Fullabrook Wind Farm

Review of Report HM:2467/R2 -

Post Construction Noise Compliance Assessment

October 2012

Report No: ***RD/1012/R01***

For:

North Devon Council
Civic Centre
Barnstaple
Devon EX31 1EA

Prepared by:

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1 Introduction

1.1 Complaints about noise have been received from residents in the vicinity of the Fullabrook Wind Farm since the wind farm became operational in 2011. Specific noise limits (in terms of noise levels not-to-be exceeded at residential properties) were imposed on the development by way of planning conditions. These conditions also required the operator to carry out noise measurements, following the commissioning of the wind farm, to demonstrate that the prescribed noise limits were complied with when all wind turbines were operating. The planning conditions also require the operator to carry out noise compliance measurements in the event of reasonable complaints about noise.

1.2 During the construction of the wind farm, the owner (ESB) appointed the Hayes McKenzie Partnership (HMP) to carry out predictions to enable the operator, in conjunction with the turbine manufacturer, to develop an operating scheme intended to ensure that the wind farm noise levels would comply with the noise limits at all dwellings in all conditions of wind speed and direction. HMP were also commissioned to carry out a programme of noise measurements at representative dwellings around the wind farm following commissioning, to determine whether the noise limits were being complied with. These measurements were carried out in the first 6 months of 2012. The results of these measurements have been submitted to the Council in Report HM 2467/R2 dated 28 September 2012 (the 'HMP Report').

1.3 I have been instructed by North Devon Council to work with Martin Smith, Senior Technical Officer in the Council's Environmental Health and Housing Services Department, to monitor the noise compliance survey and data analysis procedures, and to liaise with HMP/ESBI as necessary, to ensure as far as possible that the noise compliance assessment is carried out in an objective and robust manner. In conjunction with the Council I have also carried out noise measurements 'in parallel' with the HMP measurements at 5 locations, using an independent monitoring system, to enable checks to be carried out on selected HMP measurements.

1.4 HMP are long-established noise consultants with extensive experience in wind farm noise assessment. Neither I nor the Council has any reason to question their competence and objectivity in carrying out this work on behalf of ESBI. However, in view of the widespread concern about the noise issues at Fullabrook I support the Council's view that an independent review of their assessment procedure is

necessary in this case. HMP and ESBI have recognised this necessity and have been cooperative and constructive throughout.

1.5 I have reviewed noise assessments for over 50 wind farms and given evidence on noise at a number of wind farm Planning Appeals. These include the Fullabrook Appeal in 2006, following which the Secretary of State granted planning permission for the site, North Devon Council having previously refused planning permission on a number of grounds, including noise.

1.6 My comments and observations on the noise compliance assessment are set out in Sections 3-6 of this Report and should be read in conjunction with the HMP Report. Section 2 provides some background information.

2 Background

2.1 Planning permission for the Fullabrook wind farm was refused by North Devon Council in 2004. The applicant (Devon Wind Power - DWP) subsequently appealed; the Council contested the Appeal on several grounds, including noise. The main noise issues raised by the Council were:

- The predicted noise levels would exceed the existing background noise levels by substantial margins, such that wind turbine noise would often be audible at dwellings and at a potentially intrusive level.

- The noise limits recommended in the ETSU-R-97 Report (*'The Rating and Assessment of Noise from Wind Farms'*), as endorsed in government planning guidance and relied on by the Appellant, did not provide adequate protection to residents in this quiet rural area.

- Even to comply with the ETSU-R-97 noise limits it would be necessary to operate the selected wind turbines in noise-reduced modes (Modern variable-speed pitch-regulated wind turbines can be operated in different 'modes' by varying the blade speed and pitch angle, to enable noise levels at any wind speed to increased or decreased, with attendant changes in electrical output). However, DWP did not ((in the Council's view) at that time provide convincing evidence that the selected

wind turbines, the Vestas V90 3MW, could be operated in such a way as to ensure compliance with the ETSU-R-97 noise limits.

2.2 However, the Inspector, in allowing the Appeal, gave the view that the ETSU-R-97 noise limits were appropriate, being endorsed in government guidance such as PPS22, and, further, that compliance with these limits could be ensured by imposing specific conditions relating to noise.

2.3 An extract from the Planning Conditions is attached as Appendix I. These included noise limits to be applied at residential properties (Condition 20), a requirement to carry out noise compliance measurements after the wind farm became operational (21) and also at any time following noise complaints that the Council (22). It is implicit in Condition 22 that the requirement for the operator to carry out measurements in response to a complaint is only invoked if the Council considers the complaint to be reasonable and justified.

2.4 The use of the site with its planning permission was subsequently acquired by ESB International (ESBI), who developed the site and installed 22 Vestas V90 3MW wind turbines in accordance with the layout that had been put before the 2006 Inquiry.

2.8 During the later design stage, ESBI employed HMP to advise on noise issues (HMP were not involved in the 2006 Inquiry). A number of noise-related matters were the subject of discussions with the Council prior to and during construction and I assisted the Council in these discussions, as follows:

- The interpretation of Condition 23 was questioned. This condition refers to the derivation of wind speeds at heights other than those at which measurements were (or would be) actually made. This was dealt with in correspondence with HMP in 2010. In the event, all noise measurement data has been referenced to the wind speed measured at 10 metres height (HMP report para.3.6) and therefore the interpretation of Condition 23 is not contentious, since it has not been necessary to derive 10 metre wind speeds by calculation

- HMP corresponded with the Council in 2010 during the development (with Vestas) of the ‘noise mitigation strategy’ – the scheme for operating the wind turbines in different noise ‘modes’, depending on wind speed and direction, to enable the noise limits to be complied with. This strategy took account of variations in wind shear –

the difference between the wind speed at 10 metres height (the reference wind speed for the noise limits) and the wind speed at turbine hub height (which determines the noise output of the wind turbine). I reviewed the basis of the scheme as presented in HMP Report HM:2195/R1 dated 23 July 2010, although not the detailed calculations (which necessarily relied on extensive discussions between HMP/ESBI and Vestas) and advised the Council that it appeared to be robust.

- As required in Condition 21, HMP/ESBI entered into discussions with the Council in 2011 to agree on a protocol for carrying out noise compliance measurements. I was a party to these discussions: a protocol was agreed in June 2011 (reproduced in the HMP report as Appendix A).

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3 Actions during/following Wind Farm Commissioning

3.1 During the commissioning of wind turbines in 2011, the Council received complaints about noise from residents at many locations surrounding the wind farm. As commissioning progressed and the wind turbines were operated in the reduced-noise modes imposed by the noise mitigation strategy, complaints continued. It was concluded therefore that the complaints were not the result of the noise mitigation strategy not yet being fully implemented, or 'teething' problems with individual turbines. The Council therefore requested ESBI to investigate the noise complaints as required by Condition 22, in addition to carrying out the noise compliance measurements as required by Condition 21, as soon as possible after the grid connection allowed the wind farm to operate at maximum export capacity (up to 66MW).

3.2 The procedure for these investigations was discussed at a Meeting (NDC/ESBI/HMP/RDA) at NDC on 19 January and subsequently agreed. The key elements of the agreed procedure were as follows:

3.3 Measurements were made close to dwellings at 12 representative locations. These are identified on Figure 1 and listed on Table 2 in the HMP Report.

3.4 Potential locations for the installation of monitoring equipment near dwellings were initially identified by Martin Smith, who liaised with the appropriate resident or landowner. Mr Smith circulated photographs of these locations to me and to HMP for comment, and also provided forms for residents to keep timed records of their perception of wind farm noise (the level, character, frequency and duration of occurrence etc.).

3.5 Equipment was installed by HMP on 21 February 2012 by HMP, accompanied by me and Martin Smith. The precise locations of the measurement systems, as selected on the day, were agreed to be appropriate for noise compliance monitoring. There was some debate about the optimum measurement location at Greenhill and as a result two measurement systems were installed here (resulting in a total of 13 systems being deployed by HMP).

3.6 Unattended noise monitoring systems were placed at the selected locations. At 10 locations, the systems were based on Larson Davis LD-820 sound level meters. Microphones were protected by double-layer windscreens. In accordance with the agreed protocol (and ETSU-R-97), each system was set to record noise levels over successive 10 minute intervals. At three locations (Binalong, Crackaway, and Beara) Rion NL-52 sound level meters were installed. In addition to recording L_{A90} noise levels (see 3.5), these meters have the capability of making audio recordings and were set to record for 1 minute in each 10 minute interval (see HMP Report para.3.11 and Appendix B). One of these systems was later relocated to Patsford to obtain audio recordings at that location

3.7 The HMP systems were operating on site for periods of between 6 and 14 weeks (see Table 2 of the HMP Report). HMP visited site every 2 weeks to download data, replace batteries, and check calibration. Before equipment was removed from a site, I was provided with preliminary results which enabled me to judge whether adequate data (in terms of numbers of valid data points for the relevant range of wind speeds and directions) had been collected for that location. Provided that the scope of data was adequate, I then agreed (after discussion with Martin Smith) that the equipment could be removed from that location.

3.8 To provide sample checks on the HMP measurements, the Council installed an independent monitoring system using a Rion NL-31 sound level meter. This was

located in close proximity to the HMP system and was located in turn for continuous periods of 2 weeks each at Binalong, Fullabrook, Beara, Patsford and Halsinger

3.5 Noise levels were measured using the L_{A90} index – the noise level exceeded for 90% of the time) in accordance with standard procedure for wind farm noise assessments. The noise limits in Condition 20 are also expressed as L_{A90} levels. Measurements of the L_{A90} level are relatively insensitive to short term noise 'events' not associated with the wind farm, such as barking dogs, passing cars and normal domestic activities. However, the L_{A90} level recorded at any location will be a measure of the combined effects of wind farm noise (when the wind farm is operating) and background noise from other sources (such as wind in trees, running water, agricultural activities etc). The noise limits apply only to noise from the wind farm and if measured noise levels are found to exceed the limits it is necessary to 'subtract' the background noise from the measured levels to provide a 'true' measure of the wind farm noise. To provide background noise data, all wind turbines were stopped between approximately 22:00-midnight during the noise surveys to enable background noise levels in the absence of wind farm noise to be measured. Measurements of background noise made prior to the Planning Appeal indicated that background noise at most locations showed little variation between evening (18:00 -23:00) and night (23:00 07:00) periods. Background noise levels during the daytime would be expected to be rather higher than in the evening or at night. Adoption of the 22:00-midnight background noise levels to 'correct' measured noise levels is therefore reasonable (and probably conservative during the daytime).

3.7 Some turbines were occasionally stopped for maintenance. HMP were advised of times when turbines were out-of-service or not operating normally. Where appropriate, measurements likely to be affected by turbines being stopped were discarded.

4 Results of 2012 Noise Measurements

4.1 The results of the measurements are discussed in Section 4 of the HMP Report. Comparisons between measured noise levels and noise limits are shown graphically on the charts on Appendix C. Table 7 in the HMP Report presents a summary of the margins between the wind farm noise levels and the noise limits, a negative value indicating that noise levels exceeded the limits.

4.2 The charts in Appendix C may be found confusing and require some further explanation. It should be appreciated that turbine noise levels and noise limits vary with wind speed. For each location there are seven charts; the content of each chart is set out in Table 6 in the HMP report. On these charts, each 'marker' represents the noise level (L_{A90}) over a single 10-minute measurement interval, plotted against the average wind speed (measured at 10 metres height at the on-site met. mast) for the same interval. The measurements invariably show considerable variation (scatter) at any wind speed, particularly at lower wind speeds, because of variations in atmospheric conditions and (mainly) because of the influence of other background noise not associated with the wind farm. The accepted procedure (as set out in ETSU-R-97) of dealing with the data is to calculate a 'best fit' line through the measured data points to derive a curve of average noise level against wind speed. A curve of average background noise against wind speed is derived in the same way.

4.3 As explained above, the noise limits apply only to noise from the wind farm, whereas the levels actually measured are the combined effect of wind farm noise and background noise. The level of turbine noise alone is calculated (although it is not a precise calculation) by logarithmically subtracting the background noise from the combined; noise levels. The charts in Appendix C therefore show 4 curves:

- The noise limits extracted from the planning conditions.
- The mean measured noise levels
- The mean measured background noise levels
- The calculated noise from the wind farm alone

4.4 The most relevant and useful charts for each location are the first 4 charts (e.g. Figures 1-4 for 'Binalong'). These show turbine noise levels measured during the evening (18:00-23:00) and the early part of the night (23:00-04: 00), these being the periods of the day and night when noise measurements are least likely to be affected by background noise. The measured 'wind farm plus background' noise levels are filtered to include only measurements made when the wind direction is such as to place the measurement location effectively downwind of the closest wind turbines (which will give rise to the highest noise levels). The effect of filtering the background noise levels to take account of wind direction is also shown, although this is not very clear from the legends on the graphs. The values on Table 7 appear to fairly

represent the ‘worst case’ comparison between the wind farm noise levels and noise limits at each location, based on the average levels of measured noise against wind speed.

5 Discussion

Measured Noise Levels and comparisons with Noise Limits

5.1 The noise measurements by the Hayes McKenzie Partnership at 12 residential locations near the Fullabrook Wind Farm were carried out in a satisfactory manner in accordance with an agreed protocol. The measurement locations were representative of all dwellings in the vicinity of the wind farm: provided that the noise limits are shown to be complied with at these locations there is reasonable certainty that they will be complied with at all other dwellings.

5.2 Analysis is continuing of the parallel check measurements at 5 locations made on behalf of NDC. From the data reviewed and compared to date, agreement between HMP and NDC data is good: there is no reason to question the adequacy or reliability of the HMP data.

5.3 The measured data has been analysed in accordance with the standard procedure for comparing wind farm noise levels with noise limits. The analysis confirms that **measured** noise levels (L_{A90}) exceed the noise limits at some wind speeds at four locations:

- Burland Farm (day/evening)
- Northeigh (day/evening
- Metcombe (night)
- Patsford (night)

5.4 Although Table 7 in the HMP Report indicates that noise levels at Binalong also exceed the daytime noise limits at higher wind speeds, the HMP Report discounts this excess on the basis that the measured (wind farm plus background) night-time noise levels are rather lower than the daytime and evening noise levels, although the noise mitigation strategy as applied would actually result in the wind farm noise levels

being higher at night than during the day and evening. The conclusion (HMP Report para. 5.4) is that the day and evening noise levels are being elevated by background noise which is at a rather higher level than the background noise measured between 22:00 and midnight. I have questioned this conclusion with HMP, since it is not immediately evident from the graphs on Figures 1-4 in the HMP Report. HMP have provided me with additional information which shows that the daytime noise limits are complied with at Binalong. I am satisfied with this data.

5.5 At four locations (Crackaway, Greenhill, Pippacott and Luscott) it can be concluded with a high level of confidence that wind farm noise levels are lower than the limits at all times.

5.6 At the remaining locations (Fullabrook, Halsinger, Beara and Binalong) the analysis shows that wind farm noise levels do not exceed the noise limits, although the margins are 'tight'. This is not unexpected, since the original design intent was to operate the wind farm 'up to the noise limits' to maximise electrical output, and the noise mitigation strategy (which involves wind turbines being operated in different noise 'modes' depending on wind speed and direction) has been devised to achieve this.

5.7 ESBI are putting into effect a further noise mitigation strategy (Appendices D and E in the HMP Report) to reduce noise levels at Burland Farm, Northleigh, Metcombe and Patsford. These measures will also obviously reduce noise levels at other properties the vicinity of those named. HMP will carry out further measurement surveys to confirm that the predicted noise reductions have been achieved at these locations.

Tonal Noise

5.8 There is evidence from audio recordings at Binalong, Crackaway, Beara and Patsford that the wind turbine noise exhibits tonal characteristics (such as an audible 'hum' or 'drone') at some wind speeds. This is referred to in the HMP Report at 5.7 – 5.9, although no specific information is provided about the nature of the tones (their frequencies, audibility levels or the conditions in which they occur). As required in the planning conditions, the presence of tonal noise above a certain 'level of audibility' attracts a graduated 'penalty' of up to 5dB. This 'penalty' is added to the measured noise level and it is this 'tone-corrected' level which is compared with the noise limits. **The analysis presented to date does not include any correction to measured noise levels to take account of audible tones.** Since noise levels at all of the 12 survey locations are within 5dB of the noise limits at some wind speeds (during either day or night, or both) the addition of a penalty for tonal noise could result in noise at all locations being shown to exceed the limits.

5.9 The investigation of tonal noise is continuing. The fact that measurements at four separate and well-spaced locations show he presence of tonal noise, at levels that would incur a noise penalty at some wind speeds, suggests that the tonal noise is a generic issue with the V90 3MW turbine, rather than being (for example) the result of defects on one wind turbine (or a small number of turbines). ESBI have advised that Vestas have been provided with the data from the HMP surveys and are carrying out measurements and analysis to define more closely the characteristics of tonal noise and the conditions in which it occurs, to enable the sources of tonal noise to be identified and remedial measures to be devised.

5.10 It is likely that a complete analysis of the tonal problem will involve lengthy investigations. The situation is complicated because in most cases the noise at any particular dwelling is the result of noise from several turbines, which will often be rotating at different speeds (either because of local variations in wind speed or because they are being controlled to operate in different 'modes' in accordance with the noise mitigation strategy). Since it is likely that the turbines emit tonal noise only at some rotor speed/load conditions it may prove difficult to isolate the 'problem' condition. Eliminating or reducing tonal noise will almost certainly involve modifications to the turbines, unless this can be achieved by controlling turbines in such a way as to avoid the 'problem' operating regimes. In either case, when the

problem(s) is/are identified, a further period will be required for a solution to be devised and implemented.

5.11 In view of the potentially lengthy timescale for tonal noise to be reduced or eliminated, it may be appropriate for the Council to require ESBI to carry out a full assessment of tonal noise at an early stage, to calculate the corresponding tonal penalties to be applied, and where necessary to implement a further noise mitigation strategy to ensure that noise levels (including tonal penalties) comply with the noise limits. It must be recognised that this may not be straightforward: for example, it might not be sufficient to operate turbines in lower noise modes, to provide more 'headroom' for a tonal penalty to be applied, if the audibility level of a tone (and the magnitude of the penalty) is increased by the change to this lower-noise mode. Therefore if such action (i.e. requiring the operator to mitigate prior to investigations by Vestas being completed) is considered, it would be preferable to wait until the tonal problem has been more fully diagnosed so that the effects on tonal noise of operating turbines in different modes can be more reliably predicted. In the absence of a diagnosis of the problem, the operator would have to resort to speculative measures that might make matters worse rather than better. Also the imposition of restrictions on the operation of the turbines at this stage would inevitably hamper Vestas's investigations, which are intended to provide reliable resolution of the tonal noise problems.

Other Matters

5.12 The detailed scope of the additional noise surveys to demonstrate the effect of the further mitigation strategy on noise levels at Burland Farm, Northleigh, Metcombe and Patsford, and to investigate the tonal noise issues, has not yet been finalised and agreed with the Council. Definition of this scope, and discussion of the timescale for resolution of tonal noise issues, is recommended.

5.13 The levels of noise emitted by the wind farm are strongly dependent on the way that individual wind turbines are operated (since the noise mitigation strategy requires most turbines to be operated in 'reduced noise' modes for at least some of the time). Some concern might be expressed that the method of operation is under the control of the operator and therefore that at times in the future the turbines could be operated in higher-noise modes to maximise electrical output (but with the result that noise limits could be exceeded). In my view this is not a likely scenario: the turbine

SCADA systems are programmed remotely by Vestas and the programming cannot be changed independently by an operator, even if he wished to do so, and there is no suggestion that the Fullabrook turbines are (or would be) operated in other ways than the prescribed programme.

5.14 However, to satisfy any expressed concerns, I recommend that ESBI are requested to provide a note explaining the way in which the turbine SCADA systems are controlled, highlighting the 'security' of the procedure. It is also worth noting that the Council can (in theory, at least) verify that turbines are being operated in the prescribed manner by requesting the turbine operational data as required in Condition 23, although I foresee no necessity for such an action.

6 Summary and recommendations

6.1 The noise measurement programme carried out by HMP in 2012 confirms that the noise limits in Condition 20 are exceeded at some wind speeds and in 'downwind conditions at four of the surveyed locations:

- Burland Farm
- Metcombe
- Patsford
- Northleigh

The operator is implementing a further noise mitigation strategy to reduce measured noise to levels below the limits. Further noise surveys will be carried out to confirm compliance.

6.2 From the data, there is a high level of confidence that measured noise levels at four locations are below the noise limits.

- Crackaway
- Greenhill
- Pippacott
- Luscott

6.3 Noise levels at the remaining four locations below are shown to be compliant with the limits, but by small margins.

- Beara
- Halsinger
- Fullabrook
- Binalong

6.4 The above conclusions relate only to **measured** noise levels and take no account of the presence of audible tones. Audio recordings at 4 locations show the presence of audible tones at some wind speeds that would incur a penalty (an addition to the measured noise levels) under the terms of the noise conditions. Application of such a penalty is likely to result in tone-corrected noise levels exceeding the noise limits at most if not all of the measurement locations. Tonal noise is the subject of continuing investigations by ESBI and Vestas.

Recommendations

(Referenced to paragraphs in this Report)

6.5 The scope of additional noise measurements to assess the results of the updated noise mitigation strategy should be discussed and agreed between ESBI/HMP and the Council and these measurements carried out as soon as practicable (5.12).

6.6 ESBI should be requested to put forward a detailed scope and timescale for the tonal noise investigations, including an estimate of the time likely to be required for Vestas to identify the causes of tonal noise and for a solution to be implemented. The Council might consider requiring ESBI to operate with further mitigation (such that the tone-corrected noise levels are lower than the noise limits) in the short term, in advance of an 'engineering' solution being put into effect (5.11)

6.7 For completeness, ESBI should be requested to submit an explanatory note describing the operation of the Vestas SCADA system, and in particular setting out the procedure for changing turbine operating modes (5.13/5.14).

Appendix I

Extract from Planning Conditions

Conditions 20-23 and Guidance Notes A and B refer to Noise

seeded with a suitable grass mixture to be agreed in advance with the local planning authority.

17 No wind turbine or anemometry mast shall be externally lit for any purpose unless otherwise previously approved in writing by the local planning authority.

18 Prior to the commencement of the development the details of the concrete batching plant including the means of access and site restoration shall be submitted to the local planning authority and agreed in writing. The concrete batching plant shall only be constructed in accordance with the approved details.

19 Prior to the commencement of the development details of the external treatment of the sub-station including access from the public highway and landscaping measures shall be submitted to the local planning authority and approved in writing. The sub-station shall only be constructed in accordance with drawing MPS/102/10 Rev A and the approved details.

20 The levels of noise resulting from the combined effects of the wind turbines on the development site when measured and corrected in accordance with Notes A and B below shall not exceed the following limits at any dwelling in existence at the date of this permission:

Between the hours 23.00 – 07.00:
The greater of 43 dB $L_{A90,10m}$ or 5dB L_{A90} above the established night-time background noise level at that property.
At all other times
The greater of 40 dB $L_{A90,10m}$ or 5dB L_{A90} above the established quiet daytime background noise level at that property.

Except that at any dwelling occupied by persons having a financial involvement with the development the levels of noise shall not exceed the following

Between the hours 23.00 – 07.00:
The greater of 45 dB $L_{A90,10m}$ or 5dB L_{A90} above the established night-time background noise level at that property.
At all other times
The greater of 45 dB $L_{A90,10m}$ or 5dB L_{A90} above the established quiet daytime background noise level at that property.

For the purposes of compliance with Condition 20 the night time and quiet daytime background noise levels at any wind speed shall be taken as those given in the following table.

Location		**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Fullabrook	BG Daytime	33	33	34	34	35	36	37	38	39
	BG Night	33	33	34	34	35	36	37	38	39
Halsinger	BG Daytime	30	32	33	35	36	37	38	38	39
	BG Night	30	32	34	35	36	37	37	37	37
Crackaway	BG Daytime	32	33	35	36	36	37	37	38	40
	BG Night	33	35	36	37	37	37	37	37	38
Burland	BG	34	35	36	36	36	37	38	39	41

Farm	Daytime									
	BG Night	35	36	37	38	38	38	38	38	40
South Burland	BG Daytime	38	38	38	37	37	38	40	40	40
	BG Night	35	36	36	37	37	37	38	39	41
Lower Metcombe	BG Daytime	35	36	36	36	36	37	39	40	40
	BG Night	33	35	36	36	37	37	37	37	38
Ash Barton	BG Daytime	32	34	35	37	38	38	39	40	39
	BG Night	32	34	35	36	37	37	38	38	38
Patsford	BG Daytime	35	35	35	35	36	38	40	40	40
	BG Night	33	34	35	36	36	37	37	37	37
Beara Charter	BG Daytime	34	35	36	36	37	38	38	39	39
	BG Night	34	35	36	36	37	38	38	39	39
Luscott Barton	BG Daytime	33	35	36	36	38	39	40	40	40
	BG Night	33	35	36	36	37	37	37	37	38
Northleigh	BG Daytime	31	32	34	35	35	36	36	36	37
	BG Night	30	32	33	34	35	35	36	36	37
Pippacott	BG Daytime	36	36	36	37	37	37	37	38	37
	BG Night	35	35	35	35	36	37	38	38	38
West Stowford Barton	BG Daytime	35	35	35	36	39	40	40	40	40
	BG Night	34	35	36	37	37	38	38	38	38

The night-time background noise levels in this table shall apply between the hours of 23.00 to 07.00 and the quiet day-time levels in this table shall apply at all other times. Where there is no background noise data for any specific property then the background noise data shall be taken from the nearest property for which such data is available.

21 No wind turbine shall be operated on the site until a scheme has been submitted to and agreed with the local planning authority for monitoring noise levels at up to 5 selected residential locations (or at representative locations close to these properties, to be agreed with the local planning authority) during the 6 months following the grid connection and full operation of all the turbines on the site. The duration of such monitoring shall be sufficient to provide comprehensive information on noise levels in a representative range of wind speeds and wind directions with all wind turbines operating. Monitoring shall be carried out in accordance with the approved monitoring scheme and the results provided to the local planning authority within 4 months of completion of the scheme.

22 At the request of the local planning authority and in the event of a complaint relating to noise from the turbines, the operator of the development shall measure and assess at its

expense the level of noise emissions from the wind turbines following the procedures referred to in Notes A and B and the results shall be provided to the local planning authority within 4 months of such request.

23 Throughout the period of operation of the wind farm the operator of the development shall record wind speed and direction data. This data shall include records of wind speed (in m/s) and wind direction (in 10 degree sectors) for each 10 minute period. Where wind data is measured at a height other than 10 metres above local ground level the wind speed data shall be converted to the equivalent wind speed at 10, 25 and 65 metres height, accounting for wind shear using a method of which details shall be provided to the LPA. At the request of the LPA the recorded wind data shall be made available to them.

Note A to Noise Conditions

For the purposes of compliance with Conditions 20 to 23, noise levels from the combined effects of the wind turbines shall be measured in accordance with the procedures in Section 2 (Steps 2-5) on Pages 102-103 of 'The Assessment and Rating of Noise from Wind Farms, ETSU-R-97'; prepared by the Energy Technology Support Unit for the Department of Trade and Industry.

Note B to Noise Conditions

For the purposes of compliance with Conditions 20 to 23, tonal noise shall be assessed in accordance with the procedures in Section 2 (Step 6) on Pages 103-104 and Section 2.1 on Pages 104 – 109 of 'The Assessment and Rating of Noise from Wind Farms, ETSU-R-97'; prepared by the Energy Technology Support Unit for the Department if Trade and Industry. The appropriate penalty for tonal noise shall be added to the measured noise levels for the purposes of comparison with the noise limits in Condition 20.

24 Prior to the commencement of the development a scheme for the implementation of ecological surveys to provide sufficient survey data and mitigation proposals to ensure that habitats and species of principal importance (as listed in section 74(2) of the Countryside and Rights of Way Act 2000) that have been identified during the application as requiring special consideration shall be submitted to the local planning authority and approved in writing. The survey and mitigation scheme shall be carried out as approved.

25 Development shall not be begun until full construction details of the visibility splays at the site entrance and on the unclassified road between Burland Cross and Metcombe Cross and the highway have been submitted to and approved in writing by the local planning authority and have been carried out in accordance with the approved details.

26 No development shall take place within the development site until the implementation of a programme of archaeological work has been implemented in accordance with a written scheme of investigation previously submitted to and approved by the local planning authority. Such a programme shall include timetabled provision for a nominated archaeologist to be given reasonable access to undertake a "watching brief" during the excavation of access tracks, hedgerow openings, turbine foundations and other operational areas of the development site during the construction phase.

27 No development shall take place on site until a scheme to secure the investigation and alleviation of any electro-magnetic interference to TV and radio reception caused by the operation of the turbines has been submitted to and approved by the local planning

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