

14 Electromagnetic Interference and Aviation

Electromagnetic Interference

Introduction

- 14.1 Wind turbines can potentially interfere with communication systems that use electromagnetic waves as the transmission medium (e.g. television, radio or microwave links). Any effect depends on the turbine design and location and the fact that wind turbine rotors are not stationary. Any structure can result in the potential disruption of electromagnetic signals, either where the development creates a ‘shadow’ or where it gives rise to a ‘reflection’¹.
- 14.2 To address this issue, RES has consulted widely with all relevant organisations and system operators, which could be affected by the proposed wind farm. A summary of the comments received from consultees are shown in Table 14.1.

Television Reception

- 14.3 Wind turbines have the potential for causing interference to television reception, primarily where a viewer is in the ‘shadow’ of, and within a few kilometres (km) of, the wind farm, with their TV aerial pointing towards the wind farm. Viewers in such locations can have their signal ‘scattered’ causing loss of picture detail, loss of colour or buzz on sound. Viewers situated to the side of a wind farm in relation to a transmitter may experience periodic reflections from the blades, giving rise to a delayed image or ‘ghost’ on the picture, which is liable to flicker as the blades rotate.
- 14.4 RES has gained considerable experience in this area and in practice problems are only experienced when the receiver already has a poor signal. Specifically, if the wind farm is illuminated by the TV transmitter, problems can occur when the receiver has no line of sight to the transmitter, but has a clear line of sight to the wind farm.
- 14.5 It is also possible for a wind farm to interfere with TV rebroadcast (RBL) links or super high frequency (SHF) links that carry the TV signal between transmitters. However, such interference is predictable and is screened by the network operators.

Microwave Communications

- 14.6 Microwave links can be affected by reflection, scattering, diffraction and blocking caused by wind turbines in their ‘line of sight’. In general, the directional nature of microwave links means that interference can be avoided by defining clearance zones beyond which any degradation will be insignificant².

Effects Assessed in Full

- 14.7 Following consultation with all relevant organisations and system operators the following areas were identified as requiring full consideration or assessment:
- TV reception

¹ OfCom (The Office of Communications), August 2009, Tall structures and their impact on broadcast and other wireless services.

http://licensing.ofcom.org.uk/binaries/spectrum/fixed-terrestrial-links/wind-farms/tall_structures.pdf

² RES Ltd (2002). ‘Microwave Interference Field Study: Nine Canyon Wind Farm Final Report’, Communications, Control and Electrical Engineers Inc., November 2002. Report available from RES Ltd.

- Microwave links

Effects Scoped Out

- 14.8 Reports of new structures causing problems to radio reception are rare³ due to the lower frequencies used being able to pass through obstacles more readily than higher frequency TV signals. It is therefore anticipated that radio services in the area will not be materially affected by the proposed wind farm and no further assessment has been carried out.

Issues Identified During Consultation

- 14.9 For the purpose of safeguarding domestic TV reception in the UK, both the BBC and the Office of Communications (Ofcom) have responsibilities and jurisdictions. Arqiva are responsible for safeguarding TV RBL and SHF links in the area of Solwaybank Wind Farm.
- 14.10 Ofcom has been consulted with respect to broadcast TV and telecoms links in the area
- 14.11 Table 14.1 provides a summary of the consultation with relevant organisations and system operators.

Table 14.1: Consultee Communication

Consultee	Consultee Feedback	Response
OfCom	<p><u>Television</u></p> <p>In first instance developers should use the BBC online tool available on the internet (http://www.bbc.co.uk/reception/info/windfarm_tool.shtml). If potential interference is highlighted by this tool, a more sophisticated interference assessment should be applied.</p> <p><u>Telecoms</u></p> <p>Advised to consult Cable & Wireless, Orange and Vodafone</p>	<p>RES have produced a detailed assessment.</p> <p>All operators were contacted directly</p>
Atkins Global	No Objection	
Arquiva	Confirmed responsibility for RBL and SHF links in the area and have no comment regarding wind farm proposals	
BT	No Objection	
Cable & Wireless	Links identified and turbines spaced to operator requested clearance	Identified links were added to constraints map
Joint Radio Company (JRC)	No Objection	
O2	No Objection	
Orange	No Objection	
T-Mobile & 3G	No Objection	

³ OfCom, ‘Tall structures and their impact on broadcast and other wireless services’ (2009)

http://licensing.ofcom.org.uk/binaries/spectrum/fixed-terrestrial-links/wind-farms/tall_structures.pdf

Consultee	Consultee Feedback	Response
Vodafone	Links identified and turbines spaced to operator requested clearance	Identified links were added to constraints map

Assessment Methodology

Television Reception

- 14.12 Ofcom's policy is that in the first instance developers should use the BBC online tool available on the internet (http://www.bbc.co.uk/reception/info/windfarm_tool.shtml). If potential interference is highlighted by this tool, a more sophisticated interference assessment should be applied. As potential interference was identified, RES has produced such an assessment for the proposed wind farm.
- 14.13 RES has performed a full technical assessment through prediction modelling of the scale and location of TV interference that might occur as a result of the proposed wind farm. The prediction model is based upon International Telecommunication Union (ITU) recommendations on signal propagation and impairment to television reception by wind turbines (ITU-R, 805⁴ & 526-8⁵). The model is generally conservative, using a high value of signal reflectivity from the turbines, and assuming that reflections from different turbines all add in-phase. The model has been validated using data from existing operational wind farms where TV interference was predicted prior to construction.
- 14.14 The assessment consists of three stages. The first is an analysis of TV coverage from the transmitters in the area and the second is the prediction of possible interference to reception from each transmitter in turn. Finally, an assessment of practical solutions is performed based on the predictions of coverage and potential interference.
- 14.15 The assessment considered the Caldbeck, Sandale, Cambret Hill and Langholm transmitters and covered all locations within a 10 km radius of the proposed wind farm.
- 14.16 Online investigation suggested that the Sandale transmitter ceased transmitting TV signals in 2009, however, the BBC online tool still highlights that the transmitter may be affected by the proposed wind farm, therefore, it has been included in the assessment below for completeness.
- 14.17 A cumulative assessment was also completed using representative layouts from Minsca, Ewe Hill and Craig wind farms.

Wind Farm Layout Considerations

Microwave Communications

- 14.18 A methodology to calculate clearance zones for wind turbines has been defined in a paper published by Ofcom (Bacon, 2002)⁶.

⁴ International Telecommunication Union / ITU Radiocommunication Sector (ITU-R), 2001. P805 Assessment of Impairment to Television Reception by a Wind Turbine.

⁵ International Telecommunication Union / ITU Radiocommunication Sector (ITU-R), 2001. P526-7 Propagation by Diffraction.

⁶ Bacon, D.F. (2002) 'Fixed-link wind-turbine exclusion zone method: A proposed method for establishing an exclusion zone around a terrestrial fixed radio link outside of which a wind turbine will cause negligible degradation of the radio link performance.', Published on Radio communications Agency Website, www.radio.gov.uk, Version: 1.1.

- 14.19 RES consulted widely with organisations and system operators, which could be affected by the proposed wind farm, details are listed in Table 14.1. All microwave links identified as near or passing through the proposed wind farm site were taken into account during layout design to ensure operator defined clearance to wind turbines were adhered to.

Potential Effects

Television Reception

- 14.20 The coverage model confirmed that high signal levels are achieved around the proposed wind farm from the Caldbeck and Sandale Transmitters which are both located to the south of the proposed wind farm. The Langholm transmitter, located to the east, provides good coverage to the north-east and east of the proposed wind farm. The Cambret Hill transmitter is located 80 km from the proposed wind farm and as such has poorer coverage in the area of the proposed wind farm.
- 14.21 Application of the interference model showed that the Sandale and Caldbeck transmitters are predicted to suffer interference in a localised area directly to the north of the proposed wind farm, potentially a small pocket to the south-west and also to the north-east around the area of Langholm village. Interference to the Langholm transmitter is expected to the west of the proposed wind farm.
- 14.22 A cumulative assessment was completed (using representative layouts from Minsca, Ewe Hill and Craig wind farms) which identified areas where the service could be further degraded by the proposed wind farm in addition to other wind farms. There were a small number of localised properties located to the north and south-west of the proposed wind farm identified as potentially affected by both the Solwaybank Wind Farm and other wind farms if they are tuned into the Caldbeck or Sandale services, however, the TV interference experienced could be resolved using measures outlined in the mitigation section.
- 14.23 Interference is predicted in the Langholm area to the services provided by Sandale and Caldbeck transmitters, however, properties in the area will most likely be tuned-in to the local Langholm transmitter as the signal is much stronger, therefore affected properties will be minimal.

Mitigation

Television Reception

- 14.24 The BBC states that in the event of reception problems, there may be straightforward solutions such as improving receiving aerials or providing the affected households with an alternative source of suitable television signals from a different transmitter, from an existing cable system or in certain circumstances from a satellite. The BBC also states that, where a new development causes reception problems, they look to the developer to rectify these, and planning authorities sometimes require a legally binding commitment under a Section 75 agreement (made under the Town and Country Planning (Scotland) Act 1997 as amended) to ensure the developer meets the cost of investigating and rectifying any problems that may arise. If the proposed wind farm achieves planning permission, RES will carry out a benchmark survey of television reception quality in the area around the proposed wind farm site prior to construction starting. This would provide reference points against which future measurements could be compared once the proposed wind farm is constructed and enable any remedial measures to be implemented expeditiously.

- 14.25 Analysis has demonstrated that there will be no widespread interference to TV reception however should they be required a range of viable mitigation measures are available and the most appropriate solution must be decided on a case by case location specific basis. Solutions include:
- improved aerial system; by improved directionality, increasing aerial height, directing aerial away from or shielding from the proposed wind farm;
 - alternative transmitter; tuning existing aerial to one of the other main transmitters in the area. The Langholm transmitter is predicted to provide an adequate, interference free signal to the area north of the proposed wind farm; and
 - digital TV (terrestrial free view or satellite); likely to be an improvement to television service and can be installed if necessary.
- 14.26 Any necessary work would be carried out in a timely manner by RES at its own expense. Given the limited extent of any predicted interference, the need for corrective action would best be identified once the benchmark site survey has been undertaken and the proposed wind farm is commissioned.
- 14.27 Digital switchover in the Dumfries and Galloway area was completed during 2009. Digital signals are less susceptible to degradation and interference from wind turbines and consequently any problems will be reduced.

Aviation and Seismic Monitoring Stations

Introduction

- 14.28 Wind turbines can potentially interfere with aviation operations by either physically affecting the safeguarding of an aerodrome⁷ by the close proximity of the turbines or through interference with the Air Traffic Control (ATC) radars that direct aeroplanes and helicopters in flight.
- 14.29 The main mechanism through which the wind turbines interfere with radars is through either reducing the sensitivity of the radar in the area around the proposed wind farm such that aircraft are not picked up by the radar, or the wind turbines returns causing confusion in the processors, leading to turbines being dealt with as planes would, painting false plots on the radar operator's screen.
- 14.30 The Ministry of Defence (MoD) has several other types of radar (other than ATC) and infrastructure that are safeguarded by the Defence Infrastructure Organisation (DIO).
- 14.31 Further information can be found in the "Wind Energy and Aviation Interests" report⁸ and the Civil Aviation Authority's CAP764 'Policy and Guidelines on Wind Turbines'⁹.
- 14.32 To address this issue, RES has consulted widely with all relevant organisations which could be affected by a proposed wind farm. Results of the consultations are in paragraphs 14.34 - 14.40.

⁷ CAA (Civil Aviation Authority), 2007a. CAP 168: Licensing of Aerodromes. Available from: <http://www.caa.co.uk/docs/33/CAP168.PDF>

⁸ Wind Energy and Aviation Interests, Interim Guidelines Report 2002 <http://www.bwea.com/pdf/Wind-Energy-and-aviation-interim-guidelines.pdf> ,

⁹ CAA (Civil Aviation Authority), 2011. CAP 764: CAA Policy and Guidelines on wind Turbines. Available from: <http://www.caa.co.uk/docs/33/Cap764.pdf>

Consultation

- 14.33 An initial consultation response from NATS En-Route Ltd. (NERL) in 2000 raised no concerns, and subsequently, a re-consultation was conducted in 2006 to inform the scoping opinion provided by Dumfries and Galloway Council (DGC). Due to a change in NERL's wind farm assessment strategy, an objection was received to this 2006 consultation, owing to a detrimental impact to the radar service offered by the Lowther Hill radar.
- 14.34 The DIO and the Civil Aviation Authority were consulted using the protocol and proforma agreed with Renewable UK. DIO safeguard all Ministry of Defence (MoD) and Met Office infrastructure that could be affected by the presence of wind turbines. Similarly, the Civil Aviation Authority (CAA) highlighted in its response any other aviation stakeholders that should be consulted that may be affected by the proposed development.
- 14.35 The CAA was consulted in 2008 and responded with advice that Carlisle airport should be consulted. The CAA has subsequently stopped its pre-planning consultation service and therefore it has not been possible to re-consult.
- 14.36 Carlisle airport was consulted in 2008 and responded with no concerns. RES re-consulted in 2011 and, following the completion of a short report by an aviation consultant which identified no potential effects upon operations at the airport, subsequently Carlisle airport confirmed it had no concerns.
- 14.37 The DIO was first consulted in 2002 (named Defence Estates until 2011) and responded with no objection. A subsequent consultation was sent in 2008 and a response received with an objection to the wind farm based on both low flying considerations and potential effects on the Eskdalemuir Seismological Recording Stations.
- 14.38 The 2010 DIO response stated that the MoD would require that the wind turbines are fitted with infrared lighting. The properties of the infra-red light mean it is invisible to the naked eye, but visible to pilots wearing night vision goggles.

Wind Farm Layout Considerations

- 14.39 Through consultation with DIO and the Ministry of Defence Low Flying representatives, the turbine layout was re-designed and in 2010, consultation with the DIO confirmed that the new turbine layout was adequate for the removal of the MoD objection on the basis of low flying.

Mitigation Measures

Aviation

- 14.40 In 2009, a group was set up under the leadership of the Scottish Government, to conduct a strategic review of wind farms in the South West Scotland region and the aviation objections that were related to these projects, to devise a strategy to mitigate and release as many megawatts of wind power as possible from the planning system (South West Scotland Aviation Solution Final Report 2010)¹⁰. NERL was party to this report and the Solwaybank Wind Farm objection was included in this assessment. The conclusion of the report was that a NERL endorsed mitigation was available that would resolve the impact of Solwaybank Wind Farm on the Lowther Hill radar and thereby remove the NERL objection.

¹⁰ South West Scotland Aviation Solution Final Report, 2010. <http://www.scotland.gov.uk/Resource/Doc/917/0094738.pdf>

- 14.41 The NERL Lowther Hill primary surveillance radar is in line-of-sight to the wind farm and will therefore be affected due to either reducing the sensitivity of the radar in the immediate vicinity of the wind farm or painting false plots on the radar operator's screen. The mitigation proposed under the 'South West Scotland Aviation Solution' for Solwaybank is to 'blank' the area over the wind farm on the radar operator's screen and replace the data displayed with that from the NERL Great Dun Fell Radar, which does not have line-of-sight to the wind farm. This would exploit the NERL multi-radar tracking technology which is already in operation, and the result would be that the full effects of the wind farm are removed from the Lowther Hill radar.
- 14.42 The wind turbines will be fitted with MoD approved infrared lighting to comply with the MOD request.
- 14.43 The MoD and the relevant Air Traffic Services bodies would be notified of the construction timetable, wind turbine locations and dimensions prior to construction.

Seismic Monitoring Station

- 14.44 The MoD's Eskdalemuir Seismological Recording Station is very sensitive to ground propagated vibrations at certain frequencies. Construction of the wind farm may result in extra vibrations being produced by the wind turbines, subsequently raising the existing noise at the seismic array. Currently trials are being undertaken to measure the efficacy of using damping technology to reduce the wind turbines vibrations in the critical frequencies. Similarly, turbine manufacturers are currently investigating using existing damping technology to reduce the impacts at the critical frequencies. RES would intend to install turbines that would have suitable technology included to minimise the effects on the seismic array.
- 14.45 There is currently work being undertaken on the Eskdalemuir related issues to identify mitigation and also liaise with the Ministry of Defence to ensure that any solutions meet their specifications. One particular type of mitigation is currently in a trialling process.