RENEWABLE FUTURES.
GENERATED TODAY.

Aviation Lighting Scheme

Yeorton Wind Turbine Repowering

Condition 3

Planning Application 4/24/2057/0F1

23 January 2026

LOCO$_2$GEN

DISCLAIMER

This document contains proprietary and confidential information. All data submitted to [CLIENT] (the "Recipient") is provided in reliance upon its consent not to use or disclose any information contained herein except in the context of its business dealings with the Locogen group of company ("Locogen"). The Recipient of this document agrees to inform present and future employees of the Recipient who view or have access to its content of its confidential nature.

The Recipient agrees to instruct each employee that they must not disclose any information concerning this document to others except to the extent that such matters are generally known to, and are available for use by, the public. The Recipient also agrees not to duplicate or distribute or permit others to duplicate or distribute any material contained herein without the express written permission of Locogen.

Locogen retains all title, ownership and intellectual property rights to the material and trademarks contained herein, including all supporting documentation, files, marketing material, and multimedia.

Any liability arising out of use by a third party of this document for purposes not wholly connected with the above shall be the responsibility of that party who shall indemnify Locogen against all claims, costs, damages and losses arising out of such use.

It should be noted that where people are named in connection with a project, this information is indicative only and Locogen reserves the right to alter the composition of the team.

BY ACCEPTANCE OF THIS DOCUMENT, THE RECIPIENT AGREES TO BE BOUND BY THE AFOREMENTIONED STATEMENT.

DOCUMENT INFORMATION

Document title:	Aviation Lighting Scheme
Version number:	1
Prepared by:	DeAnna Wooler
Date:	23 January 2026
Client:	Yeorton Wind Limited
Status:	Approved
File name:	10712 - Yeorton Aviation Lighting Scheme

REVISION HISTORY

Version	Revision date	Purpose of revision	Author	Approver
1	06/01/2026	Original document	DW	IM

Executive summary

Report Purpose

This report has been prepared to define an aviation lighting scheme for a consented wind turbine located west of the Energy Coast Business Park, Egremont, CA22 2NH. The purpose of the report is to discharge Condition 3 of the planning permission (ref. 4/24/2057/0F1) by setting out how the development will be appropriately lit throughout its operational life to maintain civil and military aviation safety.

The aviation lighting scheme has been developed with reference to guidance from the Ministry of Defence (MoD), Civil Aviation Authority (CAA) and the International Civil Aviation Organization (ICAO). The assessment considers the type, location, and specification of aviation lighting required, with due regard to aviation safety and environmental considerations.

The Development

Planning permission for this development was granted by Cumberland Council (the Local Planning Authority 'LPA') under reference 4/24/2057/0F1 on 20 February 2025. The consent allows for the repowering of an existing wind turbine with a height of 46.5m to blade tip, through the installation of a replacement wind turbine with a maximum height of 77m to blade tip.

Consultation with the MoD during the planning application confirmed that the site is located within Low Flying Area 17 (LFA 17), where military fixed-wing aircraft may operate at altitudes as low as 250 feet (76.2m) above ground level for low-level flight training purposes. The MoD has identified that the development could present a physical obstruction to such operations and, as a result, requested the attachment of the aviation lighting condition to mitigate potential aviation safety risks.

Condition 3 of the planning permission requires the submission and approval of an aviation lighting scheme prior to the commencement of construction or the deployment of any construction equipment or temporary structures exceeding 50m in height above ground level. The condition requires the scheme to be agreed in consultation with the MoD and to define the aviation warning lighting to be provided during both the construction and operational phases of the development, ensuring continued compliance for the lifetime of the turbine.

Condition 3 of the planning permission notes the following:

Prior to commencing construction of the wind turbine generator, or deploying any construction equipment or temporary structure 50 metres or more in height (above ground level) an aviation lighting scheme shall be submitted to the Local Planning Authority for approval in writing in conjunction with the Ministry of Defence defining how the development will be lit throughout its life to maintain civil and military aviation safety requirements as determined necessary for aviation safety.

This shall set out:

a) *Details of any construction equipment and temporary structure with a total height of 50 metres or greater (above ground level) that will be deployed during the construction of the wind turbine generator and details of any aviation warning lighting that they will be fitted with; and*

b) *The location and height of the wind turbine generator and any anemometry mast featured in the development identifying those that will be fitted with aviation warning lighting identifying the position of the lights on the wind turbine generator; the type(s) of lights that will be fitted and the performance specification(s) of the lighting type(s) to be used. Thereafter, the lights shall remain operational as detailed in the approved aviation lighting scheme for the lifetime of the development.*

Reason: To maintain aviation safety.

Aviation Lighting Requirements

The MoD lighting requirements are outlined in guidance published by the Royal Air Force (RAF) on 1 January 2020. CAA requirements are set forth in its 2017 wind turbine lighting policy statement, with additional consideration given to the CAA's seventh edition of CAP 764, published December 2025.

Furthermore, guidance from ICAO Annex 14, Chapter 6 – International Regulations and the Air Navigation Order (ANO) 2016, Article 222 has also been considered.

The priorities of various stakeholders are different, therefore this report has sought to meet all safety requirements while satisfying amenability considerations as much as possible.

Recommended Lighting Scheme

It is proposed that the wind turbine will use a 24 VDC MoD-compatible infra-red (IR) obstruction light (CEL-IR850-24-CST LED) installed at the highest point on the nacelle. No visible red aviation lighting will operate unless required by the CAA or MoD.

The IR light provides 360° horizontal coverage, with unobstructed emission above the rotor plane. No blade-tip or intermediate tower lighting is proposed.

The light will operate automatically from sunset to sunrise, flashing at 60 flashes per minute with a 250ms duration, in line with MoD requirements.

A remote monitoring system will detect faults, and any issues will be investigated within 24 hours, with repairs undertaken promptly. A maintenance log will be maintained and made available to the LPA or MoD upon request.

Next Steps

This report is submitted to the LPA to discharge Condition 3 of planning permission reference 4/24/2057/0F1. It is recommended that the aviation lighting scheme is shared with the MoD and CAA to confirm their agreement prior to implementation.

CONTENTS

TABLES AND FIGURES

1. Introduction

1.1 Overview

This report has been prepared to define an aviation lighting scheme for a consented wind turbine located west of the Energy Coast Business Park, Egremont, CA22 2NH (planning reference 4/24/2057/0F1). The purpose of the report is to discharge Condition 3 of the planning permission by setting out how the development will be appropriately lit throughout its operational life to maintain civil and military aviation safety.

Condition 3 of the planning permission notes the following:

Prior to commencing construction of the wind turbine generator, or deploying any construction equipment or temporary structure 50 metres or more in height (above ground level) an aviation lighting scheme shall be submitted to the Local Planning Authority for approval in writing in conjunction with the Ministry of Defence defining how the development will be lit throughout its life to maintain civil and military aviation safety requirements as determined necessary for aviation safety.

This shall set out:

a) Details of any construction equipment and temporary structure with a total height of 50 metres or greater (above ground level) that will be deployed during the construction of the wind turbine generator and details of any aviation warning lighting that they will be fitted with; and

b) The location and height of the wind turbine generator and any anemometry mast featured in the development identifying those that will be fitted with aviation warning lighting identifying the position of the lights on the wind turbine generator; the type(s) of lights that will be fitted and the performance specification(s) of the lighting type(s) to be used. Thereafter, the lights shall remain operational as detailed in the approved aviation lighting scheme for the lifetime of the development.

Reason: To maintain aviation safety.

Guidance from the Ministry of Defence (MoD), Civil Aviation Authority (CAA) and the International Civil Aviation Organization (ICAO) has been considered. The assessment considers the type of lighting to be provided and defines how the turbines should be lit.

1.2 Aviation Lighting Requirement

The MoD lighting requirements are outlined in guidance published by the Royal Air Force (RAF) on 1 January 2020. CAA requirements are set forth in its 2017 wind turbine lighting policy statement, with additional consideration given to the CAA's seventh edition of CAP 764, published December 2025.

Guidance from ICAO Annex 14, Chapter 6 – International Regulations and the Air Navigation Order (ANO) 2016, Article 222 has also been considered.

Section 3 provides a detailed review of the guidance.

1.3 Consultation Responses

The MoD provided formal consultation comments in relation to aviation lighting in correspondence dated 04 April 2024.

The principal safeguarding concern of the MoD with respect to this development of a wind turbine relates to the potential to create a physical obstruction to air traffic movements.

In this case the development falls within Low Flying Area 17 (LFA 17), an area within which fixed wing aircraft may operate as low as 250 feet or 76.2 metres above ground level to conduct low level flight training. The addition of

turbines in this location has the potential to introduce a physical obstruction to low flying aircraft operating in the area.

To address this impact, and given the location and scale of the development, the MoD require conditions are added to any consent issued requiring that the development is fitted with aviation safety lighting and that sufficient data is submitted to ensure that structures can be accurately charted to allow deconfliction.

As a minimum the MoD would request the wind turbine is lit with no less than 25cd visible or infra-red (IR) lighting.

Subject to the two conditions provided in Appendix A, the MoD has no objections to the development.

This report has been prepared to address the MoD's requirements in respect of aviation lighting only. The separate requirements relating to aviation charting and safety management are outside the scope of this report.

2. Development Details

2.1 Layout and Wind Turbine Details

The consented turbine location and site boundary is shown in Figure 1 in Appendix B.

The maximum wind turbine dimensions are presented in Table 1 below. The coordinates and altitude data are presented in Appendix A, along with turbine elevations shown in Figure 2 in Appendix B.

Table 1: Assessed wind turbine details

Maximum Rotor Diameter (m)	Nominal Hub Height (m agl)	Maximum Tip Height (m agl)
62	46	77

During the operation of the project, the wind turbine is the only structure with a total height of 50m or greater associated with the development. During the construction phase, a crane will be used to lift the turbine components in place. It is likely that this will have a height between 45m and 150m AGL, and therefore will be subject to aviation lighting.

As the scheme consists of a single turbine, inter-turbine distances are not considered in this report.

2.2 Airspace Considerations

The Development is located in the London Flight Information Region (FIR), which covers most of England. FIR are managed by a controlling authority that ensures air traffic services are provided to the aircraft flying within it. The CAA is the controlling authority for the London FIR, responsible for regulation, oversight, and designation of air navigation service provision. National Air Traffic Services (NATS) is the designated Air Navigation Service Provider that delivers Air Traffic Services within the London FIR, under CAA regulation.

The Development is located within Low Flying Area 17 (LFA 17), an area within which fixed wing aircraft may operate as low as 250 feet or 76.2m above ground level to conduct low level flight training. The addition of turbines in this location has the potential to introduce a physical obstruction to low flying aircraft operating in the area.

LFA 17 covers parts of Cumbria, eastern North Yorkshire, and northern Lancashire. The Area contains several key military training assets, including the Army Field Training Centres at Catterick and Warcop, as well as QinetiQ range facilities at Eskmeals, located to the west of the Lake District.

The terrain within LFA 17 is of particular value for low-level flying training due to its varied topography and relative absence of major urban development. As a result, the Area is frequently utilised for military flying training activities,

including fast jet operations. Fixed-wing training aircraft, including Tucanos operating from RAF Linton-on-Ouse, routinely use this Area for low-level navigation and training exercises. LFA 17 accounts for approximately 5.71% of the total usable overland area of the UK Low Flying System.

3. Policy and Guidance

3.1 Summary

The most relevant applicable guidance is summarised in Table 2 below.

Table 2: Summary of Applicable Guidance

Receptor	Stakeholder	Applicable Guidance	Date
International Civil Aviation	International Civil Aviation Organization (ICAO)	ICAO Annex 14, Volume I – Aerodromes, Chapter 6: Visual Aids for Denoting Obstacles	July 2018
Civil Aviation	Civil Aviation Authority (CAA)	Air Navigation Order 2016 (as amended) - statutory requirements for lighting of structures hazardous to aviation	Ongoing
Civil Aviation	Civil Aviation Authority (CAA)	CAA Policy Statement: Lighting of Onshore Wind Turbine Generators in the UK with a maximum blade tip height at or in excess of 150 m AGL	1 June 2017
Civil Aviation	Civil Aviation Authority (CAA)	CAP 764 - CAA Policy and Guidelines on Wind Turbines (Seventh Edition – draft)	March 2024
Civil Aviation	Civil Aviation Authority (CAA)	CAP 1096 - Guidance to crane users on aviation lighting and notification	April 2021
Military Aviation	Ministry of Defence (MoD)	RAF Wind Turbine and Tall Structure Lighting Guidance	January 2020

3.2 ICAO Annex 14 Chapter 6 – International Regulations

Relevant extracts from ICAO Annex 14 Chapter 6 are presented below.

"*6.2.4 Wind turbines*

Lighting

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

a) *to identify the perimeter of the wind farm;*

b) *respecting the maximum spacing, in accordance with 6.2.3.15, between the lights along the perimeter, unless a dedicated assessment shows that a greater spacing can be used;*

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

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

6.2.4.4 Recommendation.— 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."

"6.2.3.15 Where lights are applied to display the general definition of an extensive object or a group of closely spaced objects, and

a) *low-intensity lights are used, they shall be spaced at longitudinal intervals not exceeding 45 m; and*

b) *medium-intensity lights are used, they shall be spaced at longitudinal intervals not exceeding 900 m."*

Table 6-1. Characteristics of obstacle lights

1	2	3	4	5	6	7
			Peak intensity (cd) at given Background Luminance (b)			
Light Type	Colour	Signal type/ (flash rate)	Day (Above 500 cd/m^2)	Twilight (50-500 cd/m^2)	Night (Below 50 cd/m^2)	Light Distribution Table
Low-intensity, Type A (fixed obstacle)	Red	Fixed	N/A	N/A	10	Table 6-2
Low-intensity, Type B (fixed obstacle)	Red	Fixed	N/A	N/A	32	Table 6-2
Low-intensity, Type C (mobile obstacle)	Yellow/Blue (a)	Flashing (60-90 fpm)	N/A	40	40	Table 6-2
Low-intensity, Type D (follow-me vehicle)	Yellow	Flashing (60–90 fpm)	N/A	200	200	Table 6-2
Medium-intensity, Type A	White	Flashing (20–60 fpm)	20 000	20 000	2 000	Table 6-3
Medium-intensity, Type B	Red	Flashing (20–60 fpm)	N/A	N/A	2 000	Table 6-3
Medium-intensity, Type C	Red	Fixed	N/A	N/A	2 000	Table 6-3
High-intensity, Type A	White	Flashing (40–60 fpm)	200 000	20 000	2 000	Table 6-3
High-intensity, Type B	White	Flashing (40–60 fpm)	100 000	20 000	2 000	Table 6-3

a) See 6.2.2.6

b) For flashing lights, effective intensity as determined in accordance with the *Aerodrome Design Manual* (Doc 9157), Part 4.

Figure 3. ICAO Characteristics of obstacle lights.

Table 6-2. Light distribution for low-intensity obstacle lights

	Minimum intensity (a)	Maximum intensity (a)	Vertical beam spread (f)	
			Minimum beam spread	Intensity
Type A	10 cd (b)	N/A	10°	5 cd
Type B	32 cd (b)	N/A	10°	16 cd
Type C	40 cd (b)	400 cd	12° (d)	20 cd
Type D	200 cd (c)	400 cd	N/A (e)	N/A

Note.— This table does not include recommended horizontal beam spreads. 6.2.1.3 requires 360° coverage around an obstacle. Therefore, the number of lights needed to meet this requirement will depend on the horizontal beam spreads of each light as well as the shape of the obstacle. Thus, with narrower beam spreads, more lights will be required.

a) 360° horizontal. For flashing lights, the intensity is read into effective intensity, as determined in accordance with the *Aerodrome Design Manual* (Doc 9157), Part 4.
b) Between 2 and 10° vertical. Elevation vertical angles are referenced to the horizontal when the light is levelled.
c) Between 2 and 20° vertical. Elevation vertical angles are referenced to the horizontal when the light is levelled.
d) Peak intensity should be located at approximately 2.5° vertical.
e) Peak intensity should be located at approximately 17° vertical.
f) Beam spread is defined as the angle between the horizontal plane and the directions for which the intensity exceeds that mentioned in the "intensity" column.

Figure 4. ICAO Light distribution for low intensity obstacle lights

Table 6-3. Light distribution for medium- and high-intensity obstacle lights according to benchmark intensities of Table 6-1

Benchmark intensity	Minimum requirements					Recommendations				
	Vertical elevation angle (b)			Vertical beam spread (c)		Vertical elevation angle (b)			Vertical beam spread (c)	
	0°		-1°			0°	-1°	-10°		
	Minimum average intensity (a)	Minimum intensity (a)	Minimum intensity (a)	Minimum beam spread	Intensity (a)	Maximum intensity (a)	Maximum intensity (a)	Maximum intensity (a)	Maximum beam spread	Intensity (a)
200 000	200 000	150 000	75 000	3°	75 000	250 000	112 500	7 500	7°	75 000
100 000	100 000	75 000	37 500	3°	37 500	125 000	56 250	3 750	7°	37 500
20 000	20 000	15 000	7 500	3°	7 500	25 000	11 250	750	N/A	N/A
2 000	2 000	1 500	750	3°	750	2 500	1 125	75	N/A	N/A

Note.— This table does not include recommended horizontal beam spreads. 6.2.1.3 requires 360° coverage around an obstacle. Therefore, the number of lights needed to meet this requirement will depend on the horizontal beam spreads of each light as well as the shape of the obstacle. Thus, with narrower beam spreads, more lights will be required.

a) 360° horizontal. All intensities are expressed in Candela. For flashing lights, the intensity is read into effective intensity, as determined in accordance with the *Aerodrome Design Manual* (Doc 9157), Part 4.
b) Elevation vertical angles are referenced to the horizontal when the light unit is levelled.
c) Beam spread is defined as the angle between the horizontal plane and the directions for which the intensity exceeds that mentioned in the "intensity" column.
Note.— An extended beam spread may be necessary under specific configuration and justified by an aeronautical study.

Figure 5. ICAO Light distribution for medium and high intensity obstacle lights

3.3 CAA Guidance

Relevant extracts from the CAA Safety and Airspace Regulation Group 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*" are presented below.

" 3. Taking into account the Recommendation in ICAO Annex 14 Vol 1 (Seventh edition 2016),this Policy Statement provides guidance as to the application of Article 222 with relation to onshore wind turbine generators with a maximum blade tip height at or above 150m AGL. It should be noted that:

a. Other onshore structures, including meteorological masts, at or above 150m AGL are not covered by this policy statement.

b. Individual wind turbine generators below 150m AGL are not routinely lit for civil aviation purposes; however, it is possible that aviation stakeholders, including the CAA, may make a case for aviation warning lighting where a structure is considered, by virtue of its location and nature, a significant navigational hazard. Further information is available within CAP 764."

Given this, this report has also considered extracts from paragraphs 4.4 to 4.6 from the CAP 764 (Seventh Edition), dated December 2025. Extracts from which are detailed below:

"Obstacle Notification and Charting

Guidance

1.13 Additional consideration of the aviation obstacle environment may be required during the initial build phase and the temporary use of cranes that may extend above a height of 100 metres or in the case of pre-built turbines being towed from shore to final generating position.

1.14 The CAA works closely with NATS Aeronautical Information Services (providing the relevant information to inform the required publication of UK en-route obstacles in the Aeronautical Information Publication) and the MoD Defence Geographic Centre (obstacle data that the CAA receives is shared and vice versa to support low flying).

CAA Recommendation

1.15 The CAA recommends that aviation obstacles are reported to the CAA even if they are below 100m. This information will be held in the UK obstacle database and used to support civilian and defence low flying planning. Reporting of all aviation obstacles including meteorological and anemometer masts, cranes and wind turbines contributes to ongoing air safety initiatives for the protection of property, infrastructure and aviators."

"Military impact

2.83 Wind turbine developments can have a detrimental effect on military operations. Military aviation operations predominantly take place in Class G airspace and can differ markedly from civil operations, particularly with respect to operational low flying, and the sensitivity of military CNS facilities. The DIO are to be consulted in all cases where a proposed wind turbine development may affect military operations.

2.84 Low flying is a vital element of military operations in areas of conflict, and a large proportion of the flying will be undertaken at night. Low flying training across the UK can take place as low as 100 ft for fast jet aircraft in Tactical Training Areas, and 250 ft in Low Flying Areas. Helicopters fly tactically down to 50 ft and routinely down to100 ft during training sorties in all areas."

"Onshore Obstacle Lighting

4.4 Obstacle lighting of structures located close to licensed aerodromes are covered under Section 47 of the Civil Aviation Act 1982. Government aerodromes are similarly covered. Article 222 of the ANO (2016) as amended details the requirement for the lighting of land-based tall structures located outside of the safeguarded areas of licensed and

government aerodromes. Such lighting must be displayed at night and be visible from all directions. Night is defined in the ANO (2016) as amended in Schedule 1 (Interpretation) as the time 30 minutes after sunset until 30 minutes before sunrise (both times inclusive), sunset and sunrise being determined at surface level.

4.6 In accordance with Article 222(6) of the ANO (2016) as amended and considering ICAO Annex 14 Volume 1 Chapter 6, the CAA has determined the following specific lighting requirements apply to wind turbines:

- *a) The requirement to fit lights is based on the maximum height from the ground to the tip of the blades, but the requirement for the positioning of lights is based on the fixed structure (nacelle and tower).*
- *b) One medium intensity (2000 candela) red light must be placed on the nacelle of the turbine; a second 2000 candela red light serving as an alternate should be provided in case of failure of the operating light.*
- *c) At least three (to provide 360 degree coverage) low-intensity Type B lights (32 candela) lights must be provided at an intermediate level of half the nacelle height ± 10 m.*
- *d) The lights required by sub-paragraphs 5.6(b) and 5.6(c) above must be so fitted to show when displayed in all directions without interruption.*
- *e) For a group of two or more wind turbines, obstacle lighting must be fitted and operated when required to identify the corners and perimeter of the wind farm.*
- *f) Additionally, if the height of other turbine nacelle(s) in the wind farm exceed the height of a plane extending at an elevation of 10 degrees above the horizontal from the nacelle of a turbine that is required to be lit, then obstacle lighting must be fitted and operated in accordance with sub-paragraphs 5.6(b) and 5.6(c) on these wind turbines.*
- *g) Any wind turbine that is located at a distance greater than 1800 m from the nearest lit turbine must also be lit.*
- *h) Obstacle lighting may be omitted on individual turbines that are on the perimeter of the wind farm if it can be demonstrated that:*
    - *i. the maximum distance between lit turbines does not exceed 900 metres;*
    - *ii. the corners of the wind farm are lit; and*
    - *iii. any significant change of direction of the perimeter of the wind farm can be recognised.*
- *i) Lights may be operated by a suitable control device (e.g., photocell, timer, etc.). In the event that a photocell is used, in lieu of the 30 minutes after sunset until 30 minutes before sunrise requirement, the CAA will accept a solution that turns the lights on whenever illuminance reaching a vertical surface falls below 500 LUX. The control device should turn the lights off when the illuminance rises to a level of 500 LUX or more.*
- *j) If visibility in all directions from every wind turbine generator in a group is more than 5 km, the light intensity for any visible light required by Article 222 of the ANO (2016) as amended to be fitted to any generator in the windfarm and displayed may be reduced to not less than 10% of the minimum peak intensity specified for a light of this type.*
- *k) For turbines that are more than 315 m AGL in overall height, the above requirements apply and, the developer must consider whether additional marking and lighting may be required. This typically would be expected to include a consultation with aircraft operators, or their representative organisation(s), who might be reasonably expected to operate in the vicinity of the turbines.*
- *l) Developers may apply to the CAA for other specific obstacle lighting designs/layouts. Any lighting scheme that reduces the overall lighting provision requires additional justification for such a layout, consideration of the airspace and types of operation in that airspace at night as well as possible additional mitigation measures issues."*

During the construction of the wind turbine, it is anticipated that a crane will be used to lift the turbine components into place. The crane lighting will comply with CAA guidance in CAP 1096 noted below:

*"2. **EN-ROUTE***

Height of Crane: 150 metres AGL or more

En-route obstacles (including cranes) must be fitted with lighting in accordance with the ANO. Medium intensity (generically 2000 candela) steady red lights must be displayed by night2 and be visible from all directions (omnidirectional).

Additionally, it is recommended that lights should also be displayed by day.

Note: Lighting aids should be supplied with secondary power unless agreed otherwise with the CAA.

*3. **OTHER***

Height of Crane: Less than 150 m AGL.

It is recommended that:

a. all cranes with a height 45 m to a height less than 150 m AGL are lit in accordance with the details specified in Paragraph II above;

b. all cranes with a height less than 45 m are lit in accordance with the details specified in Paragraph II above except that low intensity (generically 32 candela) steady red lights should be used.

In all cases (all 3 categories above), lights must be positioned as close as possible to the top of the crane.

Where the top of the crane is more than 45 m AGL, additional lights should be provided at intermediate levels spaced as equally as practicable, between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 52 m.

Lights should also be applied to display the general definition and the extent of the object (crane). This means that lights should provide an indication of the height and the shape of the crane (i.e. lights installed on both ends of the jib)."

3.4 MoD Obstruction Lighting Guidance

The relevant extracts from the RAF 2020 MoD Obstruction Lighting Guidance are inserted below:

*"**Introduction***

1. The proliferation of wind turbines across the UK has caused the MoD concern with regard to military low and night flying training, which is conducted at heights where wind turbines present a significant hazard. Whilst acknowledging that there is no statutory requirement, MoD considers that there is an absolute requirement for the lighting of such large vertical obstructions to enhance the probability of the obstruction being acquired visually by the crew, and therefore mitigating the unacceptable risk of controlled flight into terrain.

2. MoD will request some form of lighting in all but exceptional circumstances."

*"**Onshore Lighting***

4. MoD's standard aviation obstacle lighting standards are set for aerodromes and their environs at 200cd steady red lights (for obstacles <45m) and 2000cd steady red lights (for obstacles >45m and <150m). Understandably, with the proliferation of wind turbines, lighting pollution is an issue and so MoD has addressed this public concern for onshore developments by revising the aerodrome standard to suit the en-route requirement by requesting the use of Infra-red lighting when possible.

a) ***Infra-Red (IR) Lighting**. MoD is cognisant that the majority of military night low flying is now conducted with the aid of aircrew night vision goggles (NVGs). Previously the MoD Low Flying Ops Sqn, together with QinetiQ*

and the RAF Centre for Aviation Medicine, undertook a series of trials to determine the suitability of NVG-compatible IR obstruction lights which are invisible to the naked eye. The trials were successful, and the specification required is detailed in Appendix 1 to this Annex. When requesting lighting on turbines, MoD will specify IR lighting as an option wherever possible in the interests of public amenity."

APPENDIX 1

IR LIGHTING SPECIFICATION REQUIREMENTS

1. **Onshore Lighting Specification**

	25cd Red	200cd Red	25cd or 200cd/IR Combi	IR
				7-8nm pickup range
IR wavelength			As per IR specification	**750-900nm** ideally concentrated 800- 850nm for optimum detection.
Intensity	Equal or better than 25cd.	Equal or better than 200cd.	As per visible and IR specifications.	**600mW/sr min at peak flash** **1200W/sr max** Typically a 300mW/sr steady burn LED IR light will generate 600mW/sr at peak flash.
Horizontal Pattern	**360° unrestricted**			
Vertical Pattern	25cd minimum intensity between +15 deg and level (0 deg).	200cd minimum intensity between +15 deg and level (0 deg).	As per visible and IR specifications.	600 mW/sr Min flash intensity between +30 deg and -15 deg elevation. Up to 50% reduction between +25 to +30 deg and -10 to -15 deg is acceptable.
Overspill	Upwards overspill is acceptable. Downwards overspill is to be minimised such that the red light intensity is no more than 10% of the intensity at 0 deg.			Vertical overspill is acceptable.
Flash Pattern	60 flashes per min at 100-500ms duration (ideally 250ms).			
Synchronisation	All lights to be visually synchronised across a windfarm site.			

Figure 6. IR Lighting Specification Requirements

APPENDIX 3

LIGHTING LAYOUTS

Location	Individual (1-2 turbines)	Small Sites (3-10 turbines)	Medium Sites (11-15 turbines)	Large Sites (15+ turbines)
Standard Request	25cd **or** IR on individual turbines	25cd **or** IR on perimeter turbines	25cd **or** IR on perimeter turbines	25cd or IR **COMBI** on perimeter turbines
Vicinity of RW fg trg (see note 4)	200cd **VISIBLE** on individual turbines	200cd **VISIBLE** on perimeter turbines	200cd **VISIBLE** on perimeter turbines	200cd **VISIBLE** on perimeter turbines
Flow choke area	25cd/IR **COMBI** on lead turbine. Other lighting std.	25cd/IR **COMBI** on lead turbine. Other lighting std.	25cd/IR **COMBI** on lead turbine. Other lighting std.	25cd/IR **COMBI** on lead turbine. Other lighting std.
Offshore	200cd/IR **COMBI** on individual turbines.	200cd/IR **COMBI** on perimeter turbines		
Dark Skies Parks	25cd **or** IR on individual turbines	25cd **or** IR on perimeter turbines	25cd **or** IR on perimeter turbines	25cd **or** IR on perimeter turbines

Notes:

1. Where perimeter turbines are located close together, alternate turbines only may be lit, provided the distance between lit turbines does not misrepresent the layout, eg a large gap that might indicate a space between 2 different developments. As a guideline this gap should be no more than 500m.
2. The lead turbine is the first turbine to be encountered in the flow choke point. Traffic flow may be one way or 2 ways and this will determine which turbines should be lit.
3. For offshore turbines, MOD requirement is far exceeded by CAA and Trinity House requirements. Developers should ensure that the selected lighting meets all stakeholder requirements.
4. Visible lighting will be requested around Shawbury in all cases to support use of field landing sites (down to surface) and general LF (down to 150' agl).

Figure 7. Lighting Layouts

4. Lighting Reduction Options

4.1 Overview

This section provides an overview of potential mitigation options available to reduce the visual impact of aviation lighting. Multiple solutions may be used in combination to inform the overall mitigation strategy. Certain aviation lighting measures commonly considered for larger developments have been excluded, as they are not proportionate to the nature and scale of this development.

4.2 Light Designed to Minimise Light 'Spill'

4.2.1 Justification

Nacelle aviation warning lights are designed to be visible to aircraft operating at the level of the nacelle and above. In order to minimise unnecessary light spill towards the ground while maintaining full compliance with aviation safety

requirements, the selected lighting units will incorporate optical control to significantly restrict downward light radiation.

According to ICAO guidelines, as detailed in Section 3.2, for medium and high intensity obstacle lights (Table 6-3 shown in Figure 5 on page 11), the 2000 cd benchmark intensity has specific requirements for visibility and beam spread. For this benchmark, the minimum intensity of 1500 cd at the specified angles ensures compliance. This mitigation is achieved through narrow vertical beam spreads of 3°, typically ranging from -1° to +2°.

Achieving precise intensity reductions at different angles of elevation may require careful choice of light fittings and dimming technology.

The ICAO guidance also emphasises the need for 360° horizontal visibility around obstacles, which can be achieved by placing light fixtures to ensure no part of the structure, such as turbine hubs, obstructs visibility from approaching aircraft. Vertical directional intensity mitigation can be an effective way to reduce light impact on receptors, especially at lower elevations, ensuring that the lighting is sufficiently visible to pilots at vertical angles without excessive light spill above or below the specified angles.

4.2.2 Implementation

In this instance, no visible aviation warning lighting will be installed as part of the development.

Having reviewed the available mitigation options and taking account of the scale of the development, the 77m tip height, and the turbine's location within an MoD Low Flying Zone, it is considered that the use of infra-red (IR) aviation lighting only represents the most appropriate and proportionate solution.

4.3 Reduced Light Intensity in Good Visibility

4.3.1 Justification

As detailed in Section 3.3 of this report, paragraph 4g of the UK CAA Policy Statement means that wind farms can be fitted with a visibility sensor that reduces the intensity of the nacelle lights significantly when the visibility meets the specified criteria (greater than 5km). Effectively this allows Medium Intensity Lights (2000 Candela) to be reduced to Low Intensity Lights (200 Candela) during good visibility:

"If the horizontal meteorological visibility in all directions from every wind turbine generator in a group is more than 5 km, the intensity for the light positioned as close as practicable to the top of the fixed structure required to be fitted to any generator in the windfarm and displayed may be reduced to not less than 10% of the minimum peak intensity specified for a light of this type."

4.3.2 Implementation

No visible aviation lighting will be installed as part of this scheme, and therefore no visibility-linked dimming or intensity reduction system is required.

4.4 Infra-Red Lighting

4.4.1 Justification

IR light is invisible to the naked eye but can be detected using equipment like night-vision goggles, which are commonly used by military pilots during night time training flights. As outlined in Section 3.4, the MoD states that:

"a) Infra-Red (IR) Lighting. MoD is cognisant that the majority of military night low flying is now conducted with the aid of aircrew night vision goggles (NVGs). Previously the MoD Low Flying Ops Sqn, together with QinetiQ and the RAF Centre for Aviation Medicine, undertook a series of trials to determine the suitability of NVG-compatible IR obstruction lights which are invisible to the naked eye. The trials were successful, and the specification required is

detailed in Appendix 1 to this Annex. When requesting lighting on turbines, MoD will specify IR lighting as an option wherever possible in the interests of public amenity."

The MoD Obstruction Lighting Guidance (2020) confirms that IR aviation lighting may be used on individual wind turbines. Figure 5 in Section 3.4 of this report, sets out the technical specification requirements applicable to such IR obstruction lighting.

4.4.2 Implementation

In accordance with MoD guidance and the assessment of site constraints, it is proposed that the turbine will be fitted with a single MoD-compatible IR obstruction light installed at the highest practicable point on the nacelle.

This approach ensures that the turbine is appropriately marked for low-flying military aircraft while maintaining the least intrusive solution for public amenity and the surrounding environment.

5. Recommended Lighting Scheme

5.1 Lighting Plan

Following a review of the available mitigation measures and having regard to the size and scale of the development, it is considered that an IR aviation lighting solution represents the most appropriate option for this scheme.

It is proposed that the turbine will be fitted with a 24 VDC MoD-compatible IR obstruction light, specifically the CEL-IR850-24-CST LED Aircraft Warning Light, installed at the highest practicable point on the nacelle.

No visible red aviation lighting will operate, unless such lighting is explicitly required by the CAA and/or the MoD.

The full manufacturer's specification data sheet is included in Appendix C of this report. A summary of the principal technical parameters is provided in Table 3 below.

Table 3. CEL-IR850-24-CST - LED Aircraft Warning Light Specification

Receptor	Stakeholder
Typical intensity	300mW/sr, Peak 600mW/sr
Colour	Infra-red 850nm
Horizontal radiation pattern	360°
Vertical radiation pattern	-15° , +30°

5.2 Lighting Position

One IR obstruction light will be installed at the highest practicable point on the nacelle and will provide 360-degree horizontal coverage.

The installation will ensure unobstructed emission of IR light above the rotor plane. Given the overall height of 77m, no blade-tip lighting is proposed, and no intermediate tower lighting will be installed.

5.3 Operating Regime

The IR aviation light will operate automatically from sunset to sunrise by means of a photocell or time-switch, and will operate continuously throughout the hours of darkness.

It is proposed that the IR light will operate with a flash pattern of 60 flashes per minute, each flash having a duration of 250 milliseconds, in accordance with the MoD specification requirements for IR obstruction lighting.

5.4 Monitoring and Maintenance

The IR lighting system will be fitted with a remote monitoring and fault detection system capable of identifying lamp failure, power loss, or system malfunction. Automatic alerts will be generated in the event of a fault.

Any lighting fault will be investigated within 24 hours of detection, and repairs will be undertaken as soon as reasonably practicable thereafter.

A maintenance and inspection log will be maintained and made available to the LPA and/or the MoD upon request.

5.5 Construction

During construction of the wind turbine, a crane will be required to lift the turbine components into position. It is anticipated that the maximum height of the crane will exceed 45m AGL but will remain below 150m AGL. Any cranes used during construction will be compliant with the Civil Aviation Authority (CAA) guidance contained in CAP 1096, as outlined in Section 3.3.

APPENDIX A: WIND TURBINE DATA

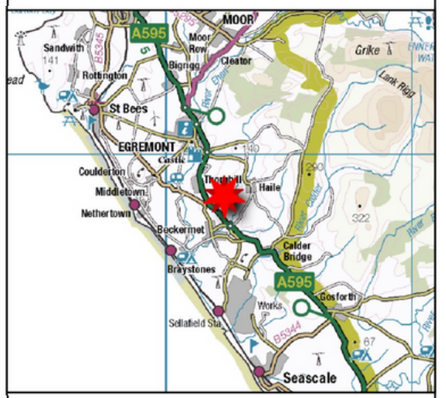
Easting	Northing	Elevation (m ASL)
302357	508321	92.58

APPENDIX B: FIGURES

Locogen Ltd, 4 West Silvermills Lane, Edinburgh, EH3 5BD
Tel: +44 (0) 131 555 4745; Email: info@locogen.com
Company Number: SC370060; VAT Number: 983383677

Legend

- Turbine Location
- Site Boundary



0 0.06 0.12 0.18 0.24 km

N

A3 Horizontal Scale 1:5,000

CRS: British National Grid (EPSG:27700)

Produced:	DW
Reviewed:	DW
Approved:	DW

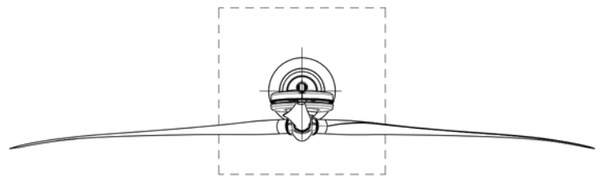
Date: 22/01/26	Revision: 4.0

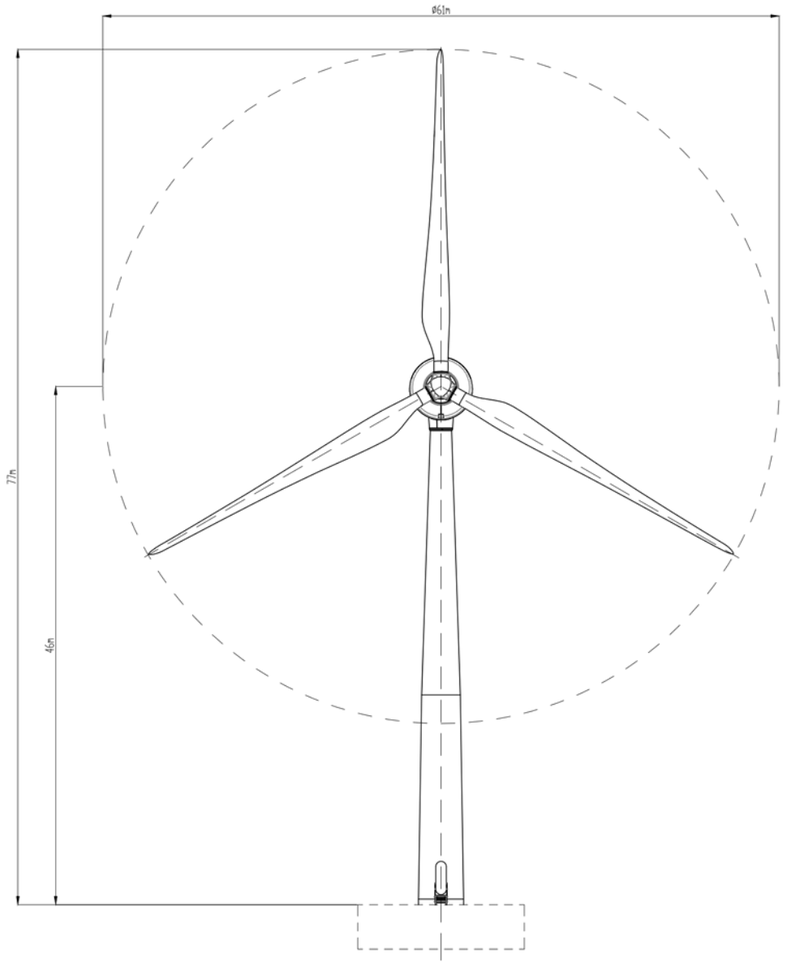
8382-DRW-PLN-0001-Location plan-v4.0

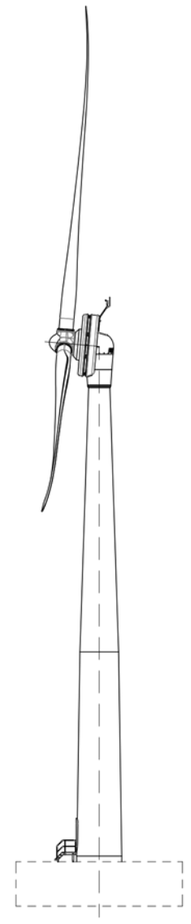
Figure 1

Locogen Ltd

Component	Material	External Colour
Tower	Tubular steel	Light Grey RAL 7035
Nacelle	Steel	Light Grey RAL 7035
Blades	Glass reinforced epoxy	Light Grey RAL 7035







1:500

0 10m 20m 30m 40m 50m

N

NO DIMENSION TO BE SCALED
ALL SIZES TO BE SITE VERIFIED
THIS DRAWING IS COPYRIGHT
IF IN DOUBT, ASK

LOCO2GEN

NOTES
V3.0

LOCOGEN LTD
RENEWABLE ENERGY DEVELOPERS
4 W SILVERMILLS LANE EDINBURGH, EH3 5BD TELEPHONE 0131 5554745

PROJECT
FIGURE 2
LAND WEST OF ENERGY COAST BUINESS PARK REPOWERING

DRAWING TITLE
TURBINE ELEVATION
EWT DW61 – HH 46

SCALE	1:500 @ A3	APPROVED BY	AT
DATE	22/01/2026	DRAWN BY	EB
DRAWING NO.	DES-0002		

APPENDIX C: 24VDC MOD COMPATIBLE IR (INFRA-RED) OBSTRUCTION LIGHT CEL-IR850-24-CST - LED AIRCRAFT WARNING LIGHT DATA SHEET

AVIATION LIGHTING

DATASHEET

29 Mar 2016

24V$_{DC}$ MOD compatible IR (Infrared) Obstruction Light

CEL-IR850-24-CST - LED Aircraft Warning Light

Application
Night vision goggles compatible 850nm infrared obstruction light for wind turbines and other vertical structures that cause aviation safeguarding concerns

Key features
- Based on LED technology
- Extremely reliable
- Very long life time
- Low power consumption
- 24V$_{DC}$ operating voltage
- Stabilised light output
- Easy to install
- Mounting set and terminal box included

Benefits
- Long maintenance intervals
- Low energy costs
- Input power voltage variations do not affect to light output
- Very low lifetime costs

Specification met
MOD Obstruction Lighting Guidance, Low Flying Operations Sqn (MOD CAS-AS LFOS) - 21 Nov 2014

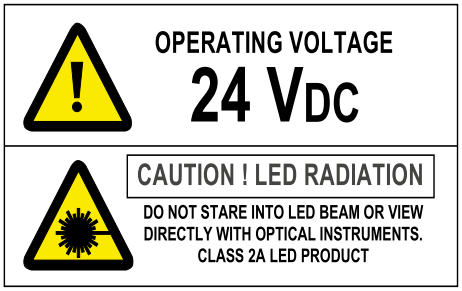
Radiometric characteristics IR
-Typical intensity 300mW/sr, Peak 600mW/sr
- Colour Infrared 850nm
- Horizontal radiation pattern 360°
- Vertical radiation pattern -15° ... +30°
- Current for the LEDs is stabilised by constant current generator
- Expected lifetime without light output falling 25% >100,000hrs

Electrical characteristics
- LEDs are in several separate groups
- Nominal operating voltage 24V$_{DC}$
- Operating voltage range 22 ... 28V$_{DC}$
- Power consumption 15W (<0.6A constant current)
- Average power consumption with 60fpm, 250ms flashing mode <3.8W

Mechanical characteristics
- Black anodised aluminium light unit body
- Galvanised mounting arm
- Acid proof U-bolts and hex nuts
- Uncoloured glass cover
- Degree of protection IP65
- Operating temperature range -55 ... +55°C
- Height 170mm, diameter 140mm
- Total weight with mounting set 3.2kg
- 5 year warranty

Order Code: CEL-IR850-24-CST

Options
- CSW-24-16-GPS, flash controller and fault monitoring unit with GPS-synchronisation



Made in EU

T: +44 (0)20 8540 1034
F: +44 (0)20 8543 3058
E: info@contarnex.com

Contarnex Europe Limited
252 Martin Way,
Morden, Surrey SM4 4AW
United Kingdom

www.contarnex.com

24V$_{DC}$ MOD compatible IR (Infrared) Obstruction Light

CEL-IR850-24-CST - LED Aircraft Warning Light

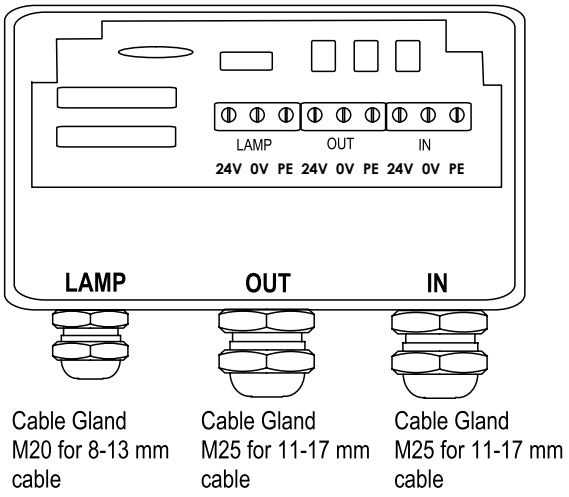
CEL LED obstacle lights cabling and installation principles are similar to those of conventional obstacle lights, the only exception being the correct polarity required by DC feed.

Terminal box include screw terminals and overvoltage protectors.

All connection alternatives can be protected with a 6A or 10A fuse or with a circuit breaker (C curve).

Installation specifications
- Cable gland for lamp: M20, 8-13mm cable
- Cable gland for IN and OUT: M25, 11-17mm cable
- Wire diameter: max. 6mm2
- Recommended cable: 3 x 1.5 or 3 x 2.5mm2

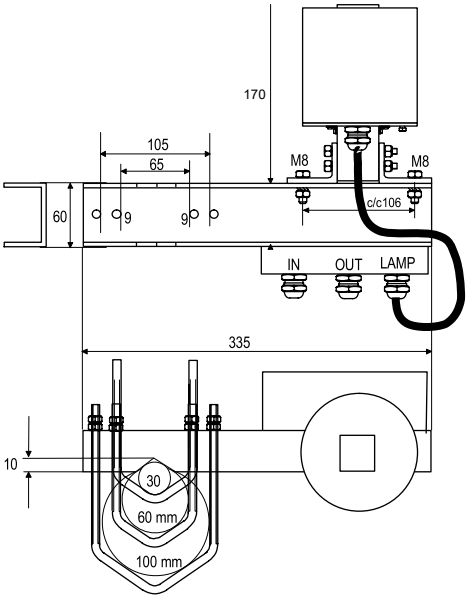
The polarity is:
Blue -
Black +
Yellow-Green PE



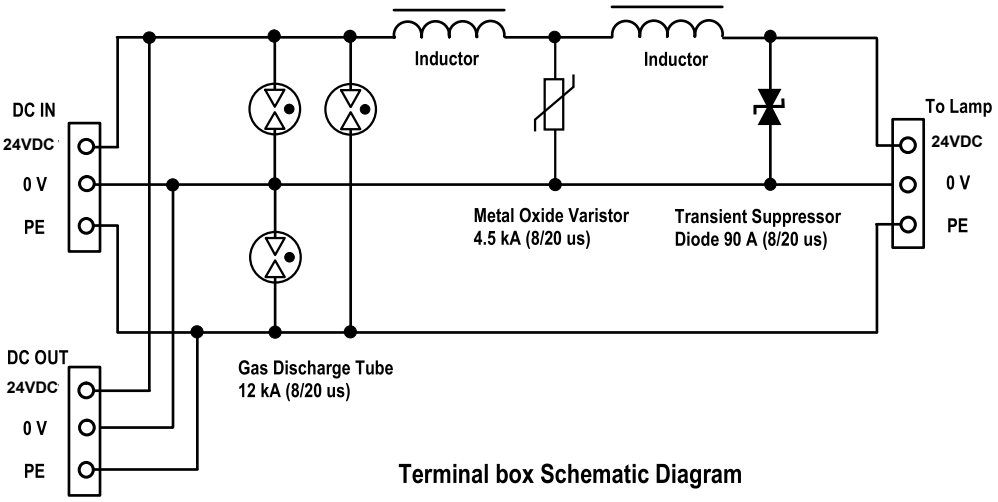
Cable Gland M20 for 8-13 mm cable

Cable Gland M25 for 11-17 mm cable

Cable Gland M25 for 11-17 mm cable



Light unit with mounting set



Terminal box Schematic Diagram

T: +44 (0)20 8540 1034 F: +44 (0)20 8543 3058 E: info@contarnex.com **www. contarnex.com**
Contarnex Europe Limited. 252 Martin Way, Morden, Surrey SM4 4AW United Kingdom

CEL AVIATION LIGHTING

Contact

Locogen Consulting Ltd.

0131 555 4745
hello@locogen.com
locogen.com

4 West Silvermills Lane
Edinburgh
EH3 5BD