

From: "Ben Moore" <bmoore@ridgewind.com>
To: "Mark Simmonds" <Mark.Simmonds@northlincs.gov.uk>

Date: Tuesday, January 18, 2011 09:17AM

Subject: Grange

Hi Mark,

See below wording on two issues:

I confirm that the mitigation agreement would enable the Glathornes to make physical alterations to their residence which, together with additional screening through a scheme of planting, would reduce the visibility of the proposed turbines. If the physical alterations are not sufficient to provide satisfactory levels of amenity for the family, the agreement facilitates their relocation, if this is deemed necessary by them.

RidgeWind believe that the current application (WF/2010/1242) is appropriate and should be granted planning permission. However if the Planning Committee were minded to grant planning permission with a condition that the nearest turbine to Burton Upon Stather should not be built, RidgeWind would not seek to challenge the imposition of such a condition.

Ben Moore | RidgeWind Ltd | office 01993 832 511 | mobile 07958 722255

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RidgeWind Ltd.

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From: Mark Simmonds/PL/NorthLincs
To: "Ben Moore" <bmoore@ridgewind.com>
Date: Monday, January 17, 2011 02:32PM
Subject: Re: Response to letters of comment

Hi Ben,

are you sending a separate email to confirm the position regarding the mitigation in place for the Glathorne family and the confirmation that Ridgewind would not object to a condition prohibiting the building of the turbine nearest to Burton?

Thanks,

Mark Simmonds
North Lincolnshire Council
-----"Ben Moore" <bmoore@ridgewind.com> wrote: -----

To: <Mark.Simmonds@northlincs.gov.uk>
From: "Ben Moore" <bmoore@ridgewind.com>
Date: 14/01/2011 04:16PM
Subject: Response to letters of comment

Dear Mark,

Please see letter of response to comments on the application.

Best Regards,

Ben Moore | RidgeWind Ltd | office 01993 832 511 | mobile 07958 722255

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Mr M Simmonds
North Lincolnshire Council
Planning Department
Church Square House
PO Box 42
Scunthorpe
North Lincolnshire
DN15 6XQ

Dear Mr Simmonds,

Reference Number:WF/2010/1242

I would like to respond to several points raised in the consultation process:

1. Residential Amenity
2. Cumulative Impact
3. Health Concerns
4. Andrew Percy request for clarification

Residential Amenity Concerns

Several identical letters of objection seem to suggest that weight should be given to the AEAT report for the Government Office for Yorkshire and Humber titled "Planning for Renewable Energy Targets in Yorkshire and Humber".

The references to the AEAT report may be a result of it forming part of the suggested template letters found on the BATS (Burton Against Turbines) Website. However, it appears that only a very selective part of the AEAT report has been quoted. For example, though the three following bullet points appear in several letters, the fourth bullet point (which is also taken from the report) is missing from the letters.

- Wind farms needed to be sited at an appropriate distance from homes and other buildings for noise as opposed to safety reasons
- Established practice is to build a turbine no nearer than 10 rotor diameters from a dwelling
- Typically this is 600m or so although it can vary according to prevailing wind direction and other conclusions obtained from noise monitoring studies prior to development
- **Can build as close as 100m to a home if there is a higher level of background noise – such as where a site is located close to a busy road**

On this basis it is clear that the report in question suggests that distances to residences should be based on the results of the noise assessment and not an arbitrary value. As a consequence, the very thorough noise assessment within the environmental statement clearly demonstrates that the proposal is considered a suitable distance from residential property. In addition the independent planning Inspector also agreed that residents would be protected.

Para 14 of the Inspector's report also confirms this : *"Furthermore, the noise limits put forward by the*

Appellants are appropriate and would protect amenity at residential properties in Flixborough and Burton, and at all stages in the assessment the Appellants have considered the worst case scenario and there would thus be a significant safety margin between predicated noise levels and acceptable noise limits."

The council did not put any evidence forward at public Inquiry on residential amenity, and likewise the Inspector did not find this a reason for refusal.

From the Council's point of view during the Public Inquiry, Mr Goldthorpe confirmed that the Council were not raising any concerns or objections relating to the visual effects of the proposed wind farm on residential amenity. Accordingly, it was not the Council's case that planning permission should be refused because of visual effects on residents in the locality. Furthermore, neither Mr Goldthorpe nor the Council raised any concerns or objections relating to visual effects on any receptors using footpaths/bridleways, roads or railways in the locality.

Cumulative Impact

Although several wind farms have been granted planning consent within the wider area, the assessment of their cumulative impact has been fully addressed in great detail both in the environmental statement and at the recent Public Inquiry. The various independent experts who have assessed the project, including the planning team at North Lincolnshire Council and the Planning Inspector all agree that neither the impact of the site alone nor taken cumulatively with the other proposals is sufficient to refuse the application.

Extract from paragraph 10 of the Inspector's report reads:

"However, all of these wind farms would be seen in the distance in views from the vicinity of the site and they would not add to or reduce the adverse effect of the appeal proposal on the character and views of the landscape. Similarly, Bagmoor wind farm is some distance away and on higher ground and there would be no cumulative impact with the appeal proposal."

Health

It is recognised that health concerns about effects associated with wind farm operation have been raised by members of the public and residents living close to the proposed wind farm site. Unfortunately, these concerns have sadly been fuelled by inaccurate and misleading articles and publications found on the internet including the notorious views put forward by Dr Nina Pierpont.

Find attached (appendix A) the report titled **Wind Turbine Syndrome an independent review of the state of knowledge about the alleged health condition**. This report concludes that:

- the scientific and epidemiological methodology and conclusions drawn by Dr. Pierpoint are fundamentally flawed;
- the scientific and audiological assumptions presented by Dr Pierpont relating infrasound to WTS are wrong; and
- noise from wind turbines cannot contribute to the symptoms reported by Dr Pierpont's respondents by the mechanisms proposed.

With regard to the concern of the resident who suffers from epilepsy, Government guidance on this issue can be found in Appendix B attached and should give comfort that this concern is unwarranted.

A statement produced by a professor in the field of epilepsy can be found in Appendix C. The statement confirms that wind turbines similar to the scale proposed at this site rotate much slower than the speed that is likely to produce any ill effects to those who suffer from photo-sensitive epilepsy.

Further government guidance can be found on the subject in Paragraph 77 of PPS 22 companion's guide:

Around 0.5 % of the population is epileptic and of these around 5 % are photo-sensitive. Of photo-sensitive epileptics less than 5 % are sensitive to lowest frequencies of 2.5-3 Hz, the remainder are sensitive only to higher frequencies. The flicker caused by wind turbines is equal to the blade passing frequency. A fast-moving three-bladed machine will give rise to the highest levels of flicker frequency. These levels are well below 2 Hz. The new generation of wind turbines is known to operate at levels below 1 Hz.

In other words, only a very small percentage of epileptics are sensitive to low frequency light flashes and even this small group would not be affected by the turbines. Also, if in the very unlikely event that there ever was a problem a planning condition will be in place to completely mitigate the effect.

Andrew Percy letter

Mr Percy's public opposition to wind farms appears to conflict directly with a) the government's position in supporting appropriate British renewable energy developments, b) his own attempts to promote North Lincolnshire as the heart of the new Humber Green Deal, as well as c) the additional jobs that Corus are providing in manufacturing wind turbine towers. One must question why Mr Percy is "saddened" by a planning application that was supported by the local planning authority, has had no statutory consultee objections, has gone through the scrutiny of a rigorous Public Inquiry, would bring direct investment into the area, and would help maintain crucial jobs in a time of austerity.

With regard to Mr Percy's comments related to the Glathorne family, before resubmitting the recent application, RidgeWind consulted the Glathorne family, seeking an appropriate solution to their circumstance. The subsequent mitigation agreement fully addresses and protects the best interests of their children. This I am sure you can now appreciate was at the forefront of the parents' thoughts in all of their decisions.

Furthermore, Mr Percy went on to question issues such as noise, residential amenity and cumulative impact, all of which were dealt with in great detail at the Public Inquiry and dismissed by the Planning Inspector.

Finally, the Council removed their reason for refusal relating to regional targets before the previous Inquiry had even started. Mr Percy's request that the planning officers not rely upon regional planning policies is odd given that in the absence of regional renewable energy targets, we are left with National EU legally binding targets, which, as a country, we fall a long way short of achieving.

Yours Sincerely,

Ben Moore

Appendix A

Wind Turbine Syndrome (WTS)

An independent review of the state of knowledge about the
alleged health condition

Health and Safety Briefing

July 2010

RenewableUK is the leading renewable energy trade association in the UK. Wind has been the world's fastest-growing renewable energy source for the last seven years, and this trend is expected to continue with falling costs of wind energy and the urgent international need to tackle CO2 emissions to prevent climate change.

In 2004, RenewableUK expanded its mission to champion wave and tidal energy, and to use the Association's experience to guide these technologies along the same path to commercialisation.

Our primary purpose is to promote the use of wind, wave and tidal power in and around the UK. We act as a central point of information for our membership and as a lobbying group to promote wind energy and marine renewables to government, industry, the media and the public. We research and find solutions to current issues and generally act as the forum for the UK wind, wave and tidal industry, and have an annual turnover in excess of four million pounds.

Status of this document

Health and Safety briefings are intended as a basic overview of a particular technical, legal or policy issue relevant to the core membership base of RenewableUK. Briefings provide general Health and Safety information on the topic concerned, and where appropriate offer basic guidance about how the issues can be addressed. Health and Safety briefings will not normally be subject to regular review or updating, and so the accuracy of the briefing can only assumed to be relevant and up-to-date at the time of publication. Attention is also drawn to the disclaimer below.

Disclaimer

The contents of this briefing are intended for information and general guidance only, do not constitute advice, are not exhaustive and do not indicate any specific course of action. Detailed professional advice should be obtained before taking or refraining from action in relation to any of the contents of this briefing, or the relevance or applicability of the information herein.

RenewableUK

RenewableUK (formerly known as BWEA) is the UK's leading trade association representing the renewable energy sector.

RenewableUK has made a commitment to ensuring that Health and Safety, including public health and safety, is given top priority in the wind, wave and tidal industry. We recognise our responsibility to take a lead on Health and Safety matters as they directly relate to the risks particular to our sector. This briefing is in response to the profile and media attention given to the alleged condition known as Wind Turbine Syndrome (WTS) that developed towards the end of 2009.

RenewableUK's initial assessment of the alleged health condition was that it had no scientific basis and could not be supported by the available evidence. RenewableUK had received no independent reports on the condition or the alleged symptoms being cited. However, as a responsible trade body, we needed to be confident that we presented a fair, accurate and independent assessment of the issues involved. RenewableUK therefore instructed three independent experts to review the evidence available on WTS and present their conclusions.

This briefing sets out:

- the background presenting the context of the alleged condition;
- the scope of the reviews conducted;
- the executive summaries of the reviews; and
- a RenewableUK commentary on the issues involved.

Wind Turbine Syndrome – Background

RenewableUK has monitored the developing state of knowledge on a range of health and environment issues in recent years, which could be relevant to renewable energy generation and in particular wind turbines

“WTGs generate infrasound that directly causes a range of physical sensations”

Concerns that noise radiating from wind turbines could contain sufficiently high levels of low frequency energy that may pose a threat to human health have been subject to significant scientific and public debate for several years. However, the consistent and scientifically robust conclusion has always been that there is no independent evidence to demonstrate any significant health effects from noise at the levels of that generated by wind turbines.

Towards the end of 2009 a few high-profile media articles were published in response to the pre-publication of a book titled *Wind Turbine Syndrome*¹. This publication provided the industry with an opportunity to update its state of knowledge of the science concerned. The central premise of the book is that WTGs generate infrasound that directly causes a range of physical sensations (e.g. tinnitus, headaches etc.) and effects (e.g. sleeplessness, anxiety etc.).

The independent reviews conducted sought to determine if there is any robustness or efficacy in the science and aetiology² proposed.

Reviews

RenewableUK instructed three independent experts to carry out reviews of the issues, and this specifically included an assessment of the:

- suitability, efficacy and robustness of the research conducted by Dr Pierpont, with particular emphasis on the strength or otherwise of any cited causal links, and with reference to recognised statistical, analytical and epidemiological techniques applied;
- underlying scientific and acoustic principles being cited for infrasound/low frequency noise generated by wind turbines; and
- medical/audiological evidence that infrasound/low frequency noise from wind turbines is the probable cause of the alleged new health condition known as Wind Turbine Syndrome.

Summaries of the reviews conducted are overleaf³.

¹ Pierpont N., *Wind Turbine Syndrome – A Report on a Natural Experiment (pre-publication draft – June 2009)*, now published by K-Selected Books, Santa Fe, NM.

² The cause and origins of disease.

³ Copies of the full reports will be made available on request.

Executive Summaries

Expert Opinion 1: Evaluation of Scientific and Epidemiological Methodology

Author: Richard J.Q. McNally, BSc, MSc, DIC, PhD

Dr McNally is a Reader in Epidemiology at the Institute of Health and Society, Newcastle University. He has particular expertise in spatial epidemiology and the analysis of disease clusters and clustering and he has published extensively in internationally recognised peer review journals.

Scope of the review:

Dr McNally was instructed to provide:

- a summary of the basic methods carried out by Dr Pierpont;
- an assessment of the competence and independence of the author;
- commentary on the adequacy and reliability of the methods;
- an assessment on the validity, veracity and relevance of the cited case histories;
- commentary on the reliability of conclusions drawn by Dr Pierpont;
- an evaluation of the general quality and efficacy of the research performed; and
- analysis of the critical evidential and epidemiological gaps in the methodology performed.

Executive summary:

The overall objective of the report was to independently review the state of knowledge about the alleged health condition known as WTS. The specific aim was to critically evaluate the scientific and epidemiological methodology. In addition to carrying out the instruction above, Dr McNally critically evaluated each part of the report and specifically critically assessed the epidemiological and statistical methods.

“Dr Pierpont’s use of epidemiological and statistical methods is seriously flawed.”

Dr McNally's summary is presented below:

- Dr Pierpont's report is based on a highly selected small case series.
- She has defined the alleged WTS by a set of vague clinical symptoms (this approach is not an accepted technique for researching the causes of diseases – a precise a priori case definition is required).
- The method of comparison is invalid; she has no clear prior hypotheses.
- She has interviewed members of 10 highly selected families.
- She has used a structured questionnaire for her interviews, but the questionnaire is not included in the report.
- She has compared symptoms in cases before and after exposure to wind turbine noise. Dr Pierpont has looked for associations between symptoms of the alleged WTS and exposure to wind turbine noise.
- Dr Pierpont has repeatedly used simple chi-squared statistics to evaluate putative associations. These statistical techniques are not robust enough in this field – there is the problem of multiple testing resulting in incorrect p-values, and also the possibility of some associations being due to confounding.
- She has only reported selected results of the chi-squared analyses.
- Dr Pierpont has concluded that there is an association between certain symptoms and exposure to wind turbine noise.
- I do not find that Dr Pierpont has either the necessary independence or the relevant competence with regard to scientific approach or epidemiological analysis.
- Dr Pierpont's use of epidemiological and statistical methods is seriously flawed.
- Dr Pierpont's conclusions are completely unreliable.
- A high-quality epidemiological study should always include a range of experts including epidemiologists and biostatisticians. Dr Pierpont has attempted to conduct a study, by herself, and without including appropriate experts.

In conclusion, the positive findings are based on a flawed design and flawed analysis, and he would not recommend publication.

Expert Opinion 2: Infrasound and Low Frequency Sound from Wind Turbines and Wind Turbine Syndrome – an Assessment

Author: Geoff Leventhall, MSc, PhD, FinstP, HonFIOA

Dr Leventhall is an independent consultant in noise, vibration and acoustics. He specialises in low frequency noise, infrasound and vibration and has extensive experience in assessing the effects of wind turbine noise. He is an Honorary Fellow of the UK Institute of Acoustics and a former President of the Institute. He is also a Member of the Acoustical Society of America and a Distinguished International Member of the American Institute of Noise Control Engineering.

Scope of the review:

Dr Leventhall was instructed to provide:

- a simple description of the terms and terminology (infrasound/low frequency noise) and their application to wind turbines;
- a summary of the peer-reviewed evidence of infrasound/low frequency noise and wind turbines;
- discussion on the audibility and physiological response to infrasound/low frequency noise;
- a summary of the basic noise and acoustic principles cited by Dr Pierpont;
- an assessment of the validity of the scientific and acoustic evidence being presented by Dr Pierpont; and
- conclusions on the available state of knowledge about any significant acoustic effects from wind turbines.

Executive summary:

- The Wind Turbine Syndrome being cited is based on the assumption that infrasound from wind turbines upsets the balance systems in the body and deceives the body into thinking that it is moving, resulting in various distressing effects, which are collected together as the syndrome.

“Dr Pierpont makes the common mistake of taking a one-dimensional view of sound, considering only frequencies and ignoring the importance of levels.”

-
- A review of published measurements of infrasound from wind turbines shows the levels to be low and inaudible. However, Pierpont assumes that infrasound at 1–2Hz and at 4–8Hz is the cause of the effects she noted, incorrectly basing this on previous work on whole body vibration, which is not relevant to excitation by sound. She also bases her theories on work for the Apollo Space Program, when potential astronauts were exposed to very high levels of infrasound in the 120–140dB range, which is also not relevant to the inaudible infrasound from wind turbines.
 - Pierpont makes the common mistake of taking a one-dimensional view of sound, considering only frequencies and ignoring the importance of levels. A weakness of her work is the absence of decibel levels or threshold levels for the effects that she claims. This is a serious failing, as urban dwellers are exposed to similar levels of infrasound to that from wind turbines.
 - The results of her case studies are credible reports from the small group of people who responded to Pierpont's telephone interviews. However, the symptoms described have been known previously as due to stress effects, which arise in a few sensitive persons when exposed to an adverse element in their environment. There is no evidence that they are patho-physiological effects of wind turbine noise.
 - Complaints of wind turbine noise result mainly from audible aerodynamic modulation, typically in the 500Hz to 1,000Hz range. The effects of wind turbine noise are similar to the effects of other noises.

Expert Opinion 3: Effects of Low Frequency Noise from Wind Turbines on Humans

Author: Mark E. Lutman, PhD, BSc, MSc

Mark Lutman is Professor of Audiology at the University of Southampton. He has led internationally recognised research projects on the effects of noise on the auditory system and has published extensively in internationally recognised peer review journals in his field.

Scope of the review:

Dr Lutman was instructed to provide a review of:

- the patho-physiology being cited by Dr Pierpont, with specific reference to the physiological pathways and symptoms being cited;
- the clinical and audiological validity of the symptoms being cited, and the availability of evidence to support a link to low frequency noise;
- commentary on the robustness of the clinical methodology applied and the veracity of the conclusions being drawn; and
- conclusions as to the existence of any substantiated evidence to indicate the existence of the alleged condition known as WTS.

Executive summary:

- The review considered whether low frequency noise from wind turbines might cause adverse physiological effects on people living in proximity, within a mile or so. The review examines the contention put forward by Dr Pierpont that there is a specific and newly identified physiological syndrome (Wind Turbine Syndrome) that is directly related to low frequency wind turbine noise and mediated via the vestibular system.
- The relevant properties of sound and its impacts on the human auditory system are outlined and contrasted with the functioning of the human vestibular system, which is responsible for perceiving posture and motion. It is demonstrated how

“Responses to low frequency vibration only occur when the vibration is applied directly to the head, causing shaking.”

the auditory system is specialised for sound and the vestibular system is specialised for motion, showing that the vestibular system is extremely unresponsive to low frequency sound, undermining any connection between low frequency sound and the symptoms of Dr Pierpont's respondents.

- The mechanisms of noise generation from wind turbines are outlined, showing that they do not create material low frequency noise. Instead, they create broadband noise that is modulated at low frequencies, leading to the characteristic "swishing" sound. The argument that wind turbine noise causes physiological symptoms in humans through low frequency noise therefore fails.
- The evidence for response of the human vestibular system to acoustic stimulation is reviewed and it is shown that such responses only occur for high intensities of sound, much greater than created by wind turbines. Responses to low frequency vibration only occur when the vibration is applied directly to the head, causing shaking. These findings further indicate that noise from wind turbines cannot contribute to the symptoms reported by Dr Pierpont's respondents, by the mechanism that she proposes.

The most-likely explanation for the reported symptoms, which are probably exceedingly rare, is a psychological reaction to the intrusion of wind farms, with consequent somatic (felt in the body) effects mediated by stress and anxiety.

RenewableUK Commentary

RenewableUK is committed to understanding all relevant technical and scientific evidence about potential health risks connected to the industry.

Experience has demonstrated that the reputation of and confidence in an industry can only be earned through open and honest debate on the issues concerned, based on the most reliable and up-to-date information available. As a responsible industry it is appropriate to consider societal concerns (actual and perceived) about a given technology, such as wind turbines. However, judgements and conclusions about what risks are acceptable must be evidence led.

The independent reviews on the alleged condition known as Wind Turbine Syndrome, summarised above, represent a robust and reliable state of knowledge on the issues involved. The experts conclude that:

- the scientific and epidemiological methodology and conclusions drawn are fundamentally flawed;
- the scientific and audiological assumptions presented by Dr Pierpont relating infrasound to WTS are wrong; and
- noise from wind turbines cannot contribute to the symptoms reported by Dr Pierpont's respondents by the mechanisms proposed.

These conclusions are further reinforced by two recently published independent reports.

The publication *Wind Turbine Sound and Health Effects – An Expert Panel Review 2009* ⁴ involves an extensive review, analysis and discussion of the large body of peer-reviewed literature on sound and health effects in general, and on sound produced by wind turbines. The principle conclusions drawn by this expert panel are:

- there is no evidence that the audible or sub-audible sounds emitted by wind turbines have any direct adverse physiological effects;
- the ground-borne vibrations from wind turbines are too weak to be detected by, or to affect, humans; and
- the sounds emitted by wind turbines are not unique. There is no reason to believe, based on the levels and frequencies of the sounds and the panel's experience with sound exposures in occupational settings, that the sounds from wind turbines could plausibly have direct adverse health consequences.

“There is no reason to believe that the sounds from wind turbines could plausibly have direct adverse health consequences.”

The Health Protection Agency (HPA) publication *Health Effects of Exposure to Ultrasound and Infrasound – Report of the Independent Advisory Group in Non-Ionising Radiation 2010*⁵ is another key source of information.

This comprehensive report presents a robust and expert state of knowledge on the health effects of ultrasound and infrasound. The most significant conclusion it presents relevant to the wind sector is that "...there is no consistent evidence of any physiological or behavioural effect of acute exposure to infrasound in humans".

All wind turbines will generate both mechanical and aerodynamic noise and vibration. Mechanical noise is not typically a significant source of noise for modern wind turbines. Aerodynamic noise will arise at all frequencies, from the infrasound range over low frequency sound to the normal audible range, and is the dominant source. Whilst wind turbines are a source of noise and vibration, any residual risks can be effectively mitigated by technical or organisational means.

Advice to industry:

RenewableUK recommends that a proactive approach be taken by the industry in addressing what is a complex and emotive subject. Whilst there is no scientific evidence that wind turbines have any patho-physiological health effects, it is important to understand that certain individuals and interested parties may, despite this evidence, perceive that health effects remain. Although it is difficult to counter these views, the industry can still take a number of actions that can assist in alleviating some or all of these concerns. Examples RenewableUK would encourage the industry to consider include:

Consultation

- Early dialogue and communication with the public and key stakeholders on any proposed development;
- Recognising and understanding that lay perceptions of health risks are valid and should be taken into account.

Planning

- Ensuring environmental impact assessments include a robust evaluation of the noise and vibration risks of the project;
- Taking specific account of any sensitive receptors (e.g. local residents) that may have concerns particular to the project.

Design

- Ensuring the design of the turbine, and where appropriate the wind farm, takes account of the relevant project and environmental issues concerned;
- Ensuring that suitable mitigation measures are considered following completion of risk assessment to address any residual risks where they exist.

Monitoring

- Ensuring a regular programme of environmental noise measurements are performed;
- Ensuring, post consent, that there is regular community engagement, and there are mechanisms in place to address any general or specific concerns relating to noise and related issues.

In the vast majority of cases the above summary merely reflects what is existing good practice operated by developers and operators throughout the UK.

4 Prepared for American Wind Energy Association and Canadian Wind Energy Association (http://www.awea.org/newsroom/releases/AWEA_CanWEA_SoundWhitePaper_12-11-09.pdf),
5 <http://www.hpa.org.uk/Publications/Radiation/DocumentsOfTheHPA/RCE14HealthEffectsofExposuretoUltrasouRCE14/>.

Appendix B

This snapshot taken on **03/07/2009**, shows web content selected for preservation by The National Archives. External links, forms and search boxes may not work in archived websites.

Find out more about web archiving at The National Archives

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Onshore Wind: Shadow Flicker

- [What is shadow flicker?](#)
- [Why does shadow flicker occur?](#)
- [What are the effects of shadow flicker?](#)
- [When does shadow flicker reduce?](#)
- [SDC Report](#)

What is shadow flicker?

The rotating wind turbine blades can cast moving shadows that cause a flickering effect and can affect residents living nearby. Similarly, gloss surface blades flash when they rotate. Although this effect is not seen as an issue in the US, it has been subject to analysis, especially in northern Europe (source: Gipe, 1995).

Why does shadow flicker occur?

Shadow flicker occurs when a particular combination of conditions coincide in specific locations at particular times of the day and year. It happens when the sun is low in the sky and shines on a building from behind a turbine rotor. This can cause the shadow of the turbine blades to be cast onto the building, which appears to flick on and off as the turbine rotates. When this flicking shadow is viewed through a narrow opening it is known as shadow flicker. Developers can calculate the extent of this effect using the geometry of the machine and the latitude of the potential site. Shadow flicker only occurs in relative proximity to sites and has only been recorded occasionally at one site in the UK.

What are the effects of shadow flicker?

Scientists agree that the frequencies that produce disturbance and nuisance to people lie above 2.5 hertz. This is true both of the general population and of the 2 per cent who suffer from epilepsy, 5 per cent of whom have exhibited an adverse reaction to flicker effects above 2.5 to 3 hertz. This is well above the maximum frequency effect from turbines, which is usually under 1 hertz, and is therefore well below that considered to be the cause of nuisance.

If a person is stationary in a building, for example, shadow flicker can result in a momentary reduction of the intensity of natural light. If the regular changes in light intensity levels are high, then the shadow flicker may cause a nuisance.

The distance between a wind turbine and a potential shadow flicker receptor affects the intensity of the shadows cast by the blades, and therefore the intensity of flickering. Shadows cast close to a turbine will be more intense, distinct and 'focused'. This is because a greater proportion of the sun's disc is intermittently blocked. Similarly, flickering is more intense if created by the area of a blade closer to the root and further from the tip.

When does shadow flicker reduce?

A shadow's intensity falls with increasing separation distance non-linearly, and more rapidly at first, while the human response to light levels is also non-linear. For example, during a solar eclipse or at sunset, a large proportion of the sun must be blocked before a perceptible change in light level occurs. This further reduces the perception of shadow flicker.

At a distance of 10 rotor diameters (equivalent to 400 to 800 metres) a person should not perceive a wind turbine to be chopping through sunlight, but rather as an object with the sun behind it. This limits the zone of potential shadow flicker and normally there are no habitable buildings in these zones.

SDC Report

[The Sustainable Development Commission \(SDC\): Wind Power in the UK report](#) was launched in May 2005. Full details of their findings on shadow flicker can be viewed in this report.

Appendix C

12 November 2004

SCOUT MOOR WIND FARM - WRITTEN STATEMENT BY PROFESSOR GRAHAM HARDING
(Curriculum Vitae attached)

Shadow Flicker

I have considered various matters, including the extract from the Environmental Statement re Shadow Flicker and the Supplementary Environmental information re Shadow Flicker.

I have considered this information with regard to the health problems posed by Photosensitive Epilepsy and also by Glare and Flicker-induced migraine. Photosensitive Epilepsy is a relatively rare condition affecting approximately 1:4000 of the population (Harding & Harding 1999). The incidence of new cases is 1.1 per 100,000 of the general population per annum.

Photosensitive epilepsy is clearly related both to intensity of light and the rate of flashing. The most provocative flash rates are between 13 and 21 flashes per second (fps) (Harding & Harding 1999). In the case of the Scout Moor turbines the rate of shadow flicker from each turbine is less than 1 fps (flash per second).

To set this in context the television broadcast industry in the UK is restricted to a flash rate of 3 fps or less (Harding & Harding 1999). Similarly the Health and Safety Executive Guidelines restrict flashing by "disco lights" or strobe lighting to 4 fps or less (Health & Safety Executive LAC 51/1).

From the above it can be deduced that the risk from shadow flicker from a single turbine is significantly less than watching television or attending a pop concert.

Consideration has to be given to the possibility that two or more turbines may be placed between the sun and an adjacent dwelling. Under these circumstances the potential flicker rate at worst would be less than 2 fps (2 turbines) or 3 fps (3 turbines). Moreover, the spacing between turbines is between 300 to 400 metres. Since the distance at which shadow flicker may be noticeable in a building is around 800 metres or less, the separation of the turbines and the distance from any dwelling mean that any effect from the second and third turbine would be minimal. It should also be understood that the turbines produce "dark flicker" that is, that the period of light is at least six times that of the dark period. Such a mark-space cycle mimics that in nature where walking past trees may interrupt the sun at a low frequency. Stroboscopes typically have a short mark to space ratio (short light period followed by long dark period) and even television has a mark to space ratio of 1:1.

For people walking within or around the wind farm site there would also not be any material risk. In order to provoke a seizure the flickering stimulus (typically at 16 - 20 fps) must involve the central 10 degrees of vision. Although peripheral flicker is

noticeable it is not provocative as it does not involve a sufficient number of neural units in the visual cortex. Given the height of the turbines it is in any event unlikely that a person would be able to position themselves so that three turbines would be in line between them and the sun with the visual angle of the second and third turbine large enough to involve sufficient of the central 10 degrees of vision and therefore the cortex, to precipitate a seizure. Even in these exceptional circumstances the risk would be less than attending a pop concert.

It should be realised that no stimuli causes photosensitive epilepsy. A small proportion of the population are photosensitive and the stimulus only precipitates a seizure.

Glare and flicker induced migraine has been less studied than photosensitive epilepsy. However, all available evidence indicates that it is only in their response to high flash rates (20 fps and above) that the brain's response of people with this condition differs from the normal. Given that the flicker produced by turbines is dark flicker the risk of inducing a migraine attack is probably no greater than that present in a natural environment in bright sunlight.

Conclusion

The risk of photosensitive seizures being precipitated by turbines of the configuration at Scout Moor is extremely low and well below that accepted in both national and international TV broadcast guidelines and the Guidance for public events. The risk for glare and flicker induced migraine is similarly extremely low.

Declaration

I understand that my duty in writing this report is to refer to matters within my expertise. I understand that this duty overrides any obligation to the person from whom I have received instructions or by whom I am paid.

To the best of my knowledge I believe the facts I have stated are true.

G F A Harding, DSc, PhD, BSc, Hon MRCP, FBPoS, CPsychol
Emeritus Professor of Clinical Neurophysiology, Aston University
Consultant Clinical Neurophysiologist, Royal Wolverhampton Hospitals Trust
Honorary Senior Research Fellow, The Medical School, University of Birmingham

References

Harding GFA & Harding PF (1999). Televised material and photosensitive epilepsy. *Epilepsia* 40 (Suppl 4) 65 - 69.

Health & Safety Executive (2000). Disco Lights and Flicker Sensitive Epilepsy. Local Authority Circular: LAC 51/1. November 2000.

CV – General

Professor Graham Harding graduated in psychology from University College in London, in 1961. He obtained a PhD in EEGs and Psychiatry from Birmingham University. He joined the Aston University in Birmingham in the same year and in the following year established the Neuropsychology Unit. He was its first Head when the Unit was formally recognised by the Council of the University. In 1978 he transferred the Unit (now the Clinical Neurophysiology Unit) to the Department of Ophthalmic Optics when he was appointed to the Chair of Clinical Neurophysiology in that Department. From 1980 to 1989 he headed the department, changing its name to the Department of Vision Sciences. He obtained a DSc from the University of Aston. He then formed the Neurosciences Research Institute from Vision Sciences Dept, and the Psychology Dept. He was the Institute's first Director until he retired in 2002. In 1998 he was elected to Honorary Membership of the Royal College of Physicians, for outstanding contributions to medicine.

Concurrent with his University appointments he has held many consultant posts in the NHS, as Consultant Clinical Neurophysiologist to Birmingham Childrens' Hospital, Birmingham and Midlands Eye Hospital, All Saints Hospital, Dudley Road Hospital, and the Royal Wolverhampton NHS Hospitals Trust. He is also Senior Research Fellow at the Medical School, Birmingham University.

He has graduated 45 PhD and MD students. He has more than 350 publications in the field of electroencephalography and visual evoked potentials. He was President of the British Society for Clinical Neurophysiology, is a Fellow of the British Psychological Society and a Chartered Psychologist and is Secretary of the International Federation of Clinical Neurophysiology. He was Vice-President of the International Society for Clinical Electrophysiology of Vision. He has delivered numerous international named and invited lectures.

One of his special areas of interest is photosensitive epilepsy, a subject on which he has published two books and many papers. He has also carried out the largest study

of a photosensitive population in the world. Many of these studies have been carried on over a period of 35 years. He is the consultant adviser to the British Broadcasting Corporation on problems of photosensitivity and televised material and drafted the original Independent Television Commission guidelines, preventing transmission of provocative material for photosensitive individuals. With the Japanese Pokemon incident, in which 560 people had seizures, he was immediately contacted by the Japanese Government, and drafted the guidelines for the Commercial Broadcasters Association of Japan, and NHK (Public Broadcasting Corporation). He delivered the keynote lecture at the 'International Forum on Influences of TV Images on Humans' in April 2003 in Japan. In 2004 he delivered the keynote lecture at a government-sponsored workshop and helped draft new guidelines for the broadcast and video-game industry of the USA. He has appeared on numerous television programmes about photosensitive epilepsy in many countries of the world.

He was one of the first authors to study the effects of anti-convulsant and other drugs on vision, and as Director of both the ElectroDiagnostic Centre Ltd and the Visual Diagnostics Centre Ltd, he continues to carry out many studies for a number of drug companies and government departments.

From: "Ben Moore" <bmoore@ridgewind.com>
To: "Mark Simmonds" <Mark.Simmonds@northlincs.gov.uk>
Date: Monday, January 17, 2011 02:34PM
Subject: RE: Response to letters of comment

Hi Mark,

Yes, I have drafted both and am awaiting feedback from the lawyers, but hope to give you a response on both by close today.

Ben Moore | RidgeWind Ltd | office 01993 832 511 | mobile 07958 722255

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From: Mark Simmonds [mailto:Mark.Simmonds@northlincs.gov.uk]
Sent: 17 January 2011 14:32
To: Ben Moore
Subject: Re: Response to letters of comment

Hi Ben,

are you sending a separate email to confirm the position regarding the mitigation in place for the Glathorne family and the confirmation that Ridgewind would not object to a condition prohibiting the building of the turbine nearest to Burton?

Thanks,

Mark Simmonds

North Lincolnshire Council

-----"Ben Moore" <bmoore@ridgewind.com> wrote: -----

To: <Mark.Simmonds@northlincs.gov.uk>
From: "Ben Moore" <bmoore@ridgewind.com>
Date: 14/01/2011 04:16PM
Subject: Response to letters of comment

Dear Mark,

Please see letter of response to comments on the application.

Best Regards,

Ben Moore | RidgeWind Ltd | office 01993 832 511 | mobile 07958 722255

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