Chapter 14 Aviation and Radar

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List of Abbreviations

Abbreviation	Description
ANO	Air Navigation Order
CAA	Civil Aviation Authority
DIO	Defence Infrastructure Organisation
EIA	Environmental Impact Assessment
HIAL	Highlands and Islands Airports Limited
IR	Infra-red
MoD	Ministry of Defence
NATS	National Air Traffic Services
PSR	Primary Surveillance Radar
RAF	Royal Air Force
SPP	Scottish Planning Policy

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14. Aviation and Radar

14.1. Executive Summary

14.1.1. The site lies approximately 20 km south-east of Inverness Airport and over 40km south-west of Royal Air Force (RAF) Lossiemouth. It is remote from all navigational aids and radio communication stations, in an area of low priority for military low flying. Studies have determined that there are no impacts to radar.

14.1.2. The aviation stakeholders consulted as a part of the Environmental Impact Assessment (EIA) were National Air Traffic Services (NATS) (En Route) plc, Highlands and Islands Airports Limited (HIAL), the Civil Aviation Authority (CAA), the Ministry of Defence (MoD), the Scottish Ambulance Service and Police Scotland.

14.1.3. As structures over 150 m high there is a statutory requirement for aviation lighting on the Proposed Development. A proposed lighting scheme has been agreed with the CAA and MoD. No further mitigation is required and there are no residual impacts.

14.2. Introduction

14.2.1. This chapter considers the potential effects of the Proposed Development on existing and planned military and civil aviation activities, including those resulting from impacts to radar. Other potential effects result from the physical presence of the turbines as obstacles, and effects on navigational aids and radio communication stations.

14.2.2. Radio waves are used in a variety of surveillance and communication systems within aviation and any large structure has the potential to interfere with their broadcast and reception. The potential of a structure to affect the propagation of radio waves is principally dependent upon the size, shape and materials of construction. Because the blades rotate, this can cause turbines to show up on radar, which are specifically designed to detect movement. Whilst turbines can impact radar, whether or not this generates significant operational effects depends upon both the use of the radar and of the airspace above the development.

14.2.3. The potential effects are highly dependent on the location of the wind farm and on the positions of the individual turbines. In some cases, there are no significant consequences and no mitigation is required, whilst in other cases the turbine specification or layout must be designed to accommodate local infrastructure. Mitigation is often available and appropriate to manage impacts.

14.3. Legislation, Policy and Guidelines

14.3.1. The relevant sections of key legislation, policy and guidance documents are described below, which together place a responsibility on the planning authorities and the developer to assess potential impacts on aviation.

Legislation

14.3.2. Civil Aviation Authority (CAA) *CAP 393* (February 2021), *The Air Navigation Order (ANO) and Regulations*, specifies the statutory requirements for the lighting of onshore wind turbines over 150 m tall.

Policy

Scottish Planning Policy (SPP), (2020)

14.3.3. The SPP states under paragraph 169 on Development Management, that consideration should be given to the, “impacts on aviation and defence interests and seismological recording; [and]

impacts on telecommunications and broadcasting installations, particularly ensuring that transmission links are not compromised".

Scottish Onshore Wind Policy Statement (December 2017)

14.3.4. Under *Chapter 4*, Barriers to Deployment, it is noted wind developments can impact significantly on civil air traffic control primary radar systems because they appear as clutter on radar displays, potentially obscuring aircraft flying above them from view. This is a common factor in creating delay and cost to wind power developments.

14.3.5. *Paragraphs 61* to *66* in this chapter, specifically address impacts to civil aviation radar, extracted below:

"*The main mitigation method which has been deployed in numerous schemes over a number of years involves 'in-filling' from a radar which has no line of sight of the turbines in question*.

While this is a proven mitigation (albeit not one that can be deployed for every development), the Scottish Government recognises that it can result in a significant financial burden, especially in cases where more than one in-fill feed is necessary. Since the financial environment facing wind energy development has changed radically, we believe that we need to reconsider this approach.

The Scottish Government remains committed to working with airports, radar operators and the wind industry in order to pursue and develop a more strategic approach to mitigating impacts of wind development on civil aviation radar.

Wind farms are no longer the new and unexpected feature that they once were, and are an established part of Scotland's landscape. ***Given this, we expect in the longer term, a move on the part of the air navigation industry towards self-management of this issue. This could be achieved through the deployment of wind farm tolerant radar, or other technical solutions****.*

In the shorter term, we will support any strategic use of radar, with a special focus across the central belt, where there is potential to maximise the application of mitigation and reduce costs.

The Scottish Government will also continue to work as part of the UK Government Chaired Aviation Management Board (AMB), and as part of the Renewable UK Aviation Working Group to make progress on this issue."

Onshore Wind Policy Statement Refresh 2021: Consultative Draft (October 21)

14.3.6. Under *Section 3.3*, Aviation Lighting, the document notes that Aviation lighting is becoming a more prominent issue, one which could have a significant effect on the development of onshore wind. Further that work is underway on technical and airspace-related solutions and that The Scottish Government has set up a short-term working group (anticipated lifespan of 18-24 months) to consider this issue and, ultimately, to deliver practical and consistent guidance to aid both the renewables sector and decision makers in assessing these impacts.

Planning Circular 2/03: Safeguarding of Aerodromes, Technical Sites and Military Explosives Storage Areas (revised March 2016)

14.3.7. This *Circular* summarises the Scottish Ministers' understanding of the general effect of the relevant primary or secondary legislation.

14.3.8. It contains 4 annexes. *Annexes 1* and *2* describe the formal process by which planning authorities should take into account safeguarding, including in relation to wind energy developments. *Annex 3* lists officially safeguarded civil aerodromes and *Annex 4* lists planning authority areas containing civil en-route technical sites for which separate official safeguarding maps have been issued (as at 27 January 2003).

14.3.9. The circular also refers planning authorities, statutory consultees, developers and others to CAA *CAP 764 (CAA Policy and Guidance on Wind Turbines*), which is discussed further under Guidance below, and Met Office guidelines.

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 (June 2017)

14.3.10. This policy statement highlights and clarifies the requirements set out in *CAP 393*, the *Air* Navigation *Order*, for the lighting of onshore turbines. Key sections are described further under the assessment methodology below.

Guidance

CAP 764: CAA Policy and Guidance on Wind Turbines (Feb 2016)

14.3.11. CAA guidance within *CAP 764*, sets out recommended consultation and assessment criteria for the impacts of wind turbines on all aspects of civil aviation.

14.3.12. The CAA involvement in the Wind Farm Pre-Planning Consultation Process ceased on 25 December 2010. CAP 764 now states that "developers are required to undertake their own pre- planning assessment of potential civil aviation related issues."

14.3.13. Within *CAP 764* the CAA provides a chapter describing the "*wind turbine development planning process*", within which the main civil aviation stakeholders and their interests are listed and described in brief. *Table 1* within the guidance document provides an overview of considerations and the following paragraphs detail what developers will need to consider, conducting associated consultations as appropriate.

14.3.14. The CAA observes in *section 2.36* that impact on communications, navigation and surveillance infrastructure alone is not sufficient to support an objection; rather those impacts need to have a negative impact on the provision of an air traffic service.

14.3.15. The CAA notes in section 5.25 of CAP 764 that "it is incumbent upon the developer to liaise with the appropriate aviation stakeholder to discuss – and hopefully resolve or mitigate – aviation related concerns without requiring further CAA input. However, if these discussions break down or an impasse is reached, the CAA can be asked to provide objective comment".

14.3.16. *Section 5.26* of CAP 764 states that "the CAA will not provide comment on MoD objections or arguments unless such comments have been requested by the MoD."

14.4. Consultation

14.4.1. The aviation stakeholders consulted as a part of the EIA were NATS, HIAL, the CAA and the MoD via the Defence Infrastructure Organisation (DIO).

14.4.2. An additional round of consultations was conducted to gain approval for the aviation lighting design, subsequent to the scoping consultations. This involved direct consultation with HIAL, The Scottish Ambulance Service, Police Scotland, the CAA and the Ministry of Defence (MoD). These consultations are shown within **Table13-1** below.

Table 13-1: Consultation in regard to Aviation

Consultee	Consultation Response	Applicant Action
HIAL 01 March 2021 Their reference 2021/0029/INV	Within range of the Primary Surveillance Radar (PSR). Would object if any radar performance degradation affected air traffic services and in that event would work with the developer to a resolution. HIAL would require a radar impact assessment to	A radar Line of Sight assessment has been conducted and established that none of the turbines are visible to

Consultee	Consultation Response	Applicant Action
	demonstrate that the development would not be line of sight to the PSR.	the Inverness PSR. This removes the potential for impacts to Inverness Airport.
HIAL 01 October 2021 Their reference Lethen Wind Farm Aviation Lighting	HIAL are content that the revised lighting scheme, in line with the requirement laid down in *article 222* of the *ANO*, is sufficient for the Propose Development and HIAL shall not be requesting any changes to the scheme.	No action required.
DIO 03 March 2021 Their reference 10050591	Subject to specified conditions addressing lighting and charting, the MoD has no objection to the Proposed Development. The MOD require that the Proposed Development is fitted with aviation safety lighting and that sufficient data is submitted to ensure that structures can be accurately charted to allow deconfliction.	The MoD lighting requirements have been included in the lighting design approved by the CAA. Accurate positional information will be provided to enable charting.
DIO 01 July 2021 Their reference 10050591	The MoD are content with the submitted provisional lighting scheme as long as CAA directive is adhered to.	No actions required.
CAA 18 August 2021 Their reference Windfarms/Lethen	The CAA confirms in principle that it would provide a variation to the lighting requirements specified in the *ANO Article* for the Lethen wind farm, under provisions given in the *ANO Article 222 section 6*, as per the following: • medium intensity steady red (2000 candela) lights on the nacelles of turbines T01, T02, T04, T14, T18 and T19 (six turbines in total); • a second 2000 candela light on the nacelles of the above turbines to act as alternates in the event of a failure of the main light; • the lights on these turbines to be capable of being dimmed to 10% of peak intensity when the visibility as measured at the wind farm exceeds 5 km; and • infra-red lights to MoD specification installed on the nacelles of all perimeter turbines, that is T01 to T05 (inclusive), T07, T08, T10, T11, T13, T14 and T16 to T19 (inclusive). Intermediate level 32 candela lights are not required to be fitted on the turbine towers.	The lighting design for the development is as specified by the CAA, meeting both the requirements of the CAA with respect to civil aviation interests and those of the MoD with respect to military interests.
Scottish Air Ambulance Service 01 July 2021 Their reference Lethen Wind Farm	No detrimental impact on our air ambulance operation from your lighting proposals	No action required

Consultee	Consultation Response	Applicant Action
Police Scotland 30 June 2021 Their reference Lethen Wind Farm	No issues with the proposal from me with regards to Babcock MCSO/Police operations.	No action required
NATS	No response from scoping	The assessment shows no impacts to NATS infrastructure, hence no actions are expected to be required.

14.5. Assessment Methodology

14.5.1. The requirement is for the Proposed Development to have no significant residual impacts on aviation infrastructure. This is addressed through consultation with all relevant stakeholders within the consenting process. The task of the Applicant is to independently assess the potential effects and where significant effects may occur, to enter a dialogue with the affected stakeholders prior to submission as far as is possible. Whilst the aim of this pre-submission dialogue is to enable the approval of all stakeholders, typically solutions are identified but do not reach full maturity in terms of the assessment by the stakeholders and the contracting of mitigation where required. The stakeholders consider dialogue a higher priority and more meaningful, once design iterations are completed and a live application exists.

14.5.2. An initial scoping study identified those stakeholders potentially affected by the Proposed Development. The scoping process involves considering all military and civil aerodromes in the wider area out to circa 60 km, all radar installations out to the limit of their range, all navigational aids, air-ground-air communications stations and low flying activities. A key sensitivity is the visibility of the turbines to those radars potentially affected. Because of this, studies have been conducted prior to submission to assess the visibility of the Proposed Development to all relevant radars in the area.

14.5.3. Radar visibility is initially determined using a radar Line of Sight (LoS) analysis. The terrain profile between the radar antenna and the turbine tip is extracted from a digital terrain map. This is interrogated to establish whether or not the terrain blocks the direct path between these points and if so by how much. Refraction arising from atmospheric variations is estimated by using a standard 4/3rds earth radius curvature model. If there is a high degree of screening, ie the turbine tip falls well below the LoS path, then there should be no radar impacts. Contrastingly if the turbine clearly projects above the LoS then there are likely to be impacts. In marginal cases a more robust analysis is required that additionally takes account of both specific radar and turbine characteristics and radar diffraction around the terrain. Both these methods of analysis are conducted as required to generate a robust result.

14.5.4. The scoping process identified NATS, HIAL (Inverness Airport), the CAA and the MoD as relevant stakeholders.

14.5.5. As structures over 150 m high there is a statutory requirement for aviation lighting on the Proposed Development. The precise details of the lighting will need to be agreed with the CAA prior to construction. The requirements for the lighting of en–route obstacles (i.e. those away from the vicinity of a licensed aerodrome) are set out in *Article 222 of the UK Air Navigation Order (ANO) 2016* as modified by the June 2017 *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*. *Article 222* requires medium intensity (2000 candela) steady red aviation warning lights to be mounted as close as possible to the top of all structures

at or above 150 m above ground level (AGL) and illuminated at night. In terms of requirement for lighting wind turbines generators, the CAA interprets this as the fitting of lights on the top of the supporting structure (the nacelle) rather than the blade tips. Additionally, the *2017 Policy Statement* requires at least three (to provide 360-degree coverage) low-intensity lights (32 candela) be provided at an intermediate level of half the nacelle height. The lights should be turned on only when illuminance reaching a vertical surface falls below 500 LUX (dusk like conditions). If the horizontal meteorological visibility in all directions from every wind turbine generator in the Proposed Development is more than 5 km, the intensity of the nacelle mounted lights may be reduced to not less than 10% of the minimum peak intensity specified for a light of this type.

14.5.6. If four or more wind turbine generators are located together in the same group, with the permission of the CAA, only those on the periphery of the group need be fitted with a light.

14.6. Baseline Conditions

14.6.1. The site lies approximately 20 km south-east of Inverness Airport and over 40 km south-west of RAF Lossiemouth. These are the closest aerodromes and the only aerodromes with any potential for any kind of impact. The site is also remote from lower airspace routes, conurbations and the coast, in a relatively remote area.

14.6.2. The site is beyond the physical safeguarding zones of both Inverness and Lossiemouth aerodromes.

14.6.3. The site is remote from all navigational aids, radio communication stations and weather radar. It is in an area of low priority for military low flying training.

14.6.4. The principal sensitivity is the visibility of the turbines to those radars potentially affected. Because of this, studies have been conducted prior to submission to assess the visibility of the Proposed Development to all relevant radars in the area. These studies determined that no impacts are anticipated to any key radar; i.e. any radar operated by NATS, Airports or the MOD.

14.7. Potential Effects

14.7.1. There are no significant aviation impacts during construction, operation or decommissioning. The physical presence of additional, tall structures in the landscape does require appropriate marking to minimise aircraft collision risk. As en-route obstacles, there are well established regulations and processes to ensure this risk is managed effectively; details are provided under mitigation below.

14.8. Mitigation

14.8.1. Collision risk is managed through both the lighting of the turbines and their addition to aviation charts. After consultation with key aviation stakeholders it was concluded that a scheme based on cardinal lighting only was suitable for this site, in the interests of reducing visible impacts. This lighting scheme has been approved by the CAA, who will also need to provide a final approval prior to construction.

14.8.2. The specification of the lighting is provided below and **Figure13.1** shows the lit turbines within the Proposed Development layout.

- Medium intensity steady red (2000 candela) lights on the nacelles of turbines T01, T03, T14, T15 and T17 (five total);
- a second 2000 candela light on the nacelles of the above turbines to act as alternates in the event of a failure of the main light;

- the lights on these turbines to be capable of being dimmed to 10% of peak intensity when the visibility as measured at the wind farm exceeds 5km;
- infra-red lights to MoD specification installed on the nacelles of all perimeter turbines, that is all turbines except T02, T06, T09 and T13; and
- No other mitigation is required.

14.9. Residual Effects

14.9.1. There are no residual effects.

14.10. Summary

14.10.1. The site lies approximately 20 km south-east of Inverness Airport and over 40 km south-west of RAF Lossiemouth, beyond the physical safeguarding zones of both aerodromes. It is remote from all navigational aids, radio communication stations and weather radar, in an area of low priority for military low flying training.

14.10.2. Studies have determined that no impacts are anticipated to any key radar; i.e. any radar operated by NATS, Airports or the MOD.

14.10.3. As structures over 150 m high there is a statutory requirement for aviation lighting on the Proposed Development. Proposed lighting has been agreed with the CAA and MOD, but will need final approval again with the CAA, prior to construction.

14.10.4. There are no residual effects.

Table 13-2: Summary of Effects

Description of Effect	Significance of Potential Effect		Mitigation Measure	Significance of Residual Effect	
	Significance	Beneficial/Adverse		Significance	Beneficial/Adverse
Effects on aviation, radar and telecommunication interests during construction and decommissioning	Negligible	Neutral	Aviation lighting will be installed as soon as practicable on erected turbines.	Negligible	Neutral
Effects on aviation, radar and telecommunication interests during operation	Negligible	Neutral	Aviation lighting will be installed. The location of erected turbines will be notified to the CAA and Defence Geographic Centre for inclusion in relevant obstacles data bases	Negligible	Neutral

14.11. References

Civil Aviation Authority (Feb 2016). *CAP 764: CAA Policy and Guidelines on Wind Turbines*.

Civil Aviation Authority (Jun 2017). *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*

Civil Aviation Authority (Feb 2021). *CAP 393: The Air Navigation Order 2016 (ANO) and Regulations*

Scottish Government (revised March 2016). *Planning Circular 2/03: Safeguarding of Aerodromes, Technical Sites and Military Explosives Storage Areas.*

Scottish Government (Dec 2020). *Scottish Planning Policy*

Scottish Government (Dec 2017). *Onshore wind: policy statement*

Scottish Government (Oct 2021). *Onshore Wind Policy Statement Refresh 2021: Consultative Draft*

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