Modeling of secondary optics LED aerodrome fires

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***Abstract*- The development of LED technology has allowed the Ukrainian Association of Lighting Enterprises of Vatra Corporation to develop the construction of LED equipment for the airfield light signal systems. Features of fire design, angles of installation of fires, difficulties in observing LED aerodrome fires - these factors influence the decision making when establishing visual contact. In the event of the signaling system failure, the crew will not be able to determine its location in the space or the visual contact may be erroneous. To solve the complex problem of observing light signals from LED light-signal aerodrome fires, need a tool using the MatLab interface is offered. The tool is used to simulate secondary optics for the design of LED aerodrome fires with the appropriate light distribution.**

I. Introduction

The fires of the light-signal system at the aerodrome are set in a certain sequence with the required light characteristics and color. The lighting characteristics and locations of aerodrome fires must be such that, in difficult meteorological conditions, the pilot can clearly see the required number of fires of the light-signal system. Each aerodrome fire of the light-signal system must be visible within such a horizontal angle as to allow the pilot to observe during the piloting of the aircraft both strictly in the direction of the runway and taking into account the permissible inaccuracy guidance by radio facilities.

The requirements for the design and lighting characteristics of the glide fire are given in the applicable regulatory documents [1, 2, 3, 4, 5].

The questions of visual search for objects on the runway, depending on the transparency of the atmosphere with the help of modeling in the created tools of MatLab environment, are considered in [6, 7, 8].

II. Problem statement

Taking into account that visibility as a aerodrome fires observation must be provided from a certain area of space, it is clear that the photometric figure (frame) must be normalized in accordance with ICAO recommendations [1]. Spatial radiation parameters (Fig. 1) provide the necessary guidance during approach.

According to the perception of light color by the pilot, it is necessary that the technical conditions in determining the chromaticity of the colors of airfield lights meet the current conditions of the International Commission on Lighting (ICL)(Fig. 2) [3,4].

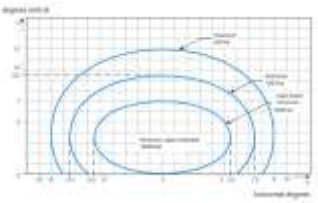

Fig.1. Diagram of isocandles of side lights at a runway width of 45 m (White lights)

But it is impossible to set the technical conditions for colors so as to completely eliminate the possibility of their misperception. For sufficiently reliable recognition, it is important that the illumination of the eye significantly exceeds the threshold of perception, that the color does not undergo significant changes due to selective (selective) atmospheric attenuation (absorption) and the color vision of the observer was normal. There is also a risk of distorted color perception in very bright light, which can be caused by a high-intensity light source at close range. Experience has shown that satisfactory recognition is possible when these parameters are given due attention.

Fig.2 Colors of LED aerodrome light signals

Characteristics of chromaticity are made on the basis of research of visual perception and correspond to the coordinate system accepted by ICL. The parameters of the fire color are compared with the parameters determined on the outer curve of the isocandel, in order to ensure the absence of such a color change that could lead to incorrect perception of the light signal by the pilot.

III. Computational methodology

The development of LED technologies has allowed the Vatra Ukrainian Corporation to develop a design of LED aerodrome universal side light (Fig. 3). The use of LED modules in the construction of airfield lights has a number of advantages. The most significant advantages of LED airfield light include: low power consumption, instant on and off, vibration resistance,

long service life, high light quality with a color rendering index in the range of 80-95 and an optimal radiation pattern with the ability to create directional light.

Fig.3 Ground side fire of the runway

The design of the ground side runway light consists of two oppositely directed LED assemblies of eight LEDs mounted on a board complete with special optics to assemble and maximize light flux. Each module is represented by eight Cree LEDs (Fig. 4).

Fig.4 Ground bidirectional side fire of the runway

The design of the bidirectional LED side light of the runway is additionally supplemented by a reflector that forms the output light in the upper hemisphere.

Fig. 5 Improved design of bidirectional runway side lights

Thus, the improved design of the bidirectional side light of the runway can be considered a universal fire, which is a replacement for the installation of two ground lights and a roundabout type "bush". This design of universal fire must emit light intensity in the upper hemisphere of not less than 50 cd, performing the function of circular fire (Fig. 5).

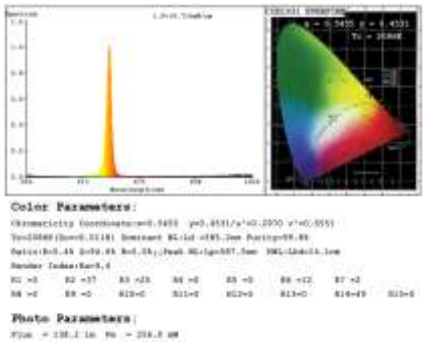

Fig.6 The result of the study of the chlorine characteristics of the side fire of the runway

In the study of bidirectional side LED runway light, the light radiation has parameters that meet (Fig. 6):
- chromaticity coordinates: x = 0,5455 y = 0,4531 / u '= 0,2970 v' = 0,5551
- dominant wavelength 585.2 nm with 99.8% color purity
- luminous flux 138.2 lm
- RGB color ratio: R = 5.4% G = 94.6% B = 0.0%.

IV. Conclusions

Airfield lights installed on the ground must be certified.

Accordingly, the light signal system aerodrome equipment must meet certification requirements for the criteria:

-functionality;

- climatic;

- structural;

- electrical;

- lighting and reliability.

Requirements for the design of LED aerodrome fires devices:

- reduction of energy costs;
- minimizing construction of airfield lighting devices;
- manufacturability of designs airfield lighting devices.

The use of LED lights in the construction of airport design requires modern appearance, namely the right to select secondary optics for LED airfield lights. Therefore, a tool is needed to help model secondary optics in the design of LED lights with appropriate light distribution.

References

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