INTERNATIONAL CIVIL AVIATION ORGANIZATION

TWENTY NINTH MEETING OF THE ASIA/PACIFIC AIR NAVIGATION PLANNING AND IMPLEMENTATION REGIONAL GROUP (APANPIRG/29)

Bangkok, Thailand, 3 to 5 September 2018

Agenda Item 3: **Performance Framework for Regional Air Navigation Planning and Implementation**

3.1: **AOP**

INFRARED SPECIFICATIONS FOR AVIATION OBSTRUCTION LIGHT COMPATIBILITY WITH NIGHT VISION GOGGLES

(Presented by the United States)

SUMMARY

The use of Night Vision Goggles (NVGs) is increasing in civilian aviation to conduct search-and-rescue, emergency medical transport, and other flight operations. The use of NVGs can function to increase pilot situational awareness. However, the Federal Aviation Administration (FAA) has found that with the gradual replacement of incandescent obstruction light fixtures with LED light fixtures, some pilots using NVGs are unable to acquire red-colored LED obstruction lights due to the light generated being outside of the combined visible and near-infrared spectrum of NVGs with objective lens filters. The FAA conducted research on the interaction of Light Emitting Diodes (LEDs) used in obstruction lighting fixtures with NVGs and has determined performance specifications for infrared (IR) emitters to be added to or used in conjunction with LED L-810, L-864 and L-885 obstruction light fixtures to ensure compatibility with NVGs with a Class B filter.

This paper relates to –

Strategic Objectives:
*A: **Safety** – Enhance global civil aviation safety*
*E: **Environmental Protection** – Minimize the adverse environmental effects of civil aviation activities*

1. INTRODUCTION

1.1 The FAA has recently determined performance specifications for IR emitters are to be added to red LED obstruction light fixtures to ensure compatibility with NVGs currently in use. The determination was based on research conducted by the FAA to investigate IR spectrum issues preventing the acquisition of red LED obstruction light fixtures by pilots using NVGs and to recommend appropriate performance specifications for IR emitters that would resolve these issues.

2. DISCUSSION

2.1 A Night Vision Imaging System (NVIS) is an optical instrument that allows images to be produced in levels of light approaching total darkness. NVGs constitute one component of a NVIS. NVGs in aviation are designed to be used for flying at night, primarily during Visual

Meteorological Conditions (VMC). They are mounted in a binocular form on a pilot's helmet. The term usually refers to a complete unit, including an image intensifier tube, a protective water-resistant housing, and mounting system.

2.2 Pilots using NVIS equipment that filter the adverse effects of cockpit lighting might not be able to see LED-based obstruction lighting. The preceding could result in a safety hazard to both the pilot and ground personnel. NVGs function by amplifying ambient light, allowing the pilot to better see terrain and other potential hazards in dark or overcast conditions. NVGs help pilots maintain spatial orientation and general situational awareness. LED-based lighting has largely replaced incandescent technology for red (and some white) obstruction lighting because of its reduced maintenance requirements and extended service life. Traditionally, NVIS systems were built to detect the high short wave IR emission of incandescent-based lights – this facilitated easy detection despite the presence of filters for the aircraft cockpit lighting. This is no longer true with LEDs which have little IR emission. In addition, LEDs have a relatively narrow band of spectral emission. The same cockpit lighting filters used to block red emission from the cockpit lighting may prevent the pilot from seeing LED obstruction and aviation ground lighting.

2.3 Current NVGs are sensitive to light with wavelengths between approximately 450 nm and 920 nm. This range overlaps the visible spectrum of light (approximately 390 nm to 700 nm). If visible light in the cockpit is not effectively filtered by NVGs, the automatic gain control of the NVGs to be activated and potentially reduce the visual acuity for the pilot. As a result, filters are installed on the objective lenses of the NVGs. NVG filters include Class A, Class B, and Class C. Class B filters, which were the focus of this FAA research, restrict lighting with wavelengths below 665 nm from being viewed by NVG, allowing the use of some red lighting in cockpit displays and other Class B lighted instrumentation. However, because red LED obstruction lights have a limited emission range (approximately 620 nm to 645 nm), some red LEDs may not be visible using Class B filters.

2.4 Aviation red obstruction lights are used to increase conspicuity of obstructions during nighttime. The red obstruction light system is composed of flashing omnidirectional lights (L-864 and L-885) and/or steady-burning or flashing (L-810) lights. The FAA currently has in place standards and recommended practices for the marking and lighting of obstructions. Generally, obstructions include structures with heights of 200 ft. Above Ground Level (AGL) or greater, and structures on, or in the vicinity of airports.

2.5 The FAA conducted research to determine the minimum radiant intensity, output wavelength and beam width of IR emitters to be incorporated into or used in conjunction with red LED obstruction light fixtures. The research involved flight evaluations using subject pilots to determine the level of radiant intensity needed for pilots to acquire a variety of L-810 and L-864 obstruction light fixtures with IR emitters. The acquisition and avoidance distances of pilots using NVG with LED based obstruction lights with IR emitters should meet or exceed the nighttime acquisition distances of pilots without the aid of NVG. A L-810 fixture with an IR emitter should be acquired at a minimum distance of 1.4 SM and a L-864/L-885 fixture should be acquired at a minimum distance of 3.1 SM. These distances are necessary to provide pilots with adequate time to see the obstruction and take evasive action to avoid coming within 2,000 ft. of an obstruction.

2.6 The FAA has determined performance specifications for IR emitters to resolve the issues precluding the acquisition of LED obstruction light fixtures by pilots using NVGs with a Class B filter.

2.7 The nominal IR output wavelength is 800-900 nm. This range coincides with the nominal spectral response range of NVGs, ensuring the fixtures will be visible by all current NVGs regardless of the class of objective lens filter used.

2.8 The vertical beam width of IR emitters included in a LED-based L-810 light fixture or used in conjunction with a LED-based L-810 light fixture is minimum 10° centered between +4 and +20°. The vertical beam width of IR emitters included in a LED-based L-864 and L-885 fixture or used in conjunction with a LED-based L-864 and L-885 light fixture is minimum 3°. The horizontal beam width is 360° unobstructed. These requirements are to be identical to the existing FAA requirements for the photometric beam width and distribution of the visible light.

2.9 The minimum radiant intensity for IR emitters included in LED-based L-810 light fixtures or for standalone IR emitters to be used in conjunction with LED-based L-810 light fixtures is 4 mW/sr. The minimum radiant intensity for IR emitters included in LED-based L-864 and L-885 light fixtures or for standalone IR emitters to be used in conjunction with LED-based L-864 and L-885 light fixtures is 246 mW/sr.

2.10 In the event of a failure of the IR emitter, the visible light must be de-energized and an alarm signal must be generated to provide indication of the failure. The IR emitter must be monitored in accordance with the monitoring requirements for FLASH/FAIL status of L-864, L-810 and L-885 visible light units.

2.11 The IR emitters are to be on whenever the visible light is energized and off whenever the visible light is de-energized.

3. CONCLUSION

3.1 The FAA Office of Airports will continually and proactively use any available resources to enhance aviation safety to the best extent practicable.

4. ACTION BY THE MEETING

4.1 The Meeting is invited to:

a) Note the contents and conclusions of this paper; and

b) Consider adoption or implementation of the technologies and/or processes discussed to address on-going safety challenges.

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