14 Aviation and Radar

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14 Aviation and Radar

14.1 Executive Summary

14.1.1 An aviation assessment has been conducted by Wind Power Aviation Consultants Ltd in accordance with the relevant policy and guidance as detailed below. The assessment has concluded that the Proposed Development will have an effect on two aviation stakeholders, Glasgow Prestwick Airport (GPA) and NATS En Route Ltd (NERL) and that technical mitigation may be required.

14.2 Introduction

14.2.1 Wind turbines have the potential to affect civil and military aviation. This Chapter explains the methodology used to undertake the aviation safeguarding scoping assessment, lists the aviation references used and describes the aviation baseline condition, consultation requirements and mitigations to be applied where required.

14.2.2 The Proposed Development is located under unregulated airspace up to 5500 ft and is approximately 26 km to the south of Glasgow Prestwick Airport.

14.2.3 The Aviation Chapter has been written by Cdr John Taylor RN (Ret) of Wind Power Aviation Consultants Ltd (WPAC). He has over 35 years of experience as an Air Traffic Controller, Fighter Controller and Aviation Regulator and was Head of Air Traffic Control for the Royal Navy between 2002 and 2006. His responsibilities included responding to wind farm consultations on and offshore. Since 2008, his company has provided advice on the interaction between wind turbines and aviation including assessing over 3000 wind turbine proposals and giving evidence at over 20 Inquiries and Appeals in England and Scotland. He has also advised a number of Local Authorities on this issue. His team includes experts on radar propagation modelling and low flying operations.

14.3 Legislation, Policy and Guidelines

14.3.1 There are a number of aviation publications relevant to the interaction of wind turbines and aviation containing guidance and legislation, which cover the complete spectrum of aviation activity in the UK as shown below:

- Civil Aviation Publication (CAP) 764 Civil Aviation Authority (CAA) Policy and Guidance on Wind Turbines Version 6, Feb 2016 (CAA, 2016);
- CAP 168 Licensing of Aerodromes, Version 11 March 2019 (CAA, 2019);
- CAP 670 ATS Safety Requirements Version 3 June 2019 (CAA, 2019);
- CAP 774 UK Flight Information Services, Ed 3 May 2017 (CAA, 2017);
- CAP 738 Safeguarding of Aerodromes Version 2 Dec 2006 (CAA, 2006);
- CAP 793 Safe Operating Practices at Unlicensed Aerodromes Ed 1 July 2010 (CAA, 2010);
- CAP 493 Manual of Air Traffic Services Part 1 Ed 7.0 2017 (CAA, 2017);
- CAP393 The Air Navigation Order 2016 and Regulations (CAA, 2016);
- CAP 660 Parachuting Ed 5 March 2020 (CAA, 2020);
- Military Aviation Authority Regulatory Article 2330 (Low Flying) (MOD MAA, 2019);
- UK Military Aeronautical Information Publication (MIL AIP) (MOD, 2020);
- UK Aeronautical Information Publications (AIP) (NATS, 2020);
- CAA 1:250,000 and 1:500,000 VFR Charts (NATS, 2019, 2020); and

- CAA Policy Statement: Lighting of Onshore Wind Turbine Generators in the United Kingdom with a maximum blade tip height at or in excess of 150 m Above Ground Level dated 01/06/17.

14.4 Consultation

Consultation is carried out in accordance with the guidance laid down in Section 14.5. As shown in Table 14.1 below, there is a requirement to consult with aviation stakeholders in the area including Glasgow Prestwick Airport (GPA), NATS En Route Ltd (NERL) and the Ministry of Defence (MOD).

Table 14.1 – Aviation Stakeholder Consultation

Consultee, Ref and Date	Issue Raised	Applicant Action
NERL, SG30928, dated 28 January 2021	*"Based on our preliminary technical findings, the proposed development does conflict with our safeguarding criteria. Accordingly, NATS (En Route) plc objects to the proposal. We will notify you within 4-6 weeks of the results of our operational assessment. Only if this assessment shows the impact to be acceptable will we be able to withdraw our objection."*	See row below.
NERL, SG30828, dated 25 February 2021	*"The proposed development has been examined by our technical safeguarding teams and conflicts with our safeguarding criteria. Accordingly, NATS (En Route) plc objects to the proposal. The reasons for NATS's objection are outlined in the attached report TOPA SG30928"*	The Applicant will engage with NERL to explore mitigation options available, including use of the new Lowther Hill Radar mitigation method.
GPA	GPA responded to scoping stating: *1. "On behalf of Glasgow Prestwick Airport (GPA) Ltd – I have reviewed the Scoping Report (and associated documents available on the Energy Consents Unit portal for Knockcronal Wind Farm (ECU00002181).* *2. The proposed scope of the Environmental Impact Assessment (EIA) seems appropriate – and we are pleased that the Developer*	The Applicant has attempted to open dialogue with GPA in order to resolve the outstanding aviation issues, but has yet to receive a substantive response from the Airport. It is clear that the aviation issues listed by GPA are capable of resolution through dialogue and technical mitigation and further additional

Consultee, Ref and Date	Issue Raised	Applicant Action
	intends to engage with GPA in respect of aviation safety matters in respect of radar display clutter likely from turbines visible to the GPA primary radars – and we welcome early engagement with GPA in respect of these aviation matters. *3. Preliminary Line of Sight (LOS) analysis at proposed 200m tip height of Knockcronal Windfarm – indicates all turbines will be visible to GPA's primary radars - and it is likely that further detailed radar modelling assessments/flight trials would be necessary to confirm the exact number of turbines visible to GPA radar – and whether their impact can be mitigated for the lifetime of the windfarm. We would be happy to discuss this further with the Developer as and when they formally engage with GPA on this proposed development.* *4. Furthermore GPA will also require an assessment to be undertaken for this proposed windfarm against our published Instrument Flight Procedures (IFP's) (both conventional and RNAV/RNP) – to satisfy ourselves that the turbine tip heights have no impact on our existing published IFP's.* *5. GPA would be minded to object to this development on aviation safety grounds as detailed above - and respectfully request that we are consulted with - should this proposed development be submitted as a formal Section 36 Planning application.*	attempts are being made to engage with them which will be reported upon when possible.

Consultee, Ref and Date	Issue Raised	Applicant Action
	6. As above GPA request early engagement with the Developer in efforts to resolve the aviation safety matters detailed above."	
MOD, Defence Infrastructure Organisation(DIO), 10050280, dated 22 January 2021	*"I am writing to inform you that the MOD has no concerns about this proposed development."* *"The development site occupies Tactical Training Area 20T (TTA 20T) therefore in the interests of air safety, the MOD would request that the development be fitted with MOD accredited aviation safety lighting in accordance with the Civil Aviation Authority, Air Navigation Order 2016."*	A lighting layout will be designed that is compliant with both CAA and MOD requirements.
CAA	The CAA have been consulted in regard to the proposed requirement for aviation lighting and will respond once the aviation lighting design report at Appendix 14.1 has been submitted to them for approval.	

14.5 Assessment Methodology and Significance Criteria

Consultation

14.5.1 Consultation with all relevant aviation stakeholders is ongoing and the latest status of these discussions is reported in this Chapter at the time of writing (September 2021).

Study Area

14.5.2 The assessment of effects of the Proposed Development is based upon the guidance laid down in CAA Publication CAP 764 - Policy and Guidelines on Wind Turbines Version 6, Dated February 2016, with the consultation criteria for aviation stakeholders defined in Chapter 4. These distances inform the size of the study area and include:

- Airfield with a surveillance radar – 30 km;
- Non radar licensed aerodrome with a runway of more than 1,100 m – 17 km;
- Non radar licensed aerodrome with a runway of less than 1,100 m – 5 km;
- Licensed aerodromes where the turbines would lie within airspace coincidental with any published Instrument Flight Procedure (IFP);
- Unlicensed aerodromes with runways of more than 800 m – 4 km;
- Unlicensed aerodromes with runways of less than 800 m – 3 km;

- Gliding sites – 10 km; and
- Other aviation activity such as parachute sites and microlight sites within 3 km – in such instances developers are referred to appropriate organisations.

14.5.3 CAP 764 goes on to state that these distances are for guidance purposes only and do not represent ranges beyond which all wind turbine developments will be approved or within which they will always be objected to. These ranges are intended as a prompt for further discussion between developers and aviation stakeholders which results in the study area being modified as required based on specific airspace and operational considerations.

14.5.4 It is also necessary to take into account the aviation and air defence activities of the MOD as safeguarded by the Defence Infrastructure Organisation (DIO). The types of issues that are addressed in this Chapter include:

- Ministry of Defence Airfields, both radar and non-radar equipped;
- Ministry of Defence Air Defence Radars;
- Ministry of Defence (now UK Met Office) Meteorological Radars; and
- Military Low Flying.

14.5.5 It is necessary to take into account the possible effects of wind turbines upon the National Air Traffic Services En Route Ltd (NERL) communications, navigation and surveillance systems – a network of primary and secondary radars and navigation facilities around the country.

14.5.6 As well as examining the technical impact of wind turbines on Air Traffic Control (ATC) facilities, it is also necessary to consider the physical safeguarding of ATC operations using the criteria laid down in CAP 168 Licensing of Aerodromes to determine whether a proposed development will breach obstacle clearance criteria.

Desk Study and Radar Modelling Methodology

14.5.7 The radar calculation results shown in this Chapter have been produced using specialist propagation prediction software (RView Version 5). Developed over a number of years, it has been designed and refined specifically for the task. RView uses a comprehensive systems database which incorporates the safeguarding criteria for a wide range of radar and radio navigation systems. RView models terrain using the Ordnance Survey (OS) Terrain 50 digital terrain model, which has a post spacing of 50 m and has a root mean square (RMS) error of 4 m. The results are verified using the Shuttle Radar Topography Mission (SRTM) dataset, a separate smoothed digital terrain model with data spacing of 3 arc seconds. By using two separate and independently generated digital terrain models, anomalies are identified, and consistent results assured. RView models the refractive effects of the atmosphere on radio waves and the First Fresnel Zone. A feature of RView is that as well as performing calculations in the manner believed to be most appropriate it also allows comparison with results from simpler models. For example, RView can perform calculations using the true Earth Radius at the midpoint between the radar and the wind turbine or the simplified 4/3 Earth Radius model. If needed, RView is also capable of modelling a range of atmospheric refractive conditions. RView models the trajectory of radar signals at different elevations, enabling modelling of both volume surveillance and pencil beam radars as well as the effects of angular sterilisation as applied, for example, in Met Office radars.

Site Visit

14.5.8 A site visit was not necessary in order to undertake the assessment.

Assessment of Potential Effects

14.5.9 Assessment of potential effects has been undertaken by identifying whether impacts are anticipated upon aviation and radar infrastructure and therefore whether aviation stakeholders are anticipated to object to the Proposed Development.

14.5.10 The assessment does not determine significant or non-significant effects, but whether there is an effect or no effect.

Requirement for Mitigation

14.5.11 Should effects upon aviation and radar infrastructure from the Proposed Development be identified, mitigation measures will be identified and reported.

Assessment of Residual Effect Significance

14.5.12 As per the assessment of potential effects, the assessment will not determine significance but whether the Proposed Development will give rise to an effect or not.

14.6 Baseline Conditions

Licensed Aerodromes

14.6.1 An assessment undertaken by Wind Power Aviation Consultants Ltd (WPAC) using the above criteria shows that the only civil licensed radar equipped aerodrome within 30 km is at Glasgow Prestwick Airport (GPA), 26 km to the north. GPA has two primary surveillance radars (PSR), including a new Terma Scanter 4002 radar installed specifically to mitigate the effect of wind turbines on the original PSR. Radar line of sight (RLOS) modelling has been undertaken against both radars with the results shown in Tables 1 and 2 below. With a 200 m turbine tip height, any figures in the tables that are less than 200 m indicate that turbines are in line of sight of the radar, where the figure exceeds 200 m, the turbine will be completely screened by the intervening terrain.

Table 14.2 - Prestwick PSR Results

Turbine	Radar Line of Sight (metres AGL)	Turbine	Radar Line of Sight (metres AGL)
1	77.5	6	13.9
2	56.6	7	34.5
3	42.7	8	40.4
4	16.1	9	48.3
5	24.6		

Table 14.3 - Prestwick Terma Radar Results

Turbine	Radar Line of Sight (metres AGL)	Turbine	Radar Line of Sight (metres AGL)
1	77.2	6	7.3
2	37.5	7	17.8
3	26.6	8	23.1
4	7.1	9	48.1
5	22.8		

14.6.2 The results show that all of the turbines within the Proposed Development will be in line of sight of both radars at GPA. The result will be that an area of radar clutter will be generated on the PSR, in a location that is almost certainly already affected by clutter from other wind turbines, however, it will be for GPA to determine if the technical effect will have any operational effect. It should be possible to utilise the Terma Radar to mitigate the effect subject to the conclusions of a suitable technical study. The Applicant has engaged with GPA in order to agree a suitable mitigation method and this will be reported upon when the outcome is finalised.

Ministry of Defence

14.6.3 The closest military ATC radar is at the former RAF West Freugh, 52 km to the south-west. The radar is mainly used for range safety in the Luce Bay danger area complex and is not normally used to provide ATC services to the north of the danger areas. However, for completeness, radar modelling was undertaken. The results show that due to the intervening terrain, there is no radar line of sight below 1000 m above ground level (AGL). The MOD have been consulted about the Proposed Development, however, it is clear that there will be no MOD ATC radar objection to the Proposed Development and this was confirmed by the MOD in their 'no objection' response dated 22 January 2021.

14.6.4 **Air Defence Radars** - the closest Air Defence radar is located at Brizlee Wood, well over 100 km to the east. Radar modelling shows that there is no radar line of sight below 1000 m AGL and there will be no MOD Air Defence objection to the Proposed Development.

14.6.5 **Low Flying** - the Proposed Development is located in an MOD Tactical Training Area and designated in wind farm consultation guidance as a Red Zone, however, this does not necessarily lead to an objection. The MOD will closely examine the Proposed Development but in this case it would appear that an objection is unlikely as they did not object to a previous consultation when WilloWind Energy Ltd submitted the Linfairn proposal on the same land (MOD DIO Reference 1921, dated 27 January 2015), since then low flying has decreased significantly. The MOD have been consulted and an infra-red lighting layout is proposed in the attached aviation lighting report which will be submitted to the MOD for their approval.

NATS En Route Ltd (NERL)

14.6.6 An assessment has been conducted to determine any effect of the Proposed Development on NERL communications, navigation and surveillance infrastructure (CNS). The closest radars in the NERL network are at Lowther Hill and Great Dun Fell. The results for Lowther Hill are shown in Table 14.4. All of the turbines except turbine 2 are potentially visible to the radar at a distance of 52 km. In the case of Great Dun Fell, radar line of sight is in excess of 500 m AGL across the site and that radar will not be affected.

Table *14.4* - NATS Lowther Hill Radar Results

Turbine	Radar Line of Sight (m AGL)	Turbine	Radar Line of Sight (m AGL)
1	199.9	6	136.6
2	214	7	138.6
3	184	8	159.3
4	165.1	9	167
5	167.8		

14.6.7 The results are broadly the same as those at scoping and therefore the NERL response will almost certainly remain the same with the finalised site design. NERL have been consulted about the

Proposed Development and it is anticipated that negotiations will need to be undertaken in order to agree suitable mitigation. It will be for NERL to determine the technical method to be applied and their interests will be protected through the imposition of a suitably worded planning condition.

Met Office Radars

14.6.8 The Met Office safeguards its network of radars using a European methodology known as OPERA. In general, they will object to any turbine within 5 km in line of sight and will examine the impact of any turbines within 20 km. Where a site is within 20 km, the Met Office will undertake an operational assessment based on three main criteria, having determined whether there is a technical effect on the radar. The factors they will consider include the following:

- Proximity to Airports;
- River catchment response times; and
- Population density.

14.6.9 In this case the closest Met Office radar is at Holehead, north of Glasgow and well beyond 20 km from the Proposed Development. There will be no Met Office radar objection to this Proposed Development and consultation is not required. This issue can be scoped out of the EIA Report.

14.7 Aviation Obstruction Lighting

14.7.1 Appendix 14.1 to this Chapter is a detailed aviation lighting and visual impact assessment and mitigation report. The visible lighting layout design contained in that report will be submitted to the CAA for approval and the proposed Infra-Red lighting layout will be submitted to the MOD for approval.

Construction

14.7.2 The locations and heights of the turbines and of any cranes will be provided to the military and civil aviation authorities prior to construction in order for the information to be publicised in Notices To Airmen (NOTAM) and the aviation mapping authorities for inclusion on aviation charts where appropriate.

Operation

14.7.3 Aviation lighting will be installed and operated as detailed in Appendix 14.1 to this Chapter.

Decommissioning

14.7.4 The locations and heights of the wind turbines will remain on aeronautical charts, enabling aircraft to avoid the Proposed Development vertically or horizontally.

14.8 Residual Effects

14.8.1 There will be no residual effects caused by the Proposed Development during construction, operation or decommissioning.

14.9 Cumulative Assessment

14.9.1 With the exception of aviation lighting effects which are covered in the LVIA (Chapter 6), there are no other cumulative effects given the turbines' induced effects on radars will be mitigated prior to construction.

14.10 Summary

14.10.1 The Proposed Development is located under unregulated airspace up to 5500 ft and is approximately 26 km to the south of Glasgow Prestwick Airport.

14.10.2 The turbines will be visible to the radars at GPA and mitigation is likely to be required utilising the capabilities of the Terma radar installed at the airport.

14.10.3 There will be no effects on any MOD radars or facilities.

14.10.4 The NERL radar at Lowther Hill will have visibility of the turbines and mitigation is likely to be required.

14.10.5 Aviation Lighting will be required as shown in Appendix 14.1.

Table 14-5 – Summary of Effects

Description of Effect	Significance of Potential Effect		Mitigation Measure	Significance of Residual Effect	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Construction, Operation and Decommissioning					
Effects on GPA aviation radar	Major	Adverse	Mitigation measures will be agreed between the Applicant and GPA.	Negligible	Neutral
Effects on aviation interests and low flying.	Negligible	Neutral	Infra-Red aviation lighting will be installed.	Negligible	Neutral
Effects on NERL radar at Lowther Hill.	Major	Adverse	Mitigation measures will be agreed between the Applicant and NERL.	Negligible	Neutral
Effects on MOD radar.	None	N/A	None	None	N/A

14.11 References

CAA (2016). Civil Aviation Publication (CAP) 764: Policy and Guidance on Wind Turbines, Version 6.

CAA (2019).CAP 168: Licensing of Aerodromes, Version 11.

CAA (2019). CAP 670: Air Traffic Services Safety Requirements, Issue 3.

CAA (2017). CAP 774: UK Flight Information Services, Version 3.

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