Technical Appendix

Lairdmannoch Energy Park

Technical Appendix 14-2: Reduced Lighting Scheme

Lairdmannoch Energy Park Limited

May 2025

Windfarm Reduced Lighting Scheme Proposal

Lairdmannoch Energy Park

Proposal

Client:	Lairdmannoch Energy Park Limited	Document Reference:	110WIN007
Date:	19 February 2025	Version	2.0

Executive Summary

Lairdmannoch Energy Park Limited (LEPL) proposes a reduced lighting scheme for the wind farm element of the Energy Park, which consists of up to nine turbines with tip heights reaching 180m. This proposal aims to mitigate visual impacts, especially given the proximity of the project to a designated Dark Sky Park, while ensuring aviation safety.

Key aspects of the proposal include:

1. **Proposed Lighting Scheme**:
    - Implementation of a cardinal lighting system with medium-intensity steady red lights (2000 candela) on four turbines (north, south, east, and west positions).
    - Dimmed lighting to 10% of peak intensity (200 candela) in visibility exceeding 5km.
    - Elimination of intermediate-level lighting (32 candela).
    - Infra-Red (IR) lighting fitted to all turbines per Ministry of Defence (MoD) specifications.

2. **Location Context**:
    - The development site lies 7km northeast of Gatehouse of Fleet, adjacent to Galloway Forest Park, a designated Dark Sky Park.
    - The nearest active airports (e.g., Prestwick and Carlisle) are over 70km away, while nearby airfields are inactive or limited in use.

3. **Regulatory Framework**:
    - The lighting scheme complies with UK Civil Aviation Authority (CAA) regulations, including Article 222 of the Air Navigation Order and SERA requirements for visual flight rules (VFR).
    - The proposal also considers aviation operations such as emergency medical services, police, search and rescue, and military training.

4. **Environmental and Safety Assessments**:
    - The revised scheme aligns with CAA lighting policy (DAP Policy 124), balancing aviation safety and environmental concerns.
    - The safety review confirms no significant change to aviation risk compared to the baseline environment without turbines.
    - The risk of Controlled Flight into Terrain (CFIT) remains mitigated by minimum altitude regulations and pre-flight planning requirements for VFR at night.

5. **Key Justifications**:
    - The reduced lighting scheme minimises visual impact on the Dark Sky Park and surrounding residential areas.
    - The mountainous terrain and low likelihood of nighttime VFR flights over the area further support the reduced lighting proposal.
    - Infrared lighting ensures compatibility with night vision equipment used by Police, MoD, and emergency services.

In conclusion, LEPL requests approval of the proposed cardinal lighting scheme, supplemented by MoD-compliant infrared lighting. The proposal maintains the current safety environment while mitigating unnecessary light pollution in an ecologically sensitive area.

Contents

List of Figures

List of Tables

Introduction

Overview

1. Lairdmannoch Energy Park Limited (LEPL) is committed to a sustainable and safe energy future while preserving the natural beauty and darkness of our skies.
2. The wind farm consists of nine turbines (tip height up to 180m) with a proposed reduced lighting scheme. This plan balances aviation safety with minimizing visual impact in proximity to the Galloway Forest Dark Sky Park.
3. This proposal sets out a review and recommendation of a reduced lighting scheme without impacting aviation safety.
4. As the proposed development is within close proximity to a designated Dark Sky Park, a reduced lighting scheme would reduce potential visual impacts on the nearby designated area, as well as residential properties in proximity to the site.
5. The intention to secure agreement for a reduced lighting scheme has been recommended by Stephenson Halliday, the landscape architects who are responsible for carrying out the Landscape and Visual Impact Assessment as part of the Environmental Impact Assessment.
6. The key objectives of this proposal are to:
    - Minimise visual impact on the surrounding Dark Skies area and nearby residential properties.
    - Maintain compliance with aviation safety regulations.
    - Integrate feedback from the Civil Aviation Authority (CAA) and prior application processes.

Location

7. The proposed development is located 7km northeast of Gatehouse of Fleet and 10km west of Castle Douglas in Dumfries and Galloway, in close proximity to the designated international dark sky park in Dumfries and Galloway.
8. Figure 1 provides an indication of the proposed development (yellow pin) within the Galloway Forest Park, it is approximately:
    a) 72km south of Prestwick Airport;
    b) 84km west of Carlisle Airport;
    c) 87km south of Strathaven Airfield;
    d) 110km south of Glasgow Airport; and
    e) 125km southwest of Edinburgh Airport.
9. There are a number of nearby airfields identified with uncertainty over activity. Research indicates these are either closed or not active.
    a) Baldoon Airfield – Former RAF Wigtown and listed on Airfields of Britain as ‘disused’;

b) Castle Kennedy – Former RAF Castle Kennedy listed in Airfields of Britain as 'limited flying';
c) MOD West Freugh – Runways appear in good conditions but are marked as closed. The Military Aeronautical Information Publication (MAIP) does not list the aerodrome.

FIGURE 1: PROPOSED DEVELOPMENT RELEVANT TO NEARBY AERODROMES

Background

10. The UK CAA sets out a Policy Statement on lighting of onshore windfarms[1] whereby the statutory requirements[2] for lighting of en-route obstacles[3].
11. Article 222 of the Air Navigation Order requires medium intensity (2000 candela) steady red aviation warning lights to be mounted as close as possible to the top of the structures (at and above 150m). The Article expands further on the exact positioning in relation to turbines including intermediate lighting requirements, of lower intensity (32 candela).

[1] 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.
[2] Article 222 of the UK Air Navigation Order 2016.
[3] Due to the location of the proposed development, the turbines are classified at en-route obstacles.

12. The purpose of lighting of tall obstacles is for aviation safety, lit obstacles permit a pilot to identify tall structures from a distance and permit sufficient time to safely adjust direction and/or altitude of the aircraft.
13. The UK, in compliance with International Civil Aviation Organisation (ICAO) Standards and Recommended Practices (SARPS), sets out the Rules of the Air[4] contained in the Air Navigation Order (ANO).
14. The UK CAA sets out the requirements of Standardised Rules of the Air (SERA) and contained in UK Reg (EU) No 923/2012 (as amended) which applies to every aircraft operating in UK airspace regardless of type or state of registration.
15. Flights operate under Visual (VFR) or Instrument (IFR) flight rules. For the purpose of this document, only VFR applies. The minimum altitude for IFR aircraft, within the area of the proposed development, provides adequate vertical clearance of obstacles and is therefore not under consideration.
16. Section 5 of the SERA regulations contain the applicable requirements for VFR aircraft. The general rule for maintaining VFR is that the flight is flown "*clear of cloud and in sight of the surface*." There are technical criteria contained within SERA.5005 with specific information to visibility and weather conditions.
17. VFR flights by night are not permitted by all ICAO Contracting States, provision is provided in the UK under SERA.5005 (c) as detailed below:

    "(c) When so prescribed by the competent authority, VFR flights at night may be permitted under the following conditions:

    (1) if leaving the vicinity of an aerodrome, a flight plan shall be submitted in accordance with SERA.4001(b)(6);

    (2) flights shall establish and maintain two-way radio communication on the appropriate ATS communication channel, when available;

    (3) the VMC visibility and distance from cloud minima as specified in Table S5-1 shall apply except that:

    (i) the ceiling shall not be less than 450 m (1500 ft);

    (ii) the reduced flight visibility provisions specified in Table S5-1(a) and (b) shall not apply;

    (iii) in airspace classes B, C, D, E, F and G, at and below 900 m (3000 ft) AMSL or 300 m (1000 ft) above terrain, whichever is the higher, the pilot shall maintain continuous sight of the surface; and

    (iv) Provision repealed before document was retained.

    (v) for mountainous area, higher VMC visibility and distance from cloud minima may be prescribed by the competent authority."

18. In addition, SERA.5005 (c) (5) provides minimum altitude criteria as follows:

    (5) except when necessary for take-off or landing, or except when specifically authorised by the competent authority, a VFR flight at night shall be flown at a level which is not below the minimum

[4] ICAO Annex II, Rules of the Air (as amended).

flight altitude established by the State whose territory is overflown, or, where no such minimum flight altitude has been established:

(i) over high terrain or in mountainous areas, at a level which is at least 600 m (2000 ft) above the highest obstacle located within 8 km of the estimated position of the aircraft;

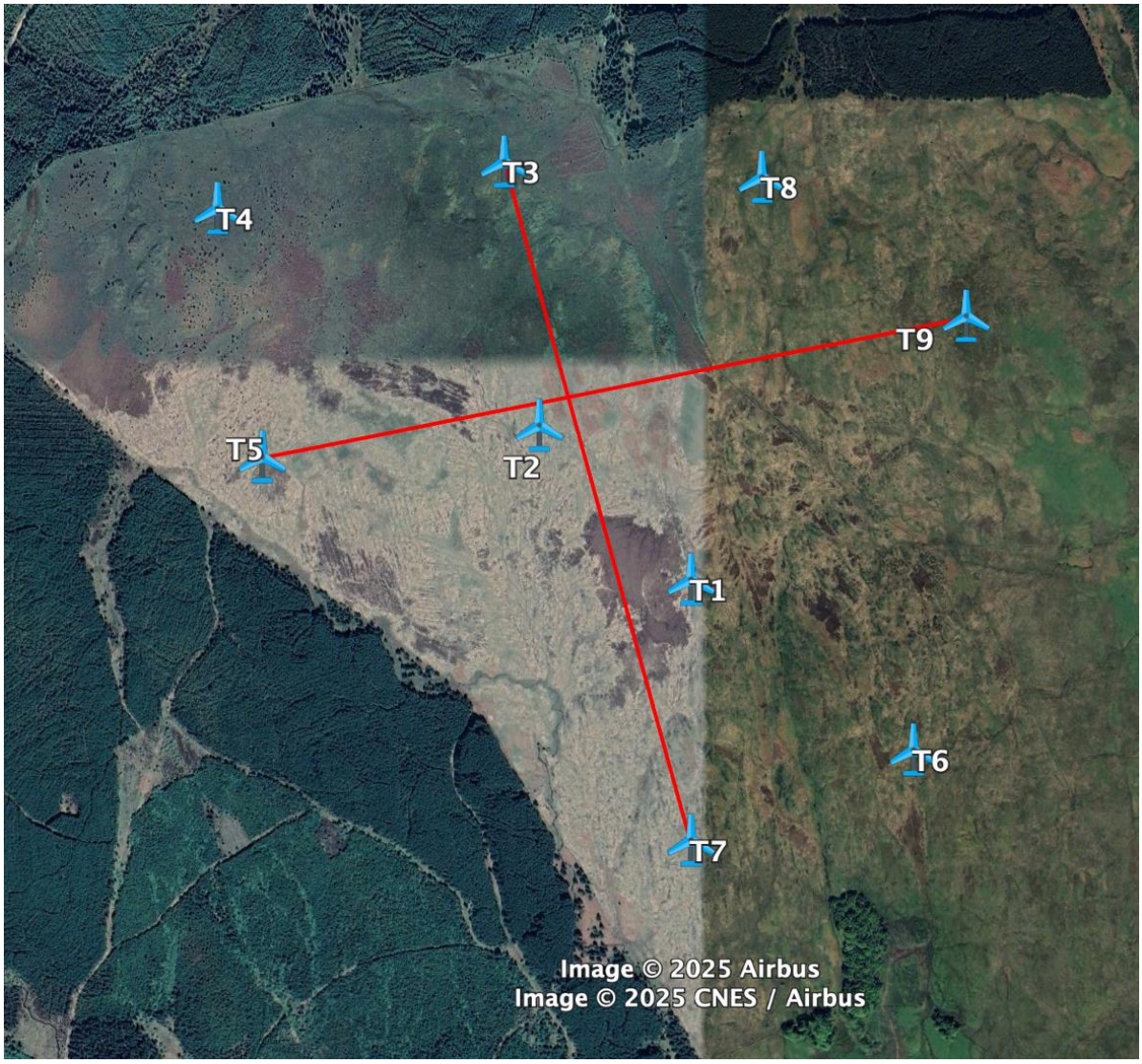
(ii) elsewhere than as specified in i), at a level which is at least 300 m (1000 ft) above the highest obstacle located within 8 km of the estimated position of the aircraft.

19. In summary, an aircraft may not fly low-level, and in close proximity of a windfarm. CAP1535, The Skyway Code[5], published by the CAA provides further guidance to pilots in terms of pre-flight preparation and planning routes for selecting the appropriate cruising altitude.
20. In summary, aviation regulations contained within SERA and guidance material contained with the Skyway Code ensure that an aircraft will remain clear of obstacles and terrain (as published) to reduce the risk of an airborne conflict. Obstacles, 150m and above, are lit to enhance safety, in addition they are required to be published in the Aeronautical Information Publication (AIP) and on aeronautical charts.

[5] CAP1535, The Skyway Code, version 4, dated November 2023.

Environmental Assessment

21. As previously mentioned, an earlier version of this report provided two proposals with no lighting and reduced lighting with two turbines lit.
22. The CAA responded regarding concerns with aircraft operating outside SEAR limitations. These aircraft are identified as National Police Air Services (NPAS), Police Scotland, Helicopter Emergency Medical Services (HEMS), Search and rescue (SAR) and the Ministry of Defence (MOD). These operations typically operate with Night Vision Devices (NVDs); however, consideration to mitigation of NVD equipment must be considered with these aircraft operations.
23. LEPL is therefore submitting a revised proposal supporting the above operational considerations with an alternate reduced lighting scheme to support no impact to aviation safety.
24. The proposed lighting scheme is a 'Cardinal' format of lighting turbines to the north, south, east and west of the windfarm layout. Turbines T3, T5, T7, and T9 will be lit with aviation lighting.



25. The four turbines will be lit with medium intensity (2000 candela (cd)) red lights positioned as close as practicable to the top of the fixed structure and fitted to show when displayed in all directions without interruption.
26. It is further proposed, and requested, that the lighting scheme are reduced to no less than 10% of the minim peak intensity, i.e., 200cd, when the horizontal meteorological visibility in all directions, from each turbine generator, is more than 5km. This request is in line with DAP Policy 124: Lighting of Onshore Wind Turbine Generators, issued 01 June 2017.
27. In addition to the CAA lighting for onshore wind turbines, each turbine will be fitted with infrared lighting as per the MoD's guidance issued 01 January 2020 under Appendix 1.
28. The reason for this request is that the area consists of high terrain, which could be considered mountainous, and it is adjacent to a Dark Skies area.
29. As this affects VFR flights at night, the ability for an aircraft to "remain within sight of ground" and therefore remain VFR would be challenging, and it is highly unlikely for a pilot to reasonable fly in a safe manner and in accordance with the law.
30. The lowest available altitude, as published in the UK Aeronautical Information Publication[6] (AIP), is 3,700ft. Figure 2 provides the proposed development (red circle) contained within an area depicted with 37, this indicates a minimum altitude of 3,700ft.
31. As aircraft fly at intervals of 500ft, and in accordance with the UK noted cruising levels[7], the lowest available altitude for VFR flight (day and night), in the area of the proposed development, shall be conducted at 4,500ft.

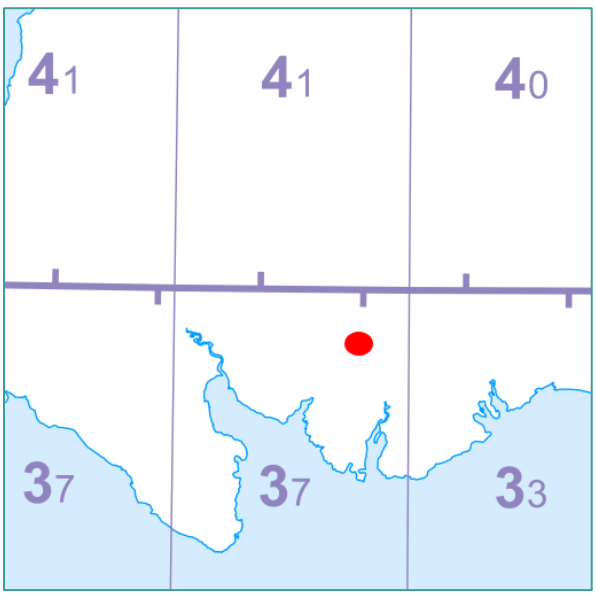


FIGURE 2: UK AIP ENR 6-81 MINIMUM ALTITUDES

[6] UK AIP, ENR 6-81 UK Area Minimum Altitudes (AMA)
[7] UK AIP, ENR 1.2 Visual Flight Rules, Section 6 Tables of Cruising levels.

32. The addition of 180m (591ft) turbines results in a tip elevation of 1,746ft (figures rounded up and using highest elevation). The minimum flying altitude, at night, for a VFR would be 1,746ft + 2,000ft = 3,746ft.
33. Therefore, there is no impact to the first available minimum VFR altitude by day or night of 4,500ft.
34. For aircraft operating below SERA levels, where permitted, all turbines will be fitted with IR lighting as discussed in Paragraph 27.
35. Further examination of the layout is examined further and includes additional diagrams to support this proposal.
36. The distances[8] between the proposed lit cardinal points are as follows:

    North (T3) to West (T5) = 760m
    West (T3) to South (T7) = 1,150m
    South (T7) to East (T9) = 1,170m
    East (T9) to North (T3) = 960m

37. To provide some perspective of the windfarm layout and expected visibility of the turbines, Google Earth pictures are provided in 3-Dimensional views with approaches from between the cardinal points. The purpose of this exercise is to demonstrate that terrain is not causing any obstruction to the windfarm. The turbine diameter is not accurate and applied for demonstration purposes only.
38. The diagrams provide turbines extending to the tip height of 180m above ground level with views taken at 1,000ft above ground level at a distance of 3,000m from the cardinal centre point.
39. The red represents the cardinal lit turbines. The green represents turbines with infra-red lighting only.

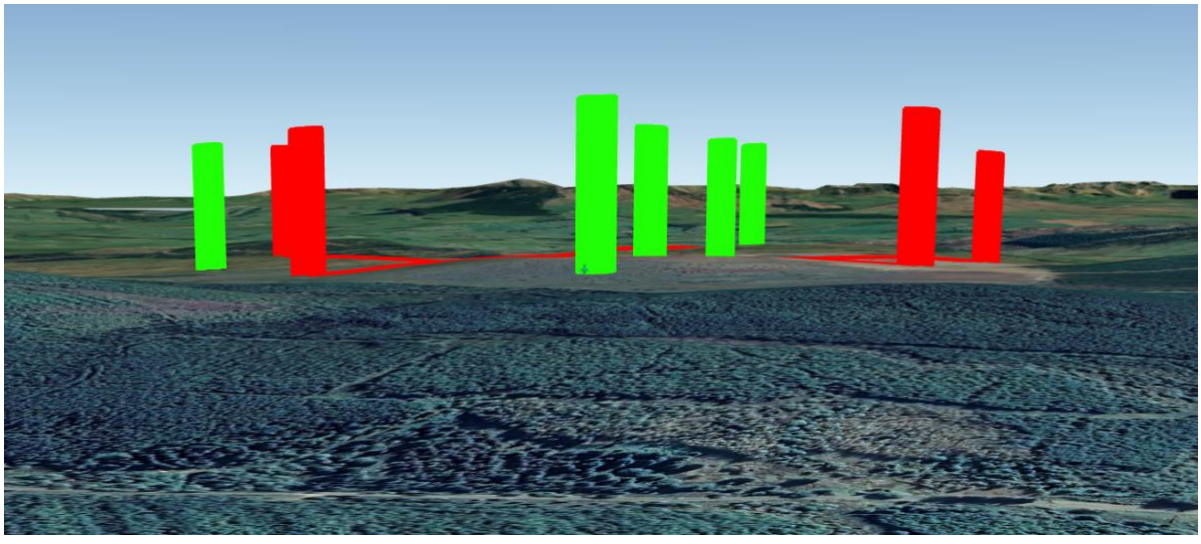


FIGURE 3: VIEW APPROACHING FROM THE NORTHWEST

[8] Distances are estimates and rounded up.

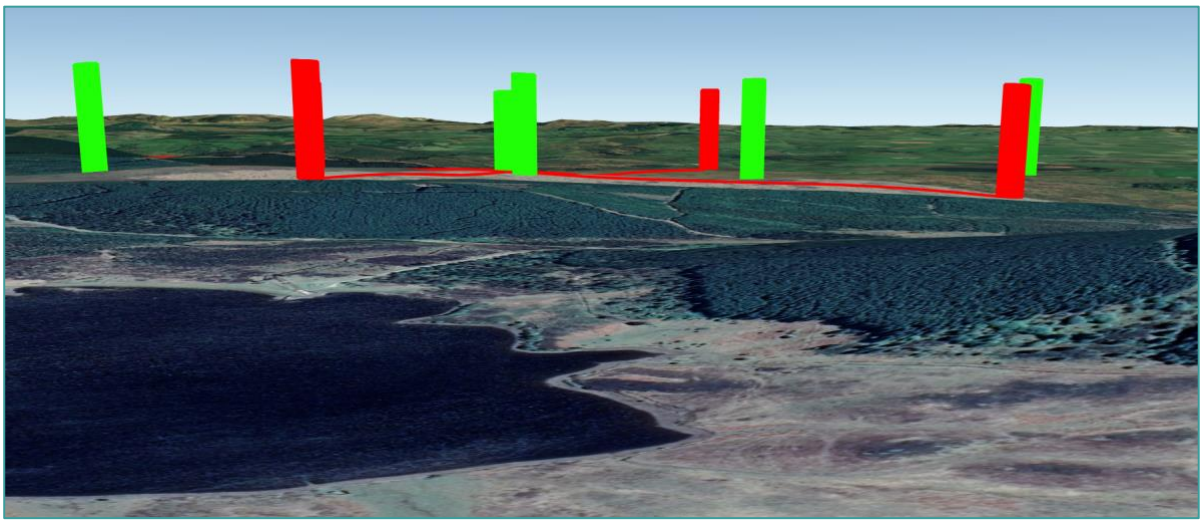


FIGURE 4: VIEW APPROACHING FROM THE SOUTHWEST

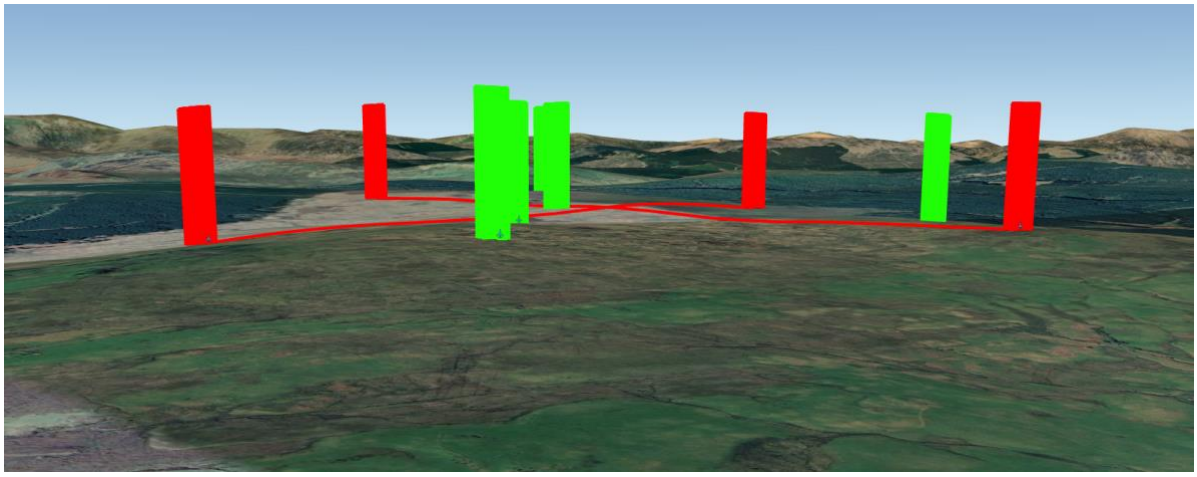


FIGURE 5: VIEW APPROACHING FROM THE SOUTHEAST

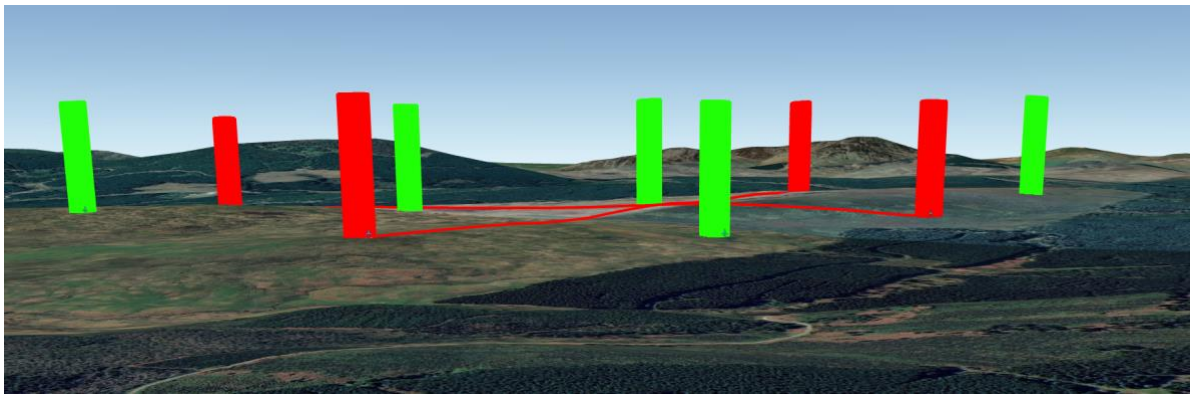


FIGURE 6: VIEW APPROACHING FROM THE NORTHEAST

40. The layout ensures that at least three lit turbines will be visible at all times providing adequate visual sighting of the windfarm.
41. The windfarm will be published providing data to pilots for pre-flight briefings.

Proposed Lighting Scheme

42. Following the assessment of the environment with the proposed lighting scheme layout, LEPL requests the following:

- Medium intensity steady red (2000 candela) lights on the nacelles of turbines T3, T5, T7 and T9 forming a cardinal layout;
- 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 noting that both lights will not be lit at the same time;
- The lights the lights on these turbines to be capable of being dimmed to 10% of peak intensity when the lowest visibility as measured at a suitable point around the wind farm by one or more visibility measuring devices exceeds 5km;
- Removal of the requirement for intermediate level 32 candela lights; and
- All turbines will be fitted with Infra-Red as per MOD specification.

Safety Assessment

43. A basic safety assessment has been undertaken to best understand the safety implications of the current environment (baseline) versus the environment with the windfarm lit to a cardinal layout and reduced lighting.

Scenario	Risk Severity	Risk Likelihood	Result
Baseline	Flight conducted with no emergency at minimum altitude – risk = negligible. Controlled Flight into Terrain (CFIT) is unlikely due to compliance with minimum altitude. Flight experiencing an emergency – risk = Catastrophic. Police/MOD/HEMS/SAR	Based on average incident rates, the likelihood of an emergency event occurring is remote. However, the likelihood of a catastrophic event occurring as a result of an emergency requiring a successful landing in the undulating environment in a dark environment is Frequent. These flights are flown with Night Vision (NV) capability.	Non-emergency Acceptable risk Emergency Unacceptable

Proposal	Flight conducted with no emergency at minimum altitude – risk = negligible. Controlled Flight into Terrain (CFIT) is unlikely due to compliance with minimum altitude. Flight experiencing an emergency – risk = Catastrophic. Since the risk is at maximum risk severity, an aircraft accident as an uncontrolled flight into terrain environment with or without turbines remains the same. Police/MOD/HEMS/SAR	Based on average incident rates, the likelihood of an emergency event occurring is remote. However, the likelihood of a catastrophic event occurring as a result of an emergency requiring a successful landing in the undulating environment in a dark environment is Frequent. The only additional consideration is the likelihood of an aircraft accident into terrain versus the likelihood of colliding with turbines. In this case, there are very few reported incidents in relation to flights into turbines versus terrain. It is therefore considered the likelihood can be no more likely than for flight into terrain. The turbines are published and lit with Infra-Red lights on all turbines with additional lighting on four turbines. This will result in highlighted visibility for NV flights.	Non-emergency Acceptable risk Emergency Unacceptable

TABLE 1: RISK SEVERITY MATRIX

44. The application of safety principles to risk related to probability and severity of an event as no change to the existing environment. Application of the UK CAA Hazard Log template[9] Risk Tolerability table results in the review in Table 1.
45. In each case, a flight at night in an area characterised by conspicuous peaks and ridges. No natural light permitting identification of high and low ground, vegetation and outcrop areas.
46. In summary, the is no change to the safe operation of night flights in this environment.
47. Descending to low altitudes, below the published minimum safe altitudes, in an undulating/mountainous area at night requires some form of pre-planning and detailed knowledge of the area.
48. In the case of the MOD, tactical training events are not ad-hoc, these are planned with briefings prior to getting airborne.
49. In the same manner, search and rescue also undertakes extensive planning of search areas before flights are undertaken, this is to ensure search time is used effectively as time is critical to rescue missions.
50. The area is not densely populated, and not an extreme mountainous area therefore unlikely to lend itself in an area where rescue operations are frequently required.

[9] Available on the UK CAA website, Safety Management Systems at https://www.caa.co.uk/safety-initiatives-and-resources/working-with-industry/safety-management-systems/safety-management-systems/.

Conclusion

51. By implementing this innovative reduced lighting scheme, LEPL ensures aviation safety, preserves the integrity of the Dark Skies designation, and sets a new standard for sustainable wind farm developments. We request the CAA to approve this proposal, which prioritises both public safety and environmental stewardship.
52. The justification for the proposals is as stated under the requirements of SERA.5005 whereby there are sufficient fail-safes within the planning and operating of a flight at night in clear weather conditions.
53. VFR flights may not operate in reduced weather conditions; however, the proposal considers the potential situation whereby the weather environment closes in quickly on a pilot thereby enhancing safety with the proposed lighting scheme proposal.
54. The proposed development falls adjacent to the Galloway Forest Park, an officially designated Dark Sky Park in 2009.
55. Flying at night, in a Dark Sky environment would make complying with VFR by Night very difficult if not impossible to achieve. Pilots wishing to fly VFR by night should plan the flight with safety as the primary concern, flying over a mountainous and remote area by night does not provide a pilot with the appropriate fail-safes in the event of an emergency.
56. CAA policy and guidelines sets out the minimum requirements for VFR flight by night together with minimum safe altitudes. It remains the pilot's responsibility to comply with policy and adhere to guidelines. A small, single engine aircraft should consider the possibility of a single-engine failure requiring a safe landing. Flying over the area of the proposed development, in close proximity to the Galloway Forest Park at night, a Dark Sky Area, does not provide a pilot any possibility to carry out a safe emergency landing.
57. In addition, the review of airfields in the area indicates a very little in terms of available airfields or in fact a high volume of general aviation flying. All indications are that it is a remote area, which may at the most attract flights from the nearest, established airports. Operations from these airports, nearest being Strathaven and Carlisle, would require significant flight pre-planning given the distance to fly, number of available diversion airfields and the inclement weather conditions this area is known for.
58. Therefore, the probability of VFR nighttime flight taking place over the proposed development is highly unlikely.
59. The consideration of Police, MOD, HEMS and SAR includes the operation of Infra-Red lighting as these flights operate with NV capability.

60. The safety review has indicated that the risk presented to aircraft operations would be no different than what is experienced today without the turbines.
61. A pilot undertaking a risk assessment for any type of flight (VFR, emergency or training) at night over a dark sky area without opportunity for an emergency landing must consider the undertaking of such a flight as unacceptable in the first instance. The publication and lighting of the turbines provides sufficient mitigation to maintain the risk environment to know less than what is experienced today.
62. Notwithstanding the decision for civilian lighting requirements, it is the intention of LEPL to install MOD lighting requirements as per the required specification.

Strategy and Policy Group
Windfarm Policy

John van Hoogstraten
Managing Director
Straten CSL
Straten House,
66 Front St, Sowerby
Thirsk
YO7 1JF

31 March 2025
Ref Windfarms / Lairdmannoch Energy Park

Dear John,

Proposed Obstacle Lighting Scheme for Lairdmannoch Energy Park Wind Farm

Reference: 110WIN007, dated 19 February 2025

1. Thank you for the report at reference. The report provides a proposal for a reduced aviation obstacle lighting plan against the Air Navigation Order en-route lighting requirements for the Lairdmannoch Energy Park wind farm.

2. The proposed Lairdmannoch Energy Park wind farm consists of 9 turbines, located approximately 7km northeast of Gatehouse of Fleet and 10km west of Castle Douglas in Dumfries and Galloway. The turbines will have tip heights of up to 180 metres above ground level (AGL), which brings them within scope of the Air Navigation Order (ANO) Article 222, in respect of mandatory civil aviation obstruction lighting.

3. We have considered the report carefully and take note of the intent to address concerns relating to the night-time visual impact of such aviation lighting while ensuring that the lighting installed on the turbines meets air safety requirements.

4. As a result, the CAA agrees a variation to the lighting requirements specified in the ANO Article for the Lairdmannoch Energy Park wind farm, under provisions given in the Air Navigation Order (ANO) Article 222 section 6, as per the following:

- medium intensity steady red (2000 candela) lights on the nacelles of turbines T03, T05, T07, and T09;
- 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 (note that both lights should not be lit at the same time);

Civil Aviation Authority
2E Aviation House Beehive Ring Road Crawley West Sussex RH6 0YR www.caa.co.uk
Telephone 0330 138 3166 andy.wells@caa.co.uk

• the lights on these turbines to be capable of being dimmed to 10% of peak intensity when the lowest visibility as measured at a suitable point around the wind farm by one or more visibility measuring devices exceeds 5km.

infra-red lights to MoD specification installed on the nacelles of turbines T01, T02, T03, T04, T05, T06, T07, T08 and T09 (note that dimming permission is applicable only to visible lights, not infra-red lighting).

5. We consider that the series of single tip/hub lights, on a group of structures, will provide a good horizon reference such that, in this case, intermediate level 32 candela lights are not required to be fitted on the turbine towers.

6. Please let me know if you have any further queries.

Yours sincerely,

Andy Wells
Manager Rulemaking and Safety Publications

Continued (2 of 2 pages)