

Dick Bowdler  
Acoustic Consultant

01383 882 644  
077 8535 2534  
dick@dickbowdler.co.uk

**BRYN TITLI WIND FARM**

**EXTENSION OF TIME**

**REVIEW OF THE NOISE SECTION OF THE APPLICATION**

**Powys County Council: P/2017/0764**

**Dick Bowdler**

## **INTRODUCTION**

This report is prepared for Powys County Council to review the noise section of the planning application for this wind farm. My comments are primarily related to Technical Appendix 9.1 and Annexes 1-7 of the application which form the detailed report. I assume the reference in Chapter 9 of the Environmental Statement to Appendix 7.1 is an error. Following my initial investigations, with the approval of the Council, I contacted the applicant's consultants with a request for further information on a number of points. These were:

- A more comprehensive list of the number of properties subject to turbine noise greater than 35dBA, particularly those around Dollech that might be subject to a "valley effect".
- Better resolution copies of the time series graphs.
- Clarification of some of the numbering.
- Clarification of the standard under which the original tests of the turbines were made.

Answers to these questions were provided by an email letter on 18<sup>th</sup> October 2017 (TNEA Response) the contents of which I have also taken into account.

I visited the area surrounding the site on 12<sup>th</sup> August 2017 between about 1200 and 1700hrs to look at the locations and details of affected houses.

Bryn Titli wind farm is an existing wind farm constructed around 1994. It consists of 22 Bonus B37/450 turbines. These have a 450kW rating, a rotor diameter of 37m and a hub height of 35m. The application is for an extension of time for the life of the wind farm which currently expires in 2019. I assume there are to be no changes to the existing turbines or their running modes.

The applicants report says that it has been carried out in accordance with ETSU-R-97 and the Institute of Acoustics Good Practice Guide (IOAGPG). It also refers to an article in the Acoustics Bulletin in 2009 (the 2009 Article). I agree that these are appropriate documents. I note that this was agreed between the Council and the Applicant's consultant.

## **SUMMARY**

I am satisfied that the background noise levels as measured represent a realistic level at these locations. The allocation of background noise and consequent limits to surrounding properties needs careful attention.

There is an anomaly in the turbine noise shown in tables and graphs but I do not consider it to be significant. The levels shown in the tables and graphs are therefore satisfactory.

There are around twenty properties that will exceed 35dB at some wind speeds, most of them marginally at wind speeds of 10m/s and above. None is above 40dB even at 12m/s. Background noise at these properties is strongly influenced by water noise from the River Wye.

An assessment shows that, even allocating the lowest background noise levels to form the limits, the turbines meet ETSU-R-97 limits by a large margin (probably in excess of 7dB or more).

I recommend a noise condition to control noise at nearest houses.

## **1 BACKGROUND NOISE MEASUREMENTS**

1.1 Background noise measurements were carried out in May and June of 2013. The methodology is described in section 5 of the report and data was used at each location for periods when the existing turbines were turned off plus times when the monitor was upwind of the turbines. Monitoring was carried out at five locations. The measurements were carried out in accordance with current good practice and I am satisfied that the results represent a realistic set of background noise values during the period of monitoring.

1.2 At NAL4 (Dolhelfa Ganol) and NAL3 (Chapel House) the background noise graphs and the time series graphs clearly show water noise. I could clearly hear the noise of the River Wye at NML9 on my site visit. Inspection of Fig A6.1c shows that, in the early hours of 16<sup>th</sup> May, following several days of rain, the lowest background noise level at night with little wind was 42dBA. After periods without rain this drops – eventually to about 26dBA on 16<sup>th</sup> June – before rising again. The question arises as to whether the noise measured during the monitoring period is typical of the noise at that location. Most of the higher background noise levels have been excluded and the monitoring took place during a relatively dry part of the year so, my opinion is that the background noise levels measured at NAL4 and NAL3 are representative of the typical levels at those locations. However, they may not be typical of other locations and care should be exercised when using them in other locations. I deal with this in my §3.

1.3 According to the descriptions given in the ES the sound measuring equipment, the met mast location and the processing of data was correctly carried in accordance with the IOAGPG. I have examined the time series carefully and there are no anomalies that would suggest that I need to analyse data in any more detail.

## **2 TURBINE NOISE LEVELS**

2.1 There is an anomaly in the turbine noise levels in Tables 6.2 and 6.3 of the original Appendix 9.1 and the figures in Appendix 1 of the TNEI Response. I have discussed this in Appendix 1 of this report and conclude that it is reasonable to ignore the anomaly in the assessment.

2.2 Accordingly, I agree that the turbine noise levels reproduced in the TNEI Response represent realistic estimates of turbine sound level. The only criticism that I have is that they only go up to 9m/s whereas ETSU-R-97 requires assessments to be made up to 12m/s or 10m/s for the simplified method. With modern turbines, which are generally pitch regulated, the noise level reaches a maximum at about 8m/s. The turbines at Bryn Titli are stall regulated and the noise level carries on increasing with wind speed.

### **3 ASSESSMENT**

3.1 There are no other wind farms that are close enough to require a cumulative noise assessment to be carried out.

3.2 An important starting point in the preliminary assessment of a wind farm is the number of properties affected by turbine noise levels in excess of 35dB up to a wind speed of 10m/s. TNEI provided a series of graphs in Appendix 1 of their response which show the turbine noise levels against the noise limits. They do not provide a full list of affected properties. If we extrapolate these graphs to 10m/s then we can see which properties exceed 35dB. Five or six properties at Neuadd-ddu (NAL2); Dermol Old School and possibly the two adjacent properties (NAL3), Dolhelfa-ganol and possibly Dolhelfa Uchaf and Ty Gwyn (NAL4). Dollech Bungalow and, presumably, Ysgubor Dollech (NAL7), Croesty (NAL8) and Tan-y-Berth (NAL10). Two properties at Tyncoed (NAL13), Ty-Mawr(NAL14) and Safn-y-coed (NAL15). This makes in the region of twenty properties that are subject to turbine noise in excess of 35dB though it is true that most of these are marginal and may only exceed 35dB at the highest wind speeds.

3.3 We need to allocate the background noise levels measured at the various properties to each house (noise sensitive receptor - NSR). Table 1 below shows this. The second column shows the approximate number of properties at each location, the third column shows which background noise levels have been allocated by TNEI and the last column my proposed allocation. Whilst it appears that the location used by TNEI for most of them (NAL6) is the quietest location it seems to me more logical to use the background noise at

a more representative place – otherwise two locations close to each other might have different noise limits for no apparent reason.

**Table 1 – Background Noise Allocation**

NSR	Props	TNEI	DB
NAL2	6	NAL2	NAL1
NAL3	3	NAL3	NAL3
NAL4	3	NAL4	NAL1
NAL7	2	NAL6	NAL3
NAL8	1	NAL6	NAL3
NAL10	1	NAL6	NAL3
NAL13	2	NAL6	NAL1
NAL14	1	NAL6	NAL3
NAL15	1	NAL6	NAL3

3.4 I have also taken account of the fact that there is water noise from the River Wye at those properties west of the river Wye when they are downwind of the turbines. However, properties on the east of the River Wye along the A470 will be upwind of the river when they are downwind of the turbines. This might have been an appropriate site for directional filtering of background noise but, with the turbines already operating it would probably have been difficult to get enough wind from the eastern half of the compass with turbines off. I have therefore taken the figures for NAL1 which are lower than NAL2 or NAL4.

#### **4 CONDITIONS**

4.1 With the noise limits I suggest, based on the background noise levels specified in Table 1, all properties comfortably meet the day time noise limits. ETSU-R-97 provides for the situation where day and night background noise is similar at a site, which is broadly the case here. In that case day and night limits can be the same. That seems to me to be an appropriate approach here. In any case, with standardised wind speeds day and night noise levels will be the same and the day time limits are comfortably met – by at least 7dB. Accordingly, I suggest that the night limit is the same as the day limit (I have not processed the day and night background noise levels together but used the day limits for both).

4.2 I am suggesting a new form of noise condition which will be published under the authorship of several wind farm acoustic consultants in the Acoustics Bulletin in the first week of November. It is attached as Appendix 2.

## **APPENDIX 1 – TURBINE NOISE**

As TNEI confirmed in their response, the turbine noise as in the manufacturers sound power specification is measure in accordance with the International Energy Agency document "4. *Acoustics: Measurement of Noise Emission from Wind Turbines: Edition 1988*". It is different from subsequent test methods because it relates noise levels to wind speed measured at 10m not measured at hub height and standardised to 10m which is the current accepted methodology. The difference between the two depends on the wind shear conditions at any particular time.

As a result of this anomaly the turbine noise levels at the various locations shown on the graphs in Appendix 1 of the TNEI Response are not related to standardised wind speed but the noise limits shown on the same graph are. That means that, strictly speaking, the two graphs on each sheet are not directly comparable. There is no easy way of plotting them in a comparable way. If the wind shear increases, as it usually does at night and in evenings some of the year, the turbine noise curve on these graphs shifts to the right so, in effect, the noise level at any particular wind speed reduces. (I should also be noted in passing that the background noise created by the wind is likely to reduce under these conditions because the low-level winds are less). In the opposite way, if wind shear reduces (which is likely to be less common) then the wind turbine noise increases slightly. The same anomaly occurs in Tables 6.2 and 6.3 of the original Appendix 9.1 in that the Predicted Wind Turbine Noise is related to 10m measured wind speed and the background noise to the 10m standardised wind speed.

A further point about the manufacturers test is that the turbine measured in the tests had "tip torpedoes". As I understand it, Bonus introduced these torpedoes in the 1990s specifically to reduce noise levels. Whether they were particularly effective or not we do not know.

In the original noise assessment, the total existing noise including turbine noise and background noise was also measured at each property when the property was downwind of the nearest turbines. An inspection of the figures indicates that there is nothing to suggest that actual turbine noise is significantly above that calculated.

Taking all these points into account and the large margin of turbine noise under the limits, I think that it is reasonable to treat the turbine noise shown in the graphs in the TNEI response as related to standardised wind speed and ignore the anomaly. I



want to emphasise that, under the circumstances of this case, the effect on the assessment is small. Nevertheless, I think it important to have addressed the matter so that it can be clearly see that is the case.

## **APPENDIX 2 – NOISE CONDITIONS**

### **Proposed planning conditions on noise for Bryn Titli Wind Farm**

The rating level of noise immissions from the combined effects of the wind turbines hereby permitted (including the application of any tonal penalty and amplitude modulation (AM) penalty), when determined in accordance with the attached Guidance Notes, shall not exceed the values for the relevant integer wind speed set out in or derived from Table 1 attached to these conditions and:

- A) Within 21 days from receipt of a written request of the Planning Authority, following a complaint to it alleging noise disturbance at a dwelling, the wind farm operator shall, at its expense, employ an independent consultant and provide a written protocol to be approved by the Planning Authority. The protocol shall describe the procedure to assess the level and character of noise immissions from the wind farm at the complainant's property in accordance with the procedures described in the attached Guidance Notes. The written request from the Planning Authority shall set out as far as possible the time or meteorological conditions to which the complaint relates and time or conditions relating to tonal noise or AM if applicable. Measurements to assess compliance with the noise limits shall be undertaken in accordance with the assessment protocol which shall be approved in writing by the Planning Authority.
- B) The wind farm operator shall provide to the Planning Authority the independent consultant's assessment of the rating level of noise immissions undertaken in accordance with the protocol within 2 months of the date of the approval of the protocol by the Local Authority unless otherwise agreed by the Planning Authority. The assessment shall include all data collected for the purposes of undertaking the compliance measurements and analysis, such data to be provided in a format to be agreed with the Planning Authority. Certificates of calibration of the equipment shall be submitted to the Planning Authority with the report.
- C) Where a further assessment of the rating level of noise immissions from the wind farm is required pursuant to Guidance Note 5 of the attached Guidance Notes, the wind farm operator shall submit a copy of the further assessment within 21 days of submission of the independent consultant's initial assessment unless otherwise agreed by the Planning Authority.

Table 1 – Rating Level Limits at all times.

	Wind speed Standardised at 10m.								
	4	5	6	7	8	9	10	11	12
Group 1	37	38	40	41	43	44	46	46	46
Group 2	39	40	41	43	43	43	43	43	43
Group 3	35	36	38	40	42	43	45	45	45

Group 1 properties are along the A470 namely Five or six properties at Neuadd-ddu (NAL2); Dolhelfa-ganol, Dolhelfa Uchaf and Ty Gwyn (NAL4). Two properties at Tyncoed (NAL13).

Group 2 properties are to the west of the River Wye namely: Dermal Old School and the two adjacent properties (NAL3), Dollech Bungalow, Ysgubor Dollech (NAL7), Croesty (NAL8) and Tan-y-Berth (NAL10). Ty-Mawr(NAL14) and Safn-y-coed (NAL15).

Group 3 is all other properties.

### Guidance Notes for Noise Condition

These notes are to be read with and form part of the planning condition on noise. The measured data is to be split into bins as described below. The rating level in each bin is the arithmetic sum of the wind farm noise level, any tonal penalty applied in accordance with Note 3 and any AM penalty applied in accordance with Note 4. Reference to ETSU-R-97 refers to the publication entitled "The Assessment and Rating of Noise from Wind Farms" (1997) published by the Energy Technology Support unit (ETSU) for the Department of Trade and Industry (DTI). IOAGPG is "A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise" or any update of that report current at the time of measurement. The IOA Metric is "A Method for Rating Amplitude Modulation in Wind Turbine Noise" dated 9<sup>th</sup> August 2016 or any update of that current at the time of measurement.

### Note 1 – Data Collection

- a. Values of the LA90,10-minute noise index should be measured in accordance with the IOAGPG. Measurements shall be undertaken in such a manner to enable a tonal penalty to be calculated and to allow an AM penalty to be calculated for selected periods where a tonal or AM assessment is required.
- b. To enable compliance with the conditions to be evaluated, the wind farm operator shall continuously log arithmetic mean wind speed in metres per second (m/s) and arithmetic mean wind direction in degrees from north in each successive 10-minutes period in a manner to be agreed in writing with the Planning Authority. The wind speed at turbine hub height shall be 'standardised' to a reference height of 10 metres as described in ETSU-R-97 at page 120 using

a reference roughness length of 0.05 metres. It is this standardised 10 metre height wind speed data which are correlated with the noise measurements determined as valid. The wind farm operator shall continuously log arithmetic mean nacelle anemometer wind speed, arithmetic mean nacelle orientation, arithmetic mean wind direction as measured at the nacelle, arithmetic mean rotor RPM and whether each wind turbine is running normally during each successive 10-minutes period for each wind turbine on the wind farm. All 10-minute periods shall commence on the hour and in 10-minute increments thereafter synchronised with Universal Time (UT).

### **Note 2 – Data Analysis**

- a. The independent consultant shall identify a sub-set of data having had regard to:-
- the conditions (including time of day and corresponding wind directions and speeds) at times in which complaints were recorded;
  - the nature/description recorded in the complaints if available;
  - information contained in the written request from the local planning authority;
  - likely propagation effects (downwind conditions or otherwise);
  - the results of the tonality/AM analysis where relevant.

In cases where it is possible to identify patterns of clearly different conditions in which complaints have arisen additional sub-sets may be considered provided this does not introduce unreasonable complexity in the analysis and can be justified by the independent consultant.

- b. Within each of the sub-set(s) of data identified, data shall be placed into separate 1 m/s wide wind speed bins.

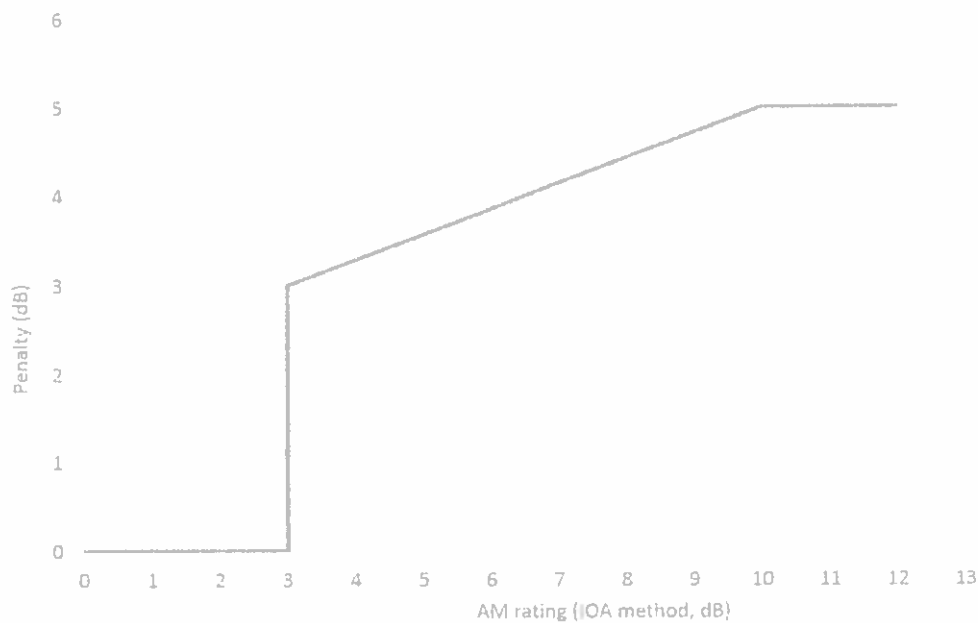
### **Note 3 – Tonal Penalty**

- a. Where, in accordance with the protocol, the noise contains or is likely to contain a tonal component, a tonal audibility shall be calculated for each ten-minute period using the following procedure.
- b. For each 10-minute period for which a tonal assessment is required this shall be performed on noise immissions during 2-minutes of each 10-minute period. The 2-minute periods should be spaced at 10-minute intervals provided that uninterrupted uncorrupted data are available ("the standard procedure").
- c. For each of the 2-minute samples the tone level above audibility shall be calculated by comparison with the audibility criterion given in Section 2.1 on pages 104 -109 of ETSU-R-97. Samples for which the tones were below the audibility criterion or no tone was identified, a value of zero audibility shall be substituted. Where data for a ten-minute period are corrupted, that period shall be removed from the tonal analysis.

- d. The tone level above audibility for each ten-minute period shall be placed in the appropriate data sub-set and wind speed bin.

**Note 4 – AM Penalty**

- a. Where, in accordance with the protocol, the noise contains or is likely to contain AM, an AM penalty shall be calculated for each ten-minute period using the following procedure.
- b. For each 10-minute interval for which an AM assessment is required this shall be performed in accordance with The IOA Metric. The value of AM for each ten-minute period shall be converted to a penalty in decibels in accordance with the graph below and the penalty shall be placed in the appropriate data sub-set and wind speed bin. Where a penalty is zero it should be placed in the bin in the same way.



**Note 5 – Calculation of Rating Level**

- a. The LA90 sound pressure level for each data sub-set and wind speed bin is the arithmetic mean of all the 10-minute sound pressure levels within that data sub-set and wind speed bin except where data has been excluded for reasons which should be clearly identified by the independent consultant. The tonal penalty for each bin is the arithmetic mean of the separate 10-minute tonal audibility levels in the bin converted to a penalty in accordance with Fig 17 on page 104 of ETSU-R-97. The AM penalty for each bin is the arithmetic mean of the AM penalties in the bin. The assessment level in each bin is normally the arithmetic sum of the bin LA90, the bin tonal penalty and the bin AM penalty

except where the AM penalty and the tonal penalty relate to the same characteristic (e.g. amplitude modulated tones) when the sum of both penalties may overly penalise the characteristics of the noise. Such cases should be identified and only the larger of the AM or tonal penalty should be applied.

- b. If the assessment level in every bin lies at or below the values set out in the Table(s) attached to the conditions then no further action is necessary. In the event that the assessment level is above the limit(s) set out in the Tables attached to the noise conditions in any bin, the independent consultant shall undertake a further assessment of the rating level to correct for background noise so that the rating level relates to wind turbine noise immission only. Correction for background noise need only be undertaken for those wind speed bins where the assessment level is above the limit.
- c. The wind farm operator shall ensure that all the wind turbines in the development are turned off for such periods as the independent consultant requires to undertake the further assessment. The further assessment shall be undertaken in accordance with the following steps:-

- i. Repeating the steps in Note 1, with the wind farm switched off, and determining the background noise ( $L_3$ ) in each bin as required in the protocol. At the discretion of the consultant and provided there is no reason to believe background noise would vary with wind direction, background noise in bins where there is insufficient data can be assumed to be the same as that in other bins at the same wind speed.
- ii. The wind farm noise ( $L_1$ ) in each bin shall then be calculated as follows where  $L_2$  is the measured level with turbines running but without the addition of any tonal nor AM penalty:

$$L_1 = 10 \log \left[ 10^{L_2/10} - 10^{L_3/10} \right]$$

- iii. The rating level shall be calculated by adding the tonal and AM penalties to the derived wind farm noise  $L_1$  in that bin.
- iv. If the rating level after adjustment for background noise contribution and adjustment for tonal and AM penalties in every bin lies at or below the values set out in the Tables attached to the condition at all wind speeds then no further action is necessary. If the rating level at any integer wind speed exceeds the values set out in the Table(s) attached to the condition then the development fails to comply with the planning condition in the circumstances represented by that bin.