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Application of policy by local authorities to wind turbine noise applications in England.

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Abstract

With ETSU-R-97 facing calls for its revision, assessment methodologies constantly evolving, and seemingly contradictory planning appeal decisions, Planning Authorities in England have a difficult task when reviewing new applications for wind turbine sites to ensure their adequacy. Most applications are subject to the Environmental Impact Assessment (EIA) procedures transposed into UK legislation as required by Council Directive 85/337/EEC, which requires a thorough assessment of the impacts of a scheme. However, despite Planning Guidance PPS22 in England appearing to give a clear steer to Local Authorities on what level of impact is acceptable, there is variability in how this has been applied. This paper, based on the authors' recent experience of providing advice to Local Authorities, will review the latest information on the key issues, the available options applicants have to provide an adequate assessment, and how Local Authorities are currently ensuring that they are up to date with the latest developments in wind farm noise assessment. In this respect the issues surrounding a consistent and robust approach to the review of noise chapters and other supporting documentation is considered, including how decision makers can deal with the various uncertainties inherent in the assessment methodology.

Introduction

The noise associated with wind turbines is one of the main issues associated with any application for a wind turbine installation. Most application sites tend to be in remote and sparsely populated areas, many of which are accustomed to lower ambient noise levels than those found in urban areas. Managing the expectations and fears of the residents adjacent to new sites has become a significant and challenging part of the planning application process for both developers, and decision makers.

This paper, explores the various factors that need to be considered, the current issues being raised, and what could be done to improve the planning process to adequately deal with these issues.

National and Local Planning Policy

Most wind farm applications and even some single turbine applications are subject to the Environmental Impact Assessment (EIA) procedures transposed into UK legislation as required by Council Directive 85/337/EEC [1], which requires a thorough assessment of the impacts of a scheme. Planning Guidance in England, Planning Policy Statement (PPS) 22: Renewable Energy [2] appears to provide a clear steer towards the method of assessment i.e. The Assessment and Rating of Noise from Wind Farms (ETSU-R-97) [3]. However, what the PPS actually states is *'Local planning authorities should ensure that renewable energy developments have been located and designed in such a way to minimise increases in ambient noise levels. Plans may include criteria that set out the minimum separation distances between different types of renewable energy projects and existing developments. The 1997 report by ETSU for the Department of Trade and Industry should be used to assess and rate noise from wind energy development'.*

The Companion Guide to the PPS expands on this; *'The Assessment and Rating of Noise from Wind Farms (ETSU-R-97), describes a framework for the measurement of wind farm noise and gives indicative noise levels calculated to offer a reasonable degree of protection to wind farm neighbours, without placing unreasonable restrictions on wind farm development or adding unduly to the costs and administrative burdens on wind farm developers or planning authorities. The report presents the findings of a cross-interest Noise Working Group and makes a series of recommendations that can be regarded as relevant guidance on good practice. This methodology overcomes some of the disadvantages of BS 4142 [4] when assessing the noise effects of wind farms, and should be used by planning authorities when assessing and rating noise from wind energy developments'*. Accordingly, it is apparent that the ETSU-R-97 methodology is not the one and only hurdle that has to be jumped, rather that it is part of the toolkit for assessment which will provide a decision maker with a balanced view as to the significance of any noise impacts.

The Assessment Process

The current assessment process involves a number of activities which can broadly be categorised into the following stages:

- The collection of field data (background noise, wind speed / direction, rain, etc.);
- The derivation of appropriate noise limits for the wind farm;
- The calculation of turbine noise levels at the neighbouring receptors; and
- The demonstration of compliance with the noise limits.

Each of these stages must be robustly completed before the impact of the scheme can be assessed in conjunction with other environmental impacts such as landscape/visual and shadow flicker. The key issues relating to the four stages are further considered in this paper.

Applicants Background Noise Data

With the current prescribed method of deriving noise limits for a wind farm scheme relative to the background noise, the first part of any assessment is to obtain a representative sample of noise data. This is no different to any other application for an industrial noise source, other than the data set must be of sufficient size to account for wind speed, rain and anomalous conditions, the latter two variables acting to reduce the sample size.

The data is normally collected using unattended measurements, and is therefore subject to the vagaries of this data collection method, which are well documented. It has become standard practice to agree the choice of locations with the local authority both in terms of which properties are used, and the exact positioning of the equipment at each property. If this is not achieved, then a robust justification of the positions chosen would be expected. The ability to get permission to use the most ideal measurement locations is not without its problems, despite the fact that the closest residential receptors would be best advised to participate to ensure that their circumstances are adequately taken account of.

To make the sample size robust, applicants must be flexible to increase the length of the survey to ensure that wind speed is adequately covered, and a sufficient sample size is achieved once rain and anomalous data has been removed. ETSU-R-97 suggests that a week's worth of data is required, however in reality with the British weather the process may take at least two weeks and in some cases as much as four weeks. Occasionally there are sites that are subject to large seasonal variances in background noise. In these cases, it might be expected to have more than one site survey, depending on their size and the amount to which the seasonal variance is thought to influence the background noise levels at the surrounding properties.

Applicants Wind Data

The noise output from a wind turbine varies with wind speed, which is the main difference between these and other industrial noise sources. Applicants must therefore take account of the various wind speeds and directions to ensure that the data provides a typical representation of the range of wind speeds and directions prevalent at the site. This is particularly important if there is a significant noise source impacting on the neighbouring receptors such as industrial plant or a major road.

The calculation of the wind speed is a topical issue at present. The noise assessment is concerned with the actual noise output at any given time, so the ability to predict the noise output is paramount to this process. Wind speed data is described in terms of a "standardised" 10m height, but this is a calculated wind speed based on a hub height measurement corrected with a standard formula. This is not the same as a 10m measured wind speed. The larger the turbine, the more important the wind shear factor becomes. Wind shear is site specific, and therefore it is current practice for Applicants to take account of this in their submittals. However, as there is more than one method of doing this, applicants are encouraged to justify the approach taken.

Derivation of ETSU-R-97 Limits

Following the data collection process, data should be analysed, any rain affected and anomalous data removed, and the background noise correlated with wind speed for each receptor. There will be a spread of data at each wind speed, and a best fit 2nd or 3rd order polynomial is required to define the typical background noise level. There are many opponents of this approach, but it is the prescribed ETSU-R-97 method. Clearly failure to adequately site the measurement locations, or remove rain affected or anomalous data can artificially raise the best fit curve, and thereby increase the permissible noise levels. Applicants are expected to adequately describe the corrections made to the data, and in many cases provide the complete data set and analysis to the local authority or third parties for peer review.

The ETSU-R-97 noise limit is based on a lower fixed limit or the background +5 dB, whichever is higher. The lower fixed limit is in the range of 35-40 dB $L_{A90,10min}$ for daytime, and 43 $L_{A90,10min}$ at night. The choice of the site specific lower fixed limit should be fully justified by the applicant. ETSU-R-97 justifies the higher limit at night as protecting internal space, whereas the daytime limit is to protect external spaces. This issue is keenly contested at every Public Inquiry as being out of step with current guidance on health effects (World Health Organisation 'Night Noise Guidelines for Europe' 2009 [5]), although this guidance has yet to be adopted in the UK. It has been known for Local Authorities to apply a better standard than ETSU-R-97 recommends at night time, where the daytime limit forms the constraining limit for the site.

Calculation of turbine noise

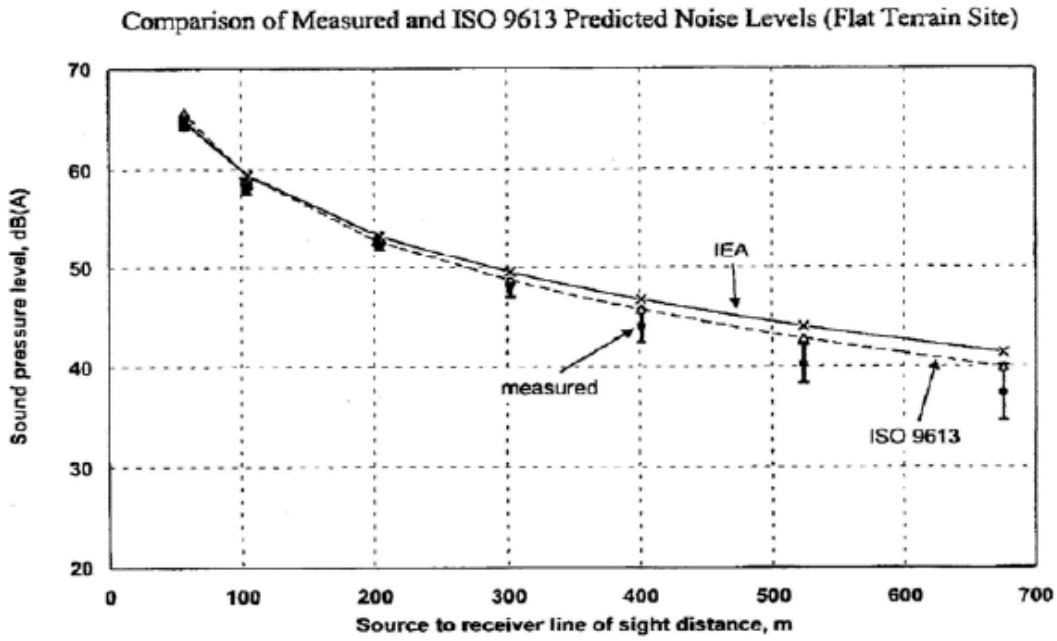
The calculation methodology is not prescribed in ETSU-R-97; in fact ETSU is entirely silent on the matter of prediction methodology. It is usual practice in the UK for the noise modelling for a site to implement the procedures within ISO 9613-2:1996, 'Acoustics – Attenuation of sound during propagation outdoors, Part 2: General method of calculation' [6]. However it is generally acknowledged that wind direction and speed has a major effect on sound propagation; it can increase sound levels downwind of a source by 5-10 dB, and reduce them upwind of a source by up to 12 dB, compared with still air conditions.

ISO 9613 has to date only been extensively validated against typical downwind conditions, where noise levels are slightly elevated relative to still air. Consequently the modelling of noise from the wind turbines may not fully take into account wind speed and direction, or other meteorological effects such as temperature inversions. However it should be noted that this approach is in common with that adopted for most wind farm Environmental Statements (ES) and although ETSU-R-97 is silent on the issue of noise prediction, later ETSU research indicates that ISO 9613 is an appropriate methodology.

An article appeared recently in the March/April 2009 publication 'Acoustics Bulletin' published by the UK Institute of Acoustics titled 'Prediction and Assessment of Wind Turbine Noise' [7]. Written by a number of recognised practitioners in the field of wind farm noise, they indicated that ISO 9613 is now routinely being agreed in Statements of Common Ground at Public Inquiries as the preferred prediction methodology.

Elsewhere, ETSU commissioned other research 'A Critical Appraisal of Wind Farm Noise Propagation' (ETSU W/13/00385/REP) [8]. The appraisal utilised measurements of noise over distances up to about 700 metres and compared the results against a number of noise prediction methods. Of particular interest is the comparison of results over flat terrain sites, which is illustrated in **Figure 1** below. It can be seen that under those measurement circumstances ISO 9613 is consistently over-predicting noise levels at distance and as such could be considered to provide a precautionary approach.

Figure 1



Compliance with noise limits

When comparing the predicted turbine noise levels against the derived ETSU-R-97 noise limits, the greatest concern invariably occurs where the 'headroom' between the predicted noise levels and the derived noise limits are relatively small (i.e. <2-3 dB(A)). This means that any uncertainties which arise in the assessment methodology could in practice result in an exceedance of the limits. The following factors are considered to be important:

- Measured noise levels and seasonality effects
- Measurement location
- The prediction methodology
- The wind shear effect

The important issue is to understand how these points can be taken into account such that there is greater certainty in determining the acceptability of noise from wind farms. Whilst the measurement location and measured noise levels can reasonably be taken into account and agreed with the planning authorities at an early stage,

such that these specific issues do not need to be contentious, it is invariably impossible to reach a similar position with the 'third party objectors' who often are unwilling to reach such an agreement or have only reached some status level late in the day.

The prediction methodology is often criticised by objectors and their noise consultant as not providing realistic predictions of noise under all circumstances. Of course, the same could be said for most prediction methodologies where noise levels need to be predicted at relatively large distances. What is important to understand is whether the generality of the noise predictions will be so wrong as to illicit a different response from the public in respect of wind turbine noise levels experienced over a relatively long period of exposure. On balance would the existing methodology result in an appropriate planning decision which protects the amenity of the public?

Common Issues

A number of other issues are regularly raised as objections to wind farm assessments. These include low frequency noise, wind turbine syndrome, amplitude modulation and wind shear.

It is now considered by most experts that low frequency noise is well below perceptible levels, and the case for wind turbine syndrome has yet to be proven. Amplitude Modulation was examined in a Defra study by Salford University in 2007 [9]. The study concluded that it is not yet fully understood, and not widely prevalent at the time. Further research is currently underway funded by the Renewable Energy Foundation [10].

The wind shear effect was for a very long time ignored in ES noise assessments until research carried out by G P van den Berg on the 'Effects of the wind profile at night on wind turbine noise' [11] appeared to indicate that at night, noise levels may be 15 dB higher than are caused by the same reference wind speed during the daytime period when measured at a 10 metre height. This is the so-called 'wind shear effect' when a higher rotational speed of the turbine results in higher emitted noise levels received at the receptor.

Those aspects of wind shear which have most recently concerned those involved with the prediction of noise from wind turbines are now usually dealt with using the methodology described in the agreement advocated in the March/April 2009 publication of the IOA Acoustics Bulletin. In this respect that particular methodology is implementing what is presently considered to be good practice. However, Planning Appeal Decisions have variously swayed both ways as to the applicability of the methodology which provides even more uncertainty in how best to carry out an 'appropriate assessment'.

The IOA article method for calculating wind shear has also been interpreted in some areas as being the only applicable method, a daunting prospect for the small developer looking to install a smaller scale wind turbine on a budget. Alternative

methods to account for wind shear are acceptable and more work in this area is required if there is to be a wider uptake of the 'Feed- in-Tariff' scheme[1].

Discussion and Recommendations

It is clear from the number of wind farm applications that go to Public Inquiries, and the issues examined in evidence that clearer guidance is required for all Stakeholders involved in bringing forward wind farm projects on the various issues discussed above, and a clear unambiguous assessment framework established.

Whether this can be achieved with the current ETSU-R-97 guidance is debatable, especially when the document mixes Government Policy (the "noise limits"/guidance) with the assessment methodology, but remains silent on the propagation method.

Noise Policy decisions for other sources such as roads, rail and industry draw on dose response relationships between noise level and annoyance to estimate the percentage of population annoyed. Studies to establish a dose response relationship for wind farms have been undertaken in other European countries [12], but have not yet been attempted in the UK. There is anecdotal evidence to suggest that wind farm noise may well cause annoyance to give rise to indirect health effects. This has yet to be conclusively proven. As a result, the UK Government has currently concluded that there is insufficient evidence on which to base a review of the ETSU-R-97 methodology, but is keeping the issue under review, although the Department of Energy & Climate Change (DECC) did commission research on how ETSU-R-97 was being used for wind farm noise assessments.

On a positive note, the time spent discussing noise issues in Public Inquiries does suggest that the noise impact of schemes is being given a thorough examination, the adverse noise impacts of schemes are being considered in relation to the wider economic benefits of renewable energy, and the methodologies being adopted by Stakeholders are evolving to improve noise impact predictions and assessments for future schemes. However, in such a dynamic environment, it is difficult for local authorities to keep up to date with the latest developments.

Often forgotten in the process is informing the nearest wind farm neighbours of the potential impacts of a scheme in a timely and informative manner to allay their fears, and to manage expectations. Early wind farm schemes are reported to have been guilty of insisting that wind turbines are not noisy. The general public is more aware of noise issues than they were a decade ago, and anti-wind farm lobby groups are now well organised and very active.

Conclusions

There are many issues that require attention in the assessment of noise impact from a wind farm to ensure that a robust application has been made by a developer. Local authorities are advised to keep abreast of the latest developments, and to engage with developers at an early stage in the application process.

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[1] The Department of Energy and Climate Change (DECC) has used powers in the Energy Act 2008 to introduce a system of feed-in tariffs to incentivise small scale (less than 5MW), low carbon electricity generation.

References

[1] European Commission, *85/337/EEC - Council Directive of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment*, Journal NO. L 175, 05/07/1985 P. 0040 - 0048

[2] Office of the Deputy Prime Minister, *Planning Policy Statement (PPS) 22: Renewable Energy*, 2004

[3] Department of Trade and Industry, *ETSU-R-97 - The Assessment and Rating of Noise from Wind Farms*, 1996

[4] British Standard, *BS 4142:1997 – Method for rating industrial noise affecting mixed residential and industrial areas*, 1997

[5] World Health Organisation, *Night Noise Guidelines for Europe*, 2009

[6] International Organization for Standardization, *ISO 9613-2:1996 Acoustics -- Attenuation of sound during propagation outdoors --Part 2: General method of calculation*, 1996

[7] Institute of Acoustics, *Prediction and Assessment of Wind Turbine Noise*, Acoustics Bulletin, March/April 2009

[8] Department of Trade and Industry, *ETSU W/13/00385/REP - A Critical Appraisal of Wind Farm Noise Propagation*, 2000

[9] DEFRA, *Research into Aerodynamic Modulation of Wind Turbines (NANR 233)*, 2007

[10] Renewable Energy Foundation, http://www.ref.org.uk/press-releases, 2011

[11] G P van den Berg, *Effects of the wind profile at night on wind turbine noise*, Journal of Sound and Vibration, Vol 277, Issues 4-5, Nov 2005, Pages 955-970

[12] E Pederson, *Response to noise from modern wind farms in the Netherlands*, J. Acost. Soc. Am., Vol 126 Issue 2, Aug 2009