



Safety and Operational
Management

Haverigg III Wind Farm

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1 Introduction

1.1 Haverigg III Wind Farm

Haverigg III wind farm consists of four Vestas V52 wind turbines, each with a rated capacity of 850kW, along with the associated access tracks, underground cabling and site substation. The turbines were installed in 2005.

The site is managed by WPO for the site owner, Windcluster Ltd. WPO is a long established and highly experienced manager of renewable energy assets, with a Europe-wide portfolio of over 5GW. The turbines continue to be maintained by Vestas Wind Systems A/S, which was responsible for their installation and has been responsible for their maintenance throughout their operational life to date. The site high voltage electrical equipment is maintained and inspected by High Voltage (HV) specialist Freedom Group. Elements of the electrical equipment at the substation is the responsibility of the District Network Operator, Electricity North West, and is maintained by them along with the wider electricity distribution network.

There is no public right of access to the site or within proximity of the wind turbines. Land around the wind turbines is used for livestock grazing. Other activities take place on the site occasionally, with the landowner's permission including events associated with a motocross track.

1.2 Windcluster Ltd

Windcluster Ltd is a privately owned wind energy company. It developed and constructed its first project (called Haverigg I) at Haverigg airfield in 1992, the second commercial windfarm in the UK. The company owned and operated this project until 2005, when the five original wind turbines were taken down and replaced by four larger, more modern variants. The original turbines were sold to new owners and continue to operate. The new four-turbine project was called Haverigg III and is 100% owned by Windcluster Ltd.

1.3 Bridge Wind Management Ltd (BRIDGE)

BRIDGE has been engaged by both Windcluster Ltd. (owner of Haverigg III) and Thrive Renewables (owner of the neighbouring Haverigg II) to coordinate technical aspects of extending operational activities of both wind farms beyond their current respective consented planning permission.

BRIDGE is an independent, privately owned, pan European onshore and offshore wind asset manager. The group has a presence in both the UK and Germany and offers comprehensive financial, commercial and technical management. The team consists of engineers, financial professionals, IT specialists, accountants and internal legal.

BRIDGE currently provides technical, data analysis, corporate and financial services to twelve UK onshore wind farm projects and is involved in the management of a total of over 400MW of generating capacity.

1.4 Purpose of this Document

This document provides an overview of the safety and operational management of the Haverigg III wind farm. It describes how the owner, Windcluster Ltd., with the support of its appointed contractors, manages the safe and efficient operation of the turbines, and confirms that they will continue to do so.

2 Regulatory Context

2.1 Legislation and Regulation

The Haverigg III wind farm is operated in accordance with all relevant UK legislation and regulation.

The principal legislation relating to health and safety risks for onshore wind energy projects in England, Scotland and Wales is the *Health and Safety at Work etc. Act* (HASWA) 1974. It sets out general health and safety duties, without being specific to an industry sector.

The HASWA makes those who create risks in the course of work activity, for example employers, workers or those in control of premises, responsible for protecting workers and the public from the consequences of their activities. It also established the Health and Safety Executive (HSE) as the regulator and a system for more prescriptive regulations to be made to address specific activities and hazards. The Lifting Operations and Lifting Equipment Regulations 1998 (LOLER), which address lifting (work involving cranes, hoists etc) are an example of such regulations applicable to wind farms.

Such regulations are supported by Approved Codes of Practice (ACoPs), which provide further guidance on how to comply with regulatory requirements. For example, LOLER is supported by the *Safe Use of Lifting Equipment ACoP*.

In addition, industry-specific regulation on electricity generating, transmission and distribution equipment, the *Electricity Safety, Quality and Continuity Regulations* (ESQCR) 2002, is applicable to wind farms. These cover technical and reporting requirements on the safety of electrical equipment and place duties on the generator (wind farm owner) and on Distribution Network Operators, including periodic inspection of networks and provision of approved warning signage.

As a result of the above, a range of safety measures are applied at the wind farm by Windcluster Ltd. and WPO, to comply with specific requirements set out in regulation and to fulfil their broader health and safety duties. These include

- Risk assessing the site and all work to be carried out;
- Regular inspection and maintenance (further detailed in Section 3.2 below);
- Ensuring all contractors engaged to work at the site are competent and adequately resourced to carry out their work;
- Putting plans in place to manage emergencies; and
- Displaying suitable warning signage and emergency contact information at the site.

2.2 Planning

The Haverigg III wind farm was granted planning consent by the Local Planning Authority in August 2002.

The consent does not contain any conditions which relate directly to the safe operation of the scheme, as this is properly addressed by the above legislation and regulation. However, it does stipulate a time limit of 20 years from first connection of the site to the electricity grid, which the site owner is now applying to vary. It also requires that any turbine that does not generate electricity for a continuous period of 6 months must be removed. This provides assurance that the turbines are not permitted to be left in an unserviceable condition for an extended period.

3 Site Operation and Maintenance

3.1 Vestas V52 Wind Turbine

The turbines were supplied by Danish wind turbine manufacturer, Vestas Wind Systems A/S. Vestas is one of the largest wind turbine manufacturers in the world and has a long track record in wind energy, having supplied its first wind turbine in 1979 and installed a total capacity of over 100 GW to date. Vestas released the V52 model in 2000. Several thousand of the units have been installed worldwide.

The turbine design is characterised by a simple and robust construction, typical of wind turbines of this period, and based on the manufacturer's many years of experience. It consists of:

- a conical tubular steel tower on a concrete foundation;
- gearbox, generator, converter and other ancillary equipment in a nacelle with a steel / cast iron base frame and glass fibre casing;
- 3 bladed upwind rotor (composite fibre blades and cast iron hub);
- control equipment; and
- a transformer, located in the tower base.

The turbine is pitch regulated, with the blades being constantly adjusted to the optimal position for current wind conditions. When the turbine requires to shut down, braking is achieved by pitching the blades. The pitching is fail-safe and a mechanical brake is also provided on the high-speed shaft.

The turbine control system provides for automatic operation, monitors a range of parameters

to ensure safe operation (vibration, temperatures, hydraulic system pressure etc.), and shuts the turbine down in a safe manner should a fault occur. The wind turbines are equipped with a SCADA system that sends alerts to the operator when faults occur and allows access to various operational data and parameters. In an emergency the turbines can be shut down remotely.

The Haverigg III wind turbines were designed and specified in accordance with IEC 61400, a series of international standards for wind turbines, first issued in 1999. Along with a range of other technical matters, the standards consider design, safety and reliable operation. IEC 61400-1 includes a system of classification based on the average wind speed, extreme (gust) wind speed and turbulence that a turbine is designed to withstand. The Haverigg III wind turbines are class Ia machines, which corresponds to an average wind speed of 10m/s, an extreme wind speed of 70m/s and a turbulence intensity of 18% at 15m/s wind speed. The actual wind climate at the site, as assessed for the development of the Haverigg III project and a previous scheme at the same location, known as Haverigg I, is substantially more benign than these conditions. This provides confidence that the wind turbine design is more than sufficient for the site. It would be expected to have considerable serviceable life remaining.

3.2 Routine Inspection and Maintenance

Wind Turbines

The wind turbines are maintained by Vestas Wind Systems A/S under their AOM 4000 contract, the most comprehensive service offered by the company. In accordance with its standard maintenance protocols for this turbine model there is a programme of 6 monthly, annual and 4 yearly maintenance activities. The maintenance includes a wide range of checks including (but not limited to):

- Visual checks of all major components
- Oil sampling and filter changes
- Lubrication
- Bolt tightness checks
- Electrical and control system checks
- Operational and safety system checks (yaw, blade pitch, emergency stop, brakes etc.)

Windcluster Ltd also employs WPO (an internationally experienced company) as the local asset manager. WPO carries out regular internal and external visual inspections of the turbines on behalf of Windcluster Ltd., to confirm they remain in suitable condition.

Where any of the above checks indicate the turbines or equipment are not in the desired

condition, repairs are carried out.

Statutory Inspections

Certain safety related equipment is subject to routine inspections defined by regulation. Such inspections are carried out by competent specialists. They include annual statutory inspections of anchor points, ladder fall arrest systems and emergency equipment (e.g. fire extinguisher, rescue kits).

High Voltage Equipment

All high voltage electrical equipment at the site, including the turbine transformers, is inspected on an annual or six-monthly basis and more in-depth maintenance carried out every four years.

Other Site Infrastructure

Other site infrastructure such as gates, access tracks, signage and the substation building are routinely inspected by WPO in its role as asset manager, typically monthly.

Schedule

The site inspection and maintenance schedule is managed and monitored by WPO to ensure that all necessary activities are carried out. A typical annual schedule is set out in Figure 1 below. Actual dates are defined and adjusted as necessary to allow for weather conditions and other non-routine activities at site.

Activity	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
Turbine Annual Service												
Turbine Semi-Annual Service												
Statutory Inspections												
Turbine HV Inspection												
HV 6 Monthly Inspection												
HV 4 Yearly Maintenance			2021									
Site Manager Inspections												
Site Manager HSQE Audit												
Site Manager Turbine Inspection												

Figure 1: Typical Planned Inspection and Maintenance Schedule

WPO and Windcluster work with Windcluster's other appointed contractors to follow industry good practice, ensuring that the routine maintenance programme and the scope of each maintenance activity carried out remains suitable and up to date.

3.3 Site Monitoring

As noted above, the wind turbines are equipped with a SCADA system that sends alerts to the operator should a fault occur and allows access to various operational data and parameters. The SCADA system will safely stop a turbine automatically for certain fault codes, allowing any anomaly to be properly investigated before the turbine is restarted.

As well as monitoring for alerts, the SCADA system is checked for correct operation four times per day. Faults are investigated by the operator remotely and either reset, where it is safe to do so, or a maintenance team dispatched to site to carry out further checks and repairs.

WPO monitors turbine performance based on data from the SCADA and reports monthly to the owner, Windcluster Ltd. Any issues identified are investigated and corrective actions progressed where necessary.

The turbines are also monitored by Vestas under their AOM4000 contract.

A 24-hour control room provides additional ad hoc monitoring, manages safe access and egress to the site and co-ordinates an emergency response should it be required at any time of day or night.

In addition to the automatic and remote site monitoring arrangements, Windcluster Ltd. has a local site representative appointed who lives nearby and visits the site frequently. A part of their contracted role is to visually and aurally check turbine operations, reporting anything unusual to the site managers.

3.4 Non-Routine Maintenance

Should a fault be identified through routine inspections, maintenance or monitoring, action is taken to resolve it.

In the case of wind turbine faults, repairs are normally carried out by Vestas Wind Systems A/S. Additional specialist services are sourced where required, for example for glass fibre repairs to blades. Repairs to high voltage equipment are carried out by the owner's appointed HV contractor, Freedom Group. Repairs to other infrastructure such as tracks and buildings are procured from competent contractors on a case by case basis, using local providers where possible.

Any fault or issue considered to have a safety implication is prioritised and addressed as soon as reasonably practicable. Windcluster Ltd. has suitable arrangements in place with its turbine

maintenance and HV contractors to ensure a prompt response.

Other repairs are scheduled according to contractor availability and may be undertaken alongside planned maintenance visits or in suitable weather windows. WPO, as site manager, maintains records of all maintenance actions, to ensure they are closed out.

3.5 Additional Specialist Advice

In addition to the routine inspection and maintenance activities set out in Section 3.2, the wind farm owner commissioned detailed independent inspections of the wind turbines to inform its decision to consider extending operations. The inspections were carried out by energy and renewables industry specialist DNV GL during June 2019. They found that the turbines are currently in a generally good condition and did not identify any apparent visible barriers to potential extension of their operation. They did identify certain areas where action was required to prevent deterioration which could eventually affect ongoing operation. Windcluster Ltd., supported by WPO and Vestas Wind Systems A/S, is progressing the necessary actions.

Actions completed since the inspection include repairs to small blade defects, in order to prevent the damage from progressing and various small housekeeping items. Actions in progress include removal of corrosion and recoating of areas on the tower base flanges on all turbines and addressing minor surface corrosion at other locations on Turbine 3. The other turbines will be monitored, and any notable surface corrosion spots will be remedied as required.

Most recently, the turbines have been remotely inspected using drone-mounted cameras and this process will become a regular part of the turbine monitoring.

The owner will continue to engage specialist advice where this adds value to the normal maintenance regime or is deemed necessary to fulfil its safety obligations. This could for instance involve further detailed one-off inspections or additional analysis. The owner expects to commission additional analysis of the prevailing wind conditions at the site and the turbine design characteristics, to assist in quantifying the remaining serviceable life of the turbines and any necessary refurbishment.

4 Summary

As a responsible owner, Windcluster Ltd. ensures that the Haverigg III wind farm is operated in accordance with all relevant UK legislation and regulation and the planning conditions applied when it was consented.

Windcluster Ltd. engages competent contractors to manage the site, monitor performance

and carry out routine, reactive and proactive maintenance. Where necessary, it brings in third-party specialists to carry out inspections required by regulation or statute, make specialist repairs and provide additional advice.

Maintenance and inspection schedules and corrective actions are monitored by WPO, as Windcluster's appointed asset manager to ensure they are closed out.

The proper operational management of the site ensures it operates and can continue to operate safely and efficiently.

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