



ICAO

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**Ninth Meeting of the Aerodromes Operations and Planning Sub-Group (AOP/SG/9)**

*Bangkok, Thailand, 30 June to 4 July 2025*

**Agenda Item 8: Airport Innovation and Technology**

**REQUIREMENT OF PASSABLE GUIDANCE REGARDING LIGHT-EMITTING DIODES (LEDs) BASED AERONAUTICAL GROUND LIGHTING (AGL) SYSTEM INSTALLATION AND MAINTENANCE IN ICAO DOCUMENTS**

(Presented by Pakistan)

**SUMMARY**

This paper highlights the need for publishing specific guidance on the design, installation, and maintenance of solid-state technology-based LED AGL systems in ICAO Design and Maintenance Documents for Visual Aids and Electrical Systems i.e. Airport Design Manual (Doc 9157) Part 4 & 5 and Airport Service Manual (Doc 9137) Part 9. Given the overwhelming increase in the use of Light Emitting Diodes (LEDs) in AGL, and the fact that most Greenfield and Brownfield airports are now opting for LED AGL instead of conventional incandescent and tungsten halogen lights, a dedicated guidance document on LED AGL installation and maintenance is essential for aerodrome operators and personnel responsible for installing and maintaining these systems, ensuring they maximize their investment.

**1. INTRODUCTION**

1.1 The advent of solid state technology is progressively revolutionizing Aeronautical Ground Lighting (AGL) Systems. The use of Light Emitting Diode (LED) in AGL has overwhelmingly increased and now a day's most of Greenfield as well as Brownfield Airports are opting LED based AGL systems instead of conventional incandescent and tungsten halogen lights. It is also anticipated that eventually incandescent and tungsten halogen lights will be completely replaced by solid state technology based Light Emitting Diode (LED) AGL Systems.

1.2 This development has brought forth some new challenges and issues for Aerodrome Operators. Owing to rapid increase in use of solid state technology for AGL applications, a specific guidance on LED AGL installation and maintenance regime is necessary for the aerodrome operator's personnel who install and maintain these lights. A common misconception about LED lights is that, given their claimed longer life span in comparison with their incandescent counterparts, they require little or no maintenance. However, an LED AGL fixture needs to be well-maintained to maximize life expectancy. The infant mortality ratio (a term used to refer early failures of LED fixtures due material defects and errors in assembly) among solid state light is very high as compared to conventional tungsten halogen lights. LED AGL fixtures also lose their brightness /intensity with passage of time. To preserve the life of LEDs, a specific maintenance schedule has to be implemented because fixtures no longer require frequent re-lamping. Lack of attention can quickly result in a small problem becoming a bigger problem that can result in permanent failure to the fixture.

1.3 Annex 14 Vol I requires States to develop aerodrome maintenance programs including visual aids that are mainly comprise of LED AGL fixtures now a day. Whilst going through the ICAO Documents for Aerodrome Design and Maintenance for Visual Aids and Electrical Systems i.e. ICAO Doc 9157 Part 4 & 5 and Airport Service Manual Part 9, it is observed that guidance provided in these documents is insufficient to understand and resolve issues faced by Aerodrome Operator in maintaining LED AGL systems.

1.4 Since the solid state technology based lights in AGL are still in evolution phase, adequate guidance on installation, acceptance testing and maintenance may be published in ICAO documents to help Aerodrome operators understand possible issues with LED AGL System including vibration, moisture and temperature etc. The proposed guidance may also include understanding of implication of possible warranty issues with LED AGL manufacturers so that aerodrome operator can maximize the investment in AGL infrastructure.

## 2. DISCUSSION

### Use of LEDs in Aeronautical Ground Lighting (AGL) System & Guidance available in ICAO Documents

2.1 Over the past recent years, the efficacy of LEDs has improved to such a degree that this technology is now used for all types of AGL, including signs, high intensity edge lights, high intensity approach lights, runway guard lights. LEDs in AGL when compared to traditional incandescent or halogen lighting offer several benefits. For example, LEDs tend to have a higher color saturation, which may provide a better opportunity to separate color boundaries and improve discriminability of airfield lights—this is particularly true during conditions such as fog or haze which tend to desaturate any light source color.

2.2 At the same time LEDs may not be compatible with certain flight deck vision technologies, such as Night Vision Imaging Systems (NVIS), Enhanced Flight Vision Systems (EFVS), or Enhanced Vision Systems (EVS), which may filter out and fail to display the wavelengths emitted by LEDs. LEDs may not produce enough natural heat to melt ice and snow from accumulating around the lighting fixture. This lack of heat also makes LEDs incompatible with some flight deck vision systems. Lastly, one of the more concerning issues relates to failure detection. While incandescent lights experience a complete failure when they reach the end of their lifecycle, LEDs tend to become slowly less bright over time until a failure. This would require a standard maintenance schedule to check the brightness of each fixture to ensure the luminance level has not decayed below a standard threshold.

2.3 While the LEDs offers some unique benefits when they are used in AGL applications like longevity of LED modules itself and bright / crisp color and color chromecity that attracts the aerodrome operators for low maintenance costs and massive savings in terms of schedule lamp replacing and frequent burns. However, feedback from some Aerodrome Operators confirms failure of considerable number LED AGL fixture in initial months of installation.

2.4 A good AGL maintenance program/plan require timely refurbishment of AGL Fixtures which will enhance useful life of AGL System. In a way, the refurbishment of LED AGL Fixture is different from traditional Tungsten Halogen AGL Fixtures. The refurbishment of later is simple & usually involves re-lamping but refurbishment of former is more delicate & involves expensive spare parts. Usually in those states, where Original Equipment Manufacturer (OEM) of compliant LED AGL fixtures is not locally available, the Aerodrome Operators in such states have to import the AGL fixtures / spares which may involve foreign exchange rate anomalies, extra duties/taxes and logistical expenditures, etc. Thus, increasing per unit cost of AGL fixture/ spare enormously.

2.5 In Pakistan, three (03) major reconstruction projects i.e. Runway Reconstruction Project at Faisalabad Int'l Airport, Quetta Int'l Airport and Allama Iqbal Int'l Airport have been completed in last three years. All the three Aerodromes have been equipped with LED CAT I, CAT II & CAT III AGL system respectively. Moreover, a fourth runway reconstruction project is under execution phase at Jinnah Int'l Airport in Pakistan and LED CAT I AGL is planned to be installed.

2.6 As LED AGL becomes a more prominent part of the visual aid system, the preventive maintenance practices once used with conventional tungsten halogen/ incandescent fixtures will, in some cases, differ from those from use of LED fixtures as in case of LED AGL fixtures the issues like effects of vibration, moisture and temperature etc are more impactful. Having cognizance of these issues arising from use of LED fixtures in Airside environment, the OEMs are now considering to include moisture, temperature and vibration sensors in light fixture to avoid early failures.

2.7 It is also found that many training opportunities offered for airfield lighting are costly and often provided in OEM premises. Once such guidance is published, member States can then develop their training modules which are necessary for the personnel who maintain these lights. The airport's staff will be able to access the guidance provided in ICAO documents. Whereas, specific equipment based training may continue to be provided by the fixture manufacturers or the Aerodrome Operator may ask the manufacturer to conduct in-house seminars. After adopting industry best practices, the adoption of this new LED technology into modern day Aviation environment will be more economically viable for ICAO member States. Therefore, there is need to include guidance related to best maintenance practices for LED Aeronautical Ground Lights. The proposed guidance may also focus on development of aerodrome maintenance programs which are required under Chapter 10 of ICAO Annex 14 Vol I. The guidance once published will help aerodrome operator to develop a suitable maintenance regime which will eventually help in saving maintenance costs for LED AGL System.

### **3. ACTION BY THE MEETING**

3.1 The meeting is invited to:

- a) note the information contained in this paper;
- b) share best practices in operation and maintenance of LED AGL Systems and lesson learned; and
- c) discuss any relevant matters as appropriate.

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