International Civil Aviation Organization
Western and Central African Office

Eleventh Meeting of the Aerodrome Operational Planning Sub-Group (AOPSG/11)
(Dakar, Senegal, 3 to 7 August 2015)

(Presented by Kenya)

Agenda 6: A Paper on Retro-Reflective Airfield Lighting

SUMMARY
Major safety, reliability and cost benefits can be achieved by use of retro-reflective lighting for airfields where there would otherwise have been no lighting. There are numerous examples in Africa where practical reasons such as cost or lack of infrastructure do not allow installation of conventional airfield lighting. The same benefits can be achieved where cost or human capital limitations restrict regular maintenance.
Consideration should be given to immediate installation of retro-reflective lights in view of the immense safety improvements that would be achieved.

Reference
ICAO Doc 9157 Aerodrome Design Manual Part 4 Visual Aids Para. 2.4

Action by the Meeting:
Proposed action by the meeting is at Paragraph 1.7

1. Introduction

1.1 Technological Background

1.1.1 According to basic optics, a mirror or other reflective surface reflects light back to the source only if it is perfectly aligned; any misalignment results in the reflected light getting directed away at twice the angle of incidence. One degree of misalignment of the mirror reflects the light away at two degrees. At long distances, a small misalignment would result in the reflected light not being visible to the source. This poses a challenge for the user who would like to detect the

reflected light. In order for the reflected light to return to the source despite some misalignment, a modification of the reflecting surface is necessary.

1.1.2 Reflective materials technology has improved dramatically in the recent past. This has enabled manufacture of special surfaces with thousands of recessed square corner shapes per square centimeter that reflect light back to the direction of incidence. This has been termed retro-reflection. The material is manufactured as thin flexible sheets that is then pasted onto a supporting structure, either metal or plastic, with the desired shape.

1.1.3 With the correct geometry and directivity of the supporting structure, up to 80% of light that falls incident to the surface can be reflected back to the source. If the surface size is appropriately chosen and the reflector well-positioned, light from aircraft headlights can be reflected in sufficient brightness to be used for some airfield lighting.

1.2 Advantages of Retro-reflective Lights:

- Do not use or depend on electricity; only aircraft headlights,
- Are always available and are not dependent on switching on or off,
- Have low procurement cost, typically about one tenth of equivalent airfield lighting,
- Require no cables to install or maintain; no trenching during installation,
- Require little or no maintenance,
- Use no bulbs or other consumables to replace,
- Have minimal training needs for installation and maintenance,
- Are available in all airfield lighting colours
- Have minimal degradation of quality over long periods (years),
- Are usable in remotest areas,
- Are easy to replace,
- Are certified by FAA, Transport Canada and other CAAs.

1.3 Disadvantages Retro-reflective Lights:

- Do not radiate own light and must be illuminated by aircraft headlights,
- Brightness dependent on aircraft headlights and not controllable from Control Towers
- Not yet ICAO-approved, although process is underway.

1.4 Applications

Used to substitute for runway edge lighting, taxiway edge lighting, apron edge lighting, approach lights, runway threshold and end lighting, PAPI, heliport lighting.

Installation of active (conventional) lighting to guide in location and initial alignment of the runway is necessary in applications where the retro-reflective lights are intended or may be used as the only guidance. Solar airfield location and identification lighting may be a practical solution, possibly installed with radio-activated on-off control for greater availability.

Retro-reflective lighting would open up areas that currently have no reliable air transport. It would also enhance safety dramatically in situations where vehicle headlights are used for emergency runway lighting operations.

1.5 Countries Where Approved or in Use,

- USA – remote airports and military airports (all applications)
- Canada - remote airports and military airports (all applications)
- Nigeria – used in major airport (all applications)
- Singapore – approved and used for straight parts of taxiways in major airports
- South Africa – domestic airports (all applications)
- Kenya – on trial for taxiway lighting at JKIA
- Somalia – domestic airport (all applications)
- Europe - use and type of application could not be confirmed in time for this paper.

1.6 Conclusion

Major safety, reliability and cost benefits can be achieved by use of retro-reflective lighting for airfields where there would otherwise have been no lighting. There are numerous examples in Africa where practical reasons such as cost or lack of infrastructure do not allow installation of conventional airfield lighting. The same benefits can be achieved where cost or human capital limitations restrict regular maintenance.

Consideration should be given to immediate installation of retro-reflective lights in view of the immense safety improvements that would be achieved.

1.7 ACTION BY THE MEETING

1.7.1 The meeting is called upon:

a. to note the information in this paper;

b. for States to consider the use of retro-reflective lighting in situations where safety of aircraft operations would be enhanced.

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