

INVESTIGATION AND ANALYSIS OF RELIABILITY OF POWER SUPPLY IN ADO-EKITI METROPOLIS, EKITI STATE, NIGERIA

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Key words

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Electrical energy
Reliability
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9-S

Abstract

The incessant power failure in Nigeria has necessitated the investigation and analysis of reliability of power supply in Ado-Ekiti metropolis. This situation has adversely affected the development of the country particularly the domestic consumers and the effects on the small scale industries are numerous. This paper investigates and analyses the supply of electricity to the consumers in Ado-Ekiti metropolis and reliability index was a vital tool used in carrying out this research. The methods used are direct interviews, distribution of questionnaires, 9-S reliability method and reliability index. Recommendations were made with the view of improving power supply to Ado-Ekiti residents. They are: generation of the needed power MW by the metropolis, improved service by the power-company, adequate sizing of conductors, and correct capacity of the transformers as well as re-orientation of the consumers on the energy usage. The employment of renewable energy by individuals and Organization will adequately meet our power demands in this present time.

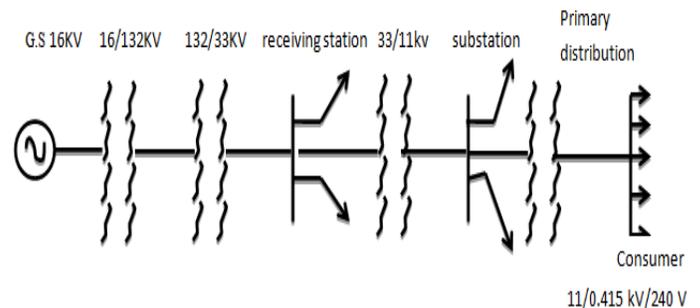
1. INTRODUCTION

Electrical energy is essential for growth and development of any country. In fact in this present time, the constant availability of power supply in any nation of the world is one of the indices used in measuring the prosperity of nations [1]. The structure of power system is a complex enterprise that may be subdivided into generation, transmission, distribution and utilization of electrical energy [2].

The operating voltages in Nigeria are: 11-16 kV for power generation, 330 kV at transmission level, 132 kV at sub-transmission level, 33 kV at primary distribution level, 11 kV at secondary distribution, 415V for 3phase consumers while 240V is for utilization by single phase consumers [3]. A basic electrical system has four constituents: the source, the load, and the transmission system as well as control apparatus [4]. Electric supply system is the conveyance of electric power from a power station to consumer's premises [5]. A layout for typical a.c power supply scheme is shown in fig 1 by a one line diagram.

An outage refers to that state of device when it is not available to perform its intended function due to some event directly associated with that device. An outage may be forced, momentary or scheduled

[6]. Reliability is the probability of a device performing its function adequately for the intended period of time under specified operating conditions. The probability value is the first index of reliability and in most cases it is considered to be most significant and sufficient index. However, many other indices are also used. Some of these are: expected number of failures in a specified period; average time between failures; expected downtime; expected loss in revenue due to failure and expected loss in plant output due to failure [6].



Source: [5]

Fig.1: A typical a.c power supply scheme

The reliability indices are:

- (1.) System Average Interruption Duration Index (SAIDI): This is the average total duration of interruptions of supply that a consumer experiences annually e.g in Singapore the SAIDI is 1.1minutes, 88 minutes in U.S.A and 51 minutes in France [7].
- (2.) System Average Interruption Frequency Index (SAIFI): This is the average number of interruptions of supply that a consumer experiences annually. It is an average of 1.5 in U.S.A [7].
- (3.) Consumer Average Interruption Duration Index (CAIDI): This is the average duration of an interruption of supply for a consumer who experiences the interruptions of supply annually [7].
- (4.) Average Service Availability Index (ASAI): This is the ratio of consumer hour’s service availability to consumer hour’s service demand [7].
- (5.) Momentary Average Interruption Frequency Index (MAIFI): This is the average number of momentary interruptions that a consumer would experience during a given period. It is calculated as the ratio of the total number of consumer interrupted less than define time to total number of consumers served [7].

The developed countries of the world ensured that power supply is constantly made throughout the year thereby enhancing the growth of their economy. A study shows that power outage in Netherlands and Italy are 238 minutes and 293 minutes per year respectively [8]. It is worthy of note that Japan has celebrated 50years free of power interruption while Ghana also celebrated one year free of power interruption [8]. The maintenance of thermal station was compared to the world class standard noted that their performance values were below average [9]. Lines are generally not maintained which makes inspection to be difficult and tracing of faults seem to be cumbersome [10]. In Lagos, Nigeria, a study shows that 80% of power failures are due to illegal connections [8]. Ado – Ekiti is the State capital of Ekiti State with a small quantity of about 3 to 4 MW was released by Akure injection substation at nights periods when the state depended on 132/33KV injection substation at Akure[11]. The state now depends of 132KV station in which the injected power has increased based on the sources with 4MW to 12.7MW [12]. Ado- Ekiti requires minimum of 19.752MW and maximum power demand of 29.01MW [12]. In view of erratic power supply in Ado-Ekiti metropolis, it was opined that allocation of power to Ekiti be increased, planning scheme should be adequate, cable sizing must be standardized, maintenance of power equipment be thorough, and renewable energy be invested upon for drastic improvement [13]. Forced is as a result of emergency conditions directly associated with requiring that the component be taken out of service immediately either automatically with the switching operation can be performed or an outage caused by improper operation or human error, momentary outage is caused by reclosing the breaker to clear a temporary fault. It lasts for a short time. The causes of forced or momentary outages are lightning, tree contact, wind, animals, vehicle accidents and construction activity [14].

Steps to be taken in reliability study are definition of the system, definition of failure criteria, assumption to be made, model preparation, failure effect analysis, evaluation of reliability indices, results are analyzed and preparation of reliability in improvement plans [14].

2. METHODOLOGY

The methods used in carrying out this research work are: the use of questionnaires, direct interviews with residents in the metropolis, the use of micro-soft spreadsheet to analyze data obtained from the

distributed questionnaires. The paper investigates and analyses the electricity supply to the residents with the comparison of the supply with the 9-S reliability method. Three Hundred questionnaires were distributed and only Two Hundred and seventy-nine were returned representing 93%. This paper investigates and analyses the power disruption which may be forced or momentary in Ado-Ekiti metropolis.

Table 1: The 9s of reliability in power delivery

Number of 9s	Reliability	Expected disruptions/years	Ok for
3	99.9%	9 hours	Homes
4	99.99%	59 minutes	Factories
5	99.999%	5 minutes	Hospitals
6	99.9999%	32 seconds	Banks

Source:[15]

Table 2: Power disruptions in Ado- Ekiti per day and year

S/N	Areas	Power outage/day(hr)	Power outage/year(hr)
1	Erifun	0.5	182.5
2	Adehun	6	2190
3	Aba, FPA	0.75	231.75
4	CBN	11	4015
5	Olujoda	6	2190
6	Afao road	6	2190
7	Fakale	5	1825
8	Dalimore	10	3650
9	Bashiri	8	2920
10	Ajebandele	8	2920
11	Ori – Apata	6	2190
12	Moferere	16	5840
13	Irona	6	2190
14	Olokuta	3	1095
15	Abe Koko	24	8760
16	OkeOniyo	4	1460
17	Oke Bola	4	1460
18	Annex Hostel	3	1095
19	Omisanjana	5	1825
20	Olorunda	3	1095
21	Emirin	10	3650
22	Bamgboye	10	3650

Source: Primary data obtained from questionnaires and direct interviews

3. RESULT AND DISCUSSION

Table 1 shows the standard for homes with reliability of 99.9% for homes in which the maximum expected disruption per year is 9 hours and the three digits of nine. For factories, the disruption per year is fifty nine minutes; the reliability is 99.99% with four digits of nine. The reliability for hospitals is 99. 999 % having five digits of nine with five minutes of disruption per year while the reliability for banks is

99.9999% with disruption of 32 seconds having six digits of nine. Table 2. shows that all the area exceed the standard Erinfun has disruption Level to be 182.5hours, Adehun at 2190hours, Aba, Federal Polytechnic, Ado-Ekiti area has disruption level of 233.75hours. CBN area has power outage of 4015 hours; Olujoda's outage level was 2190 hours. Other areas such as Abe Koko has outage of 8760 hours, Emirin, Dalimore and Bamgboye areas have same level of power outages put at 3650 hours. The mean value for disruption per year for the residents in the study area is 2499.17 hours. The residents do not have access to convenience and meaningful life due to erratic supply of power that is being experienced in most part of the State. All the areas do not conform to the standard for homes, factories, hospitals and banks. This affirms that the reliability of electricity supply in the metropolis is poor, has been transformed into bar chart in fig 2. The fig 2 shows that Abe Koko has disruption of 8760hours per years. Erinfun has the minimum disruption of 182.5 hours per year.

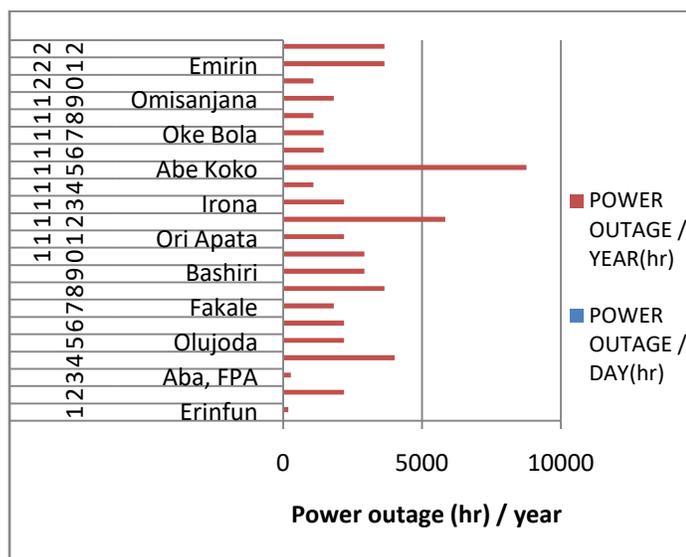


Fig 2: Power disruption level in Ado-Ekiti in one year

Effects of Power disruption on Ekiti State:

This unreliability of power supply in Ekiti has affected the development of the State in the following ways: investors are discouraged to come for investment particularly in the areas of agriculture and mining, small scale industries could not thrive; poverty level has increased for the citizenry, lack of employments for young school leavers and graduates and finally lack of comfort for the domestic consumers of electrical energy.

4. CONCLUSION

The result shows that the reliability of electricity supply to Ado –Ekiti metropolis is very poor when compared to the 9-S reliability standard except for areas like Erinfun and Federal Polytechnic areas where the power supply in one year is fair with reduced power outages of 182.5 hours per year.

5. RECOMMENDATIONS

The following recommendations are suggested to improve the reliability of electricity supply to the metropolis.

- 1) Above 30MW of power generation will adequately supply the metropolis from time to time throughout the year.

- 2) Renewable energy source will solve the inadequacy of injected power supply to the entire state through the injection of solar energy, wind energy, biomass or small hydropower.
- 3) Conductor sizing for the distribution lines must be correctly done.
- 4) Capacity of transformers should be adequate and obsolete ones should be replaced with new ones.
- 5) Consumers should be given orientation on electricity usage by opting for energy saving bulbs and switching off loads when they are not in use.
- 6) The service offered by distribution companies in Ekiti and other parts of the country should be improved.
- 7) Reliability of electricity supply to the metropolis and other points above should be thoroughly carried out.

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