

Evaluation of power supply outages in Edo State, Nigeria.

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Abstract

This study presents the evaluation of power supply outages in Nigeria, using Benin substation and Irrua Substation 33kv feeders, different causes of power outages and possible solution were highlighted. The obtained average data for a period of one year from 1st June, 2012 to 31st May 2013 are deployed in this analysis. Also, Energy losses from both Benin and Irrua feeder were analyzed, the following results are obtained; morning and evening peak period were determined, causes of outages were highlighted and energy loss (Mw) due to power supply outages. It was observed that the total energy (Mw) consume both in the morning and the evening has close correlation in all the nine areas considered, and open circuit faults occurrence on the transmission lines has the highest occurrence. It was observed that Guinness has the highest energy losses and highest load loss (MW). In addition; it is observed that 68% energy losses are from Benin region, while 32% are from Irrua region feeders.

Keywords: power outages, feeders, transmission, energy losses, and faults.

1.0 Introduction

Power system is very important in economic growth; it is the life wire of any economic, industrial growth, infrastructural development, and increase human power development etc [1-3]. Power system or an electric power system is a network of electrical components used to supply, transmit and uses electric power. An example of an electric power system is the network that supplies a region's homes and industry in a region, this power system is known as the grid and can be broadly divided into the generators that supply the power, the transmission system that carries the power from the generating centers to the load centers and the distribution system that feeds the power to nearby homes and industries [4-7]. Power outage (also referred to, as power cut, blackout, or power failure) is a short- or long-term loss of the electric power to an area. There are many causes of power failures in an electricity network. Examples of these causes include faults at power stations, damage to electrical transmission lines, damage to transformers substations, open circuit on distribution network lines, a short circuit, the overloading of electricity mains etc [7-9]. Institutions such as hospitals, Educational sectors, industries, sewage treatment plants, mines industries, telecommunications etc, have witnessed a lot of draw back activities resulted from power outages. Power failures can resort on environment impact at site and place public safety at risk. The economy impact of this reoccurrence decimal of power outages is immeasurable and incomparable with the huge loss in the economic values. Despite, the provision of backup power sources such as standby generators, solar panel, wind electricity etc there is need to have stable power supply in this part of the world [1,2,10,11].

Electric power is the rate at which electric energy is transferred by an electric circuit. The SI unit of power is the watt, one joule per second [7,8].

Electric power is usually produced by electric generators, but can also be supplied by chemical sources such as electric batteries. Electric power is generally supplied to businesses and homes by the electric power industry. Electric power is usually sold by the kilowatt hour (3.6 MJ) which is the product of power in kilowatts multiplied by running time in hours. Electric utilities measure power usage by electricity meter, which measure and store the total electric energy delivered to a customer. Electrical energy is refers to energy which has been converted from electrical potential energy. This energy is supplied by the combination of electric current and electrical potential that is delivered by the circuit. At the point that this electrical potential energy has been converted to another type of energy, it ceases to be electrical potential energy. Thus, all electrical energy is potential energy before it is delivered to the end-use. Once converted from potential energy, electrical energy can always be described as another type of energy (heat, light, motion, etc.) [5,7,12].

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An electric utility is an electric power company (often a public utility) that engages in the generation, transmission, and distribution of electricity for sale generally in a regulated market. The electrical utility industry is a major provider of energy in most countries. It is indispensable to factories, commercial establishments, publicly owned institutions, co-operate institutions and nationalized entities, homes, and even most recreational facilities. Lack of electricity causes not only inconvenience, but also economic loss due to reduced industrial production. Electricity markets are also considered electric utilities--these entities buy and sell electricity, acting as brokers, but usually do not own or operate generation, transmission, or distribution facilities. Utilities are regulated by local and national [5,13,14,15].

2.0 Background Study

An electric power system is a group of generation, transmission, distribution, communication, and other facilities that are physically connected. The flow of electricity with the system is maintained and controlled by dispatch centers. It is the responsibility of the dispatch center to match the supply of electricity with the demand. In order to carry out its responsibilities, the dispatch center is authorized to buy and sell electricity based on system requirements. The interconnected utilities within each power grid coordinate operations and may buy and sell power among power supply operators. The bulk power system makes it possible for utilities to engage in wholesale (for resale) electric power trade. Wholesale trader has historically played an important role, allowing utilities to reduce power costs, increase power supply options, and improve reliability. Authority for those transactions has been pre-approved under interconnection agreements signed by all the electric utilities physically interconnected or with coordination agreements among utilities that are not connected [5].

Electric power is transformed to other forms of power when electric charges move through an electric potential (voltage) difference, which occurs in electrical components in electric circuits[7]. When electric charges move through a potential difference from a high voltage to a low voltage, the potential energy is converted to kinetic energy of the electric charges, which perform work on the device. Devices in which this occurs are called passive devices or loads; they consume electric power, converting it to other forms such as mechanical work, heat, light, etc. Examples are electrical appliances, such as light bulbs, electric motors, and electric heaters (found in our environment). If the charges are forced to move by an external force in the direction from a lower potential to a higher level, work is being done on the charges, so power is transferred to the electric current from other type of energy, such as mechanical energy or chemical energy. Devices in which this occurs are called active devices or power sources; sources of electric current, such as electric generators, batteries etc, which are used as standby power [15-18].

3.0 Research Method

The power outages data report was obtained from the regional transmission Power Holding Company of Nigeria (case study of Benin RCC).The obtained data involve: names of the transmission line, power rating, morning peak (Mw) power energy consumed, evening peak (Mw) power energy consumed, time (hrs) and energy losses. The study was investigated for a period of one year duration from 1st June, 2012 to May 31th 2013. The graphical displays obtained from the data are presented in Fig 1-6.

4.0 Data Analysis, Results and Discussion

Based on the data obtained from the investigated areas (Benin substation region and Irrua substation region), the following results were obtained and presented graphically in the following Figures;

Fig 1 show the comparison of peak power usage in ten (10) different areas and also the comparison between the morning peak (Mw) and evening peak (Mw) energy consumption level. It is observed that the total energy (Mw) consumed both in the morning and the evening have a close correlation in all the ten areas considered. Except in delta area, were industrial activities running into the evening's period. It is also, observed that Benin area consume more energy (Mw) than the nine other areas from Fig 1.

Two basic regional substations were considered in this study. They are Benin and Irrua region, which have total of nine feeders. In Fig 2, the various common faults were considered in Benin region are presented, which are homogeneous kind of faults duplicated in other areas investigated. These various faults occurrences in power system lead to energy losses in the network. It is observed that the highest fault occurrence, is the tripped due to open circuit on the transmission lines followed by opened circuit occurred, for the B/U to change aluminum conductors to copper type.

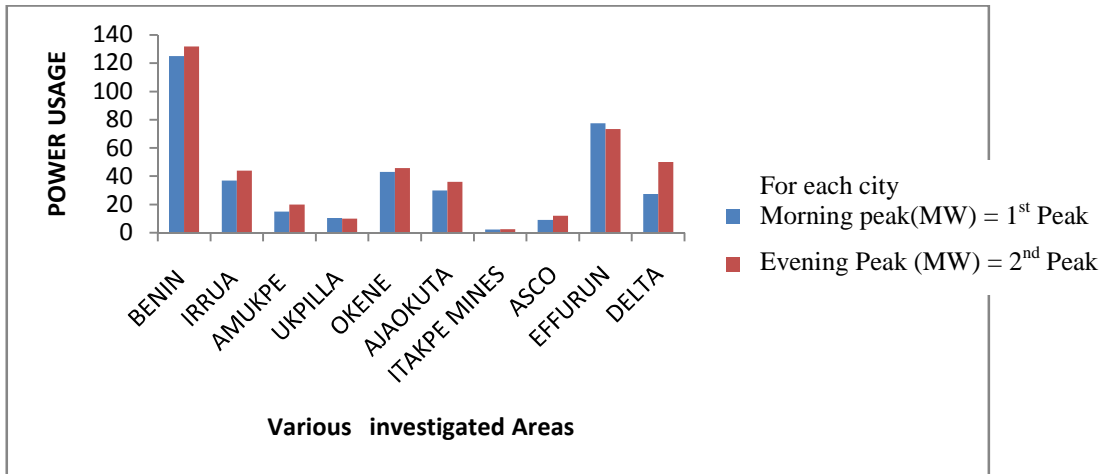


Fig 1: plot of peak power usage in different areas

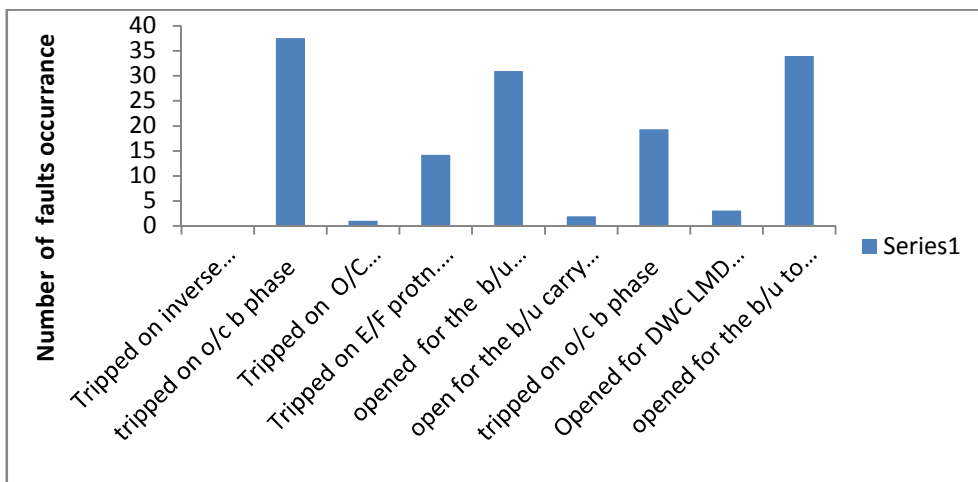


Fig 2: Plot of various faults related to the energy losses

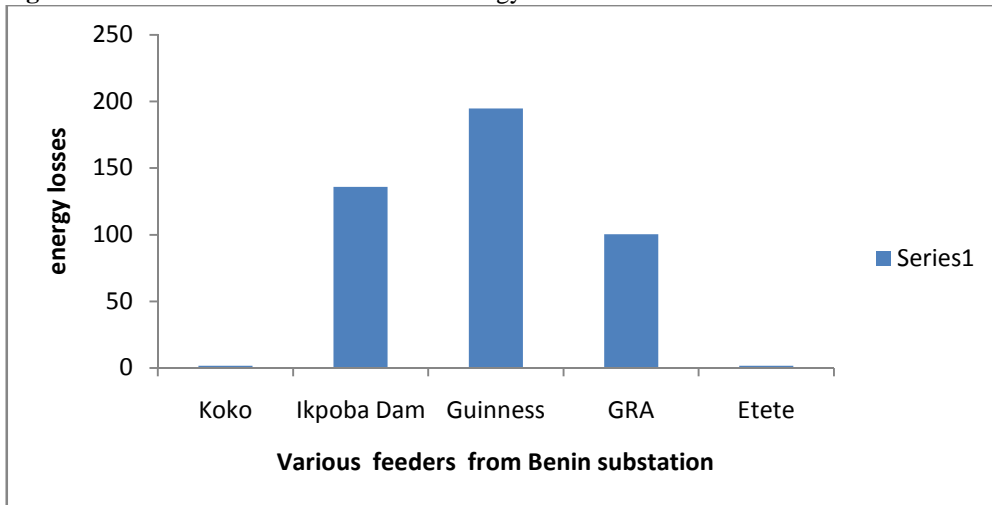


Fig 3: Plot various feeder energy losses in Benin substation

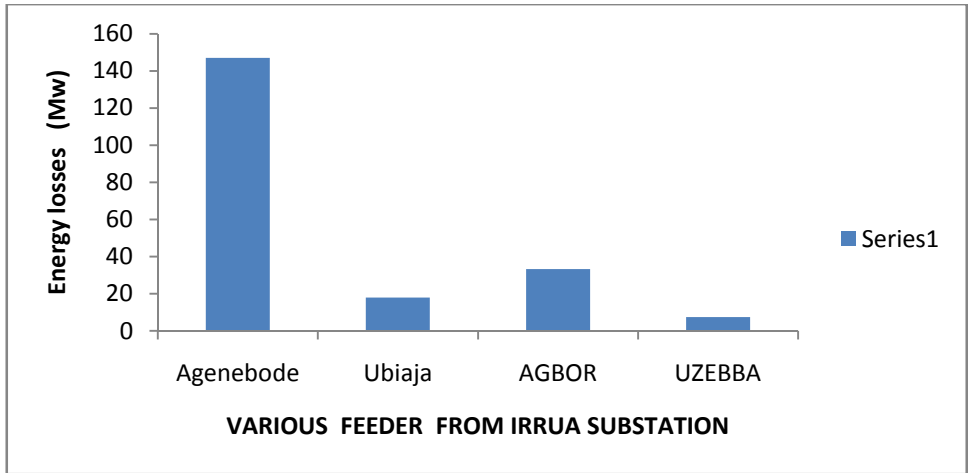


Fig 4: Plot various feeder energy losses in Irrua substation

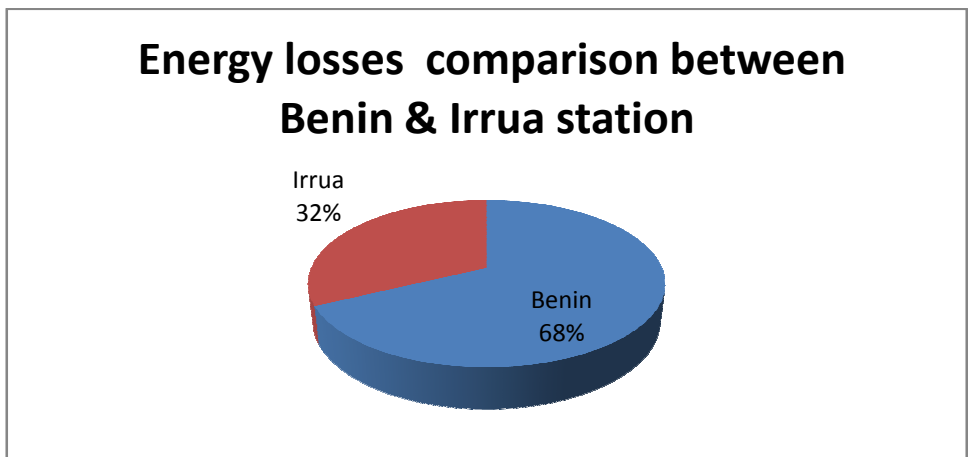


Fig 5: Comparison between the energy losses in Benin and Irrua substation

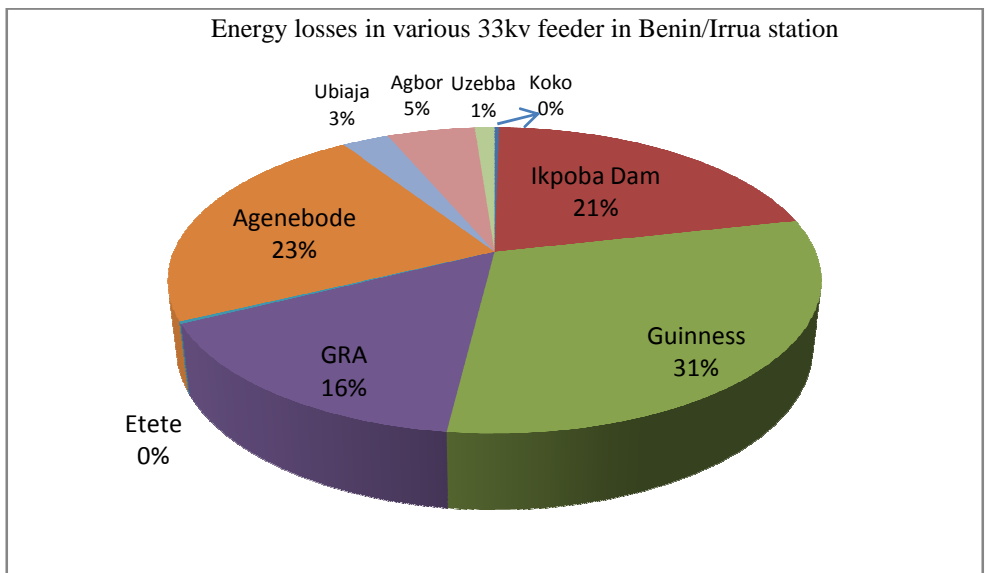


Fig 6: Plot various feeder energy losses in Benin substation

In Benin region, total of 68% energy losses was experienced due to various kinds of electrical faults, shown in Fig 5. The Benin substation investigated has five basic feeders, with associated energy losses show in Fig 3. It was observed that Guinness has the highest energy losses and highest load loss (MW) followed by Ikpoba Dam, GRA, koko and Etete under the period of investigation.

It is observed that the highest load losses experienced is 37.6 Mw per day, from Ikpoba Dam 33kv feeder due to faults. Also the average total time of power outage is given as 9:35mins per day from the study.

Meanwhile, Irrua region experienced 32% energy losses and it consists of four basic feeders. In Fig 4, it is observed that Agenebode has the highest energy losses and highest load loss (Mw) followed by Ubijaja, Agbor and Uzebba as shown in Fig 4.

However, Fig 5 shows the comparison between the Benin and Irrua power outages associated to losses of energy (Mw) and Fig 6 shows the comparison between nine investigated feeders power outages associated to losses of energy (Mw) in Benin and Irrua respectively.

The critical open circuit faults should be given quick attention, to avoid subsequent power outages. The high load losses in Guinness feeder should be addressed and the relevant authority should ensure that frequent power outages are eliminated or reduced in this Guinness feeder.

5.0 Conclusion

The issue of stable power supply cannot be over emphasized, because electric power is a life wire of any developing country. Basic facilities such as hospitals, educational sectors, telecommunications etc are depending on constant power supply for optimum performance. Power supply outages have become normal scenario in developing countries. Government, political leaders etc, should put their resources together and ensure that power supplies are stable in their respective domains. Also, the issues of power supply outages should be analyzed, to enable engineers to deploy the right techniques in eradicating the menace of power supply outages in developing countries. This study presents “evaluation of power supply outages in Nigeria” using Benin and Irrua substation. Based on the analyses, the following results were obtained; morning and evening peak period were determined, causes of outages and energy loss (Mw) were highlighted. It was observed that the total energy (Mw) consumed both in the morning and the evening have close correlation and open circuit faults occurrence on the transmission lines has the highest occurrence. It was observed that Guinness has the highest energy losses and highest load loss (MW), with 68% energy losses are from Benin region, while 32% are from Irrua region feeders.

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