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Electricity Distribution and its Challenges in Nigeria

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ABSTRACT

Electricity distribution deals with the sharing of electric power generation and transmitted down to the final consumers. However in Nigeria, the distribution of electricity is associated with many hazards. From the results obtained, it was observed that the major problems in distribution of electricity are lack of sufficient power. The consumers of electricity are more than the power generated, hence life and the economy of the nation is heavily affected. Also most of the power installations are ageing, including transformers which are not sufficient to carry the loads used by consumers due to modernization, industrialization and urbanization. These challenges have resulted into poor life style and hardship and economic breakdown due to power outages and load shedding. A number of evidences suggest that electricity distribution in Nigeria, Abakaliki as a case study are having a low distribution of electricity, low current and outages of current due to high number of populations billed and industrial activities. However, there is need for government of Nigeria to totally overhaul the power the sector and its installation, especially in the area of more transformer to meet up with trend of present realities.

Keyword: Electricity Distribution, Consumers, Electrical energy, Phase, Electric power Installation, Alternating current load Shedding and transformers

INTRODUCTION

Electricity is the set of physical phenomena associated with the presence and motion of electric charge. Electricity supply in Nigeria dates back to 1886 when two small generating sets were installed to serve the then Colony of Lagos. By an Act of Parliament in 1951, the Electricity Corporation of Nigeria (ECN) was established, and in 1962, the Niger Dams Authority (NDA) was also established for the development of Hydro Electric Power. However, a merger of the two was made in 1972 to form the National Electric power Authority (NEPA), which as a result of unbundling and the power reform process, was renamed Power holding Company of Nigeria (PHCN) in 2005 [1].

The Nigerian power sector is controlled by state-owned Power Holding Company of Nigeria (PHCN), formerly known as the National Electric Power Authority (NEPA). In March 2005, President Olusegun Obasanjo signed the Power Sector Reform Bill into law, enabling private companies to participate in electricity generation, transmission, and distribution. The electricity distribution in Nigeria was finally privatised to six companies in the six geographical zones in Nigeria by President Goodluck Jonathan, otherwise referred to as Electricity Distribution Company, EDC [2].

Electricity Distribution System

In the early days of electricity distribution, direct current (DC) generators were connected at loads at the same voltage. The generation, transmission and loads had to be of the same voltage because there was no way of changing DC voltage levels. Low DC voltages were used since that was a practical voltage for incandescent lamps, which were the primary electrical loads then. The adoption of alternating current (AC) for electricity generation dramatically changed the situation. Power transformers, installed at power stations, could be used to raise the voltage from the generators, and transformer sat local substations reduced it to supply loads. Increasing the voltage reduced the current in the transmission and distribution lines and

hence the size of conductors and distribution losses. This made it more economical to distribute power over long distances [3], [4].

Distribution network are typically of two types: radial network and interconnected network. A radial network leaves the station and passes through the network area with no normal connection to any other supply. This is atypical of long rural lines with isolated load areas. An interconnected network has multiple connections to other points of supply. These points of connection are normally open but allow various configurations by the operating utility by closing and opening switches. Operation of these switches may be by remote control from a control centre or by a lineman. The benefit of the interconnected model is that in the event of a fault or required maintenance, a small area of network can be isolated and the remainder kept on supply [5], [6], [7], [8].

Primary distribution system

These consist of high voltage (11 and 33KV) networks from primary and sub-primary substations. These substations are interconnected with high voltage transmission lines. In most cases, large industries consumers like cement factories, refineries, breweries, flour mills, steel rolling mills and so on take supply at primary distribution system with associated transformers, switchgears and breakers [9], [10].

Secondary distribution systems

These consist of low voltage feeder networks from the secondary transformers that are constructed along main roads and streets. Service connections are made to individual consumers by service cables from these networks feeder lines [11], [12].

The various system of alternating current distribution for domestic consumers includes:

(i) Single-phase 2-wire system
(ii) Single-phase 3-wire system
(iii) Three-phase 3-wire system
(iv) Three-phase 4-wire system [3], [8].

Of these, the single phase 2-wire and the three phase 4-wire system are the most widely used in Nigeria. The direct current distribution is rarely used in Nigeria. Alternating current is usually converted into direct current by rotary converters. Direct current (DC) is supplied to substation bus bars and distributed locally by feeders, distributors and service lines. Usually DC is distributed by single phase 2-wire system at 230 volts and three-phase 3-wire at 460/230 volts [8].

How Electricity Distribution Works

Today, the fundamentals of the electricity distribution system are similar to the first alternating current systems designed by Tesla and Westinghouse. After electricity is generated and moved along the high-voltage transmission system, it comes off the transmission grid at local distribution substations where the voltage is reduced or “stepped down” by special equipment called transformers. This process can take electricity of up to 765,000 volts and step it down to levels under 50,000 volts The distribution lines have voltages below 50,000volts. These transformers have a relay that automatically switches off when there is overload on the transforms through the feeders on the injection transformer. These relays are adjustable and are rated in amperes. They have maximum of 420 amperes [10], [11].

Load Shedding on Feeders

This is the rationing of electricity among feeders as a result of either insufficient supply or overload on the transformer feeding the high tension lines.

Feeders are high tension lines that send point from the injection substation down to the distribution substations. It is either 33KV feeder or 11KV feeder.

There are about eight feeders in Ebonyi State: They include: Township feeder, Azuiyiokwu feeder, Industrial feeder, Udemezue feeder, Yahee feeders, Itigidi feeders, Ishieke feeders, Nkalagu feeders and Afikpo feeders [12].

Collection of Data

Data was collected at Enugu Electricity Distribution Company of Nigeria, Abakaliki, Ebonyi State.

RESULTS AND DISCUSSION

Data were collected at Enugu Electricity Distribution Company, EEDC in Abakaliki in Ebonyi State of Nigeria. The results obtained were represented in figures 1 to 4.

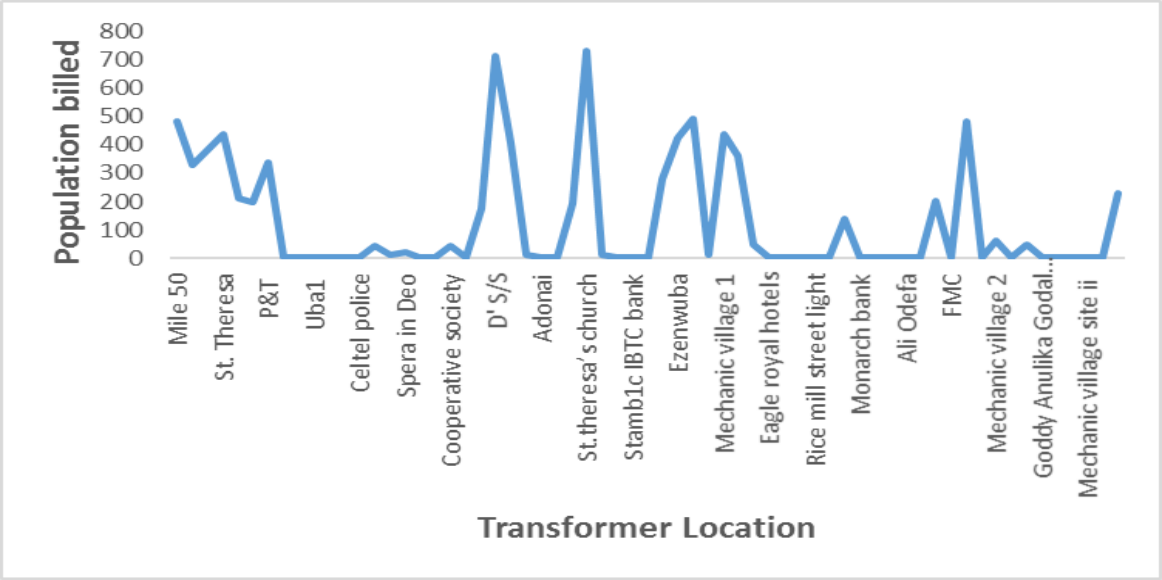

Fig.1: Township feeder (feeder 1)

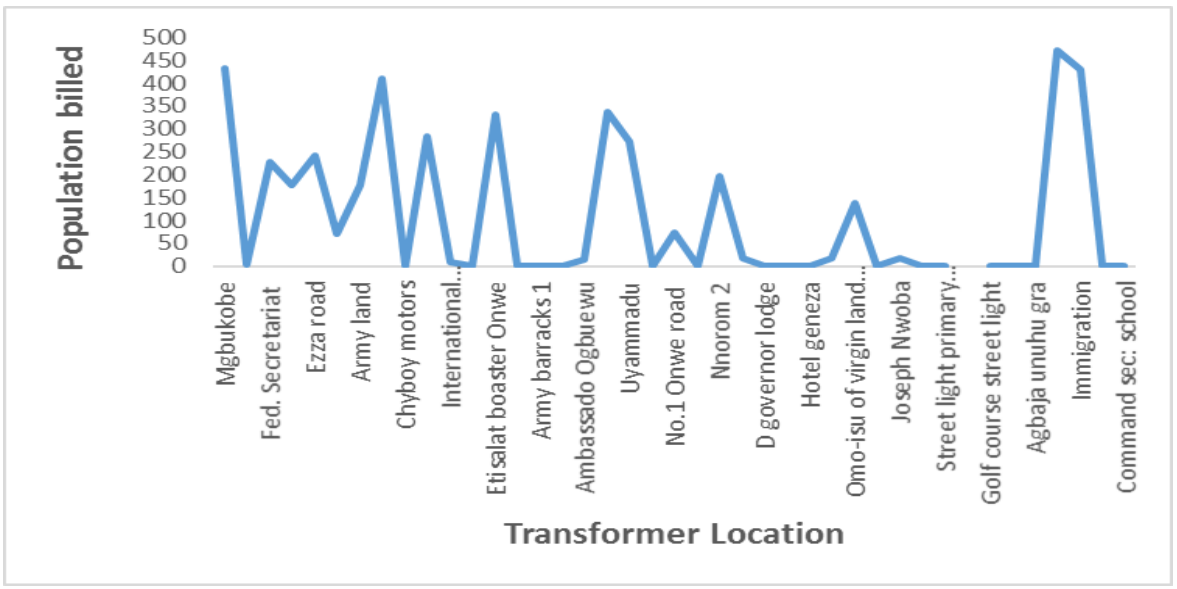

Fig. 2: Azuiyiokwu feeder (feeder 2)

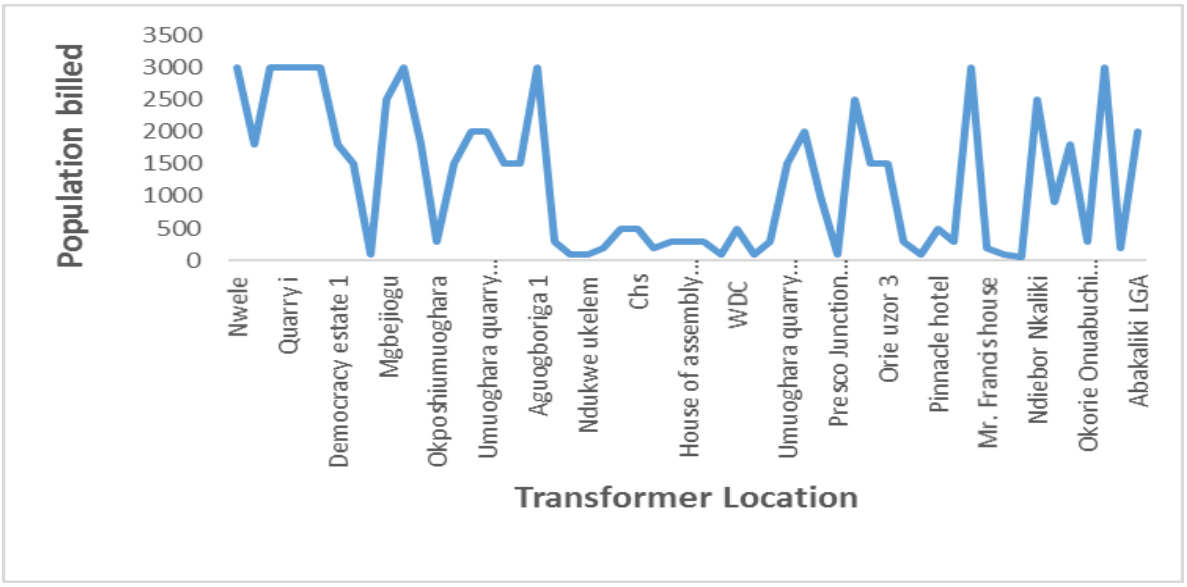

Fig. 3: Industrial feeder (feeder 3)

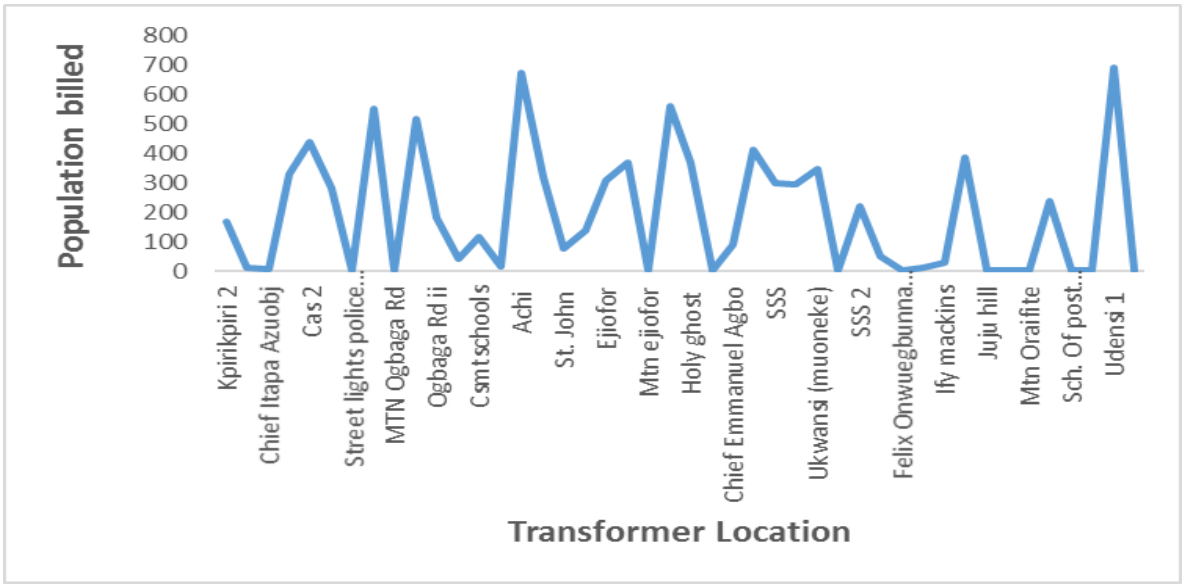

Fig. 4: Udemezue feeder (feeder 4)

DISCUSSION

A number of evidences suggest that electricity distribution in Nigeria, Abakaliki as a case study are having a low distribution of electricity due to insufficient transformer in the area and high number of populations billed.

From the survey carried out and data collected from the EEDC feeders, Abakaliki, it was observed that feeders are high tension lines (i.e 33KV and or 11KV) that sends point from the injection substation down to the distribution substation.

Generally, there are four feeders within Abakaliki metropolis as area of research: Township feeders (feeder 1), Azuiyiokwu feeder (feeder 2), Industrial feeder (feeder 3) and Udemezue feeder (feeder 4)

From figure 1 and in feeder 1 (Township feeder), it has highest number of transformer location, with population billed of 733. This results to low supply of electricity within the area, which seriously affect the life and businesses of the people living in the area.

The graph in figure 2 shows that there is a low transformer capacity and therefore requires a transformer with high capacity so that there would be a proper distribution of light within the vicinity.

From figure 3 (Industrial feeder) it shows that the number of billed customers within the feeder is 654 greater than that of feeder 2 which is 587,with high number of transformer locations with many industrial activities, this always results to low current within the area.

Finally, in figure 4 (Udemezue feeder) has a highet number of transformer location with overwhelming population billed, this usually results to low current and outage of current always due to overload.

Generally, it shows that all the feeders need more transformers for the consumers to effectively and efficiently utilized and enjoy the electricity. Also it was observed that most of the power installations were ageing with many loads due to expansions of the town and industrial activities.

CONCLUSION

The government should work effectively towards installation more transformers and the old ones changed to enable a functional distribution of enough electricity to the people within the vicinity. The population of the town and the awareness of usage of electricity have increased tremendously due to the fact that Abakaliki town is now the capital of Ebonyi State. The town is expanding and people are trooping into the town on daily bases with increase in business and industrialization. However, there is need to totally overhaul the power the sector in Nigeria and its installation to meet up with trend of present realities.

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