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Evaluation Of Electric Energy Losses In Ehor 33kv Distribution Line.

Ogedegbe Omozei Joshua, Enobakhare Golden, Ehigie Eghe.
(Department Of Electrical And Electronics Engineering, Ambrose Alli University, Ekpoma Edo State.)

Abstract:
Electrical energy losses are an inherent part of power distribution systems, representing energy that is generated but never reaches the end-user. Minimizing these losses is crucial for an efficient power supply. A key strategy involves managing reactive power to maintain a power factor as close to unity as possible, which provides significant economic benefits for all consumers. For distribution companies, reducing losses translates directly to increased revenue, as more supplied energy is billed and paid for, rather than being written off as debt from unbilled losses. This requires universal metering for accurate energy accountability. When customers receive a more reliable supply and are billed correctly, their payment compliance improves. This study analyzed the Ehor 33 kV distribution line to quantify energy losses using data from transmission and distribution companies. It identified the causes of losses and evaluated mitigation methods, including the use of capacitor banks to improve the power factor. The findings confirmed that while losses financially burden the distribution company (Benin Electricity Distribution Company Plc), they paradoxically increase the revenue of the Transmission Company of Nigeria.

Keyword: *Energy losses, billing, Sag-conductors, distribution line,*

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I. Introduction

The three subsystems of a power system for electric energy are generation, transmission, and distribution. Transmission stations use high-voltage transmission lines to transport the electricity generated at the producing station to the distribution substations [1]. The distribution system serves as the link from the distribution substations to the consumer. Electricity has emerged as a significant issue that influences the motivation required for technology to advance and support the growth of contemporary society **[2]**. This has demonstrated the importance of energy supply for socioeconomic and industrial development, boosting output across all segments of the national economy, including business, industry, agriculture, and mining. Electric power distribution is an essential conduit between utilities and consumers., thus playing a very important role in the entire power network [3]. Transmission and Distribution losses in Nigeria are becoming very high, but that of distribution is higher [4]. Due to the physics involved with the many system components that make up any power system, distribution system losses are a fact of life. Due to a lack of data, techniques for estimating losses have mostly concentrated on examining system losses during specific peak demand periods [5].

Power losses in the form of copper losses, core losses, and auxiliary losses demonstrate that distribution transformers experience significant amounts of distribution losses. This is because no transformer is flawless, and the highest level of efficiency is only attained when copper losses are equal to iron losses [6]. Energy losses in networks differ from generation to transmission and distribution. As for the distribution network, the amount of energy losses when energy is supplied to the network may or not be accounted for as a result of the energy losses on the line. Electric utilities have long been interested in distribution system losses due to the loss of revenue from power and energy that are purchased or generated, as appropriate, but are not sold [7]. The need for a more precise understanding of when system losses occur and their quantity throughout various pricing periods grows as a result of today's environment of hourly energy markets distribution congestion charges. Distribution businesses have given increasing energy efficiency a high priority [8]. Electric resistance in distribution lines continuously wastes energy in the electric power system. About 7% of the total quantity of energy produced was lost, with 2% lost during transmission and 5% lost during distribution [9]. Except for the voltage level and power handling capabilities, transmission lines and distribution lines are identical. Limited amounts of power are transported across shorter distances through distribution lines (networks). The voltage drops in lines depend on the lines' resistance, reactance, cable length, and current drawn [10]. The larger the current drawn and the bigger the voltage drop are all related to the voltage and the amount of power handled, respectively.

For a given amount of power handled, the voltage level is inversely proportional to the current drawn [11]. The main purpose of distribution equipment is to move electricity efficiently and dependably from one place to another. High voltages are carried via conductors in the form of wires and cables suspended from towers and poles. This paper focuses mainly on all the energy meter readings in all the 11 kV feeders in injection stations

and 33 kV distribution substations on Ehor 33 kV line of Benin Electricity Distribution Company Plc, and energy meter readings on Ehor 132/33 kV feeder in Transmission Company of Nigeria Station, Irrua.

II. Reviewed Literature

Electric energy losses in a distribution network occur as a result of commercial and technical losses throughout the process of supplying electricity to consumers.

In [12] the authors, presented an experimental study on frictional energy losses to lengthen the life of hydraulic cylinders, and respectively lifetime of the hydraulic drive system.while the authors in [13] presented research work on the reduction of power losses in a distribution network system using model and simulation results which demonstrated that putting his ideas into practice results in a noticeable improvement in voltage profile and a decrease in active and reactive power losses.

The authors in [14] opined a research work on improvement in power losses using distribution, and generation in the analysis of costs associated with system losses. [15] presented and evaluated losses in the distribution system using data from the installed advanced metering infrastructure and geographical information system. A broad evaluation using elements like conductors, and insulators were used to determine the overall system losses evaluation.

Research on the cost that is associated with system losses and the adoption of a new technique using a calculation to drive the cost associated with power losses was proposed by the authors in [16]. Further-more, authors in [17] presented a traditional analysis estimate on employing widely established methods that significantly rely on assumptions and that only consider peak and average demands on key system components, energy losses are produced.

An artificial intelligence technology concept was put together to develop formal search methods for energy losses in [18]. Comparison of the losses that would have occurred if the loads on the transformer were evenly divided throughout the phases to the consumers and the losses that were calculated for the transformer's copper were presented by [19].

III. Research Methodology

The source of electricity supply to Transmission Company of Nigeria (TCN) Irrua 132/33 kV station is from Benin-city 330/132 kV Transmission Company of Nigeria station, situated at kilometre six (6) along Sapele Benin high way road Benin-City, Edo State. While, the transmission company of Nigeria (TCN) Irrua 132/33 kV station, which is one of the major sites of this project work is situated along Benin/Auchi highway road after Irrua specialist teaching hospital junction Irrua.

Transmission Company of Nigeria (TCN) Irrua 132/33 kV station is supplying electricity to 90% of Edo North, parts of Delta State (Agbor, Abavo, Akoko-Agbor, Umunede etc.), and some parts of Edo South (Ehor, Ugbiyaya, Uhi, Eguneki, Ugha, Isi, etc.). The company has two power transformers which are 60MVA and 30MVA. The 60 MVA transformer is called transformer (T1) with three outgoing feeders, which are Uzebba Feeder, Agenebode feeder and Ehor feeder, and each feeder has its circuit breaker. While the 30 MVA transformer is called transformer (T_2) with two outgoing feeders which are Agbor and Ubiaja feeders with individual breakers.

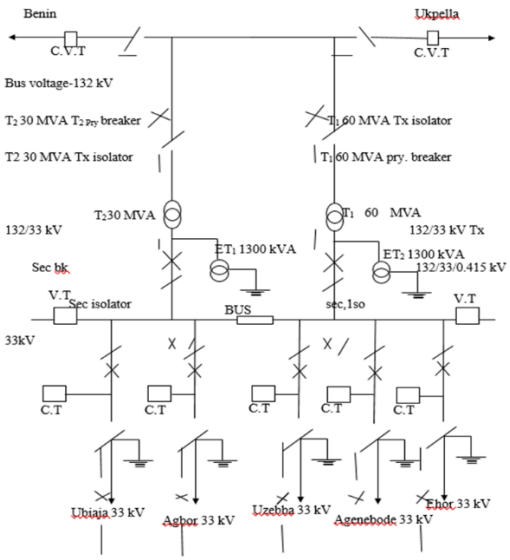

Fig. 1. The line diagram of TCN Irrua 132/33 kV station.

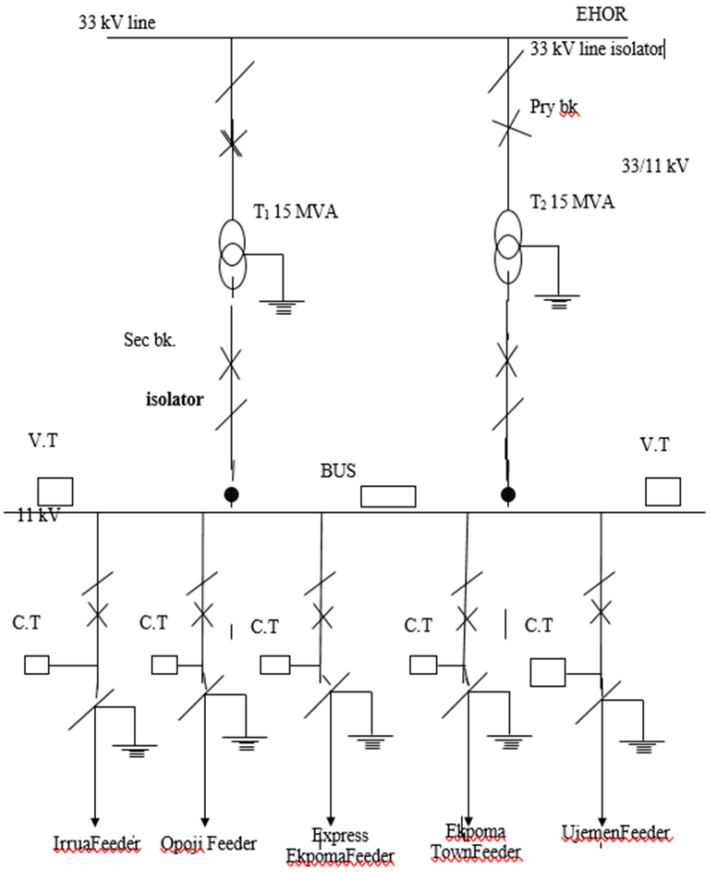

Fig. 2. Line diagram of BEDC Ekpoma 33/11 kV Injection station.

Also, the Benin Electricity Distribution Company (BEDC) Ambrose Alli University 33/11 kV injection station (Figs. 3. – 4) is situated inside the Ambrose Alli University compound close to their power station. The injection station has one power transformer of 7.5 MVA and two outgoing feeders which are Iruekpen feeders, with individual meters mounted on the feeders. The Ehor 33 kV network is the main scope of this project work which has its source from the Ehor 33 kV feeder from Transmission Company of Nigeria (TCN) Irrua station and ends at the Watchtower headquarters along Benin/Auchi express road in Igieduma, Ehor community. The Ehor 33 kV network from Transmission Company of Nigeria (TCN) Irrua station is presently supplying electricity to BEDC Irrua specialist teaching hospital (ISTH) 33/11 kV station, BEDC Ekpoma 33/11 kV station, BEDC Ambrose Alli University 33/11 kV station and BEDC Watchtower 33/11 kV station. Benin Electricity Distribution Company (BEDC) Irrua specialist teaching hospital (ISTH) 33/11 kV station has one power transformer of 2.5 MVA. This power transformer supplies electricity to six (6) 11/0.415 kV stations, which are the clinical 300 kVA transformer, doctors quarter 300 kVA transformer, Ortibor 500 kVA transformer, labour ward 300 kVA transformer, Larsa fever 300 kVA transformer and bank PHB 100 kVA transformer. All the transformers are metered. The Benin Electricity Distribution Company (BEDC) Ekpoma injection 33/11 kV station is situated along Benin Auchi highway road before Irrua specialist teaching hospital (ISTH) in MOPOL junction Ekpoma. The station has two power transformers which are 15 MVA each. One of the 15 MVA transformers is called transformer (T_1) and the other transformer (T_2) i.e. ($T_1 = T_2$) =15 MVA transformer (T_1) with three outgoing feeders, which are Irrua feeder, Opoji feeder and express Ekpoma feeder. While the transformer (T_2) with two outgoing feeders which are Ekpoma town and Ujemen dedicated feeders. All these feeders are metered with individual whole meters which record all energy consumption by consumers.

Ehor 33 kV distribution line is extended up to the Jehovah witnesses' headquarters in Igieduma, Uhoumode local government area. Along the distribution line, some communities have distribution stations of 33/0.415 kV which comprise Ugbiyaya, Ukpoli, Arosa, Okemun and Ehor Market. All the individual 33/0.415 kV substations are properly metered, which records all the monthly energy consumed in a kilowatt hour.

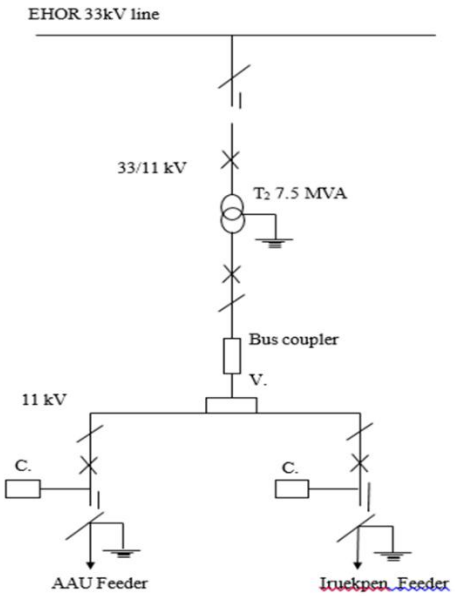

Fig. 3. The line diagram of BEDC Ambrose Alli University 33/11 kV injection station.

Data Collection

Data based on energy transmitted from the Transmission Company of Nigeria (TCN) Irrua station as the source of electricity supply to the Ehor 33 kV distribution line based on power transmitted is extracted from their log book and recorded for the period of October 2018 to September 2019. Also, data based on energy consumption in all the distribution injection stations and substations along the Ehor 33 kV line of Benin Electricity Distribution Company are taken from their meter reading card and log books as recorded on monthly basis, based on energy distributed by the company in the period of October 2018 to September 2019

Therefore,

$TTEC = TPSR - TPVR$ in MWH 3.1

Where,

Total Present Reading = $TPSR$ in MWH

Total Pervious Reading = $TPVR$ in MWH

Total Transmitted Energy Consumed = $TTEC$ in MWH

For Benin Electricity Distribution Company:

Total Present Reading = $TPSR$ in MWH

Total Previous Reading = $TPVR$ in MWH

Total Distribution Energy Consumption = $TDEC$ in MWH

$TDEC = TPSR - TPVR$ in MWH 3.2

Table. 1. Energy data obtained from Transmission Company of Nigeria (TCN) Irrua Station from October 2018 to September, 2019

Months	Availability Period(AP) (h)	Previous Reading (MWh)	Present Reading (MWh)	Consumption (MWh)
October, 18	495	112574	115297	2723
November, 18	468	115297	118511	3214
December, 18	447	118511	122032	3521
January, 19	443	122032	125237	3205
February, 19	496	125237	128710	3473
March, 19	558	120710	132200	3490
April,19	564	132200	135504	3304
May,19	589	135504	138776	3272
June, 19	568	138776	1/41885	3109
July, 19	470	141885	144562	2677
August, 19	493	144562	146763	2201
September, 19	484	146763	149276	2513

Table.2. Energy data obtained from Irrua Specialist Teaching Hospital (ISTH) 33/11 kV Station from October 2018 to September 2019.

Period	ISTH Injection Substations	Availability Period (h)	Previous Reading (MWh)	Present Reading (MWh)	Consumption (MWh)
October, 2018	Clinical	495	55.853	59.054	3.201
	Bank PHB	495	147.032	148.283	1.251
	Doctors Quarters	495	2412.951	2450.163	37.212
	Otibhor	495	3398.291	3450.845	52.554
	Labour Ward	495	2.914	3.935	1.021
	Lassa Fever	495	1.812	2.913	1.010
	Total				96.340
November, 2018	Clinical	468	59.054	62.701	3.647
	Bank PHB	468	148.283	149.697	1.414
	Doctors Quarters	468	2450.163	2500.315	50.152
	Otibhor	468	3450.845	3527.644	76.799
	Labour Ward	468	3.935	8.020	4.085
	Lassa Fever	468	2.913	3.421	0.508
	Total				136.605
December, 2018	Clinical	447	62.701	66.060	3.359
	Bank PHB	447	149.697	151.306	1.609
	Doctors Quarters	447	2500.315	2536.663	36.348
	Otibhor	447	3527.644	3583.165	55.521
	Labour Ward	447	8.020	9.605	1.585
	Lassa Fever	447	3.421	4.530	1.109
	Total				99.231
January, 2019	Clinical	443	66.060	70.699	4.639
	Bank PHB	443	151.306	153.379	2.073
	Doctors Quarters	443	2536.663	2574.234	37.571
	Otibhor	443	3583.165	3644.274	61.109
	Labour Ward	443	9.605	11.391	1.786
	Lassa Fever	443	4.530	5.755	1.225
	Total				108.403
February, 2019	Clinical	496	70.699	76.189	5.490
	Bank PHB	496	153.379	154.301	0.922
	Doctors Quarters	496	2574.234	2660.513	86.279
	Otibhor	496	3644.274	3761.756	117.482
	Labour Ward	496	11.391	12.011	0.620
	Lassa Fever	496	3.755	6.465	0.710
	Total				211.503
March, 2019	Clinical	558	76.189	79.184	2.995
	Bank PHB	558	154.301	155.331	1.030
	Doctors Quarters	558	2660.513	2678.510	17.997
	Otibhor	558	3761.756	3791.758	30.002
	Labour Ward	558	12.011	13.084	1.073
	Lassa Fever	558	6.465	7.048	0.583
	Total				53.680

Table 4. Energy data obtained from Benin Electricity Distribution Company 33/11 kV Ekpoma injection station from October, 2018 to September, 2019.

Period	Ekpoma Injection Substations	Availability Period (h)	Previous Reading (MWh)	Present Reading (MWh)	Consumption (MWh)
October, 2018	Ekpoma Town	249	53626	54320	694
	Ujemen	405	15531	15592	61
	Express Ekpoma	202	37780	38272	492
	Irrua	211	32393	32768	375
	Opoji	219	11268	11401	133
	Total				1755
November, 2018	Ekpoma Town	287	54320	55225	905
	Ujemen	404	15592	15678	86
	Express Ekpoma	221	38272	38879	607
	Irrua	256	32768	33305	537
	Opoji	252	11401	11565	164
	Total				2299
December, 2018	Ekpoma Town	304	55225	56192	967
	Ujemen	390	15678	15782	104
	Express Ekpoma	242	38879	39507	628
	Irrua	302	33305	33926	621

	Opoji	297	11565	11740	175
	Total				2495
January, 2019	Ekpoma Town	258	56192	57047	855
	Ujemen	408	15782	15848	66
	Express Ekpoma	269	393507	40258	751
	Irrua	234	33926	34418	492
	Opoji	231	11740	11892	155
	Total				2,319
February, 2019	Ekpoma Town	253	57047	57919	872
	Ujemen	408	15848	15949	101
	Express Ekpoma	209	40258	40845	587
	Irrua	232	34418	34866	448
	Opoji	230	11895	12050	155
	Total				2,163
March, 2019	Ekpoma Town	263	57919	58813	894
	Ujemen	504	15949	16038	89
	Express Ekpoma	248	40845	41447	602
	Irrua	221	34866	35306	440
	Opoji	218	12050	12197	147
	Total				2,172

Table 6. Energy data obtained from BEDC 33/11kV Ambrose Alli University Injection Station from October, 2018 to September, 2019.

Period	AAU Injection Station Feeder	Availability Period (h)	Previous Reading (MWh)	Present Reading (MWh)	Consumption (MWh)
October, 2018	AAU	403	3772	3865	93
	Iruekpen	202	22318	22756	438
	Total				531
November, 2018	AAU	412	3865	3948	83
	Iruekpen	198	22756	23188	432
	Total				515
December, 2018	AAU	390	3948	3995	47
	Iruekpen	208	23188	23679	491
	Total				538
January, 2019	AAU	352	3995	4051	56
	Iruekpen	243	23679	24222	543
	Total				599
February, 2019	AAU	439	4051	4150	99
	Iruekpen	223	24222	24661	439
	Total				538
March, 2019	AAU	520	4150	4283	133
	Iruekpen	289	24661	25266	605
	Total				738
April, 2019	AAU	521	4283	4406	123
	Iruekpen	209	25266	25710	444
	Total				567
May, 2019	AAU	492	4406	4501	95
	Iruekpen	210	25710	26135	425
	Total				520
June, 2019	AAU	483	4501	4570	69
	Iruekpen	186	26135	26491	356
	Total				425
July, 2019	AAU	403	4570	4654	84
	Iruekpen	192	26491	26872	381
	Total				465
August, 2019	AAU	462	4654	4733	79
	Iruekpen	248	26872	27277	405
	Total				484
September, 2019	AAU	402	4733	4801	68
	Iruekpen	234	27277	27738	461
	Total				529

Table 9. The Voltage and Current on Ehor 33 kV Distribution line for the month of October, 2018 to September, 2019.

Months	Vpeak(volts)	Ipeak(ampere)
October, 18	33000	495
November, 18	33000	468
December, 18	33000	447

January, 19	33000	443
February, 19	33000	496
March, 19	33000	558
April, 19	33000	564
May, 19	33000	589
June, 19	33000	568
July, 19	33000	470
August, 19	33000	493
September, 19	33000	484

IV. Results And Discussion

Results

The total transmitted energy consumed (TTEC) from Transmission Company of Nigeria, Irrua 132/33 kV Station by Benin Electricity Distribution Company and total distributed energy consumed (TDEC) from Benin Electricity Distribution Company by consumers, where obtained and calculated using algorithms.

Data Analysis

Total transmitted energy consumed from the month of October, 2018 to September, 2019 where analyses using algorithm equation, as shown in table 10

Table 10. Total transmitted energy consumed from the month of October, 2018 to September, 2019.

Months	Previous Reading, PVR (MWh)	Present Reading, PSR (MWh)	Consumption, TTEC (MWh)
October, 18	112574	115297	2723
November, 18	115297	118511	3214
December, 18	118511	122032	3521
January, 19	122032	125237	3205
February, 19	125237	128710	3473
March, 19	120710	132200	3490
April,19	132200	135504	3304
May,19	135504	138776	3272
June, 19	138776	1/41885	3109
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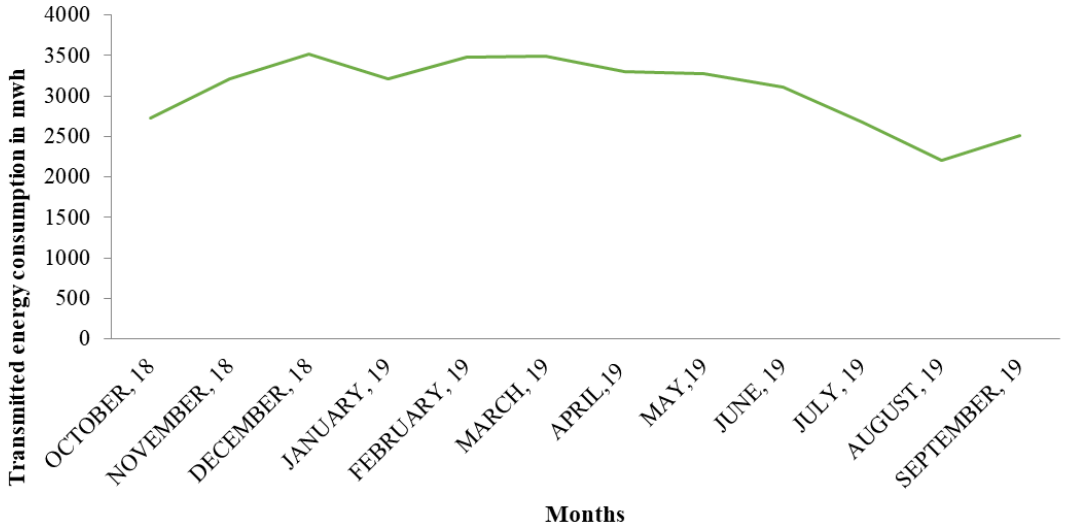

Fig.4. Transmitted Energy Consumption

Tables (11 – 15) shows the total distributed energy consumed in ISTH (which is represented by Ic), the 33/11 kV Ekpoma injection station (which is represented by Ec), the Ambrose Alli University injection station (which is represented by Ac), and the 33/0.415 kV Ehor direct station (which is represented by Dc), respectively.

Table 11 and Fig.5 shown energy consumption in megawatt hour (MWh) in ISTH 33/11 kV stations from October, 2018 to September, 2019.

Table 11. Energy consumption (MWh) in ISTH 33/11 kV stations from October, 2018 to September, 2019.

Months	Clinical (MWh)	Bank PHB (MWh)	Doctors Quarters (MWh)	Otibor (MWh)	Labour ward (MWh)	Lassa Fever (MWh)	Total Consumption (MWh)
October, 18	3.201	1.251	37.212	52.554	1.021	1.010	96.340
November, 18	3.647	1.414	50.152	76.799	4.085	0.508	136.605
December, 18	3.359	1.609	36.348	55.521	1.585	1.109	99.231
January, 19	4.639	2.073	37.571	61.109	1.786	1.225	108.403
February, 19	5.490	0.922	86.279	117.482	0.620	0.710	211.503
March, 19	2.995	1.030	17.997	30.002	1.073	0.583	53.680
April, 19	0.072	0.300	39.426	53.038	0.684	0.710	94.230
May, 19	2.810	0.601	29.749	51.049	0.527	0.811	85.547
June, 19	3.210	0.168	22.447	33.224	0.725	0.621	60.395
July, 19	2.011	0.236	26.123	56.789	0.652	0.523	86.334
August, 19	1.500	0.356	21.354	61,021	0.542	0.902	85.675
September,19	3.582	0.408	24.013	54.693	0.412	0.756	83.864

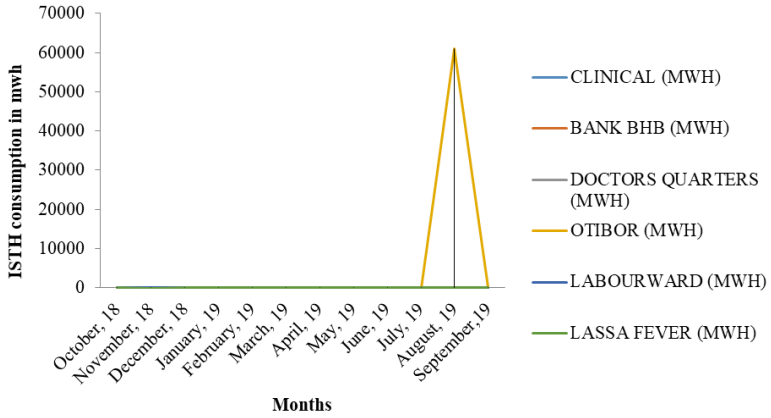

Fig. 5. Energy consumption in Irrua specialist teaching hospital

Table 12. Energy consumption (MWh) in ISTH 33/11 kV Ekpoma Injection stations from October, 2018 to September, 2019.

Months	Ekpoma Town (MWh)	Ujemen (MWh)	Express Ekpoma (MWh)	Irrua (MWh)	Opoji (MWh)	Total Consumption (MWh)
October, 18	694	61	492	375	133	1755
November, 18	905	86	607	537	164	2299
December, 18	967	104	628	621	175	2495
January, 19	855	66	751	492	155	2319
February, 19	872	101	587	448	155	2163
March, 19	894	89	602	440	147	2172
April, 19	808	95	648	467	147	2165
May, 19	611	87	444	341	115	1598
June, 19	515	68	453	392	137	1565
July, 19	750	81	530	470	192	2023
August, 19	459	64	326	269	110	1228
September,19	741	85	421	341	103	1691

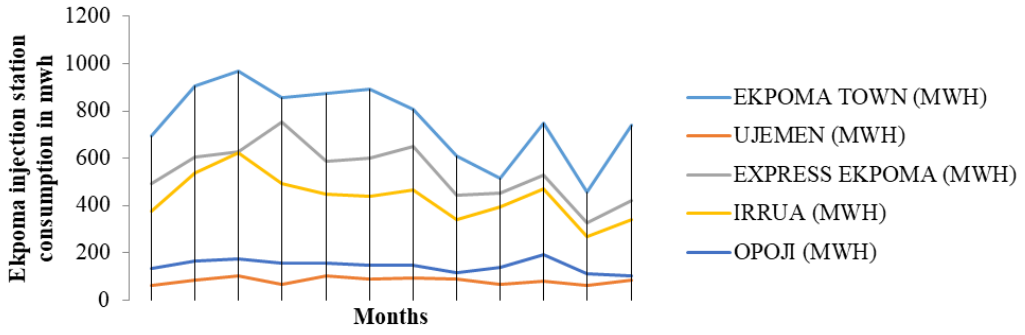

Fig. 6: Energy consumption in Ekpoma 33/11 kV injection station

Table 13. Energy consumption analysis in megawatt hour (MWh) of all the feeders in Ambrose Alli university (AAU) 33/11 kV injection station from October, 2018 to September, 2019.

Months	AAU (MWh)	Iruekpen (MWh)	Total (MWh)
October, 18	93	438	531
November, 18	83	432	515
December, 18	47	491	538
January, 19	56	543	599
February, 19	99	439	538
March, 19	133	605	738
April, 19	123	444	567
May, 19	95	425	520
June, 19	69	356	425
July, 19	84	381	465
August, 19	79	405	484
September, 19	68	461	529

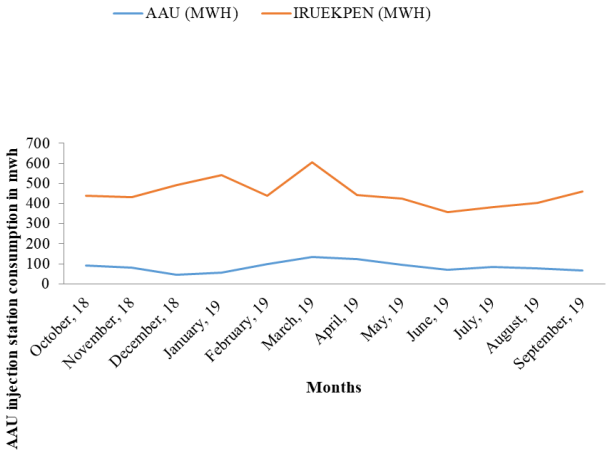

Fig. 7: Energy consumption in AAU injection station

Table 14: Energy consumption in megawatt hour of all 33/0.415 kVdirect Ehor substations from October, 2018 to September, 2019.

Months	Aiko Hotel (MWh)	Ugbiyuya (MWh)	Okemum Ehor (MWh)	Arosa Ehor	Market Ehor (MWh)	Upohi Ehor (MWh)	Watch Tower (MWh)	Total (MWh)
October, 18	1.010	0.284	0.201	2.239	3.011	1.211	25.850	33.836
November, 18	1.121	0.341	0.251	2.141	3.214	1.120	42.780	50.968
December, 18	0.960	0.322	0.305	1.984	2.981	1.058	221.050	228.660
January, 19	1.271	0.405	0.281	2.654	2.842	1.358	118.000	126.811
February, 19	1.126	0.289	0.255	2.418	3.141	1.253	195.810	204.292
March, 19	1.024	0.354	0.241	1.876	3.052	1.098	100.130	107.775
April, 19	1.131	0.309	0.408	2.102	2.168	1.128	24.810	33.056
May, 19	1.041	0.311	0.389	2.241	2.749	1.257	35.200	43.188
June, 19	1.204	0.365	0.352	2.012	3.451	1.284	57.820	66.488
July, 19	1.108	0.389	0.325	2.118	3.127	1.222	14.840	23.129
August, 19	1.212	0.411	0.256	2.315	3.502	1.985	29.280	38.961
September,19	1.132	0.387	0.351	2.041	3.110	1.204	38.750	46.975

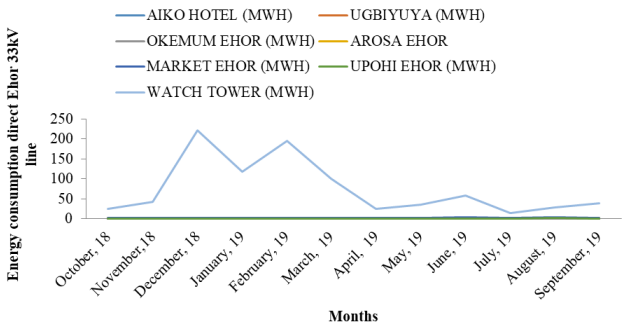

Fig. 8: Energy consumption on direct Ehor 33kV line.

Table 15: The total distributed energy obtained from BEDCPlc.

Months	Ic (MWh)	Ec (MWh)	Ac (MWh)	Dc (MWh)	TDEC (MWh)
October, 18	96.340	175.000	531.000	33.836	2416.176
November, 18	136.605	2299.000	515.000	50.968	3001.573
December, 18	99.231	2495.000	538.000	228.660	3360.891
January, 19	108.403	2319.000	599.000	126.811	3153.214
February, 19	211.503	2163.000	538.000	204.292	3116.795
March, 19	53.680	2172.000	738. .000	107.775	3071.455
April, 19	94.230	2165.000	567.000	33.056	2859.286
May,19	85.547	1598.000	520.000	43.188	2246.735
June, 19	60.345	1565.000	425.000	66.488	2116.833
July, 19	86.334	2023.000	465.000	23.129	2597.463
August, 19	85.675	1228.000	484.000	38.961	1836.636
September, 19	83.864	1691.000	529.000	46.975	2350.803

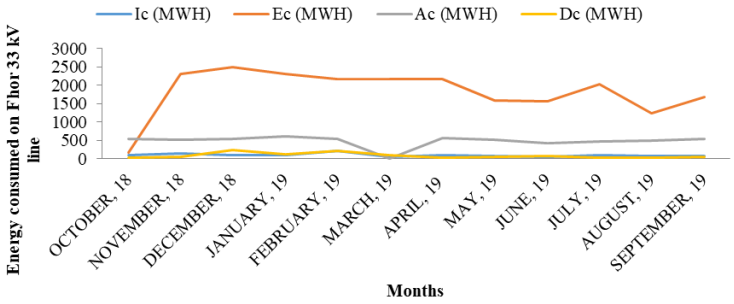

Fig. 9: The total distributed energy consumed on Ehor 33 kV line

Table 16: The difference between total transmitted energy consumed and total distributed energy consumed (MWh) from transmission company and distribution company.

Months	TTEC (MWh)	TDEC (MWh)	EEL (MWh)
October, 18	2723.000	2416.176	306.824
November, 18	3214.000	3001.573	212.427
December, 18	3521.000	3360.891	160.109
January, 19	3205.000	3153.214	51.786
February, 19	3473.000	3116.795	356.205
March, 19	3490.000	3071.455	418.545
April, 19	3304.000	2859.286	444.714
May, 19	3272.000	2246.735	1025.265
June, 19	3109.000	2116.833	992.167
July, 19	2677.000	2597.463	79.537
August, 19	2201.000	1836.636	364.364
September, 19	2513.000	2350.803	162.197

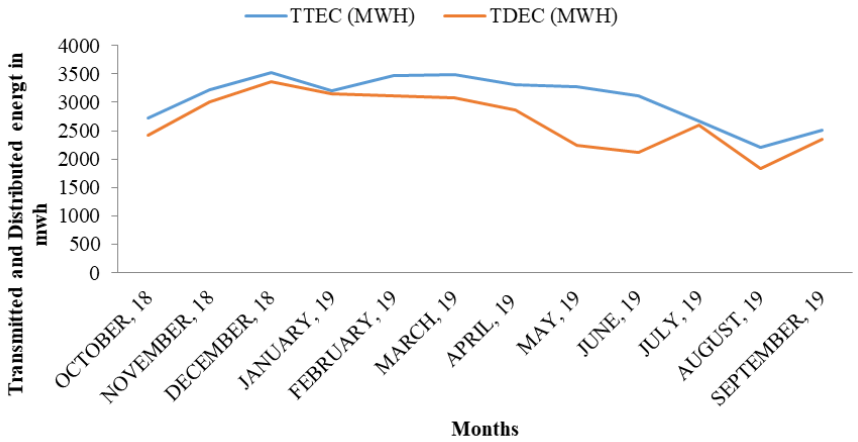

Fig. 10: The difference between total transmitted energy consumed and total distributed energy consumed (MWh) from transmission company and distribution company.

Table 17: The difference between total transmitted energy consumed and total distributed energy consumed (kWh)from transmission company and distribution company.

Months	TTEC(kWh)	TDEC (kWh)	EEL(kWh)
October, 18	2,723,000	2,416,176	30682
November, 18	3214,000	3001573	212427
December, 18	3521,000	3360891	160109
January, 19	3205,000	3153214	51786
February, 19	3473,000	3116795	356205
March, 19	3490,000	3071455	418545
April, 19	3304000	2859286	444714
May, 19	3272,000	2246735	1025265
June, 19	3109000	2116833	992167
July, 19	2677000	2597463	79537
August, 19	2201000	1836636	364364
September, 19	2513000	2350803	162197
Total	36,702,000		

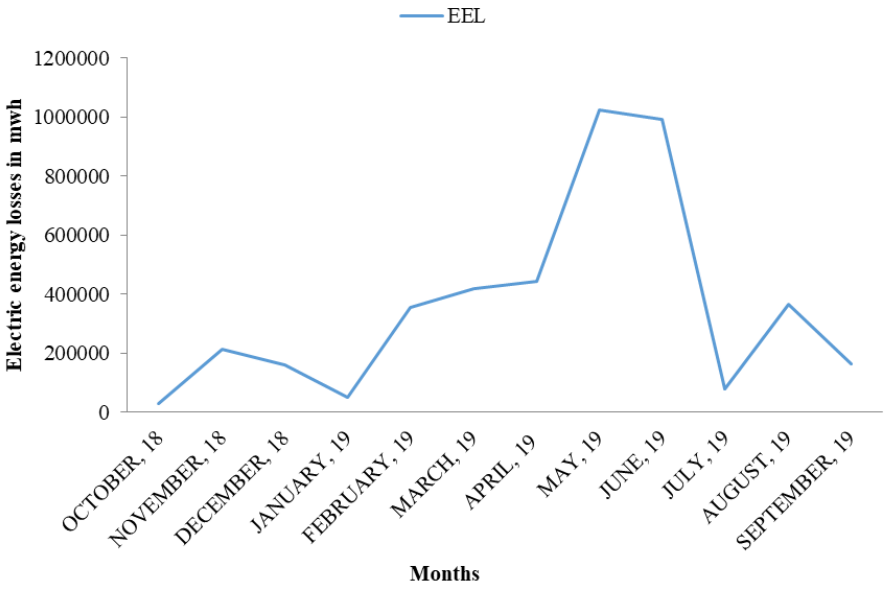

Fig. 12: The difference between total transmitted energy consumed and total distributed energy consumed (kWh)from transmission company and distribution company.

Table 18: The total voltage, current and apparent power on Ehor33kV distribution line from the month of October, 2018 to September, 2019.

Months	Vpeak (volts)	Ipeak (ampere)	Vrms (volts)	Irms (ampere)	TAP (Vrms)(Irms)
October, 18	33000	495	23334.52	350.02	8167548.69
November, 18	33000	468	23334.52	330.93	7722092.70
December, 18	33000	447	23334.52	316.08	7375575.08
January, 19	33000	443	23334.52	313.25	7309538.39
February, 19	33000	496	23334.52	350.72	8183882.85
March, 19	33000	558	23334.52	394.57	9207101.56
April, 19	33000	564	23334.52	398.81	9306039.92
May, 19	33000	589	23334.52	416.49	9718594.24
June, 19	33000	568	23334.52	401.64	9372076.61
July, 19	33000	470	23334.52	332.34	7754994.38
August, 19	33000	493	23334.52	348.60	8134413.67
September, 19	33000	484	23334.52	342.24	7986006.13

Table 19: The total availability period, total transmitted energy consumed in kWh, kW, W and total apparent power (VA) on Ehor 33 kV distribution line.

Months	AP (h)	TTEC (kWh)	TTEC (kW)	TTEC (W)	TAP (VA)
October, 18	495	2723000	5501.010	5501010	81675499
November, 18	468	3214000	6867.521	6867521	7722093
December, 18	447	3521000	7876.957	7876957	7375575

January, 19	443	3205000	7234.763	7234763	7309538
February, 19	496	3473000	7002.763	7002016	8183883
March, 19	558	349000	6254.480	6254480	9207102
April, 19	564	3304000	5858.156	5858156	9306040
May, 19	589	3272000	5555.178	5555178	9718594
June, 19	568	3109000	5473.592	5473592	9372077
July, 19	470	2677000	5695.744	5695744	7754994
August, 19	493	2201000	4464.503	4464503	8134414
September, 19	484	2513000	5192.149	5192149	7986006
Total				72976069	166027865

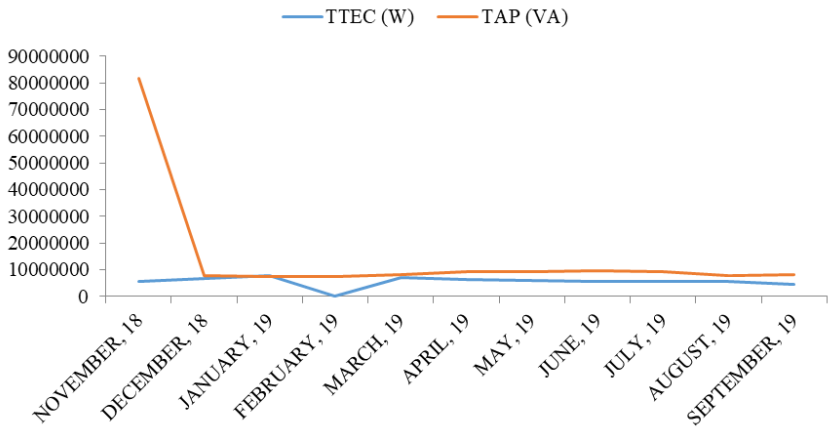

Fig. 11: Total Transmitted Energy Consumed and Total Apparent Power

Table 20: The difference between TTEC, TDEC (kWh), tariff classification and RL on Ehor 33 kV distribution line.

Months	**TTEC (kWh)**	**TDEC (kWh)**	**EEL (kWh)**	**TARIFF R2S**	**RL (₦)**
October, 18	2,723,000	2,416,176	30,682	31.26	959,119.32
November, 18	3214,000	3,001,573	212,427	31.26	6,640,468.02
December, 18	3,521,000	3360891	160,109	31.26	5,005,007.34
January, 19	3,205,000	3,153,214	51,786	31.26	1,618,830.36
February, 19	3,473,000	3,116,795	356,205	31.26	11,134,968.30
March, 19	3,490,000	3,071,455	418,545	31.26	13,083,716.70
April, 19	3,304000	2,859,286	444,714	31.26	13,901,759.64
May, 19	3,272,000	2,246,735	1,025,265	31.26	32,049,783.90
June, 19	3,109,000	2,116,833	992,167	31.26	31,015,140.42
July, 19	2,677,000	2,597,463	79,537	31.26	2,486,326.62
August, 19	2L201,000	1,836,636	364,364	31.26	11,390,018.64
September, 19	2,513,000	2,350,803	162,197	31.26	5,070,278.22

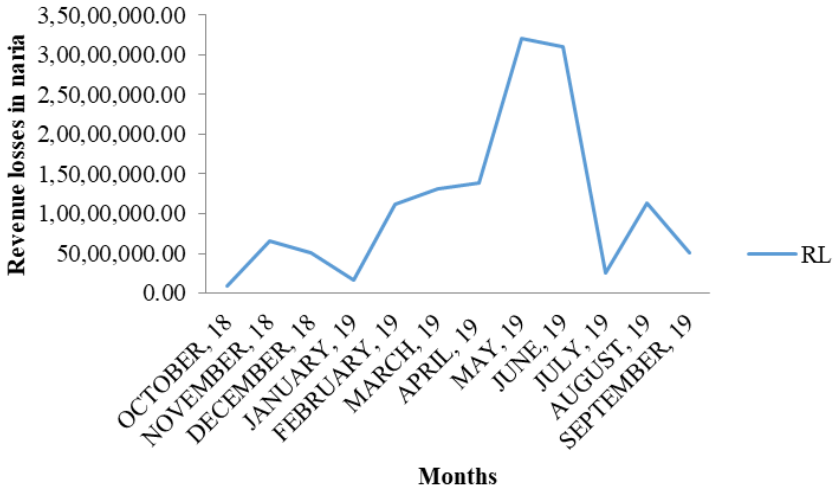

Fig. 12: Revenue Losses in Distribution Company

V. Conclusion

Conclusion

Finding a solution to the issue of electric energy loss at Benin electricity distribution company Plc network has been successfully attempted, using Ehor 33 kV distribution line as a sample. Analysis of data obtained from both the transmission company of Nigeria Irrua station and Benin Electricity Distribution Company Plc, where used to identify the losses on Ehor 33 kV distribution line. It was discovered that the increase in availability brings about increase in energy losses. It is clear that, if capacitor banks are installed close to transformers which are the source of supply to consumers, the power factor will reduce to approximately unity. This suggests that the flow of reactive power will be at its lowest level. Also, the inspection method carried out along Ehor 33 kV distribution line shows that 65% of the distribution line are covered with light vegetation along the line, almost 70% of the porcelain insulations are piloted on concrete poles with broken cross-arm tired to the pole, sag wires along the line and different rating of conductors were used in constructing Ehor 33 kV distribution line. Also, the rate of revenue lost on the side of the distribution company is high, which affect the company cost of purchasing energy from market operators.

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