

Appendix 12: Amended Obstacle Lighting Plan

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February 2025

By email: tbuchan@umwelt.com.au

Our ref: 102206-03

Dear Thomas

Re: Bullawah Wind Farm – Wind Turbine Obstacle Lighting

This correspondence responds to a request for an Aviation Obstacle Lighting Plan in accordance with the relevant guidelines and as per CASA's advice on the EIS.

1.1. References

- Advisory Circular (AC)139.E-05 *Obstacles (including wind farms) outside the vicinity of a CASA-certified aerodrome*
- Civil Aviation Safety Regulation (CASR) 1998 Part 139: *Aerodromes, Manual of Standards*
- Department of Planning, Housing and Infrastructure – *Wind Energy Guideline* (November 2024)
- National Airports Safeguarding Framework (NASF) Guideline D: *Managing the Risk of Wind Turbine Farms as Physical Obstacles to Air Navigation*

1.2. Background

Aviation Projects prepared an Aviation Impact Assessment (AIA) for the Bullawah Wind Farm and concluded that obstacle lighting would not be required to maintain an acceptable level of safety for aircraft.

CASA has reviewed the AIA and agrees with the recommendations in section 10, except recommendation 9, "Lighting of WTGs and WMT."

The Environmental Impact Statement (EIS), including the AIA, was placed on public exhibition between 27 August 2024 and 23 September 2024. BWF received feedback from the community and Government agencies, including the NSW Department of Planning, Housing and Infrastructure (DPHI) and CASA.

1.2.1. Recommendation 9 of Section 10 in Aviation Impact Assessment

Recommendation 9 in Section 10 of the AIA (refer: 102226-02 Bullawah WF_AIA_V1.2_241113) indicated the following:

Lighting of WTGs and WMT

9. Aviation Projects considers that the WMTs will not require an obstacle light installed at the top to ensure aviation safety standards are met.

Note: CASA has stated Recommendation 9 in their advice, which makes specific reference to wind monitoring towers (WMTs). However, the remainder of its advice relates to obstacle lighting standards, and specifically

references lighting to WTG's. The CASA advice relating to WTG lighting aligns with current Government advice on the matter, as described in the DPHI Wind Energy Guideline (November 2024).

As such, this Aviation Obstacle Lighting Plan has been prepared to address the WTG lighting matter raised by CASA. In addition, this Aviation Obstacle Lighting Plan considers specific circumstances which may warrant permanent WMT lighting for the Project. Refer to Section 1.7 below for further information.

1.2.2. CASA advice on the EIS

CASA responded on 21 August 2024, and required obstacle light for Bullawah Wind Farm:

Contrary to Recommendation 9, CASA considers the proposed wind farm will be a hazard to aviation safety and recommends that the wind farm is obstacle lit with steady medium-low intensity red obstacle lighting in accordance with the National Airports Safeguarding Framework Guideline D 'Managing the Risk of Wind Turbine Farms as Physical Obstacles to Air Navigation' National Airports Safeguarding Framework Principles and Guidelines (infrastructure.gov.au) and section 9.31 of Part 139 Aerodromes Manual of Standards Part 139 (Aerodromes) Manual of Standards 2019 (legislation.gov.au)

International standards require 2,000 candela lighting intensity on the nacelle / generator housing (also recommended in the NASF guideline) and 200 candelas at the mid-point of the turbine mast. CASA recommends that 200 candela as a minimum intensity lighting on the nacelle would suffice (due mainly to the lack of background lighting in the vicinity of the turbines). Mid-point lighting on the turbine mast is not essential. The obstacle lighting should be monitored to alert the wind farm operator of any outage. The lighting system design should ensure that some of the obstacle lights remain on during an outage. CASA is prepared to review a lighting plan that indicates which turbines are proposed to be lit.

As the Aviation Safety regulator, CASA does not consider the visual impact of obstacle lighting on neighbours / homesteads. However, there are mitigations for visual impact such as baffling and intensity control (as described in the Aviation Impact Assessment Table 13 / Page 60 'Effect of obstacle lighting on neighbours'). Also, Section 15.4 'AHL Mitigation Measures' and Section 16.2 of the Landscape and Visual Impact Assessment by Moir describe recommendations to reduce the potential visual impacts from Aviation Hazard Lighting (AHL).

Further to Recommendation 5, AS 3891.2:2018 Air navigation – Cables and their supporting structures – Marking and safety requirements Part 2: Low level aviation operations. AS 3891.2, Air navigation – Cables and their supporting structures – Marking and safety requirements, Part 2: Low-level aviation operations is available.

The recommended changes to air routes W762 and Q60 lowest safe altitudes (LSALT) and 25 nm MSA are covered in Aviation Impact Assessment Sections 6 and 10 but not specifically included in Section 11 Recommendations. The proponent (or the proponent's Aviation Consultant) should engage with Airservices Australia regarding the changes to the LSALTs and the 25 nm MSA before the offending WTGs have been erected. The proponent (or the proponent's Aviation Consultant) should also advise the Hay Aerodrome Operator (Hay Shire Council) of the recommended change to the 25 nm MSA.

Following receipt of Government Agency advice on the EIS, DPHI raised a formal request for information (RFI) on 3 December 2024, requesting the preparation of an Aviation Obstacle Lighting Plan as per the recommendations made by CASA in their advice on the EIS. This Obstacle Lighting Plan has been prepared at the request of DPHI, in accordance with CASA's recommendations.

1.3. CASR Part 139 (Aerodromes) Manual of Standards 2019 (13 March 2024)

CASR Part 139 (Aerodromes) Manual of Standards 2019 (13 March 2024) Section 9.31, (8) and (9) specifies as follows in relation to obstacle lights for wind farms:

(8) *Subject to subsection (9), for wind turbines in a wind farm, medium-intensity obstacle lights must:*

- (a) mark the highest point reached by the rotating blades; and*
- (b) be provided on a sufficient number of individual wind turbines to indicate the general definition and extent of the wind farm, but such that intervals between lit turbines do not exceed 900 m; and*
- (c) all be synchronised to flash simultaneously; and*
- (d) be seen from every angle in azimuth.*

Note This is to prevent obstacle light shielding by the rotating blades of a wind turbine and may require more than 1 obstacle light to be fitted.

(9) *If it is physically impossible to light the rotating blades of a wind turbine:*

- (a) the obstacle lights must be placed on top of the generator housing; and*
- (b) a note must be published in the AIP-ERSA indicating that the obstacle lights are not at the highest position on the wind turbines.*

Section 9.33 specifies the characteristics of medium-intensity obstacle lights

9.33 Characteristics of medium-intensity obstacle lights

(1) *Medium-intensity obstacle lights must:*

- (a) be visible in all directions in azimuth; and*
- (b) if flashing – have a flash frequency of between 20 and 60 flashes per minute.*

(2) *The peak effective intensity of medium-intensity obstacle lights must be $2\,000 \pm 25\%$ cd with a vertical distribution as follows:*

- (a) for vertical beam spread – a minimum of 3 degrees;*
- (b) at -1 degree elevation – a minimum of 50% of the lower tolerance value of the peak intensity;*
- (c) at 0 degrees elevation – a minimum of 100% of the lower tolerance value of the peak intensity.*

(3) *For subsection (2), vertical beam spread means the angle between 2 directions in a plane for which the intensity is equal to 50% of the lower tolerance value of the peak intensity.*

(4) *If, instead of obstacle marking, a flashing white light is used during the day to indicate temporary obstacles in the vicinity of an aerodrome, the peak effective intensity of the light must be increased to $20\,000 \pm 25\%$ cd when the background luminance is 50 cd/m² or greater.*

CASR Part 139 MOS allows for obstacle lights to be provided on a sufficient number of individual wind turbines to indicate the general definition and extent of the wind farm, with intervals between lit turbines not exceeding 900 m.

1.4. AC139.E-05 Obstacles (including wind farms) outside the vicinity of a CASA certified aerodrome

In Australia, CASA has accepted the use of 200 candela lighting in some circumstances due to a lack of back lighting in rural and remote areas, meaning that a lower intensity light is still visible to pilots at an acceptable distance to permit a pilot to see and avoid the obstacle. In AC 139.E-05 Section 2.6 describes the reasoning behind CASA's preference to recommend aviation hazard lighting for tall structures and aircraft detection systems for wind farms.

2.6.2 Hazard lighting for wind farms and other tall structures is intended to alert pilots, flying at low altitude, to the presence of an obstacle allowing them sufficient awareness to safely navigate around or avoid it. The pilot is responsible for avoiding other traffic and obstacles based on the "alerted" see-and-avoid principle.

2.6.3 Unless the wind farm or tall structure is located near an airport, it is not expected to pose a risk to regular public transport operations. The kind of air traffic that is usually encountered at low altitude in the vicinity of a wind farm or tall structure includes light aircraft (e.g., private operators, flight schools, sport aviation, agricultural, survey, and fire spotting and control) and helicopters (military, police, emergency services, survey, and fire spotting and control). Hazard lights are therefore designed to provide pilots with sufficient awareness about the presence of the structure(s), so they can avoid it. This means that the intensity of the hazard lights should be such that the acquisition distance is sufficient for the pilot to recognise the danger, take evasive action and avoid the obstacle by a safe margin in all visibility conditions. This outcome considers the potential speed of an aircraft to determine the distance by which the pilot must become aware of the obstacle to have enough time and manoeuvrability to avoid it.

1.5. National Airports Safeguarding Framework (NASF) Guideline D

NASF Guideline D provides guidance to State/Territory and local government decision makers, airport operators and developers of wind farms to jointly address the risk to civil aviation arising from the development, presence and use of wind farms and wind monitoring towers.

Paragraphs 35 to 37 provide guidance in relation to obstacle lighting for wind turbines:

35. When lighting has been recommended by CASA to reduce risk to aviation safety, medium-intensity obstacle lights should be used. Where used, lighting on wind farms should be installed:

- (a) to identify the perimeter of the wind farm;*
- (b) respecting a maximum spacing of 900m between lights along the perimeter, unless an aeronautical study shows that a greater spacing can be used;*
- (c) where flashing lights are used, they flash simultaneously; and*
- (d) within a wind farm, any wind turbines of significantly higher elevation are identified wherever located.*

36. To minimise the visual impact on the environment, obstacle lights may be partially shielded, provided it does not compromise their operational effectiveness. Where obstacle lighting is provided, lights should operate at night, and at times of reduced visibility. All obstacle lights on a wind farm should be turned on simultaneously and off simultaneously.

37. Where obstacle lighting is provided, proponents should establish a monitoring, reporting and maintenance procedure to ensure outages, including loss of synchronisation, are detected, reported and rectified. This would include making an arrangement for a recognised responsible person from the wind farm to notify the relevant CASA office, so that CASA can advise pilots of light outages.

1.6. Department of Planning, Housing and Infrastructure – Wind Energy Guideline (November 2024)

This Wind Energy Guideline will help the community, industry, applicants and regulators navigate the planning framework under which we assess wind energy. This guideline identifies key planning considerations relevant to wind energy development and provides policy and technical guidance on key issues of the technology.

Whilst the Renewable Energy Planning Framework, inclusive of the Wind Energy Guideline does not immediately apply to the Project (as the EIS was lodged before 12 November 2024) aspects relating to aviation safety are relevant to consider to avoid ambiguity in regard to the need for obstacle lighting. Those key principles are outlined below.

5.3.1 Key principles

Aviation safety and lighting principles

- *Wind energy projects should be designed to reduce aviation safety risk.*
- *If turbines are 150 m or more above ground, lighting is required for the most critical turbines (e.g. turbines at highest elevations and/or around the project perimeter).*
- *Lighting of turbines and ancillary infrastructure should be designed to minimise potential amenity impacts by using the lowest intensity lighting suitable for the site.*
- *An aviation impact assessment must include a full assessment of the risks to aviation safety in the context of existing flight patterns and airport approach routes.*

Lighting

While important from a safety perspective, aviation obstacle lighting has the potential to impact regional and rural areas where other light sources are minimal. Applicants should seek to minimise the effects of lighting on visual amenity while still having regard to the aviation safety risk assessment. The visibility and impact of any lighting depends on the nature and intensity of the lighting required and the potential cumulative effects with other developments.

NSW adopts a risk-based approach assessing the potential risk of wind energy projects to aviation safety. We acknowledge CASA's expectation to recommend some level of aviation obstacle lighting for tall structures, including wind turbines.

For tall structures (including turbines) that are greater than 150 metres above ground level, the most critical structures (turbines at the highest elevations and/or around the project's perimeter) will require lighting.

Lighting turbines and tall structures is intended to improve safety outcomes and alert pilots to the presence of potential obstacles in low-altitude flight paths. Aircraft detection systems can be used to trigger lights only when an approaching aircraft is identified. CASA has also advised that using management systems to regulate obstacle lights and their intensity (such as visibility meters or radar detection systems) is an acceptable option in Australia.

Australia aviation authorities have generally adopted international standards²¹ for lighting intensity, which recommend 2,000 candela medium intensity obstacle lights for structures greater than 150 metres above ground level. However, CASA has accepted the use of 200 candela lighting in circumstances where a lack of back lighting, such as in rural and remote areas, means the lower intensity light is still visible to pilots at an acceptable distance to avoid the obstacle²²

To mitigate negative impacts on visual amenity, consider:

- minimising the number of turbines that need to be lit to clearly indicate the general height and extent of the development – high-risk turbines at high elevations must be lit
- using the lowest intensity turbine light suitable for the site
- where fixed lighting is proposed (instead of being controlled through detection systems), turning on all turbine lighting simultaneously, using a steady medium-intensity red light, and to not have flashing lights
- directing ancillary lighting below the horizontal to avoid unnecessary impact on residences.

²¹ ICAO (International Civil Aviation Organization) Annex 14, Volume 1, Chapter 6.2

²² CASA Advisory Circular AC 139.E-05v1.1 Obstacles (including wind farms) outside the vicinity of a CASA certified aerodrome, October 2022

1.7. Obstacle lighting arrangements

The proposed obstacle lighting layout for the Project has been prepared in Figure 1 below, with respect to the indicative Project layout presented in the EIS and in applying the requirements of CASR Part 139 MOS or NASF Guideline D (in relation to obstacle lighting on wind turbines, and in particular the 900 m interval). The specific turbines proposed to be lit are illustrated as red and orange dots in Figure 1, and are identified in Table 1.

Orange dots in Figure 1 represent select turbines that may require lighting, should the Project be constructed in stages (i.e. Stage Two, northern turbines and Stage One, southern turbines), to ensure adequate perimeter lighting is still provided.

The EIS considered a 'worst case' assessment scenario, and some aspects of the design may change during the detailed design. This flexibility allows the final Project design to be optimised and the most appropriate and efficient infrastructure selected while still ensuring the Project's impacts remain generally in accordance with (or less than) those assessed in this EIS.

Accordingly, this obstacle lighting would be varied in consultation with CASA should changes to the Project occur that necessitate further consideration of CASA feedback, or the CASR Part 139 MOS or NASF Guideline D requirements. The Project should have 200 cd low intensity steady red obstacle lighting that is fitted and operational.

If the final constructed layout changes such that wind turbine locations move or certain wind turbine locations are not built, then the 'lit' wind turbines shall be reconfigured to provide equivalent perimeter lighting around the whole wind farm similar to what is shown in Figure 1. i.e. similar distribution of 'lit' wind turbines around the whole wind farm perimeter.

Light and Shielding Specification:

- *Lights:*
 - 2 low intensity steady red lights (per lit wind turbine):
 - Fixed lights showing red
 - A horizontal beam spread that results in 360° coverage around the obstacle
 - A minimum intensity of 200 candela (cd)
 - A vertical beam spread (to 50% of peak intensity) of 10°
 - Low-intensity obstacle lights must have a peak intensity of at least 10 cd.

- A vertical distribution with 50 cd minimum at +6° and +10° above the horizontal
- Not less than 10 cd at all elevation angles between -3° and +90° above the horizontal.
- Obstacle lights should operate at night, and at times of reduced visibility.
- *Shielding:*
 - Shielding of the downward component of obstacle lighting is permitted, and if used, must be such that:
 - No more than 5% of the nominal light intensity is emitted at or below 5° below the horizontal
 - No light is emitted at or below 10° below horizontal
 - Two lights must be provided on top of the generator housing in a way that allows at least one of the lights to be seen from every angle in azimuth.
- *Department of Defence obstacle lighting requirement:*
 - The frequency range of the LED light emitted must fall within the range of wavelengths 655 to 930 nanometres.

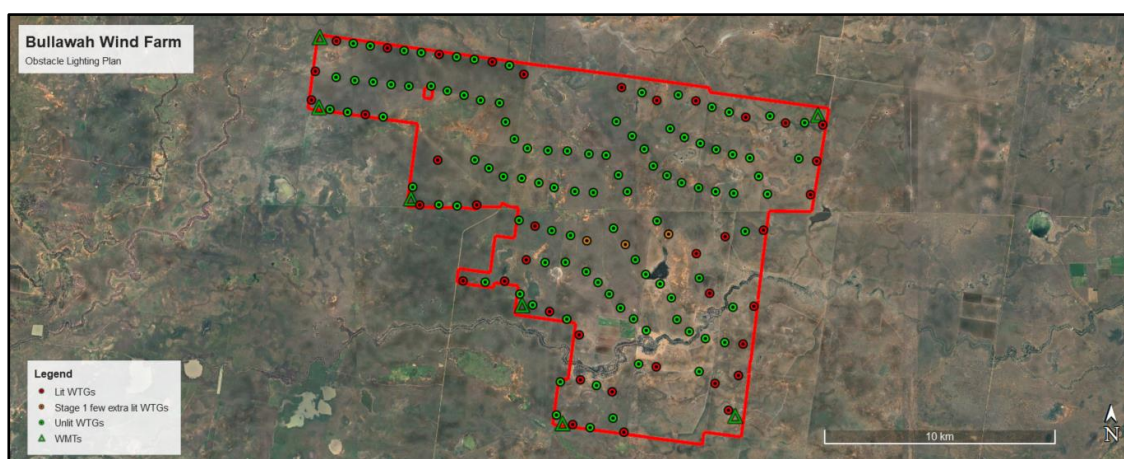


Figure 1 Proposed obstacle lighting layout

Table 1 Wind turbine ID proposed for obstacle lighting

WTG ID	X coordinates	Y Coordinates
WTG 1	325889	6148937
WTG 4	328097	6148676
WTG 6	325002	6147624
WTG 12	324858	6146391
WTG 15	327196	6145809

WTG ID	X coordinates	Y Coordinates
WTG 18	330337	6148443
WTG 21	332638	6148164
WTG 23	334009	6147654
WTG 48	330358	6143911
WTG 50	329614	6141976

<i>WTG ID</i>	<i>X coordinates</i>	<i>Y Coordinates</i>
WTG 53	332074	6142021
WTG 54	338236	6147166
WTG 55	339117	6146967
WTG 58	341453	6146650
WTG 61	343616	6145990
WTG 63	345336	6145774
WTG 65	346946	6145723
WTG 84	346710	6144163
WTG 85	346469	6142723
WTG 87	334609	6141159
WTG 90	336854	6140574
WTG 98	338519	6140442
WTG 107	343677	6136268
WTG 109	340376	6140918
WTG 110	341589	6140106
WTG 112	342195	6138414
WTG 114	344115	6137894

<i>WTG ID</i>	<i>X coordinates</i>	<i>Y Coordinates</i>
WTG 115	342819	6140857
WTG 116	343677	6141097
WTG 117	344468	6141163
WTG 120	334255	6139707
WTG 121	331546	6138756
WTG 123	333337	6138777
WTG 125	334565	6137780
WTG 128	336601	6136533
WTG 130	339948	6135225
WTG 132	342496	6134558
WTG 133	343500	6134920
WTG 134	343096	6133419
WTG 136	336684	6134609
WTG 138	338064	6134119
WTG 140	336388	6132686
WTG 142	338122	6132991

Light of Permanent WMT:

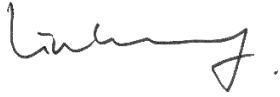
As noted in Section 1.1, this Aviation Obstacle Lighting Plan primarily focused on WTG lighting as opposed to permanent WMT lighting.

If the permanent WMTs are within the project boundary and are not installed prior to the WTG installation, due to the height of the permanent WMTs being much lower than the WTGs, they will be shielded by other lighted WTGs. Therefore, there is no lighting requirement for the WMTs are within the project boundary and not installed prior to the WTGs.

However, consistent with the AIA, there are circumstance whereby permanent WMT's may require lighting. As per the AIA permanent WMTs that are installed prior to WTG installation and permanent WMTs that are not in close proximity to a boundary WTG (>900 m), should be fitted with a medium intensity steady red obstacle light at the top of the tower to ensure visibility in low light and deteriorated atmospheric conditions.

If you wish to clarify or discuss the contents of this correspondence, please get in touch with me on 0433 747 835.

Kind regards

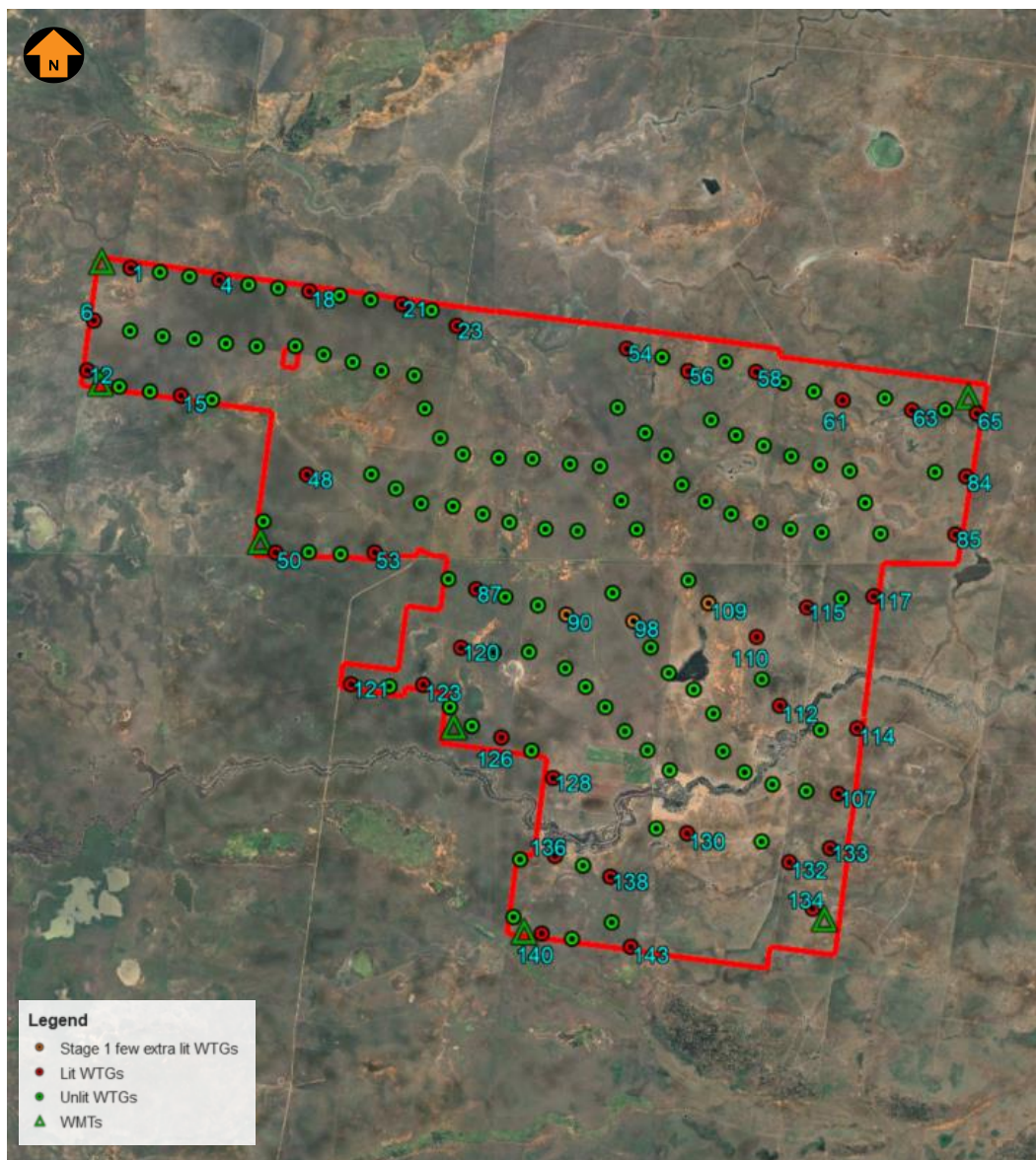


Lyn Wang

Aviation Specialist Consultant

27 February 2025

Enclosure: Obstacle Lighting Plan



1. Light and Shielding Specification:

Lights:

- **2 low intensity** steady red lights:
 - fixed lights showing red
 - a horizontal beam spread that results in 360° coverage around the obstacle
 - a minimum intensity of 200 candela (cd)
 - a vertical beam spread (to 50% of peak intensity) of 10°
 - a vertical distribution with 50 cd minimum at +6° and +10° above the horizontal
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Shielding:

- shielding of the downward component of obstacle lighting is permitted, and if used must be such that:
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 - no light is emitted at or below 10° below horizontal
- two lights must be provided on top of the generator housing in a way that allows at least one of the lights to be seen from every angle in azimuth.

Department of Defence obstacle lighting requirement:

- the frequency range of the LED light emitted must fall within the range of wavelengths 655 to 930 nanometers.

2. References

- Civil Aviation Safety Authority, *Part 139 (Aerodromes) Manual of Standards 2019*, dated 13 August 2020; Chapter 9 Division 4 Obstacle lighting (Sections 9.31, 9.32 and 9.33)
- Department of Infrastructure and Regional Development, Australian Government, National Airport Safeguarding Framework, *Guideline D Managing the Risk of Wind Turbine Farms as Physical Obstacles to Air Navigation*, v4.1.3, 15 July 2012, paragraphs 35, 36 and 37