Case Study theme 11 – Dealing with noise issues

The main barrier

In 1996 the European Commission published a Green Paper on Future Noise Policy which was the first step in the development of a policy which sought to ensure that no person should be exposed to noise levels which endanger health and quality of life. This was in response to a recognition that environmental noise, from traffic, industrial and recreational activities is a significant problem in Europe and that there is a link between environmental noise and public health. At an EU level Member States are obliged to comply with the Environmental Noise Directive (END) (EU, 2002) Directive 2002/49/EC. In 2009 the World Health Organisation (WHO) European Region published Night Guidelines for Noise in Europe.

Wind farms, both onshore and offshore, can give rise to noise during their construction and maintenance, from the devices themselves during their operation, or from associated infrastructure such as transmission lines. Steps therefore need to be taken to ensure minimisation of such noise.

Case study purpose

The purpose of the case study is to examine the significance of noise issues related to wind farms, both onshore and offshore, and to indicate by the use of examples of both good and bad practice how such issues can be ameliorated.

Case study research methodology

The case study was based on a desk review of the available literature, together with consideration of specific examples and the elaboration of lessons learned from good and bad practice.

Key issues identified

The principal factors to be considered in relation to noise from onshore wind farms are:-

- siting of wind farms in relation to residential and other areas of human activity;
- distance of wind farms from areas of human activity;
- size and type of turbine;
- level of background noise;
- nature of the area in which a wind farm is sited, e.g. urban, rural or maritime; and
- monitoring of noise from wind farms during operational phases.

For the present purposes it may be considered that noise deriving from the construction phases of onshore wind farm development is a temporary phenomenon which can be limited by application of controls such as conditions of hours of work and are similar to the establishment of other engineering operations. Although there may be some noise issues arising from infrastructure associated with onshore wind farms, notably transmission lines, it may be considered that such issues are relatively minor in scale and annoyance and to some extent can be ameliorated by sympathetic design and siting of such infrastructure. The principal factors to be considered in relation to noise from offshore wind farms relate more particularly to the potential effects on marine, rather than human life forms and especially from low frequency emissions. A report produced in 2010 for the European Commission set threshold levels for underwater noise above ambient levels which might affect deployment of marine turbines. Baseline data and research is required as well as modelling and monitoring of noise from offshore wind farms and their potential harmful effects on the marine environment. Much work in this area is underway in UK and Danish waters and is/will be available through the COWRIE and DEA websites. However, it should be noted that the construction phase for offshore wind farms may also give rise to potential harmful effects; see also here, particularly on mammals, from noise, for example from pile driving.

Wind turbines generate noise essentially from two sources, firstly, from a gearbox and generator typically housed within a nacelle mounted on top of a tower; and secondly, aerodynamic noise from the turbine blades. Leaving aside micro-generation, there has been a significant trend over the past 10 years towards larger turbines with most turbines now having towers of 25 to 100m, rotating variably at 5-20 rpm in relation to wind speed and rated between 500 kW and 3MW. Turbines with larger outputs, in particular for offshore applications are in development. Advances in design have allowed greater sound insulation of the mechanical components within nacelles and gearless turbines are also becoming more common,

thereby reducing sound emissions. A further factor to be considered is trend towards the replacement of smaller, older, turbines with larger newer models, whereby consideration has to be given to the relation between the total output from a wind farm as against the number of actual turbines present.

Industry norms show that a typical single wind turbine will produce a sound pressure level of 50-60 dB(A) at a distance of 40m from the turbine, decreasing to 35-45 dB(A) at a distance of 350m. To put this in context the latter range is equivalent to the rustling of leaves in a gentle breeze. However, there is evidence from surveys, notably in Northern Europe, that some people perceive noise from wind farms to be annoying, and demonstrably more than that from other sources of the same sound pressure level. It has also been shown that there is a correlation between annoyance caused by the flicker effect created by turbine blades and noise from turbines. These perceptions are compounded by other factors such as multiple turbines where noise may be increased incrementally and the fact that wind capture is often higher at night than in daytime. Furthermore, it has to be recognised that wind farms when in operation generate constant, rather than intermittent, noise.

Whereas noise can be shown to drop away significantly with distance from turbines, account has to be taken of the fact that onshore wind farms are frequently located in remote and isolated rural areas where background noise levels are low. In addition, onshore wind farm sites are often chosen in high ridge type locations where the resultant sound may filter down into the surrounding lower areas, which may be inhabited. Care should also be taken with the detailed siting of individual turbines within a wind farm to minimise possible increased cumulative noise generation. At the same time it may be observed that there is a relation between wind speed and sound generated by turbines; over a certain level the prevailing wind conditions may generate noise other than from turbines themselves.

Overall there is little or no evidence of direct adverse effects on human health from noise generated by wind farms. There is some evidence that wind farms can generate infrasound and low frequency sound and amplitude modulation, (AM), of aerodynamic noise, which can be detected at considerable distances and which may cause problems for some people. However, the balance of opinion would seem to indicate that such people may have similar problems from other sources of infrasound and low frequency sound, such as air-conditioning. These findings were contained in reports for the DTI and others published in 2005 and 2007 in the light of press claims of adverse health effects from wind farms.

Examples of good practice and lesson learnt

UK – England and Wales

Practice on the noise aspects of wind farms in England and Wales, and more generally in other countries, is largely based on the seminal 1996 Report from the Working Group on Noise from Wind Turbines, ETSU-R-97. This Report sought to give guidelines on the measurement on noise from wind farms and indicative noise levels to protect neighbours while not unduly restricting the development of wind farms. Subsequently, and partly in response to criticism from wind farm neighbours and others, the Department of Energy and Climate Change (DECC) commissioned a report investigate the way in which noise impacts for wind farms are determined in England, including the methods used to implement the ETSU-R-97 guidance. This study concluded that there were variances in the way in which the guidelines had been implemented. A further study for the Department for Food, Environment and Rural Affairs (Defra) examined the use of Statutory Nuisance to deal with wind farm noise complaints, when resolution via the planning system is not possible or has been ineffective. The culmination of this recent work has been the presentation to Parliament in June 2011 of a final set of energy National Policy Statements, including Overarching Statements and of particular interest for the present purpose, Statements relating to Renewable Energy Infrastructure. It should also be noted that EN-3 Renewable Energy Infrastructure makes specific reference to the potential impacts of noise from offshore wind farms. An important conclusion from this work is the need for on-going consultation with wind farm developers, manufacturers and local communities, and for the continual review of standards, methodology and policy on noise thresholds

UK – Scotland

Practice in Scotland parallels that in England (and Wales). At a national level Scottish Planning Policy (2010), contains a requirement that planning authorities should set out in their Development Plans a spatial framework for onshore wind farms over 20MW generating capacity. At a more detailed level Planning Advice Note PAN1/2011 relates specifically to Planning and Noise and refers directly to noise from wind turbines.

2 specific examples in relation to current Scottish practice are useful:-

In 2011 an updated noise assessment was undertaken regarding the reduction of turbines from 22 to 17 at Dunbeath Wind Farm, together with an increase in output for each turbine, resulting in revised noise predictions based on agreed practice between practitioners in the field.

Also in 2011 following complaints from local residents the Highland Council ordered the temporary shutting down of Achany Wind Farm. The stop notice was subsequently lifted following compliance by the operator with a planning requirement for the submission of noise monitoring data.

Belgium

Estinnes wind farm was built in 2010 and comprises 11 E-126 Enercon wind turbines, each culminating at 198m (rotor included) and with a 7 MW nominal power, producing 187,000 MWh per annum.

However, when only 6 turbines out of the 11 were operational, several residents complained of disturbance by noise. Some claimed not to be able to sleep any more, some complained about headaches, psychosomatic troubles, or troubles due to infrasound, although the turbines were located at more than 700m from the nearest houses, beyond the 350m initially provided in the legal documents. The problem was exacerbated by negative media coverage.

The turbine manufacturer determined that an abnormal level of noise was emitted by two turbines, due to a resonance phenomenon in the nacelle and sought to resolve this issue. The developer also decided to:

- tether all wind turbines at night
- commission a noise study by the University of Mons in partnership with consultants
- send a newsletter to local residents
- organise a public information meeting

Once the developer could demonstrate legal standards for noise levels were being observed opposition quickly decreased. In addition scientific studies showing that noise levels of 40 dB(A) at night are harmless to health also helped to calm protests. The transferability of this approach to other sites is

potentially high but will depend on the nature of the perceived noise nuisance, the importance of the local opposition, and the developer's willingness to admit and recognise their responsibilities.

Greece

The Terpandros and Antissa Wind Parks, Lesvos became operational in 2003 and produc 24.000 GWh of electricity per annum. The Wind Parks were harmoniously integrated into the surrounding landscape and the development process did not encounter obstacles. Special care was taken during the design and implementation process, in order to keep local residents and nearby communities fully informed of all developments and to achieve a harmony between the works and the surrounding environment as well as the avoidance of any disturbance (e.g., visual, noise, from tourist activities) to the residents.

A significant factor in the successful implementation of the Wind Parks was the elaboration of a Special Noise Study during the design and environmental authorization stages of the project. Use of modern turbines and appropriate wind park design helped to allow achievement of the legal and desired noise levels. This good practice could be replicated elsewhere.

Implications for policy and practice

The main conclusions may be summarised as the need for:-

- best possible design and pre-construction assessment to minimise noise problems
- careful siting with respect to human activities especially residential development
- stakeholders to work together and to share information
- continual review of methodology, standards and policy for wind farm design and noise thresholds
- manufacturers to review continually blade and turbine design to reduce noise
- continual monitoring of noise levels and ensuring compliance with conditions

greater co-ordination of research and policy at an EU level including maritime matters