

Appendix 15.4

Amateur Radio Commentary

Y Bryn Wind Farm

February 2022

PLANNING SOLUTIONS FOR:

- Solar
- Telecoms
- Railways
- Defence
- Buildings
- Wind
- Airports
- Radar
- Mitigation

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ADMINISTRATION PAGE

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INTRODUCTION

Purpose of this Document

This document presents an initial commentary about potential amateur radio (including RAYNET) concerns as a result of the Y Bryn wind development.

Amateur Radio Overview

Amateur radio (also known as ham radio) users typically transmit messages to other amateur radio users and is generally used for recreational purposes. An explanation of amateur radio is provided by the Radio Society of Great Britain (RSGB) below.

"Amateur radio is a popular technical hobby and volunteer public service that uses designated radio frequencies for non-commercial exchange of messages, wireless experimentation, self-training, and emergency communications.

...

As a radio amateur you are able to transmit radio signals on a number of frequency bands allocated specifically to the radio amateurs.

Radio amateurs make use of their frequencies in a number of ways:

- *Contacting people all over the world by radio which often leads to developing international friendships*
- *Competing in international competitions to test how effective your equipment is, and how good you are as an operator*
- *Technical experimentation – many of the leaps forward in radio technology have been initiated by radio amateurs*
- *Communication through amateur space satellites or with the International Space Station (which carries an amateur radio station)*
- *Providing communications at times of emergencies and undertaking exercises to ensure you keep the capability to do so."*¹

Amateur radio users can use a number of frequencies² including 136Khz LF band, HF bands, VHF bands, and UHF bands. The most popular frequencies used by amateur radio users are HF bands some of which are listed below in the table on the following page³. The HF band contain lower frequencies and therefore are generally less susceptible to interference issues stemming from physical blocking of the signal than those at higher frequencies.

¹ Source: <https://rsgb.org/main/get-started-in-amateur-radio/what-is-amateur-radio/>

² LF = Low frequency, HF = High frequency, VHF = Very high frequency, and UHF = Ultra high frequency.

³ Source: <https://rsgb.org/main/operating/band-plans/hf/>

Bandwidth	Frequency Range
80m.	3.500 – 3.800MHz.
60m.	5MHz.
40m.	7.000 – 7.200MHz.
30m.	10.100 – 10.150MHz.
20m.	14.000 – 14.350MHz.
17m.	18.068 – 18.168MHz.
15m.	21.000 – 21.450MHz.
12m.	24.890 – 24.990MHz.
10m.	28.000 – 29.700MHz.

HF bands used by amateur radio users

RAYNET Overview

Radio Amateurs' Emergency Network (RAYNET) is an amateur radio charity that provides communication support to emergency services, if required. It was created following the North Sea flood of 1953, whereby communication channels were damaged. An overview of RAYNET activities shown on their website is presented in Appendix A.

RADIO TRANSMISSIONS OVERVIEW

Sources

Radio services are provided by numerous transmitters within the UK, including television transmitters.

Radio services are broadcast digitally (DAB services) and as analogue services (such as FM). Frequencies can be:

- Protected for use by emergency services.
- Commercially licensable to private operators.
- Available for hobbyists / amateur radio operators.

Receivers

Receivers for radio services in general include mobile users, including within vehicles and dwelling locations. Amateur radio operators can communicate with each other over great distances, even internationally.

Susceptibility of Radio Transmissions to Wind Turbine Interference

Radio services are, in general, more robust to interference than some other wireless transmissions such as television signals. This is partly because radio services are audio only and that radio systems are generally designed to operate in a dynamic environment and spanning great distances over varying terrain.

Reported impacts on radio signals due to wind developments are very rare in practice. In Pager Power's experience effects from wind farms on radio services are very rare beyond distances of 5 km.

Ofcom's advice regarding radio interference (written in the context of commercial broadcast radio but presented for technical reference purposes) includes the below⁴.

"Although reports of new structures causing problems to radio reception are rare, the possibility of difficulties cannot be ruled out entirely. Broadcast radio (FM, AM and DAB digital radio) are transmitted on lower frequencies than those used by terrestrial TV signals. Lower frequency signals tend to pass through obstructions more easily than the higher frequency TV signals, and diffraction effects also become more significant at lower frequencies. Both these factors will tend to lessen the impact of new structures on radio reception.

Strong signal reflections will reduce the quality of FM reception leading to fluttering noises or sound distortion. In contrast, the signal format used for DAB digital radio is designed to offer high levels of robustness in difficult conditions and it is not materially affected by reflections.

⁴ Source: https://www.ofcom.org.uk/__data/assets/pdf_file/0026/63494/tall_structures.pdf

FM and DAB reception can be affected where a structure blocks signals and both may cease to function if signals are reduced below a certain threshold."

RADIO INTERFERENCE MECHANISMS

Overview – Radio Interference Mechanisms

There are various ways in which wind turbines can cause interference effects to radio systems that operate in their vicinity. Three potential interference mechanisms that are usually considered when assessing the extent to which one or more wind turbines may affect radio signals. These are radio emissions, signal blocking and signal reflections. Each of these effects is considered further below.

Turbine Emissions

Wind turbines contain electrical components that will themselves emit a certain amount of electromagnetic radiation. Wind turbines are significant electrical machines having electricity generators, power electronics, transformers, electrical switchgear, power cables and control systems.

All electrical equipment radiates electric and magnetic fields at a range of frequencies, including radio frequencies. Wind turbines are no exception and emit magnetic and electric fields in the same way as any other electric systems.

The level of emissions from wind turbines is usually small and radio communications systems are designed to operate satisfactorily when these small fields are present. The size of both electric and magnetic fields decreases with distance from the wind turbine.

New equipment, including wind turbines, is developed to strict international standards which limit the amount of electromagnetic radiation that can be emitted to low levels that will not interfere with radio communications systems.

New wind turbines are designed to International Electrotechnical Commission standards which stipulates electromagnetic compatibility requirements.

It is unlikely that the Y Bryn wind development will interfere with radio communications systems because of electromagnetic emissions from the turbines.

Signal Blocking

The strength of radio signals is reduced by physical objects, meaning that radio signals are weaker behind such objects than they would otherwise have been. Whilst signals are weakened, they are not eliminated completely because of diffraction effects.

Terrain, buildings, and forestry are major causes of signal blocking onshore. The level of signal attenuation that occurs is dependent on the radio frequency, the shape and size of the blocking object and the relative positions of transmitter and receiver.

Wind turbine towers attenuate radio signals with signal levels behind the towers typically reduced by about 2 decibels. Such reductions in signal level are not particularly significant and often have no noticeable effect on the radio user.

Reflections

Radio signals are often affected by reflections. A direct radio signal propagates directly from the transmitting antenna to the receiving antenna. A reflected radio signal is transmitted, reflected from an object (e.g. the ground, trees, vehicles, buildings and structures) and then reaches the receiving antenna. In many situations a combination of direct and reflected signals is received.

Terrain and buildings are typical reflectors. Reflected signals always take longer to get from transmitter to receiver than direct signals. Radio receivers are necessarily quite complex, so that the desired information can be decoded from this complex received signal.

Wind turbines can be particularly significant reflectors of radio waves. Wind turbines have large blades, meaning the ends travel at high speed, and individual turbines are not synchronized. There is often a clear line of sight between radio antennae and the wind turbine blades meaning that the magnitude of reflected radio signals can be significant. The reflected element of any radio signal can be changing constantly due to the wind turbines' motion.

Wind turbine towers can also be significant radio reflectors, although they may interfere less because they are static and lower when compared against wind turbine blade.

At the receiving antenna direct and reflected waves are summed, with some components adding to the received signal strength and some detracting.

Reflected signals can help strengthen received signals in areas where there is significant shadowing.

Other Radio Interference Mechanisms

Other radio interference mechanisms are presented below for completeness.

Shadowing

Signal strength drops when the receiver is shadowed by trees, large buildings or terrain. The received signal is made up of signals reflected from other objects or terrain and signals which are diffracted around the shadowing terrain.

Signal Strength Variability

The received radio signal is made up of direct, reflected, refracted and diffracted components. Some of the features that cause these effects change. Vehicles, ships and piles of coal appear and disappear. The tide causes sea level to change and the level of foliage on trees varies with the seasons.

The received radio signal may also include unwanted signals from other sources, including machinery and other radio equipment. These unwanted signals may have frequencies which are the same or similar to the frequency of the wanted signal.

This means that received signal strength varies with time and location. The signal strength can vary significantly over distances of a few metres. This high level of signal strength variation means that:

- Radio coverage is statistical in nature and 100% coverage of an area is never guaranteed;
- Mobile and fixed radio systems are designed to operate well in these conditions.

Atmospheric effects

Radio signal strength may vary with time due to atmospheric changes. These can include signal absorption by water vapour, variations in refractivity and changes in ionisation levels. These effects tend to be insignificant over distances of 50 km or less.

AMATEUR RADIO HIGH-LEVEL CONSIDERATIONS

Overview

The key parameters for assessing the wind farm's impact on each particular radio system is the same, although the results for each system may differ. This common assessment approach, together with some common findings, is detailed below.

Relevant considerations include:

- Is the system safeguarded against wind developments by Ofcom, the UK communications regulator?
- Is the system operator known to be adversely affected by wind developments?
- Are there known cases of wind turbines significantly interfering with this type of radio system?
- Are radio signals propagating from transmitter to receiver likely to pass through the wind farm?
- Considering emissions, signal blocking and signal reflections - is there likely to be a situation where the wind turbines can interfere with this radio system?
- Is wind farm interference likely to be greater than interference from other sources?
- Does the radio system have technical capabilities for resolving radio interference issues?
- Are their operational processes for resolving radio interference issues?
- What is the likely operational impact on the radio system?

Effect on Amateur Radio

In the case of the effect of the wind development and amateur radio:

- Amateur radio is not safeguarded by Ofcom. A review of Ofcom documentation 'Updating the Amateur Radio Licence'⁵ and 'Ofcom's EMF licence condition - What you need to know as an Amateur Radio user'⁶ does not mention wind farm applications.
- Pager Power is unaware of wind developments in the UK or elsewhere causing significant adverse effects for amateur radio services.
- It is possible that radio signals will pass through the wind development.
- Interference situations are possible.
- Wind farm interference for amateur radio is generally not greater than interference from other sources.

⁵ Source: https://www.ofcom.org.uk/__data/assets/pdf_file/0027/54099/updating-amateur-radio.pdf

⁶ Source: https://www.ofcom.org.uk/__data/assets/pdf_file/0028/220798/emf-licence-condition-what-you-need-to-know-amateur-radio.pdf

- Amateur radio operators have a variety of ways to improve radio system performance. These are mostly associated with changes to aerials and radio equipment or increasing transmitted power levels.
- An operational process to resolve radio interference issues would be to use alternative amateur radio frequencies or technologies can be used.
- Overall, small effects on amateur radio performance are possible; however, significant effects are unlikely.

Amateur Radio in the Planning Context

Not all the documentation listed below are formally enforced in Wales; however, are relevant from a technical perspective. Planning documentations have been reviewed, in particular:

- Future Wales National Plan 2040.⁷
- Planning permission: wind turbines (Wales)⁸.
- National Planning Policy Framework.⁹
- Overarching National Policy Statement for Energy (EN-1).¹⁰
- Draft National Policy Statement for Renewable Energy Infrastructure (EN-3).¹¹
- Guidance Renewable and low carbon energy - Guidance to help local councils in developing policies for renewable and low carbon energy and identifies the planning considerations.¹²
- Onshore wind turbines: planning advice (Scotland)¹³

Future Wales National Plan states:

"Policy 18 – Renewable and Low Carbon Energy Developments of National Significance

Proposals for renewable and low carbon energy projects (including repowering) qualifying as Developments of National Significance will be permitted subject to...the following criteria:

...7. there are no unacceptable adverse impacts by way of shadow flicker, noise, reflected light, air quality or electromagnetic disturbance..."

⁷ Source: <https://gov.wales/sites/default/files/publications/2021-02/future-wales-the-national-plan-2040.pdf>

⁸ Source: <https://gov.wales/planning-permission-wind-turbines>

⁹ Source: <https://www.gov.uk/government/publications/national-planning-policy-framework--2>

¹⁰Source:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1015233/en-1-draft-for-consultation.pdf

¹¹Source:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1015236/en-3-draft-for-consultation.pdf

¹² Source: <https://www.gov.uk/guidance/renewable-and-low-carbon-energy>

¹³ Source: <https://www.gov.scot/publications/onshore-wind-turbines-planning-advice/>

Planning permission: wind turbines (Wales) states:

Development is permitted only if the stand alone wind turbine installation complies with the Microgeneration Certification Scheme Planning Standards or equivalent standards...

...In addition, the following conditions must also be met. The wind turbine must:

- *use non-reflective materials on blades*
- *be removed as soon as reasonably practicable when no longer needed for microgeneration*
- *be sited, so far as is practicable, to minimise its effect on the amenity of the area."*

The national planning policy document **Overarching National Policy Statement for Energy (EN-1)** refers to communications with respect to Civil and Military Aviation and Defence Interests (Section 5.5), see below relevant text.

"5.5.21 Mitigation for effects on radar, communications and navigational systems may include reducing the scale of a project, although in some cases it is likely to be unreasonable for the Secretary of State to require mitigation by way of a reduction in the scale of development, for example, where reducing the tip height of wind turbines in an offshore wind farm would result in a material reduction in electricity generating capacity or operation would be severely constrained. However, there may be exceptional circumstances where a small reduction in such function will result in proportionately greater mitigation. In these cases, the Secretary of State may consider that the benefits of the mitigation outweighs the marginal loss of function."

The **Draft National Policy Statement for Renewable Energy Infrastructure (EN-3)** states in section 1.6.3 that the NPS does not cover onshore wind and mentions in a footnote that – *"Onshore wind farm planning applications are determined in accordance with the Town and Country Planning Act."* References to amateur radio could not be found within the Town and Country Planning Act.¹⁴

Although not formally applicable in Wales, the document **Onshore wind turbines: planning advice (Scotland)** mentions electro-magnetic interference:

Electro-magnetic interference to communications systems: Wind turbines (in common with all electrical equipment) produce electromagnetic radiation which can interfere with broadcast communications and signals. The Radiocommunications Agency (RA) register of all civil radio communications installations in the UK can identify any radio installations in the neighbourhood of a wind farm site, but will not identify their owners. Applicants should make direct contact with any authorities or bodies likely to have an interest - in particular, the local emergency services, local authority services departments, gas and electricity companies.

Conclusion

There appears to be no mention of safeguarding requirements or criteria within the relevant policy documents pertaining to windfarm development.

¹⁴ Source: <https://www.legislation.gov.uk/ukpga/1990/8>

Overall Conclusions

If interference to radio signals is experienced due to the Y Bryn Wind Farm it is most likely due to reflections of the signal caused by the turbine blades. The level of interference is unlikely to be significant because radio systems are generally designed to operate in a dynamic environment.

Amateur radio operators have a variety of ways to improve radio system performance. These are mostly associated with changes to aerials and radio equipment or increasing transmitted power levels.

APPENDIX A – OVERVIEW OF RAYNET

Overview

An overview of RAYNET activities shown on their website is presented below¹⁵.

"RAYNET-UK is a national body of Radio Amateurs who are pledged to provide communications in times of emergency.

RAYNET was formed in 1953 following the severe East coast flooding, to provide a way of organising the valuable resource that Amateur Radio is able to provide to the community. Since then, it has grown into a very active organisation with around 2000 members, providing communication assistance on hundreds of events each year.

The primary aim of the organisation is to provide communications in times of emergency and disaster. The list of 'User Services' (i.e. people who we are allowed under the terms of the Amateur transmitting licence to pass messages on behalf of) who may call on our help include:

- Any UK Police force, Fire & Rescue service or Ambulance trust.
- HM Coastguard
- Local Authority Emergency Planning Officers
- Any health authority
- Any government department
- British Red Cross
- St John Ambulance
- St Andrew's Ambulance Association
- RVS
- Salvation Army
- Any 'Public Utility'. This can include BT, Gas and Water suppliers etc.
- This support is achieved by providing a trained team of RAYNET members, together with a clearly identified set of resources at its disposal.

As well as planned events, RAYNET is available to the user services on short notice callout, with teams mobilised typically within one hour. In many cases the use of RAYNET is written into the user services' major incident plans, so that they may alert the organisation at an early stage.

If you think that all RAYNET members do is to sit around waiting for something to happen, you would be very wrong! To ensure that our approach to an incident is professional and that the members have a good idea what is expected of them, the organisation is involved with may hundreds of events which,

¹⁵ Source: https://www.raynet-uk.net/www.raynet-uk.net/info_introduction.asp

as well as providing help for the User Services (most often St. John Ambulance and Red Cross), provide a valuable training ground for our members.

During the summer months, many groups are out on events nearly every weekend. During the winter, there are regular training evenings to introduce, discuss and learn new skills.

One of the rewards members of the organisation get is a strong sense of providing worthwhile service to the community in return for the privilege of the transmitting licence, as RAYNET is the only really public face of Amateur radio."

Ofcom documentation 'Updating the Amateur Radio Licence'¹⁶ mentions that:

"2.93 Some Radio Amateurs support the emergency services by providing supplementary communications through their participation in the Radio Amateurs' Emergency Network ("RAYNET")⁵⁴. For example, they may provide HF communications to mountain rescue teams ('MRTs') if those teams' own VHF or UHF systems are unable to provide a service."

¹⁶ Source: https://www.ofcom.org.uk/__data/assets/pdf_file/0027/54099/updating-amateur-radio.pdf



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