



Figure 4. Map of Crookwell 3 Wind Farm showing turbine, house locations and theoretical annual shadow flicker duration at 6 m.

**Appendix B – Civil Aviation Safety Authority Advisory Circular
AC139-18(0) July 2007 (Withdrawn)**

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OBSTACLE MARKING AND LIGHTING OF WIND FARMS

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1. REFERENCES

- CASR Part 139, Subpart 139.E, and in particular
 - ◊ 139.365 Structures 110 metres or more above ground level.
 - ◊ 139.370 Hazardous objects etc.

- MOS-Part 139 Chapter 7 – Obstacle Restrictions and Limitations.
- MOS-Part 139 Section 8.10 – Obstacle Marking.
- MOS-Part 139 Section 9.4 – Obstacle Lighting.

2. PURPOSE

This Advisory Circular (AC) provides general information and advice on the obstacle marking and lighting of Wind Farms (including single wind turbines), where CASA has determined that the wind farm is, or will be, a hazardous object to aviation.

3. STATUS OF THIS AC

This is the first AC to be issued on this subject.

Advisory Circulars are intended to provide recommendations and guidance to illustrate a means but not necessarily the only means of complying with the Regulations, or to explain certain regulatory requirements by providing interpretative and explanatory material.

Where an AC is referred to in a 'Note' below the regulation, the AC remains as guidance material.

ACs should always be read in conjunction with the referenced regulations

4. GENERAL

4.1 This AC applies specifically to horizontal-axis wind turbines, which are the only type installed, or known to be proposed for installation, in Australia, at the date of issue of this document.

4.2 This AC applies to:

- (a) a single wind turbine; or
- (b) a group of wind turbines, referred to as a wind farm, which may be spread over a relatively large area.

4.3 The height of a wind turbine is defined to be the maximum height reached by the tip of the turbine blades.

4.4 Australian standards and recommended practices for the marking and lighting of obstacles and objects assessed as being hazardous to aviation, are consistent with international standards and recommended practices as published by the International Civil Aviation Organisation (ICAO) in Annex 14 Volume 1 (Aerodrome Design and Operations). The general requirements are:

- (a) marking is used to make objects conspicuous to pilots, by day.
- (b) lighting is used to make objects conspicuous to pilots, by night;
- (c) lights are located as close as practicable to the top of the objects, and at other locations so as to indicate the general definition and extent of the objects.

4.5 Wind turbines pose a particular practical problem in that their highest point is not a fixed structure, and therefore lights can not be appropriately located. The highest fixed part of the turbine where lights can conveniently be located is the top of the generator housing, sometimes known as the nacelle, and this is typically of the order of 2/3 the maximum height of the turbine.

4.6 ICAO has not yet published standards and recommended practices specifically suited to wind turbines. The advice in this document has been derived by allowing some variations to standards and recommended practices to accommodate the specific practical difficulties associated with wind turbines and wind farms, and taking into consideration the practices of some overseas countries.

5. WIND TURBINES IN THE VICINITY OF AN AERODROME

5.1 CASA strongly discourages the siting of wind turbines in the vicinity of an aerodrome.

5.2 A wind turbine located sufficiently close to an aerodrome so that it penetrates an obstacle limitation surface (OLS) of the aerodrome, is defined by MOS-Part 139 Section 7.1, to be an obstacle.

5.3 If the aerodrome is to be used at night, an obstacle that penetrates an OLS should be lighted, in accordance with MOS-Part 139 Section 9.4. The top lights are required to be arranged so as to at least indicate the points or edges of the object highest above the obstacle limitation surface. For a wind turbine, these lights may be located on a separate supporting structure adjacent to the wind turbine, to overcome the difficulty associated with the highest point of the obstacle being the (moving) blades of the turbine.

Note: Obstacle limitation surfaces are a complex of imaginary surfaces associated with an aerodrome. They vary depending on number and orientation of runways, and the instrument-approach type of the runway(s). Some surfaces can extend to 15 km from an aerodrome. Aerodrome operators can provide details for their particular aerodrome.

6. WIND TURBINES WITH A HEIGHT OF 110 m OR MORE

6.1 CASR 139.365 requires a person proposing to construct a building or structure, the top of which will be 110 m or more above ground level, to inform CASA of that intention and the proposed height and location of the proposed building or structure.

6.2 CASA will conduct an aeronautical study to determine if the wind turbine will be a hazardous object to aviation, in accordance with CASR 139.370.

6.3 If, as a result of the aeronautical study CASA finds that a proposed wind turbine will penetrate an OLS of an aerodrome, the proposal will be dealt with in accordance with 5 above.

6.4 The aeronautical study may find that even though the proposed wind turbine will not penetrate any OLS of an aerodrome, it will be a hazardous object to aviation.

6.5 The hazard that an object poses to aviation can be reduced by indicating its presence by appropriate marking and/or lighting.

Note: The marking and/or lighting does not necessarily reduce operating limitations which may be imposed by an obstacle or hazardous object.

6.6 The advice, in 7 and 8 below, on marking and lighting of wind turbines, should be suitable for wind turbines that do not penetrate an OLS, in most cases. However, because of the variations in configurations and layout of turbines in wind farms, the aeronautical study may indicate that a variation to that advice would be appropriate for a particular wind farm. In such a case, CASA may offer suggestions for variations to the normal advice provided in 7 and 8 below.

7. MARKING OF WIND TURBINES

7.1 Experience with wind turbines installed to date, indicates that they are sufficiently conspicuous by day, due to their shape, size, and colour.

7.2 Wind turbines that are of basically a single colour, and visually conspicuous against the prevailing background, do not require to be painted in obstacle marking colours and/or patterns.

8. LIGHTING OF WIND TURBINES

8.1 In the case of a single wind turbine:

- (a) two flashing red medium intensity obstacle lights should be mounted on top of the generator housing;
- (b) the light fixtures should be mounted at a horizontal separation to ensure an unobstructed view of at least one of the lights by a pilot approaching from any direction;
- (c) both lights should flash simultaneously; and
- (d) the characteristics of the obstacle lights should be in accordance with MOS-Part 139 subsection 9.4.7.

8.2 In the case of a wind farm, sufficient individual wind turbines should be lighted to indicate the extent of the group of turbines:

- (a) the interval between obstacle lights should not be less than the current extensive object standard of 900 metres, and at a distance that minimises the number of lighted wind turbine generators without diminishing appropriate aviation safety;
- (b) in addition, the most prominent (highest for the terrain) turbine(s) should be lighted, if not included amongst the turbines lighted in accordance with (a) above; and
- (c) the lighting of individual turbines should be in accordance with 8.1 above.

Note: There is an overseas proposal that all lighting provided at a wind farm should flash simultaneously. This proposal is still to be validated and accepted. It is suggested that wind farm operators bear in mind that the simultaneous flashing of all lights at a wind farm could become accepted practice some time in the future.

8.3 On completion of the project, CASA may choose to conduct a flight check to determine the adequacy of the obstacle lighting. This may result in a change (either more or fewer) to the number of obstacle lights required, to ensure the development remains conspicuous.

8.4 Where obstacle lighting is to be provided, it is recommended a monitoring, reporting and maintenance procedure be put in place to ensure outages are reported through the NOTAM system and repairs are implemented.

Bill McIntyre
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Limitations

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