

Aircraft Warning Light (AWL) Systems for Telecomms Structures

Design Standard (Technical Specification)

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CONTACT

Western Power welcomes your comments, questions, and feedback on this document, which can be emailed to standards.excellence@westernpower.com.au

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Revision Details

Version	Date	Summary of change	Section
1.0	23/11/2020	Original draft	
2.0	26/04/2023	Multiple updates, updated document format	1-6
3.0	1/10/2024	Multiple updates, updated with new AWL equipment	

1. Introduction

There are 88 CASA Certified Aerodromes, and over 400 regional airports and airstrips in Western Australia. Telecommunications structures may pose a safety risk to air traffic if early warning to pilots is not provided.

1.1 Purpose and scope

This document is intended to enable Western Power to comply with the regulations regarding Low and Medium Intensity Obstacle Lighting as defined in CASA Manual of Standards Part 139 2019, Chapter 9, Division 4 Obstacle Lighting.

High intensity lights are not covered by this Standard as these apply to structures above 150m which are not currently utilised by Western Power. Furthermore, obstacle markings such as painting requirements may be required to be implemented by CASA and are not covered by this Design Standard.

The CASA Manual of Standards 139 Chapter 8 was referred to during the compilation of this document, but Obstacle Marking is not covered by this standard.

This standard is intended to be used for Communications Structures and as such relates only to masts, towers and poles and not to buildings nor transmission line structures.

The document is based on current regulations and standards which may change with time. This document should be reviewed periodically and updated accordingly.

1.2 Acronyms

Acronym	Definition
AGL	Above Ground Level
AWL	Aircraft Warning Light
CASA	Civil Aviation Safety Authority
CSP	Communications Service Procedure document
DC	Direct Current
EDM	Western Power's Electronic Document Management system
LGA	Local Government Authority
NC	Normally Closed
NMC	Western Power's Telecommunications Network Management Centre
OLS	Obstacle Limitation Surfaces (as defined in CASA Manual of Standards)
PE	Photo-electric
SEQT	Western Power's Safety, Environment, Quality and Training function
SMS	Short Message Service
SWA	Steel Wire Armoured
UV	Ultra-Violet

1.3 References

References which support implementation of this document

	Title
	CASA Manual of Standards – Part 139 – August 2020
	EXAMPLE – CASA Operational Assessment – Form 406
	COM Review Minutes – AWL Standard
	Earthing Design – Transmission Substations
	Communications Service Procedure (CSP) – Obelux Aircraft Warning Light System
	Manual – Telecommunications Construction – Installation Practices
	Manual – Antenna and Feeders Construction – Telecommunications Design

1.4 Requirement for AWL System Installation

The requirement for the installation of Obstacle Lights on a structure will be determined by:

- CASA – For all new structures, a formal assessment by CASA shall be conducted by submission of CASA Form 406 – Operational Assessment of Existing or Proposed Structure. CASA shall decide on any AWL requirements. An example form is available; however, all new assessments should be undertaken using the latest form downloaded from CASA’s website.
- Local Government Authority – For all new structures, a submission should also be made to the relevant LGA requesting an assessment of the structure for any AWL requirements. Many local and unregistered airstrips and small regional airports exist that are not CASA certified Aerodromes. It is important that conditions imposed by the LGA do not conflict with the CASA determination.
- If determined by SEQT assessments during planning phase, the Department of Planning, Lands and Heritage may also need to be consulted.
- If a structure to be installed that is above 100m (not necessarily near an aerodrome) Western Power is required to notify CASA directly and CASA will make a recommendation on the requirement for Obstacle Lighting.
- Western Power may also decide to install an AWL system if deemed appropriate to do so by internal stakeholders and in consultation with relevant third parties

1.5 Materials

The following materials have been approved for use in the Western Power AWL systems.

Table 1-1 Approved Materials for use in WP AWL Systems

Item	Part Number	Manufacturer	Supplier
Low Intensity Light with built-in PE Cells (includes MS-HV80 vertical bracket)	LI-DC-100-AM	Obelux	ICS Industries
Medium Intensity Light with built-in PE Cells (includes MS-MI-V01 vertical bracket)	MI-ICAO-DC2448-2KR- IR-M	Obelux	ICS Industries
AWL System Controller	CP-DC-M1-P	Obelux	ICS Industries
Mounting Bracket - Low Intensity Light (Optional)	MS-HV80	Obelux	ICS Industries
Mounting Bracket - Medium Intensity (Optional)	MS-MI-V01	Obelux	ICS Industries

2. CASA Obstacle Lighting Requirements

2.1 Obstacle Lighting

There are three types of Obstacle Lighting that CASA may require Western Power to install on a structure: Low Intensity, Medium Intensity and High Intensity.

- Low Intensity – Steady Red Lights generally for structures below 45m
- Medium Intensity – Steady Red Light, Flashing Red Light or Flashing White Light generally for structures above 45m or where CASA determines early warning to pilots is desirable, and
- High Intensity - Flashing White Lights, generally for structures above 150m

The types, characteristics and use cases for each type are detailed in the CASA Manual of Standards Part 139, Chapter 9, division 4. Key features of each type are summarised in **Table 2-1** below:

Table 2-1 Lighting Type Information Summary

Type	Flash rate (flashes p/min)	Colour	Luminous Intensity	Typical uses
Low Intensity	Steady	Red	< 100 cd	<ul style="list-style-type: none"> • Top marker on structure < 45m • Side marker on structure > 45m & < 150m
Medium Intensity	Steady	Red	2,000 cd (± 25%)	<ul style="list-style-type: none"> • Top marker on structure > 45m • Side marker on structure > 150m
	20 - 60	Red		
	20 - 60	White		

High Intensity	40 - 60	White	2000 - 200,000 (± 25%)	• Top marker on structure > 150m
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The requirements for each of the types are detailed in CASA Manual of Standards Part 139 Sections 9.30, 9.32, 9.33 and 9.34.

As the likelihood of Western Power constructing a structure taller than 150m is very low, high intensity systems are not covered by this Standard.

2.2 Light Characteristics

The CASA standard allows medium intensity lights to be either flashing red, flashing white or steady red. To increase the operational lifespan and reduce power consumption in the event of battery backup operation, a flash rate of 30 flashes per minute shall be adopted.

Refer to CASA Manual of Standards Part 139, Chapter 9, Division 4, Sections 9.32, 9.33 respectively for more detail on vertical distribution, visibility and flashing rates, if required.

2.3 Location on Structure

Location requirements are detailed in CASA Manual of Standards Part 139, Chapter 9, Division 4, Section 9.31. These vary based on structure height and lighting type. **Figure 1** shows the typical location requirements for structures relevant to Western Power.

The required top obstacle light is to be placed as close as possible, to the top of the structure and must be visible 360° around the structure. If an antenna or other shielding protrudes above the top of the structure, additional lights may be required such that a light is visible from all angles. In this case, the top lights should be located, as close as possible to, and between 1.5 and 3m from the top of the structure

Refer to Standard Drawing C51/74/1 for recommend positions on the various type and height of structures used by Western Power.

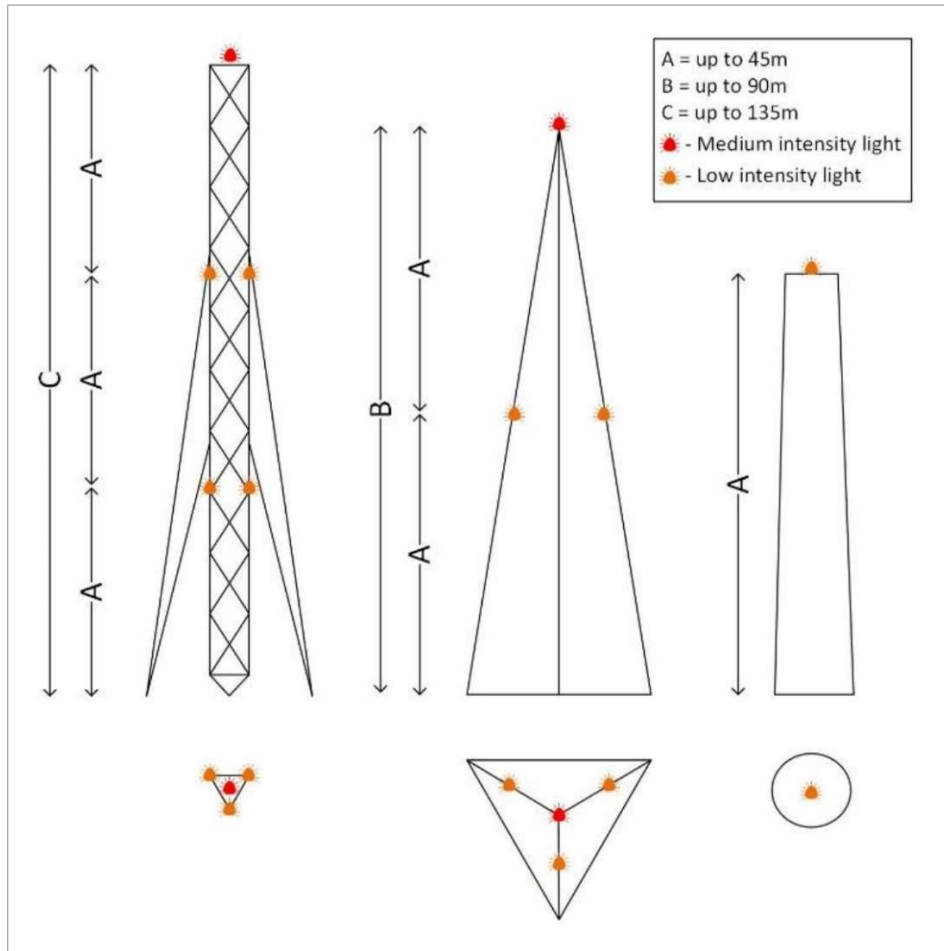


Figure 1 Typical locations of low and medium intensity lights on Western Power Comms Structures

2.4 Top Obstacle Light(s)

For structures 45m or below, typically monopole type structures at Western Power, a single, low intensity light (with built-in PE Cells) should be placed at the top of the structure, providing 360-degree visibility.

In the event that a single light at the top of the structure is obscured from any angle, multiple lights shall instead be installed, as close as possible to and between 1.5m and 3m from the highest point of any protruding antenna or object (including lighting finials).

2.5 Side/Marker Obstacle Lights

If the height of the structure exceeds 45m, or where CASA determines early warning to pilots is desirable, then a Medium Intensity Light shall be mounted on the top of the structure. Additional Low Intensity Lights shall be installed to indicate the full height of the structure.

These additional lights are to be spaced as equally as possible with vertical spacing not exceeding 45m. These side/marker lights are required to be visible 360 degrees around the structure and therefore will require multiple lights at each level, dependent on the structure. Mounting the lights on the corners of a guyed mast or tower, is preferred.

2.6 Availability of Obstacle Lights

It is important that Obstacle Lights are in working condition and the structure owner needs to establish a proactive maintenance procedure to minimise light outage.

For Western Power structures located within the obstacle limitation surfaces of an aerodrome there are stringent requirements for observation, alarming and notification. Refer to CASA Manual of Standards 139 Section 9.36.

If the structure is deemed by CASA to be within the obstacle limitation surface of an aerodrome, the following maintenance and notifications are required by the structure owner:

- Establish a program to monitor the lights that includes:
 - For aerodromes with scheduled International air transport operations during the hours of night, observation at least once every 24 hours, or
- For aerodromes with scheduled Domestic air transport operations during the hours of night, observation at least once every 48 hours, or
 - For aerodromes other than the ones mentioned above, observation at least once every 7 days, or
 - For medium intensity lights that are not readily observable, monitored alarm indicating failure of the lighting
- Establish a procedure to notify CASA and the relevant airport authority upon failure of the lighting.

If the structure is outside the obstacle limitation surfaces of an aerodrome, the following maintenance and notifications are required:

- Establish a program to monitor the lights

3. Local Government Requirements

3.1 Obstacle Lighting

Local Government Authorities may determine that obstacle lighting for Telecommunications Structures is required irrespective of CASA's determination. An application should be made to the relevant LGA for assessment of new structures.

Should it be determined that obstacle lighting is required, the direction of the LGA should be followed with respect to specific configuration and monitoring requirements at a minimum. If the standard configurations shown in **Figure 1** are determined to exceed the requirements of the LGA, then the standard should be applied instead.

4. Western Power Implementation

4.1 Visibility of Lighting

The CASA standard defines the approximate location of the lighting and requires the lights to be visible for 360 degrees around the structure. CASA does not define the number of lights required at each level and therefore number of lights provided at each level is based on Western Power policy and obstructions generated by the structure and antenna.

The quantity of side or marker lights per level will be defined by the shape of the structure and the local obstructions and should be determined on a site-by-site basis.

4.2 Lights at Top of Structure

Where possible, Obstacle Lights should be placed at the top of the structure above the antenna and extended above the structure itself.

At many Western Power sites, the lip of the top dish/dishes or mobile radio antenna are above the top of the structure. To ensure visibility, lights should be extended on poles to a height above these obstructions but still below the protection zone of the lightning finial.

The CASA standard allows for mounting the lights 3 metres below the top of the structure and therefore if impracticable to extend the lights on poles, it should be considered if a distance less than three metres would provide a practical solution. However, if below the top where the light is obstructed by antenna or the structure itself, additional lights are required to be installed to ensure 360 degree visibility.

Support poles for side mount arrays nor lightning finials do not provide a significant obstruction to be considered. Typical top light positioning arrangements are shown in **Figure 2**.

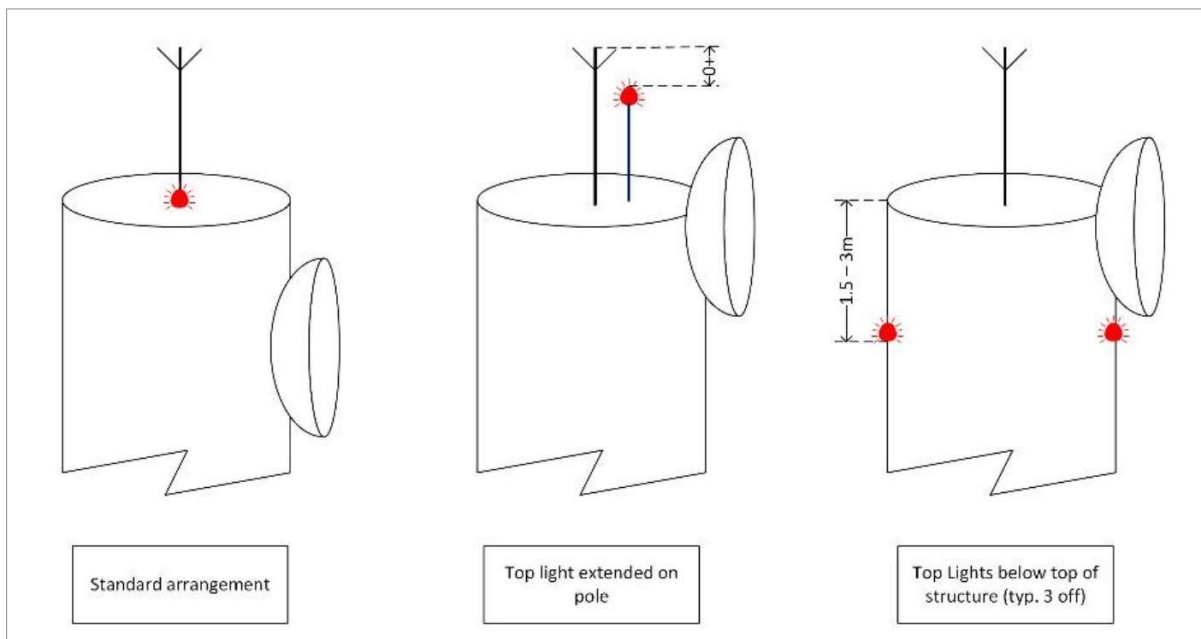


Figure 2 Positioning arrangements for structure top light

4.3 Side / Marker Lights

For structures requiring side or marker lighting at levels below the top of the structure (height > 45m), typically a group of three low intensity lights will be deployed, connected to a single DC feed via a suitable joint box.

These lights shall be placed at the same height on the structure, one on each leg to indicate the full extent of the structure.

4.4 Control Box Location

The control box shall be located inside the equipment shelter for protection from the elements and vandalism. The location is dependent on the building that it is to be installed in and while there are not specific requirements for its mounting, a location near the cable access points and in proximity to the Rectifier is preferred to minimise cable voltage drop.

4.5 PE Cell

All Aircraft Warning Lights (AWL) shall have built-in Photoelectric (PE) cell which would eliminate the requirement of separate external PE cell for the AWL system. If CASA or the relevant LGA does not provide any requirement for the lights to be permanently on, the system shall be operated in PE Cell mode which restricts the system operation to the hours of darkness and of poor visibility.

Under certain conditions CASA may dictate that the Obstacle Lighting operates at all times. In this case the system will not operate in PE cell mode but will be set to “always on”.

4.5.1 PE Cell Location

Western power shall use built-in Low and Medium intensity Air Warning Lights for the AWL system. So, shall not require any external PE cell to be installed.

4.6 Control Box Features

4.6.1 Fault Monitoring Interface

The control box shall have one fault monitoring interface connected to the site site RTU and two separate RS485 outputs, one connected to Medium intensity light chain and the other connected to Low intensity light chain input (maximum 16 lamps via RS-485). Lamp type, alarms and photocell status are reported to System Controller from each lamp that supports them.

4.6.2 48V DC Feeds

The control box shall have one 48V DC input and two separate 48V DC outputs, one for medium intensity light chain and the other for Low intensity light chain input (maximum 16 lamps via DC power cable). 48V DC output connections can be protected with rated DC Circuit breakers as required, no need to add any separate junction box.

4.7 Low Intensity System

4.7.1 Light Requirements

For Low Intensity Obstruction Lighting CASA requires a steady red low intensity light mounted to the top of the structure.

More than one light may be required to maintain 360-degree visibility.

4.7.2 48V Feeds

All Low intensity lights are to be powered in chain by a single 48V DC feed out from the Controller Box.

4.8 Medium Intensity System

4.8.1 Light Requirements

For Medium Intensity Obstruction Lighting, unless CASA requires otherwise, a red steady medium intensity light is mounted to the top of the structure and low intensity steady red side/marker lights at intervals not exceeding 45 metres, along the vertical length of the structure

More than one light may be required to maintain 360-degree visibility.

4.8.2 48V Feeds

All Low intensity lights are to be powered in chain by a single 48V DC feed out from the Controller Box.

4.8.3 Flashing Function

Although the Standard calls for steady red lights for both Medium and Low Intensity systems, there may be instances where CASA recommend the lights be flashing.

The flashing function shall be selectable in the programming of the Control Box. If implemented, all lights must flash in sync.

5. Power Supply

The AWL system is to be powered from the Communications DC supply. Sites that have a 48V DC systems, the system will be connected to a circuit breaker on the Power Subrack. For existing sites where the lights are being added to an operational power supply, the breaker can be added without a power outage. These works must be undertaken by the Telecommunications Delivery Team in accordance with the DC System CSP.

Sites with 24V DC or 12V DC systems will use a DC/DC Converter to generate the required 48V DC. The DC/DC shall be installed in an equipment rack and will be powered from the rack RDP.

In the unlikely event that it is required to install substantial Communications Structure at a site that does not have a communications supply, the unearthed 50V DC or 110V DC, in that order, will be used via a DC/DC Converter to generate the required 48V DC and isolation.

5.1 Current Requirement

Individual calculations are required to be completed for each site based on the final arrangement for the purposes of battery standby time calculations.

DC power consumption for the AWLs Considered including all the features offered by Low intensity lights, Medium intensity lights and System Controller from the Obelux product list as mentioned in table 1-1.

- Low Intensity (50cd +IR): one low intensity light – 0.08 Amp (Relay Ratings: 50VDC @1Amp)
- Low Intensity (50cd +IR): three low intensity light – 0.24 Amp (Relay Ratings: 50VDC @1Amp)
- Medium Intensity (2000cd+IR): one medium intensity light – 0.6 Amp (Relay Ratings: 50VDC @1Amp)
- System Controller: One AWL System Controller – 0.02 Amp (Relay Ratings: 30VDC @6Amp)
- In ideal scenarios: Western power AWL system shall require one System controller + one medium intensity light+ three low intensity light for maximum of 90 meter high tower.
- In Ideal scenarios: For calculation of DC battery back up support on a comms site with maximum 90m tower height shall consider (0.02A+0.6A+0.24A) ~1Amps additional current to the existing 48V DC battery back up system.

Calculations are based on steady light. Should flashing be required by CASA, the power consumption will be less than the figures above.

5.2 Circuit Breaker Requirement

The breaker size is primarily selected to protect the cable.

- CB for the AWL System controller from 48V DC RDP – 10Amp (2.5 mm² cable)
- CB for the Low Intensity Lights from AWL System controller output– 2 Amp (1.5mm² cable)
- CB for the Medium Intensity Lights from AWL System controller output – 6 Amp (2.5mm² cable)

5.3 Voltage Drops

- Low Intensity Light voltage drop: 0.2v for (1.5 mm² cable with conductor resistance of 13.3ohm/km and cable length 50m)

- High Intensity Light voltage drop: 0.8v for (2.5 mm² cable with conductor resistance of 7.98ohm/km and cable length 90m)

6. Wiring Arrangements

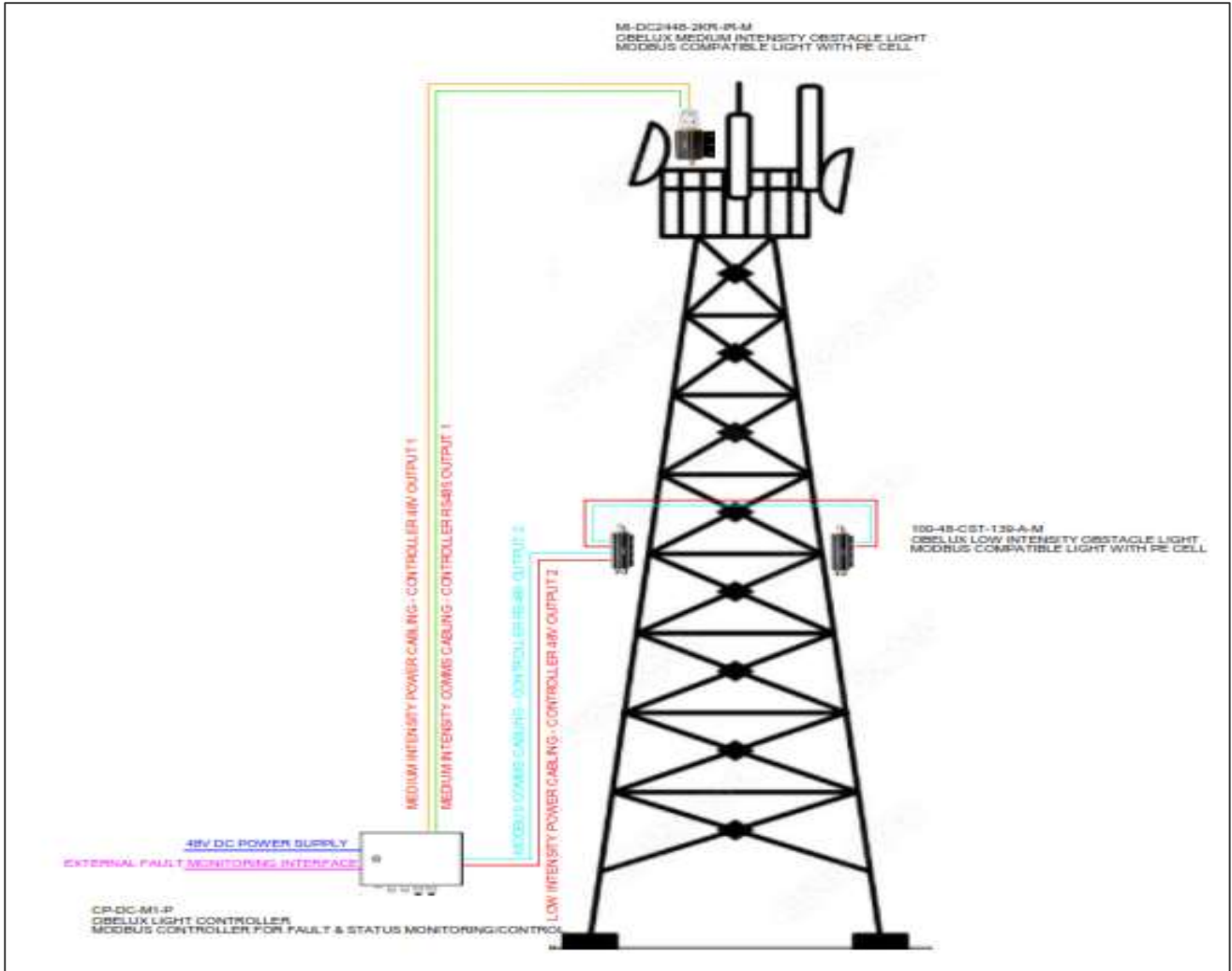


Figure 3: Generic wiring and connectivity Diagram of AWL system

6.1 Modbus-data cable internal

5 mm² RS-485 or CAT6 cables to run from AWL System Controller Input/monitoring interface to the Site RTU cross- connected through Alarm IDF.

6.2 Modbus-data cable external

- 5 mm² RS-485 data cable to run from the Output 1 of the AWL System controller to the RS 485 data interface of the medium intensity light. For more than one light – data cables to be connecting in Chain from one to the other light, same as the power chain connection to the multiple light units.

- 5 mm² RS-485 data cable to run from the Output 2 of the AWL System controller to the RS 485 data interface of the Low intensity light. For more than one light – data cables to be connecting in Chain from one to the other light, same as the power chain connection to the multiple light units.
- A 16mm harsh weatherproof flexi plastic conduit to use from the gland plate throughout the tower to the AWL lights. Flexi conduits to be fixed on the tower with correct size of hangers.

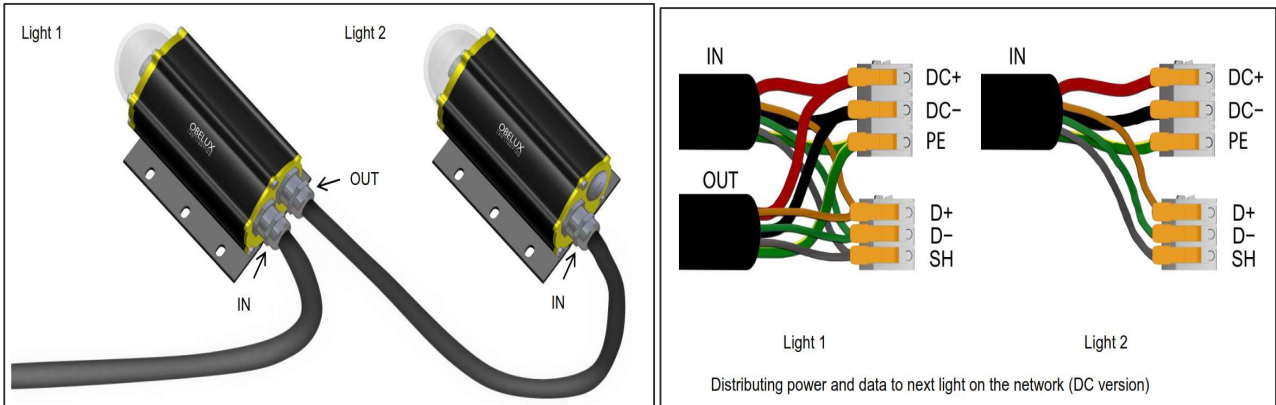


Figure 4: Chaining multiple AWL Low intensity lights

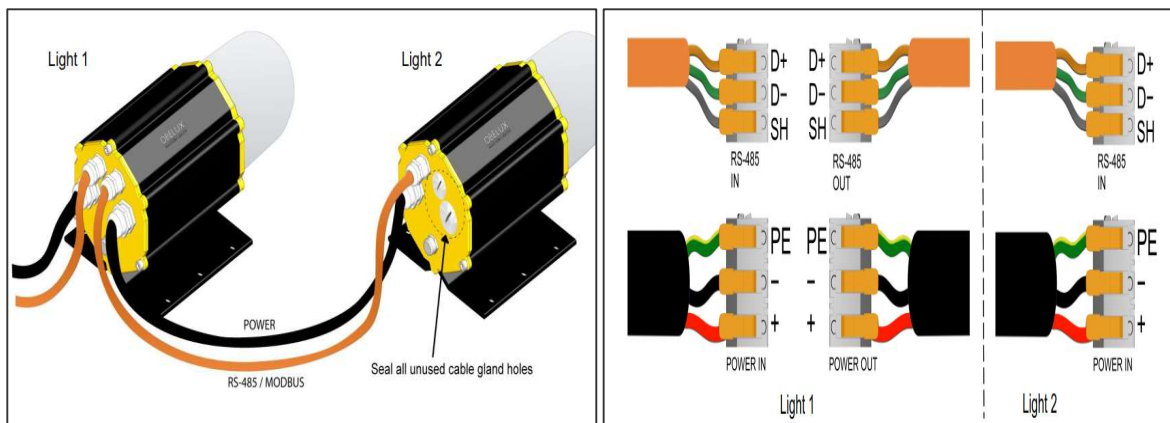


Figure 5: Chaining multiple AWL Medium intensity lights

6.3 48V Cabling Internal

The power connection from the DC supply to the AWL Control box is to be 2.5mm² Red/Blue cable.

6.4 48V Cabling External

All external 48V cabling is to be UV rated 2c 1.5mm² or 2.5mm² circular PVC steel wire armoured (SWA) cable. Cable sizing is determined based on restricting the voltage drop to 10% or 4.8V (as defined by AS3000) at the furthest light.

The SWA is to be earthed to the structure but is not extended into the building nor connected to the main earth point.

6.5 PE Cell

Considering built-in PE system into the AWL lights, no additional PE cells required to install.



Figure 6: Built-in PE in Obelux AWL Light

6.6 Joint Boxes

Considering AWL lights to be chain connected to each other, no additional joint boxes should be required other than recommended for exceptional cases.

A suitable UV and IP67 rated, structure mounted joint box in close proximity to the lights to be installed, where the feed is split to each of the lights. All cables will enter the joint box via high quality accurately sized and similarly rated SWA compatible cable glands.

6.7 Steel Wire Armour

To improve flexibility of the 48V external cable, the steel wire armour shall be stripped from the cable at the cable gland plate.

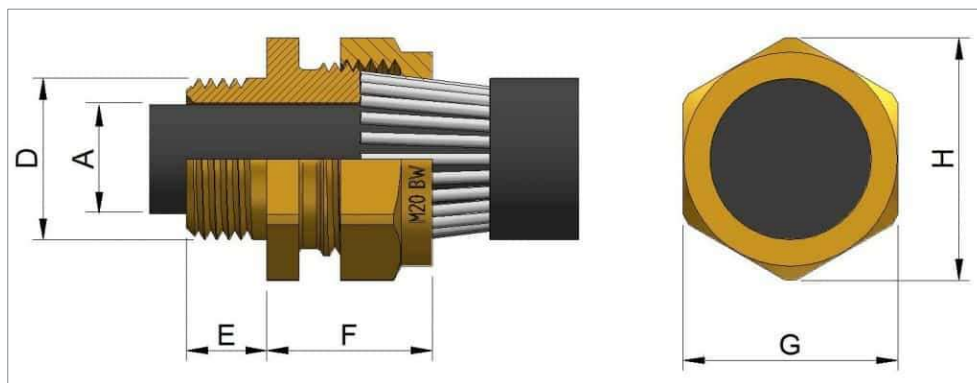


Figure 7 Example of SWA Cable Gland

6.8 Earthing

The control box is to be earth to the station earth bus by use of 16mm² green/yellow cable.

To ensure that any lightning induced voltage is not brought into the equipment building or the control box, the light fittings and the 48V feed cables SWA covering are to be earthed to the structure and not extended into the building or connected to the control box.

The SWA covering is to be earthed at the top and the base of the structure prior to the cable ladder and also dependant on the height of the structure at intervals between such that the distance does not exceed 60m. The same principals as outlined in Section 2 of the Antenna & Feeders Construction Manual, that pertain to antenna feeder cables, shall also apply to SWA AWL power cables.

Where installed within a substation site, the Substation Earthing Guidelines, shall apply.

6.9 48V Feed Cable Fixing

The 48V feed cable is to be run using feeder hangers and approved cleats.

For horizontal runs or where feeder hangers are not available, the cable is to be attached to the structure with stainless steel cable ties. The ties must be fitted with rubber buffers to avoid galvanic corrosion from the dissimilar metal contact. See **Figure 4** for example photograph of feeder hanger clamps.

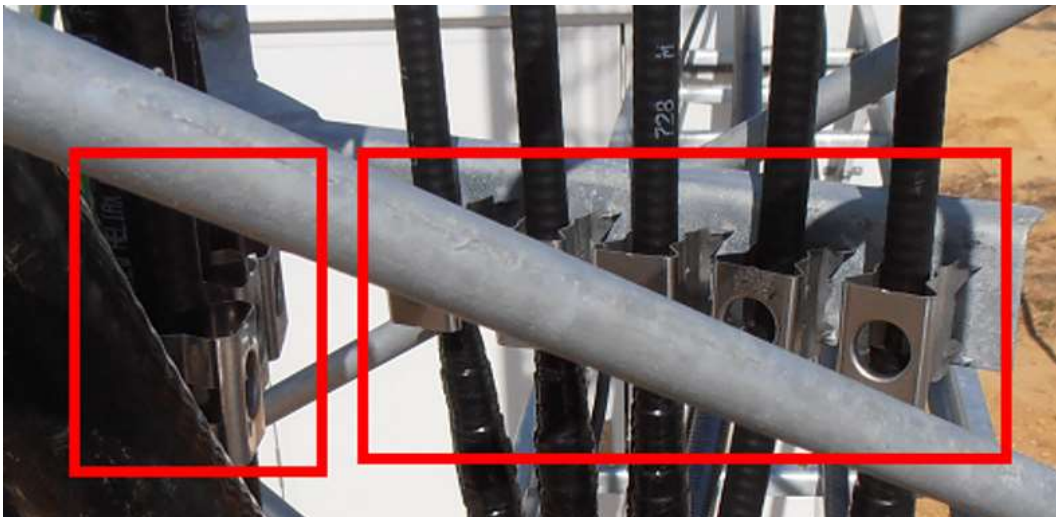


Figure 8: Feeder cable hanger bracket clamps

6.10 System Weather Protection

The cable, prior to entering the building, shall be formed on the cable ladder into a drip loop below the line of the cable run. A small nick shall be provided in the insulation at the lowest point of the loop to allow any water accumulated below the insulation, to be released.

All cable entry into the junction boxes shall be via the base of the box where possible. Where side entry is required a drip loop shall be provided.

All seals on the junction boxes are to be in good condition. If the cover is required to be removed for maintenance, unless its condition can be guaranteed, the gasket should be replaced.

7. Structural Assessment

While the wind load of the lights is small, the 48V feeder cables and RS-485 data cables with conduits do present a potential loading issue.

The lighting system should be included in the Structural Assessment.

8. Lightning Protection

Lights mounted at the top of the structure must remain within the zone of protection of the structure lightning finial.

For structures greater than 45m, side/marker lights may be outside the zone of protection of the lightning protection above and should be checked for vulnerability of side strikes using the Australian Standard AS 1768-2007 rolling sphere methodology.

Guy wires and mounting bracket design can be used to mitigate the risk of side strike.

9. Alarm Monitoring

All Medium and Low intensity lights shall turn on ALARM LED and their LARM relays to be activated for the following events:

- Internal hardware or power failure.
- Light source failure, including decreased intensity level below rated level of light.
- Incorrect photocell operation.
- GPS module failure (not applicable for Western Power).

The System controller Alarm settings can be activated for the following events:

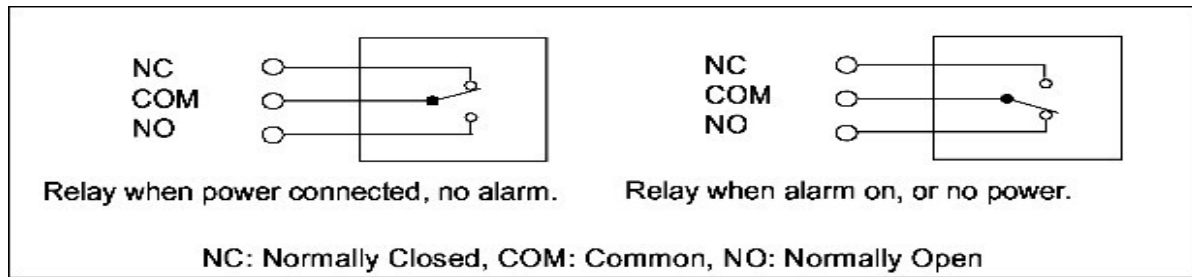
- Alarm in a lamp.
- Modbus connection error to a lamp.
- Photocell error.
- Voltage input below limit.
- Current limit breach to output 1 (DC Lights).
- Current limit breach to output 2 (DC lights).
- No Time-of-Day state change in 24h.
- GPS communication error. (not applicable for Western Power).

The RS-485 (Modbus) termination resistor DIP switch to turn onto the AWL System controller for both RS-485 (Modbus) OUTPUT 1 and RS-485 (Modbus) OUTPUT 2. Also, the DIP switch termination to turn onto each individual lamps for registering all lamp alarms to the System controller. The alarm relay on the AWL System controller shall connect with the site RTU as the external fault monitoring interface on site and activate the AWL fault alarm on the RTU.

Mark	Description	Information
NO	Normally Open	Normally open contact; in alarm, connected with COM
COM	Common	Common relay contact
NC	Normally Connected	Normally connected with COM; in alarm, open contact

Unused alarm relay connectors can be left floating, i.e. no wiring there is required. The connector is Wago Push-in CAGE CLAMP® type.

Conductor cross-section	0.2mm ² - 4mm ² (24-12 AWG)
Recommended cable size	0.75mm ² - 1.5mm ² (20-16 AWG) or CAT cable
Relay maximum load	277VAC @ 6A; 30VDC @ 6A



The following alarms will be presented on the site RTU from the AWL Control System Relay:

- AWL System failure– Critical

Also, from the Power OUTPUT 1 and OUTPUT 2 Circuit Breakers to be connected to RDP 48V DC failure alarm to Site RTU:

- Power failure _AWL Lamp output 1 – Critical
- Power failure _AWL Lamp output 2 – Critical

10. Maintenance Requirements

Lighting operational status is to be checked as part of the structure rigging checks.

- Two outlet Circuit breakers from the AWL Control System OUTPUT in the Shelter to the AWL Lights on the tower are to switch off one by one to check the alarms to trigger 1) Current limit breach to output 1 (DC Lights) and 2) Current limit breach to output 2 (DC Lights) on the AWL control system.
- Switching off Circuit breaker from 48V DC rectifier to AWL control system will generate the AWL failure alarm on the site RTU.

NMC will be able to confirm with the rigger or technician before they leave site that the switch was been returned to the normal position.