International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048
Volume 7, Issue 6, pp 173-177, June-2023
https://doi.org/10.47001/IRJIET/2023.706027

Evaluation of Efficiency of Power Allocated to the Benin Electricity Distribution Company Akure District from National Control Center

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***Abstract* - Electric power has been a major and vital instrument of development for any nation. It is an ingredient for economic, social, education, technological, industrial and commercial growth of any society. Electric energy is a form of energy that can be generated in large quantity but cannot be stored except in a minute quantity. This storage deficiency necessitates the need to ensure that the level of generation is almost equivalent to the distributed or consumed power in order to have maximum efficiency of the system. Over the years, electricity supply in Akure has been unsatisfactory and epileptic which has in turn affected the growth and development of the area particularly commercial and business activities that requires electric power for their operation, hence the need to identify the major causes of the problems bedeviling electricity supply in the city. This research was carried out to evaluate the efficiency in allocated power to the district by making a comparison between the available capacity of the power network to the actual power being distributed to the final consumer to actually ascertain where the major problem lies. The available capacity at the supply end was evaluated and at the same time data were collected from the feeders feeding the district to evaluate the consumed power and make necessary comparison with the available power. The result shows average efficiencies of 56.44%, 45.601%, 47.913%, 38.118% for the selected readings in May, June, July and August respectively. These efficiencies are assumed unsatisfactory. Although the supplied power is not enough to cater for the demand of the city but yet the available power is still not effectively and efficiently utilized thereby causing a great loss in the gas to power value chain. Necessary recommendations were made to solve this protracting challenge.**

Keywords: Electric Energy, maximum efficiency, available capacity, Electricity supply, actual power.

I. INTRODUCTION

It is a known fact that electrical power is a major need of any society. Regular and adequate power supply is the hallmark of a developed economy. Any nation whose energy need is epileptic in supply, prolongs her development and risks losing potential investors [1].This greatly determine the level of development of a community. It also serves as an input into the production of goods and services in the nation's industry, transport, agriculture, health, and education sectors, as well as an instrument for politics, security, and diplomacy [2]-[6]. Among the first created state in the southwest is Ondo state which has Akure as it capital. It is then expected that this capital should be among the occupant of front seat in terms of social and economic development in the south west.

Over the years, it has been observed that the reliability of power supplies in Akure town has been a major concern [7]. It is pathetic and quite worrisome that this goal of economic expansion has not be able to be materialized due to the epileptic power supply bedeviling the capital city. A random physical survey shows that average residents of the capital city do not enjoy more than 6 hours of power supply from the national grid per day. Most residents have resorted into the use of alternative source of power supply which is mainly fuel powered. This has been hampering the business expansion of individual residents as the cost implication of these alternate sources of power supply is nothing to write home about. Aside this, emission of carbon dioxide from this generating set has been causing a lot of environmental and climatic damages leading to the gradual global warming. It is then highly imperative to identify the problems associated with poor power supply and proffer necessary solution to address these problems. Hence the project focuses on evaluating the energy transmitted to Akure transmission substation, determine the available capacity of power supply at Akure Transmission sub-station, and to evaluate the average efficiency in power allocated to the Akure distribution unit.

II. METHODOLOGY

2.1 National Control Centre (NCC) Load Allocation to Benin Electricity Distribution Company (BEDC)

As the only body saddle with the responsibility of load allocation to the different distribution companies in Nigeria. Data were gotten to ascertain the load allocation to the

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distribution companies of Nigeria for various months which are May, June, July, August.

From the data gotten the average value was calculated to arrive at the estimated average load allocation to Benin Electricity Distribution Company for Akure, Ondo and Ado-Ekiti distribution sub-region.

2.2 Evaluation of Power Supply Network FromOsogbo 330/132/33kV Transmission Station to Akure 132/33kV Transmission Station

The 132kV transmission network devices and equipment were evaluated. The type, properties and capacity of each component making up the supply were identified. The major component identified were transformer supplying the line, breaker installed, the conductor size for the transmission line and the maximum allocated load to Osogbo-Akure transmission station.

The main transformer supplying the line is a 150MVA 330/132/33kV transformer. The conductor size is 150mm^2 aluminum conductor silicon reinforced though it was observed that there was conductor under sizing along the line which makes the line ununiformed. The tripping load of the breaker is set at 70MW, which means the peak load that the line can carry is 70MW.

2.3 Evaluation of Akure 132/33kV Transmission Station Installed Capacity and the 33kV Feeders Load Allocation

The Akure transmission substation which got is supply from Osogbo work center provide a 132kV line to Ado-Ekiti from its 132kV bus bar. It presently has a total installed capacity of 120MVA as it has in-service transformer of 3, namely T1 30MVA, T3 60MVA, T4 60MVA. It has a total of 8x33kV feeders which are Oba-Ile, Iju, Akure Mains, FUTA, Elizade, Owo, Igbara-Oke and Owena. The peak maximum power allocated to Ado 132kV is stipulated at 20MW which makes the total available power for all the 33kV feeders at the transmission substation to be around 45MW. The distribution of transformers on various feeders is as shown in Table 1.

Table 1: Feeder distribution on various power transformer at TCN sub-station Akure

S/N	Transformer	Feeders(33kV)	Peak load(MW)
1	T1, 30MVA	Igbara-Oke	13
		Owena	9
2	T3, 60MVA	Owo	13
		Iju	12
		Akure Mains	13
3	T4, 60MVA	FUTA	2
		Oba-Ile	15
		Elizade	2

2.4 Evaluation of the average load consumption on all 33kV feeders and identification of peak load for the month of May, June, July, August and Comparison with available energy capacity

To ascertain the consumption on each 33kV feeder, data were gotten for the month of May, June, July and August. Due to the bulkiness of the data and restriction in accessibility, data sampling method was adopted in which reading were taken for 1st hour, 4th hour, 8th hour, 12th hour, 16th hour, 20th hour and 24th hour for seven days in the month, that is 1st, 5th ,10th, 15th, 20th, 25th, 30th day of the month. The respective maximum and minimum load consumption for the month of May, June, July and August were taken. The average of the hourly consumption was calculated to estimate the daily consumption. This average per hour daily consumption for the selected day was plotted against the available capacity to ascertain the level of efficiency in energy distribution of the supplied energy to Benin Electricity Distribution Company Akure district based on the selected days.

2.5 Evaluation of peak load of Akure city 33kV feeders

The peak load of all 33kV feeders feeding Akure city only was evaluated to ascertain the peak demand of all the feeders and at the same time to project the total load demand for Akure city. The feeders considered for the evaluation of load demand of Akure were Iju, Akure mains and Oba-Ile 33kV feeders.

III. RESULTS AND DISCUSSIONS

3.1 Estimation of average load supply to Akure district from NCC

Figure 1 shows the allocated power to BEDC for the month selected as obtained from the national control center Osogbo.

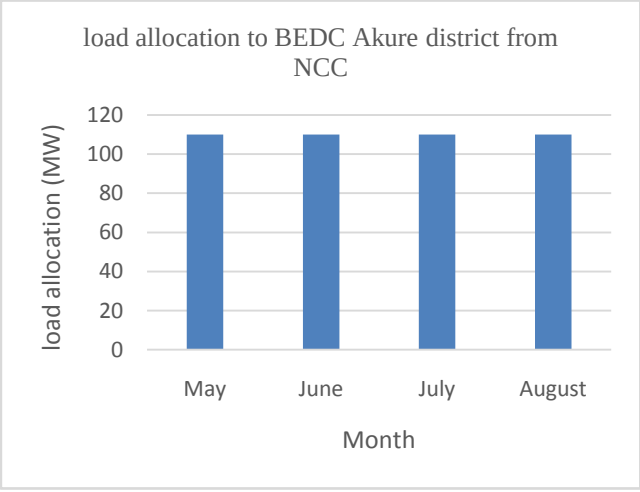

Figure 1: graphical representation of load allocation to BEDC from NCC

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From figure 1 above, the allocation for BEDC was evaluated to be 110MW.

3.2 Evaluation of efficiency in power allocated to the distribution company

From the data gotten, the average of the sum of hourly load consumed by all the 33kV feeders was calculated for the selected days of 1st, 5th, 10th, 15th, 20th, 25th, 30th day for the month of May, June, July and August and compare with the available capacity which stand at 45MW excluding Ado-Ekiti 132kV supply to ascertain the level of utilization of power allocated to Benin Electricity Distribution Company Akure Region for the month of May, June, July and August as shown in Table 2 to 5 respectively. Also the highest power consumption by all feeders for each month was identified and compare with the available capacity.

Mathematically,

$$\text{Efficiency (\%)} = \frac{Power\ \ Consumed}{Power\ \ Available} \times 100 \quad ---1$$

Where available capacity=45MW

3.3 Comparison of available capacity to the consumed power for the month of May

The average efficiency for the month of May is as shown in Table 2.

From Table 2, the average efficiency was calculated to ascertain the average level of power utilization for the month of May which is Average efficiency for May = sum of the efficiencies of the selected days/ number of samples which is equal to 56.644%. Although this efficiency is above 50%, it is still deemed to be unsatisfactory as a result of losses this may lead to.

Table 2: Average efficiency for the month of May

s/n	Day	Average hourly consumption by all feeders in (MW)	Efficiency (%) = (consumed/ available) x100
1	1st	26.714	59.36444
2	5th	21.643	48.09556
3	10th	25.429	56.50889
4	15th	21.000	46.66667
5	20th	32.143	71.42889
6	25th	31.928	70.95111
7	30th	19.571	43.49111
Average efficiency for May = sum of efficiency / 7= 56.644%			

3.4 Comparison of Available Capacity to the Consumed power for June

The average efficiency for the month of June is as shown in Table 3.

From Table 3 and analysis there, it can be seen that the efficiency of power for the selected day in June is 45.601% which is below 50%. This shows that the level of utilization for the selected days is low considering the value gotten from the table.

Table 3: average efficiency for the month of June

s/n	Day	Average hourly consumption by all feeders in (MW)	Efficiency (%) = (consumed/ available) x100
1	1st	27.142	60.31556
2	5th	20.718	46.04
3	10th	19.286	42.85778
4	15th	21.786	48.41333
5	20th	19.357	43.01556
6	25th	18.500	41.11111
7	30th	16.857	37.46
Average efficiency for June = sum of efficiencies / 7= 45.601%			

3.5 Comparison of available capacity to the consumed power for July

The average efficiency for the month of July is as shown in Table 4.

From Table 4 it has been evaluated that the average level of power utilization for the month of July based on the selected days stood at 47.913%. This efficiency is also below average which affirms the fact that the efficiency of power based on the selected days is unsatisfactory.

Table 4: Average efficiency for the month of July

s/n	Day	Average hourly consumption by all feeders in (MW)	Efficiency (%) = (consumed/ available) x100
1	1st	18.500	41.11111
2	5th	21.142	46.98222
3	10th	21.214	47.14222
4	15th	37.429	83.17556
5	20th	13.071	29.04667
6	25th	18.214	40.47556
7	30th	21.357	47.46
Average efficiency for July = sum of efficiencies / 7= 47.913%			

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3.6 Comparison of available capacity to the consumed power for August

The average efficiency for the month of August is as shown in Table 5.

Table 5: Average efficiency for August

s/n	Day	Average hourly consumption by all feeders in (MW)	Efficiency (%) = (consumed/ available) x100
1	1st	24.858	55.24
2	5th	20.643	45.87333
3	10th	22.071	49.04667
4	15th	14.714	32.69778
5	20th	17.071	37.93556
6	25th	12.429	27.62
7	30th	8.286	18.41333
Average efficiency for August= sum of efficiencies / 7= 38.1181%			

Hence, for the month of August, as seen in Table 5, it was found that the average efficiency of supply stand at 38.1181%

3.7 Comparison of highest sum of consumption by all feeders in each month to the available capacity

The highest hourly sum of load consumption by all the feeders was identified for the four month which is 12:00pm on the 20th day of May, 20:00pm on the 5th day of June, 20:00pm on the 15th day of July and 12:00pm on the 1st day of August. This shows that the peak load hour falls between 12:00pm and 20:00pm. This was graphically represented in Figure 3.

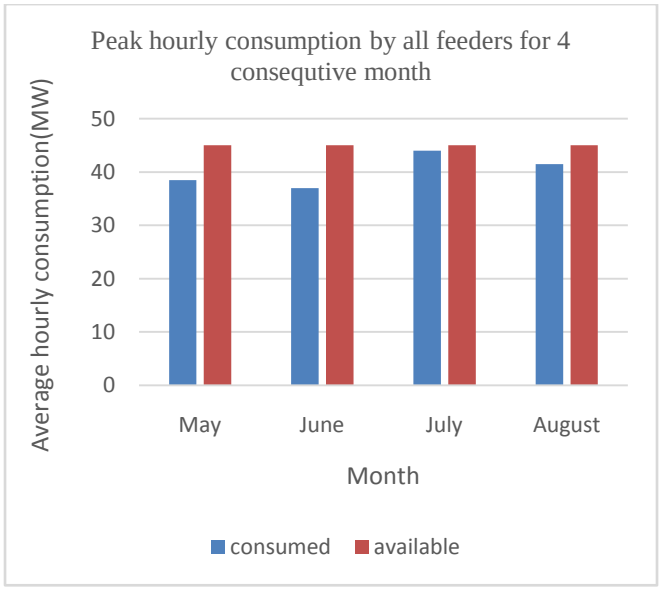

Figure 3: Graphical representation of the highest consumption by all feeders to the available capacity

Figure 3 is to ascertain and determine if the available capacity at the distribution end is enough to wheel out the capacity at the sending end of the transmission company. Hence, it reveals that the distribution company can distribute up to the available capacity.

3.8 Evaluation of Akure city peak load consumption from the feeding 33kV feeders

The peak load consumption of the three feeders feeding the entire Akure city was identified for the four month of May, June, July, August. These values were sum together to give the evaluated peak load consumption of Akure city from the 33kV feeders as shown in Table 6.

Table 6: sum of peak load consumption of Akure 33kV feeders

S/N	Month	Feeders	Peak load(A)	Sum (A)	Sum (MW)
1	May	Akure mains	200	610	30.5
		Iju	150		
		Oba-Ile	260		
2	June	Akure mains	130	500	25
		Iju	130		
		Oba-Ile	240		
3	July	Akure mains	130	570	28.5
		Iju	180		
		Oba-Ile	260		
4	August	Akure mains	140	560	28
		Iju	180		
		Oba-Ile	240		

The peak load consumption was then evaluated to be approximately 31MW.

IV. CONCLUSION

This paper has evaluated the efficiency in energy allocation to Benin Electricity Distribution Company (BEDC). The result shows average efficiencies of 56.44%, 45.601%, 47.913%, 38.118% for the selected readings in May, June, July and August respectively. It has revealed the fact that the level of distributed power to the available capacity is very unsatisfactory which has jeopardized efficiency in terms of energy distribution by the BEDC, hence the need for the total overhauling of the power distribution sector so that the available energy can be properly, effectively and efficiently utilized. It has also revealed that for the city to enjoy stable electricity, the supply power from the Transmission Company of Nigeria (TCN) Osogbo should be jacked up so as to meet the load demand of the city which stood at approximately 53MW.

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https://doi.org/10.47001/IRJIET/2023.706027

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Citation of this Article:

Michael Rotimi Adu, Owoyale Ismail, "Evaluation of Efficiency of Power Allocated to the Benin Electricity Distribution Company Akure District from National Control Center" Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 7, Issue 6, pp 173-177, June 2023. Article DOI https://doi.org/10.47001/IRJIET/2023.706027

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