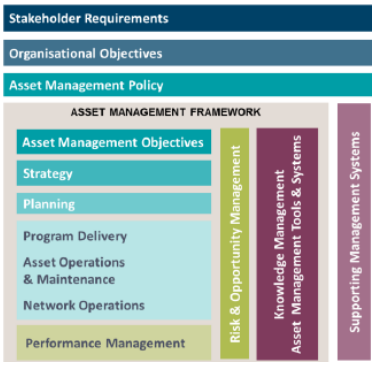
Aircraft Warning Light Systems for Telecommunications Structures

Design Standard (Technical Specification)



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RESPONSIBILITIES

Western Power's Engineering and Design Function is responsible for this document.

CONTACT

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Revision Details

Version	Date	Summary of change	Section
1.0	30/03/2024	Initial	

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.

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 Managemet 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

Reference#	Title
-	CASA Manual of Standards – Part 139 – August 2020
-	EXAMPLE – CASA Operational Assessment – Form 406
-	COM Review Minutes – AWL Standard[1]
-	Design Standard – Substations – Substations Earthing Design
-	Communications Service Procedure (CSP) – Obelux Aircraft Warning Light System[1]
-	Manual – Telecommunications Construction – Installation Practices[1]
-	Manual – Antenna and Feeders Construction – Telecommunications Design[1]

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. 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.

[1] Western Power internal document

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

Item	Part Number	Manufacturer	Supplier
Low Intensity Marker Light	LI-100-DCW-F	Obelux	ICS Industries
Medium Intensity Obstruction Light	MI-2KR-048	Obelux	ICS Industries
AWL System Controller	CSW-DCW-B-F	Obelux	ICS Industries
External Photocell for CSW	PCE-DCW-F	Obelux	ICS Industries
Low Intensity Mounting Bracket	MS-HV80	Obelux	ICS Industries
Medium Intensity Mounting Bracket	MS-2K-V	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	• Top marker on structure < 45m • Side marker on structure > 45m & < 150m
Medium Intensity	Steady	Red	2,000 cd (± 25%)	• 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

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.

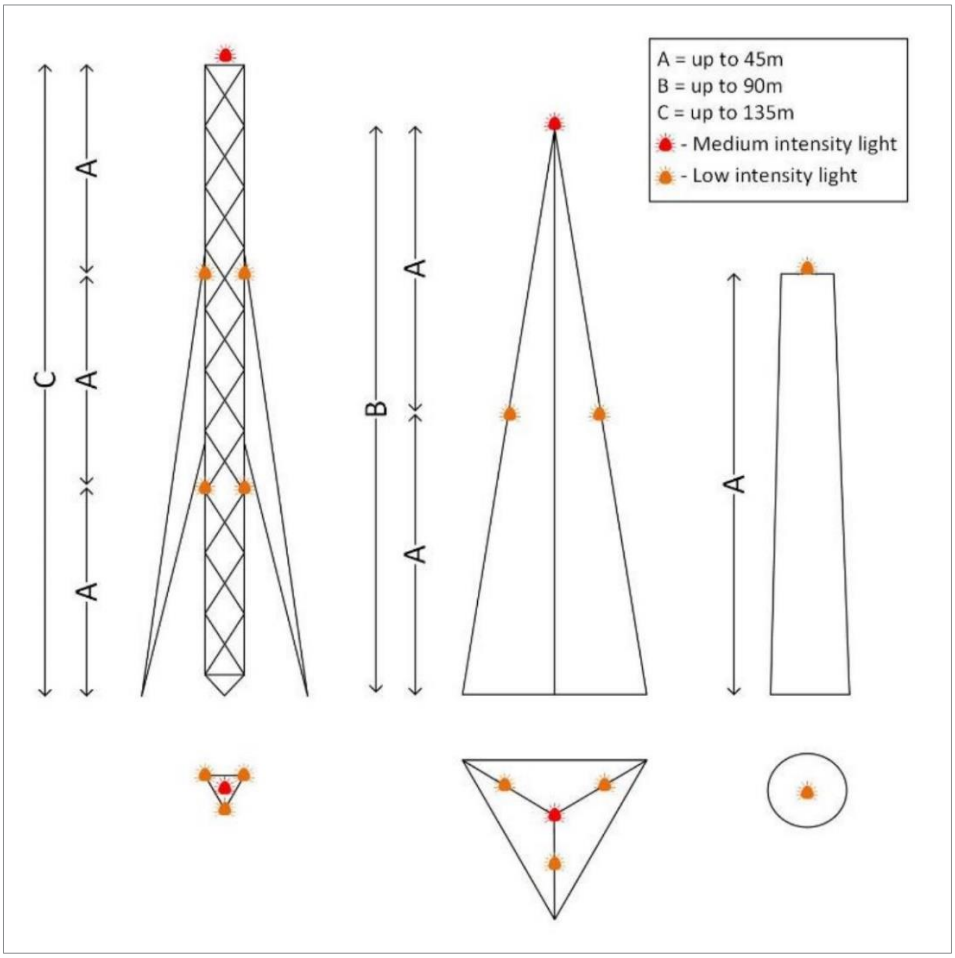

Figure 1 Typical locations of low and medium intensity lights on Western Power Comms Structures

2.4 Top Obstacle Light(s)

For structures 45m or below, typically monopole type structures at Western Power, a single, low intensity light 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**.

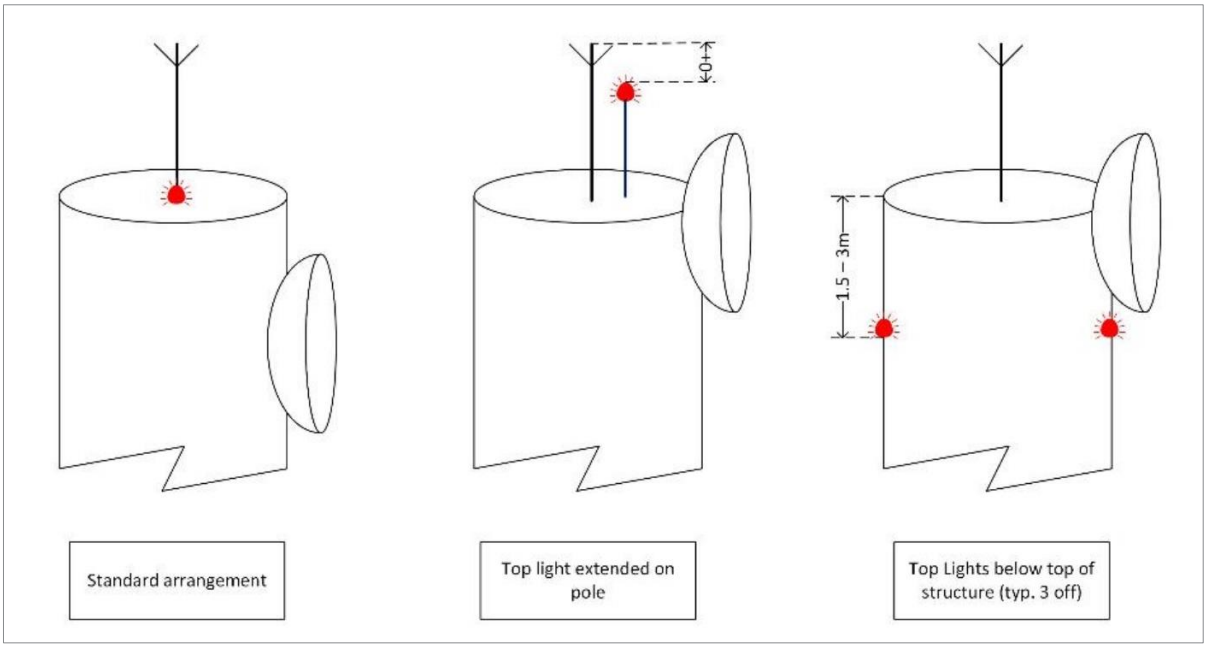

Figure 2 Positioning arrangements for structure top light

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 AWL systems shall include an external Photoelectric (PE) cell. 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

The PE Cell is to be mounted on the southern side of the building at a height that can be reached without a ladder.

Where the Cell is located at a site that has the potential to be illuminated during the hours of darkness, a shield shall be provided above the Cell to block this illumination to avoid this illumination turning the lights off.

4.6 Low Intensity System

4.6.1 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.

4.6.2 48V Feeds

All lights are to be powered by a single feed.

4.7 Medium Intensity System

4.7.1 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.

4.7.2 48V Feeds

The medium intensity light at the top of the structure is to be connected via a dedicated feed.

If more than one medium intensity light is to be installed at the top of the structure, each additional light shall have a dedicated feed due to voltage drop considerations.

The low intensity side/marker lights, which could be up to nine in three sets, will be connected to a single 48V feed.

4.8 Control Box Features

4.8.1 48V Feeds

The control box shall have four separate outputs. Three to be used for Medium Intensity Light feed and one for the Low intensity and Side/Marker Light feed.

4.8.2 Surge Arrestor

Each 48V feed is to be fitted with surge arrestor.

4.8.3 Alarming

The following NC Voltage free alarm contacts are to be provided:

- Four contacts for light failure, one for each of the 48V feeds
- One contact for PE Cell failure

- One contact for Power failure

4.8.4 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. If a PE cell is fitted the current draw during the hours of darkness only is to be used.

Calculations for the worst-case arrangements assuming steady (not flashing) lights are given below:

- Low Intensity (min): one low intensity – 0.167 Amp
- Low Intensity (max): three low intensity – 0.5 Amp
- Medium Intensity (min): one medium intensity and one set of three markers – 1.08 Amp
- Medium Intensity (max): three medium intensity and three sets of three markers – 2.25 Amp

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.

Based on half the maximum current carrying capability of the cable in unenclosed air the following are the breaker sizes: -

- Low Intensity Systems – 2 Amp (1.5mm^2 cable)
- Medium Intensity System – 10 Amp (2.5mm^2 cable)

5.3 Voltage Drop Low Intensity System

Based on the use of a single 1.5mm^2 cable, at maximum height of 45m and allowing 2m for the distance from the building to the tower less the height of the cable tray from the ground, the voltage drop at the top of the structure is:

- Low Intensity per, feed (min): one low intensity - 0.18V
- Low Intensity per, feed (max): three low intensity – 0.5V

The resistance of 1.5mm^2 circular cable is given as 13.3mΩ/m.

5.4 Voltage Drop Medium Intensity System

Based on use of a single 2.5mm2 cable for the medium intensity, at maximum height of 150m and allowing 2m for the distance from the building to the tower less the height of the cable tray from the ground, the voltage drop at the top of the structure is:-

- Medium Intensity, per feed: one medium intensity – 3.7V
- Side/Marker, per feed (min): three lights at one location – 0.39V
- Side/Marker, per feed (max): three lights at three locations – 2.3V

The side/marker lights associated with the medium intensity system is based on three sets of three low intensity markers per circuit, 1.5mm^2 cable and heights of 112.5, 75 and 37.5m.
The resistance of 2.5mm^2 circular cable per core, is given as 7.98mΩ/m and 1.5mm^2 is given as 13.3mΩ/m.

6. Wiring Arrangements

6.1 48V Cabling Internal

The power connection from the DC supply to the AWL Control box is to be 2.5mm^2 Red/Blue cable part number CF-FPLN2.5RL100M.

6.2 48V Cabling External

All external 48V cabling is to be UV rated 2c 2.5mm^2 or 1.5mm^2, 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.

6.3 PE Cell

The PE cell shall be connected to the control box using 4C+E, 1.5mm^2 cable. The cable shall be installed in corrugated conduit from the cell to the cable the gland plate. Correctly sized and rated cable glands must be used.

6.4 Joint Boxes

Where several lights are to be run off a single circuit, the feed is to be extended to a suitable UV and IP67 rated, structure mounted joint box in close proximity to the lights, 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.
Correctly sized cable glands must be used for 1.5mm^2 and 2.5mm^2 cables so as to prevent water ingress.

6.5 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.

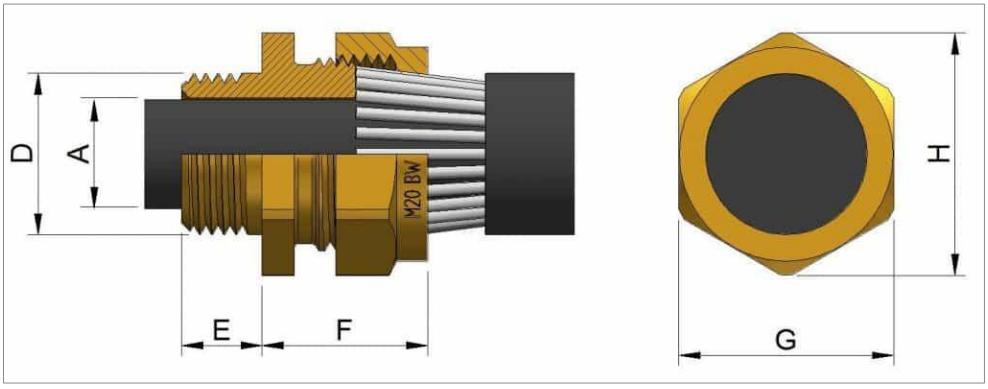

Figure 3 Example of SWA Cable Gland

6.6 Low Intensity System

The low intensity system requires a single 48V feed to be run to the low intensity lights mounted at the top of the structure, and additional 48V feed to each level set of low intensity side lights. Structures between 45 and 90m will typically have only one set of low intensity side lights, structures above 90m will have two or three sets.
A set of side lights will typically consist of three lights (one on each corner) to maintain 360^0 visibility, all at the same height AGL.

6.7 Medium Intensity System

The medium intensity system requires a single dedicated 48V circuits run to each medium intensity light mounted at the top of the structure and depending on the height of the structure, a single 48V circuit run to either one, two or three levels of side lights.

6.8 Earthing

The control box is to be earth to the station earth bus by use of 16mm^2 green/yellow cable.

To ensure that any lightning induced voltage is not bought 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 Manualthat 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.

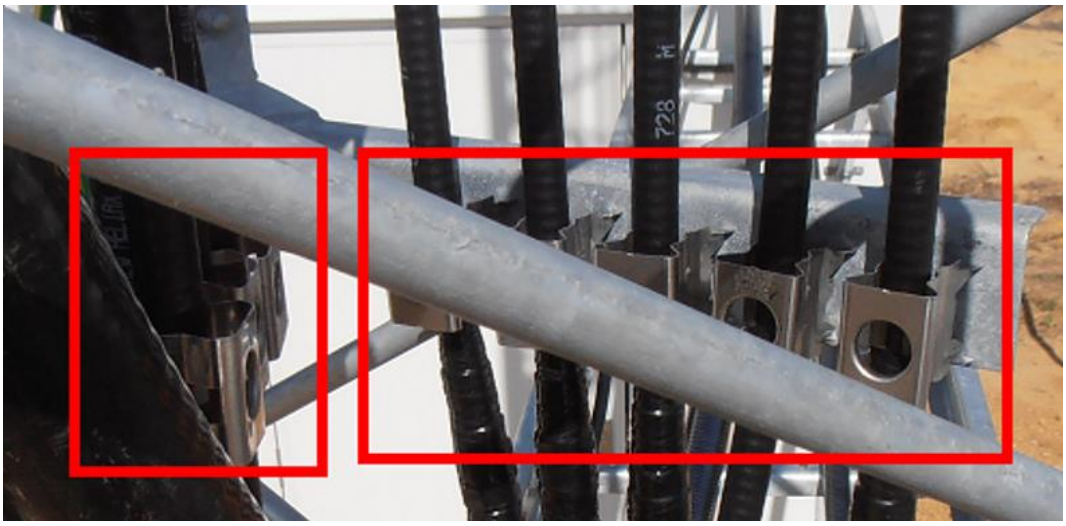

Figure 4: Feeder cable hanger bracket clamps

6.10 System Weather Protection

The cabling shall enter junction boxes and penetrate the gland plate via high quality accurately sized waterproof cable, SWA compatible glands.

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 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 alarms to be NC voltage free contacts.
The alarms contacts to be extended to the Keymile Cool 4/6 units, Eaton RTU or in the case of Mobile Radio only sites, to the BitLab.

Main and Standby top lights are to be run using different feed circuits and each circuit is to be separately alarmed in order to indicate the operational status of the lights and therefore the urgency of response.
The following alarms will be presented:

- AWL Power Failure – Critical
- AWL Feed 1 (medium intensity 1) - Critical
- AWL Feed 2 (medium intensity 2) - Critical
- AWL Feed 3 (medium intensity 3) - Critical
- AWL Feed 3 (Low Intensity Side/Marker) - Major
- Photocell - Minor

All Side/marker lights are run on one circuit and therefore only one alarm is available for to indicate failure of these lights.
Failure of an Obstacle light or power supply to the Control Box after hours should generate an SMS message to the operational staff. Failure of the PE Cell will not generate a critical alarm as the failure mode is the lights on at all times.
Failure that causes the Obstacle lights not to be lit is required to be reported to CASA Perth Office.

10. Maintenance Requirements

Lighting operational status is to be checked as part of the structure rigging checks. To enable checks to be completed at ground level by a rigger or technician a switch shall be installed in series with the PE Cell. Activation of the switch will disconnect the PE cell causing the lights to illuminate and a PE Cell alarm to be generated.
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.