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Aeronautical Ground Lighting Safety and Maintenance

Guidance Material

Foreword

This document provides operational and ground personnel engaged in the handling of aircraft with a general description of the purpose and meaning of visual aids that are typically displayed at aerodromes in Republic of Kosovo certified by the Civil Aviation Authority.

This document is not to be used to design or specify Aeronautical Ground Lighting for the purpose of aerodrome certification. Certification criteria, which include the technical specifications, are contained in Regulation No. 17/2017 on requirements and administrative procedures related to aerodromes ("Regulation No. 17/2017 on aerodromes").

Republic of Kosovo has adopted the acceptable means of compliance (AMC) and guidance materials (GM) to illustrate means to establish compliance with basic regulation and its Implementing Rules. Regulation No. 17/2017 on aerodromes includes requirements, AMC's and GM's.

This document includes Airfield Lights base information with a focus on safety, installation and maintenance procedures.

CAA requires that all involved parties are familiar with the contents and procedures described herein.

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Director General
Civil Aviation Authority

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Review Table

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Glossary

AGL	Aeronautical Ground Lighting
AVDGS	Advanced Visual Docking Guidance Systems
CAA	Civil Aviation Authority
CCR	Constant Current Regulator
CU	Concentrator Unit
FOD	Foreign Object Debris
ICAO	International Civil Aviation Organization
ILS	Instrument Landing System
ISO	International Standardization Organization
LVP	Low Visibility Procedures
IEC	International Electro technical Committee
LED	Light Emitting Diode
LMS	Light Monitor and Switch unit
MEHT	Minimum Eye Height over Threshold
MOR	Mandatory Occurrence Report
PAPI	Precision Approach Path Indicators
SMS	Safety Management System
SOP	Standard Operating Procedure
EASA	European Aviation Safety Agency

Terms and Definitions

In this manual, the terms are conform to those in Law No. 03/L-051 on Civil Aviation, Regulation No. 17/201701/2008 on requirements and administrative procedures related to aerodromes ("Regulation No. 17/2017 on aerodromes").

Republic of Kosovo has adopted the acceptable means of compliance (AMC) and guidance materials (GM) to illustrate means to establish compliance with basic regulation and its Implementing Rules. Regulation No. 17/2017 on aerodromes includes requirements, AMC's and GM's.

For the purpose of aeronautical ground lighting, safety and maintenance, the following definitions apply:

Term	Definition
Aerodrome	Aerodrome means a defined area on land or water (including any buildings, installations and equipment) intended or designed to be used either wholly or partly for the arrival, departure and surface movement of aircraft.
Aerodrome Operator	Any person or legal entity authorized by the Authority to manage and operate an aerodrome by means of issuance of an aerodrome certificate.
Aeronautical Ground Lighting	Aeronautical Ground Lighting service includes (a) approach lighting; (b) Supplementary Approach Lighting; (c) Precision Approach Path Indicator (PAPI); (d) Runway Lighting; (e) Taxiway Lighting (f) Aerodrome Beacon.
ILCMS	Systems (ILCMS) that check the status of the light by performing continuity test on the secondary of the ILCMS remote module. The monitoring option does a check on the light. In case of a failure of the light, the failure is detected by the electronics embedded in the light.

Authority	In this manual, the Authority means the Civil Aviation Authority of the Republic of Kosovo.
Basic regulation	Regulation (EC) No 216/2008, transposed into the internal legal order of the Republic of Kosovo by CAAK Regulation No 03/2009, as amended.
Runway Edge Lighting	Runway Edge Lighting is located along the edges of the area declared for use as the runway delineated by white edge markings, and may be provided either by elevated or by flush fitting lamp fixtures.
Runway threshold lighting	Runway threshold lighting is **green** and indicates the start of the available landing distance.
Pre-Threshold Lighting	Where a landing threshold is displaced, but the pre-threshold area is available for the take-off run, the lights between the beginning of the runway pavement and the displaced threshold show **red** from the approach. Pilots taking off in such a situation would see **red** edge lights up to the **green** threshold then white edge lights beyond.
Runway Exit Lighting	One or two omni-directional **blue** lights may replace or supplement the edge lights in order to indicate an exit taxiway.
Stopway Lighting	Where stopway is provided at the end of a runway, the declared stopway is delineated by **red** edge and end lighting showing ONLY in the direction of landing.
Runway Centerline Lighting	The centreline lighting is colour coded in order to warn a pilot of the approaching end of the runway. White centreline lighting extends from the threshold to 900 m from the runway end, the following 600 m is lit with alternate white and **red** lights, and the final 300 m lit by **red** centreline lighting
Touchdown Zone (TDZ) Lighting	On runways equipped for Category II and III approaches, additional lighting consisting of two rows of white barrettes is installed in order to provide textural cues in the touchdown area. The additional lighting extends from the threshold either for 900 m or to the midpoint of the runway, whichever is the lesser distance.
Rapid Exit Taxiway	Rapid exit taxiway indicator lights (RETILs) provide

Indicator Lights	pilots with distance to go information to the nearest rapid exit taxiway on the runway, to enhance situational awareness in low visibility conditions and enable pilots to apply braking action for more efficient roll-out and runway exit speeds.
Taxiway Lighting	At those aerodromes equipped for low visibility operations, taxiways are equipped with **green** centreline lighting. Where **green** centreline lighting is provided, **blue** taxiway edge lighting may also be installed as additional guidance on sections of taxiway.
Runway	A defined rectangular area on a land aerodrome prepared for landing and take-off of aircraft.
Stop Bars Lights	Stop Bars Lights are provided at those aerodromes authorised for low visibility operations. A Stop Bar consists of a row of lights spaced equally across the taxiway normally at right angles to the centreline and showing **red** towards an approaching aircraft when landing.
Safety Management System	A system for the management of safety at aerodromes including the organizational structure, responsibilities, procedures, processes and provisions for the implementation of aerodrome safety policies by an aerodrome operator which provides for the control of safety at, and the safe use of the aerodrome.
Runway Guard Lights	Runways Guard Lights are pairs of alternately flashing yellow lights, one pair located on each side of the taxiway and provide a warning of the close proximity of the runway.
Taxiway	A defined path on a land aerodrome established for the taxiing of aircraft and intended to provide a link between one part of the aerodrome and another including aircraft stand, taxi-lane, apron, taxiway, and rapid exit taxiway.
Visual Docking Guidance Systems	Advanced Visual Docking Guidance Systems (AVDGS) is a system that provides electronically displayed information, such as the azimuth position of the aircraft and stopping distance. In some cases, the AVDGS determines the aircraft type automatically and sets the relevant guidance parameters accordingly.

Introduction

The service ability and operational reliability of air navigation equipment and installations are requirement, for the safe operation of aircraft in the airport area. Apart from visual aids, the air navigation equipment and installations include electronic landing aids, navigation equipment, radar and equipment of the meteorological services. Guidance on the maintenance of visual aids is given in Chapter 5 of the manual, based on regulation 17/2017 , CHAPTER M — Visual Aids for Navigation (Lights) and CS ADR-DSN.S.895 Serviceability levels, ADR.OPS.C.015 Visual aids and electrical systems. Maintenance programs for other equipment and installations are to be established by the appropriate authorities (ATC, Meteorological Services).

The required service ability of installations and equipment will only be achieved as long as a constant power supply is maintained. To this end, regular maintenance work is required for airport equipment and installations Aeronautical Ground Lighting, distributing primary power and equipment supplying the secondary power when there is a circuit breakdown. The following paragraphs contain guidance on establishing maintenance programs for Aeronautical Ground Lighting and the individual elements of the power supply systems.

Chapter 1 - Aeronautical Ground Lighting

1.1 General

Aeronautical Ground Lighting (AGL) is the generic term used to describe the various lighting systems that are provided on an aerodrome for the guidance of pilots operating aircraft both at night and in low visibility conditions. AGL systems vary in complexity from the basic patterns found at small aerodromes in support of flying training operations, to the more advanced systems used in support of "all-weather operations", usually associated with an Instrument Landing System (ILS).

The following paragraphs outline the AGL systems that have been accepted by the CAA as meeting both of the Republic of Kosovo aerodrome certification criteria and internationally agreed standards and recommended practices.

1.2 Civil Aerodromes

Details of AGL are notified in the AIP and on the appropriate Instrument Approach Charts. Where the AGL provided at a certified aerodrome does not conform to the applicable specification in regulation No. 17/2017 on aerodromes, an appropriate aerodrome entry is included in the AIP or, if the deficiency is of a temporary nature, a Notice to Airmen (NOTAM) is issued detailing the AGL that is available.

1.3 Colour and Intensity of Lights

1.3.1 High intensity AGL systems that are provided in support of low visibility operations normally have facility to independently control the luminance intensity of each element of the system. The intensities are set up, usually by the air navigation service provider, to suit local conditions. A pilot may ask for the intensity of an element(s) of the system to be adjusted if found to be inappropriate for the flight operation.

1.3.2 The performance specification of high intensity lighting is defined by the need to provide guidance by day in low visibility conditions; the highest intensity settings are normally used in these conditions. Lower intensities are normally used by night.

1.3.3 Low intensity systems are provided at those aerodromes at which operations are conducted at night but not in low visibility conditions; the luminance intensity of these systems is not normally adjustable.

1.4 Aerodrome Beacon

1.4.1 An Aerodrome Beacon would normally be provided at those aerodromes that operate at night and where the level of background lighting, the surrounding terrain,

the proximity of other aerodromes or the lack of navigation aids would make the aerodrome difficult to locate or to identify.

1.4.2 An Identification Beacon flashing a two letter identification code in **green** would normally be provided at an aerodrome where a number of aerodromes in the same vicinity operate at night and confusion could arise as to identity.

1.4.3 A Location Beacon would normally be provided at an aerodrome that is situated well away from other aerodromes and where no confusion could exist as to identity. The signal produced by a Location Beacon is determined by the amount of background lighting as follows:

a) Where the aerodrome is also situated well away from areas of high background lighting, the Location Beacon would display a white flashing light.

b) Where the aerodrome is situated in an area where there is a high level of background lighting, such as in the vicinity of a city where a flashing a white light would be difficult to see, the Location Beacon would display a **green** light flashing alternately with a white light.

1.5 Approach lighting systems

1.5.1 The safety objective of the approach lighting system is to provide alignment and roll guidance, and limited distance-to-go information to enable safe approach to a runway.

(a) Non-instrument runway

Where physically practicable, a simple approach lighting system as specified in CS ADR-DSN.M.626 should be provided to serve a non-instrument runway where the code number is 3 or 4, and intended for use at night, except when the runway is used only in conditions of good visibility, and sufficient guidance is provided by other visual aids.

(b) Non-precision approach runway

Where physically practicable, a simple approach lighting system specified in CS ADR-DSN.M.626 should be provided to serve a non-precision approach runway, except when the runway is used only in conditions of good visibility or sufficient guidance is provided by other visual aids.

(c) Precision approach runway Category I

Where physically practicable, a precision approach Category I lighting system as specified in CS ADR-DSN.M.630 should be provided to serve a precision approach runway Category I.

(e) Precision approach runway Categories II and III

Applicability: A precision approach Category II and III lighting system as specified in CS ADR-DSN.M.635 should be provided to serve a precision approach runway Category II or III.

1.5.2 A variety of approach lighting systems, based on the centre line and cross bar concept, based on the requirements of Regulation No. 17/2017 on aerodromes, may be used at aerodromes in the Republic of Kosovo. These systems range from the simple low intensity centre line and cross bar - shown at Figure 1.1 - intended to serve visual runways at night only, to the more complex Calvert System comprising centreline and 5 cross bars - shown at Figure 1.3 and 1.4 - for day and night use on ILS equipped runways.

1.5.3 A simple approach lighting system should consist of a row of lights on the extended centerline of the runway extending whenever possible, over a distance of not less than 420 m from the threshold with a row of lights forming a crossbar 18 m or 30 m in length at a distance of 300 m from the threshold.

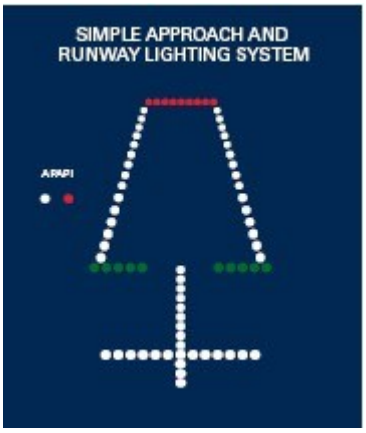

Figure 1.1

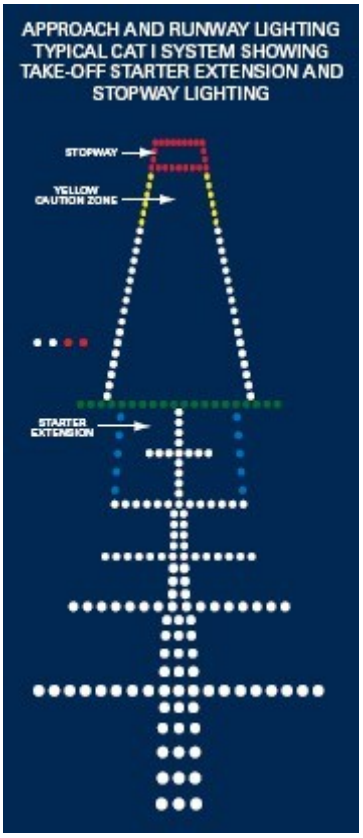

Figure 1.2

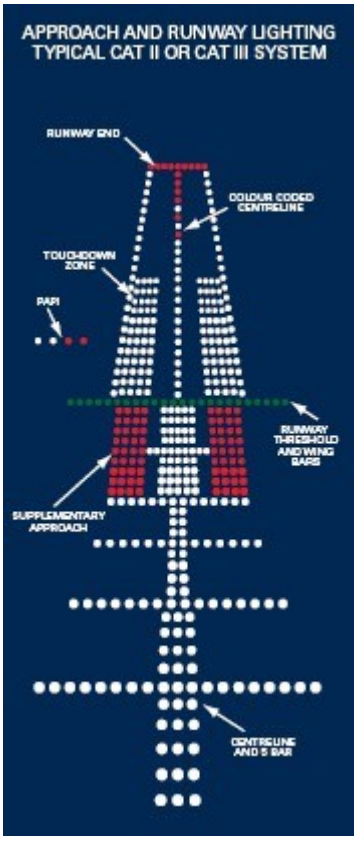

Figure 1.3

1.6 Supplementary Approach Lighting

At those aerodromes where Category II and III approaches are conducted, Supplementary Approach Lighting consisting of white centreline barrettes and two rows of **red** side barrettes, as shown at Figure 1.3, is installed in order to provide the pilot with enhanced visual cues over the last 300 m of the approach.

NOTE: At aerodromes with displaced thresholds, the supplementary approach lighting may be inset into the runway and in certain weather and ambient light conditions the centreline barrettes, at the higher intensity settings, can partially obscure the runway centreline lighting to pilots lining up for departure. Pilots experiencing problems of this nature should ask for the intensity of the supplementary lighting to be adjusted or extinguished.

1.7 Precision Approach Path Indicators (PAPI)

1.7.1 This visual aid provides approach slope guidance by use of red and white light signals which are interpreted as illustrated at Figure 1.4. The PAPI normally comprises a single row of 4 light units except that, on those runways that do not support jet public transport operations, an abbreviated 2 unit system (APAPI) may be used. The system is normally installed on the left side of the runway as seen from the approach. However, the units can be located on the right side if it is impracticable to install on the left.

1.7.2 The PAPI signal is not designed to be used beyond 15° either side of the runway centerline. Any additional restrictions placed on the use of a particular installation will be notified under the 'Warnings' section of the appropriate aerodrome entry in the AIP.

NOTE: Where obstacles located at the extremities of the visual signal preclude the provision of safe clearance, the appropriate aerodrome entry in the AIP will be annotated to that effect.

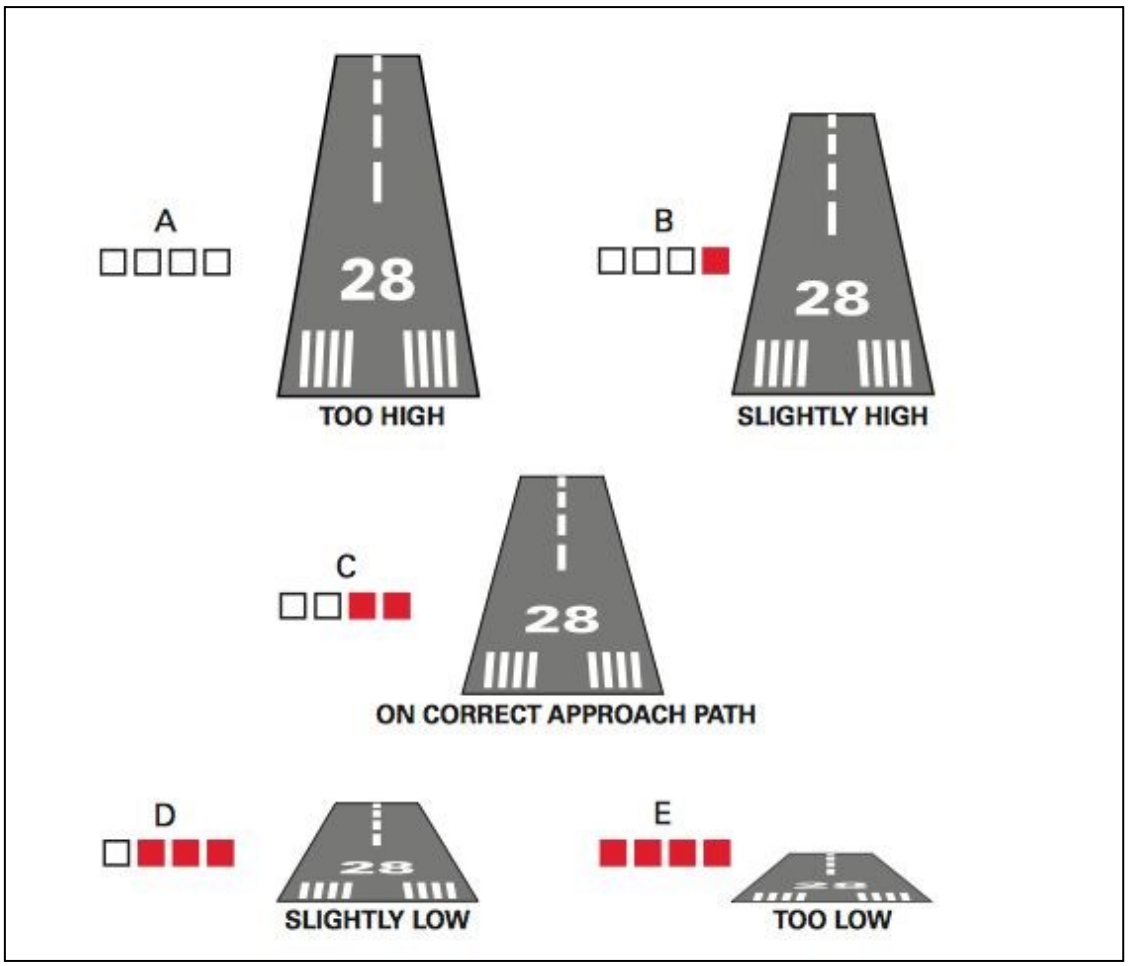

Figure 1.4 Typical PAPI Systems

1.7.3 Where used together with ILS, PAPI is located so as to ensure, as far as is practicable, correlation between the two approach paths. However, such a siting is made on the assumption that the pilot's eye level is above the ILS glide path receiver aerial, as is the case with most commercial aircraft. Pilots of aircraft in which the ILS aerial is mounted above the level of the pilot's eye may see a PAPI indication 'slightly low' (see Figure 1.4 D) when on the ILS glide path.

1.8 Runway Lighting

All runways certified for night use have Edge, Threshold and End Lighting. Centreline and Touchdown Zone Lighting is provided as additional guidance in support of low visibility operations.

A runway lead-in lighting system should be provided to avoid hazardous terrain.

(a) Location and positioning:

(1) A runway lead-in lighting system should consist of groups of lights positioned:

(i) so as to define the desired approach path. Runway lead-in lighting systems may be curved, straight, or a combination thereof; and

(ii) so that one group should be sighted from the preceding group.

(2) The interval between adjacent groups should not exceed approximately 1 600 m.

(3) A runway lead-in lighting system should extend from a determined point up to a point where the approach lighting system if provided or the runway lighting system is in view.

(4) Each group of lights of a runway lead-in lighting system should consist of at least three flashing lights in a linear or cluster configuration. The system should be augmented by steady burning lights where such lights would assist in identifying the system.

(b) The flashing lights and the steady burning lights should be white.

1.8.1 Runway Edge Lighting

Runway Edge Lighting is located along the edges of the area declared for use as the runway delineated by white edge markings, and may be provided either by elevated or by flush fitting lamp fixtures. At aerodromes where elevated runway edge lights are employed, the light fixtures may be located on the grass shoulder just beyond the declared runway width. Portable battery operated lights may be used in place of fixed lamp fittings at small aerodromes where limited operations take place at night.

Runway Edge Lighting is white except in the following instances:

a) Caution Zone Lighting

On ILS equipped runways without centreline lighting, **yellow** edge lighting as illustrated at Figure 1.2, is installed on the upwind 600 m or one third of the lighted runway length available, whichever is the less. The **yellow** 'caution zone' so formed gives a visual warning of the approaching runway end.

b) Pre-Threshold Lighting

Where a landing threshold is displaced, but the pre-threshold area is available for the take-off run, the lights between the beginning of the runway pavement and the displaced threshold show **red** from the approach, as illustrated at Figure 1.5. Pilots taking off in such a situation would see **red** edge lights up to the **green** threshold then white edge lights beyond. Where a starter extension, narrower than its associated runway is provided, **blue** edge lighting is normally used to mark the edges, as illustrated at Figure 1.5

c) Runway Exit Lighting

One or two omni-directional **blue** lights may replace or supplement the edge lights in order to indicate an exit taxiway.

d) Stopway Lighting

Where stopway is provided at the end of a runway, the declared stopway is delineated by **red** edge and end lighting as illustrated in Figure 1.5 showing ONLY in the direction of landing. A stopway is provided for emergency use only and is not normally suitable for routine use.

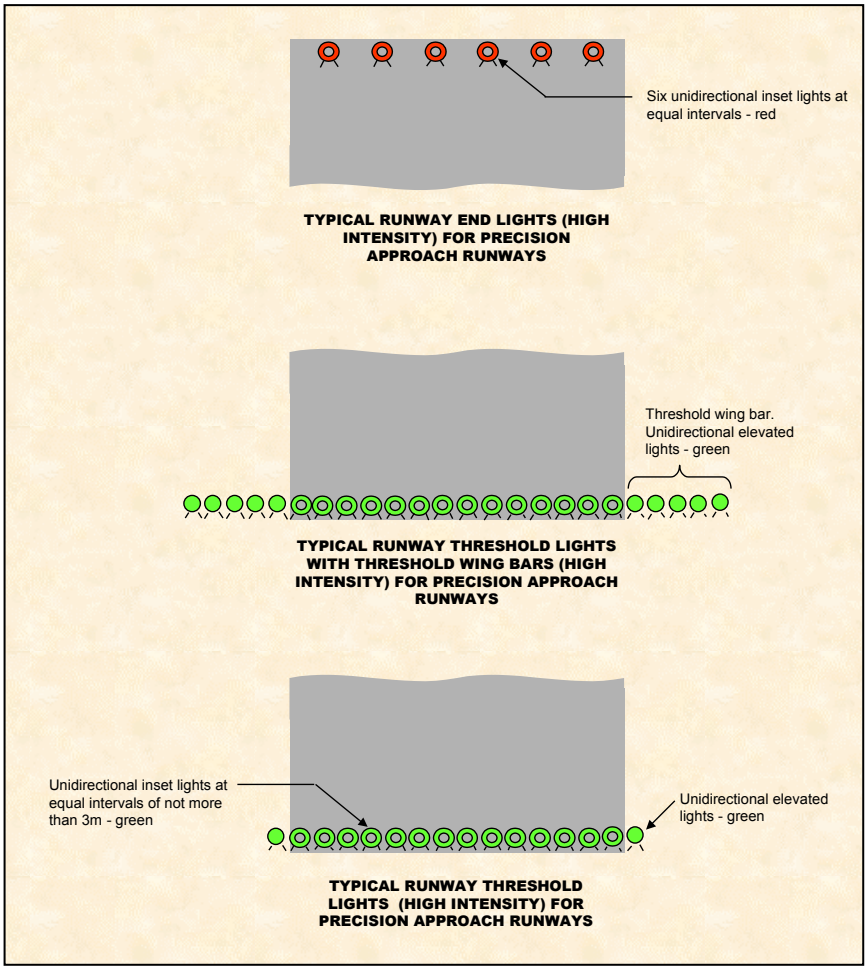

Figure 1.5 Typical Runway Threshold and Runway End Lights High Intensity for Precision Approach Runways

1.8.2 Runway Threshold and Runway End Lighting

Runway threshold lighting is **green** and indicates the start of the available landing distance. **Green** threshold wing-bars are provided at certain aerodromes where there is a need to accentuate the threshold. Patterns vary from the full threshold and wing-bar lighting shown at Figures 1.2, 1.3, and 1.5 to abbreviated versions shown at Figures 1.1 and 1.5. Runway end lighting is **red** and marks the extremity of the runway that is available for manoeuvring. Pilots should not land before the **green** threshold lighting nor continue a landing roll or taxi beyond the **red** runway end lights.

1.8.3 Runway Centerline Lighting

High intensity centreline lighting is provided **in addition** to edge lighting on runways equipped for low visibility operations. The centreline lighting is colour coded in order to warn a pilot of the approaching end of the runway. White centreline lighting extends from the threshold to 900 m from the runway end, the following 600 m is lit with alternate white and **red** lights, and the final 300 m lit by **red** centreline lighting, as shown at Figure 1.3.

1.8.4 Touchdown Zone (TDZ) Lighting

On runways equipped for Category II and III approaches, additional lighting consisting of two rows of white barrettes, as shown at Figure 1.3, is installed in order to provide textural cues in the touchdown area. The additional lighting extends from the threshold either for 900 m or to the midpoint of the runway, whichever is the lesser distance.

NOTE: The length of the TDZ lighting (normally 900 m) determines the length of the Obstacle Free Zone (OFZ) established to protect CAT II and III approaches below decision height (DH) and in the event of a baulked landing (or go- around) after DH. A go-around initiated beyond the end of the TDZ lighting is unlikely to be contained within the OFZ.

1.8.5 Rapid Exit Taxiway Indicator Lights

1.8.5.1 Rapid exit taxiway indicator lights (RETILs) provide pilots with distance to go information to the nearest rapid exit taxiway on the runway, to enhance situational awareness in low visibility conditions and enable pilots to apply braking action for more efficient roll-out and runway exit speeds.

1.8.5.2 RETILs consist of six **yellow** lights adjacent to the runway centreline and configured in a three/two/one pattern spaced 100 m apart; the single light is 100 m from the start of the turn for the rapid exit taxiway, see Figure 1.6.

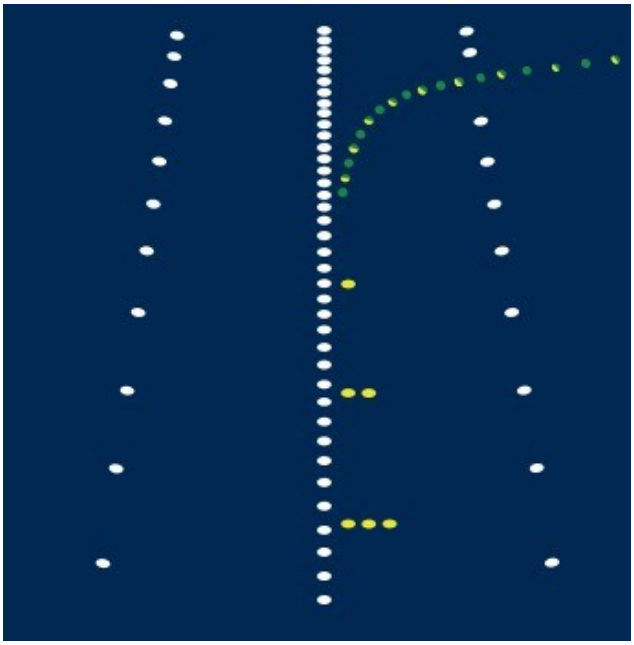

Figure 1.6 Rapid Exit Taxiway Indicator Lights

1.9 Taxiway Lighting

At those aerodromes equipped for low visibility operations, taxiways are equipped with **green** centerline lighting, otherwise **blue** edge lighting is provided, as shown in Figure 1.7. Where **green** centerline lighting is provided, **blue** taxiway edge lighting may also be installed as additional guidance on sections of taxiway that are difficult to negotiate. **Green** taxiway centerline lighting may be provided on the runway prior to an exit taxiway in order to give lead-off guidance. However, see paragraph 9.5. The edge of aprons, turning and holding areas are normally marked by **blue** lighting.

NOTE 1: Where centreline lighting is installed on a taxiway leading onto a runway, the taxiway lighting is curved onto the near side of the runway centreline and pilots should make an appropriate allowance for any loss of Runway Declared Distance incurred in following the 'lead-on' lighting whilst lining up for take-off.

NOTE 2: Taxiway centrelines are intended to provide safe clearance between the largest aircraft that the taxiway is designed to accommodate and fixed objects such as buildings, aircraft stands etc, provided that the pilot of the taxiing aircraft keeps the 'Cockpit' of the aircraft on the centreline and that aircraft on stands are properly parked. Taxi Holding Positions are normally located so as to ensure clearance between an aircraft holding and any aircraft passing in front of the holding aircraft, provided that the holding aircraft is properly positioned behind the holding position. Clearance to the rear of any holding aircraft cannot be guaranteed. When following a taxiway route, pilots and persons towing aircraft are expected to keep a good lookout, consistent with the prevailing visibility and are responsible for taking all possible measures to avoid a collision with another aircraft or a vehicle.

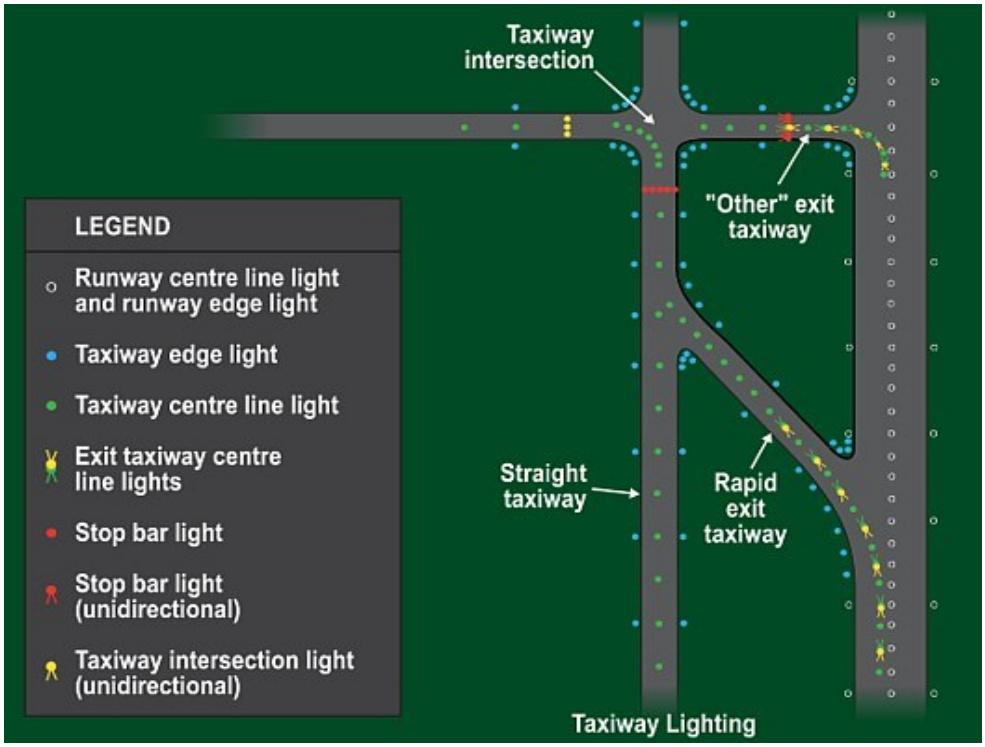

Figure 1.7 Taxiway Lighting

1.10 Stop Bars

Lighted Stop Bars are provided at those aerodromes authorised for low visibility operations. A Stop Bar consists of a row of lights spaced equally across the taxiway normally at right angles to the centreline and showing **red** towards an approaching aircraft when lit. Stop Bars are normally installed in association with **green** Lead-on Lights which form part of the taxiway centreline lighting beyond the Stop Bar.

1.10.1 A stop bar should be provided at every runway-holding position serving a runway when it is intended that the runway should be used in runway visual range conditions less than a value of 550 m, except where:

(i) appropriate aids and procedures are available to assist in preventing inadvertent incursions of traffic onto the runway; or

(ii) operational procedures exist to limit, in runway visual range conditions less than a value of 550 m, the number of:

(A) aircraft on the manoeuvring area to one at a time; and

(B) vehicles on the manoeuvring area to the essential minimum.

1.10.2 Where there is more than one stop bar associated with a taxiway/runway intersection, only one should be illuminated at any given time.

1.10.3 A stop bar should be provided at an intermediate holding position when it is desired to supplement markings with lights and to provide traffic control by visual means.

(a) Location: Stop bars should be located across the taxiway at the point where it is desired that traffic stop.

NOTE: At aerodromes where, for example, a Stop Bar is located on or close to a bend in the taxiway route, additional elevated red lights may be installed outboard of each taxiway edge as shown at Figure 1.7, in order to provide maximum advanced warning of the Stop Bar location.

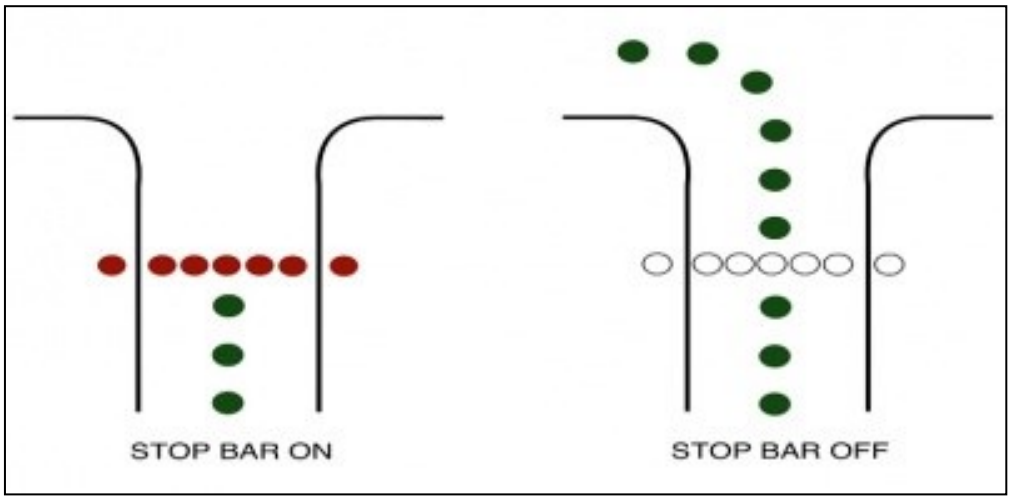

Figure 1.8 Stop Bar

1.11 Runway Guard Lights

Runways Guard Lights are pairs of alternately flashing **yellow** lights, one pair located on each side of the taxiway and provide a warning of the close proximity of the runway. Where the taxiway is wider than normal, an alternative form of Runway Guard Light may be provided comprising additional pairs of flashing **yellow** lights inset into and stretching across the full width of the taxiway. The electrical circuits are so arranged that alternate lights flash in unison. Runway Guard Lights, often referred to as "Wig Wags", are illustrated at Figure 1.9.

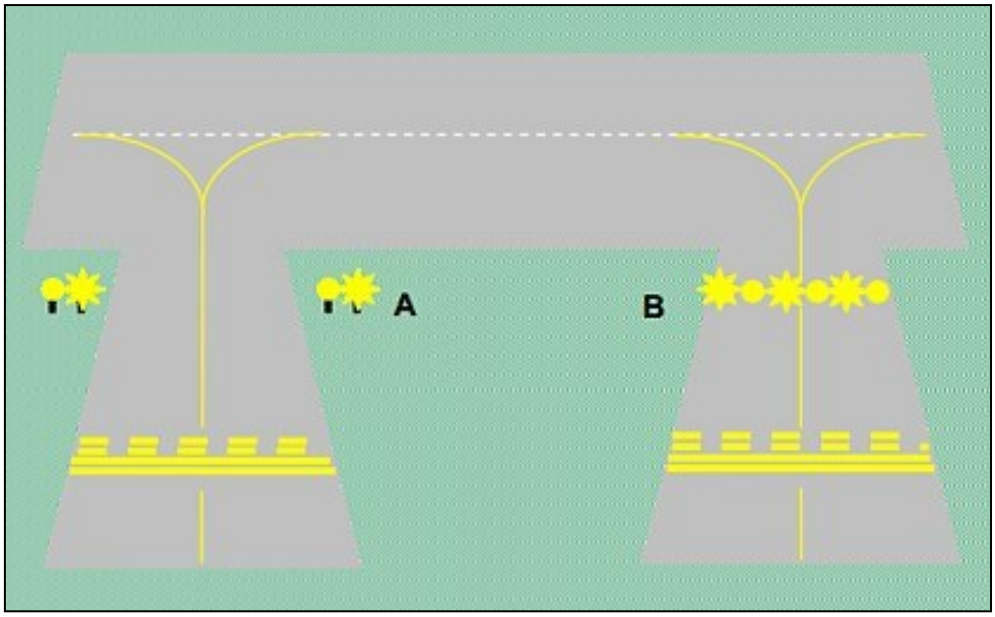

Figure 1.9 Runway Guard Lights

1.12 Taxiway Guidance System

At aerodromes where Category II and III operations take place or where ground movement requirements are complex, a surface movement guidance and control system (SMGCS) may be installed in order to regulate traffic. The system operates by selective switching of the taxiway centreline lighting so that individual sections or routes, each terminating at a lit Stop Bar, are illuminated in order to show the way ahead. The Stop Bar is extinguished as the next section of taxiway centreline lighting is selected.

1. 12.1 Color Coded Taxiway Centreline Lighting

Where part of a taxiway equipped with centreline lighting lies within the ILS Sensitive Area or is sufficiently close to a runway that aircraft on that part of the taxiway would present an obstruction to aircraft landing or taking-off, that part of the taxiway will be identified by alternate **green** and **yellow** centreline lights, as shown at Figure 1.6 and 1.7. Pilots should avoid stopping with any part of their aircraft in such areas.

1.12.2 Taxiway Intersection Lights

At some aerodromes where multiple intersecting taxiways are not provided with selective route guidance, Taxiway Intersection Lights may be provided. These consist of a row of at least 3 steady **yellow** lights disposed symmetrically about the taxiway centreline. Pilots approaching an intersection where these lights are displayed should give way to crossing traffic unless otherwise instructed by air traffic control (ATC).

1. 12.3 Unpaved Taxiway Routes

Where taxiing is confined to specific routes on unpaved areas, the routes may either be edged with **blue** portable lights laid out as for normal taxiway edge lighting, or be provided with reflective taxiway edge markers. In certain circumstances, apron floodlighting may be accepted as sufficient illumination of adjacent taxiways. On grass aerodromes where specific taxiways are not provided, portable white lights may be used to mark the boundary of the manoeuvring area.

Chapter 2 - Visual Docking Guidance Systems

2.1 General

2.1.1 A visual docking guidance system should be provided when it is intended to indicate, by a visual aid, the precise positioning of an aircraft on an aircraft stand and other alternative means, such as marshallers, are not practicable.

2.1.2 Advanced visual docking guidance system (A-VDGS) should be provided where it is operationally desirable to confirm the correct aircraft type for which guidance is being provided, and/or to indicate the stand centre line in use, where more than one is provided for.

2.1.3 The Advanced visual docking guidance system should be suitable for use by all types of aircraft for which the aircraft stand is intended.

Figure 2.1

2.1.4 The Advanced visual docking guidance system should only be used in conditions in which its operational performance is specified.

2.1.5 The docking guidance information provided by an advanced visual docking guidance system should not conflict with that provided by a conventional visual docking guidance system on an aircraft stand if both types are provided, and are in operational use. A method of indicating that the system is not in operational use or unserviceable should be provided.

NOTE 1: *The factors to be considered in evaluating the need for a visual docking guidance system are in particular: the number and type(s) of aircraft using the aircraft stand, weather conditions, space available on the apron and the precision required for manoeuvring into the parking position due to aircraft servicing installation, passenger loading bridges, etc.*

The operator should refer to the Aerodrome Design Manual (Doc 9157), Part 4 — Visual Aids for guidance on the selection of suitable systems.

NOTE 2: *A-VDGS may provide docking guidance information in three stages: the acquisition of the aircraft by the system, the azimuth alignment of the aircraft, and the stopping position information.*

2.2 VDGS maintenance

2.2.1 Maintenance programs for various types of aircraft docking guidance systems are provided at airports and it is a very difficult to describe generally applicable maintenance program for these very different systems.

Principal requirements to be checked and maintenance action to be taken, if necessary, include:

Daily:
- system for over-all operation;
- repairing lamps;
- replacing burnt-out lamps.

Semi-annually:
- alignment of the system;
- adjusting.

Annually:
- electrical connections (if provided) for corrosion, wear and tear; cleaning, tightening and replacing
- function of relays (if provided); cleaning or replacing
- structure of the system and the function of all mechanical
- parts; repairing
- system for cleanness and moisture; cleaning and drying

Chapter 3 - Safety

3.1 Use of equipment

To use the equipment safely, the responsible personnel should refer to the International Standard IEC 61820 "Electrical installation for lighting and beaconing of aerodromes - Constant current series circuits for aeronautical ground lighting - System design and installation requirements", and to the International Standard IEC 61821 "Electrical installations for lighting and beaconing of aerodromes - Maintenance of aeronautical ground lighting circuits" for instructions on safety precautions.

- The responsible personnel should observe all safety regulations. To avoid injuries, power must always be removed prior to making any wire connections and touching any live part. Refer to the International Standards IEC 61820 and IEC 61821.

- In addition for a parallel power supply, the responsible personnel should also take into account the International Standard IEC60598 (for class I equipment).

- The responsible personnel should read and carefully follow the instructions given throughout user manual (manufactures instruction) before installing, operating, maintaining, or repairing the equipment.

- The responsible personnel should follow all applicable safety procedures required by aerodrome operator, CAA, industry standards, and government or other regulatory agencies.

- The responsible personnel should obtain and read Material Safety Data Sheets (MSDS) for all materials used.

3.2 Safety symbols

The safety symbols presented in this chapter will alert the responsible personnel to safety hazards and conditions that may result in personal injury, death, or property and equipment damage.

WARNING 1: Failure to observe this warning may result in personal injury, death, or equipment damage.

WARNING 2: Risk of electrical shock. Disconnect equipment from line voltage. Failure to observe this warning may result in personal injury, death, or equipment damage.

WARNING 3: Wear personal protective equipment. Failure to observe may result in serious injury.

WARNING 4: Do not touch. Failure to observe this warning may result in personal injury, death, or equipment damage.

3.3 Responsibilities and skilled personnel

3.3.1 The term skilled personnel is defined here as individual who thoroughly understand the equipment and its safe operation, maintenance, and repair. Skilled personnel are physically capable of performing the required tasks, familiar with all relevant safety rules and regulations and have been trained to safely install, operate, maintain, and repair the equipment. It is the responsibility of the operator to ensure that its personnel meet these requirements.

3.3.2 The Accountable Manager has the overall responsibility for the provision of airport lighting facilities and associated stand-by power generating equipment.

3.3.3 The operator should appoint the responsible person who should be responsible for ensuring that appropriate maintenance and technical inspections of airport lighting facilities are carried out and recorded in accordance with the standards and the requirements.

3.3.4 The operator should appoint the Chief of AGL/PWR Unit who should be responsible for carrying out and recording the inspection and maintenance of all airport lighting systems.

3.3.5 AGL/PWR technicians are responsible for carrying out and recording the inspection and maintenance of on-airport emergency power generation facilities associated with airport lighting.

3.4 Installation of AGL

3.4.1 An AGL system should normally comprise a single control and monitoring equipment and several constant current series circuits.

The following elements make up a typical constant current series circuit:

a) A constant current regulator (CCR.)
b) A primary series circuit, which includes:
   i. Primary cable.
   ii. AGL series transformer(s) or isolating transformer.

c) A secondary series circuit, which includes:
   i. Secondary cables.
   ii. The light fitting or other devices.

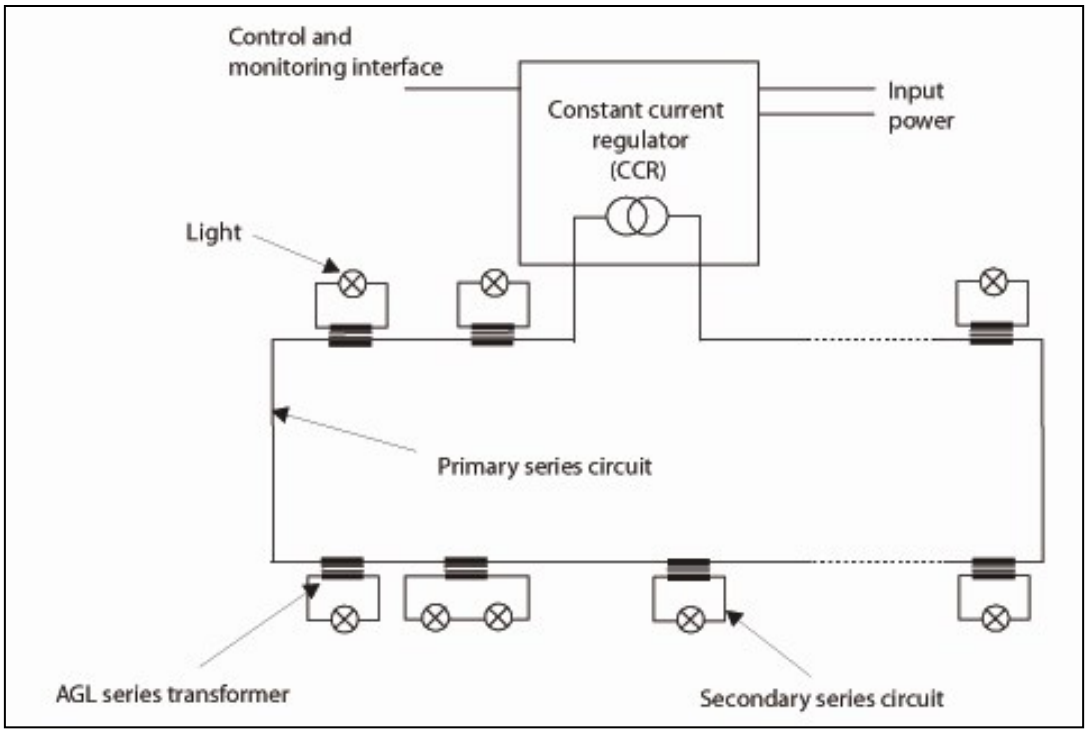

Figure 3.1– Typical AGL Constant Current Series Circuit

3.4.2 The responsible personnel should read the installation section of all system component manuals before installing the equipment. A thorough understanding of system components and their requirements will help to install the equipment safely and efficiently.

3.4.3 Only skilled personnel should be engaged to install AGL equipment. Only approved equipment should be used. Using unapproved equipment in an approved system may void CAA approvals and will void the warranty.

3.4.4 AGL/PWR Unit personnel should ensure all equipment is rated and approved for the environment in which will be used.

3.4.5 AGL/PWR technician should ensure that all instructions for installing components and accessories are followed.

3.4.6 AGL/PWR technician should ensure to install all electrical connections based on applicable standards.

3.4.7 Only electrical wire of sufficient gauge and insulation to handle the rated current and voltage demand should be used. All wiring must meet applicable standards.

3.4.8 Electrical wiring should be routed along a protected path. AGL/PWR technician should ensure they will not be damaged by moving equipment and animals (e.g. rodents).

3.4.9 AGL/PWR technician should protect components from damage, wear, and harsh environment conditions.

3.4.10 Ample room should be allowed for maintenance, panel accessibility (power products), and cover removal (power products).

3.4.11 Equipment should be protected with safety devices, as specified by applicable safety regulations.

3.4.12 If safety devices must be removed for installation, AGL/PWR technician should install them immediately after the work is completed and check them for proper functioning.

3.5 Fasteners

WARNING

- Only fasteners of the same type as the one originally supplied with the equipment should be used.
- The fasteners should be always tightened to the recommended torque. A calibrated torque wrench should be used and the recommended adhesive type should be applied.
- The responsible personnel should follow the instructions of the adhesives necessary for the fasteners.
- If this is not the case, this may cause the fasteners to loosen, damage the equipment, potentially to loosen the equipment. This can lead to a highly dangerous situation of FOD, with potential lethal consequences.

Example: It is possible to insert a 3/8" UNC screw in a M10 threaded hole. However, such a combination damages the female thread and does not ensure a correct fastening. The screw could loosen under the influence of aircrafts that roll over. The use of incorrect screws can lead to either damage to the thread in the mounting support or to an incorrect fixation of the equipment.

3.6 Operation

Only skilled personnel, physically capable of operating the equipment and with no impairments in their judgment or reaction times, should operate AGL equipment. The responsible personnel should read all procedures before operating the equipment. A thorough understanding of system components and their operation will help to operate the equipment safely and efficiently.

3.6.1 Before starting the equipment, the AGL/PWR technician must check all safety interlocks and protective devices, such as panels and covers. All devices should be fully functional. If these devices are not working properly, the equipmen shoud not be operated. Automatic safety interlocks or locked-out electrical disconnects or pneumatic valves should not be deactivated or bypassed.

3.6.2 AGL/PWR personnel should never operate equipment with a known malfunction.

3.6.3 AGL/PWR personnel should not attempt to operate or service electrical equipment if standing water is present.

3.6.4 AGL/PWR personnel should not operate the equipment in humid, flammable, or explosive environments unless it has been rated for safe operation in these environments.

3.6.5 Exposed electrical connections on equipment while the power is ON should never be touched. The technician should make sure the exposed electrical connections are proven to be dead.

3.7 Storage

The fixture should be stored in its original packing in a protected area.

Indoor storage:

- Storage temperature: -10°C to +50°C.
- Humidity: <95% non-condensing.

For long storage periods (longer than one year), the LED lights should be energized once a year at nominal intensity (6.6Amps) for 20 minutes.

Chapter 4 - Maintenance

4.1 The various elements of the organisation involved with the activities related to the applicable requirements of basic regulation should be documented in order to establish a reference source for the establishment and maintenance of this organisation.

4.2 The documented policies and procedures should be established in a way that facilitates their use. They should be clearly identified, kept up to date, and made readily available to all personnel involved in the relevant activities.

4.3 The documented policies and procedures should cover, as a minimum, the following aspects:
(1) policy and objectives;
(2) organisation structure;
(3) responsibilities and associated authority;
(4) processes and procedures;
(5) internal and external interfaces;
(6) internal control procedures;
(7) training of personnel;
(8) cross references to associated documents; and
(9) assistance from other competent authorities or the Agency (where required).

4.4 AGL maintenance staff should refer to the maintenance procedure described in the CS-ADR-DSN CHAPTER S — ELECTRICAL SYSTEMS and CS ADR-DSN.S.895 Serviceability levels.
Serviceability levels are intended to define the maintenance performance level objectives. Guidance on preventive maintenance of visual aids is given in the, ICAO Doc 9137, Airport Services Manual.

4.5 Preventive maintenance Schedule

Frequency	Check	Action
Daily	For low light output according to ICAO annex 14	- If the prism is dirty, clean the prism. - If the prism is not dirty, -replace the fixture. - and replace the faulty component in the workshop.
Monthly	Visually for condensation on inner side of the prisms (presence of moisture or water)	- Replace the fixture. - and replace the faulty component in the workshop.
	For failed fixture	- Replace the fixture. - and replace the faulty component in the workshop.
Half-yearly	For presence of water in the mounting support	- Remove all water from the mounting support. - Dry all parts of the fixture. - Replace all corroded parts. - Remove the cause of the water ingress.
After snow removal	For damaged fixture.	- Replace the total fixture. - Use a power broom to remove the snow near the fixture, if practical.

4.6 Maintenance and repair

4.6.1 Only AGL/PWR staff should be allowed to perform maintenance, troubleshooting, and repair tasks. Only persons who are properly trained and familiar with industry equipment are permitted to service the equipment.

4.6.2 Valid safety regulations must always be followed. AGL staffs should never carry out any maintenance or maintenance measures before the current is confirmed as safely disconnected. Extreme caution should be paid when disconnecting or connecting high voltage primary connectors.

- Safety devices should always be used when working on the equipment.
- Recommended maintenance procedures in the equipment manuals should be always followed.
- Staff should not service or adjust any equipment unless another person trained in first aid and Cardio Pulmonary Resuscitation (CPR) is present.
- After servicing, all disconnected equipment ground cables and wires should be reconnected.
- All conductive equipment should be grounded.
- Only approved industry replacement parts should be used. Using unapproved parts or making unapproved modifications to equipment may impair specified performance and create safety hazards.
- Interlock systems should be checked periodically to ensure their effectiveness.
- Staff should not attempt to service electrical equipment if standing water is present. Staff should have caution when servicing electrical equipment in a high-humidity environment.
- When working with electrical equipment tools with insulated handles should be used.

4.6.3 The staff engaged in the maintenance of the electrical power supply systems, prior to the commencement of work, should ensure that all electrical services must be isolated from the supply and connected to earth. Full details of the work involved must be given to the authorized person responsible for the electrical engineering services at the airport with regard to the duration of the work and so on. It is recommended that prior to starting any cutting work the nature and location of services such as cable ducts and so on should be identified. Any installation or maintenance work should only be carried out by trained and experienced personnel

4.7 Monitoring option

4.7.1 General

The monitoring option should be available. AGL staff can use the monitoring option with the Lamp Fault Detection of Constant Current Regulators or with Individual Light Control and Monitoring Systems (ILCMS) that check the status of the light by performing a continuity test on the secondary of the ILCMS remote module. The monitoring option does a check on the light. In case of a failure of the light, the failure is detected by the electronics embedded in the light.

4.7.2 Reporting of Aerodrome Lighting Outage

Any aerodrome light outage detected must be fixed as soon as is practicable. The specifications listed below are intended to define the maintenance performance level objectives. They are not intended to define whether the lighting system is operationally out

of service, nor are meant to condone outage, but are intended to indicate when lighting outage must be notified to the NOTAM office. The specifications must be used as triggers for NOTAM action, to advise pilots of actual outage, unless the outage can be rectified before the next period of use.

A light is deemed to be on outage when the main beam is out of its specified alignment or when the main beam average intensity is less than 50 per cent of the specified value. For light units where the designed main beam average intensity is above the specified value, the 50 per cent value shall be related to that design value

4.7.3 As-built Drawings

A set of as-built drawings should be kept readily available. These drawings must be kept up to date and any changes at site should be reflected immediately on these drawings. The completeness and the accuracy of all circuit diagrams, drawings and descriptions should be checked at least annually.

4.8 AGL fixture operation test

AGL/PWR staff performing AGL fixture operation test should consider:

- The power of the series transformer shall not exceed 200 W, for versions with the monitoring option.
    - Connect the fixture to the transformer.
    - At this moment, do not connect a remote communication unit between the fixture and the transformer.
    - Set the step of the constant current generator to 6.6 A.
    - Check if the light works properly for 10 s.
    - Turn OFF the constant current generator.
    - If the fixture did not work or has switched off before the end of the test time.

4.9 Maintenance and inspection of lightning protection systems

Routine maintenance and inspection of lightning protection systems are imperative to ensure continuity and compliance with national safety standards.

Airports should consider implementing preventative maintenance programs to evaluate and maintain the integrity of their lightning protection systems.

Here are a few important provisions of a lightning protection maintenance check-list that AGL staff should take into consideration:

- Inspection of all air terminals to ensure none are bent, cracked, broken or otherwise damaged.
- Refastening and tightening of components and conductors where required.
- Check for loose, damaged or cut cable connections; check connectors and splice fittings to ensure all leads are firmly connected with no loose ends.
- Ensure through-roof connectors are firm with roof conductors and attached according to industry standards and cable holders and anchors remain firmly attached with proper spacing and runs secured.
- Continuity tests and measurement of system resistance and grounding electrodes.
- Inspection and testing of surge protection devices.
- Confirmation that no part of the system has been weakened by corrosion or vibration.
- Follow-up inspection (recommended every 3-5 years, or as structural changes and/or re-roofing necessitates) to ensure overall installation methods and materials comply with industry safety standards.
- Risk assessment methodology to determine if additional structures on the property are at risk to lightning.

Figure 4.1 Lightning

4.10 Troubleshooting guide

Problem	Possible cause	Possible solution
No light or light flickers	Connection to the input power has a malfunction.	- Remove the fixture. - Check the electrical connection, the cable and the receptacles.
	The LED has a malfunction	Replace the optical assy.
	Connection of the optical assy to the PCB has a malfunction.	- Remove the optical assy. - Check the electrical connections and the cable.
	The PCB has a malfunction	Replace the inner cover assy.
Light output too low	The prism is dirty.	Clean the prism.
	The LED has a malfunction.	Replace the optical assy.
	The PCB has a malfunction.	Replace the inner cover assy.

Bibliography

- Regulation 17-2017 on requirements and administrative procedures related to aerodromes.
- ICAO Annex 14 Aerodromes (Volume I)
- ICAO Doc 9137 - Airport Services Manual Part 9
- CAP 637 - Visual Aids Handbook (UK CAA)
- IDMAN – Airfield Lighting Manual
- ADB – AGL Instruction Manual
- LPI - Lightning Protection Institute