12 SHADOW FLICKER

12.1 Background Information

12.1.1 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.

12.1.2 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.

12.1.3 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 Mynydd Maen Wind Farm would rotate at a maximum of approximately 18 rpm, well below this threshold.

12.2 Reflected Light

12.2.1 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.

12.2.2 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.

12.2.3 Secondly, due to the convex surfaces found on a turbine, light will generally be reflected in a divergent manner.

12.2.4 Thirdly, as with shadow flicker, certain weather conditions and solar positions are required before an observer would experience this phenomenon.

12.2.5 It is therefore concluded that the proposed Mynydd Maen Wind Farm would not cause a material reduction to amenity owing to reflected light.

12.3 Policy and Guidance

12.3.1 The update to 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.

12.4 Methodology

12.4.1 Analysis was performed on all properties within 10 rotor diameters of any turbine.

12.4.2 This shadow flicker assessment is based on turbines with a 117 m rotor diameter and the planning application includes a 50 m micro-siting distance for infrastructure. As such, this 50 m distance is added to the ten-rotor diameter 1170 m (10 * 117) distance to give a total distance of 1220m (1170 + 50) from any turbine.

12.4.3 Analysis has been undertaken for shadow flicker at all properties within 1220m from any of the 13 wind turbines.

12.4.4 This analysis takes into account 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 13 turbines, each with maximum tip heights of 149.9 m.

12.5 Results

12.5.1 With due reference to the DECC report, and an allowance for 50 m micro-siting, There are 51 properties that are predicted to experience shadow flicker in the assessment of the worst-case scenario.

12.5.2 The total amount of time that shadow flicker is experienced varies by property. The greatest number of hours per year for any property is 68 hours.

12.5.3 The shortest distance from any property to any turbine is 905 m, excluding any future micro-siting.

12.5.4 The above impacts represent a worst-case scenario for the following reasons:

a. The analysis assumes that there is always sufficient sunlight (i.e. lack of cloud cover) for shadows to be cast by the turbine.

b. The analysis assumes that there is always sufficient wind speed for the turbine to be operating.

c. The analysis assumes that the wind is always coming from the right direction for the turbine rotor to be facing towards the house, thus casting a moving shadow on the house.

d. The analysis assumes that the property has windows and/or glazed doors facing towards the turbine.

e. The analysis assumes that there is no shielding, e.g. in the form of trees, between the turbine and the property.

12.6 Mitigation

12.6.1 Mitigation measures can be incorporated into the operation of the proposed wind farm to reduce the instance of shadow flicker. Mitigation measures include planting tree belts between the affected dwelling and the responsible turbine(s) or shutting down individual turbines during periods when shadow flicker could theoretically occur.

12.7 References

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

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