Chapter 11: Aviation

Chapter 11
Aviation

Introduction

11.1 This chapter presents the findings of the assessment of likely significant effects of the Proposed Development in relation to aviation and defence. The assessment considers potential effects on the aviation and air defence activities of the Ministry of Defence (MOD) as safeguarded by the Defence Infrastructure Organisation (DIO). It also considers the possible effects of wind turbines upon civil airports and the National Air Traffic Services En Route Ltd (NERL) Communications, Navigation and Surveillance (CNS) systems which consist of a network of primary and secondary radars and navigation facilities around the country.

11.2 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 to determine whether a development will breach obstacle clearance criteria.

11.3 This assessment should be read in conjunction with **Appendix 11.1: Wind Farm Aviation Lighting and Mitigation Report** and **Figure 11.1**: **VFR 500k Chart Extract**.

11.4 Wind turbines have the potential to affect civil and military aviation. This chapter presents the methodology used to undertake the aviation safeguarding assessment, lists the aviation references used and describes the aviation baseline condition, consultation requirements and mitigations to be applied if required.

Methodology

Effects Scoped Into the Assessment

11.5 The following potential operational effects of the Proposed Development have been assessed in full:

- Licensed airfields with a surveillance radar;
- MOD Air Defence Radar;
- NERL surveillance radar; and
- CAA and MOD Lighting Requirements.

Effects Scoped out of the Assessment

11.6 The following potential aviation and defence receptors have been scoped out of detailed assessment (based on policy and guidance):

- MOD ATC Radars (none affected);
- Met Office radars (none affected); and
- Unlicensed Aerodromes, glider, parachute and microlight sites (none affected).

Legislation and Guidance

11.7 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 Authority (CAA) (2016) Policy and Guidance on Wind Turbines Version 6 Civil Aviation Publication (CAP) 764 CAA
- CAA (2019) Licensing of Aerodromes, Version 11 CAP 168 CAA;
- CAA (2019) ATS Safety Requirements Version 3 CAP 670 CAA;
- CAA (2017) UK Flight Information Services, Ed 3 CAP 774 CAA;
- CAA (2006) Safeguarding of Aerodromes Version 2 CAP774 CAA;
- CAA (2010) Safe Operating Practices at Unlicensed Aerodromes Ed 1 CAP 783 CAA;
- CAA (2017) Manual of Air Traffic Services Part 1 Ed 7.0 CAP 493 CAA;
- CAA (2020) Parachuting Ed 5 CAP660 CAA;
- MOD (2022) Military Aviation Authority Regulatory Article 2330 (Low Flying) MOD; and
- CAA (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 150m Above Ground Level (AGL) CAA.

Radar Modelling Methodology

11.8 The radar line of sight calculations are produced using specialist propagation prediction software (Radar View Software (Review) 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 latest Ordnance Survey (OS) Terrain 50 digital terrain model, which has a post spacing of 50 metres (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 it enables a comparison between its results and those 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 allowing the 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.

Consultation

11.9 In undertaking the assessment, consideration has been given to the Scoping responses and other consultation as detailed in **Table 11.1.**

Table 11.1: Consultation responses

Consultee and Date	Scoping/Other Consultation	Issue Raised	Response/Action Taken
Edinburgh Airport EDI13230 dated 05 April 2022	Scoping	Objection as the site conflicts with the aerodrome safeguarding criteria stating*: Instrument Flight Procedure (IFP) Assessment* *'No turbine tower of any turbine may be erected, unless and until such time as the Scottish Ministers receive confirmation from the Airport Operator in writing that: (a) an IFP Assessment has demonstrated that an IFP Scheme is not required; or (b) if an IFP Scheme is required such a scheme has been approved by the Airport Operator; and*	EDF Energy Renewables Ltd has consulted with Edinburgh Airport and agreed to instruct an IFP Assessment which will be carried out by the airport's Approved Procedure Design Authority (APDO).

Consultee and Date	Scoping/Other Consultation	Issue Raised	Response/Action Taken
		(c) if an IFP Scheme is required the Civil Aviation Authority has evidenced its approval to the Airport Operator of the IFP Scheme (if such approval is required); and (d) if an IFP Scheme is required the scheme is accepted by NATS AIS for implementation through the AIRAC Cycle (or any successor publication) where applicable) and is available for use by aircraft'	
MOD DIO 10054650 dated 08 April 2022	Scoping	'*The MOD has concerns about the proposed development'* *'The turbines will be approximately 71.6 km from and detectable by the AD radar at RAF Brizlee Wood'* *'As a minimum the MOD would require that the development be fitted with MOD accredited aviation safety lighting in accordance with the Air Navigation Order (ANO) 2016.'* *'At present we are not able to state definitively that we would object, as the MOD can only accurately assess the operational impact of the development at the point in time at which we are consulted on the application by a planning authority.'*	The MOD will be reconsulted and provided with the details of the Proposed Development and the radar modelling results shown in **Table 11.3** below. If the MOD determine that an objection based on the potential operational impact is required, the Applicant will enter into discussions relating to technical mitigation options including the same method used to mitigate the adjacent Fallago Rig Wind Farm. In relation to the aviation safety lighting request, all turbines will be fitted with Infra-Red lighting to the MOD specification as detailed in **Appendix 11.1**. The MOD have already been consulted in relation to the lighting design.
NERL TOPA SG33045 Issue 1	Scoping	NERL have stated that the Proposed Development will have a technical effect on the Great Dun Fell radar which will lead to an unacceptable effect on their operations. There is no effect on any navigation or communications facilities.	The Applicant will be working with NERL to identify a suitable technical mitigation as the basis of a Statement of Common Understanding leading to the imposition of a suitably worded planning condition which will protect NERL operations.

Method of Baseline Characterisation

Desk Study

11.10 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. Consultation criteria for aviation stakeholders are defined in Chapter 4 of the guidance. These include distances that inform the size of the study area including:

- Airfield with a surveillance radar – 30 kilometres (km);
- Non radar licensed aerodrome with a runway of more than 1.1 km – 17 km;
- Non radar licensed aerodrome with a runway of less than 1.1 km – 5 km;
- Licensed aerodromes where the turbines would lie within airspace coincidental with any published Instrument Flight Procedure (IFP) (in this case Edinburgh Airport out to 60 km);
- 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.

11.11 CAP 764 further states 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.

11.12 It is necessary to consider the aviation and air defence activities of the MOD as safeguarded by the DIO. The types of issues that are routinely addressed in the Environmental Impact Assessment (EIA) include:

- MOD Airfields, both radar and non-radar equipped;
- MOD Air Defence Radars;
- MOD Meteorological Radars; and
- Military Low Flying.

11.13 It is necessary to consider the possible effects of wind turbines upon the NERL communications, navigation and surveillance (CNS) systems – a network of primary and secondary radars and navigation facilities around the country.

11.14 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. In this case there are no physical safeguarding issues associated with this Proposed Development.

Field Survey

11.15 The assessment has been desk based, drawing largely from published guidance and data.

Data Sources

11.16 The following data sources have informed the assessment:

- WPAC 'Rview' Version 5 Radar Modelling Software
- NATS Aeronautical Information Publication (AIP) 03/23 Published 09 Feb 2023 Effective from 23 March 2023

Criteria for the Assessment of Effects

11.17 There is no agreed definition for assessing significance in an aviation context. This is due to the fact that whilst technical effects on CNS systems are simple to identify and evaluate, operational and flight safety effects can be subjective and are often challenged by third parties. It is enough in this context to identify any technical effects and then, taking into account the statements in CAP 764 regarding the status of aviation stakeholders, in general to accept the judgement of those stakeholders in assessing the significance of the effects. For example, CAP 764 states:

"*Where an Air Navigation Service Provider (ANSP) determines that it is likely that a planned wind turbine development would result in any of the above effects on their CNS infrastructure, this may not, in itself, be sufficient reason to justify grounds for rejection of the planning application. The ANSP must determine whether the effect on the CNS infrastructure has a negative impact on the provision of the ATS. The developer should pay for an assessment of appropriate mitigating actions that could be taken by the ANSP and/or wind energy developer to deal with the negative impact. The position of an ANSP at inquiry would be significantly degraded if they had not considered all potentially appropriate mitigations.*"

11.18 Taking the above into account, it is not considered appropriate for the Applicant to be making an assessment of significance of an effect in relation to aviation interests. It is also the case that different Air Navigation Service Providers (ANSP) can take a different view of the same scenario based on their varying responsibilities. Therefore, this assessment does not make a judgement of significance, but is focused on identifying potential impacts and agreeing mitigation with the relevant aviation stakeholders as required.

Baseline Conditions

11.19 The Proposed Development is located in an area relatively remote from any significant aviation facilities. It is 50 km to the south-east of Edinburgh Airport and 15 km to the east of the Edinburgh Control Zone (CTZ) and within Class G unregulated airspace. There are no MOD aviation facilities within the respective study area, the closest is the ATC radar at Deadwater Fell within Royal Airforce (RAF) Spadeadam which is over 60 km to the south.

Assessment of Likely Effects

Ministry of Defence Low Flying

11.20 The Proposed Development is located on the western end of the Lammermuir Hills in the Scottish Borders. This location is within MOD Low Flying Area (LFA) 16. At night this area converts to Night Allocated Region (NAR) 2A, an area primarily reserved for fast-jet low flying in the hours of darkness. In addition, this part of the East Coast Borders region is also used as an Operational Training Area (OTA). This provides relatively restriction free airspace for fighter versus fighter-bomber training. In essence, this region is a valuable piece of low flying training airspace to both the MOD and NATO. The Proposed Development will therefore require a comprehensive lighting arrangement as detailed in the **Appendix 11.1.**

Edinburgh Airport

11.21 Radar modelling has been undertaken to assess the effect on the Edinburgh Primary Surveillance Radar. The results are shown in **Table 11.2** below. Where the radar line of sight result is in excess of the turbine maximum blade tip height of 220 m, the turbines will be screened by terrain.

11.22 The results in **Table 11.2** show that most of the turbines will be marginally visible to the radar at Edinburgh Airport. The airport does not consider wind turbines beyond 40 km in terms of operational effects or safeguarding. Where the Proposed Development site beyond 40 km, it is expected that there will be no operational effect as the nearest turbine is more than 45 km from the airport.

Table 11.2: Radar Line of Sight Edinburgh Airport Primary Surveillance Radar

Turbine	Radar Line of Sight (metres AGL)	Turbine	Radar Line of Sight (metres AGL)
1	**158.4**	9	**148.3**
2	**176.3**	10	**158.1**
3	**165.7**	11	**165.6**
4	**167.3**	12	**196.5**
5	**185.7**	13	**190**
6	221.8	14	227.8
7	**154.3**	15	231.5
8	**214.8**		

NB: Figures in Bold show that the turbine is in the Radar Line of Sight

11.23 As stated in their Scoping response, Edinburgh Airport require an Instrument Flight Procedure (IFP) assessment to be undertaken to ensure that the minimum obstacle clearance designated for each part of each procedure will be maintained. The Applicant is liaising with Edinburgh Airport and instructing the IFP assessment to be undertaken.

MOD Air Defence Radar

11.24 The MOD operate an integrated network of long range air defence radars which produce a Recognised Air Picture (RAP) in order to be able to detect unauthorised entries into UK airspace. The closest radar in the network is located at Remote Radar

Head (RRH) Brizlee Wood, near Alnwick, Northumberland. At Scoping the MOD stated that: *The turbines will be approximately 71.6 km from and detectable by the AD radar at RAF Brizlee Wood'.* Radar modelling has been undertaken by WPAC using the finalised turbine layout and the results are shown in **Table 11.3** below.

11.25 The results in **Table 11.3** show that the radar can 'see' down to almost ground level and that every turbine will be visible to the radar. The effect is that the Proposed Development is likely to generate an area of clutter and possible obscuration above and in the immediate vicinity of the Proposed Development. The fact that the turbines will create clutter does not automatically mean that an objection is inevitable. The MOD will decide if the technical effect will create an unacceptable operational impact as they state in their response to Scoping: '*At present we are not able to state definitively that we would object, as the MOD can only accurately assess the operational impact of the development at the point in time at which we are consulted on the application by a planning authority'.* The Applicant has provided the finalised turbine layout to the MOD for their consideration.

Table 11.3: Radar Line of Sight Brizlee Wood Primary Surveillance Radar

Turbine	Radar Line of Sight (metres AGL)	Turbine	Radar Line of Sight (metres AGL)
1	**1.7**	9	**94.4**
2	**28.1**	10	**104.9**
3	**0**	11	**14.7**
4	**12**	12	**98.8**
5	**11.8**	13	**3.8**
6	**38.6**	14	**106.5**
7	**28.1**	15	**8.7**
8	**33.6**		

NB: Figures in Bold show that the turbine is in the Radar Line of Sight

NATS En Route Ltd (NERL) Radar

11.26 The closest NERL 'en route' radars in their network are located at Lowther Hill, over 100 km to the south-west and Great Dun Fell, over 120 km to the south. In the case of Lowther Hill the turbines are all screened by terrain as confirmed by NERL in their Technical and Operational Assessment (TOPA). With the radar at Great Dun Fell, the results are shown in **Table 11.4** below. The results show that all of the turbines will be exposed to a greater or lesser extent to the radar and will be likely to create an area of clutter or obscuration above or within the vicinity of the Site.

11.27 The initial NERL response stated that the effect would be 'unacceptable'. Technical mitigation will be required as set out in the mitigation section below.

Table 11.4: Radar Line of Sight NERL Great Dun Fell Primary Surveillance Radar

Turbine	Radar Line of Sight (metres AGL)	Turbine	Radar Line of Sight (metres AGL)
1	**192.8**	9	**132**
2	**200.8**	10	**151.7**
3	**184.8**	11	**192.8**
4	**185.8**	12	**164**
5	**202.4**	13	**164.5**
6	**210.5**	14	**164**

7	**184.8**	15	**172**
8	**212.8**		

NB Figures in Bold show that the turbine is in the Radar Line of Sight

Potential Construction Effects

11.28 During the construction phase, where large cranes are in use, it will be necessary to inform the MOD, Edinburgh Airport and NATS of the height and location of the cranes together with details of obstruction lighting. This issue is routinely addressed in the wording of a standard planning condition.

Potential Cumulative Effects

11.29 During the period when the operation of the Proposed Development overlaps with the operation of the adjacent wind farm at Fallago Rig, there is the potential for a cumulative effect on the performance of the Brizlee Wood Air Defence Radar due to the fact that the area of potential effect will appear to be a single contiguous wind farm. This will need to be taken into account when addressing and discussing mitigation options with the MOD following receipt of their formal consultation response post submission.

Decommissioning

11.30 At the end of the Proposed Development's operational life (35 years), an application could be submitted to retain or replace the turbines, or they could be decommissioned. Decommissioning of the Proposed Development will be carried out in line with the legislation and guidance current at the time of decommissioning. With regards to decommissioning, it is expected that effects will be the same or no less than construction, and as with construction activities, the MOD, Edinburgh Airport and NATS will need to be advised of the presence of large cranes including location, operating times and lighting arrangements during decommissioning.

Mitigation

Mitigation During Operation

MOD Air Defence Radar

11.31 If required, discussions will take place with the MOD to establish the technical mitigation option. It is likely that if mitigation is required, it will be through the application of a 'Non-Auto Initiation Zone' (NAIZ), a technical process already available within the capability of the radar system using the same mitigation method applied at the adjacent Fallago Rig Wind Farm. This may require the Applicant and the MOD to follow what is known as the 'Front Door Process', which is the MOD method of identifying and applying radar mitigation to a wind farm. This is part of the process required to enable the discharge of any air defence radar mitigation planning condition. Once the mitigation is in place, the effect of the Proposed Development upon the radar will be Negligible.

NATS En Route Great Dun Fell Radar

11.32 Technical mitigation options will be discussed with NERL (prior to consent) to agree a Statement of Common Understanding (SOCU) leading to a mitigation agreement. It will be for NERL to decide the best mitigation method in this location taking into account the availability and coverage of other radars in the network that are unaffected by the Proposed Development and the operational coverage requirement, however it is likely that an agreement to fund a 'blanking contract' and infill with another radar already in the network will suffice.

Aviation Lighting

11.33 An aviation lighting and mitigation scheme consisting of a minimised lighting layout has been designed and was submitted to the CAA and MOD for approval as detailed in **Appendix 11.1**. CAA approval has now been granted and this is

reflected in the appendix. This also addresses the regulatory situation in relation to future potential Automatic Detection Lighting Systems (ADLS).

Summary

11.34 This chapter has examined potential aviation effects and where required, identified a mitigation process. Once the IFP assessment required by Edinburgh Airport is completed to the satisfaction of the Airport, their issues will have been resolved. In radar terms, mitigation where required is likely to be available using existing and available mitigation methodologies and aviation stakeholder interests can be protected through the imposition of suitably worded planning conditions.

Glossary/Abbreviations

Table 11.5: Glossary and abbreviations

Term in Full	Abbreviation	Meaning/Description
Automatic Detection Lighting System	ADLS	
Above Ground Level	AGL	
Above Mean Sea Level	AMSL	
The Air Navigation Order	ANO 2016	
Air Navigation Service Provider	ANSP	A provider of ATC services such as NERL or GPA
Air Traffic Control	ATC	
Civil Aviation Authority	CAA	UK Civil Aviation Regulatory Authority
Civil Aviation Publication	CAP	
Class D Regulated Airspace	Class D	Class D airspace is for IFR and VFR flying. An ATC clearance is needed and compliance with ATC instructions is mandatory. Control areas around aerodromes are typically class D and a speed limit of 250 knots applies if the aircraft is below FL 100 (10,000 feet).
Communications, Navigation and Surveillance	CNS	The three technical elements required for ATC services
Control Area	CTA	Regulated airspace from a specified level to another specified level
Control Zone	CTZ	Regulated airspace from ground level to a specified level
Defence Infrastructure Organisation	DIO	MOD Safeguarding Organisation
Glasgow Prestwick Airport	GPA	
Instrument Flight Procedures	IFP	Published and safeguarded procedures for airports
Instrument Flight Rules	IFR	

Instrument Landing System	ILS	Radio navigation facility for precision approaches
Infra-Red	IR	IR lights are not visible to the naked eye
Low Flying Area	LFA	
Ministry of Defence	MOD	
Non Auto Initiation Zone	NAIZ	A technical mitigation method of removing wind farm generated clutter
Night Allocated Region	NAR	MOD Night Low Flying Area
North Atlantic Treaty Organisation	NATO	
National Air Traffic Services Ltd	NATS	
NATS En Route Ltd	NERL	
Ordnance Survey	OS	
Operational Training Area	OTA	
Royal Air Force	RAF	
Radar View Software	Rview	Used to calculate radar line of sight from any radar
Statement of Common Understanding	SOCU	
Scottish Terminal Area	TMA	Class D airspace used to sequence and separate aircraft departing and arriving from Glasgow, Edinburgh and Prestwick Airports
Technical and Operational Assessment (NERL)	TOPA	