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Analysis on the Evaluation of the Energy Needs and Power Projection in the City Of Kikwit in DRC By 2030

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Abstract: *In this article, we address the analysis on the evaluation of the energy need and power projection to 2030. This article describes the approach of the information and indications on the minimum power for the optimal operation of the electrical network of the city of Kikwit. In accordance with the method of projection of the electric power, we will proceed with the analysis step by step; that is to say from one year to another over eleven years from 2020 to 2030. The power available from the Kikwit thermal power plant is 0.6 MW, the power demanded by the Kikwit electricity network is estimated at 2.160 MW, with 609 subscribers served. The length of the MV network is 11.297 km and the length of the LV network is 50.678 km. The substation operates with a medium voltage load factor of 56%.*

Keywords*: Energy need, Power projection, Kikwit city, Horizon 2030.*

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I. INTRODUCTION

In today's world, the availability of electrical energy is of paramount importance. With the help of electrical energy, more complex works can be carried out, with the aim of promoting the development of societies. Therefore, energy is an essential support for the development of modern societies. Therefore, the quality, continuity of service and supply become imperative for the managers of electric companies. First of all, it is a question of producing, transporting and distributing it at the same time [1-4].

The growth in electricity needs requires an increase in the amount of electricity transported. In the DRC, the networks, which are on average 50 to 60 years old, are already overloaded

Usually, the transmission of electrical energy does not attract the same interest as its production and use, so that the study of this important subject is often neglected. However, the human and material investments in transmission far exceed those in the generation sector. It is well known that electrical energy is transmitted over conductors such as overhead lines and underground cables. Despite their apparent simplicity, these conductors hide important properties that greatly influence the transmission of electrical energy [5-7].

In the DRC, the construction of electrical networks greatly favors the blossoming of the population and the development of the country in general and the city of KIKWIT in particular. Thus, in order to allow the population, even in remote areas of the country, to have access to electrical energy, the Congolese State has set up rural electrification projects consisting of supplying the populations in the vicinity of existing or newly built power lines. The direct consequences of the realization of these electrification projects are the modification of the consumption habits of the populations and the increase of local economic activities. This is manifested by the acquisition of energy-consuming equipment and the development of businesses or industries along the route of the line.

Faced with such a demand, it would be judicious in the medium term to conduct a predictive analysis of the behavior of the network after a given period, for example ten (10) years, in order to anticipate the possible problems that the power line will face. It is within this framework that we approach our study.

The objective of this work is to set up a global and automated energy management system and to realize gains (direct or indirect) by introducing an analytical and digital management of the consumptions (rebilling, distribution by cost center) of the city of Kikwit by 2030.

II. Electrical condition of the city of Kikwit

The City of Kikwit has only one voltage substation which receives the low voltage at the primary and injects the medium voltage at the secondary (LV/MV). This substation has only two transformers, the first one with an apparent power of 1600 kVA and the second one of 630 kVA which serves as a reserve. The total power of the substation is 2.230 MVA. The Kikwit substation has two feeders supplying a total of ten subscriber stations. The Kikwit thermal power plant, with only one of the four machines installed, produces on its alternator 1600 kVA, 400V (i.e. 0.4 kV) and this voltage is injected to the low-voltage busbars in the control room, and at the output of the low-voltage busbars of the control room, it feeds the substation (Substation) which is inside the production plant which receives 0.4 kV, at the output it gives 6.7 kV at no-load, and 6.6 kV at load. This medium voltage enters the control room in its medium voltage part which in turn feeds the low voltage network (MV/LV transformer station) through the two feeders that the substation has.

III. Characteristic of the Kikwit thermal power plant

The Kikwit thermal power plant has 4 machines which present the following situation, the first engine is coupled with a 900 kVA - 400 V, 50 Hz alternator and rotates at a speed of 750 rpm; the second is the 825 kVA - 400V, 50 Hz alternator. Once these are running at its rated speed, the alternator produces a voltage of 0.4kv. This 400V voltage goes to the 0.4kV busbars in the control room, and then it goes to the transformer room and the output is 6.6kv, which returns to the 6.6kv busbars in the control room. There we have 2 circuit breakers 6,6kv that feed 2 feeders, feeder 1 feeds 2 cabins and feeder 2 feeds 8 cabins, these engines are diesels and run on fuel oil and SAE 40. Their cooling is done by means of water in the radiators.

III.1 LV/MV transformer station (Substation)

The feeder n°1 has two subscriber substations, namely

- ACA substation: 400 KVA ;
- Plateau substation: 250 kVA.

The feeder n°2 supplies eight subscriber stations which are

- Potopoto substation: 400 KVA;
- PHP-Palu substation: 160 kVA;
- Market substation: 400 kVA;
- ITPK substation: 100 kVA;
- Procure substation: 160 kVA;
- Administrative Complex substation: 100 kVA;
- Mutangu substation: 90 kVA;
- CADC substation: 100 kVA.

IV. ELECTRIC POWER PROJECTION EQUATION

III.1 Transcription of the power

The initial current power (PA) is 2400 kW. This allows us to transcribe the power variation numerically by the said formula which is put in the form of a power function:

$$P(n) = PA.(1{,}0015)^n \qquad (1)$$

The interpretation of all the tables in the projection representations will be done with the help of the bar graphs that take into account the powers calculated each year over a short period of time. This is a method used to determine the future power of low-voltage customers, given by the relationship :

$$\mathrm{P_2} = \mathrm{P_1}(1 + \frac{\mathrm{i}}{100})^{\mathrm{n}} \qquad (2)$$

From the maximum power studies of the transformers of all the substations, we obtained the power for the year 2020 to 2030. The current power drawn at final power is given by:

$$P_F = P_A \left(1 + \frac{i}{100}\right)^n \qquad (2.3)$$

The general power of a site or an important electrical network is obtained by the model of the sum of the products.

$$P = \sum_{i=1}^{n} P_n \qquad (2.4)$$

V. RESULTS AND DISCUSSION

V.1 Power calculation per sector

V.1.1 Subscribers' powers until 2030.

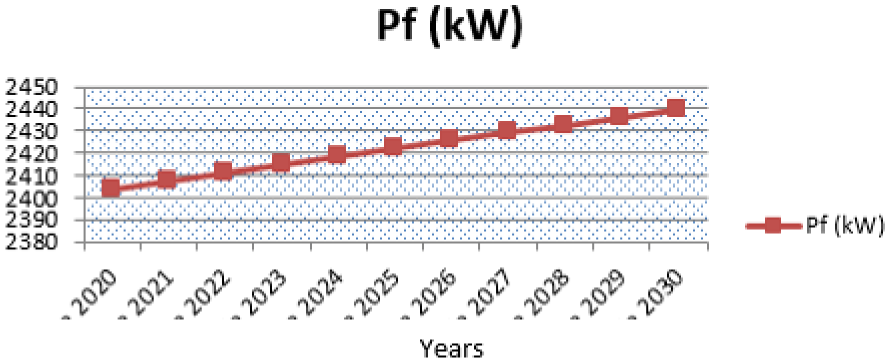

Figure 1 : Projection of actual subscriber power to 2030.

The result of calculation and simulation proves that the power grows linearly from one year to another; the addition power is estimated annually at 4 kW. In the interval from 2020 to 2030, the subscriber power varies from 2403.6 kW to 2439.89834 kW.

V.1.2. Industrial power by 2030

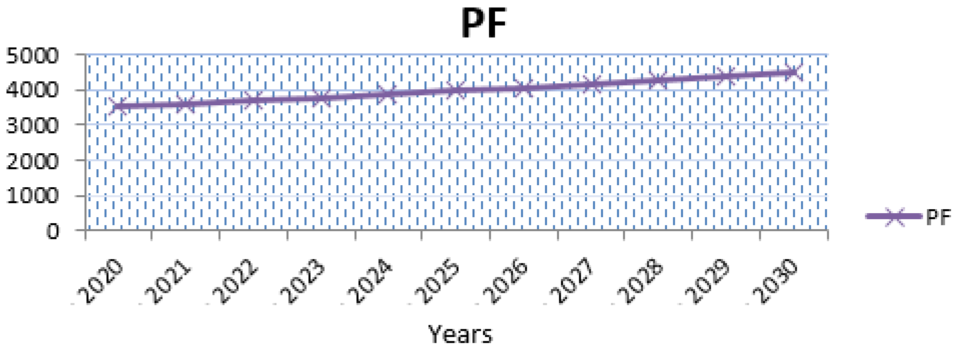

Figure 2 : Projection of actual industrial power to 2030.

The calculation and simulation result in Figure 2 proves that the power grows linearly from year to year; the addition power is estimated annually at 90 kW. In the interval from 2020 to 2030, the subscriber power varies from 2403.6 kW to 2439.89834 kW.

V.1.3. Tertiary power by 2030

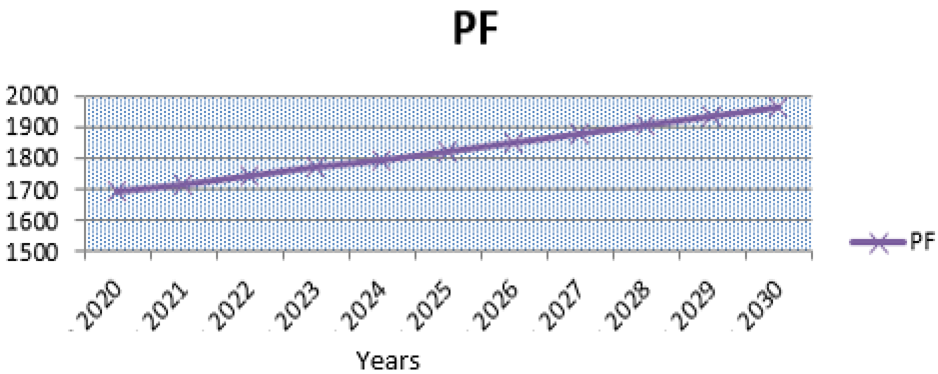

Figure 3. Tertiary power projection to 2030

The simulation result proves that the tertiary power grows linearly from one year to another; it is estimated annually at 24.9 kW. In the interval from 2020 to 2030, the subscriber power varies from 1689.975 kW to 1961.28498 kW.

IV.1.4. Public lighting power 2030

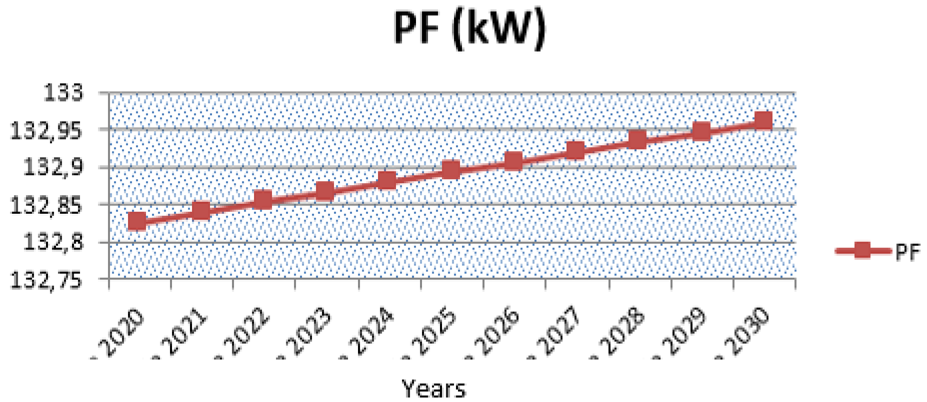

Figure 4 : Projection of Public Lighting Power to 2030.

The simulation result in Figure 4 proves that the street lighting power grows linearly small from year to year; it is estimated annually at 0.013 kW. In the interval from 2020 to 2030, the subscriber power varies from 132.825781 kW to 132.958667 kW.

IV.1.5 General power

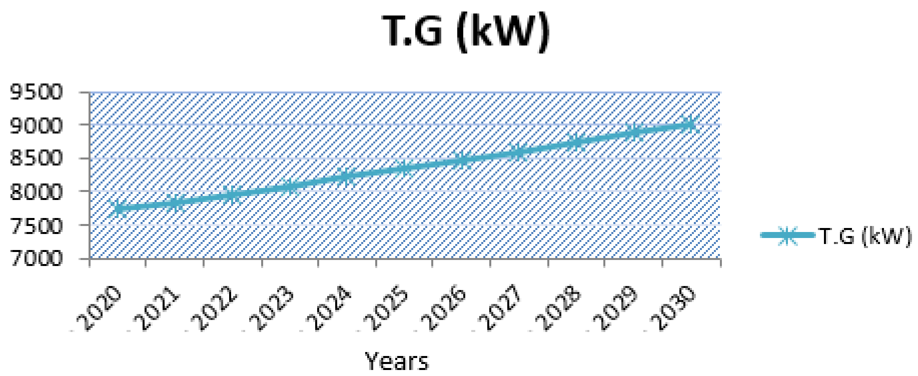

Figure 5 : Power (TG) during the period from 2020 to 2030.

We observe that the power is increasing, the result of the simulation proves that in the interval from 2020 to 2030, the power of the city of Kikwit varies from 7726.51953 kW to 9014.5899 kW (Figure 5).

IV.2 General evolution of the power of all sectors

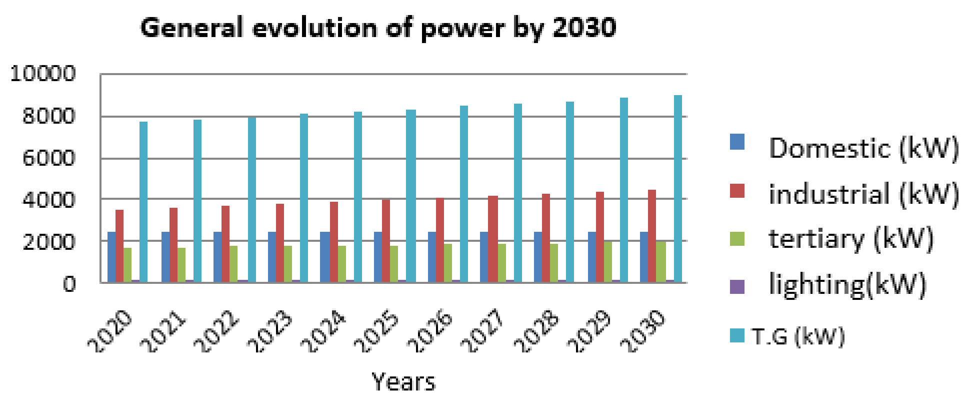

Figure 6 : General evolution of power by 2030

The result in Figure 6 proves that the subscriber power grows linearly from one year to another by the difference of to 3.66 kW. While, the industrial power grows linearly from one year to another by the difference of 85 kW. In order to the tertiary power grows linearly from one year to another by the difference of 24.9 kW.

CONCLUSION

This article consisted of an analysis of the energy needs and the power projection to 2030. Based on the confirmation of the electrical network of the city of Kikwit, we note that the deficit exists. The energy deficit is the difference between the power demand of the city of Kikwit and the power available at the Production (thermal plant). Knowing the power demand in 2020 which is estimated at 7.7 MW and that the power available at the thermal power plant is 0.6MW, then the energy deficit will be equal to 7.1 MW. Projecting the power demand from 2020 to 2030, there is an evolution of the power demand from 7.7 MW in 2020 to 9 MW in 2030, hence the energy deficit in 2030 is 8.4 MW. The available capacity of the Kikwit thermal power plant is 0.6 MW, the power demanded by the Kikwit electricity network is estimated at 2.160 MW, with 609 subscribers served.

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