

Directorate of Airspace Policy



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1 August 2003

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THE LIGHTING OF OFFSHORE WIND TURBINES

In February 2000 the Government published its conclusions on policy for renewable energy, setting out targets for the amount of electricity to be generated from renewable resources. By 2010 10% of UK electricity should be met from renewables, a substantial proportion being provided by wind energy in both onshore and offshore locations.

Wind turbines located at onshore locations are treated as tall structures and are required to be lit during the hours of darkness in accordance with established regulations. Offshore wind turbines create additional problems for pilots given the greater difficulties in navigating over generally featureless large tracts of the sea. This Directorate is of the opinion that there is a need for additional provisions for lighting offshore wind turbines, the first of which are currently under construction at North Hoyle, off the coast of North Wales.

At Annex A you will find a draft of an addition to the Air Navigation Order 2000. The attached first draft Regulatory Impact Assessment (RIA), Annex B, explains the background to the proposal. You are invited to send any comments on the proposed Regulation and on the options and costs shown in the RIA to the person named below before 6 October 2003. Comments will be reflected in the final draft of the RIA.

In the absence of comment, this Directorate will assume that there are no objections to the proposed Regulation and will proceed to the next stage in the legislative process. Any comments will be made available for public view by the person named below unless the respondent indicates otherwise; in such a case the Directorate will respect the respondent's wishes.

Civil Aviation Authority

CAA House 45-59 Kingsway London WC2B 6TE www.caa.co.uk

Telephone 020 7453 6502 Fax 020 453 6565 ian.middleton@dap.caa.co.uk

J R D Arscott
Director of Airspace Policy

Attachment:

Regulatory Impact Assessment - The Lighting of En-Route Obstructions

Point of Contact for advice or response:

Mr D R Cutler
Directorate, Airspace Policy
K6 Gate 3
CAA House
45-59 Kingsway
London
WC2B 6TE

Tel: 0207 453 6545
Fax: 0207 453 6565

E-mail: david.cutler@dap.caa.co.uk

Annexes:

- A. Proposed Amendment to the ANO
- B. RIA for the Proposed Amendment to the Air Navigation Order 2000 to regulate the manner of the Lighting Of Offshore Wind Turbines - First Draft

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Proposed Amendment to the ANO

Lighting of Wind Turbine Generators in United Kingdom Territorial Waters

- (1) This article shall apply to any wind turbine generator which is situated in waters within or adjacent to the United Kingdom up to the seaward limits of the territorial sea and which is 60 metres or more above the level of the sea at the highest astronomical tide.
- (2) Subject to paragraphs (2) and (3) the person in charge of a wind turbine generator shall ensure that it is fitted with at least one medium intensity steady red light positioned as close as possible to the top of the fixed structure.
- (3) When visibility in all directions from every wind turbine generator in a group is more than 5km the light intensity for any light required by this article to be fitted to any generator in the group and displayed may be reduced to not less than 10% of the minimum permitted peak intensity.
- (4) Where three or more wind turbine generators are located together in the same vicinity, with the permission of the CAA only those on the periphery of the group need be fitted with a light in accordance with paragraph 2.
- (5) (a) Subject to subparagraph (b) the light required by paragraph (2) shall be so fitted as to show when displayed in all directions.

(b) The angle of the plane of peak beam intensity shall be elevated to 3.5 degrees above the horizontal plane and not more than 45% or less than 20% of the minimum permitted peak intensity shall be visible below the horizontal plane.
- (6) (a) Subject to subparagraph (b) the person in charge of a wind turbine generator shall ensure that, by night, any light required to be fitted by this article shall be displayed.

(b) In the event of the failure of the light which is required by this article to be displayed by night, the person in charge shall repair or replace the light as soon as is reasonably practicable.
- (7) In any particular case the CAA may direct that a wind turbine generator shall be fitted with and shall display such additional lights in such positions and at such times as it may specify.
- (8) This article shall not apply to any wind turbine generator in respect of which a permission has been granted by the CAA to the person in charge provided any conditions specified in such a permission are complied with.
- (9) A permission may be granted for the purposes of this article in respect of a particular case or class of cases or generally and subject to such conditions as the CAA thinks fit.

(10) In this article:

(a) “wind turbine generator” is a generating station which is wholly or mainly driven by wind;

(b) “medium intensity steady red light” means a light which complies with the characteristics described for a medium intensity Type C light as specified in Volume 1 (Aerodrome Design and Operations) of Annex 14 (Third Edition November 1999) to the Chicago Convention;

(c) the height of a wind turbine generator is the height of the fixed structure or if greater the maximum vertical extent of any blade attached to that structure.

The Regulatory Impact Assessment for the Proposed Amendment to the Air Navigation Order 2000 to regulate the manner of the Lighting Of Offshore Wind Turbines - First Draft

1. Purpose and Intended Effect of the Measure

- 1.1. The maritime protection requirement for the lighting and marking of offshore wind farms is specified in the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) document 0-117 dated May 2000. There are currently no international standards to protect the safety of air navigation in the offshore environment.
- 1.2. The treatment of shore 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 Act (General Permitted Development) Order 2000. Article 109A of the Air Navigation Order 2000 details the requirement for the lighting of tall structures located outside of the safeguarded areas of licensed and government aerodromes. Except where an offshore wind turbine constitutes an obstacle to a licensed or government aerodrome there is no current requirement to light such structures unless they are 150 metres or more in height. The existing legislation relating to such tall structures is not appropriate for use on wind turbines where the highest point is the tip of a rotating blade.
- 1.3. With the exception of special flights, for example magnetic surveys, there is very little general aviation activity at low level over the sea beyond the immediate coastline. Commercial passenger carrying fixed wing aircraft will always operate at levels well above the wind turbines. Offshore wind turbines will, however, constitute an obstruction to four principal aviation activities:
 - Flights by military low flying aircraft;
 - Flights by helicopters in connection with the offshore oil and gas industries;
 - Flights by helicopters engaged in search and rescue operations;
 - Flights by DEFRA aircraft on fishery protection operations.
- 1.4. For flights by both civil and military aircraft there are minimum weather conditions for conducting flight by visual reference. They are:
 - **Military Fixed Wing Aircraft and Helicopters at 140 kts or more** - 5 km visibility, 1500 metres horizontal and 500 ft vertical separation from cloud.
 - **Military Helicopters** - (airspeed of 140 kts or less) - as above or clear of cloud and in sight of the surface. It should be noted that helicopters engaged on search and rescue operations where the safety of life is at risk may operate in conditions that are at the margin of these weather minima.

- **Civil Fixed Wing Aircraft** - 5 km visibility, 1500 metres horizontal and 500 ft vertical separation from cloud. Aircraft flying at a speed of less than 140 kts may also fly clear of cloud and in sight of the surface. However, in most cases the horizontal visibility is increased to 3 km as a condition of the pilot's licence.
- **Civil Helicopters**
- VFR - 5 km visibility, 1500 metres horizontal and 500 ft vertical separation from cloud. If flying at 140 kts or less this may be reduced to clear of cloud and in sight of the surface provided flight is conducted at a speed that is reasonable for the visibility.
- IFR - When conducting approaches to offshore destinations in IMC, $\frac{3}{4}$ nm visibility and 200' cloud base.

When conducting descents from IMC to establish VMC below, en route to an offshore destination or coastal aerodrome, 600' cloud base and in sight of the surface with no specified minimum visibility.

- 1.5. During daylight hours wind turbines are similar in effect to terrestrial obstacles. During the hours of night, or in periods of reduced daylight, offshore windfarms are of greater significance and will need to be fitted with aviation obstacle lighting to supplement those required for maritime purposes. The standard for lighting terrestrial tall structures is the use of medium intensity steady red lights. In the interests of standardisation and to minimise confusion with maritime navigation lights, that is also the preferred scale for offshore wind turbines. Depending on the spacing of the turbines, not all turbine masts will need to be lit to this standard, but the interval between such masts should not exceed 2 km.

2. Objective

- 2.1. The proposed amendment to the ANO is intended to introduce a requirement to fit obstacle lighting, primarily for night-time use, on offshore wind turbines with a height of 60 metres or more above the highest astronomical tide (HAT). This measure will assist in achieving compliance with provisions of the Air Navigation Order by reducing the risk of such structures endangering an aircraft and assisting the pilots of such aircraft to avoid endangering their aircraft, persons or property.
- 2.2. Pilots of aircraft are required to carry aeronautical charts which will show the position of offshore wind turbines and their height above HAT. Obstacle lighting is not a substitute for the knowledge of the presence of such structures but is a significant and important aid to their visual acquisition and hence avoidance.

3. Options

- 3.1. Three options have been identified:

- Option 1 - for the CAA to offer advice on the lighting of offshore turbines on an informal basis.
- Option 2 - to introduce a requirement to light offshore turbines with light units complying with the provisions of ICAO Annex 14, during the hours of both day and night. This would be achieved by the adoption of a dual

standard system incorporating high intensity white lights for use by day and medium intensity red lights by night.

- Option 3 - To introduce a requirement to light offshore turbines with light units complying with the provisions of ICAO Annex 14, only during the hours of night.

3.2. Option 1. This is in effect the 'do nothing' option in that it places no obligation on a developer to accept CAA advice.

3.3. Option 2. A DERA report (Reference A) commissioned by the CAA recommended the use of medium intensity steady red lights for marking tall structures at night; this scale of lighting is both effective and environmentally friendly. The report also concluded that the case for fitting high intensity lights to all tall structures for daytime marking was not proven and should only be adopted where an aeronautical study shows there is a requirement for an obstacle to be lit outside of the hours of darkness. To be effective, high intensity flashing lights used for marking obstacles by day must produce light with an intensity of 200,000 cd and a flash rate of between 40-60 fpm. To achieve this performance the light units are heavy and have a high power consumption.

3.4. Option 3. As previously stated, medium intensity steady red obstacle lights meet the ICAO photometric requirements for marking tall structures by night. Medium intensity light units are relatively lightweight, have a modest power consumption and a comparatively high lamp life, thereby increasing availability and reducing maintenance costs. Thus the objective of enhancing the conspicuity of the turbines is achieved.

4. Benefits

4.1. The purpose of lighting of offshore turbines by night is to minimise the risk of aircraft colliding with the structures. Persons benefiting from this proposal are those associated with the ownership and function of the structure and the passengers and flight crews of aircraft in the air. Furthermore, damage to one or more turbines would deny the national grid green energy from a non-fossil source.

4.2. Option 1 does not meet the objective of 4.1 above.

4.3. Option 2 meets the objective of 4.1 above. However, as previously explained, the case for requiring the routine use of high intensity flashing white lights by day on tall structures has not been proven. This option would therefore incur significant costs to wind power companies that are difficult to justify. Moreover, high intensity lighting is visually intrusive and the omnidirectional characteristics of the light beam might result in confusion with maritime lighting.

4.4. Option 3 achieves the requirement of 4.1 above. It also conforms to the scale of lighting required on land based obstacles and is of proven effectiveness. The use of steady rather than flashing lights minimises the risk of confusion with maritime lights. Provision can be made to permit a reduction of light intensity during periods of good visibility. Furthermore elevating the plane of peak intensity of the light beam above the horizontal will limit the downward spread of the light. The result has been incorporated in the proposed requirement. These measures will minimise the environmental light pollution effect and present less of an attractant to birds.

5. Compliance Costs to Owners of Offshore Wind Turbines

5.1. The number of turbines which form an offshore windfarm that will need to be lit to conform with the proposed regulation will depend on the shape and spacing of the component structures. It is also likely that the visibility measurement and switching systems necessary to meet maritime regulations could be utilised for controlling aviation obstacle lights. A trial¹ was carried out to establish the beam angle and spread which optimised visibility from an aircraft but minimised the spread of light below the horizontal plain. It was evident from this trial that a single light unit mounted on the turbine nacelle was not visible from all directions because of obstruction by the rotor hub and blade roots. This shielding effect can be overcome by the use of a dual light system. The cost of a dual light unit and installation is in the region of £25,000 for each turbine that is required to be lit.

6. Consultation with Small Business: “The Litmus Test”

6.1. The construction and operation of a group of offshore wind generators is a major undertaking, more often than not by a consortium. There is no perceived impact on small businesses.

7. Results of Consultations

7.1. This section will be included following responses to the first consultation paper.

8. Enforcement, Sanctions, Monitoring And Review

8.1. This provision will be enforced in the same way as other provisions of the Air Navigation Order. Where a report is received by the CAA of an alleged contravention, it may be investigated. A contravention will be a criminal offence. Application of the provision will be monitored by the Directorate of Airspace Policy of the Civil Aviation Authority and the provision will be reviewed after two years.

9. Summary and Recommendations

	Option 1 Expected costs and benefits.	Option 2. Expected costs and benefits.	Option 3. Expected costs and benefits.
Participants	Existing	The full cost of the installation and maintenance of a dual day/night system.	The full cost of the installation and maintenance of a night time only system
Citizens including aircraft operators	Existing	Enhanced safety to both aircraft and wind turbines during the hours of darkness but unproven benefit in	Enhanced safety to both aircraft and wind turbines during the hours of darkness.

¹ DAP would like to thank No 202 Squadron RAF, Amec Wind and Orga Suisse for their assistance in conducting the lighting trial.

		daylight conditions.	
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- 9.1. It is recommended that the Air Navigation Order 2000 be amended to require the lighting of tall structures described at paragraph 1.2b in accordance with the provisions set out at Annexe A.

10. Reference

DRA/AS/FDS/CR97130/1.0 dated April 1997. Obstacle lighting and Marking.

11. Contact Name and Address for Enquiries

Mr D R Cutler
Directorate of Airspace Policy
Off-Route Airspace Section
K6 Gate 3
CAA House
45-59 Kingsway
London WC2B 6TE

Tel: 0207 453 6545
Fax: 0207 453 6565