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Design of Outdoor Lighting Area of 13 Lpg Arun Substation With Point By Point Calculation Method Using Softwaredialux 4.10

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ABSTRACT
lighting is one of the important factors in designing a space to support user comfort. A room with a good lighting system can support the activities carried out in it. In designing a room or a location, it must be done in full, among others, in the selection of lamps, calculating the number of lamps and the amount of Lux needed for the room. The Arun LPG Terminal is one of the projects being worked on by PT. Engineering Engineering. One of the stages of the work is to design the intensity level of artificial lighting on Substation 13. Calculation of the number of Lux obtained by the point-by-point method using DIAlux 4.10 Software so that the intensity of the lighting produced is in accordance with the API 540 standard. The simulation results show that the effect of LLF variations, field The working and tilt angle is in accordance with the API Standard where the average light intensity (Eav) in the outdoor area is not less than 50 Lux.
Keywords: DIALux 4.10, API 540, Strong lighting intensity

I. INTRODUCTION

Lighting is one of the important factors in designing a space to support user comfort. A room with a good lighting system can support the activities carried out in it. To carry out all activities that are in a room, an adequate lighting intensity is needed, namely in accordance with predetermined lighting standards, so in designing the lighting of a room it must be carried out with full accuracy, among others, in terms of choosing lamps, and calculating the number of lamps needed. to light up the room.The Arun LPG Terminal is located at the Arun LNG/LPG facility in Lhokseumawe Aceh which was built in 1987 and is designed as an LPG Storage and Loading facility. Since 2001, this facility has stopped producing LPG in line with the expiration of the LPG sales contract.

The revitalization of the Arun LPG Terminal is intended to replace the function of Floating Storage - STS Teluk Aru in P. Susu and TelukSemangka in Lampung with the aim of saving operating costs, increasing the resilience of domestic pressurized LPG reserves, asset utilizationnasionaldanuntukjangkapanjangdapatdikembangkansebagai Terminal LPG Transhipment.

The future concept of the Arun LPG Distribution Terminal is to modify the Propane and Butane Storage Tanks and existing Loading facilities to be able to receive refrigerated Propane and refrigerated Butane from other sources (hereinafter referred to as "unloading") and store them in the existing refrigerated Propane and Butane Storage Tanks. The existing loading system will still be used to transfer refrigerated Propane and refrigerated Butane to Semi Refrigerated tankers. A new system will be added, namely to produce mixed pressurized LPG and store it in Spherical Tanks, before being sent (loading) to ships and trucks for distribution.

The benefit of this paper is to learn how to design and design the Arun LPG Terminal 13 Substation Outdoor Area Lighting in accordance with predate

rmined standards, in this case the standard used is the API 540 (American Petroleum Institute) standard

1. Design Method
Lighting Basics

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Light is only one part of the various types of electromagnetic waves that fly into space. These waves have a specific length and frequency, whose values are distinguished from other light energies in their electromagnetic spectrum.

Visible light, as can be seen in the electromagnetic spectrum, given in Figure 1, represents a narrow band between ultraviolet (UV) light and infrared (heat) energy. These light waves are able to stimulate the retina of the eye, which produces a visual sensation called sight. Therefore, vision requires a functioning eye and visible light. :

Figure 1 Visible Radiation

DIALux

DIALux is Engineering software originating from Germany which is used to simulate an area and lighting system needed to determine the distribution of light in accordance with predetermined standards. Dialux is used to design lighting for indoor and outdoor areas as well as lighting for other objects. Dialux can design an area as well as lighting complete with furniture and knick-knacks that can be adjusted to the wishes of the user.

3. Outdoor Substation 13 Arun LPG Terminal

In the design, the Arun LPG Outdoor area also needs lighting planning, because in the outdoor there is also equipment such as transformers, compressors, bank capacitors, emergency fuse links, etc. The purpose of this outdoor lighting is to find out where the equipment is and can control equipment activities so that the equipment is safe. In addition to lighting equipment, this outdoor lighting also aims to provide access to street lighting for officers and can find out the direction of the exit in case of an emergency situation.
The outdoor design of the Arun LPG Substation to be built, here is the outdoor floor plan in CAD form:

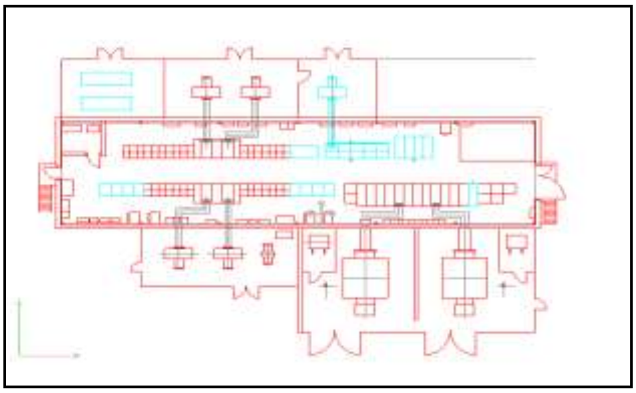
Figure 2 Drawing Layout Substation 13 LPG Terminal Arun

Calculation Methods
Point By Point Method

A method for calculating horizontal luminance on a workplane in space, as well as uniformity. Only direct lighting from the luminaire to the workplane is taken into account. The illumination at each point is determined by the inverse square law and the cosine law for the intensity data for each luminaire under a certain angle.

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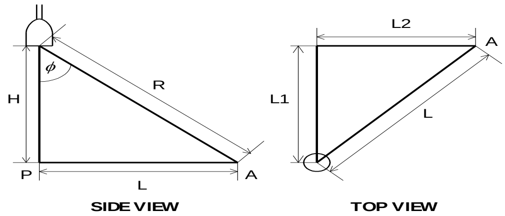

Figure 3 Determination of lux measurement using point by point method

$$E_{\text{(at point A)}} = \frac{cd \times \cos\phi \times LLF}{R^2} = \frac{cd \times \cos^3\phi \times LLF}{H^2}$$

Light Settings

According to the previous discussion, there are 2 types of lights that are used to provide outdoor lighting, including:

- COOPER CROUSE – HIND VMV VMVS2A150G-RD70

Lamp : LU150
Luminous Flux : 16000 lm
Power : 189 W
Correction Factor : 1

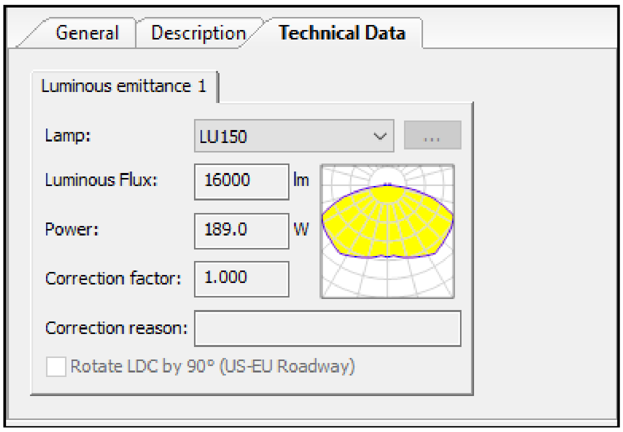

Figure 4 COOPER CROUSE – HIND VMV VMVS2A150G-RD70 .lamp selection

High Pressure Sodium (HPS)

- COOPER CROUSE – HINDS eLLK eLLK92036_36

Lamp : T26 36W/830
Luminous Flux :6700 lm
Power : 72 W
Correction Factor : 1

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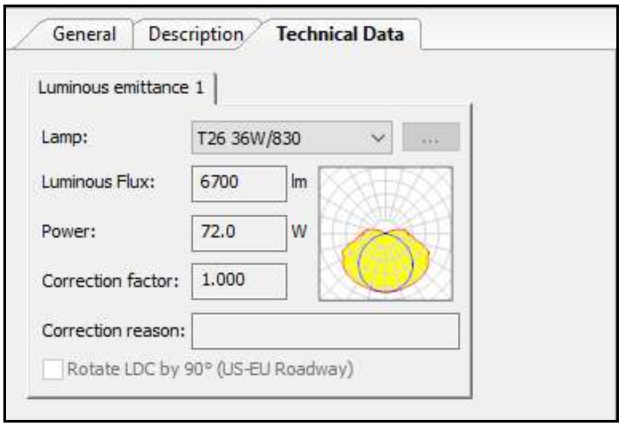

Figure 5 COOPER CROUSE – HINDS eLLK eLLK92036_36 .lamp selection

After the selection of lamps is complete, then proceed with the placement of lamps according to their placement.

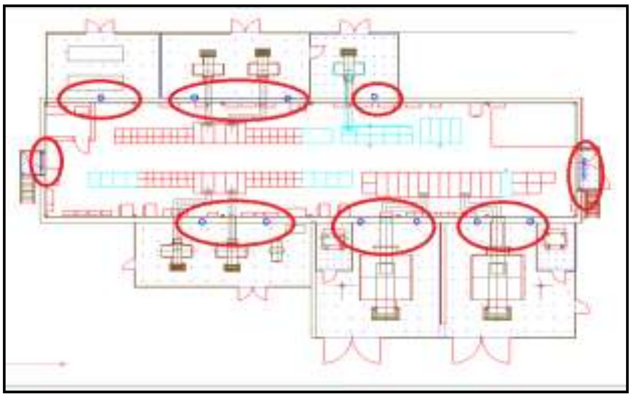
Figure 6 Outdoor 2D Visualization with lighting

II. SIMULATION RESULTS

The test was carried out by running a simulation on the dialux and the results were in the form of a 3D visualization image for each area along with the lighting visualization and data on the average lighting intensity of each area. The way to do this is by selecting the Start Calculation feature, and after that the illumination calculation will be processed.

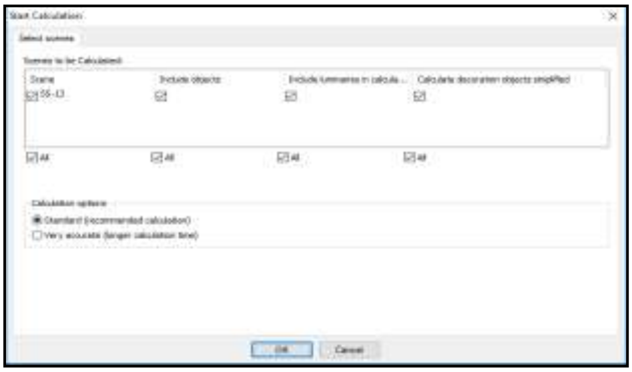
Figure 7 Display Start Calculation

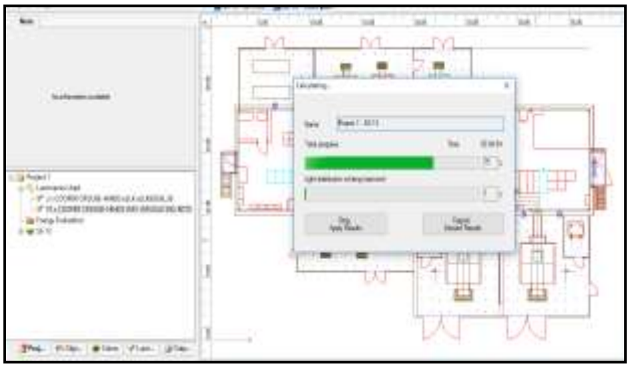

Figure 8 Illumination calculation process

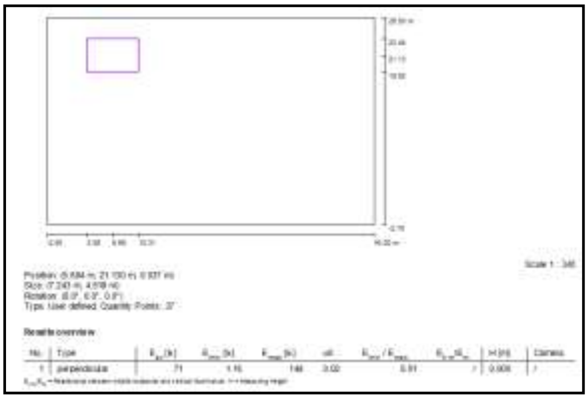

Figure 9 Lux Calculation Results on Capacitor Bank Area

Figure 9 is one of the lux calculations from one area, namely the capacitor bank area. In this area a High pressure sodium (HPS) lamp COOPER CROUSE – HIND VMV VMVS2A150G-RD70 can be seen that the average lux value (Eav) is 71 lux , the minimum lux value (Emin) is 1.16 lux and the maximum lux value (Emax) is 148 lux.

Calculation Lux Area Platform

Table 1 Calculation Lux Area Capasitor Bank

NO	AREA	LLF	E_{av}(lux)	E_{min} (lux)	E_{max}(lux)	u0	E_{min}/E_{max}
1	Capasitor Bank	0,6	72	1,71	147	0,02	0,01
		0,7	84	1,37	172	0,02	0,01
2	Trafo Area PT-8313-C & D	0,6	95	5,36	165	0,06	0,03
		0,7	111	6,25	1,92	0,06	0,03
3	Platform Right side	0,6	125	101	149	0,81	0,68
		0,7	146	118	174	0,81	0,68
4	Trafo Area PT-8313-H	0,6	87	2,75	154	0,03	0,02
		0,7	102	3,2	180	0,03	0,02
5	Trafo Area PT-8313-E	0,6	77	1,41	186	0,02	0,01
		0,7	90	1,64	217	0,02	0,01

	& F						
6	Platform Left side	0,6	71	57	83	0,81	0,69
		0,7	82	67	97	0,81	0,69

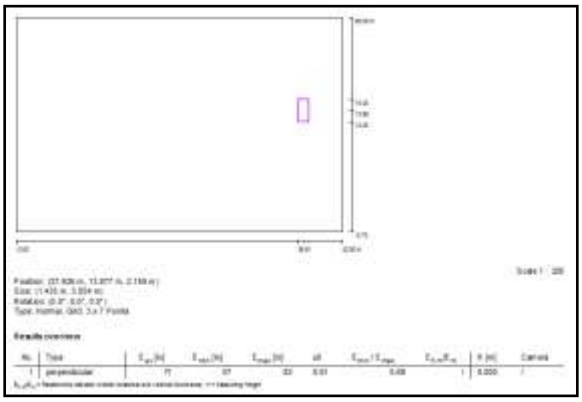
Figure 10 Lux Calculation Results on Platform Area left side

Figure 10 is one of the calculations for lux from one area, namely the Platform left side area. In this area the COOPER CROUSE – HINDS eLLKeLLK eLLK92036_36 TL (Fluorescent) lamp is used, it can be seen that the average lux value (Eav) is 71 lux, the value of lux the minimum (Emin) is 57 lux and the maximum lux value (Emax) is 83 lux.

From the simulation, the Lux value results based on variations:

a. Variation of LLF (light loss factor) to the number of Lux

The variation of LLF (light loss factor) is 60% (0.6) and 70% (0.7). The LLF value greatly influences the lux value obtained. For example, a capacitor bank with an LLF of 0.6 produces an average lux (Eav) of 72 lux, while the LLF of 0.7 produces a lux value of 84 lux. So the greater the LLF value then the resulting lux will also be even greater.

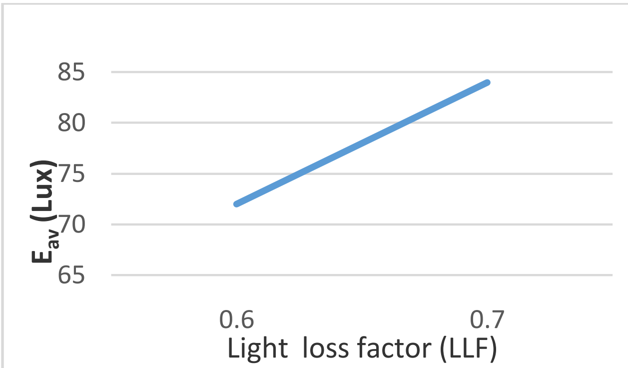

Figure 11 Graph of the effect of LLF variations on the Lux .value

In Figure 11 is a graph of the effect of LLF variations on Lux in the Capacitor Bank area, it can be seen that the increase in the LLF value has an effect on the Lux value. The increase in the LLF value is directly proportional to the lux value. The greater the LLF value, the greater the lux value.

Variation of workplane to number of Lux

Table 2 Variation of workplane to the number of Lux

NO	AREA	Workplane (m)	E_{av}(lux)	E_{min} (lux)	E_{max}(lux)	u0	E_{min}/E_{max}
1	Capasitor	0	72	1,71	147	0,02	0,01

	Bank	1	101	30	236	0,3	0,13
2	Trafo Area PT-8313-C & D	0	95	5.36	165	0,06	0,03
		1	127	6,75	256	0,05	0,03
3	Platform Right side	0	125	101	149	0,81	0,68
		1	257	138	420	0,54	0,33
4	Trafo Area PT-8313-H	0	87	2,75	154	0,03	0,02
		1	118	23	250	0,19	0,09
5	Trafo Area PT-8313-E & F	0	77	1,41	186	0	0,01
		1	111	1,27	271	0,01	0
6	Platform Left side	0	71	57	83	0,81	0,69
		1	126	82	171	0,65	0,48

In Table 2 using Workplane variations, namely 0 m and 1 m. For example in the Capacitor bank area, the lux measurement at 0 m produces an average Lux (Eav) of 72 lux. The measurement from a height of 0 m in this simulation is not at 0 m but at a height of 0.037 m from the floor surface. Meanwhile, if the measurement height is increased to 1 m, the average Lux value (Eav) is 101 lux. In the platform area right side and platform left side, the measurement point is 0 m from the top floor of the stairs. So the higher the measurement point (workplane), the greater the lux value.

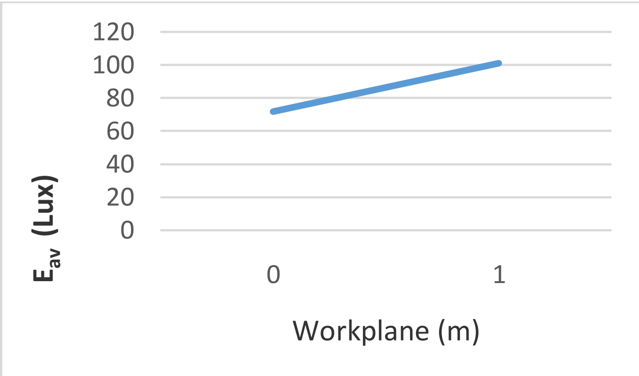

Figure 12 Graph of the effect of workpalne variations on Lux

Figure 12 is a graph of the effect of Workplane variations on Lux in the Capacitor Bank area, it can be seen that the increase in the Workplane value/measurement point has an effect on the Lux value obtained. The increase in the workplane value is directly proportional to the lux value. the higher the workplane/measurement point, the greater the lux value.

Variation of the tilt angle of the Lamp to the amount of Lux

Table 3 Variation of the angle of the lamp tilt to the number of Lux

NO	AREA	sudutkemiringan (°)	E_{av}(lux)	E_{min} (lux)	E_{max}(lux)	u0	E_{min}/E_{max}
1	Capasitor Bank	15	72	1,71	147	0,02	0,01
		25	71	1,16	148	0,02	0,01
2	Trafo Area PT-	15	95	5,36	165	0,06	0,03
		25	93	5,74	168	0,06	0,03

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	8313-C & D						
3	Platform	0	125	101	149	0,81	0,68
	Right side	0	125	101	149	0,81	0,68
4	Trafo	15	87	2,75	154	0,03	0,02
	Area PT-8313-H	25	85	2,77	155	0,03	0,02
5	Trafo	15	77	1,41	186	0,02	0,01
	Area PT-8313-E & F	25	76	1,42	182	0,02	0,01
6	Platform	0	71	57	83	0,81	0,69
	Left side	0	71	57	83	0,81	0,69

Table 3 uses a variation of the lamp angle of 15º and 25º. For example, the capacitor bank area at an angle of 15º produces an average Lux (Eav) of 72 lux. while at a slope angle of 25º produces an average lux value (Eav) of 71 lux. It can be seen that the effect of the slope angle on lux is that the greater the angle of the slope, the smaller the value of lux will be. However, the difference in lux is not very significant. On the right side platform and the left side platform there is no tilt angle because in this design the platform uses TL (Fluorescent) lights which cannot be adjusted.

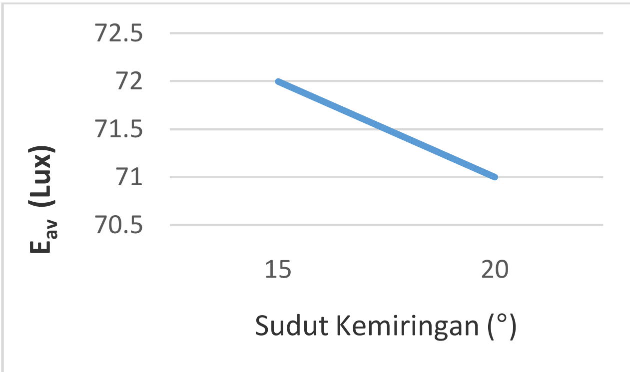

Figure 13 Graph of the effect of variations in the tilt angle of the lamp on Lux

In Figure 13 is a graph of the effect of the variation of the lamp tilt angle on Lux in the Capacitor Bank area, it can be seen that the increase in the lamp tilt angle has an effect on the Lux value. The increase in the value of the tilt angle of the lamp is inversely proportional to the value of lux. The greater the angle of inclination of the lamp, the value of lux will also be smaller.

The simulation results show that the resulting lighting design is in accordance with the API standard where the average lighting intensity in Outdoor is not less than 50 lux.

III. CONCLUSION

1. On the effect of LLF variation on lux in the capacitor bank area, it is obtained with LLF 0.6 producing an average lux (Eav) of 72 lux, while LLF 0.7 produces a lux value of 84 lux. So the greater the LLF value, the lux output will also be greater.
2. On the effect of Workplane variations on lux in the capacitor bank area, the lux measurement bank at 0 m produces an average Lux (Eav) of 72 lux. The measurement from a height of 0 m in this simulation is not at 0 m but at a height of 0.037 m from the floor surface. Meanwhile, if the measurement height is increased to 1 m, the average Lux value (Eav) is 101 lux.
3. In the platform area on the right side and platform left side, the measurement point is 0 m from the top floor of the stairs. So the higher the measurement point (workplane), the greater the lux value.
4. On the effect of variations in the angle of inclination of the lamp on lux in the area of the capacitor bank, it is obtained at a slope angle

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of 15º resulting in an average Lux (Eav) of 72 lux. while the slope angle of 25º produces an average lux value (Eav) of 71 lux. The increase in the value of the tilt angle of the lamp is inversely proportional to the value of lux. The greater the angle of inclination of the lamp, the value of lux will also be smaller.

5. On the right side platform and the left side platform there is no tilt angle because in this design the platform uses TL (Fluorescent) lights which cannot be adjusted.
6. The simulation results show that the existing design is in accordance with the API standard where the average lighting intensity (Eav) in Outdoor is not less than 50 lux.

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