Technical Appendix

Swarclett Wind Farm

Appendix 14-2: Wind Turbine Lighting Review

Swarclett Wind Energy Limited

December 2023

Wind Turbine Lighting Review

Swarclett Wind Farm

Caithness

22 September 2023

CL-5976-RPT-002 V1.0

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Document Information	
Document title	Wind Turbine Lighting Review
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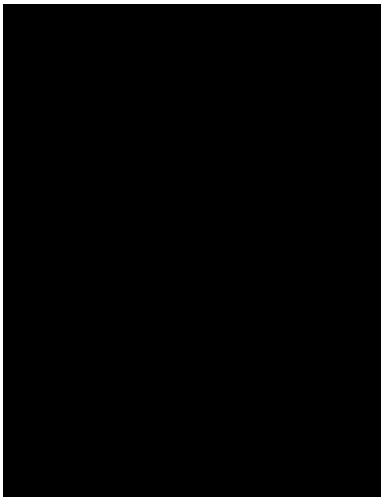
Produced by	
Document reference and Version	CL-5976-RPT-002 V1.0
Date of release	22 September 2023

Change History Record

Issue	Change Reference	Date	Details
1.0	Initial Issue	22 September 2023	Initial Issue

Executive Summary

The two proposed wind turbines constitute a wind farm and are situated approximately 18 kilometres (just under 10 nautical miles) northwest of Wick Airport. Highlands and Islands Airports Limited (HIAL), the owner/operator of the Airport, have requested the developer to consider certain elements of the wind farm and its construction along with an Instrument Flight Procedure Assessment.

Consideration of the lighting aspect of the wind farm as well as crane usage during construction was requested. Due to the wind farm potentially impacting the prescribed protective surfaces associated with the Instrument Flight Procedures, this specialist assessment is also being undertaken.

The height of the turbines has been proposed at 149.9 metres which places them under the mandatory lighting requirement height of 150 metres. Should the wind farm be considered to be in a position where it would not constitute a safety issue to aviation, then this regulation would hold true. However the regulation is caveated to ensure that turbines that fall below the 150 metre exclusion height are subject to lighting should they be deemed to be in such a position to potentially be a hazard to aviation.

The Local Planning Authority, in conjunction with HIAL, will determine such potential. HIAL have a legal obligation to the Civil Aviation Authority to reasonably safeguard their airports as well as the airspace and flight procedures associated with them.

The position of the wind farm directly below certain Wick flight procedures *may* result in HIAL taking a position that, even if it is shown that the turbines do not physically penetrate the procedures prescribed surfaces, they would still require lighting. The wind farm is close to two Visual Reporting Points and also in the vicinity of two Helicopter Main Route Indicators.

The area is adjacent to a large tactical military low flying area. However, the proposed wind farm is positioned well clear of the boundaries of this airspace and is highly unlikely to trigger any response from the Ministry of Defence.

The wind farm will be required to furnish final details on exact turbine positions, maximum heights and final lighting scheme (should this be necessary) to the Civil Aviation Authority who will update national obstacle databases.

Abbreviations

AGL	Above Ground Level
AIP	Aeronautical Information Publication
ANO	Air Navigation Order
APDO	Approved Procedure Design Organisation
ATC	Air Traffic Control
CAA	Civil Aviation Authority
CAP	Civil Aviation Publication
DME	Distance Measuring Equipment
FT	Feet
HIAL	Highlands and Islands Airports Limited
HMRI	Helicopter Main Route Indicator
IAP	Instrument Approach Procedure
ICAO	International Civil Aviation Organisation
IFP	Instrument Flight Procedure
IFR	Instrument Flight Rules
KM	Kilometre
LPA	Local Planning Authority
M	Metre
NATS	National Air Traffic Service
OLS	Obstacle Limitation Surface
RNP	Required Navigation Performance
VFR	Visual Flight Rules
VOR	Very High Frequency Omni-Range
VRP	Visual Reporting Point

References

[1] CAP 168 *Licencing of Aerodromes*

[2] CAP 738 *Aerodrome Safeguarding*

[3] CAP 764 CAA *Policy and Guidance on Wind Turbines*

[4] Air Navigation Order (ANO) 2016

Contents

List of figures

1. Swarclett Wind Farm

1.1. Overview

1.1.1. Swarclett Wind Farm was originally proposed as a four-turbine development in Caithness near Castletown. Over time, as the project evolved and requirements refined, this has become a two-turbine wind farm with the turbine design height at 149.9 metres (m) above ground level (AGL).

1.1.2. The position of the two Wind Turbine Generators (WTGs) near Wick Airport resulted in the necessity to consult with the owners and operators of the Airport, namely *Highlands and Islands Airports Limited (HIAL).*

1.1.3. Initial engagement with HIAL in March 2022 resulted in a request being received from *TRAX* who are a UK Civil Aviation Authority (CAA) Approved Procedure Design Organisation (APDO) acting on behalf of HIAL in a safeguarding role.

1.1.4. The request was for assessments covering various aspects of aerodrome safeguarding including evaluation of the Obstacle Limitation Surface (OLS) and Instrument Flight Procedures (IFP). In total there were five assessments requested.

1.1.5. Subsequent consultation with HIAL in May 2023 of refined turbine data resulted in an amended assessment requirement request by HIAL. This had been amended to the provision of three assessments for consideration. These were:

- *Instrument Flight Procedures (IFPs) (see CAP785) requirement.*
- *Aviation Lighting Requirements (see Article 222 of the ANO, CAP168 & CAP764) requirements*.
- *Crane and Lifting equipment used during construction (see CAP1096) requirement*.

1.1.6. Wick Airport is an 'Officially Safeguarded Civil Aerodrome' under Planning Circular 2/2003: Town and Country Planning (Safeguarded Aerodromes, Technical Sites and Military Explosives Storage Areas) (Scotland) Direction 2003.

1.1.7. This report considers the Lighting Requirements for Onshore Wind Farms in the UK.

2. Air Navigation Obstacles

2.1. En-Route (ENR) 1.1 General Rules 5.4 Air Navigation Obstacles 5.4.3 Land Based Air Navigation Obstacles (Aeronautical Information Publication - AIP)

2.1.1. '*Article 225A of the Air Navigation Order 2016 mandates the requirement for the CAA to be notified of any existing or proposed en-route obstacles (permanent or temporary) which (or will) attain or exceed a height of 100 M (328 FT) AGL. Proposed changes to any existing en-route obstacles which (or will) attain or exceed a height of 100 M (328 FT) AGL must also be notified. This requirement is applicable to any building or work, including waste heaps, which attains or exceeds the above-stated height. Details of those obstacles of which the CAA has been notified are listed in ENR 5.4. In cases where a number of structures form the obstacle, the position of the highest is given. In the case of masts, the position of the centre of the mast is given (but it should be noted that the stays or guys may spread out for a considerable distance). Article 222 of the Air Navigation Order 2016 imposes mandatory lighting requirements on en-route obstacles that are 150 M (492 FT) AGL or more in height. For en-route obstacles that are less than 150 M (492 FT) AGL in height, the CAA recommends that such structures should be lit if, by virtue of their nature or location, they are considered to present a significant hazard to air navigation.*'

2.1.2. From this we are able to see that the turbines at 149.9m AGL are considered an Air Navigation Obstacle that is required under Article 225A of the ANO 2016 to be notified to the UK Civil Aviation Authority (CAA). Of more relevance here is the lighting requirement imposed on these obstacles.

2.1.3. Obstacle lighting is only mandatory on en-route obstacles that are 150m or more AGL. It is sometimes recommended by the CAA that obstacles less than 150m AGL are also lit. This occurs when the obstacles *'….by virtue of their nature or location, they are considered to present a significant hazard to air navigation*.'

3. Lighting Requirements

3.1. CAP168 Licensing of Aerodromes

Wind Turbines

The rotor blades, nacelle and upper 2/3 of the supporting mast of wind turbines should be painted white, unless otherwise indicated by an aeronautical study.

When lighting is deemed necessary, medium intensity obstacle lights should be used. In the case of a wind farm, i.e. group of two or more wind turbines, it should be regarded as an extensive object and the lights should be installed:

1) *To identify the perimeter of the wind farm;*

2) *respecting the maximum spacing between the lights along the perimeter, unless a dedicated assessment shows that a greater spacing can be used;*

3) *so that, where flashing lights are used, they flash simultaneously; and*

4) *so that, within a wind farm, any wind turbines of significantly higher elevation are also identified wherever they are located.*

3.1.1. *The obstacle lights should be installed on the nacelle in such a manner as to provide an unobstructed view for aircraft approaching from any direction.*

Further information is available in CAP 764, CAA Policy and Guidance on Wind Turbines and ICAO annex 14 Volume 1, chapter 6, Paragraph 6.4

3.2. CAP 764 CAA Policy and Guidance on Wind Turbines

Obstructions, lighting and marking

3.2.1. *The treatment of land-based obstacles to air navigation is covered by existing legislation. Obstacles located close to licensed aerodromes are covered under Section 47 of the Civil Aviation Act 1982. Government aerodromes are similarly covered under the Town & Country Planning Act (General Permitted Development) Order 2000. article 219 of the ANO 2009 details the requirement for the lighting of land-based tall structures located outside of the safeguarded areas of licensed and government aerodromes.*

3.2.2. *Onshore Obstacle Lighting Requirement ICAO regulations (Annex 14 Chapter 6) and article 219 of the ANO 2009 require that structures away from the immediate vicinity of an aerodrome, which have a height of 150 m (492 ft) or more AGL are:*

1) *Fitted with medium intensity steady red lights positioned as close as possible to the top of the obstacle, and also equally spaced at intermediate levels, so far as practicable, between the top lights and ground level with an interval not exceeding 52 m;*

2) *Illuminated at night, visible in all directions and any lighting failure is rectified as soon as is reasonably practicable;*

3) *Painted appropriately: the rotor blades, nacelle and upper 2/3 of the supporting mast of wind turbines that are deemed to be an aviation obstruction should be painted white, unless otherwise indicated by an aeronautical study.*

In addition, the CAA will provide advice and recommendations regarding any extra lighting requirements for aviation obstruction purposes where, owing to the nature or location of the structure, it presents a significant hazard to air navigation. However, in general terms, structures less than 150 m (492 ft) high, which are outside the immediate vicinity of an aerodrome, are not routinely lit; unless the 'by virtue of its nature or location' argument is maintained. UK AIP ENR 1.1 para 5.4 'Air Navigation Obstacles' refers.

When input is sought, the CAA routinely comments to the effect that, in respect to a proposed wind turbine development, there might be a need to install aviation obstruction lighting to some or all of the associated turbines, when specific concerns have been expressed by other elements of the aviation industry; i.e. the operators. For example, if the MoD or a local aerodrome suggest and can support such a need, the CAA (sponsor of policy for aviation obstruction lighting) would wish, in generic terms, to support such a claim. However, this would only be done where it can reasonably be argued that the structure(s), by virtue of its/their location and nature, could be considered a significant navigational hazard. That said, if the claim was clearly outside credible limits (i.e. the proposed turbine(s) was/were many miles away from any aerodrome or it/they were of a height that was unlikely to affect even military low flying), the CAA would play an 'honest-broker' role. It is unusual for the CAA, in isolation, to make a case for aviation warning lighting unless article 219 demands such lighting.

All parties should be aware that, in any case where a wind turbine development lies (or would lie) outside any aerodrome safeguarding limits and the turbine height was less than 150 m (492 ft) (and therefore the provisions of article 219 of the ANO 2009 would not apply), the aviation industry, including the CAA, is not in a position to demand that the turbines are lit. In such cases the decision related to the fitting of aviation warning lighting rests with the relevant LPA, which will necessarily need to balance the aviation lighting requirement against other considerations (e.g. environmental). If deemed as an aviation obstruction, and thus requiring a specific marking scheme, the CAA advice on the colour of wind turbines would align with ICAO criteria.

3.3. The Air Navigation Order 2016

Lighting of en-route obstacles:

1) *The person in charge of an en-route obstacle must ensure that it is fitted with medium intensity steady red lights positioned as close as possible to the top of the obstacle and at intermediate levels spaced so far as practicable equally between the top lights and ground level with an interval of not more than 52 metres.*

2) *The person in charge of an en-route obstacle must, subject to paragraph (3), ensure that by night the lights required to be fitted by this article are displayed.*

3) *In the event of the failure of any light which is required by this article to be displayed by night the person in charge must repair or replace the light as soon as reasonably practicable.*

4) *At each level on the obstacle where lights are required to be fitted, sufficient lights must be fitted and arranged so as to show when displayed in all directions.*

5) *In any particular case the CAA may direct that an en-route obstacle must be fitted with and must display such additional lights in such positions and at such times as it may specify.*

6) *A permission may be granted for the purposes of this article for a particular case or class of cases or generally.*

7) *This article does not apply to any en-route obstacle for which the CAA has granted a permission to the person in charge permitting that person not to fit and display lights in accordance with this article.*

8) *In this article, an "en-route obstacle" means any building, structure or erection, the height of which is 150 metres or more above ground level, but it does not include a building, structure or erection:*

    a. *which is in the vicinity of a national licensed aerodrome or an EASA certificated aerodrome; and*

    b. *to which section 47 of the Civil Aviation Act 1982 (warning of presence of obstructions near licensed aerodromes) applies.*

4. Wick Airport

4.1. Instrument Approach Procedures

4.1.1. For orientation, the proposed wind turbines are shown in relation to two Wick Airport Instrument Approach Procedures (IAPs): the Required Navigation Performance (RNP) procedure for Runway (RWY) 13 (130 deg) and the VOR/DME (Very High Frequency Omni-Range/Distance Measuring Equipment) procedure for RWY 13.

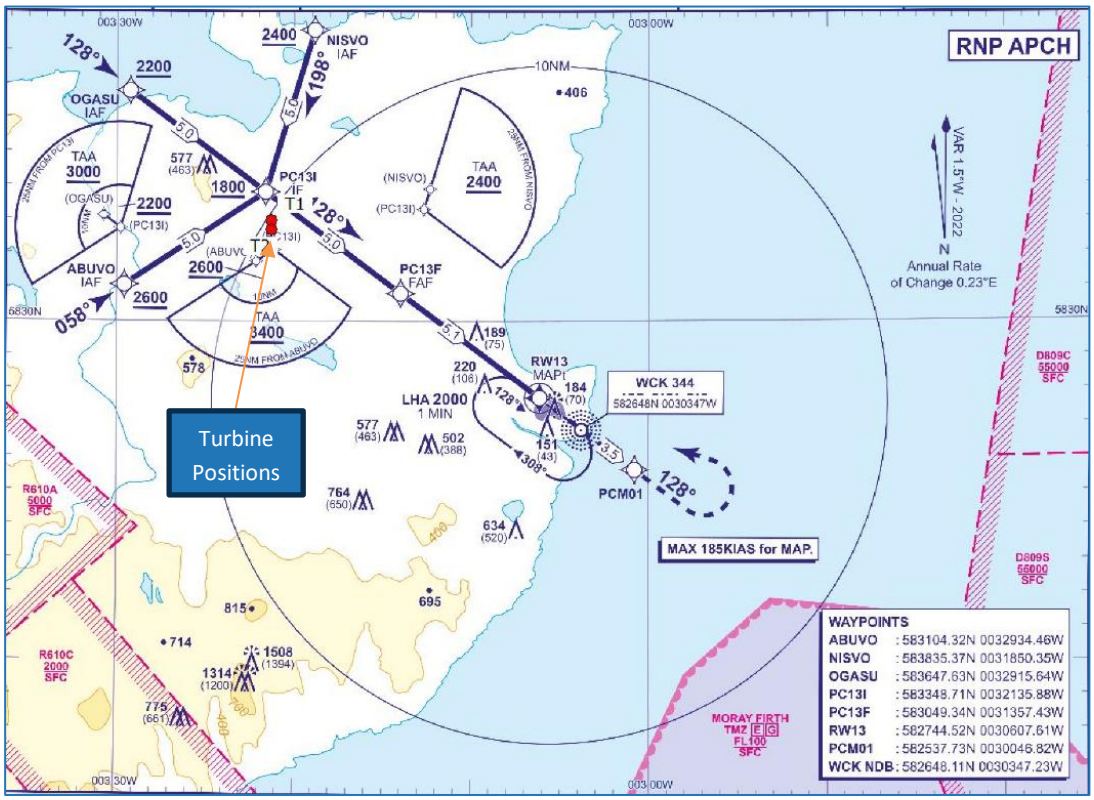


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Figure 1: Proposed turbines in relation to Wick Airport RNP Approach Procedure RWY 13

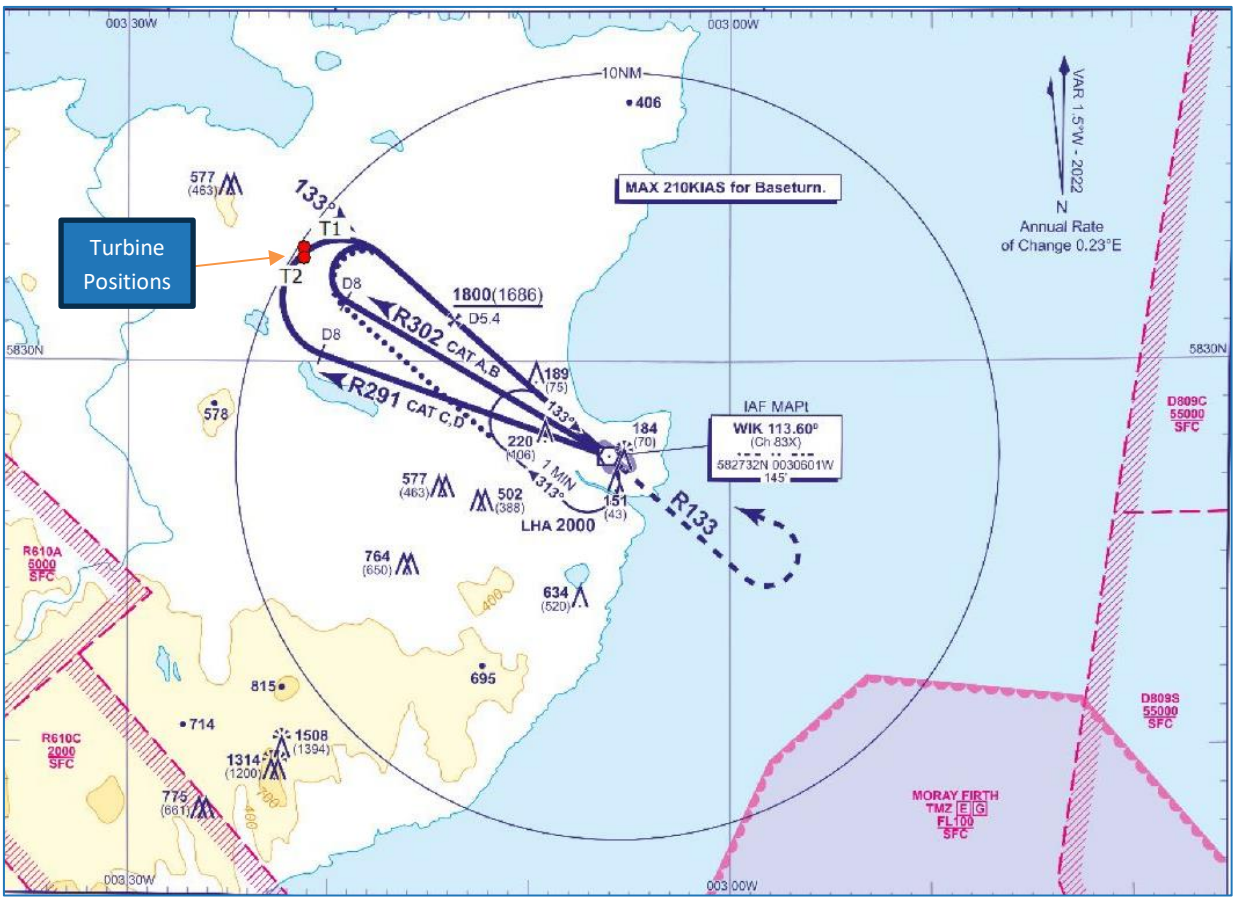

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Figure 2: Proposed turbines in relation to Wick Airport VOR/DME Approach Procedure RWY 13

5. Ministry of Defence

5.1. Overview

5.1.1. Whilst incandescent lighting is not normally required for structures below 150m AGL, it remains the prerogative of the Ministry of Defence (MoD) to request the provision of Infra-Red (IR) lighting on such structures. This is generally speaking only enacted when the structures are in designated areas of military low flying. Additionally the MoD may require both incandescent and IR lighting where it believes 'choke points' may be formed by structures, controlled airspace etc.

5.1.2. The above does not apply to the proposed wind farm and the turbines are situated outside of the adjacent designated military low flying area. Figure 3 below shows the proposed turbines relative to the military low flying areas in the vicinity.

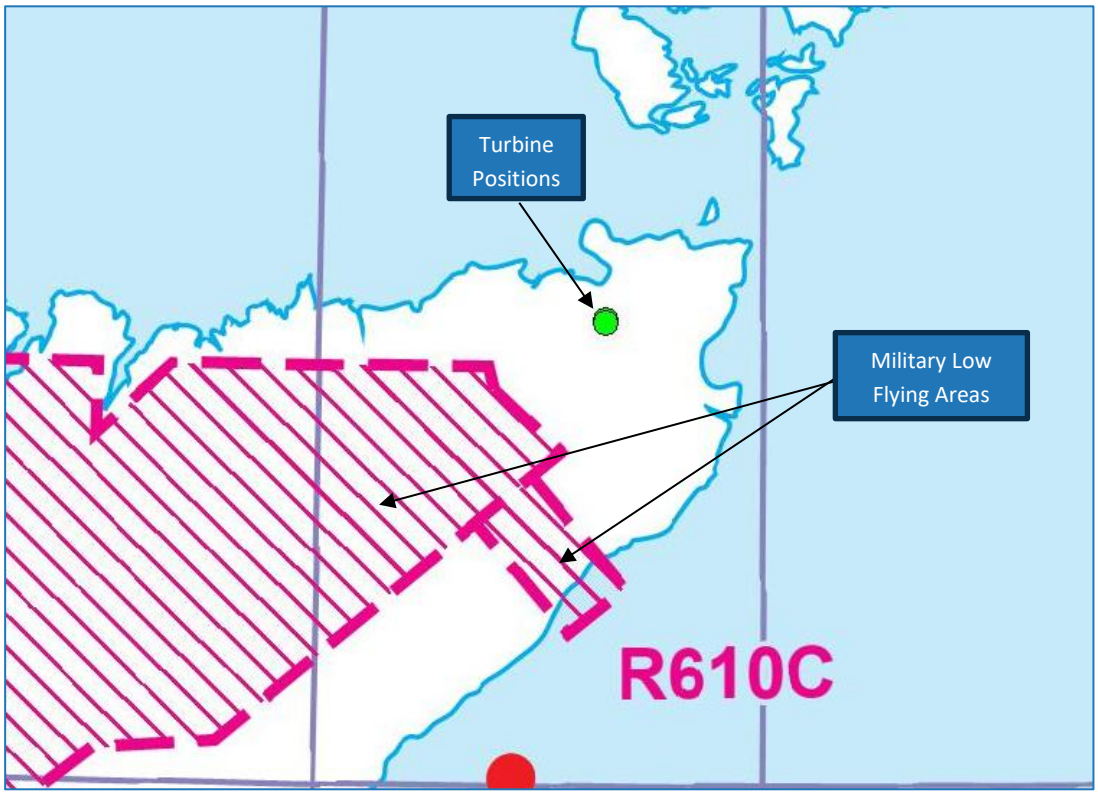

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Figure 3: Proposed turbines in relation to Military Low Flying Areas in the vicinity

5.1.3. Although there is a significant amount of military low flying and military training flights in general in the Highlands, this is largely contained within the specially designated areas.

5.1.4. This particular Low Flying Area is only in place when activated by NOTAM[1].

[1] **No**tice **T**o **A**ir**m**en – An international system of rapid notification to all Pilots, Air Traffic Service Units (ATSUs),Airlines and other airspace users.

5.1.5. There are occasional military flights using Wick Airport but these flights comply with general Instrument Flight Rules (IFR) or Visual Flight Rules (VFR) arrival and departure procedures.

5.1.6. There are no ‘choke points’ around Wick associated with airspace, either military or civilian.

6. Conclusion

6.1. Overview

6.1.1. Two or more WTGs constitute a 'wind farm'. The two WTGs have been proposed as having a designed maximum tip height of 149.9m AGL and therefore are, under normal circumstances, not subject to lighting requirements.

6.1.2. However, it *may* be that the turbines, '*by virtue of its nature or location*' (see Chapter 2, paragraph 2.1.1) need to be lit. The turbine positions are such that they may very well be deemed to be an obstacle to aviation and HIAL would require lighting.

6.1.3. HIAL have requested that the developer provide an IFP assessment of the potential impact (if any) to the instrument procedures associated with the Airport. Extracts of two of Wick Airports IAPs are shown in figures 1 & 2 with the position of the wind farm marked. It is this proximity of the turbines to the protected procedures that has generated the request for assessment. This may very well prompt a decision by HIAL to additionally request obstacle lighting.

6.1.4. Other factors that may lead to a lighting requirement are the proximity of Visual Reference Points (VRPs), to the wind farm. VRPs enable aircraft complying with VFR a degree of navigational certainty when flying to, from or past Wick Airport. These points enhance Air Traffic Control's (ATC) situational awareness when dealing with VFR aircraft that do not make use of the structured 'flight paths' that the instrument procedures provide for IFR aircraft. The VRPs in that area are the old Castletown Airfield and Loch Watten, although these two VRPs are noted as lacking conspicuity at night and are unsuitable. However, this does not prevent these VRPs being used during times of limited visibility and low cloud when obstacle lighting is beneficial.

6.1.5. An additional factor is the proximity of a Helicopter Main Route Indicator (HMRI) that originates in Aberdeen, routing via a ground-based navigational aid at Wick Airport and then splits into two separate routes – HMRI X-Ray and HMRI Yankee[2] – which pass in the vicinity of the wind farm. These routes are used by helicopters engaged in off-shore oil and gas support operations.

6.1.6. The wind farm is situated adjacent to the MoD's Area 14T (Tactical) HRA (Highlands Restricted Area). This area would potentially support low level tactical fast-jet operations down to 100 feet AGL. Wind Farms in these types of areas would almost certainly require IR lighting schemes approved by the MoD. The proposed wind farm is not located within this area, nor close to its boundaries. This report is not aware of any specific military flight operations that would be impacted by the proposed wind farm and therefore the MoD is not likely to impose any lighting restriction.

6.1.7. It remains for HIAL, in conjunction with the Local planning authority (LPA), to determine whether or not it considers a lighting scheme for the turbines to be necessary. The LPA would take HIAL's aviation safeguarding concerns into account, but would potentially balance this with the need for environmental visual impact prudence. The visual impact would, of course,

[2] UK AIP *ENR 6 En-Route Charts*, *ENR 6-27 ABERDEEN - ATLANTIC RIM HMRI X-RAY/YANKEE*

be small given the size of the wind farm and the rural location. Ultimately, the aviation safety aspect must take priority.

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