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Shadow Flicker Assessment

Land off Bemersley Road, Bemersley Green, Knypersley, Staffordshire Moorlands, ST8 7QX

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1. Shadow Flicker Analysis

1.1. Introduction

1.1.1. This report examines the potential shadow flicker effects and safety issues relating to the installation and operation of the wind turbine proposed at land off Bemersley Road, Bemersley Green, Knypersley, Staffordshire Moorlands.

1.1.2. This proposed development consists of the following wind turbine parameters that are based on a preferred candidate wind turbine, the Enercon E44 Turbine. The Enercon E44 has a hub height of 45m supporting a 44m diameter rotor blade, with the overall height of the turbine being a maximum of 67m.

1.2. Shadow flicker

1.2.1. Shadow flicker is the term given to an effect that can occur under certain conditions when the sun passes behind a wind turbine and casts a shadow through narrow window openings which 'flicks' on and off within a neighbouring property.

1.2.2. Relevant guidance in the *Department of Energy and Climate Change: Update of UK Shadow Flicker Evidence Base*, 16 March 2011, states that there is unlikely to be an effect within a building if a wind turbine is located a distance greater than 10 × the rotor diameter. It will not happen where there is intervening topography, vegetation or other obstruction between the turbines and the house.

1.2.3. The likelihood and duration of the effect depends upon:

- orientation of the property's windows relative to the turbines: in the UK only properties within 130 degrees either side of north relative to the turbines can be affected as turbines do not cast shadows on their southern side;
- distance from the turbines: the further the receptor is from the turbine, the less pronounced the effect would be;
- turbine height and rotor diameter;
- time of year and day; and,
- weather conditions (cloudy days reduce likelihood).

1.3. Context for assessment

1.3.1. The following explanation of the shadow flicker effect is provided at paragraph 2.7.63 and 2.7.64 of the National Policy Statement for Renewable Energy Infrastructure (EN-3) issued in July 2011:

Shadow flicker is the effect caused when an operating turbine is located between the

sun and a receptor, such as a dwelling or place of work. The effect occurs when the shadow of the rotating blades falls over the dwelling causing the light intensity within specific affected rooms of the occupied building to fluctuate.

The potential significance of the effect is dependent on a number of factors:

- *the location of the relevant building relative to the path of the sun and the turbines;*
- *the distance of turbines from such buildings; the size of the window apertures and their location in the building relative to the turbines;*
- *the turbine height and rotor diameter;*
- *the presence of intervening topography, buildings or vegetation;*
- *the frequency of bright sun and cloudless skies;*
- *the time of the year; and*
- *the prevailing wind direction and hence usual rotor orientation.*

Research and computer modelling on flicker effects has demonstrated that there is unlikely to be a significant impact at distances greater than ten rotor diameters from a turbine. Therefore if the turbine has 80m diameter blades, the potentially significant shadow flicker effect could be observed up to 800m.

1.4. Methodology

1.4.1. Savills and One Associates have prepared an analysis of potential shadow flicker effect using bespoke industry software. This system takes into account the proposed development, the site location and identified properties in the surrounding area. It is calculated using the following parameters:

- A 440m radius (Rotor diameter × 10) from the turbine has been used as the maximum shadow flicker area boundary.
- Proposed turbine coordinates: 388869, 354524
- Height data is based on OS Terrain 5 Digital Terrain Model data on a 5m grid.
- The shadow flicker is based on a viewer height of 1.5m.
- The shadow flicker is based on a bare earth model, and as such does not account for the screening effects of settlement or woodland. As such the plan represents a potential 'worst case' scenario.
- Curvature of the Earth has been accounted for.

1.4.2. The output of this process produces a figure indicating the theoretical extent of shadow flicker.

1.4.3. According to the Update of UK Shadow Flicker Evidence Base published in 2011 by the Department of Energy and Climate Change[1], a property subjected to 30 hours or more of shadow flicker during one year (or more than 30 minutes per calendar day) is regarded as an effect that may require mitigation in the form of a control applied to the operation of the turbines.

1.5. Potential effects

1.5.1. The coloured shading shown on the drawing Shadow Flicker Plan (Ref: N294-GR-SF1-001B) accompanying this report indicates the areas that could possibly experience shadow flicker effects within the theoretical extent of shadow flicker, i.e. up to of 440m from the turbines (10 times the approximate rotor diameter of up to 44m).

1.5.2. No potential receptors are identified within the shadow flicker analysis plan.

1.6. Mitigation

1.6.1. Notwithstanding that no potential receptors have been identified by the shadow flicker analysis undertaken, should shadow flicker be experienced, a mitigation measure can be implemented.

1.6.2. A shadow flicker protocol can be secured by a planning condition imposed on a planning consent. If shadow flicker is reported from the property when the turbine is in operation, a detailed model would be prepared with specific survey information for each of the relevant windows, using their elevation, orientation and size. The owner would also be requested to record a 'log' of shadow flicker events.

1.6.3. In the event that the detailed modelling finds that shadow flicker effect occurs so as to cause significant effects within any residential property (30 hours or more of shadow flicker during one year or more than 30 minutes per calendar day), then stopping the turbine from rotating is the most effective mitigation measure. This can be achieved be programming the system that controls the operation of the turbine, causing it to shut down when a number of defined operating conditions coincide, such as:

- Specified times of the year and day that correspond with an identified period when shadow flicker is possible; and
- When a turbine-mounted photocell indicates that the sun is bright enough to give rise to an effect; and
- When the wind direction corresponds to an orientation of the turbine which could affect an identified receptor with shadow flicker.

1.6.4. EN-3 paragraph 2.7.68 states that with the use of such mitigation '*the IPC [Infrastructure Planning Commission] should be able to judge the shadow flicker impacts on that property to be of negligible significance*'.

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[1] http://www.decc.gov.uk/en/content/cms/meeting_energy/renewable_ener/ored_news/ored_news/uk_shad_flick/uk_shad_flick.aspx

1.6.5. The Planning Practice Guidance for Renewable and Low Carbon Energy published online (Paragraph: 020, Ref ID: 5-020-20140306, Revision date: 06.03.2014) also states[2]:

> *Modern wind turbines can be controlled so as to avoid shadow flicker when it has the potential to occur. Individual turbines can be controlled to avoid shadow flicker at a specific property or group of properties on sunny days, for specific times of the day and on specific days of the year. Where the possibility of shadow flicker exists, mitigation can be secured through the use of conditions.*

[2] http://planningguidance.planningportal.gov.uk/blog/guidance/renewable-and-low-carbon-energy/particular-planning-considerations-for-hydropower-active-solar-technology-solar-farms-and-wind-turbines/#paragraph_020 [last accessed 30.04.2014]

2. Conclusion

2.1. Summary and conclusions

2.1.1. The study has presented a worst-case scenario of possible shadow flicker effects without taking into account intervening vegetation, physical obstructions and assuming clear skies and constant sunshine all year round. The assessment has confirmed that no receptors would experience shadow flicker effect.

2.1.2. In the event that shadow flicker occurs and causes significant effects at any residential property, then mitigation can be implemented.

2.1.3. Shutting down the wind turbine is the most effective mitigation measure when operating conditions correspond to an identified period of potential shadow flicker. A shadow flicker protocol which would implement such mitigation can be secured by a planning condition imposed on a planning permission.

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