# CERC/Proof/Barrowcliffe

**TOWN & COUNTRY PLANNING (INQUIRIES PROCEDURE) (ENGLAND) RULES 2000**

**APPEAL REF: APP/D0840/A/09/2113075/NWF**

**Land at Rostowrack Farm, Wheal Remfry, Goonvean and Parkandillick Dryers, St Dennis, St Austell**

# Air Quality - Proof of Evidence of Roger Barrowcliffe

On behalf of SITA Cornwall Limited

February 2010

ERM

## 1 QUALIFICATIONS AND EXPERIENCE

1.1 My name is Roger Barrowcliffe. Since 1989, I have worked within Environmental Resources Management (ERM), where I am a Partner of the company.

1.2 I was responsible for the air quality and health effects assessment work carried out for the proposed CERC, as contained within both the Environmental Statement [CD A7] and the Environmental Permit application [CD M1].

1.3 My experience with the air quality effects of waste management facilities is extensive and dates back to 1990. I have appeared as an expert witness at many public inquiries, including those held in respect of the following proposals and plans:

- Graham and Graham versus Rechem International Ltd in the High Court,for the defendant (1993-94);
- Widnes sewage sludge incinerator, for North West Water (1995);
- Replacement Clinical Waste Incinerator at Bolton General Hospital, for White Rose Environmental (1995);
- Clinical Waste Incinerator at Hillingdon Hospital, for Blue Circle Incineration (1996);
- Energy Recovery Facility in Portsmouth, for Hampshire Waste Services (now Veolia) (2000);
- An Energy from Waste Facility at Ridham Dock, Kent for SITA (2001);
- Belvedere energy from waste facility, for Cory Environmental (1992) and Riverside Resources Recovery Limited (2003);
- Public Examination of the Waste Plan, for Surrey County Council, (2007).

1.4 In addition to my role as ERM's leading practitioner in air quality, I am also recognised nationally within the air quality community as the vice Chairman of the Institute of Air Quality Management. I am also a member of the US based Air and Waste Management Association, as well as a Fellow of the Royal Meteorological Society, under whose auspices I am accredited as a

Chartered Meteorologist (CMet). I have a BSc (Hons) in Physics and Meteorology.

## 2 SCOPE OF THE EVIDENCE

2.1 My evidence is concerned with the emission to atmosphere of a range of substances from the CERC, chiefly through the main chimney stack. I explain how the impact of these emissions can be quantified and comment on the significance of these impacts in the context of existing air quality, air quality standards and the effects on ecosystems. With regard to human health effects of these emissions, I quantify the exposure to a number of substances, but I defer to the evidence of Professor Jim Bridges for an opinion on the magnitude of any health effects and their significance In summary, my evidence provides a commentary on the dispersion and fate of a number of pollutants from the point at which they exit the chimney to the point at which they constitute an exposure for a receptor (which could be human or a natural habitat.)

2.2 The pollutants which warrant the greatest attention are as follows.

1) Particulate matter, sulphur dioxide ($SO_2$) and nitrogen dioxide ($NO_2$). These pollutants are associated with many combustion processes and are the subject of policies at local, national and European level. The understanding of their effects on human health has advanced considerably in recent years and it is now possible to quantify their effects on human health (for populations not individuals) with considerable confidence. $SO_2$ and $NO_x$, along with hydrogen chloride (HCl), also contribute to acid deposition, a topic of importance for some sensitive natural habitats.

2) Metals and persistent organic pollutants, such as 'dioxins'. These pollutants are of interest for their possible effects over prolonged exposure

times, as measured in years. This exposure includes both direct inhalation and uptake through the food chain. Some of these pollutants are carcinogens and their impact has to be quantified in probabilistic terms, ie the risk of an individual contracting cancer.

2.3 The evidence I present here is a concise summary of the assessments presented in the Environmental Statement and the Environmental Permit application. The salient points are given here and the supporting detail can be found in either of these two documents.

2.4 Air quality has been raised as an issue by the Council in its Statement of Case only through the assertion that an Appropriate Assessment is needed. Otherwise, it is my understanding that air quality (and human health) is not part of the Council's case for refusing planning permission.

2.5 Two Third Parties (STIG and St Dennis Parish Council) assert that the applicant has provided insufficient evidence to counter local worries about local health. Specifically, the topics of 'dioxins', 'nanoparticles', 'the admixture of emissions with clay dust in the locality' and the effect of 'nitrate emissions on Goss Moor' are mentioned. They also refer to the landform and climatic condition specific to the area around St Dennis.

2.6 All these matters have been addressed in previous assessments provided by Sita, but I deal with them again here where there is a direct connection with the assessment of air quality. Otherwise, matters relating to health are addressed by Professor Bridges.

## *3 RELEVANT POLICIES AND LEGISLATION*

3.1 Policy and legislation for the regulation and improvement of air quality is formulated at both the European and national level.

3.2 The European Commission has adopted a number of directives relating to air quality, the most important of which is Directive 2008/50/EC on 'ambient air and cleaner air for Europe'. This directive merges several previous directives into one and, for the first time, provides an air quality standard for $PM_{2.5}$.

3.3 In addition, the Commission has introduced a directive aimed at controlling the total emissions of pollutants in Member States (the National Emissions Ceiling Directive) and from industrial sources (such as through the Waste Incineration Directive, which is to be absorbed into the forthcoming Industrial Emissions Directive.)

3.4 In the UK, Defra has produced successive versions of its Air Quality Strategy, the most recent of which appeared in 2007. This document sets out the air quality standards applicable to the UK (transposed directly from the relevant EC directives) and air quality objectives, which may differ slightly from the standards. More importantly, the strategy also sets out the measures that the Government expects to be implemented to improve air quality and to meet its air quality objectives.

3.5 Since 1995, the Government has placed considerable emphasis on the role of local authorities in managing local air quality, through Part IV of the Environment Act 1995. This legislation requires local authorities to review air quality and, where necessary declare Local Air Quality Management Areas in places where airborne concentrations are thought to be non-compliant with air quality objectives.

3.6 Finally, the role of the Environment Agency in regulating the air quality impacts of industrial installations through the Environmental Permitting Regulations should not be forgotten. The permit to operate is only granted when the Agency is assured that the any impacts are so small that they can be regarded as harmless. The Agency also requires measurement of pollutant concentrations in the emissions and also, on occasion, in the environment.

3.7 The relationship between planning and pollution control is set out in Planning Policy Statement 23 (Planning and Pollution Control) (1). This document makes clear the respective roles of the two systems, the key paragraph being as follows:

> *'The planning and pollution control systems are separate but complementary. Pollution control is concerned with preventing pollution through the use of measures to prohibit or limit the release of substances to the environment from different sources to the lowest practicable level. It also ensures that ambient air and water quality meet standards that guard against impacts to the environment and human health. The planning system controls the development and use of land in the public interest. It plays an important role in determining the location of development which may give rise to pollution, either directly or from traffic generated, and in ensuring that other developments are, as far as possible, not affected by major existing, or potential sources of pollution. The planning system should focus on whether the development itself is an acceptable use of the land, and the impacts of those uses, rather than the control of processes or emissions themselves. Planning authorities should work on the assumption that the relevant pollution control regime will be properly applied and enforced. They should act to complement but not seek to duplicate it.'*

3.8 In the case of the CERC, an application for an Environmental Permit has been lodged by Sita. The determination process has been completed, in that Sita has provided supplementary information to the satisfaction of the Environment Agency over a period of time culminating in the response of 12

(1) DCLG (2004) PPS23 Planning and Pollution Control, available at http://www.communities.gov.uk/documents/planningandbuilding/pdf/planningpolicystatement23.pdf

November 2009 to a Schedule 5 Notice. The Agency is now 'minded to issue a permit', as illustrated in recent correspondence with Natural England [(1)].

(1) See correspondence by e-mail between Fiona Devine (EA) and David Hazelhurst (NE) of February 2010 and reproduced in Appendix F

## 4 *METHODS FOR ASSESSING AIR QUALITY*

*Approach*

4.1 The Environmental Statement and the application for an Environmental Permit both provide a full description of the methods used to quantify air quality impacts and my evidence here will not repeat this comprehensive description. Instead, a brief summary is provided below.

4.2 The approach taken is to quantify the *additional* concentrations of the key pollutants in the environment, resulting from operation of the CERC and to evaluate the significance of these additional concentrations in the context of existing concentrations, air quality standards and their consequent effects on human health and ecosystems.

4.3 A number of established tools exist for the quantification of impacts, the most important of which is a model for the dispersion of pollutants in the atmosphere. I take the view that models and methods used for impact assessment should be recognised by regulatory authorities and be based on sound science. In this respect, it should be noted that the modelling work carried out by ERM has been subjected to considerable scrutiny by the Environment Agency's Air Quality Modelling and Assessment Unit (AQMAU) and also by Bureau Veritas, on behalf of Cornwall County Council, ie the Waste Planning Authority. These two organisations have confirmed that conventional practice was followed, although a number of questions were raised, all of which have been answered.

4.4 A further point that I would make in relation to dispersion modelling, within the framework of Environmental Impact Assessment, is that it is not carried out with the aim of achieving a perfect simulation. Instead, the aim is to understand the significance of any air quality impacts. It is understood by the modellers that uncertainty is inherent in the modelling exercise and so the effect of this uncertainty needs to be negated by understanding the sensitivity of the model to the input data chosen and by making realistic worst case assumptions.

*Terrain*

4.5 It is common practice in a dispersion modelling exercise to incorporate the underlying terrain in the model. The data for the terrain can be purchased from the Ordnance Survey in digital form and entered into the model as an input file. The data used in this case are illustrated in *Appendix A*. The first diagram in the sequence shows the terrain data across the 20 km x 20 km modelling terrain. In the context of dispersion modelling, the terrain is not significant, in that it does not influence plume trajectories and ground level concentrations. The second diagram is exactly the same information as the first, but has been given a vertical exaggeration of five times in order to reveal better the individual terrain features. It does not represent the actual terrain or the data used as input to the model. For clarity, a two dimensional view in colour is also presented.

4.6 The topic of terrain is mentioned here primarily as a reminder that this aspect of the locality has been included explicitly in the modelling exercise carried out and that any influence the terrain might have is incorporated into the results.

*Meteorological data*

4.7 It is often remarked by some participants in planning inquiries that the modeller has used the 'wrong' meteorological data as input. In one sense this is perfectly true, since the 'right' data are never available. Instead, the modeller has to use whichever data are most appropriate. In many cases, this will involve using more than one dataset, so that the range of possible outcomes can be understood.

4.8 The meteorological data used in the model needs to include a number of key variables and be in the correct format. Typically, they are purchased from the Meteorological Office or another provider who has processed the original observations from a Met Office observing station. It is important to rely on observations a station where the quality assurance procedures ensure that the data are valid. The model requires data on wind speed, wind direction and cloud cover, from which the atmospheric stability can be calculated. These data are entered into the model on an hour by hour basis for a number of years, usually five. In this way, the complete range of possible meteorological conditions affecting dispersion is captured by the modelling exercise, with a calculation performed for each one of these hours. So, for each defined receptor or point on the modelling grid, the concentration is calculated 8,760 times for every year for which meteorological data are available.

4.9 For the dispersion modelling carried out in the EIA and permit application, ERM considered the use of two meteorological data sets available in 'model ready form': St Mawgan and Camborne. These two observing stations are operated by the Meteorological Office. The St Mawgan dataset is not likely to be representative of the location of the CERC, displaying as it does a very omni-directional wind rose. The Camborne data appear to be more plausible, despite the observations being made further afield than those at St Mawgan. Wind speed and wind direction data were collected by the County Council at the St Dennis School but were not used for the principal modelling outputs, as data were available for only one year and no observations of cloud cover or solar radiation were made. Further, this is not a Met Office observing station, but part of the ambient air quality measurement programme.

4.10 *Appendix C* presents a comparison of the early modelling results obtained using different meteorological data sets, but using a stack height of 75 m.

*Model Choice*

4.11 Two models are commonly used in the UK for this type of application, these being ADMS and AERMOD. The former has been developed in the UK by Cambridge Environmental Research Consultants and the latter is a model developed in the USA, which is now approved for use by the US Environmental Protection Agency. ERM holds a licence for both of these models and routinely uses both when carrying our air quality assessments. In the case of the CERC, preliminary results were obtained with both models, before ADMS was chosen as the primary model for the majority of the assessment, partly because it is able to produce 15 minute average concentrations for $SO_2$ concentrations, whereas AERMOD cannot. This approach has been scrutinised by Bureau Veritas and the Environment Agency's Modelling and Assessment Unit and is not in dispute.

*Sensitivity Analysis*

4.12 As part of the EIA, the permit application and subsequent requests from the EA for further information, the sensitivity of the dispersion model to changes in various inputs was explored. In addition to the choice of model and the choice of meteorological data referred to above, other variables in the model set up were also changed, such as parameters relating to the local terrain (ie roughness length) and the receptor grid spacing. Some of these choices lead to predictions for higher ground level concentrations and some produce lower concentrations, as might be expected.

## *5 EXISTING AIR QUALITY*

5.1 In terms of the air pollution climate and sources of emissions, the area around the CERC site could be considered as being largely rural, but with some industrial sources of atmospheric emissions. The available measurements show that air quality is good, by comparison with many areas of the UK and by reference to air quality standards.

5.2 A good data set on existing air quality was collected as part of the EIA, through a measurement programme funded by the County Council. This was reported in the ES and the data are still valid as a representation of the current pollution climate. The values adopted for use in the assessment as annual average concentrations for the pollutants considered are shown in *Table A1* of *Appendix A*. (Note values have been 'rounded' in this proof of evidence as compared with the ES, in order to reflect the level of accuracy present in the measurements.)

5.3 Particular concern was voiced by members of the local community during the EIA phase on the subject of $PM_{2.5}$ concentrations. The instrument deployed by the Council at St Dennis School was able to measure concentrations of this size fraction of particulate matter and the annual average concentration was found to be approximately 11 $\mu g\ m^{-3}$. This is consistent with the concentration measured at other similar locations around the country where $PM_{2.5}$ concentrations have been routinely measured. At most locations, i.e. not adjacent to specific sources of combustion such as road vehicles, it is observed that long term average $PM_{2.5}$ concentrations are about 50-60% of $PM_{10}$ concentrations.

5.4 The $PM_{2.5}$ measurements referred to above were made by Jacobs on behalf of the County Council in the period 27 January 2006 to 28 March 2007. The corresponding $PM_{10}$ concentration in this period was 20 µg $m^{-3}$.

5.5 The local area has been subject to relatively intensive $PM_{10}$ measurements, as a consequence of the desire to investigate the effects of the china clay industry on local air quality. The results have been summarised in a report published in March 2007 by the China Clay Area Dust Monitoring Forum (CCADMF) [(1)].

5.6 The $PM_{10}$ concentrations recorded at two sites in St Dennis as part of this CCADMF investigation cannot be compared directly with the value reported above, as they were not annual averages and were for an earlier time (86 days in 2005). However, the Forum's results were similar to the value of 20 µg $m^{-3}$ for $PM_{10}$ concentration at the school and are supportive of the measurement made by Jacobs. The CCADMF report concluded that some of the $PM_{10}$ concentrations at St Dennis and at Little Treviscoe were affected slightly by the china clay industry. The report also noted that the industry had made considerable progress in reducing impacts at some of the measurement locations, eg Port of Par and Little Treviscoe, chiefly through implementation of measures to reduce 'fugitive' emissions.

5.7 Concentrations of $PM_{10}$ (and $PM_{2.5}$) are influenced by a number of factors, depending on location. For example, sea salt aerosol makes a significant contribution, even at places well inland. However, in comparison with some other pollutants, concentrations are usually much more uniform across the UK. This is partly because there is a significant contribution to concentrations from regional sources and some of the $PM_{10}$ (and $PM_{2.5}$) is so called secondary particulate matter, formed through transformation of pollutants emitted originally in gaseous form. So, for example, sulphur dioxide ($SO_2$) is emitted initially as a gas but is transformed after some time in the atmosphere to sulphate, present in particulate form.

5.8 As a consequence of this relative uniformity of concentrations across the country, human exposure to $PM_{10}$ (or $PM_{2.5}$) is also more uniform than it is for some other pollutants, such as $NO_2$, which shows a more marked urban/rural difference.

5.9 In addition to the measurement programme operated by Jacobs, ERM conducted some sampling of soils at five sites in the locality to measure concentrations of dioxins and furans, polychlorinated biphenyls (PCBs) and various metals. This sampling was carried out for two reasons. Firstly, to establish the existing conditions as context for the human health risk assessment in which food chain modelling is a substantial component and secondly as a measure of the historical pollution burden, including aerial deposition. All of these substances are persistent in the environment and once deposited in soils tend to remain there for a considerable period of time, measured in years.

5.10 The results of this sampling showed that there are only trace amounts of PCBs and dioxins in the soil, with no evidence of any prior contamination. Concentrations of metals were also consistent with there being no history of contamination by aerial deposition, allowing for the fact that soils in Cornwall tend to have naturally high amounts of some metals, such as arsenic.

(1) The China Clay Area Dust Monitoring Forum (2007) An investigation into the china clay industry's on $PM_{10}$ in Cornwall. Previously available through the Cornwall County Council and Restormel Borough Council

## *6 EFFECTS ON LOCAL AIR QUALITY*

6.1 The additional airborne concentrations of various pollutants that will result from the CERC's operation have been quantified thoroughly as part of the EIA and the EP application processes.

6.2 As described in *Section 4*, the principal means of predicting the impacts is dispersion modelling. This is a well understood and relatively advanced technique and can be relied upon to give meaningful results that are readily understood by regulatory bodies such as the Environment Agency. I would emphasise again at this point that the aim behind the modelling is not to produce a perfect simulation, but rather to understand significance of impacts. It is understood by modellers that the results are subject to uncertainty and should be seen in this context. Conversely, the fact that uncertainty is inherent in the results does not render them invalid. Knowing what the outcome will be within well understood limits is of value to decision makers.

6.3 The effects of the CERC on local air quality have been set out in the ES and the EP application in considerable detail. Just as importantly, this work has been extended subsequently through the need to address queries raised by the Waste Planning Authority (as advised by Bureau Veritas) and the Environment Agency.

6.4 A critical input to the dispersion modelling is, of course, the data assumed for the flue gases emitted through the chimney stack and the quantities of the pollutants considered. The values used in the EIA and permit application are reproduced in *Table B2* of *Appendix B*.

6.5 The data on the physical properties of the flue gases originates from the engineering contractors engaged by Sita. Values for the concentrations of individual pollutants are mostly based on the limit values stipulated by the Waste Incineration Directive (WID), except for oxides of nitrogen ($NO_X$) and sulphur dioxide ($SO_2$), for which lower values have been taken. WID does not provide a limit value for ammonia ($NH_3$).

6.6 The values chosen for some of the input data reflect the outcome of an iterative process designed to reduce impacts relating to acid and nutrient nitrogen deposition on the nearby Special Area of Conservation (SAC), discussed further in *Section 7*. As a consequence, the stack height and the emission concentrations of $NO_x$ and $SO_2$ are not typical of most current EfW plant designs for a facility of this waste throughput. The stack height is higher than for similar sized EfW facilities (to reduce ground level concentrations) and the deliberate decision to accept lower emission limit values for $NO_x$ and $SO_2$ gives the CERC an even better environmental performance than is defined by the permits at other proposed or recently constructed EfW facilities.

6.7 These inherent features of the CERC will ensure a very low impact on local air quality, by comparison with other EfW plants and also in comparison with existing air quality and air quality standards.

6.8 The EIA process and EP application has produced a large volume of dispersion modelling results and I have deliberately not reproduced them all here. For specific modelling results, according to such factors as choice of model or meteorological data, the ES or EP application should be used as a reference source. Instead, I have included a simplified form of the modelling results for the annual average concentration at the most affected location in *Appendix B* as *Table B2*. In addition, the annual average concentrations predicted for $NO_2$ are included as a contour plot as *Figure B1*. Another way of looking at the results is to consider the concentrations experienced by a receptor at a given location for every hour throughout a year. Such an example is given in *Figure B2* of *Appendix B*, for a location in St Dennis, with concentrations recorded at a rural site near Exeter (Yarner Wood) included for comparison. The CERC concentrations are shown in dark blue and the 'background' concentrations in pink. For most hours in a year, the additional concentration is zero, as the plume is elsewhere. On those occasions when there is an effect, the additional concentration of $NO_x$ is very small and varies according to the weather. The annual average concentration for this location is the sum of all these individual hourly contributions, divided by the number of hours in a year.

6.9 It is readily apparent, from the most cursory inspection of these results, that the impact of the CERC on local air quality is very slight and might reasonably be described as negligible.

6.10 As noted in *Section 4* of this proof of evidence, the dispersion modelling carried out for the EIA, before and after submission of the ES, incorporated a considerable number of additional model runs, to explore the sensitivity of the results to changes in inputs and mode set up. One of the aspects often remarked on in these situations is the effect of using different meteorological data.

6.11 The location of the CERC in Cornwall is such that there is no clear cut choice of observing station from which meteorological data should be derived for input to the model. The nearest geographically is St Mawgan, near Newquay. However, inspection of the wind roses for this station suggests that the most frequent wind directions recorded thee may not be consistent with those likely to be present near the proposed CERC site. I would expect to see a greater frequency of south westerly winds. In this respect, the data for Camborne are more plausible.

6.12 It is good practice for a dispersion modelling exercise of this kind to explore the consequences of using different meteorological data in the modelling. At an early stage of the EIA, ERM produced modelling results for a CERC with a stack height of 75 m, using meteorological data from Camborne, St Mawgan and also wind speed and direction measurements made at St Dennis. Some of the results have been presented here in *Appendix C*. Examination of the outputs shows that the spatial distribution of the annual average concentrations is different in each case and dependent on the observing station used as the source of the meteorological data, which is entirely to be expected. So, for predictions at a given receptor location, the choice of meteorological data may be important. The maximum concentration, however, is largely invariant with consistency across all statistics, as the comparison between St Mawgan and St Dennis shows. This, it can be stated with a high degree of confidence that the assessment is robust with regard to the use of meteorological data.

6.13 An issue raised by Third Parties, both in evidence and during the EIA, was the combined impact of the CERC and the china clay industry on local airborne particle concentrations. This is an understandable concern, given the local history and the experience of the china clay activities.

6.14 My view of this issue is that there is no combined effect of any significance, primarily because the impact of the CERC on $PM_{10}$ and $PM_{2.5}$ concentrations is minuscule. As the dispersion modelling results show, the additional PM concentrations attributable to the CERC are, at most, 0.009 µg $m^{-3}$ as an annual average concentration. This is a very small contribution and quite undetectable. (Current $PM_{10}$ concentrations are approximately 2,000 times greater.) It is probably a substantially smaller contribution than the china clay industry currently makes, as indicated by the CCADMF report.

6.15 One aspect of this issue that arouses some anxiety is the belief that the china clay particles will interact with the particles emitted from CERC. This is most unlikely, if not impossible. To begin with, the chances of collision in the atmosphere are remote for most particles emitted. Secondly, the two sets of particles are largely inert and are sufficiently large individually that agglomeration in the atmosphere is not a natural process. This tends to occur for much smaller particles, typically in the ultrafine range (less than 0.1 µm.)

## 7 *EFFECTS ON ECOSYSTEMS*

7.1 It was apparent from an early stage in the EIA process that the largest single issue in the context of air quality impacts is the additional deposition of acidic compounds and nutrient nitrogen on the nearby SAC (Goss Moor). The direct effect of plants being exposed to the gaseous pollutants was shown to be not significant and is not discussed further in this proof of evidence.

7.2 To date, most of the dispersion modelling work carried out by myself and my colleagues has been concerned with quantifying the impacts on Goss Moor, partly in response to questions posed by Natural England. This SAC is not the only Natura 2000 site or ecosystem of interest within the vicinity, but it is the one that is nearest and it is also the most sensitive.

7.3 The dispersion modelling results relevant to the assessment of impacts on the Natura 2000 sites have been compiled into one document for this inquiry, included as a Core Document [(1)]. This has been done for convenience; no new results have been generated for this report. All assessment results reported in it are those that have been submitted previously to the Environment Agency.

7.4 The principal concern relating to Goss Moor is the Marsh Fritillary butterfly and its habitat containing the Devil's Bit scabious plant. Jeff Picksley explains this in much greater detail in his proof of evidence.

7.5 The pollutants of interest in this context are $SO_2$, $NO_x$, hydrogen chloride (HCl) and $NH_3$. All of these contribute hydrogen ions to the soil following

(1)A Compendium of Dispersion Modelling Results Quantifying the Effects of the CERC Emissions on Natura 200 Sites
A joint report prepared by ERM and Terence O'Rourke (February 2010)

deposition, either by the process of 'dry deposition' or 'wet deposition' following wash out of these pollutants in the plume by rain. This constitutes 'acid deposition' and could have an effect on size of the Devil's Bit scabious plant community. $NO_x$ and $NH_3$ also contribute nitrogen to the soil, which can affect those plants adapted to nutrient poor conditions.

7.6 The methods for estimating acid deposition (and nutrient nitrogen) and assessing its impact are reasonably well established, although subject to more uncertainty than is the case for air quality impacts. The first stage requires the estimation of the rate of deposition of the gaseous pollutant, eg $SO_2$, to the surface. The conventional approach is to apply a simple 'deposition velocity' ($m\ s^{-1}$) to the annual average ground level concentration ($\mu g\ m^{-3}$) to generate a deposition rate ($mg\ m^{-2}\ year^{-1}$ or $kg\ ha^{-1}\ year^{-1}$). Values for deposition velocities are recommended by the Environment Agency and ERM followed the Agency's guidance (1) when making these calculations (see *Table D3* in *Appendix D*). Although there are accepted values for deposition velocities, it is also recognised by modelling practitioners that there is considerable uncertainty in these estimates and there is therefore a tendency to use values that err on the side of pessimism, ie are larger than maybe the case in reality. It is also a relatively crude approach and disguises a more complex set of physical processes that influence the rate of deposition.

7.7 Once the deposition rates have been estimated the next step is to compare these with a criterion that defines the impact. This is the 'critical load', defined as the threshold rate of deposition below which an impact does not occur and above which the impact becomes progressively larger. This concept

(1) Environment Agency AQTAG 06. Technical Guidance on detailed modelling approach for an appropriate assessment for emissions to air. Final Draft for Approval. 12/01/04, version 6. Air Quality Modelling and Assessment Unit, Environment Agency, Cardiff.

embodies that idea that the ecosystem can tolerate a certain amount of additional acid or nitrogen with no discernible effect but above which the additional input cannot be absorbed and an effect will occur. For acid deposition, the value of the critical load is influenced by the underlying geology and the target species that may be affected. The geology is important because soils that are alkaline act as a 'buffer' and neutralise the additional acid, whereas acidic soils become more acidic.

7.8 Critical loads for the all habitats in the country have been mapped by the Centre for Ecology and Hydrology (CEH) and estimates made accessible through the Air Pollution Information System (APIS) (1). A very important point to note regarding these estimated values is that they are presented as ranges in some cases, which may span an order of magnitude. The nature of critical loads is that they are subject to considerable uncertainty and are not something that can be measured.

7.9 The critical load for Goss Moor, in respect of acid deposition and the Marsh Fritillary was taken in the assessment work as 0.47 – 4.72 keq $H^+$ $hectare^{-1}$ $year^{-1}$. The principal results given in the ES and the EP application are evaluated against the lower end of this range, ie 0.47 keq $H^+$ $ha^{-1}$ $year^{-1}$. This is much the worst case and should be borne in mind when considering the significance of the impact. Allied to this is the fact that ERM chose to use the highest deposition velocities cited by the Agency in their guidance. The combination of this choice, together with the use of the lowest critical load in the range, means that the magnitude of the estimated deposition rate as fraction of the critical load could be overestimated by a factor as great as 30.

(1) www.apis.co.uk

7.10 The calculation of the acid deposition rate was made on a number of occasions by ERM, in response to comments by various parties. Initially, the deposition of acid was confined to the contribution from $SO_2$ and $NO_x$, in line with conventional practice. Successively, the relatively minor contributions of ammonia and hydrogen chloride have been added.

7.11 For $SO_2$, $NO_x$ and $NH_3$, the deposition has been calculated solely through the dry deposition mechanism, as advised by the Agency guidance and for consistency with the physical processes. The gases $SO_2$ and $NO_x$ are not very soluble in water and rainfall is not an effective removal mechanism. HCl, on the other hand, is thought to be more likely to be deposited by rain falling through the plume and has been included in the most recent set of calculations performed by ERM.

7.12 The deposition rate for acid can be compared with the relevant critical load to assess the impact. Even though the Marsh Fritillary habitat is quite sensitive to acid, the additional contribution that the CERC would create is very small in comparison. However, it is thought that the critical load is currently being exceeded by the background contribution and so the fact there is any addition is of interest to Natural England.

7.13 The Environment Agency and Natural England have jointly devised an approach to the assessment of air pollution impacts from regulated installations on Natura 2000 sites. Their guidance is contained in a document familiar to practitioners but which otherwise has a limited circulation [(1)]. The

(1) Environment Agency (2007) (Appendix 7) Stage 1 and 2 Assessment of new PIR permissions under the Habitats Regulations Operational Instruction Issued 05/06/07 [Core Document K7]

process is a four stage one. The crucial stage in this context is 'Stage 2 – Assessing Likely Significant Effect'. The key phrase within the guidance is:

> *'Where the concentration within the emission footprint in any part of the European site(s) is less than 1% of the relevant long-term benchmark (EAL, Critical Level or Critical Load), the emission is not likely to have a significant effect alone or in combination irrespective of the background levels.'*

7.14 The guidance goes on to state:

> *'Where the concentration within the emission footprint in any part of the European site(s) is greater than 1% of the relevant long-term benchmark (EAL, Critical Level or Critical Load), do not automatically conclude 'cannot conclude no likely significant effect' '*

7.15 It is worth examining the origin and meaning of the first statement, as it is prone to misuse and misinterpretation. The threshold of 1% has commonality with other tests of significance used by the Environment Agency when considering the impacts of regulated installations. Such a threshold is given because the regulator is conscious that there must be a point at which any emission from a single installation and its consequent impact is so trivial that it can be screened from further consideration. Otherwise, every application would be too cumbersome and effective regulation would be impossible. The value of 1% is somewhat arbitrary in that a value of 0.1% is probably too low and a value of 10% too high for such a threshold, but a value of 2% might have been considered equally reasonable by some. The threshold value is cited as 1% and not 1.0%; it was not intended to be used with a high degree of precision and ought not to be used as a hard boundary to define insignificance/significance.

7.16 The clear implication of the 1%threshold, as used in the guidance, is that an impact which is quantified as being less than this can be neglected and regarded definitively as inconsequential. If an impact above this threshold is predicted then guidance indicates that the question of significance should be considered in conjunction with other factors before the applicant moves to Stage 3 (Appropriate Assessment). Only at this later stage does the process make a judgement on the effect that the additional deposition might have, in terms of there being 'an adverse effect on the integrity of the site'.

7.17 My evidence is concerned with the magnitude of the additional acid deposition at the Goss Moor SAC and not the nature and vulnerability of habitats found within the SAC; I leave these matters to Mr Picksley and his evidence.

7.18 Before consideration of the additional contribution of the CERC to acid deposition, it is instructive to examine the existing contributions to deposition. The APIS web site provides estimates of the amounts of sulphur and nitrogen currently being deposited on the SAC in total and according to a number of source categories.

7.19 For sulphur, the largest contributors are shipping, other forms of transport and emissions originating overseas. This is illustrated in *Figure D1* of *Appendix D*. Most of the background deposition is accounted for by emissions of $SO_2$ from distant sources with the acidic compounds being deposited chiefly by rainfall. The amount of sulphur deposited in 2003 is estimated to have been 10.4 kg $ha^{-1}$ $year^{-1}$ (equal to 0.65 keq $H^+$ $ha^{-1}$ $year^{-1}$). This is estimated to decline to 8.3 kg $ha^{-1}$ $year^{-1}$ (0.52 keq $H^+$ $ha^{-1}$ $year^{-1}$) in 2010.

7.20 Nitrogen compounds contribute proportionately less to acid deposition than sulphur compounds, but amounts are greater. The estimated deposition rate for 2003 is 17.8 kg $ha^{-1}$ $year^{-1}$ (1.27 keq $H^+$ $ha^{-1}$ $year^{-1}$), declining to 16.2 kg $ha^{-1}$

year$^{-1}$ (1.16 keq $H^+$ ha$^{-1}$ year$^{-1}$) in 2010. As is the case for sulphur, the contributions are estimated on the APIS web site and shown here in *Figure D2* of *Appendix D*. Note the dominant contribution of livestock emissions through the effects of ammonia and ammonium compounds.

7.21 In the ES, the CERC contribution to total acid deposition at the most affected part of the SAC was estimated as 0.0043 keq $H^+$ ha$^{-1}$ year$^{-1}$. As can be seen from a simple comparison with the figures given above for the existing deposition rate, this is a very small contribution indeed. It is also only 2% of the decline in acid deposition rate over the period 2003 -2010 (ie 2% of 0.24 keq $H^+$ ha$^{-1}$ year$^{-1}$); a very small offset to the improvement in these seven years.

7.22 The ERM estimate of the acid deposition rate has since been revised upwards slightly, to account for the contribution of HCl (by both wet and dry deposition). The current estimate for the most affected location on the SAC is 0.0058 keq $H^+$ ha$^{-1}$ year$^{-1}$. The most recent estimates of the deposition rates at Goss Moor and other Natura 2000 were sites made by ERM as part of the response to a Schedule 5 notice question submitted to the Environment Agency on 12 November 2009.

7.23 Another way of looking at the acid deposition rate attributable to the CERC emissions is to express the estimated deposition rate as a fraction of the critical load, given the importance attached to the threshold of 1%. This has been done previously in the EIA process and is produced again here, using the most up to date modelling results (ie including wet and dry deposition of HCl). The result can be seen in *Figure D3* of *Appendix D*. The emphasis in this contour plot is on the Goss Moor SAC and shows that only a very small portion of the SAC is within the 1% contour line, with the maximum value at any point being 1.2%. Note also that it includes the effects of the access route to the CERC site and that there is no real cumulative effect of the road and the area where the CERC is predicted to exert it largest effect through stack emissions.

7.24 When considering the significance of this impact in the context of this significance threshold, it should not be forgotten that it is very much an upper estimate through using, as explained previously, the combination of the lowest critical load estimate and the highest deposition velocity. The effects of these choices on the modelling far outweigh any uncertainties contributed by model choice or model set up. These factors are summarised as follows, together with an estimate of how much they might exaggerate the acid deposition rate as a fraction of the critical load;

- Deposition velocity, ( x3 );
- Emission concentration of $SO_2$, taken as 20 mg $Nm^{-3}$, but likely to be in the range 10-15mg $Nm^{-3}$ over a year (x 1.5);
- Critical load, up to an order of magnitude different to the real value (x 10).

7.25 Another way of expressing this uncertainty is to say that the true deposition rate attributable to CERC lies between 0.0001 keq $ha^{-1}$ $year^{-1}$ and 0.0058 keq $ha^{-1}$ $year^{-1}$, or 0.05% and 1% of the critical load.

7.26 Another aspect to note is that the spatial pattern of the deposition rate estimate is governed by the choice of meteorological data used as input to the dispersion model. The use of another data set would result in the maximum contour line appearing in a different location and perhaps take the 1% contour line away from the SAC.

7.27 A permit has not yet been granted by the Environment Agency for the CERC. All the requisite information has been submitted, however, and the Agency is 'minded to issue a permit'. In this context, it should be noted that the Agency has previously granted a permit to the Indian Queens Power Station, which was shown in the operator's submission to cause an acid deposition rate at Goss Moor of up to six times greater than the maximum for the CERC, depending on assumptions made regarding fuel type and number of operating hours for the power station.

7.28 In summary, my view is that the additional effect of the CERC on the Marsh Fritillary habitat is so small as to be inconsequential, when the basis for the estimated impact is taken into account and the nature of the assessment criterion fully understood. Mr Picksley will also comment on the actual effects on the habitat and the integrity of the habitat.

7.29 The other Natura 2000 site that has been raised as a concern with regard to atmospheric emissions is St Austell Clay Pits. This is a very small site approximately 1.75 km south of the CERC and contains some liverworts and other bryophytes. These plants are sensitive to acid gases and could be affected by sufficiently high exposures to $SO_2$ and could have a critical level as low as 10 $\mu g\ m^{-3}$. However, these plants will not be affected by the CERC as its contribution to airborne concentrations of $SO_2$ at this location will be very low, at 0.004 $\mu g\ m^{-3}$. By any objective criteria, the St Austell Clay Pits site is not an issue and has not been raised as such by Natural England or the Environment Agency.

## *8 OTHER ISSUES*

*Transport*

8.1 The CERC will be associated with a number of heavy goods vehicle movements into and out of the facility, on week days and Saturdays. Such vehicle movements will result in some emissions to atmosphere, chiefly through engine exhaust.

8.2 The impact of these emissions on local air quality was considered in the EIA and reported in the ES. Naturally, air quality impacts are confined to the roadside, along routes used by the vehicles. These impacts are very small and are even smaller than the impacts attributable to the stack emissions.

8.3 The new access road touches the edge of the Goss Moor SAC on its western flank. The presence of this road and its CERC vehicles will have some effect on airborne concentrations of $NO_x$ along the edges of the SAC, but the dispersion modelling has shown convincingly that the impacts on the SAC will be very small and less than the 1% threshold of insignificance.

8.4 This impact on acid and nutrient nitrogen deposition occurs in a different part of the SAC to the greater impact of the stack emissions and the combined effect of the two sources is minimal. This can be clearly seen on the contour plot of acid deposition rate shown in *Figure B3* of *Appendix B*.

*Plume Visibility*

8.5 The plume emerging from the stack will be visible for a fraction of the time. The water vapour content of the plume will, on some occasions, condense into visible water droplets, before evaporating again a short distance downwind.

8.6 The physical processes for condensation and evaporation are well understood and a module within the ADMS dispersion model can be used to predict the frequency with which a visible plume will occur, along with its length. Essentially, when the ambient air is at a combination of low temperature and high relative humidity the water vapour will condense into droplets. In this form, the plume will appear white when the sun is behind the observer and dark when the sun is in front of the observer.

8.7 Low air temperatures and a high relative humidity are most common at night and in winter and, therefore, it is at these times a visible plume is most likely to occur. The ES gave predictions of the number of occasions in a year that a visible plume could occur. Such predictions tend to be more pessimistic than is likely in practice, given the experience at recently constructed EfW facilities.

*Ash Handling*

8.8 The bottom ash resulting from the combustion process and fly ash captured by the fabric filters will not have a means of escaping to the atmosphere and can therefore be discounted as affecting local air quality or having the potential to affect human health through this pathway.

*Odour*

8.9 The design of the CERC is such that odour from the incoming waste will not be released to the atmosphere but is, instead, destroyed by entering the combustion furnace. This process eliminates the odorous compounds such that the flue gases exiting the chimney stack are free of odour.

*Non-routine emissions*

8.10 It is often assumed that should an EfW plant experience 'abnormal' operating conditions that require it to be shut down then emissions of pollutants will increase relative to the 'normal' conditions. In fact, the opposite is true. In the event that the CERC has to shut down, the waste feed to the furnace is interrupted and the abatement equipment continues to operate. A more complete explanation was provided in the EP application at Section D5.2.7 of Volume 4.

8.11 A very useful investigation of the effect that shut-down and start-up operations have on the emissions of dioxins was conducted by AEA Technology for the Environment Agency and published in November 2008 (1). The findings of this careful measurement programme were that mass release rates of dioxins are elevated during the period of shut down or start up, but only by an order of magnitude, so that over a period of a 4 or 5 day shut down, there is no net effect on dioxin emissions when compared with normal operations over the same period.

(1) AEA Energy and Environment (2008) Investigation of Waste Incinerator Dioxins during start up and shut down phases A report prepared for the Environment Agency . Available at http://publications.environment-agency.gov.uk/pdf/GEHO0409BPVA-e-e.pdf

## 9 SUMMARY AND CONCLUSIONS

9.1 I have made an assessment of the CERC plant emissions on local air quality, using appropriate tools and assessment criteria. Where possible, I have used pessimistic input assumptions in the assessment process. I have concentrated on those substances emitted that are included within the Government's Air Quality Strategy, along with metals and dioxins and with an emphasis on the deposition of acid and nutrient nitrogen on the nearby SAC (Goss Moor).

9.2 The assessment criteria I have used for air quality are primarily those declared by the Government as air quality objectives, but reference could also be made to European Union limit values and World Health Organization guidelines. .

9.3 The existing air quality in the area is good in comparison with many other parts of the UK . Based on available monitoring results, concentrations of $NO_2$ and other pollutants do not exceed any of the relevant air quality standards where people are likely to be exposed over the relevant averaging period.

9.4 The CERC will emit quantities of oxides of nitrogen, sulphur dioxide, carbon monoxide, metals, dioxins and particulate matter through the chimney stack. All of these releases will be subject to regulation by the Environment Agency and the magnitude of the releases will be limited to concentrations in accordance with the latest guidance issued by the Agency for new waste incineration processes. The emissions will be restricted by the terms of the permit to operate under the Environmental Permitting regulations. For two substances, $SO_2$ and $NO_x$, the emission concentrations will be lower than currently defined in the Waste Incineration Directive.

9.5 I have used the most up to date dispersion model available (ADMS, Version 4), which is of a type that is favoured by the Environment Agency, to predict the incremental increase in concentrations of pollutants such as $NO_x$ in the vicinity of the CERC.

9.6 My analysis of air quality impacts is based on the impact at the worst case location for all measures of air quality. Therefore, the situation will always be more favourable at all other locations.

9.7 Even at the most affected location, the $NO_2$ concentrations arising from the CERC operation are predicted to be very small in comparison with existing concentrations, on an annual average basis, and smaller than existing short term peak concentrations, in terms of the maximum one hour average concentrations. No exceedences of the relevant air quality objectives set by the Government will occur as a result of the emissions.

9.8 Impacts on local air quality from pollutants other than $NO_x$ and included within the Government's Air Quality Strategy (ie $SO_2$, CO and $PM_{10}$) will be small and not add significantly to local concentrations as measured by air quality standards and guidelines. This conclusion applies to both long term and short term average concentrations.

9.9 This proposal has been the subject of much discussion with the Environment Agency and Natural England with regard to the effects of the emissions on the Marsh Fritillary habitat on Goss Moor, especially for acid deposition. My view is that the scale of the impact is inconsequential, when seen in the context of the existing deposition rate and the range of critical load estimates provided by the Centre of Ecology and Hydrology. I also believe that conducting an Appropriate Assessment will not add significantly to the knowledge of impacts relating to acid deposition and that sufficient information is already available on which to base a sound decision in this respect. My opinion, therefore, is that there is no requirement to conduct an Appropriate Assessment in this case.

9.10 The effects of the additional concentrations of $PM_{10}$, $NO_2$ and $SO_2$ can be quantified in terms of 'loss of life years' and additional hospital admissions for respiratory causes, as was described in the ES.

9.11 I have also calculated the additional accumulation of certain metals and the total dioxins as concentrations in soils over a 70 year period. Even at the most affected location, these additional concentrations are a very small fraction of the existing concentrations. Even with worst case assumptions, the increase is less than 1% at the most affected location.

9.12 The possibility exists that the CERC may experience equipment failure or undergo an emergency shut down procedure from time to time. These will have no implications for my air quality assessment, as mass release rates of the pollutants with potential short term impacts will not be increased relative to normal operations.

9.13 The design and intended operation of the CERC is such that it would have no odour or dust emissions.

9.14 Emissions from transport used to bring waste to the site and remove ash will be such that local air quality impacts, even under worst case assumptions regarding the use of road transport, would be minimal and have no effect on the habitats within the SAC.

9.15 In summary, the development will result in small but quantifiable increases in ambient concentrations of some airborne pollutants, but these increases will not be significant in the context of existing air quality and meeting air quality objectives. These air quality impacts are not, in my opinion, of sufficient magnitude that they should prevent the issue of a permit under EP Regulations by the Environment Agency, nor be in conflict with the responsibilities of the Council with regard to Local Air Quality Management.

*The evidence which I have prepared and provide for this appeal reference APP/*D0840/A/09/2113075/NWF *in this proof of evidence is true and has been prepared and is given in accordance with the guidance of my professional institution and*
*I confirm that the opinions expressed are my true and professional opinions.*