



Upper Ogmore Wind Farm

Shadow Flicker & Reflected Light Assessment

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1 Background Information

- 1.1.1 In sunny conditions, any shadow cast by a wind turbine will mirror the movement of the rotor. When the sun is high, any shadows will be confined to the wind farm area but when the sun sinks to a lower azimuth moving shadows can be cast further afield and potentially over adjacent properties. Shadow flicker is generally not a disturbance in the open as light outdoors is reflected from all directions. The possibility of disturbance is greater for occupants of buildings when the moving shadow is cast over an open door or window; since the light source is more directional.
- 1.1.2 Whether shadow flicker is a disturbance depends upon the observer's distance from the turbine, the direction of the dwelling and the orientation of its windows and doors from the wind farm, the frequency of the flicker and the duration of the effect, either on any one occasion or averaged over a year.
- 1.1.3 The potential for shadow flicker is assessed for the new larger rotor diameter, 117m, proposed in this variation.
- 1.1.4 In any event and irrespective of distance from the turbines, the flickering frequency will depend upon the rate of rotation and the number of blades. It has been recommended (Clarke, 1991) that the critical frequency should not be above 2.5 Hz, which for a three-bladed turbine is equivalent to a rotational speed of 50 rpm. The proposed turbines at Upper Ogmores Wind Farm would rotate at a maximum of approximately 16 rpm, well below this threshold.

2 Reflected Light

- 2.1.1 A related visual effect to shadow flicker is that of reflected light. Theoretically, should light be reflected off a rotating turbine blade onto an observer then a stroboscopic effect would be experienced. In practice a number of factors limit the severity of the phenomenon and there are no known reports of reflected light being a significant problem at wind farms.
- 2.1.2 A limiting factor is that wind turbines have a semi-matt surface finish which means that they do not reflect light as strongly as materials such as glass or polished vehicle bodies.

- 2.1.3 Secondly, due to the convex surfaces found on a turbine, light will generally be reflected in a divergent manner.
- 2.1.4 Thirdly, as with shadow flicker, certain weather conditions and solar positions are required before an observer would experience this phenomenon.
- 2.1.5 It is therefore concluded that Upper Ogmores Wind Farm will not cause a material reduction to amenity owing to reflected light.

3 Policy and Guidance

- 3.1.1 The Update of UK Shadow Flicker Evidence Base (2011), published by the then Department for Energy and Climate Change (DECC), states that assessing shadow flicker effects within ten times the rotor diameter of wind turbines has been widely accepted across different European countries, and is deemed to be an appropriate area.

4 Methodology

- 4.1.1 Analysis was performed on all properties within 10 rotor diameters of any turbine using the latest software available to the Applicant at the time of assessment, WindPro 3.5.
- 4.1.2 This shadow flicker assessment is based on turbines with a 117m rotor diameter and the original consent includes a 50m micro-siting distance for infrastructure. As such, this 50m distance is added to the ten-rotor diameter ($1170 = 10 * 117$)m distance to give a total distance of ($1220 = 1170 + 50$)m from any turbine.
- 4.1.3 Analysis was undertaken for shadow flicker at all properties within 1220m from any wind turbine.
- 4.1.4 This analysis considers the motion of the Earth around the Sun, the local topography and the turbine locations and dimensions. The analysis was performed using a layout of seven turbines, with turbine tip heights of:
 - i 130.0m for T1, T2 and T6.
 - ii 149.9m for T3, T4, T5 and T7.

5 Results

- 5.1.1 With due reference to the DECC report, and an allowance for 50m micro-siting, there are nine inhabited properties within 1220m of any wind turbine, listed below.
- 5.1.2 Flicker analysis was completed to assess the potential for flicker at any property listed, under a worst-case consideration of the following assumptions:
- i The analysis assumes that there is always sufficient lack of cloud cover, for there to be sufficient sunlight for shadows to be cast by the turbine.
 - ii The analysis assumes that there is always enough wind for the turbine blades to be turning.
 - iii The analysis assumes that the wind is always coming from the right direction for the turbine rotor to be facing towards the house, to thus cast a shadow.
 - iv The analysis assumes that the property has windows and/or glazed doors facing towards the turbine.
 - v The analysis assumes there is no shielding, e.g. in the form of trees, between the turbine and the property.
 - vi The analysis returns that none of the listed properties are predicted to have any shadow flicker.
- 5.1.3 The potential shadow flicker is given in the Table 1 below:

Table 1 - Shadow Flicker Hours at Assessed Properties

Property Address	Maximum Hours of Flicker Per Year
Nantymoel Farm, Garon Terrace, Nantymoel, Bridgend, CF32 7RH	0.0
21 Pwllcarn Terrace, Blaengarw, Bridgend, CF32 8AS	0.0
20 Pwllcarn Terrace, Blaengarw, Bridgend, CF32 8AS	0.0
19 Pwllcarn Terrace, Blaengarw, Bridgend, CF32 8AS	0.0
18 Pwllcarn Terrace, Blaengarw, Bridgend, CF32 8AS	0.0
17 Pwllcarn Terrace, Blaengarw, Bridgend, CF32 8AS	0.0
16 Pwllcarn Terrace, Blaengarw, Bridgend, CF32 8AS	0.0
15 Pwllcarn Terrace, Blaengarw, Bridgend, CF32 8AS	0.0
14 Pwllcarn Terrace, Blaengarw, Bridgend, CF32 8AS	0.0

- 5.1.4 Given that all properties assessed are predicted to experience 0 hours per year, it is therefore concluded that Upper Ogmores Wind Farm will not cause a material reduction to residential amenity owing to shadow flicker.

6 References

[1] Clarke A.D (1991), A case of shadow flicker/ flashing: assessment and solution, Open University, Milton Keynes

[2] Brinckerhoff, Parsons (2011) 'Update of UK Shadow Flicker Evidence Base', Department of Energy and Climate Change, UK Government