

Safety Considerations for the Location of a Single Wind Turbine on an Industrial Estate

This document has been prepared by Infinite Renewables Group Limited (IRGL) to inform decision makers on the safety protocols that are adopted in the construction and operation of single wind turbines in urban settings.

IRGL Development History

IRGL is a specialist merchant wind power and renewable energy scheme developer based in South Wales, UK. Infinite was formed in 2010 to develop renewable energy merchant power schemes for commercial clients on industrial and brownfield sites. Infinite currently co-owns, operates and manages a portfolio of 17 schemes totalling 10MW across the UK. IRGL specialises in providing embedded (private wire) generation to high energy off-takers, such as industrial and manufacturing businesses, resulting in a number of the developed and managed turbines being located on industrial estates. A selection of such turbines that are owned or managed in South Wales is included in Appendix A. This appendix also includes the height of each turbine to tip height, and the distance of the turbine from base to the nearest public highway (the topple distance). These examples demonstrate how these turbines have been permitted by local planning authorities in Wales where the topple distance exceeds the distance to the highway, as is the case for the proposed turbine at Kenfig Industrial Estate.

Site Suitability and Turbine Selection

When assessing suitable sites for wind turbine development, IRGL undertakes a site specific risk assessment. The risk assessment for the proposed wind turbine is included at Appendix B, informed by the international standard ICE61400 on wind turbine safety. ICE 61400 is a set of design requirements made to ensure that wind turbines are appropriately engineered against damage from hazards within the planned lifetime. The standards concerns most aspects of the turbine life from site conditions before construction, to turbine components being tested, assembled and operated, including tower and foundation design requirements, measurement of mechanical loads, lightning protection, full scale structural testing of rotor blades and gearbox design requirements.

As well as finding a site that is in close proximity to a high energy off-taker and/or has grid availability, a key determining factor in site selection is the commissioning of an independent Wind Resource and Site Suitability Assessment. This report is undertaken by Digital Engineering – a specialist energy consultancy in Bristol who create a detailed three-dimensional model of the terrain and ground features and apply weather data to calculate the average wind speed across the site at hub height, taking into account all the effects of vegetation, buildings and other local wind breaks.

This data is then used to inform what 'Wind Class' a site is, as set out in ICE 61400. Wind classes determine which turbine is suitable for the normal wind conditions of a particular site. Turbine classes are determined by three parameters - the average wind speed, extreme 50-year gust, and turbulence. The turbine selected for this site is an appropriate Class for the conditions on site.

Safety Record

Our selected model for this location is a Vensys 70 which is an IEC Class IIA machine and suitable for the wind speeds on site. Its steel tube tower is 64.4m in height. It has a cut out wind speed of 25

m/s , meaning that when wind speeds exceed this level for over 3 seconds, the machines will safely shut down.

A special feature of VENSYS wind turbines is the lubrication-free toothed belt for transmitting the force between the pitch drive and the rotor blade. This prevents wear as a result of corrosion or pitting which can be found in conventional rotor blade adjustment systems using gearing and drive pinions. The pitch system requires virtually no maintenance. Due to integrated special fibres, the toothed belt is also impervious to shock load and can easily be exchanged if the need arises. The blade pitch system has stood the test of time in the most diverse locations: impervious to moisture, dirt and temperature changes as well as constant exposure in areas with strong and turbulent winds. In addition, triple redundancy further enhances safety. The drive of each rotor blade comes with an energy storage device (capacitor), making sure that in the event of power failure the rotor blades can safely be driven into braking position.

IRGL will enter into a full operation and maintenance contract with Vensys for the life of the turbine to ensure all planned and reactive maintenance is undertaken, and the turbines are remotely monitored 24/7

Site Specific Considerations

Shadow Flicker

Rotating wind turbine blades can cast flickering shadows on sunny days. This can cause a safety or amenity issue on sensitive receptors such as residential premises or motorways. The schedule for when this shadow flicker becomes a concern for sensitive receptors, for a given sun illuminance threshold, can be determined in advance through a computer model.

The report generated by the computer model for the proposed Kenfig turbine was submitted with the planning application and demonstrates that the risk of shadow flicker from the Kenfig turbine to the M4 is very minimal - under the precise climatic conditions the maximum timeframe that shadow flicker could occur across the M4 motorway is 30 hours a year.

For shadow flicker to occur during the 30 hour period, exact climatic and other conditions must occur at the same time e.g. ;

- Wind Blowing from a precise direction
- sun shining i.e. no cloud cover
- particular time of year when sun is low in the sky

Shadow flicker is therefore unlikely, but in the event that all conditions occur at the same time, the turbine can be programmed to stop while these conditions prevail, and re-started once the conditions have changed.

To ensure the safe operation of the turbine, IRGL would accept the following condition be imposed on the planning permission for the turbine:

Unless otherwise agreed in writing with the Local Planning Authority, prior to the commissioning of the wind turbine hereby approved a shadow flicker management system shall be installed at the wind turbine for the purpose of controlling shadow flicker.

Ice Throw

Under icing conditions, all exposed parts of the wind turbine are liable to ice build-up. However, it has been observed that a moving turbine rotor is liable to accrete significantly heavier quantities of ice than stationary components. Furthermore, the rotor blade ice has the potential to be cast some distance from the turbine if it breaks off a rotating blade. Ice throw or ice falling from a stationary turbine poses a significant hazard to persons in close proximity to the turbine.

To minimise the risk of ice build-up on the turbine an Ice Detection system (BladeControl or equivalent) will be fitted to the turbine.

Under icing conditions the Ice detection system will automatically shut-down the turbine. The turbine will remain shut-down until:

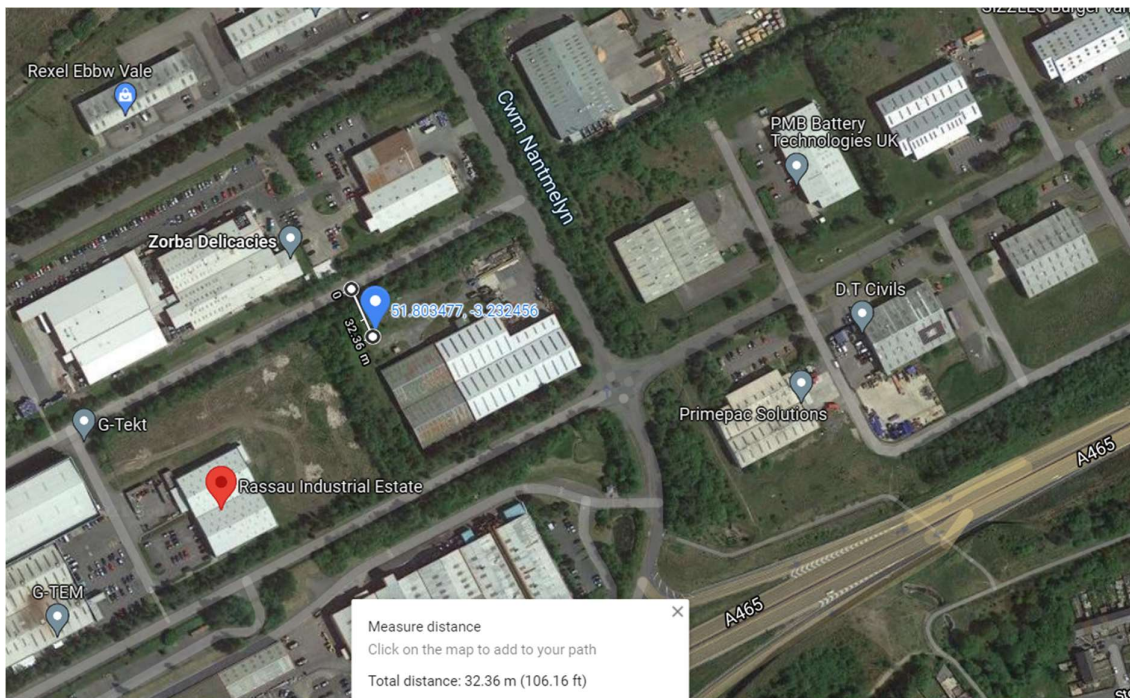
1. the turbine has been visually inspected by a competent person to check that the blades and other external components are clear of any ice
2. the ice detection system is manually reset at the turbine site and the start button is activated

To ensure the safe operation of the turbine, IRGL would accept the following condition be imposed on the planning permission for the turbine:

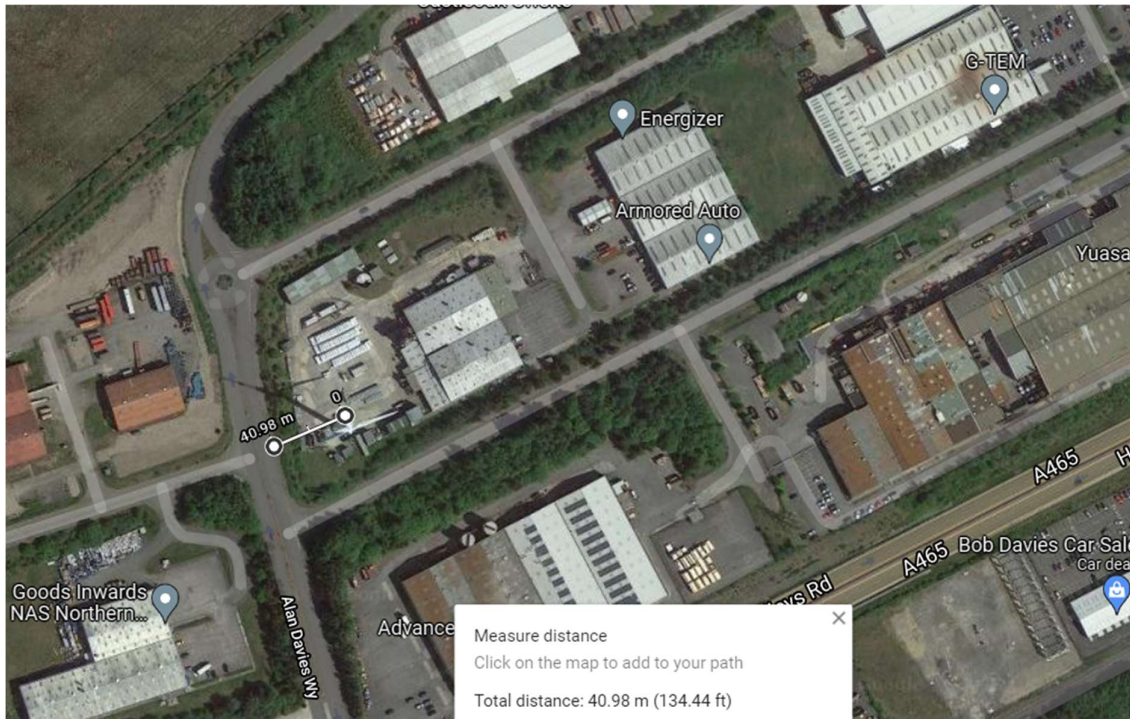
Unless otherwise agreed in writing with the Local Planning Authority, prior to the commissioning of the wind turbine hereby approved an ice detection management system shall be installed at the wind turbine which will automatically shut down the turbine under icing conditions.

Appendix A

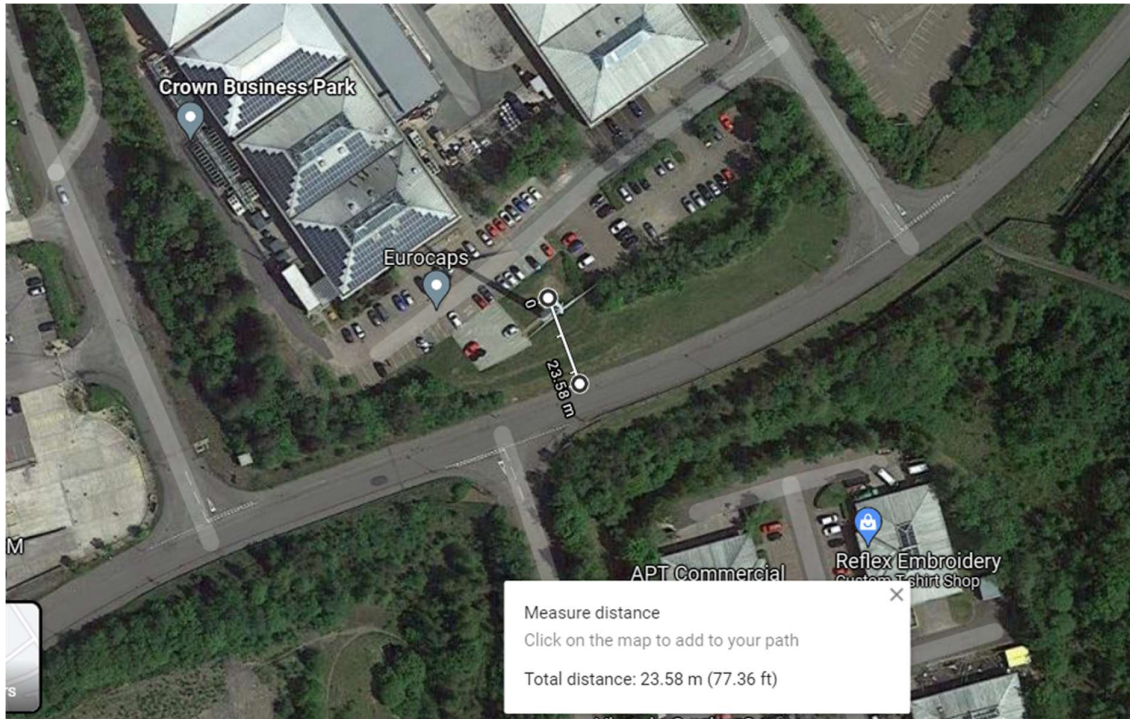
IRGL Developed Sites on Industrial Estates in South Wales



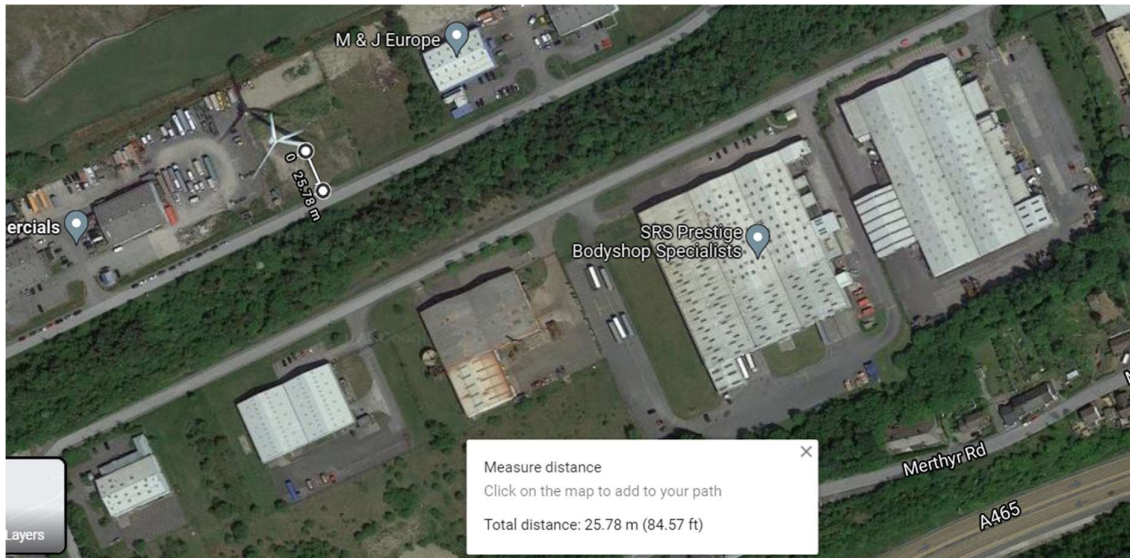
Unit 19 Rassau Industrial Estate – consented wind turbine 77m tip height



Redlands, Rassau Industrial estate – 74m tip height



Eurocaps – 45m tip height



Tafarnaubach Industrial Estate – 77m tip height

Appendix B

Risk Assessment