13 AVIATION AND RADAR

13.1 Introduction

13.1.1 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 ('Navaids') and radio communication stations.

13.1.2 The chapter includes a description of the assessment methodology that has been adopted, the consultations conducted, relevant policy and legislation, the overall baseline conditions, the impacts assessed and associated mitigation measures. The chapter concludes with a summary of the residual effects.

13.1.3 Radio waves are used in a variety of Navaids, radio communication systems and radar; any large structure has the potential to interfere with their propagation and reception. Radars are designed to detect movement; hence a turbine's rotating blades can be interpreted as aircraft, with the potential to then affect air traffic management.

13.1.4 Wind turbines can also have an impact on flying simply by virtue of their physical presence. In this respect they are no different to any other tall obstacles such as pylons or television masts, with recognised criteria for safeguarding the airspace around airfields. Away from airfields, such obstacles are a normal part of the aviation scenery and measures are in place to enable aircraft to safely navigate around them.

13.1.5 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.

13.2 Scope and methodology

13.2.1 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 elicit 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.

13.2.2 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 approximately 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 Proposed Development 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.

13.2.3 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, i.e. 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, 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.

13.2.4 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 be agreed with the Civil Aviation Authority (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 fall 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.

13.2.5 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 and intermediate lights may not be required. Where acceptable to airspace users, and very much subject to the specific location, the CAA has increasingly supported the use of visible spectrum lighting of the cardinal turbines only; these being the 'corner' turbines that mark the geographical extent of the development. In addition to this, infra-red lights would be used on all peripheral turbines. This reduces the visual impacts of the lighting scheme.

13.3 Consultation undertaken

13.3.1 The Scoping process identified National Air Traffic Services (NATS), Highlands and Islands Airports Ltd (HIAL), the UK Civil Aviation Authority (CAA) and the Ministry of

Defence (MoD) as relevant stakeholders; the CAA only with respect to the provisional approval of the lighting design.

13.3.2 In addition to the above, Police Scotland and the Scottish Air Ambulance Service were consulted on the proposed lighting scheme. All responses were provided to the CAA to support their assessment and approval process.

13.3.3 No objection responses were received back from the MoD, NATS and HIAL from the Scoping submission.

13.3.4 All the above airspace users approved the proposed lighting scheme. Agreement was reached with all parties that visible spectrum lighting on cardinal turbines only, with no tower lights, would meet their requirements for air safety. IR lights to be fitted to all other perimeter turbines. The proposed lighting scheme report was submitted to the CAA on 01 October 2021. The CAA reviewed the proposed scheme and advised to light one additional turbine in their response of 22 December 2021. The lighting scheme used throughout this assessment is the CAA revised and approved scheme.

13.4 Statutory and planning context

13.4.1 The relevant sections of key legislation, policy and guidance documents are described below, which together place a responsibility on the decision maker and the applicant to assess potential impacts on aviation.

Legislation

13.4.2 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), (2014)

13.4.3 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)

13.4.4 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.

13.4.5 Paragraphs 61 to 66 of Chapter 4 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.

13.4.6 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.

13.4.7 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.

13.4.8 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.

13.4.9 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.

13.4.10 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."

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

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

13.4.12 It contains four annexes. Annexes 1 and 2 describe the formal process by which decision makers should consider 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 of 27 January 2003).

13.4.13 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 The Meteorological Office (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)

13.4.14 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)

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

13.4.16 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."*

13.4.17 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.

13.4.18 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.

13.4.19 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".

13.4.20 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."

13.5 Existing environment

13.5.1 The Proposed Development is remote from all civil and military aerodromes, being approximately 70 km north-west of RAF Lossiemouth, just under 70 km north of Inverness Airport and 80 km south-west of Wick Airport.

13.5.2 The site is also far removed from all NATS infrastructure, though the visibility to their radar has been assessed.

13.5.3 The site lies within the military Tactical Training Area 14T, a high priority low flying training area. Any MoD concerns relating to impacts on low flying training would have been raised within the scoping response from the Defence Infrastructure Organisation (DIO). They raised no concerns in their response.

13.6 Predicted impacts

13.6.1 The Proposed Development is not expected to have any aviation impacts.

13.6.2 There are no radars affected, including those operated by NATS, airports and the MoD.

13.6.3 The MoD has no concerns in relation to low flying.

13.6.4 "No objection" Scoping responses have been received from all relevant aviation stakeholders.

13.7 Mitigation

13.7.1 Because the proposed turbines exceed 150 m in height, there is a statutory requirement for aviation obstruction lighting. In addition, the MoD has requested that all peripheral turbines be fitted with infra-red lighting.

13.7.2 Light pollution from aviation obstacle lighting is of potential concern to residents and The Planning Authority. In balancing the requirements for obstacle lighting against the need to minimise light pollution, it is considered appropriate to use a reduced lighting scheme, with not all turbines being lit.

13.7.3 A cardinal lighting scheme was proposed for consultation. Stakeholder feedback has confirmed that this is acceptable, with the final approval of the CAA having been received on 22/12/2021. The cardinal lighting scheme comprises:

- Cardinal turbines to be fitted with combi-lighting comprising both visible spectrum lighting and IR (infra-red) lighting.
- All peripheral turbines to be fitted with IR lighting.

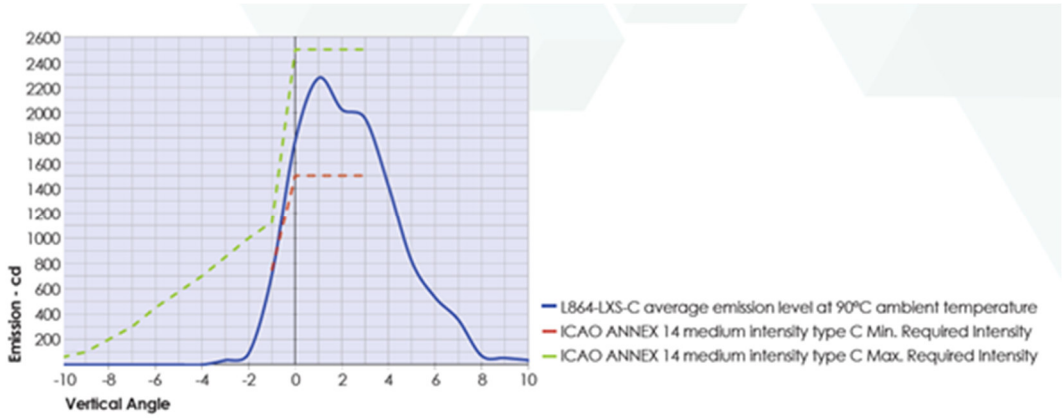
Lighting Specification

13.7.4 The specification of the lighting is provided below.

- Medium intensity steady red (2000 candela) lights on the nacelles of turbines T1, T6, T11, T14 and T16 (five 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;
- infra-red lights to MoD specification installed on the nacelles of all perimeter turbines, that is T01 to T06 (inclusive), T10, T11, T12, T14, T15 and T16.

Commentary on light intensity

13.7.5 The intensity of the light emitted from an aviation obstruction light is designed to vary with the observed angle. It aims to be at its brightest when observed from a similar level or just above, but less bright as the observer falls significantly below or above the light. Different manufacturers produce lights with slightly varying characteristics, though broadly similar in complying with international standards. The below graph illustrates the variation of intensity with observed angle from a current obstacle light. It shows the published characteristics of the Luxsolar obstruction light, model L864-LXS-200-CAP168-C.



Graph 13.1 Light emitted by a 2000 candela light at different vertical angles[136]

13.7.6 The graph depicts a rapid drop in intensity for observation from elevations below that of the light, falling to near zero at -2 degrees or less. In practice the light intensity reaching an observer is further reduced by absorption and scatter from particles and aerosols in the air.

13.7.7 The other critical aspect of the brightness of the lights to an observer is their distance from them. As the light spreads from the source the intensity diminishes. At twice the observed distance the intensity drops to one quarter the intensity.

13.7.8 Hence overall it can be seen that the light levels reaching an observer at some distance and in the valleys below the Proposed Development, will be substantially diminished, in comparison to views from very close to and at the same height as the nacelles of lit turbines.

Aircraft Detection Lighting Systems

13.7.9 The CAA, together with the UK Wind Sector, is exploring the future use of Aircraft Detection Lighting Systems (ADLS). This can reduce the time that the obstacle lights are on. The lights are triggered by the presence of any aircraft within a defined area around the development, otherwise remaining off. Such systems are unable to be used within the current regulatory environment, with anticipated changes offering the potential alongside UK airspace modernisation. Whilst the Proposed Development is unable to specify ADLS, the timescale to implementation may allow for the use of ADLS and its use will be reviewed at the time of implementation.

13.7.10 Further information on turbine lighting is provided in **Section 2.8.14** and **2.8.15** of **Chapter 2** and in **Section 1.4** "Potential Mitigation" of **Appendix 6.2: Aviation Lighting Assessment.**

13.8 Summary of effects

13.8.1 There are no aviation impacts.

13.8.2 Night-time visible spectrum obstacle lighting will be fitted to only four turbines, to minimise light pollution. These will be dimmed during periods of good visibility.

[136] C&E SRL. Nd. Luxsolar Data Sheet: Medium Intensity Obstruction Lights - Type C.

13.9 References

C&E SRL. (Nd.) Luxsolar Data Sheet: Medium Intensity Obstruction Lights - Type C.

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 (2014), 'Scottish Planning Policy'.

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