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Management of the Maintenance of Public Lighting Through Geographic Information Systems

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ABSTRACT : *The purpose of this work is to effectively expose preventive maintenance management in public lighting. For this, an analysis of the public lighting system installed in the urban area of a city of more than 70,000 inhabitants was carried out based on the characteristics, uses and types of elements used in the public lighting systems of different manufacturers, the accessories installed in each of the luminaires obtaining a detailed description to create an adequate management system for their maintenance, regardless of the type of technology used. Finally, the frequency of failures of the public lighting installations was analyzed and the proposed maintenance techniques that make up the proposed methodology are analyzed under an economic, social and environmental analysis.*

KEYWORDS - *maintenance, public lighting system, energy management*

I. INTRODUCTION

Currently it is estimated that 35% of primary energy resources are used in the production of electricity, influencing CO2 emissions into the atmosphere. It is estimated that 15% of energy consumption in the world is used in lighting systems. For such reasons for public lighting (PA) in particular, measures are adopted for energy saving and efficiency to reduce excessive energy consumption. In this work, maintenance procedures focused on the corrective field with the use of the remote management technique are analyzed, in order to establish the maintenance time period in the defined areas and take the appropriate measures in each element with a view to improving the efficiency in the public lighting system and the saving of materials [1][2].

II. TOOLS AND METHODS

This study was carried out in a public lighting system with a total of 580 luminaires installed.The procedure began with the numbering of the luminaires, the orientation of the luminaires being considered a very important factor. The information was recorded for both the numbered luminaires and the luminaires evaluated based on their photometric parameters, location, code, type of luminaire, power, power level, form of control, brand, model, and the characteristic data of each accessory that make it up [3][4].

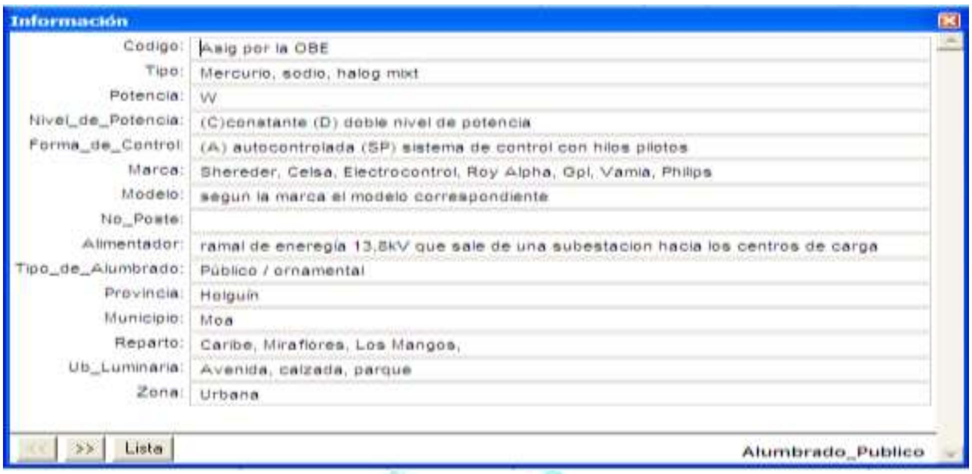

Fig.1 Data to enter for one of the lights

Among the types of maintenance, three types stand out: predictive or maintenance by condition, preventive, which is usually by cyclical replacement or reconditioning, and corrective. However, detective maintenance or fault detection can be considered, which consists of searching for signs or symptoms that allow a fault to be identified before it occurs, for which purpose inspections, monitoring and verifications are carried out. A characteristic that to make a corrective decision depends on the measurement condition carried out and verified. For example, from the measurement of the vibrations of an equipment, it can be decided to change it or not or to determine if there is a potential failure condition, that is, there must be clarity in the symptoms and that the failure in the process of happening. This type of maintenance was applied in the work considering the following categories depending on the type of failure.

• For failures with hidden consequences, the optimal task is one that achieves the required availability of the protection device.

• For failures with safety or environmental consequences, the optimal task is one that manages to reduce the probability of failure to a tolerable level.

• For failures with economic consequences (operational and non-operational), the optimal task is one that minimizes total operating costs.

III. RESULTS

Once the lighting circuit data has been digitized, different layers are introduced into the software, introducing all the information for each point, this would facilitate the geographical location of each element with a visual display of that information. A feature that geographic information systems have is that the information can be organized by layers, which guarantees a simple form and allows a faster visualization, so that the information is easily identified and displayed in a certain area. Of course, not including the ability to display and extract information through listings or other convenient ways when preparing reports [4].

One of the advantages of this methodology is that it not only allows the proper identification of the luminaire, but also reports that the luminaires are in poor condition and that their luminous flux is below the norms, which in turn consume energy and provide reagent. to network. Another advantage that the system has is the geographical location, which allows graphically evaluating its location and analyzing only the consequences within that area. Another important characteristic when carrying out all the information is that it allows knowing when the date of installation was and its useful life, to account for the maintenance or replacement time of the same. The representation of each analyzed point and its location with the use of the software for this work are shown below [5].

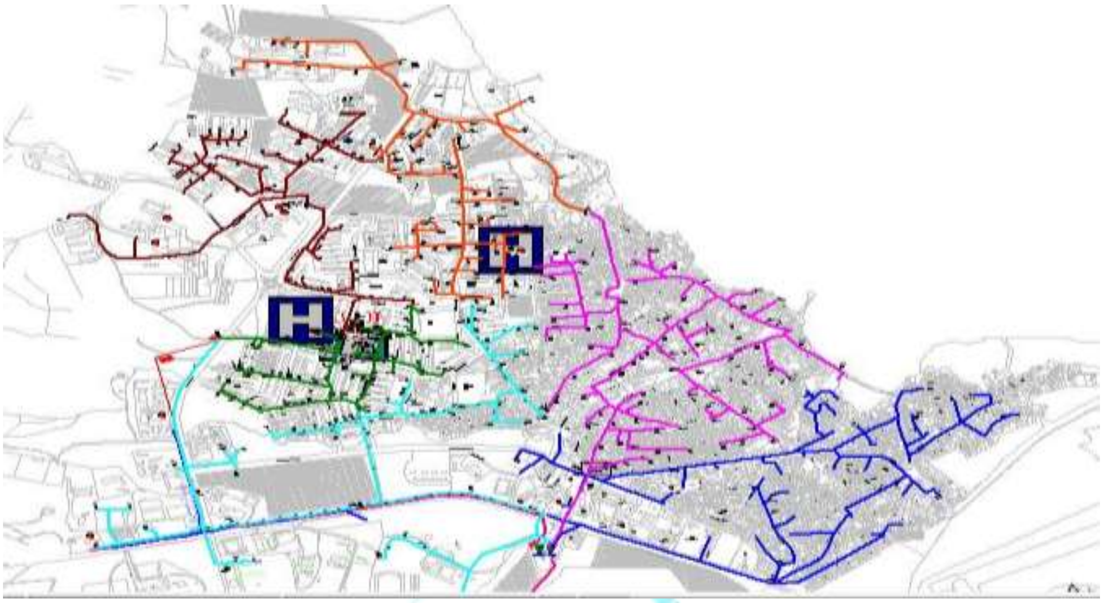

Fig. 2 Graphical representation of points

For the implementation of maintenance management, luminaires with LED technology are introduced, taking advantage of their performance, hours of useful life and color discrimination. The initial parameters of the methodology for its application to public lighting systems are shown in Fig. 2. The previous figure represents the first part of the proposed methodology, in which it is defined that the problem to be dealt with in this case is the maintenance of public lighting. In order to obtain the expected results, the characteristics and dimensions of the road to be illuminated must be entered, and the lighting levels are within the established standards. The height and distribution of the installed luminaires are subject to a permissible lighting level for the type of lamp depending on the manufacturer and its construction characteristics. Once the necessary calculations have been made, the necessary parameters and variables are obtained to determine the number of luminaires based on the number of lumens [6][7].

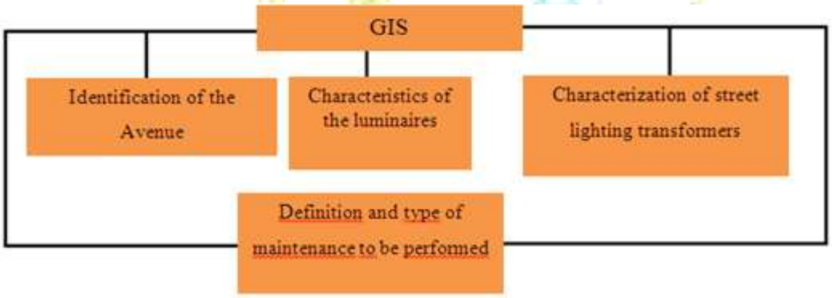

Fig.3 Algorithm of application of the methodology

To complete the analysis, possible solutions must be programmed, implemented and verified. Of course, all this depends on the good performance of the work carried out in the first stage. This second stage is carried out from the use of the software, storing the data from the first stage that will allow decision-making for the maintenance of the public lighting circuit, the replacement of luminaires, the maintenance and with this, Increase the efficiency of the lighting system.

Advantages of the proposed maintenance management system
• Longer response time to a specific failure.
• Fuel savings on the way to the job site.
• Clarity and effectiveness of reports to the provincial office.
• Better performance of the SAP service.

• Forecast of the growth of the demand of the electrical system.
• Diagnosis of failures and reliability of the municipality's electrical power system.
• Data physically stored in its entirety.
• The maintenance, recovery and replacement of SAP from its characteristic data can be carried out at lower costs.
• It allows a great variety of cartographic models with a minimum investment of time and money.
• Spatial and nonspatial data can be analyzed simultaneously in a rational way.
• Conceptual models can be tested quickly and repeatedly, facilitating their evaluation.
• Analysis of temporal changes can be carried out efficiently.
Disadvantages
• Costs and technical problems to convert analog data into digital format.
• You need specialists to keep data digitally on computers.
• False feeling of greater reliability and precision.
• High cost of acquiring the necessary equipment and programs.
• Data acquisition, spatial analysis, and decision-making processes are integrated into a common information flow context.

IV. DISCUSSION

Once you have all the characteristics of the system entered in the georeferencing system, you go on to choose the type of lamp, for that you start from a comparison between the sodium vapor technology and the LED technology, to establish which of the two technologies is more efficient to meet the main lighting parameters, to achieve rational and efficient Among the characteristics to consider are [8].

• Useful life of the equipment
• Type of light emitted by the equipment (not harmful in terms of glare, for vehicular and pedestrian traffic).
• Equipment cost.
• Mounting height
• Light area
When evaluating all these aspects, a new LED lighting system is proposed:
Characteristics
Nominal power: 100W + -50% T Color: 5000 k
Nominal voltage: 150 v -230 V Service life: 50,000 h
Working voltage: 90v- 265V
Luminous flux: 9000 lm

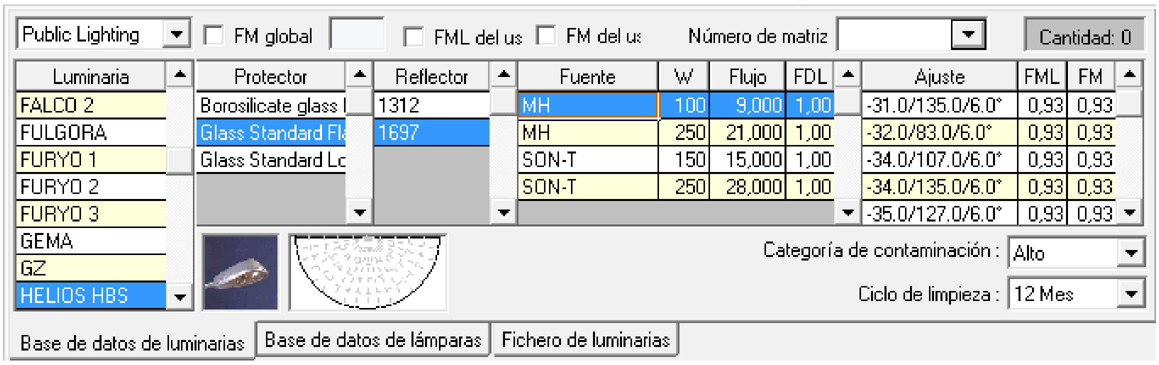

Table 1. Luminaire and lamps database

The application of the methodology was carried out for a circuit of 580 lamps, with 48 poles for the evaluation of costs. Energy saving through the improvement of the studied street lighting ignition system. The calculation of the energy to be invoiced was carried out on the basis of 90%, in accordance with the established utilization coefficient and 11 average hours of use, in addition the calculation of power in watts was carried out with the value indicated by the manufacturer of the lamps that They operate directly on the line and are affected by the consumption of auxiliary equipment by those who use additional devices or ballast for their connection to the network.

V. Conclusion

An AP maintenance management system was developed for a public lighting circuit through a georeferenced system (GIS), integrating quantitative, qualitative and economic aspects to carry out adequate maintenance.

The maintenance management system was validated through GIS obtaining proposals to change the current technology for LEDs and thus obtain a total saving of 648 MW and $ 155,520.00, with a recovery time of 0.33 years.

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