

15 Aviation & Radar

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15 Aviation & Radar

15.1 Executive Summary

15.1.1 This chapter addresses the potential effects of the Proposed Development on aeronautical radar and radio navigation aids, meteorological radars and low flying aircraft. The assessment found that the Proposed Development will not be within line of sight of any radars and that it will not have a significant effect on the obstacle hazard to low flying aircraft. An aviation obstruction lighting scheme, consisting of infra-red lights to mark the perimeter of the Development, has been approved by the Civil Aviation Authority (CAA).

15.2 Introduction

15.2.1 This chapter considers the likely significant effects on aviation and radar associated with the construction, operation and decommissioning of the Proposed Development. Wind turbines within line of sight of primary surveillance radars used for air traffic control, air defence and meteorological reporting may cause false plots on the radar and reduce detection performance. Wind turbines may also cause an obstacle hazard to aircraft flying at low level and in the vicinity of airfields. Wind farms in the vicinity of airfields may require changes in instrument flight procedures, and wind turbines can also generate adverse effects on secondary surveillance radar and aeronautical radio communications equipment and navigation aids. Turbines with tip heights of 150 metres or more above ground level (agl) are required to be fitted with aviation warning lighting.

15.2.2 This chapter is supported by Appendix 15.1: Proposal for Alternative Lighting Scheme.

15.3 Legislation, Policy and Guidelines

Legislation

15.3.1 Relevant legislation and guidance documents have been reviewed and taken into account as part of this aviation assessment. This includes the Air Navigation Order 2016 and the following aviation Statutory Instruments enacted under the European Union (Withdrawal) Act 2018:

- The Civil Aviation Act 1982 (Amendment) (EU Exit) Regulations 2018;
- The Civil Aviation (Amendment etc.) (EU Exit) Regulations 2019;
- The Aviation Safety (Amendment etc.) (EU Exit) (No. 2) Regulations 2019;
- The Aviation Safety (Amendment) (EU Exit) Regulations 2020; and
- The Aviation Safety (Amendment) (No. 2) Regulations 2021.

Planning Policy

15.3.2 Scottish Planning Policy (SPP) (2020) advises that wind energy proposals should take account of impacts on aviation and defence interests and seismological recording.

15.3.3 The Scottish Government Onshore Wind Policy Statement (December 2017) advised of the government's intention to pursue a more strategic approach to the mitigation of effects of wind farms on civil and military radar.

Guidance

15.3.4 The Highland Council Onshore Wind Energy Supplementary Guidance (November 2016) advises that:

"All proposals should seek to avoid significant adverse effects, individually and cumulatively, on airport, defence or emergency service operations. This includes flight activity; navigation and surveillance systems; and associated infrastructure"

and that: “Developers should make themselves aware of the full extent of the aviation stakeholders in their area who may be affected by their proposal. The CAA general advice continues to be that developers of potential wind farms should engage with aviation stakeholders at the earliest opportunity, using the guidance provided in CAA Publication 764. Any impact on aviation can therefore be mitigated ahead of the formal planning process.”

15.3.5 The assessment of potential effects on aviation and radar has also been informed by the following aviation guidance and sources of information:

- Civil Aviation Authority (CAA) Policy and Guidelines on Wind Turbines (CAP 764) (2016);
- CAA Air Traffic Services Safety Requirements (CAP 670) (2019);
- CAA Policy Statement: Lighting of Onshore Wind Turbine Generators in the United Kingdom with a maximum blade tip height at or in excess of 150m Above Ground Level (June 2017);
- International Civil Aviation Organisation (ICAO), Annex 14 to the Chicago Convention, Vol.1, Eighth Edition (2018);
- UK Aeronautical Information Publication (AIP); and
- UK Military AIP.

15.4 Consultation

15.4.1 Consultation has been undertaken with aviation stakeholders as follows:

Table 15.1 – Aviation consultations

Consultee	Date of response	Response	Action Taken
Ministry of Defence (MoD)	26 July 2019	<i>“the MOD has no concerns with the proposal”</i>	Noted
Highlands & Islands Airports Ltd (HIAL)	22 August 2019	<i>“This development falls inside the safeguarded areas for Inverness Airport (as defined in CAP 764 – CAA Policy and Guidelines on Wind Turbines). The turbines could possibly affect the performance of electronic aeronautical systems for the airport and is potentially line of sight from our radar. HIAL would not wish to see a degradation of the Radar installation.”</i>	Line of sight from the Inverness radar assessed and results submitted to HIAL.
NATS	30 July 2019	<i>“The proposed development has been examined from a technical safeguarding aspect and does not</i>	Noted

Consultee	Date of response	Response	Action Taken
		<i>conflict with our safeguarding criteria. Accordingly, NATS (En Route) Public Limited Company ("NERL") has no safeguarding objection to the proposal."</i>	
HIAL	5 March 2021	<i>"we are content that there is no line of sight to the Inverness PSR"</i>	Noted
Police Scotland Air Support Unit	27 February 2021	<i>"With regards this latest project, given that it is an extension of an existing windfarm, and is lower than the current turbines, I do not envisage any issues as far as the Police operation is concerned."</i>	Noted. Response copied to CAA.
Babcock Mission Critical Services Onshore (Scotland's Charitable Air Ambulance)	2 March 2021	<i>"I am happy that the Babcock Air Ambulance operation for SCAA would not be unduly affected by the absence of visible obstruction lighting on the proposed extension to the Bhlaraidh windfarm."</i>	Noted. Response copied to CAA.
Bristow Helicopters Search & Rescue Unit, Inverness	5 May 2021	<i>"I have no issue with proposed extension to the windfarm with respect to the Bristow UK SAR operation. I will re-iterate, as I always do, the importance of lighting the turbines with IR lighting (that can be seen with NVIS devices) in such a way that the entire boundary of the development is clearly delineated. This proposal appears to do that."</i>	Noted. Response copied to CAA.
Gama Aviation/Scottish	14 May 2021	<i>"I've had a look at the proposal and see no issue with it from our point of</i>	Noted. Response copied to CAA.

Consultee	Date of response	Response	Action Taken
Ambulance Service, Inverness		<i>view. Again, I think the most important thing is consistency with the lighting with surrounding wind farms and this seems to be the objective here."</i>	
Highland Aviation Training Ltd	25 May 2021	<i>"I see no issue with the proposal. The majority of our training night flights take place in the local area with occasional excursions north and south, but rarely in the direction of Invermoriston. Our qualified Night Rated pilots tend not to venture too far from the field. It is rare night VFR minima allow us the opportunity to cross the mountains or fly down the Great Glen."</i>	Noted. Response copied to CAA.
CAA	25 June 2021	<i>"the CAA confirms that in accordance with the Air Navigation Order (ANO) Article 222 section 6, we agree a variation to the lighting requirements specified in the ANO Article for the Bhlairaidh Extension wind farm as per the proposed lighting scheme as follows:</i> <ul style="list-style-type: none"> <i>• No visible obstacle lights on the Bhlairaidh Extension wind farm turbines</i> <i>• infra-red lights to MoD specification installed on the nacelles of perimeter turbines:</i> <i>Turbines 2, 5, 7, 13, 18, 28 and 31."</i>	Noted

15.5 Assessment Methodology and Significance Criteria

Study Area

15.5.1 Study areas with the following radii were used in determining the aviation baseline. These radii are in line with the operational ranges of radars and the safeguarding consultation zones recommended by the CAA in CAP 764.

- 150 km for air traffic control and air defence primary surveillance radars;
- 30 km for Meteorological Office rainfall radars;
- 20 km for secondary surveillance radars and aeronautical radio navigation aids;
- 30 km for licensed, certificated and Government aerodromes; and
- 10 km for unlicensed aerodromes, airstrips and gliding sites.

Desk Study

15.5.2 The description of baseline conditions for aviation has been completed using the following methods:

- Assessment of the turbine visibility to all potentially affected air traffic control and air defence radars;
- Desk studies to identify all potentially affected airfields, airstrips and other aviation activity sites in the vicinity of the Site, referencing the UK Aeronautical Information Publication (NATS, 2021), the UK Military Aeronautical Information Publication (Ministry of Defence (MoD), 2021), aeronautical charts (CAA 2020) and published pilots' guides; and
- Consultation with identified aviation consultees.

15.5.3 The potential impacts of the Proposed Development on aviation have been assessed by considering whether any of the turbines would be within line of sight of, and in an area of operational significance to, any aeronautical or defence radar equipment; whether any of the turbines would breach the obstacle limitation surfaces around civil or military airfields, or pose an obstacle hazard to aircraft in the vicinity of airfields or conducting military low flying; and whether the turbines would be within the safeguarding zones for aeronautical radio navigation or communication equipment.

Assessment of Likely Effect Significance

15.5.4 The significance of an impact on the use of air traffic control or air defence radar has been determined by assessing any technical effects on the radar in the context of the classification of the airspace in which the radar provides a service; the nature and density of air traffic in the airspace; the routes flown by aircraft in the vicinity of the Site; the types of service requested by, and provided to, aircraft using services provided from the affected radar; and the capacity of normal operational air traffic management measures to address the effects on the radar.

15.5.5 The significance of potential obstacle hazard impacts of the turbines has been determined by assessing the proximity of the Proposed Development to airfields, airstrips and aerodromes, including whether any obstacle limitation surfaces at Government or licensed aerodromes would be infringed; and whether the turbines, in combination with the terrain and other vertical obstructions in the area, would impose constraints on military low flying.

15.5.6 The significance of potential effects on aviation and radar receptors is based on industry regulations for safe obstacle avoidance and the ability to maintain radar separation from radar clutter (UK Government (2016); Civil Aviation Authority (2016)).

15.5.7 The significance of effects on aviation assets is determined based on the criteria provided below in Table 15.2. Major and moderate effects are considered significant in relation to the EIA Regulations.

Table 15.2 – Significance Criteria

Significance	Description
Major	Major loss/improvement to key elements/features of the baseline conditions such that post-development character/composition of baseline condition will be fundamentally changed. For example, continual appearance of widespread radar clutter close to regular flight routes, creation of obstacles blocking valleys regularly used for low flying, or raising of instrument flight procedure minima to levels that render the airport inaccessible for appreciable periods of time.
Moderate	Loss/improvement to one or more key elements/features of the baseline conditions such that post-development character/composition of the baseline condition will be materially changed. For example, intermittent appearance of radar clutter close to regular flight routes, creation of obstacles close to regularly used low flying routes, or raising of instrument flight procedure minima to levels that reduce the airport’s accessibility in bad weather.
Minor	Changes arising from the alteration will be detectable but not material; the underlying composition of the baseline condition will be similar to the pre-development situation. For example, intermittent appearance of radar clutter away from regular flight routes, creation of obstacles close to infrequently used low flying routes, or raising of instrument flight procedure minima to levels that have no measurable impact on the airport’s accessibility in bad weather.
Negligible	Very little change from baseline conditions. Change is barely distinguishable, approximating to a “no change” situation.

Requirements for Mitigation

15.5.8 No mitigation is required for effects on radar or aeronautical radio equipment. Mitigation of potential obstacle hazards at night has been addressed through design of an obstacle lighting scheme and consultee responses (see Table 15.1).

Assessment of Residual Effect Significance

15.5.9 The significance of residual effects, taking mitigation into account, has been determined from consultee responses.

Limitations to Assessment

15.5.10 Based on information available at the time of writing there are no known limitations to the assessment.

15.6 Baseline Conditions

15.6.1 The Site is located in uncontrolled (Class G) airspace from ground level to Flight Level 195 (approximately 19,500 feet above sea level). The nearest controlled airspace is Lower Air Traffic Service Route N560, the closest part of which is 22km east of the Site.

15.6.2 The Site is located in Low Flying Area 14 in the daytime UK Military Low Flying System, where flight may be authorised down to 250 feet Minimum Separation Distance (MSD), and in Allocated Region 1B East in the Night Low Flying System. The co-terminous boundaries of Low Flying Area 14(T), where daytime flight down to 100 feet MSD is authorised, and R610A, the Highlands Restricted Area, where low level flight without visual reference is authorised, lie 11km west of the Site. The Site is in an area classified by the Ministry of Defence (MoD) as a “*low priority military low flying area less likely to raise concerns*”. The MoD has not objected on grounds of impacts on low flying to any other wind farm developments within a 25km radius of the Proposed Development. Consequently effects on military low flying have been scoped out of the assessment.

- 15.6.3 There are four primary surveillance radars (PSRs) within 150km radius of the Site:
- Inverness Airport (48km north east of the Site);
 - RAF Lossiemouth (93km north east of the Site);
 - Leuchars Diversion Airfield (146km south east of the Site); and
 - Kincardine (142km south east of the Site).
- 15.6.4 The Leuchars and Kincardine radars both have instrumented ranges of 111km and are therefore incapable of monitoring the airspace over the Site. Consequently they have been scoped out of the assessment. The Site is within the instrumented ranges of the Inverness Airport and RAF Lossiemouth radars; consequently these have been scoped into the assessment.
- 15.6.5 There are no Meteorological Office rainfall radars within 30km; no secondary surveillance radars and aeronautical radio navigation aids within 20km; no licensed or Government aerodromes within 30km; and no unlicensed aerodromes, airstrips or gliding sites within 10km of the Site¹.

15.7 Receptors Brought Forward for Assessment

- 15.7.1 The Inverness Airport and RAF Lossiemouth PSRs have been taken forward for assessment. In addition the potential effects on aircraft flying at low level in the vicinity of the Site at night have been considered in designing an aviation obstruction lighting scheme.

15.8 Embedded Mitigation

- 15.8.1 The standard design measure for mitigating impacts on radar is to develop a turbine layout and/or turbine size that avoids areas of radar visibility. In the case of the Proposed Development, the design iteration process has taken into account the potential visibility from the Inverness Airport PSR. All turbines have been located outwith the line of sight of the radar.
- 15.8.2 Objects that extend to 150m or more above ground level are required by Article 222 of the Air Navigation Order (UK Government (2016)) to be lit with medium intensity steady red lights in order to mitigate the risk of aircraft colliding with the turbines at night. For onshore wind turbines, this requirement is modified by the CAA Policy Statement of June 2017.
- 15.8.3 ICAO Annex 14 (2018) and the ANO (UK Government (2016)) also make provision for the approval by the CAA of a lighting scheme other than that specified in the ANO, on the basis of a special aeronautical study.
- 15.8.4 A special aeronautical study has been conducted of the requirement for obstruction lighting on the proposed turbines, and is provided within Appendix 15.1. This took account of the following factors:
- the adjacent operational Bhlaraidh wind farm ('the Operational Development') has infra-red lighting only – not visible to the unaided human eye – on only seven of the 32 turbines;
 - the heights of the blade tips of the Proposed Development above sea level will be lower than those of the Operational Development;
 - there is terrain up to 2,294 feet above sea level within 6km of the Proposed Development; and
 - there is a very low probability of aircraft that are not equipped to see infra-red lighting flying visually at low level at night in the area of the Proposed Development.
- 15.8.5 The study concluded that there was a case for the Proposed Development to be provided with a lighting scheme similar to that of the Operational Development, consisting of infra-red lighting on the turbines marking the perimeter of the wind farm, and for visible lighting to be excluded from the lighting scheme.

¹ The reference in paragraph 15.1.5 of the Scoping Report to a gliding and soaring site 9km south of the Proposed Development was found to be in error.

- 15.8.6 In consultation with potential users of the night low level airspace, a proposed lighting scheme consisting of infra-red lights on Turbines 3, 5, 6, 8, 9, 12, 13, 14, 16 and 18 has been designed. All consultees have confirmed that the scheme is acceptable (see Table 15.1).

15.9 Likely Effects

Construction

- 15.9.1 During construction the turbine blades will not be rotating, therefore there is no possibility of the turbines appearing as targets on the radar displays at Inverness Airport and RAF Lossiemouth. In addition, all turbines are located in areas that are terrain-screened from both radars. The magnitude of the effect of the Proposed Development on these radars during the construction phase is therefore found to be **zero** and the significance of the effect is found to be **nil**.
- 15.9.2 The locations and heights of the wind turbines, and of any cranes and other construction equipment, will be advised to the military and civil aviation authorities prior to construction allowing the details to be promulgated on aeronautical charts, in the AIP and by Notices to Airmen (NOTAMS) to enable aircraft to avoid the Proposed Development vertically or horizontally. The magnitude of the effect of the Proposed Development on low flying aircraft at night during the construction phase is therefore found to be **low** and the significance of the effect is found to be **negligible**.
- 15.9.3 The overall magnitude of the effect of the Proposed Development on aviation during the construction phase is therefore found to be **low** and the significance of the effect is found to be **negligible**.

Operation

- 15.9.4 The radar line of sight from the Inverness Airport PSR to the blade tip height of 180m above ground level (agl) over the Site was assessed using Global Mapper software and 5m resolution terrain data. The assessment found that none of the proposed turbines would be within line of sight of the radar due to intervening terrain. The results of the analysis were submitted to Highlands & Islands Airports Ltd (HIAL), operators of Inverness Airport, who responded that “*we are content that there is no line of sight to the Inverness PSR*” (see Table 15.1). The magnitude of the effect of the Proposed Development on Inverness Airport PSR is therefore found to be **zero** and the significance of the effect is found to be **nil**.
- 15.9.5 The radar line of sight from the RAF Lossiemouth PSR to the blade tip height of 180m above ground level (agl) over the Site was assessed using Global Mapper software and 5m resolution terrain data. The assessment found that none of the proposed turbines would be within line of sight of the radar due to intervening terrain. The magnitude of the effect of the Proposed Development on RAF Lossiemouth PSR is therefore found to be **zero** and the significance of the effect is found to be **nil**. The Ministry of Defence has advised that it has no concerns about the Proposed Development (see Table 15.1).
- 15.9.6 Infra-red aviation lighting will be installed on the nacelles of Turbines 3, 5, 6, 8, 9, 12, 13, 14, 16 and 18 and will be lit at all times during operation of the wind farm. Potential users of the night low level airspace in the vicinity of the Site have been consulted on the proposed lighting scheme. All have advised that the proposed lighting scheme is acceptable. The magnitude of the effect of the Proposed Development on low flying aircraft at night during the operational phase is therefore found to be **low** and the significance of the effect is found to be **negligible**.
- 15.9.7 The overall magnitude of the effect of the Proposed Development on aviation during the operational phase is found to be **low** and the significance of the effect is found to be **negligible**.

Decommissioning

- 15.9.8 During the decommissioning phase the turbine blades will not be rotating, therefore there is no possibility of the turbines appearing as targets on the radar displays at Inverness Airport and RAF Lossiemouth. The magnitude of the effect of the Proposed Development on these radars during the decommissioning phase is therefore found to be **zero** and the significance of the effect is found to be **nil**.

- 15.9.9 The locations and heights of the wind turbines will remain on aeronautical charts, enabling aircraft to avoid the Proposed Development vertically or horizontally. The magnitude of the effect of the Proposed Development on low flying aircraft at night during the decommissioning phase is therefore found to be **low** and the significance of the effect is found to be **negligible**.
- 15.9.10 The overall magnitude of the effect of the Proposed Development on aviation during the decommissioning phase is therefore found to be **low** and the significance of the effect is found to be **negligible**.

15.10 Additional Mitigation and Enhancement

- 15.10.1 Since the proposed turbines will not be within line of sight of any PSR, there is no requirement for mitigation of effects on radar.
- 15.10.2 The Proposed Development will be depicted on aeronautical charts and in the AIP to assist aircrew in avoiding the structures.

15.11 Residual Effects

Construction

- 15.11.1 The magnitude of the residual effect of the Proposed Development on the Inverness Airport and RAF Lossiemouth radars during the construction phase is **zero** and the significance of the effect is **nil**.
- 15.11.2 During construction, cranes and other structures will present a potential hazard to low flying aircraft. This will be mitigated by the promulgation of the location and height of all obstacles on aeronautical charts and in the AIP.
- 15.11.3 The overall magnitude of the residual effect of the Proposed Development on aviation during the construction phase is **low** and the significance of the effect is **negligible**.

Operation

- 15.11.4 The magnitude of the residual effect of the Proposed Development on aviation during the operational phase will be **low** and the significance of the effect will be **negligible**.

Decommissioning

- 15.11.5 The magnitude of the residual effect of the Proposed Development on aviation during the decommissioning phase will be **low** and the significance of the effect will be **negligible**.

15.12 Cumulative Assessment

- 15.12.1 The cumulative effects of the Proposed Development have been assessed in combination with the Operational Development and the operational Corrimony wind farm.
- 15.12.2 Neither the Proposed Development nor the Operational Development and Corrimony wind farm are within line of sight of any air traffic control or air defence PSR. Consequently there is no cumulative impact on radar.
- 15.12.3 The Proposed Development is immediately adjacent to the Operational Development. The maximum tip heights above sea level of the Proposed Development are lower than those of the Operational Development. The Proposed Development will increase the area in which turbines are deployed but will not increase the vertical extent of any hazard to low flying aircraft. The Corrimony wind farm, 4.5km from the Proposed Development, has 100m tip height turbines which are not defined under the ANO as en route obstacles. It does not present a significant additional hazard to low flying aircraft in combination with the Proposed Development.
- 15.12.4 The Proposed Development will be fitted with infra-red lights, as is the Operational Development. The infra-red lighting will delineate the perimeter of the combined developments to ensure their visibility to aircraft flying at low level in the vicinity using night vision goggles. The Corrimony wind

farm is fitted with visible lighting on all turbines therefore its potential effects on night low flying are also mitigated.

15.12.5 The magnitude of the cumulative effect of the Proposed Development on low flying aircraft is **low** and the significance of the effect is **negligible**.

15.12.6 The overall cumulative effect of the Proposed Development on aviation is of **low** magnitude and the significance of the effect is **negligible**.

15.13 Summary

15.13.1 The Proposed Development is located in uncontrolled airspace, beyond the CAA-recommended consultation distances from all aviation facilities.

15.13.2 The Proposed Development has the potential to cause effects on the primary surveillance radars at Inverness Airport and RAF Lossiemouth. However, radar line of sight assessment has determined that none of the turbines will be visible to those radars due to intervening terrain. Thus there will be no effects on these radars.

15.13.3 The Proposed Development has the potential to present an obstruction hazard to low flying aircraft. This is mitigated by promulgation of data on the locations and heights of the turbines on aeronautical charts and in aeronautical information publications.

15.13.4 The potential obstruction hazard to low flying aircraft at night will be mitigated by the provision of infra-red lighting on the perimeter turbines.

15.13.5 The overall cumulative effect of the Proposed Development on aviation is of **low** magnitude and the significance of the effect is **negligible**.

Table 15.3 – Summary of Effects

Description of Effect	Significance of Likely Effect		Mitigation Measure	Significance of Residual Effect	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Construction					
Effects on primary surveillance radar	Nil	N/A	None required	Nil	N/A
Obstruction hazard to low flying aircraft	Negligible and not significant.	Adverse	Promulgation of information on aeronautical charts and in aeronautical information publications.	Negligible and not significant.	Adverse
Operation					
Effects on primary surveillance radar	Nil	N/A	None required	Nil	N/A
Obstruction hazard to low flying aircraft	Negligible and not significant.	Adverse	Promulgation of information on aeronautical charts and in aeronautical information publications. Infra-red lighting on perimeter turbines.	Negligible and not significant.	Adverse
Decommissioning					
Effects on primary surveillance radar	Nil	N/A	None required	Nil	N/A

Description of Effect	Significance of Likely Effect		Mitigation Measure	Significance of Residual Effect	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Obstruction hazard to low flying aircraft	Negligible and not significant.	Adverse	Promulgation of information on aeronautical charts and in aeronautical information publications.	Negligible and not significant.	Adverse

Table 15.4 – Summary of Cumulative Effects

Receptor	Effect	Cumulative Developments	Significance of Cumulative Effect	
			Significance	Beneficial/ Adverse
Low flying aircraft	Obstruction hazard	Operational Development and Corrimony Wind Farm	Negligible and not significant.	Adverse

15.14 References

Legislation and guidance

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