

13 Aviation and Radar

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13 Aviation and Radar

13.1 Introduction

13.1.1 This chapter assesses the potential for the Proposed Development to affect aviation communications, navigation and surveillance (CNS) infrastructure in the vicinity of the site. The assessment has been undertaken by aviation specialists Wind Power Aviation Consultants Ltd (WPAC), taking into account the guidance laid down in CAP 764 and other aviation regulations. The assessment considers whether the Proposed Development is likely to have any effect on the following:

- civil aviation interests, including “En Route” facilities managed and operated by National Air Traffic Services (En Route) Ltd (NERL), airports, licensed and unlicensed aerodromes, light aircraft landing strips, microlight sites, parachute and gliding sites; and
- military facilities including Ministry of Defence (MOD) Airfields and military Air Traffic Control (ATC) facilities, Air Defence Radars, Danger Areas and Ranges and low flying operations.

13.2 Legislation, Policy and Guidelines

13.2.1 This assessment takes into account consultation, regulatory, safeguarding and operational requirements as laid down in a number of publications and regulations including:

- Civil Aviation Publication (CAP) 764 Civil Aviation Authority (CAA) Policy and Guidance on Wind Turbines Version 6, Feb 2016;
- CAP 168 Licensing of Aerodromes, Version 11 January 2019;
- CAP 670 ATS Safety Requirements Version 3 May 2014;
- CAP 774 UK Flight Information Services, Ed 3 May 2017;
- CAP 738 Safeguarding of Aerodromes Version 2 Dec 2006;
- CAP 793 Safe Operating Practices at Unlicensed Aerodromes Ed 1 July 2010;
- CAP 493 Manual of Air Traffic Services Part 1 Ed 6.1 April 2015;
- UK Aeronautical Information Publications (AIP);
- CAA 1:250,000 and 1:500,000 Aviation Charts;
- CAA Policy Statement: “Lighting of Onshore Wind Turbine Generators with a maximum blade tip height at or in excess of 150 metres AGL 01/01/2017”; and
- Scottish Planning Policy para 169.

13.3 Consultation

13.3.1 Aviation consultation has been undertaken through the EIA Scoping process and in accordance with the guidance described in paragraph 13.5 below. Table 13.1 – Aviation Consultation

Consultee	Response
Ministry of Defence: Defence Infrastructure Organisation (DIO) (Scoping Response)	Ref DIO10036161 dated 05/02/18 “The turbines will be 19.3 km from, detectable by, and will cause unacceptable interference to the AD radar at RRH Saxa Vord.”
Scatsta Airport (Scoping Response)	Ref SCS01 dated 08 January 2018 “Serco (in its capacity as the operator of Scatsta Airport) objects to the proposed

Consultee	Response
	<i>development</i> " Full details of the consultation response are contained within paragraph 13.5.9 below.
Scatsta Airport – were reconsulted by WPAC on 18/10/18 providing detailed responses to each specific aviation issue raised in SCS01	No response has been received
Scatsta Airport – were reconsulted by WPAC on 21/02/19	No response has been received
National Air Traffic Services Ltd (NATS) (NERL) (Scoping Response)	Ref 18/12/17 " <i>The proposed development has been examined from a technical safeguarding aspect and does not conflict with our safeguarding criteria. Accordingly, NATS (En Route) Public Limited Company ("NERL") has no safeguarding objection to the proposal.</i> " Ref 27/02/18 " <i>The proposed development has been examined from a technical safeguarding aspect and does not conflict with our safeguarding criteria. Accordingly, NATS (En Route) Public Limited Company ("NERL") has no safeguarding objection to the proposal.</i> "

13.4 Assessment Methodology and Significance Criteria

13.4.1 This section provides an outline description of the methodology and significance criteria used to assess any effects that the Proposed Development would have on aviation operations in the area.

Consultation Criteria

Civil Aerodromes

13.4.2 CAP 764 states the distances from various types of airfields where consultation should take place. These distances include:

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

13.4.3 CAP 764 goes on to state that these distances are for guidance purposes only and do not represent ranges beyond which all wind turbine developments will be approved or within which they will always be objected to. These ranges are intended as a prompt for further discussion between developers and aviation stakeholders. As well as examining the technical impact of wind turbines on ATC facilities, it is also necessary to consider the physical safeguarding of ATC operations using the criteria laid down in CAP 168 to determine whether a proposed development will breach obstacle clearance criteria.

Ministry of Defence

13.4.4 It is necessary to take into account the aviation and air defence activities of the MOD. The issues that will be assessed include the likely significant effect of the Proposed Development on:

- MoD Airfields, both radar and non-radar equipped;
- MoD Air Defence Radars;
- MoD Meteorological Radars;
- Military Aviation Authority Aerodrome Design and Safeguarding; and
- Military Low Flying.

National Air Traffic Services (NERL) Facilities

13.4.5 It is necessary to take into account the possible effects of wind turbines upon NERL radar systems – a network of primary and secondary radars and navigation facilities around the country.

Radar Projection Information

13.4.6 Radar modelling has been undertaken using WPAC's "Rview" system which utilises a comprehensive systems database incorporating 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 and has a root mean square (RMS) error of 4 metres. 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. If needed, Rview is also capable of modelling a range of atmospheric refractive conditions. RView models the trajectory of radar signals at different elevations enabling modelling of both volume surveillance and pencil beam radars as well as the effects of angular sterilisation as applied, for example, in Met Office radars.

Study Area

13.4.7 The study area for the aviation assessment was based upon standard practice as laid down in CAA CAP 764 as detailed in 13.5.1.

Significance criteria

13.4.8 The effects of turbines on either civil or military aviation safeguarding fall into two categories:

- effects on an aerodrome and the associated safeguarded surfaces which surround it i.e. the presence of structures and obstacles that could potentially cause physical harm through risk of collision or lead to an increase in instrument approach minima; and
- effects on the communications, navigation and surveillance (CNS) systems used enable the provision of air traffic control terminal and "en route" services and air defence.

13.4.9 In order to assess the effect that wind farms have on aviation operations it is necessary to undertake an assessment of the potential technical effects on CNS systems and to then determine if the technical effect would lead to a significant effect on operations or flight safety. The fact that a wind farm might affect the performance of a radar system for example, does not always lead to the conclusion that there will be a significant effect. The guidance laid down in CAP 764 encourages a dialogue between the developer and aviation stakeholders to agree what effect if any there will be on operations and then to agree mitigation if that is feasible

13.4.10 To determine the potential effects of the Proposed Development on aviation operations, the sensitivity of a receptor was considered in relation to the magnitude of effect (see Table 13.2).

Table 13.2 - Sensitivity of aviation receptor/stakeholders around aerodromes and safeguarded surfaces

Sensitivity	Criteria
High	Affected facility or airspace user has no capacity to accommodate the proposed form of change
Medium	Some restriction on the stakeholder's ability to provide full and unrestricted ATC services across their entire area of responsibility
Low	Minor restriction on the stakeholder's ability to provide full and unrestricted ATC services across their entire area of responsibility
Very Low	Very minor or no restriction the stakeholder's ability to provide full and unrestricted ATC services across their entire area of responsibility

13.4.11 The 'magnitude of impact' for the Proposed Development is based on potential radar and operational impacts. These are categorised according to criteria in Table 13.3.

Table 13.3 - Aviation Magnitude of Impact

Magnitude	Criteria
High	Significant compromise to receptor's CNS ability to continue safe operations or safe provision of air navigation services
Moderate	Some restriction on receptor's CNS ability to continue safe operations or safe provision of air navigation services
Minor	Minor restriction on receptor's CNS ability to continue safe operations or safe provision of air navigation services
Negligible	Very minor or no restriction on receptor's CNS ability to continue safe operations or safe provision of air navigation services

Table 13.4 - Overall Significance of Effect Table

Sensitivity of Receptor/Magnitude of Effect	High	Medium	Low	Very Low
High	Major	Moderate	Minor	Negligible
Moderate	Moderate	Moderate	Minor	Negligible
Minor	Minor	Minor	Minor	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

13.4.12 The definitions of the effects above are:

- **Major:** a significant restriction on the ability of the Air Navigation Service Provider (ANSP) to continue to ensure safety and/or provide unrestricted air traffic services;
- **Moderate:** a possible restriction on the ability of the ANSP to continue to ensure safety and/or provide unrestricted air traffic services but which might be mitigated by changes to operating procedures or technical mitigation;
- **Minor:** a possible restriction on the ability of the Air Navigation Service Provider to continue to provide unrestricted air traffic services but which is manageable with little change to existing operating procedures; and
- **Negligible:** any effect should be completely manageable within current operating practices and without any requirement for change to procedures

13.5 Baseline Conditions and Potential Effects

- 13.5.1 The Proposed Development is located in an area remote from significant aviation facilities. The closest radar equipped licensed aerodrome is at Sumburgh, 90 km to the south. The primary surveillance radar (PSR) at Sumburgh is located at Compass Head, 93 km to the south of the proposed development
- 13.5.2 The closest non-radar equipped licensed aerodrome is at Scatsta, 30 km to the south-west of the Proposed Development. The airport obtains radar data from the Compass Head radar.
- 13.5.3 The MOD have recently re-installed a Lockheed Martin TPS-77 Air Defence radar at Remote Radar Head (RRH) Saxa Vord, 20 km to the north-east of the Proposed Development. There are no other MOD aviation facilities on Shetland.
- 13.5.4 The UK Met Office do not have any radars on Shetland, however, they do have Radiosonde Station to the west of Lerwick with a consultation distance of 20 km. The Proposed Development is 60 km to the north of the site and consultation is not required.
- 13.5.5 There are two small unlicensed aerodromes in the area, at Fetlar (10 km to the east) and Unst (20 km to the north-east).
- 13.5.6 NATS En Route Ltd (NERL) do not have any facilities on Shetland but provide radar services for the North Sea including Sumburgh using the Compass Head radar.

Desk Study

- 13.5.7 An assessment of any potential aviation effects of the Proposed Development was undertaken in accordance with the guidance and methodology described in 13.5. The location of the Proposed Development in relation to aviation facilities is shown in **Figures 13.1 and 13.2**.

Sumburgh Airport Radar (Compass Head)

Radar modelling was undertaken to calculate the radar line of sight (RLOS) of the Compass Head radar at each of the 29 turbine locations. The results varied across the site ranging between 576 metres (1884 ft) above ground level (AGL) and 1060 metres (3466 ft) AGL. These figures show that there is no possibility of the turbines being visible to or affecting the performance of the Compass Head radar. **Scatsta Airport**

- 13.5.8 The Proposed Development is 30 km to the north-east of Scatsta Airport. An assessment was undertaken of any potential effects on technical and physical safeguarding of aviation operations. These included the following:
- Radar – the radar data provided to the controllers at Scatsta comes from the Compass Head radar. Given that there is no possibility of the turbines being detected by or having any technical impact upon the performance of the Compass Head radar, there will be no effect upon the provision of ATC radar services to aircraft arriving to or departing from Scatsta.

- Technical Safeguarding – the airport is equipped with radio navigation aids including an Instrument Landing System (ILS) Localiser, a Non Direction Beacon (NDB) and associated Distance Measuring Equipment (DME), all located on or adjacent to the airport. On runway 24 the ILS is limited in use. All radio navigation systems are safeguarded to ensure new structures do not compromise their performance. The details of the safeguarded areas are defined in CAA CAP 670 ATS Safety Requirements. Each has been checked and the maximum dimensions of any of these zones is 610 metres. Given that the Proposed Development is in excess of 30 km from the facilities, there is no possibility of there being any effect on the navigation systems at the airport
- Physical Safeguarding – every licensed aerodrome has a precisely defined set of safeguarded surfaces as laid down in CAP 168. In the case of Scatsta, the runway is 1360 metres long, which results in an Outer Horizontal Surface with a radius of 10 km. There are further safeguarded surfaces (the Approach Surface and the Take Off Climb Surface) that extend out to 15 km from the end of the runway. However, the Proposed Development is 30 km from the airfield and therefore well beyond any physical safeguarded surfaces. There will be no effect on safeguarded surfaces.
- Instrument Approach Procedures – each of the published procedures has been examined, however, the Proposed Development is located at least 8.4 km (4.5 nm) to the north of the maximum extent of the procedures as shown in **Figure 13.3** and will have no effect on the safe operation of the procedures or require any changes to procedures or the minima associated with them. There is no effect on Instrument Approach Procedures.
- Minimum Altitude Chart – the minimum altitude promulgated in the location of the Proposed Development is 2100 ft above mean sea level (AMSL) as shown in **Figure 13.4**. Calculations have been undertaken taking into account the height of terrain of each turbine location, adding on the turbine tip height and then adding the required safety margin in accordance with the safeguarding regulations. In every case, the resulting figure does not exceed 2100 ft which means there will be no effect on the minimum altitudes promulgated for the airport.
- The detailed calculations and evidence to support the assessment above have been provided to Serco/Scatsta Airport for comment. To date there has been no response.

Unlicensed Aerodromes in the Area

- 13.5.9 There are two small unlicensed aerodromes in the area, Fetlar and Unst as shown in **Figure 13.1**. Fetlar is over 10 km to the east of the Proposed Development and well beyond the consultation distance of 3 km. Unst is 20 km to the north-east. Neither aerodrome will be affected by the Proposed Development.

Ministry of Defence - Saxa Vord TPS-77 Air Defence Radar

- 13.5.10 The MOD relocated a Lockheed Martin TPS-77 radar to Saxa Vord from North Yorkshire in May 2018 and re-activated the radar site which had been dormant for many years, in response to the changing operational environment. Saxa Vord is a Remote Radar Head (RRH), with the radar data being transferred to an operations centre in England where the data is combined with other radars in the network to create a coherent UK wide air defence picture. Radar modelling has been undertaken which shows that every turbine in the Proposed Development will be visible to the radar at a distance of approximately 20 km and is likely to generate clutter (unwanted radar returns) and possibly the generation of false tracks emanating from within the Proposed Development as the system attempts to cope with multiple radar returns from rotating blades.
- 13.5.11 The TPS-77 radars were funded by the wind farm industry as wind farm mitigation with inbuilt systems for managing the effects of wind turbines. The MOD have recently announced that the radar has not been performing as well as anticipated over wind farms and have suspended the arrangement through which mitigation was arranged and funded. MOD (DIO) announced in Autumn

2018 that they anticipated it would take up to six months for studies to be undertaken to enable changes to the radar processing system to be developed in order for the mitigation scheme to be re-introduced. Until that is achieved they are not engaging with wind farm developers and are likely to maintain objections to wind farm proposals visible to the radar where they consider that the technical impact is likely to affect air defence operations. As of March 2019 there is still no MOD progress and they do not yet have a timeline for when this will be resolved.

- 13.5.12 An assessment of the significance of the effect could be considered contentious: it will be considered to be **major** by the MOD without mitigation, however, it could be argued that although the magnitude of impact is **high** in as much as the turbines will definitely affect the performance of the radar, the geographical location of the Proposed Development could lead to the conclusion that the effect would be **moderate**. It is fully anticipated that once the mitigation system has been improved, the effect would be **moderate** or **minor**. This issue will require continued engagement with the MOD throughout the application process and is unlikely to be resolved before Summer 2019.

13.6 Requirements for Mitigation

- 13.6.1 The only effect requiring mitigation will be in relation to the TPS-77 at Saxa Vord, probably through the establishment of a Non-Auto-Initiation Zone (NAIZ) within the radar data processing system. As previously stated, it will be essential to maintain a dialogue with the MOD as this matter is likely to be on-going for some time. There are other mitigation schemes currently in development to enable this issue to be resolved, one known as “*Project Greenblades*”, with initial trials taking place in early 2019 and a full MOD trial and demonstration planned for early 2020. This project is an industry led initiative designed specifically to overcome the issue of wind turbine effects on Air Defence radars and is being driven by offshore wind farm developers, however it would be equally applicable in this location. Delivery of the solution is confidently anticipated to be within 2 years.

- 13.6.2 Once a mitigation scheme has been proposed to and accepted by the MOD as feasible solution, it will also be necessary to protect their operations through the imposition of a suitably worded planning condition. The radar mitigation scheme will only be required during the operational phase of the Proposed Development.

Construction

- 13.6.3 The only potential aviation effect will be the presence of tall cranes. These will require aviation lighting and it will also be necessary to inform the Defence Geographic Centre prior to tall cranes being operated on site.

Operation

- 13.6.4 The only potential aviation effect will be the effect of the rotating wind turbine blades on the performance of the TPS-77 radar at Saxa Vord as discussed in 13.6.12

Decommissioning

- 13.6.5 The only potential aviation effect will be the presence of tall cranes. These will require aviation lighting and it will also be necessary to inform the Defence Geographic Centre prior to tall cranes being operated on site.

13.7 Residual Effect

- 13.7.1 The residual effect of the Proposed Development in relation to the Saxa Vord radar is likely to be **minor** once the radar mitigation scheme is installed and set to work.

- 13.7.2 There are no effects on any other aviation stakeholders or receptors.

13.8 Aviation Lighting

- 13.8.1 As the turbines will have a tip height of 200 metres they will be classified as “*en route navigation hazard*” and require lighting in accordance with CAA policy statement dated 01/06/17 “*Lighting of Onshore Wind Turbine Generators in the United Kingdom with a maximum blade tip height at or in*

excess of 150 metres AGL". Article 219 of the UK Air Navigation Order (ANO) 2009 (Article 219") stipulates that any en-route structure extending 150m or greater must be fitted with medium intensity (2000 candela) steady red lights mounted as close as possible to the top of the structure and at intermediate levels not exceeding 52 metres.

- 13.8.2 Every turbine will therefore require medium intensity steady red lights (2000 candela) to be fixed to the top of the nacelle. Additionally at least three low intensity (32 candela) lights (to provide 360° coverage) should be provided at an intermediate level of half the nacelle height.
- 13.8.3 To minimise the lighting effects, if the horizontal meteorological visibility in all directions is more than 5 km the lighting intensity can be reduced to not less than 10%. The full detail is contained in the reference document.
- 13.8.4 To further reduce the effect of lighting on the environment, the CAA are planning to issue a new policy document to define the requirement and usage of radar activated lights. It is anticipated that an automated system will be installed that will ensure that the lights are turned on when an aircraft approaches a wind farm below a specific height and within a certain distance. As the policy has not yet been published it is not possible to describe the specific parameters of the requirement, however in the case of the Proposed Development, given the minimal amount of air traffic at low level in the area, particularly at night, a radar activated lighting system would be able to reduce the amount of time the lights were illuminated by a very significant percentage.
- 13.8.5 Article 219 also stipulates that aviation lighting should be displayed at night and be visible from all directions at night, dusk and during low level light conditions during the day. Illuminating the turbines at night could result in significant effects and consequently, an assessment of the landscape and visual effects arising from the visible lighting at the Proposed Development has been undertaken.

13.9 Cumulative Assessment

- 13.9.1 Given that the Proposed Development will not be visible to any ATC radars or affect any other civilian CNS systems, or have a physical safeguarding effect on any aerodrome or airfield, there is no cumulative impact to assess in a civilian or military ATC context. Any cumulative effect of wind farms within view of the MOD TPS-77 radar at Saxa Vord or the associated air defence ground environment, is likely to be minimal, however, it is not possible to assess the cumulative impact of the Proposed Development on the operation of a classified system and the MOD will have to be relied upon to assess any cumulative effect and determine its acceptability after mitigation has been applied

13.10 Summary

- 13.10.1 The Proposed Development has been assessed by aviation consultants Wind Power Aviation Consultants Ltd (WPAC), taking into account the guidance laid down in CAP 764 and other aviation regulations. Radar modelling has been undertaken which demonstrates that the turbines will be screened by terrain from the Compass Head radar used at both Sumburgh and Scatsta. Given the location 30km to the north of Scatsta Airport, there will be no effects on any civil aviation facilities however, the turbines will all need to be fitted with aviation lighting. On the military side, the only affected system will be the air defence radar located at Saxa Vord, 20km to the north-east of the Proposed Development. It will be necessary to agree a mitigation scheme with the MOD and for a suitably worded planning condition to be imposed. Subject to a satisfactory mitigation scheme being agreed with the MOD, the Proposed Development would have no residual significant effects on aviation interests and radar systems.

Table 13.5 – Summary of Effects

Description of Effect	Significance of Potential Effect		Mitigation Measure	Significance of Residual Effect	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Construction					
Presence of tall cranes	Minor	Adverse	Lighting and informing Aviation Stakeholders	None	
Operation					
Effect on MOD TPS-77 Air Defence Radar at Saxa Vord	Moderate	Adverse	Radar Mitigation Scheme	Minor	Adverse
Decommissioning					
Presence of tall cranes	Minor	Adverse	Lighting and informing Aviation Stakeholders	None	

Table 13.6 – Summary of Cumulative Effects

Receptor	Effect	Cumulative Developments	Significance of Cumulative Effect	
			Significance	Beneficial/ Adverse
Effect on the MOD TPS-77 Air Defence Radar at Saza Vord	Cumulative effect of a number of windfarms on the performance of the radar	Beaw Wind Farm	Minor	Adverse

13.11 References

UK Govt Civil Aviation Publication (CAP) 764 Civil Aviation Authority (CAA) Policy and Guidance on Wind Turbines Version 6, Feb 2016; Available at:

<http://publicapps.caa.co.uk/docs/33/CAP764%20Issue6%20FINAL%20Feb.pdf>

UK Govt CAP 168 Licensing of Aerodromes, Version 11 January 2019; Available at:

<http://publicapps.caa.co.uk/docs/33/CAP%20168%20Issue11%20Licensing%20of%20Aerodromes.pdf>

UK Govt CAP 670 ATS Safety Requirements Version 3 May 2014; Available at:

<http://publicapps.caa.co.uk/docs/33/CAP%20670%2023%20May%202014.pdf>

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<http://publicapps.caa.co.uk/docs/33/CAP738Issue02.pdf>

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<http://publicapps.caa.co.uk/docs/33/CAP793.pdf>

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[https://publicapps.caa.co.uk/docs/33/CAP493%20Edition%206%20Amendment%201%20Corrigendum%20\(April%202015\).pdf](https://publicapps.caa.co.uk/docs/33/CAP493%20Edition%206%20Amendment%201%20Corrigendum%20(April%202015).pdf)

UK Govt CAA Policy Statement Lighting of Onshore Wind Turbine Generators with a maximum blade tip height at or in excess of 150 metres AGL 01/01/2017; Available at:

http://publicapps.caa.co.uk/docs/33/DAP01062017_LightingWindTurbinesOnshoreAbove150mAGL.pdf