing. Both applicants and objectors would have firm views on the likely health impacts before any discussion started.
15.11 Probably the most important point about using, or not using, a Health Impact Assessment approach is underlined in section 2.1 of the above guideline. "The World Health Organisation's definition of health as 'a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity'

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serves to emphasise the range of factors that influence health and is the definition adopted in this guide".
15.12 An Environmental Impact Assessment which is confined to substance exposures ignores, for example, the stresses and fears outlined by Professor Colin Bradley in his presentation.

16 The Problem of Risk Perception

16.1 The local population probably feel (especially on hearing the evidence of Dr George Fitzgerald, Dr Harry Kelleher, Dr Paul Macdonald, Dr Declan Pender, Professor Colin Bradley, Dr Gavin 10 Tuscher and Professor Vyvyan Howard) that there are serious toxicological and psychological threats to their health. The type of discussions, education, risk negotiation and risk agreement which would be ideal in situations like this has never taken place, and, at this stage, never will take place.

17. The Classical Approach to Risk

17.1 Hazard identification (includes basic and experimental toxicology and analogy with other toxins, animal experiments and tissue experiments such as those carried out by Professor Howard). It seeks to answer the question, "what might be a poison"?
17.2 Risk analysis answers the question "how might this identified poisoned effect

people in this particular situation”?

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17.3 Risk prevention which includes substitution, engineering control, pollution control, pollution control monitoring and, finally, species, (including human health), monitoring.

18 Risk Analysis

18.1 Risk analysis in this case seeks to answer certain questions

18.2 What is the result of the Hazard identification already undertaken?

18.3 Where, and in what quantities, is this hazard produced? (by Modelling in this case)

18.4 What are the resulting levels in air, water and deposition on land?

18.5 What are the resulting levels in various body tissues of humans exposed to these environmental levels?

18.6 How are these spread across various sub divisions of the population (those with existing health problems, the elderly, children, mothers)

18.7 Are the resulting levels in the environment and in all biological receptors including vegetables and meat and in humans within internationally stipulated limit values?

19. Increase in the level of pollutants?

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The question that needs to be answered here is, taking all the named pollutants discussed during the hearing, is what are the actual increases over background levels in the Cork harbour area?

20. Weaknesses in Classical Analysis

20.1 It is immediately obvious that the classical analysis of risk focuses on chemical toxins in the environment and how they reach elements of the biological environment, including human beings.

20.2 This is where the broad concepts of Health Impact Assessment would probably come into their own, if the environmental legislation, under which we work at the moment, included such a broad approach. The WHO definition of health would look at the happiness and overall lifestyle of the affected population.

21. Integrated Risk Assessment

21.1 An interesting WHO document[8] looks at the problem of environmental impact assessment and health impact assessment, usually considered in isolation. In the preface to this online document it says

21.2 “Historically, human health and environmental risk assessment methodologies have generally developed independently. Regulatory agencies often use a chemical bychemical
approach, focusing on a single media, a single source, and a single toxic endpoint. Many international and national organizations have expressed a need for an

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integrated, holistic approach to risk assessment that addresses real life situations of multichemical, multimedia, multiroute, and multispecies exposures. In response to this need, the International Programme on Chemical Safety (IPCS) convened a group of international scientific experts to develop approaches for integrated risk assessment.”

21.3 Without concentrating on the specific subject matter of this document I found it was well worth reading as an indication of what is being missed in the present approach to risk assessment in this particular project. It does, nonetheless, pose the question "how could we assemble the necessary team expertise in Ireland to approach the problem of integrated environmental and health assessments"?

22. Acceptance of Processes

22.1 There are a number of documents which might point to an alternative process of assessment. There must remain a serious question as to whether this is a legal option and what amount of resources would it take in terms of time and money. Such documents include the WHO Health Impact Assessment guideline the Institute of Public Health HIA guideline.

23. "Other Pieces of the Jigsaw"

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23.1 The oral hearing has been faced with a range of experts in various fields. It may be of interest to consider which experts were not represented. This would include;

- World Health Organisation and European Commission scientists who have contributed to the agreements on environmental limit values now incorporated into the incinerator directive.
- The scientific experts who contributed to the Irish Health Research Board and UK Department of the Environment Food and Rural Affairs 2004 reports.
- Experts (including Dr. Staines) who convened at the WHO workshop in Rome in 2006 on the Population health and waste management[9].

24. Precautionary Principle

24.1 At various points during those sessions of the public planning hearing which I attended the Precautionary Principle was raised.

24.2 The Institute of Public Health in Ireland guidance on HIA[10] suggests in section 3.4.1, "To address this issue, HIA adopts the World Health Organisation approach and applies the precautionary principle when dealing with evidence. This means that where there are threats of serious damage to health, a lack of full scientific certainty should not be used as a reason for postponing measures to minimise this damage".

24.3 This concept does not in itself provide any solution for decision-makers. Different sides of an argument might have a different concept of "threats of Serious damage to

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health" likewise there is an argument that internationally agreed limit values provide "measures to minimise this damage".

25. WHO workshop 2006

25.1 One significantly valuable point identified in Dr. Staines' paper was the existence of a relatively more recent update of international scientific opinion on the matter of health and waste disposal[11]

25.2 On the subject of Incinerators this report has the following to say;

"With regard to incinerators most of the points raised for landfills are valid. It has to be stressed that most of the time confounding makes studies hard to do and even harder to interpret and, as in landfill studies, increases in relative risk are difficult to detect because they are generally caused by long-term low-level exposures. Studies pointing to an increase in STS and NHL (Soft tissue sarcoma and Non Hodgkin's Lymphoma) support a possible etiologic role of 2,3,7,8 T4CDD. The evidence is inadequate to draw conclusions that are valuable for guiding current policy choices on incineration: relatively few good quality studies exist and they refer mostly to old generation incineration plants. In addition in some studies in which risk excesses were found, alternative interpretations, for example involving exposures from sources other than the incinerators were put forward. It is important to point out that stack emissions from modern plants are much reduced compared to old generation plants. The few studies carried out on new generation incinerators are difficult to compare with the previous ones, because of these

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differences in technology between the plants. The adoption of the BAT(Best Available

Technology principle), enforced by the EU, results in the fact that the occurrence of measurable health effects on populations resident in close proximity of new generation incinerators is becoming less likely. However their overall impact on the general environment and on human health through indirect mechanisms of action, has not been evaluated yet. In particular waste incineration, currently on the increase in many countries, may be a non negligible contributor of greenhouse gases and persistent pollutants on a global scale".[12]

25.3 It would seem that the ingredients for perfect epidemiological studies are a long period of time, perfect health data on exposed populations, very large populations and excellent exposure knowledge.

25.4 These observations seem to underline that epidemiology has little to offer with regard to the present decision (or even policy decisions at national level) for the time being.

26. Some Further Questions Analysed

26.1 The EIS produced by the applicants seems to follow a framework from previous such studies it certainly does not follow a full Health Impact Assessment methodology. As pointed out by Dr Staines there is no detailed baseline study of the population structure (He seems not to be content with the tables in the main EIS, chapter 7). I have no comment on the baseline studies of environmental pollution levels and will go by your advice on these.

26.2 The EIS section prepared by EHA Cork is titled "Précis of Evidence of Human Health Effects". It does not purport to be a full Health Impact Assessment. Thus any criticism of the document must come from its own stated objectives rather than from criticisms raised by other health specialists.

26.3 I have considered the suggestion made by Dr Anthony Staines that it ought to have followed the procedures of a full Health Impact Assessment. The point I must make is that, desirable as such an assessment might now appear to us to be, such an assessment was probably not in the minds of those preparing it at the outset of this oral hearing. I believe, from what I have looked at on the subject, that a full Health Impact Assessment could take a number of months of input from one professional with skill and experience in carrying out such assessments.

26.4 The assumptions made, with regard to limit values as being the basis for safe levels of exposure, in the light of many of the observations which have been made, for example, on the meteorology of the Cork harbour area, could obviously prove not to be valid to this particular case. (I am referring here to the possibility of fugitive emissions from sources other than the stack, unusual behaviour of plume etc).

26.5 Nonetheless the remodelling would have to be very carefully calculated in the light of any future re-examination of the evidence, as it would have to be shown that the actual exceedence of limit values in air, land or water was such that it was likely to give rise to doses in those exposed that were significantly in excess of those originally planned by the scientists who set these limits

26.6 With regard to the information provided, as I have already stated, I do see a weakness in that the report has presumed that we will accept the evidence that

epidemiological research that has been reviewed covering the interim period since the secondary information sources (HRB, DEFRA), were published but provided no bibliography to show this, and certainly no study by study analysis. (He was unaware of the WHO 2006 workshop, as were many of us, prior to hearing about this from Dr. Staines).

26.7 A number of criticisms were made, on behalf of the objectors, by various experts.

As I've already indicated in this report the most telling of these criticisms are in fact those by Dr Anthony Staines. As I've already indicated these criticisms include an inadequate examination of how the emissions might in fact affect, for example, sites where there were unusually high numbers of small infants, lactating mothers or elderly persons who already have compromised respiratory systems.

26.8 On re-examining the papers by Professor Howard and Mr Watson I'm slightly puzzled as it would seem that there are criticisms aimed at inadequacy in the environmental modelling rather than in the health assessment. Thus aspects of the EIS targeted as "health aspects" by some of the experts for the objectors (Professor Howard and Mr Watson) may well have been more appropriately aimed at the pollution control aspects of the EIS.

27. Is There a Need for Further Information?

27.1 It is unlikely that the extra information, such as a full Health Impact assessment, demanded by the objector's experts would in fact contribute very much to the debate. As I stated earlier, circumstances have provided certain experts to the oral

hearing and this has not included experts who are in fact part of the European Union or World Health Organisation machinery for examining and setting environmental limit values.

27.2 If there is any information deficit it arises both from methodology (as outlined in Dr Staines' criticisms), and from any environmental measurements which have not been carried out. However even Professor Howard agreed that the measurement of Ultra Fine Particles, for example, was currently confined to laboratories at the present stage of development.

27.3 The methodological deficit could only be filled by seeking a revised EIS with a full Health Impact Assessment along the lines proposed by Dr Staines.

27.4 I have already commented on the fact that the precautionary principle interpretation depends on who was interpreting it.

28. Attendance by Local General Practitioners

28.1 I have outlined the presentations by local general practitioners from Cobh (which is downwind of this site). I am sure that their attendance has some significance but I would be more impressed with their evidence with regard to the unease and stress in their patients generated by the proposed development.

28.2 Their other contributions on toxic effects and accidents have been well dealt with by experts from other areas.

28.3 They also outlined, albeit indirectly in some cases, that they serve a population which has a high proportion of the socially deprived. I agree that a full HIA might well

find that such a population was vulnerable and might require greater protection. The population has also suffered from previous environmental disasters such as the toxic dump at the Haulbowline steel plant and the Hicksons fire in 1993 in Ringaskiddy itself. Apart from underlining the desirability of a full health impact assessment, if such were possible at this stage, I do not see the evidence of the general practitioners as pointing to a particular way of examining health impacts.

29. Prof Bradley's Comments on Occupational Health

29.1 I have a great deal of sympathy for the problem raised by Prof Bradley as regards the appropriateness of having specialists in occupational medicine comment on general environmental health.

29.2 Occupational medicine is defined as that branch of medicine which looks at the effect of work on health and the effect of health on work. In their day-to-day work most occupational physicians are dealing with the effect of health on work (fitness

critical occupations, return to work after illness and on-the-job rehabilitation).
29.3 However, over the years some occupational physicians have taken a special interest in environmental medicine. Many of the journals in the field of occupational medicine have added "occupational and environmental medicine" to the Journal title. The American College of occupational medicine changed its title to the American College of Occupational and Environmental Medicine some years ago. Occupational physicians in training schemes are given instruction in this particular area.

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29.4 Where has this development come from? The simple answer is that physicians working in those industries which gave rise to environmental pollution were obviously asked by their employers to apply the experience they had gained in protecting workers from in-plant pollution to problems "over the factory fence". Obviously not all occupational physicians practice in this area. I have only been able to identify two working in this area in the Republic of Ireland and I'm uncertain whether any of the occupational physicians in the north of Ireland are doing this.
29.5 This approach is also mirrored in the academic units of occupational medicine in the United Kingdom where there is usually a member of staff who practices and researches in this particular area.
29.6 I raise this point because Professor Bradley's question, quite straightforwardly, was coming from a possible perceived conflict of interest. I would say that if an occupational physician has been asked to give advice, for example, to a community group (or volunteers to do so) he will seek to give the scientific truths as he or she sees it but will obviously try to cater for the needs of that particular constituency.
29.7 He has, however indirectly, raised another problem. There is no academic unit of occupational medicine, at the moment, on the island of Ireland. By the same token I note that Dr Staines is currently employed at the School of nursing in Dublin city University and states in his background "I have developed the first environmental epidemiology unit in the country". I am not clear as to whether this is situated, with his present post in DCU or is in the Department of public health in UCD.

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29.8 In other words public health in Ireland at least has some academic/research base to work from. I was unaware until hearing Dr Staines latest evidence that there was actually an academic department of environmental epidemiology. If I were restating Professor Bradley's question I would be more inclined to ask, “why can we not have evidence from practising academics with a strong foot in scientific research, as opposed to day-to-day practitioners, albeit in that particular specialty”?
30. Other Possible Criticisms of the Health Impact Section
30.1 I agree it could be argued that a full Health Impact Assessment might have looked at substances not included in the incinerator directive and did not consider fugitive emissions from the waste transfer station.
30.2 Likewise the EIS did not look at the psycho / social impacts, (but prior to the learning curve instigated by this particularly searching public hearing, those preparing the EIS might reasonably have considered they were not expected to do so. All unwelcome planning projects must to a certain extent impact on health when taking the broad WHO definition).
30.3 The mechanism of high cancer rates, (and many other diseases including lung and heart disease), among socially deprived populations is obviously a complex one. Ironically some of it, at least, is due to the heavy and polluted industrial occupations and some to the general environment around the plants that produce pollution.

Signed:
Date:

[1] Population health and waste management: scientific data and policy options Report of a WHO workshop Rome, Italy, 29–30 March 2007 (accessible on http://www.ranchopark.com/who.pdf)

[2] World Health Organisation HIA website (accessed 28/6/09 at http://www.who.int/hia/about/why/en/index.html)

[3] Health Impact Assessment Guidance Published by The Institute of Public Health in Ireland, April 2006 (accessible on http://www.publichealth.ie/publications/healthimpactassessmentguidance)

[4] Population health and waste management: scientific data and policy options Report of a WHO workshop Rome, Italy, 29–30 March 2007

[5] ENVIROS Evaluation of the 4th Report of the British Society for Ecological Medicine: ”The Health Effects of Waste Incinerators” accessed on http://www.surreyfire.gov.uk/sccwebsite/sccwspublications.nsf/591f7dda55aad72a80256c670041a50d/df91fa51b4a522398025714d003e9636/$FILE/8%20Evaluation%20of%20BSEM%20Report%20on%20incineration%20-%20ENVIROS.pdf

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[7] Health Impact Assessment Guidance Published by The Institute of Public Health in Ireland 2006

[8] Integrated Risk Assessment Report Prepared for the WHO/UNEP/ILO International Programme on Chemical Safety (WHO/IPCS/IRA/01/12) ,December 2001(accessible on http://www.who.int/ipcs/methods/risk_assessment/en/index.html)