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DEVELOPMENT OF A MODEL FOR THE ESTABLISHMENT OF A HYDRO ELECTRIC POWER GENERATING PLANT: AKURE DISTRIBUTION NETWORK AS A CASE STUDY

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ABSTRACT

Nigeria as a nation has suffered a lot when it comes to the availability of electricity. A clear comparison between this nation's electric power supply and other countries revealed the present incessant electric power supply in the country. The average power per capital (watts per person) in the United States is 1,377 Watts. In Canada, it is as high as 1,704 Watts per person and in South Africa; it is 445 Watts per person. The average power per capital in Australia is 1,112 Watts and in New Zealand it is 1,020 W per person. Whereas, the average power per capital (watts per person) in Nigeria is 14 W person. The power system structure is characterized with a lot of faults and outages. These electric power problem has destroyed the industrial processes in the country. As a result, unemployment has increased in the country. As at February, 2020, according to the Federal Government of Nigeria, the number of unemployed youths in the country is 23 million. Data from the International Transparency in the United State stated that there are 40 million unemployed youths in the country. This has increased crime rates among the youths. The country experience a high level of hardship, insecurity and socio-economic disorder as results. Therefore, there is an urgent need to solve this incessant supply of electric power in the country. Hence, a detail study of Akure132/33kV substation Network of the Benin Electricity Distribution Company under which there are 84,264 customers was carried out. Reliability index of the distribution system were estimated. A model for establishing a hydro Electric Power Generating Plant was developed. Power Generation and Improvement techniques for the generation, transmission and distribution of electricity were achieved. The research work developed a model for establishing a hydro Electric Power Generating Plant and establish a monogram for increasing the value of power generation in a hydro generating station.

OBJECTIVES OF THE RESEARCH WORK

The objectives of the research work are

1. to carry out detail study of Akure132/33kV Substation Network of Benin Electricity Distribution Company (BEDC)

2. To measure the reliability index of the distribution system.
3. To develop a model for establishing a Hydro Electric Power Generating Plant.
4. To establish a monogram for increasing the value of power generation in the generating station.
5. To study the requirements for the establishment of an alternative Hydro Electric Power Generating plant

INTRODUCTION

The Federal Government of Nigeria promised to increase the power output by launching nine power plant projects in the country. But many of the power projects have been abandoned. After over 30 years, many of them were never completed. Even when all these projects are 100% completed, the total generating capacity in the country from the old power generating plants and these new projects will just be 8,274 MW. The average electricity consumed in watts per person in Nigeria will just be 45.97 Watts/person. Where-as, the average power per capital (watts per person) in the European Union with a population of 513,949,445615 is 615Watts/person, in the United States it is 1,377 Watts/person. In China, a country with population of 1,373,541,000, the average power per capital (watts per person) is 492 Watts/person, in South Africa, it is 445 Watts per person. The average power per capital in Australia is 1,112 Watts, in Russia it is 854 W per person and in Canada, it is as high as 1,704 Watts per person as shown in table 1.1

The lists of the said ongoing power projects in country are as follows:

1. 1700 Megawatts Hydro Power Plant Zungeru power plant in Niger state: This project was first conceived in 1982, but was abandoned due to lack of funds, corruption and dispute among the parties involved. Construction started again in 2016 and is expected to be completed by 2019. Though never completed.

2. 240 Mega Watts Afam Power Plant: Afam Power Plc is a thermal power plant located in the gas rich Rivers State. It is expected to be completed by December 2017. However, this power project has never been completed.

3. 40 Mega Watts Kashimbilla Hydro Power Plant Located in Taraba state: the construction of this 40 Mega Watts Kashimbilla power plant started in March 2017 and it is expected to be running by the end of the year 2017. Again, this Hydro Power Plant is not yet in operation

4. 215 Mega Watts Kaduna Power Plant: This power project contract in Kaduna state was awarded in 2009 and it was expected to be completed within 36 months. However, the project experienced great delay due to inadequate budgetary allocation and corruption among Nigerian Politicians. It was expected to be running before the end of year 2017. This power plant has not been completed up till today.

5. 450 Megawatts Azura Power Plant: Azura Thermal power station is a natural gas powered electricity generation plant with a proposed capacity of 1,500 megawatts, under construction in Edo state, Nigeria. It is an IPP project, with the first phase under construction. It is expected to be commissioned in 2018

6. 40 Mega Watts Gurara Power Plant in Kaduna state: it was estimated that the completion of the Gurara Hydro power plant would generate additional 30 megawatts. The project experience great delay due to inadequate budgetary allocation and corruption in the country.

7. 29 Mega Watts Dadin Kowa Hydro Power Plant Located in Gombe State: the construction of the Dadin Kowa plant is expected to be completed in November, 2017. Yet, this power plant is still incomplete.

8. 10 Mega Watts Katsina Wind Power Plant: The N4.4 billion Katsina Wind power plant project was awarded to a French company in 2010 and was scheduled for completion in 2012. However, the project has been stalled due to corruption and other several reasons. No completion date has been announced yet" AdeolaOpeyemi, 2016.

9. Mambilla Power Station: The Mambilla Power Station, one of Nigeria's biggest dam projects is a projected hydro power plant which will be connected to three dams across the Donga River in Taraba State, Nigeria, with a generating capacity of 3,050 megawatt.

Finally, the total generating capacity from these new 9 power plant projects, even when completed, is 4,774 MW. The present power generating capacity in Nigeria is estimated to be 6,803 megawatts, with average working capacity between 3,500 MW. Hence, the total generating capacity in the country will only become 11,577 MW (6,803 +4,774). The total power generated in the country will only be 8,274 MW (3,500 + 4,774MW) and the average electricity consumed in watts per person in Nigeria will just be 45.97 Watts/person.

In order to provide solution to this incessant problem, a detail study of Akure132/33kV substation Network of the Benin Electricity Distribution Company under which there are 84,264 customers was carried out. Reliability index of the distribution system were estimated. A model for establishing a hydro Electric Power Generating Plant was developed. A monogram for increasing the value of power generation in the generating station was also developed. Power Generation and Improvement techniques for the generation, transmission and distribution of electricity were achieved.

Table 1.1: Electricity Energy Consumption in the World from the World Fact Book

Rank	Country/Region	Electricity consumption (kW·h/yr)	Year of Data	Source	Population	As of	Average energy per capita (kWh per person per year)	Average power per capita (watts per person)
—	World	21,776,088,770,300	2014	CIA	7,322,811,468	2016	2,674	309
1	China	5,920,000,000,000	2016	CIA	1,373,541,000	2016	4,310	492
2	United States	3,911,000,000,000	2015 EST.	CIA	323,995,528	2016	12,071	1377
—	European Union	2,771,000,000,000	2013 EST.	CIA	513,949,445	2016	5,391	615
3	India	1,408,624,400,000	2016 EST.	CSO[31]	1,266,883,598	2016	1,122	128
4	Russia	1,065,000,000,000	2014 EST.	CIA	142,355,415	2016	7,481	854
5	Japan	934,000,000,000	2014 EST.	CIA	126,702,133	2016	7,371	841
6	Germany	533,000,000,000	2014 EST.	CIA	80,722,792	2016	6,602	753
7	Canada	528,000,000,000	2014 EST.	CIA	35,362,905	2016	14,930	1704
8	Brazil	518,000,000,000	2014 EST.	CIA	205,823,665	2016	2,516	287

Rank	Country/Region	Electricity consumption (kW·h/yr)	Year of Data	Source	Population	As of	Average energy per capita (kWh per person per year)	Average power per capita (watts per person)
9	Korea, South	495,000,000,000	2014 EST.	CIA	50,924,172	2016	9,720	1109
10	France	431,000,000,000	2014 EST.	CIA	66,836,154	2016	6,448	736
11	United Kingdom	309,000,000,000	2014 EST.	CIA	64,430,428	2016	4,795	547
12	Italy	291,000,000,000	2014 EST.	CIA	62,007,540	2016	4,692	535

13	Saudi Arabia	272,000,000,000	2014 EST.	CIA	28,160,273	2016	9,658	1102
14	Taiwan	249,500,000,000	2015 EST.	CIA	23,464,787	2016	10,632	1,213
15	Mexico	238,000,000,000	2014 EST.	CIA	123,166,749	2016	1,932	220
16	Spain	234,000,000,000	2014 EST.	CIA	48,563,476	2016	4,818	550
17	Australia	224,000,000,000	2014 EST.	CIA	22,992,654	2016	9,742	1,112
18	Iran	218,000,000,000	2014 EST.	CIA	82,801,633	2016	2,632	300
19	South Africa	212,000,000,000	2014 EST.	CIA	54,300,704	2016	3,904	445
20	Turkey	207,000,000,000	2014 EST.	CIA	80,274,604	2016	2,578	294
21	Indonesia	195,000,000,000	2014 EST.	CIA	258,316,051	2016	754	86
22	Thailand	164,000,000,000	2014 EST.	CIA	68,200,824	2016	2,404	274

23	Egypt	143,000,000,000	2014 EST.	CIA	94,666,993	2016	1,510	172
24	Ukraine	143,000,000,000	2014 EST.	CIA	44,209,733	2016	3,234	369
25	Poland	142,000,000,000	2014 EST.	CIA	38,523,261	2016	3,686	420
26	Malaysia	131,000,000,000	2014 EST.	CIA	30,949,962	2016	4,232	483
27	Sweden	127,000,000,000	2014 EST.	CIA	9,880,604	2016	12,853	1467
28	Norway	126,400,000,000	2014 EST.	CIA	5,265,158	2016	24,006	2740
29	Vietnam	125,000,000,000	2014 EST.	CIA	95,261,021	2016	1,312	149
30	Argentina	116,000,000,000	2014 EST.	CIA	43,886,748	2016	2,643	301
31	Netherlands	108,000,000,000	2014 EST.	CIA	17,016,967	2016	6,346	724

32	United Arab Emirates	96,000,000,000	2014 EST.	CIA	5,927,482	2016	16,195	1848
33	Kazakhstan	91,000,000,000	2014 EST.	CIA	18,360,353	2016	4,956	565
34	Philippines	90,797,891,000	2016	DOE [1]	102,624,209	2016	885	101
35	Pakistan	82,000,000,000	2014 EST.	CIA	201,995,540	2016	405	46
36	Finland	81,000,000,000	2014 EST.	CIA	5,498,211	2016	14,732	1681
37	Belgium	81,000,000,000	2014 EST.	CIA	11,409,077	2016	7,099	810
38	Venezuela	78,000,000,000	2014 EST.	CIA	30,912,302	2016	2,523	288
39	Austria	69,750,000,000	2015 EST.	CIA	8,711,770	2016	8,006	913
40	Chile	66,000,000,000	2014 EST.	CIA	17,650,114	2016	3,739	426

41	Czech Republic	60,000,000,000	2014 EST.	CIA	10,644,842	2016	5,636	643
42	Colombia	60,000,000,000	2014 EST.	CIA	47,220,856	2016	1,270	145
43	Israel	59,830,000,000	2014 EST.	CIA	8,174,527	2016	7,319	835
44	Switzerland	58,000,000,000	2014 EST.	CIA	8,179,294	2016	7,091	809
45	Bangladesh	55,500,000,000	2015 EST.	CIA	157,826,578	2017	351	40
46	Kuwait	54,000,000,000	2014 EST.	CIA	2,832,776	2016	19,062	2176
47	Greece	53,000,000,000	2014 EST.	CIA	10,773,253	2016	4,919	561
48	Algeria	49,000,000,000	2014 EST.	CIA	40,263,711	2016	1,216	138
49	Romania	48,000,000,000	2014 EST.	CIA	21,599,736	2016	2,222	253

50	Uzbekistan	48,000,000,000	2014 EST.	CIA	29,473,614	2016	1,628	185
51	Singapore	47,180,000,000	2014 EST.	CIA	5,781,728	2016	8,160	931
52	Portugal	46,000,000,000	2014 EST.	CIA	10,833,816	2016	4,245	484
53	Hong Kong	42,000,000,000	2014 EST.	CIA	7,167,403	2016	5,859	668
54	Iraq	42,000,000,000	2014 EST.	CIA	38,146,025	2016	1,101	125
55	New Zealand	40,000,000,000	2014 EST.	CIA	4,474,549	2016	8,939	1020
56	Peru	39,000,000,000	2014 EST.	CIA	30,741,062	2016	1,268	144
57	Qatar	34,000,000,000	2014 EST.	CIA	2,258,283	2016	15,055	1718
58	Belarus	33,000,000,000	2014 EST.	CIA	9,570,376	2016	3,448	393
59	Denmark	32,000,000,000	2014 EST.	CIA	5,593,785	2016	5,720	653

60	Bulgaria	31,000,000,000	2014 EST.	CIA	7,144,653	2016	4,338	495
61	Morocco	29,000,000,000	2014 EST.	CIA	33,655,786	2016	861	98
62	Slovakia	28,360,000,000	2014 EST.	CIA	5,445,802	2016	5,207	594
63	Serbia	26,910,000,000	2014 EST.	CIA	7,143,921	2016	3,766	430
64	Bahrain	25,000,000,000	2014 EST.	CIA	1,378,904	2016	18,130	2069
65	Ireland	25,000,000,000	2014 EST.	CIA	4,952,473	2016	5,047	576
66	Oman	25,000,000,000	2014 EST.	CIA	3,355,262	2016	7,450	850
67	Nigeria	24,000,000,000	2014 EST.	CIA	186,053,386	2016	128	14
68	Hungary	21,550,000,000	2015 EST.	CIA	9,874,784	2016	2,182	249

69	Ecuador	21,000,000,000	2014 EST.	CIA	16,080,778	2016	1,305	149
70	Azerbaijan	20,000,000,000	2014 EST.	CIA	9,872,765	2016	2,025	231
71	Puerto Rico	19,000,000,000	2014 EST.	CIA	3,578,056	2016	5,310	606
72	Iceland	17,000,000,000	2014 EST.	CIA	335,878	2016	50,613	5777
73	Syria	17,000,000,000	2014 EST.	CIA	17,185,170	2016	989	112
74	Croatia	16,970,000,000	2014 EST.	CIA	4,313,707	2016	3,933	449
75	Jordan	16,000,000,000	2014 EST.	CIA	8,185,384	2016	1,954	223
76	Lebanon	16,000,000,000	2014 EST.	CIA	6,237,738	2016	2,565	292
77	Dominican Republic	15,140,000,000	2014 EST.	CIA	10,606,865	2016	1,427	162
78	Tunisia	15,000,000,000	2014 EST.	CIA	11,179,995	2016	1,341	153

79	Cuba	15,000,000,000	2014 EST.	CIA	25,115,311	2016	597	68
80	Korea, North	15,000,000,000	2014 EST.	CIA	11,134,588	2016	1,347	153
81	Slovenia	13,000,000,000	2014 EST.	CIA	1,978,029	2016	6,572	750
82	Turkmenistan	13,000,000,000	2014 EST.	CIA	5,291,317	2016	2,456	280
83	Tajikistan	12,000,000,000	2014 EST.	CIA	8,330,946	2016	1,440	164
84	Mozambique	12,000,000,000	2014 EST.	CIA	25,930,150	2016	462	52
85	Kyrgyzstan	11,000,000,000	2014 EST.	CIA	5,727,553	2016	1,920	219
86	Sri Lanka	11,000,000,000	2014 EST.	CIA	22,235,000	2016	494	56
87	Zambia	11,000,000,000	2014 EST.	CIA	15,510,711	2016	709	80

88	Bosnia and Herzegovina	11,000,000,000	2014 EST.	CIA	3,861,912	2016	2,848	325
89	Myanmar	11,000,000,000	2014 EST.	CIA	56,890,418	2016	193	22
90	Uruguay	10,000,000,000	2014 EST.	CIA	3,351,016	2016	2,984	340
91	Lithuania	9,900,000,000	2014 EST.	CIA	2,854,235	2016	3,468	395
92	Sudan	9,900,000,000	2014 EST.	CIA	36,729,501	2016	269	30
93	Georgia	9,800,000,000	2014 EST.	CIA	4,928,052	2016	1,988	227
94	Paraguay	9,700,000,000	2014 EST.	CIA	6,862,812	2016	1,413	161
95	Libya	9,300,000,000	2014 EST.	CIA	6,541,948	2016	1,421	162
96	Congo, Democratic	9,300,000,000	2014 EST.	CIA	81,331,050	2016	114	13

	Republic of the							
97	Costa Rica	9,200,000,000	2014 EST.	CIA	4,872,543	2016	1,888	215
98	Ghana	9,200,000,000	2014 EST.	CIA	26,908,262	2016	341	39
99	Trinidad and Tobago	9,100,000,000	2014 EST.	CIA	1,220,479	2016	7,456	851
100	Guatemala	8,915,000,000	2014 EST.	CIA	15,189,958	2016	586	66
101	Estonia	8,200,000,000	2014 EST.	CIA	1,258,545	2016	6,515	743
102	Angola	8,100,000,000	2014 EST.	CIA	20,172,332	2016	401	45
103	Zimbabwe	8,000,000,000	2014 EST.	CIA	14,546,961	2016	549	62
104	Panama	7,800,000,000	2014 EST.	CIA	3,705,246	2016	2,105	240

105	Albania	7,793,000,00 0	2014 EST.	CI A	3,038,594	201 6	2,564	292
106	Kenya	7,600,000,00 0	2014 EST.	CI A	46,790,75 8	201 6	162	18
107	Bolivia	7,500,000,00 0	2014 EST.	CI A	10,969,64 9	201 6	683	78
108	Macedo nia	6,960,000,00 0	2014 EST.	CI A	2,100,025	201 6	3,314	378
109	Latvia	6,800,000,00 0	2014 EST.	CI A	1,965,686	201 6	3,459	394
110	Ethiopia	6,700,000,00 0	2014 EST.	CI A	102,374,0 44	201 6	65	7
111	Luxemb ourg	6,200,000,00 0	2014 EST.	CI A	582,291	201 6	10,647	1215
112	Camero on	6,100,000,00 0	2014 EST.	CI A	24,360,80 3	201 6	250	28
113	Ivory Coast	5,800,000,00 0	2014 EST.	CI A	23,740,42 4	201 6	244	27
114	El Salvador	5,700,000,00 0	2014 EST.	CI A	6,156,670	201 6	925	105

115	Mongolia	5,600,000,000	2014 EST.	CIA	3,031,330	2016	1,847	210
116	Honduras	5,300,000,000	2014 EST.	CIA	8,893,259	2016	595	68
117	West Bank	5,200,000,000	2014 EST.	CIA	2,697,687	2016	1,927	220
118	Yemen	5,200,000,000	2014 EST.	CIA	27,392,779	2016	189	21
119	Armenia	5,100,000,000	2014 EST.	CIA	3,051,250	2016	1,671	190
120	Tanzania	5,000,000,000	2014 EST.	CIA	52,482,726	2016	95	10
121	Afghanistan	4,700,000,000	2014 EST.	CIA	33,332,025	2016	141	16
122	Macau	4,500,000,000	2014 EST.	CIA	597,425	2016	7,532	859
123	Nicaragua	4,412,000,000	2014 EST.	CIA	5,966,798	2016	739	84

124	Moldova	4,305,000,000	2014 EST.	CIA	3,510,485	2016	1,226	139
125	Cambodia	4,100,000,000	2014 EST.	CIA	15,957,223	2016	256	29
126	Laos	3,900,000,000	2014 EST.	CIA	7,019,073	2016	555	63
127	Nepal	3,900,000,000	2014 EST.	CIA	29,033,914	2016	134	15
128	Cyprus	3,900,000,000	2014 EST.	CIA	1,205,575	2016	3,234	369
129	Brunei	3,766,000,000	2014 EST.	CIA	436,620	2016	8,625	984
130	Botswana	3,700,000,000	2014 EST.	CIA	2,209,208	2016	1,674	191
131	Namibia	3,700,000,000	2014 EST.	CIA	2,436,469	2016	1,518	173
132	Papua New Guinea	3,000,000,000	2014 EST.	CIA	6,791,317	2016	441	50

133	Senegal	3,000,000,00 0	2014 EST.	CI A	14,320,05 5	201 6	209	23
134	Kosovo	2,887,000,00 0	2014 EST.	CI A	1,883,018	201 6	1,533	175
135	Monten egro	2,800,000,00 0	2014 EST.	CI A	644,578	201 6	4,343	495
136	Jamaica	2,800,000,00 0	2014 EST.	CI A	2,970,340	201 6	942	107
137	Uganda	2,700,000,00 0	2014 EST.	CI A	38,319,241	201 6	70	8
138	Mauriti us	2,600,000,00 0	2014 EST.	CI A	1,348,242	201 6	1,928	220
139	Gabon	2,100,000,00 0	2014 EST.	CI A	1,738,541	201 6	1,207	137
140	Bhutan	2,085,000,00 0	2014 EST.	CI A	750,125	201 6	2,779	317
141	New Caledonia	2,000,000,00 0	2014 EST.	CI A	275,355	201 6	7,263	829

142	Malta	2,000,000,00 0	2014 EST.	CI A	415,196	201 6	4,817	549
143	Surinam e	1,900,000,00 0	2014 EST.	CI A	585,824	201 6	3,243	370
144	Malawi	1,900,000,00 0	2014 EST.	CI A	18,570,321	201 6	102	11
145	Bahama s	1,600,000,00 0	2014 EST.	CI A	327,316	201 6	4,888	558
146	Guam	1,500,000,00 0	2014 EST.	CI A	162,742	201 6	9,217	1052
147	Swazila nd	1,500,000,00 0	2014 EST.	CI A	1,451,428	201 6	1,033	117
148	Mali	1,400,000,00 0	2014 EST.	CI A	17,467,10 8	201 6	80	9
149	Liechten stein	1,360,000,00 0	2012	CI A	37,937	201 6	35,848	4092
150	Madaga scar	1,300,000,00 0	2014 EST.	CI A	24,430,32 5	201 6	53	6
151	Burkina Faso	1,200,000,00 0	2014 EST.	CI A	19,512,533	201 6	61	7

152	Niger	1,200,000,000	2014 EST.	CIA	18,638,600	2016	64	7
153	Togo	1,100,000,000	2014 EST.	CIA	7,756,937	2016	141	16
154	Benin	1,000,000,000	2014 EST.	CIA	10,741,458	2016	93	10
155	Curacao	968,000,000	2008 EST.	CIA	149,035	2016	6,495	741
156	Congo, Republic of the	900,000,000	2014 EST.	CIA	4,852,412	2016	185	21
157	Guinea	900,000,000	2014 EST.	CIA	12,093,349	2016	74	8
158	Barbados	900,000,000	2014 EST.	CIA	291,495	2016	3,087	352
159	Mauritania	800,000,000	2014 EST.	CIA	3,677,293	2016	217	24
160	Lesotho	800,000,000	2014 EST.	CIA	1,953,070	2016	409	46

161	Guyana	800,000,000	2014 EST.	CIA	735,909	2016	1,087	124
162	Fiji	800,000,000	2014 EST.	CIA	915,303	2016	874	99
163	Aruba	800,000,000	2014 EST.	CIA	113,648	2016	7,039	803
164	French Polynesia	700,000,000	2014 EST.	CIA	285,321	2016	2,453	280
165	South Sudan	694,100,000	2012 EST.	CIA	12,530,717	2016	55	6
166	Jersey	630,100,000	2004 EST.	CIA	98,069	2016	6,425	733
167	Bermuda	600,000,000	2014 EST.	CIA	70,537	2016	8,506	971
168	Cayman Islands	600,000,000	2014 EST.	CIA	57,268	2016	10,477	1196
169	U.S. Virgin Islands	600,000,000	2014 EST.	CIA	102,951	2016	5,828	665

170	Marshall Islands	600,000,000	2014 EST.	CIA	73,376	2016	8,177	933
171	Andorra	562,400,000	2012	CIA	85,660	2016	6,565	749
172	Rwanda	500,000,000	2014 EST.	CIA	12,988,423	2016	38	4
173	Burundi	400,000,000	2014 EST.	CIA	11,099,298	2016	36	4
174	Belize	400,000,000	2014 EST.	CIA	353,858	2016	1,130	129
175	Djibouti	400,000,000	2014 EST.	CIA	846,687	2016	472	53
176	Haiti	400,000,000	2014 EST.	CIA	10,485,800	2016	38	4
177	Seychelles	300,000,000	2014 EST.	CIA	93,186	2016	3,219	367
178	Somalia	300,000,000	2014 EST.	CIA	10,817,354	2016	27	3

179	Saint Lucia	300,000,000	2014 EST.	CIA	164,464	2016	1,824	208
180	Antigua and Barbuda	300,000,000	2014 EST.	CIA	93,581	2016	3,205	365
181	Cabo Verde	300,000,000	2014 EST.	CIA	553,432	2016	542	61
182	Eritrea	300,000,000	2014 EST.	CIA	5,869,869	2016	51	5
183	Faroe Islands	300,000,000	2014 EST.	CIA	50,456	2016	5,945	678
184	Gambia	300,000,000	2014 EST.	CIA	2,009,648	2016	149	17
185	Greenland	300,000,000	2014 EST.	CIA	57,728	2016	5,196	593
186	Liberia	300,000,000	2014 EST.	CIA	4,299,944	2016	69	7
187	Maldives	300,000,000	2014 EST.	CIA	392,960	2016	763	87

188	Chad	200,000,000	2014 EST.	CIA	11,852,462	2016	16	1
189	Saint Kitts and Nevis	200,000,000	2014 EST.	CIA	52,329	2016	3,821	436
190	Central African Republic	200,000,000	2014 EST.	CIA	5,507,257	2016	36	4
191	Sierra Leone	200,000,000	2014 EST.	CIA	6,018,888	2016	33	3
192	Turks and Caicos Islands	200,000,000	2014 EST.	CIA	51,430	2016	3,888	443
193	Gibraltar	200,000,000	2014 EST.	CIA	29,328	2016	6,819	778
194	Grenada	200,000,000	2014 EST.	CIA	111,219	2016	1,798	205
195	Micronesia,	178,600,000	2002	CIA	104,719	2016	1,705	194

	Federated States of							
196	Timor-Leste	125,300,000	2014 EST.	CIA	1,261,072	2016	99	11
197	British Virgin Islands	100,000,000	2014 EST.	CIA	34,232	2016	2,921	333
198	Saint Vincent and the Grenadines	100,000,000	2014 EST.	CIA	102,350	2016	977	111
199	American Samoa	100,000,000	2014 EST.	CIA	54,194	2016	1,845	210
200	Samoa	100,000,000	2014 EST.	CIA	198,926	2016	502	57
201	Equatorial Guinea	91,140,000	2014 EST.	CIA	759,451	2016	120	13
202	Dominica	90,210,000	2014 EST.	CIA	73,757	2016	1,223	139

203	Western Sahara	83,700,000	2014 EST.	CIA	587,020	2016	142	16
204	Solomon Islands	79,050,000	2014 EST.	CIA	635,027	2016	124	14
205	Sao Tome and Principe	65,100,000	2014 EST.	CIA	197,541	2016	329	37
206	Vanuatu	55,800,000	2014 EST.	CIA	277,554	2016	201	22
207	Tonga	46,500,000	2014 EST.	CIA	106,513	2016	436	49
208	Saint Pierre and Miquelon	41,850,000	2014 EST.	CIA	5,595	2016	7,479	852
209	Comoros	40,920,000	2014 EST.	CIA	794,678	2016	51	5
210	Guinea-Bissau	31,620,000	2014 EST.	CIA	1,759,159	2016	17	2
211	Cook Islands	31,620,000	2014 EST.	CIA	9,556	2016	3,308	377

212	Kiribati	27,900,000	2014 EST.	CIA	106,925	2016	260	29
213	Nauru	23,250,000	2014 EST.	CIA	9,591	2016	2,424	276
214	Montserrat	21,390,000	2014 EST.	CIA	5,267	2016	4,061	463
215	Falkland Islands	13,950,000	2014 EST.	CIA	2,931	2016	4,759	543
216	Saint Helena, Ascension and Tristan da Cunha	9,300,000	2014 EST.	CIA	7,795	2016	1,193	136

The average power per capital/person in Nigeria is just 14 Watts. Therefore, there is need for a detail study of Akure132/33kV substation Network of the Benin Electricity Distribution Company under which there are 84,264 customers. In this research work, reliability index of the distribution system were estimated and a model for establishing hydro Electric Power Generating Plant in the country was developed

POWER SYSTEM STRUCTURE IN NIGERIA

An electric power system consists of three major components: Generation, transmission and distribution (Kothari and Nagrath, 2008). The generating stations output voltage is usually between 11-25 kV. This will be increased by the step up transformers to 132 kV High Tension or 330 kV Extra High Voltage and transferred over long distance transmission lines. The transmission lines also connect one grid system to the other. Then all the loads in a particular network are connected to the transmission lines through the distribution transformers. For economic reasons, power plants are usually built close to the source of raw materials. This is because it is cheaper to transmit bulk electric energy over High Voltage (HV) of 132 kV or 330 kV Extra High Voltage (EHV) transmission lines than transport equivalent quantities of raw material like coal used in a thermal power plant over a long distance.

In case of Akure Power System, the first step down of voltage takes place at the transmission sub stations through 60 MVA, 132/33 kV injection transformers where the output transmission lines are 33 kV feeders. The next step down takes place at the 15 MVA, 33/11 kV substations. The outputs at the later substations are 11 kV feeders or primary distribution lines: a feeder in a distribution network is a circuit carrying power from a main substation to a primary or secondary substation such that the current loading is the same all along its length. The main criterion for the design of a feeder is its current carrying capacity. The last step down takes place at the secondary distribution sub-station which may be 200,300 or 500 kVA, 11/0.415 kV distribution transformer. These distribution transformers supply power to the domestic, industrial and commercial consumers through the distribution lines called distributors as shown in figure 1.2. A distributor has a variable loading along its length. This is due to the service condition, tapping off at intervals by the individual consumers and the voltage variation at consumers terminals must be maintained within ± 5% (Electricity Regulation of Nigeria, 2005)

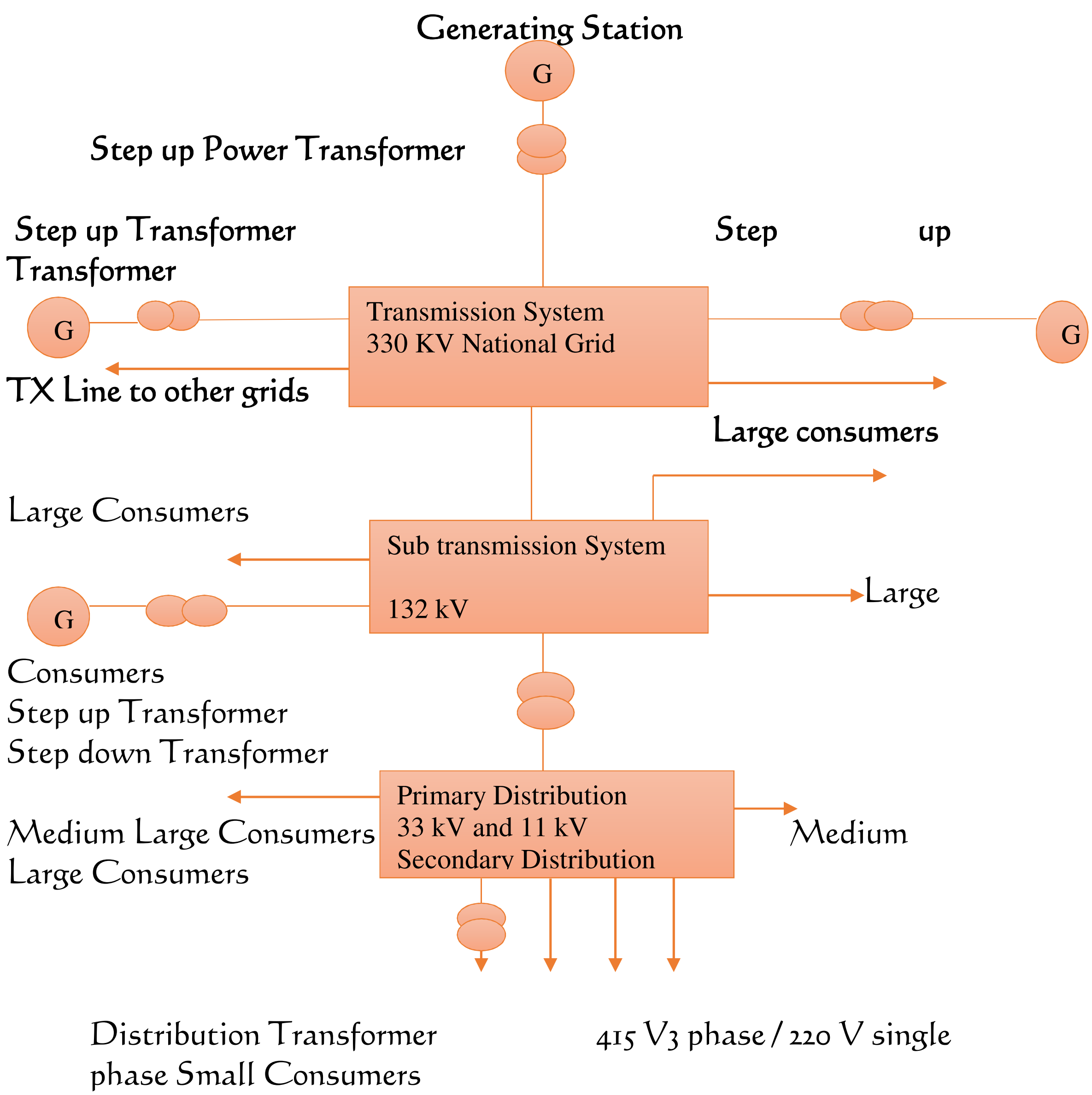


Fig 1.2 A typical power system network

CLASSIFICATION OF DISTRIBUTION SYSTEMS

Distribution system in Nigeria are classified according to the following factors:

Classification According to the Nature of Current.

A distribution system are classified according to the nature of current as:

(a) D.C. distribution system and (b) A.C. distribution system

Classification According to the Types of Construction

This is the classification of the distribution system according to their type of construction. This include :(a) Overhead system: when the cable is overhead and (b) Underground system: when the cable is buried underground. The overhead system is generally employed for distribution in the country. This is because it is 5 to 10 times cheaper than the equivalent underground system.

Classification According To the Scheme of Connection

Distribution system are classified according to scheme of connection. This include: (a) Radial system (b) Ring main system and (c) Inter-connected system

CONNECTION SCHEMES OF DISTRIBUTION SYSTEM

The following distribution circuits are generally used in Akure distribution network:

1. **Radial System**

In this system, separate feeders radiate from a single substation and feed the distributors at only one end. All distribution of electrical energy is done by constant voltage system. Oshin O.A, Adanikin Ariyo, Fakorede Ebenezer, Joseph Ojotu, (2018) as shown figure below shows in figure 1.3

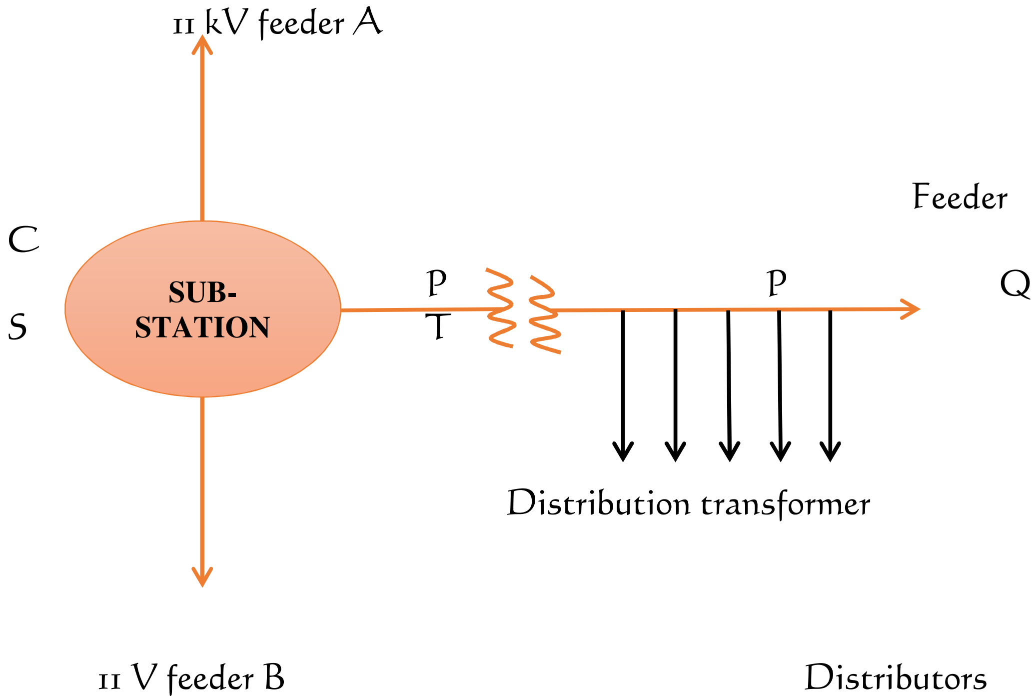


Figure 1.3: Single Line Diagram of a Radial System

RING MAIN SYSTEM

In this system, the primaries of distribution transformers form a loop. The loop circuit starts from the substation bus-bars, makes a loop through the state capital, and returns to the substation again as shown in figure 1.4: single line diagram of Ring Main System for A.C. distribution where a substation supplies electric power to the closed feeder LM, NO, PQ and RS. The distributors are tapped from different points M, O and Q of the feeder through the distribution transformer

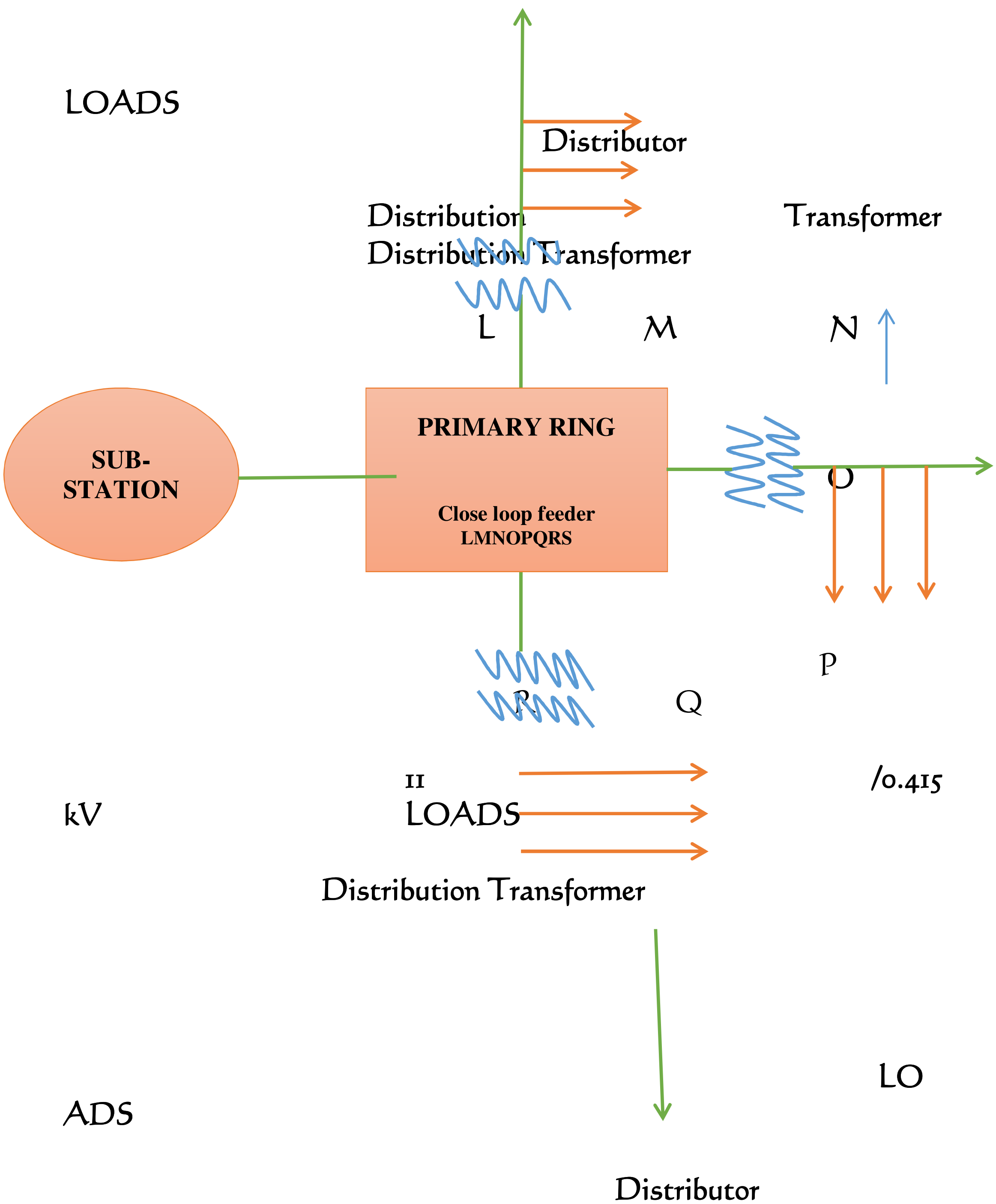
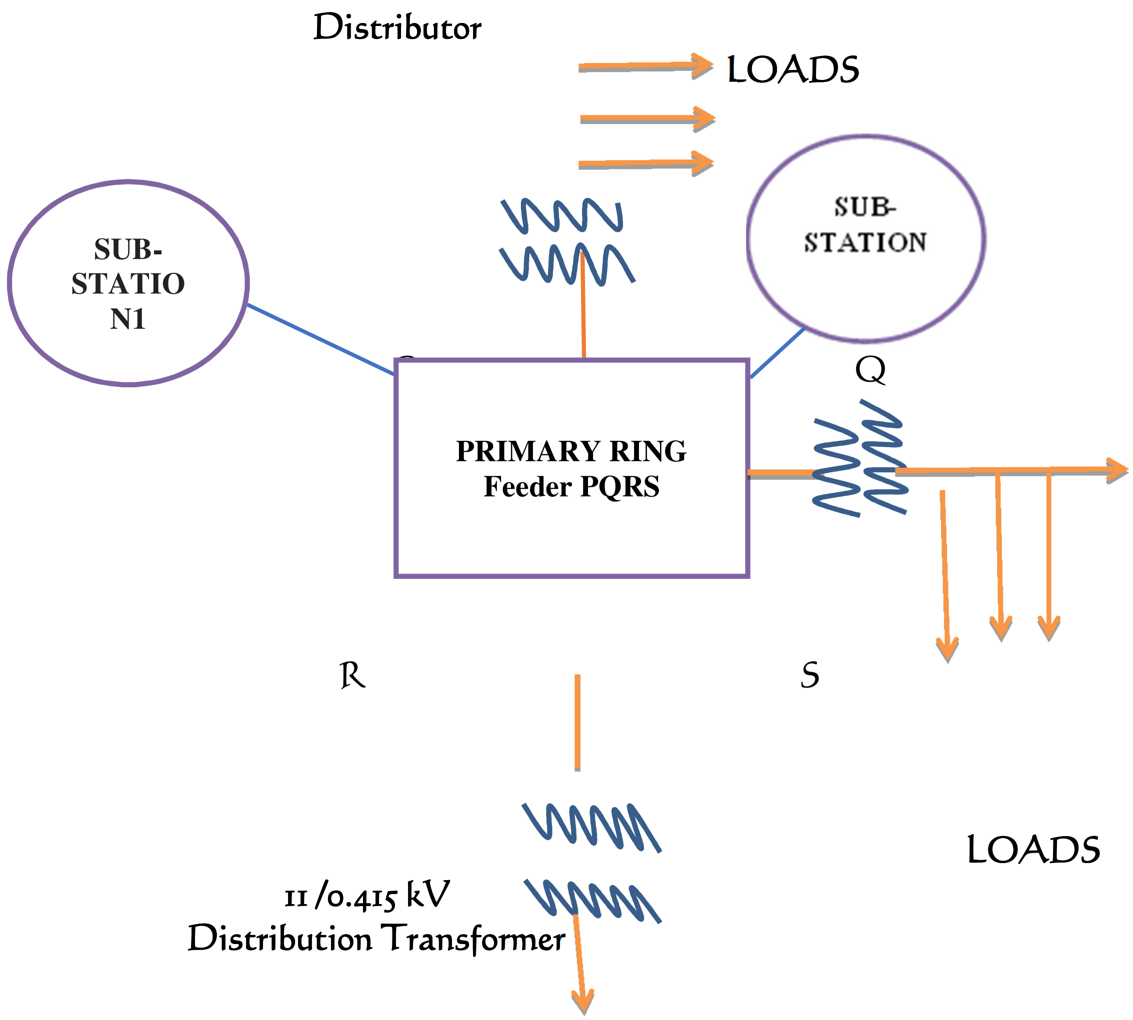


Figure 1.4 : Ring Main System

INTERCONNECTED SYSTEM

This is the feeder used when the feeder ring is energized by two or more than two generating stations or substations. Figure 1.5 shows the single line diagram of interconnected system where the closed feeder ring PQRS is supplied by two substations S1 and S2 at points P and Q respectively. Each feeder supplies a distribution transformer. The use of interconnected system provide reliable power supply than the first two methods of distribution systems. The distributors are connected to the transformers as shown below. This is recommended for the distribution of electricity in the country.


Distributor
LOADS
SUB-
STATION
SUB-
STATIO
N1
PRIMARY RING
Feeder PQRS
Q
R
S
LOADS
11 /0.415 kV
Distribution Transformer

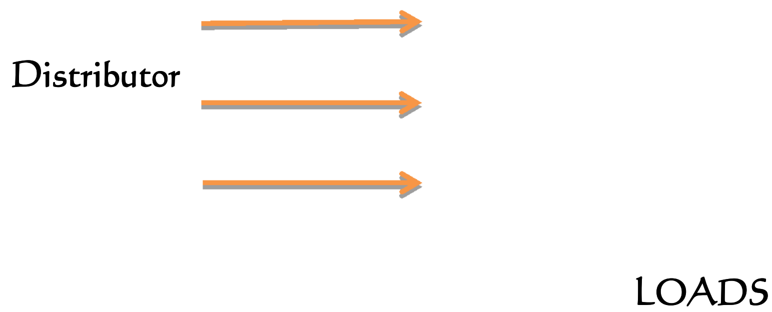


Figure 1.5: Interconnected System

The interconnected system has the following advantages:

1. It increases the service reliability.
2. Any area fed from one generating station during peak load hours can be fed from the other generating station. This reduces reserve power capacity and increases efficiency of the system.

RESEARCH METHODOLOGY

INTRODUCTION

The detail study of Akure132/33kV substation Network of the Benin Electricity Distribution Company under which there are 84,264 customers was carried out. Reliability index of the distribution system were estimated. A model for establishing a Hydro Electric Power Generating Plant was developed. A monogram for increasing the value of power generation in the generating station was also developed. Power Generation and Improvement techniques for the generation, transmission and distribution of electricity were also established.

Reliability index of the distribution network shows that power system of the study area were determined as follows.

System Average Interruption Frequency Index (SAIFI)

$$\text{SAIFI} = \frac{\text{Total numer of sustained customers interruption in a year}}{\text{Total number of customer served}}$$

System Average Interruption Duration Index (SAIDI)

$$\text{SAIDI} = \frac{\text{Total duration of sustained interruption in a year}}{\text{Total number of customer served}}$$

Customer Average Interruption Frequency Index (CAIFI)

$$\text{CAIFI} = \frac{\text{Total number of annual customer interruptions}}{\text{Total number of customers affected}}$$

Customer Average Interruption Duration Index (CAIDI)

$$\text{CAIDI} = \frac{\text{Total Duration of Sustainable interruption in a year}}{\text{Total number of customer interruptions}}$$

Average Service Availability Index (ASAI)

$$\text{ASAI} = \frac{\text{Customer hours of availble service}}{\text{customer hours demnded}}$$

Average Service Availability Index (ASUI)

$$\text{ASUI} = \frac{\text{Customer hours of unavailble/ service in a year}}{\text{customer hours demnded in a year}}$$

Oshin O.A, Adanikin Ariyo, Abiodun Onile, January, 2017,

Analysis of Ilesha Road Feeder

Improvement on power generation, transmission and distribution of electricity in the country is the only solution to the incessant electrical power supply which has grounded many activities and destroyed many industrial processes in the country. Otherwise, the present poor industrial systems, high unemployment rates, crimes, suffering and untimely deaths in the country will continue to increase. This is because industrial development, employment, production of good and services of any country is directly proportional to the electrical energy consumed by the citizens of that country. Also, more efforts should be given to fault clearing systems and improvement in the reliability of the system. The Federal Government of Nigeria needs to genuinely privatize only the distribution aspect of electricity in Nigeria as this is the normal practice in the developed countries. The present privatization of the electrical generating stations in the country is a wrong method of privatization. Instead, individual or organization who is/are interested in electric power generation should establish his/her generating plant and supply excess power generated to the national grid.

Ondo Road Feeder Results

Mean time between failure stands at an average of 491.46 hours between year 2010 and 2017.That means there will be an average of one failure in every 491.46 hours. Mean down time along the feeder is 195.6 hours. This result shows that the supply of electricity along the feeder is characterize with high number of failures. Availability of electric power along feeder is 73.34 %. But the reliability of the feeder is 1.83904 $X\ 10^{-7}$ i.e. 0.00000018 %

SAIFI =0.002734failure/customer SAIDI = 0.27556hour/customer

CAIFI = 0.005088interruption/consumer CAIDI = 100.8

ASAI = 0.827397or 82.7397% ASUI = 0.172603or 0.17.2603 %

Ijapo Feeder Results

The failure rate of the feeder is 0.0017706 failure/ hour. Mean time between failure stands at an average of 564.78022 hours between year 2010 and 2017. The Mean down time along the feeder within this period is 205.32967 hours. This result shows that the supply of electricity along the feeder is also characterize with high number of failures. Availability of electric power along the feeder is 73.337614%; while the reliability of the feeder stands at an average of 1.84×10^{-7}

SAIFI =0.002432failure/customer SAIDI = 0.306445 hour/customer
CAIFI = 0.003902interruption/consumer CAIDI = 126hours
ASAI = 0.827397 or 82.7397 % ASUI = 0.172603 or17.2603 %

Oba Ile Feeder Results

The failure rate of the feeder between year 2010 and 2017 is 0.001855034 failure/ hour. Mean time between failure stands at an average of 539.07hours. Mean down time along the feeder is 198.61 hours. This result shows that the supply of electricity along the feeder is characterize with high number of failures. Availability of electric power along Oba Ile feeder is 73.08%, but the reliability of the power system: 8.778×10^{-8} is a very poor one.

SAIFI =0.002138275 failure/customer SAIDI = 0.323236 hour/customer
CAIFI = 0.002439 interruption/consumer CAIDI = 151.1667hours
ASAI = 0.792922 or 79.2922 % ASUI = 0.207078or 20.7078 %

Alagbaka Feeder Results

The failure rate of the feeder between year 2010 and 2017 is 0.0018089failure/ hour. Mean time between failure stands at an average of 552.83hours. Mean down time along the feeder is 208.913hours. The result shows that the supply of electricity along the feeder is characterize with high number of failures. Availability of electric power along the feeder is 72.574% whereas the reliability along the feeder is approximately equal to zero i.e. 1.315×10^{-7}

SAIFI =0.002866failure/customer SAIDI = 0.355374hour/customer

CAIFI = 0.004276interruption/consumer CAIDI = 124 hours

ASAI = 0.801826or 80.1826 % ASUI = 0.198174or 19.8174 %

Oke Eda Feeder Results

The failure rate of the feeder between year 2010 and 2017 is 0.00185 failure/ hour. Mean time between failure stands at an average of 540.46875 hours. Mean down time along the feeder is 189.53 hours. This result shows that the supply of electricity along the feeder is characterize with high number of failures. Availability of electric power along the feeder is 74.0368%, while the reliability is 9.1542×10^{-8}

SAIFI =0.0023015failure/customer SAIDI = 0.31339hour/customer

CAIFI = 0.00406interruption/consumer CAIDI = 136.167hours

ASAI = 0.81347or 81.347% ASUI = 0.18653 or 18.653 %

Oyemekun Feeder Result

The failure rate of the feeder between year 2010 and 2017 is 0.00216577 failure/ hour. Mean time between failure stands at an average of 461.728972 Hours. Mean down time along the feeder is 193.224 hours. This result shows that the supply of electricity along the feeder is characterize with high number of failures. Availability of electric power along the feeder is 70.498 %, while the reliability is 5.772×10^{-9}

SAIFI =0.002328failure/customer SAIDI = 0.374736hour/customer

CAIFI = 0.003563 interruption/consumer CAIDI = 161hours

ASAI = 0.797831or 79.7831% ASUI = 0.202169or 20.2169%

Ilesha Road Feeder Results

The failure rate of the feeder between year 2010 and 2017 is 0.001857failure/ hour. Mean time between failure stands at an average of 538.554 hours. Mean down time along the feeder is 223.185 hours. This result shows that the supply of electricity along the feeder is characterize with high number of failures. Availability of electric power along the feeder is 70.7%, while the reliability of the feeder is approximately equal to zero i.e. 8.642×10^{-8}

SAIFI =0.00249failure/customer SAIDI = 0.33749hour/customer

CAIFI = 0.00416interruption/consumer CAIDI = 135.462

ASAI = 0.798973or 79.8973 % ASUI = 0.201030r 20.103 %

Isikan Feeder Results

The failure rate of the feeder between year 2010 and 2017 is 0.001882279failure/ hour. Mean time between failure stands at an average of 531.2708 hours during the eight years. Mean down time along the feeder is 198.7292 hours. Again, this results show that the supply of electricity along the feeder is characterize with high number of failures. Availability of electric power along the feeder is 72.7768%, but the reliability of the feeder is 6.914×10^{-8}

SAIFI =0.003577 failure/customer SAIDI = 0.392801 hour/customer

CAIFI = 0.004462 interruption/consumer CAIDI = 109.8125

ASAI = 0.79943 oro.79.943 % ASUI = 0.20057 or 20.057

MODELLING OF AN HYDRO ELECTRIC POWER GENERATING PLANT

Modelling Of an Hydro Electric Power Generating Plant

In order to provide solution to the present incessant electrical power supply in the country, this research work established a model for the establishment of Hydro Electric Power Generating Plant was developed. Hydro-electric power stations require the utilization of energy in falling water for the rotation of water turbine and the rotor situated in an alternator for the generation of electricity. They are generally located in hilly areas where dams can be built conveniently and large water reservoirs can be obtained. In a hydro-electric power station, water head is created by constructing a dam across a river or lake and from the dam, water is led to a water turbine. The water turbine captures the energy in the falling water and changes the hydraulic energy (i.e. product of head and flow of water) into mechanical energy at the turbine shaft. V.K Metha and Rohit Metha, (2010), Oshin O.A, Adanikin Ariyo, Abiodun Onile, (2017). The turbine drives the alternator which converts mechanical energy into electrical energy as shown in figure 3.1

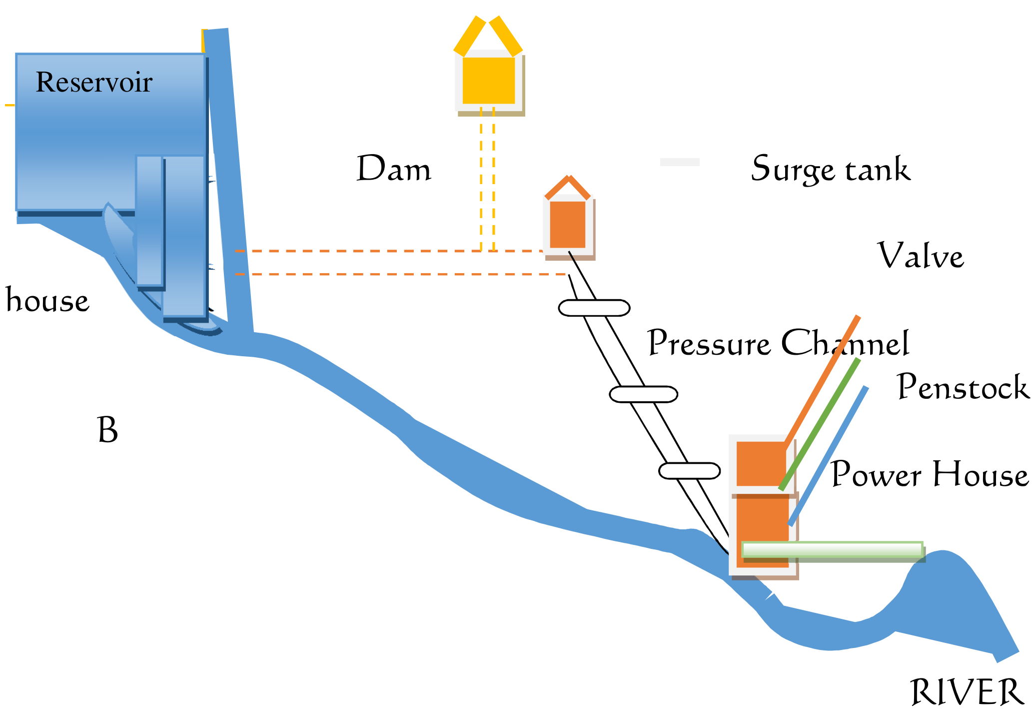


Figure 3.1 : Hydro Electric Power Plant

The power generated in a hydro-electric power station is given in the equation below

Power Generated $= \ell \int \left[\frac{(h_s - h - h_1)\, g\, A}{L}\, dt\right] + q_c \quad g \, [h_s - h - h_1]$

Where

a. L = incompressible conduit length of the penstock L
b. A = cross sectional area of the penstock in m^3
c. ℓ = density of water
d. q = discharge rate in $m^3/\sec = \int \left[\frac{(h_s - h - h_1)\, g\, A}{L}\, dt\right] + q_c$
e. $h_s = static\ head\ of\ water\ column\ in\ meters$
f. h_1 = loss in height because of friction in the penstock in meters
g. h = head of turbine admission in meters
h. T_w = water time constant or water starting time

The rate of change of the discharge rate with respect to time is equal to $\frac{dq}{dt}$

Where system operating discharge rate $= \frac{dq}{dt} = \frac{(h_s - h - h_1)\, g\, A}{L}$

Flow rate q $= \int \left[\left(\frac{(h_s - h - h_1)\, g\, A}{L}\, dt\right) + q_c\right]$

Power Generated $= \ell\, q\, g\, [h_s - h - h_1]$

Then, Power Generated $= \ell \left\{\int \left[\left(\frac{(h_s - h - h_1)\, g\, A}{L}\, dt\right)\right] + q_c\right\} g \, [h_s - h - h_1]$

In a Hydro- Electric Power Plant, the value of $\int \left[\left(\frac{(h_s - h - h_1)\, g\, A}{L}\, dt\right)\right]$ $is\ negligible$

Hence, Power Generated $= \ell\ q_c\, g\, [h_s - h - h_1]$

POWER GENERATED FROM THE MODELLED HYDRO-ELECTRIC POWER GENERATING PLANT UNIT 1

POWER GENERATED FROM THE MODELLED HYDRO ELECTRIC POWER GENERATING PLANT

S/N	Density of water	Discahrge rate	Acc (g) x Turbine Eff (0.9:	Hs	h	h1	hs-h-h1	Power Generated in kW
1	1000	34	9.025	65	6	0.264	58.736	18023.1416
2	1000	40	9.025	68	6	0.264	61.736	22286.696
3	1000	46	9.025	70	6	0.264	63.736	26460.0004
4	1000	52	9.025	72	6	0.264	65.736	30849.9048
5	1000	58	9.025	74	6	0.264	67.736	35456.4092
6	1000	64	9.025	76	6	0.264	69.736	40279.5136
7	1000	70	9.025	78	6	0.264	71.736	45319.218
8	1000	76	9.025	80	6	0.264	73.736	50575.5224
9	1000	82	9.025	82	6	0.264	75.736	56048.4268
10	1000	88	9.025	84	6	0.264	77.736	61737.9312

Table 3.1: Power generated in a Hydro-Electric Power Generating Plant

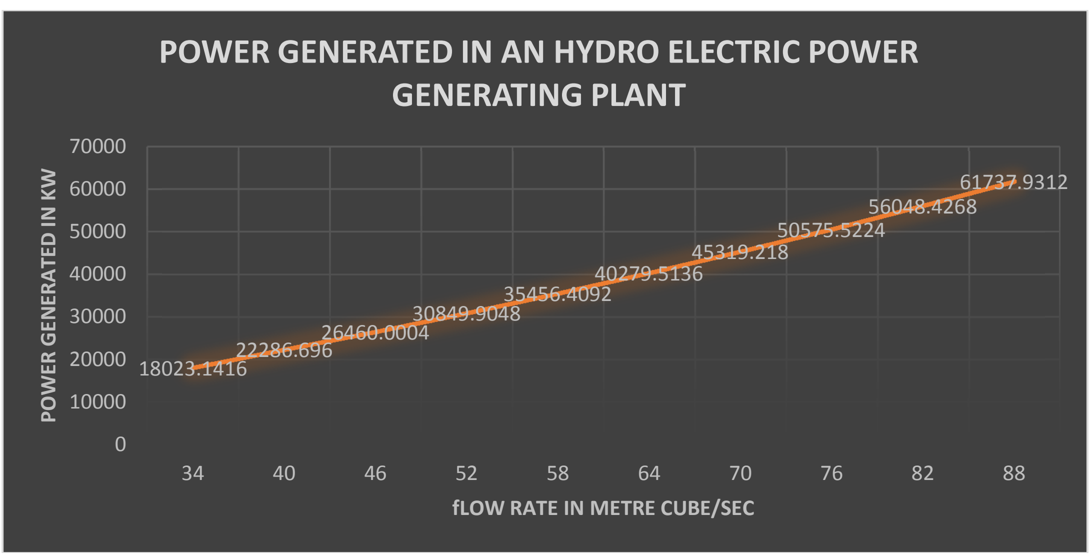


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Figure 3.2: Power generated in a Hydro-Electric Power Generating Plant, Unit 1a

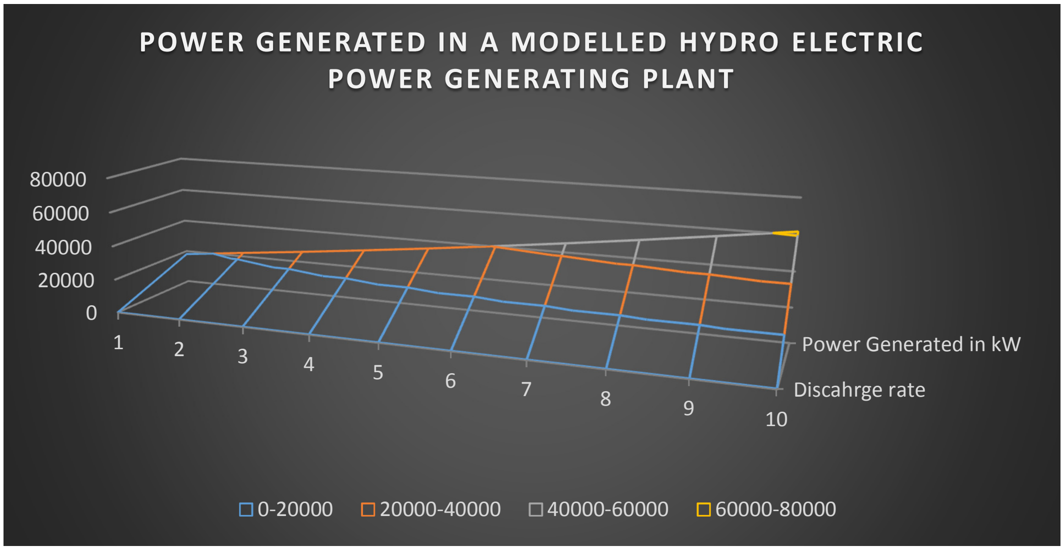


Figure 3.3: Power generated in a Hydro-Electric Power Generating Plant, Unit 1b

POWER GENERATED FROM THE MODELLED HYDRO-ELECTRIC POWER GENERATING PLANT UNIT 2

POWER GENERATED FROM THE MODELLED HYDRO ELECTRIC POWER GENERATING PLANT									
S/N	Density of water	Discahrge rate	Acc (g) x Turbine Eff	Hs	h	h1	hs-h-h1	Power Generated in kW	
1	1000	34	9.025	65	6	0.264	58.736	18023.1416	
2	1000	40	9.025	68	6	0.264	61.736	22286.696	
3	1000	146	9.025	70	6	0.264	63.736	83981.7404	
4	1000	74	9.025	72	6	0.264	65.736	43901.7876	
5	1000	58	9.025	74	6	0.264	67.736	35456.4092	
6	1000	64	9.025	76	6	0.264	69.736	40279.5136	
7	1000	70	9.025	78	6	0.264	71.736	45319.218	
8	1000	124	9.025	80	6	0.264	73.736	82517.9576	
9	1000	82	9.025	82	6	0.264	75.736	56048.4268	
10	1000	88	9.025	84	6	0.264	77.736	61737.9312	

Table 3.2: Power generated from the modelled Hydro-Electric Power Generating Plant, Unit 2a

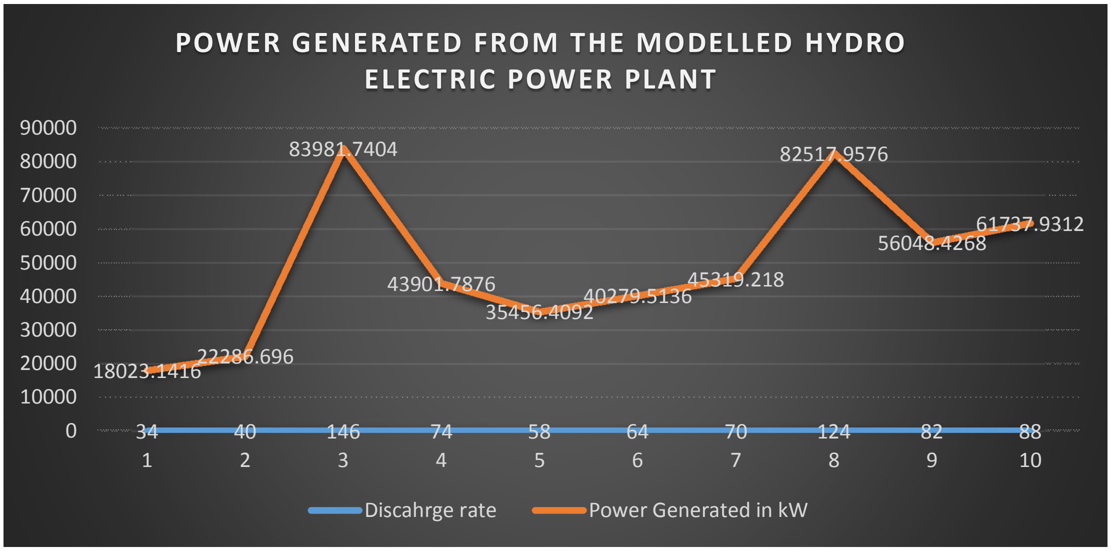
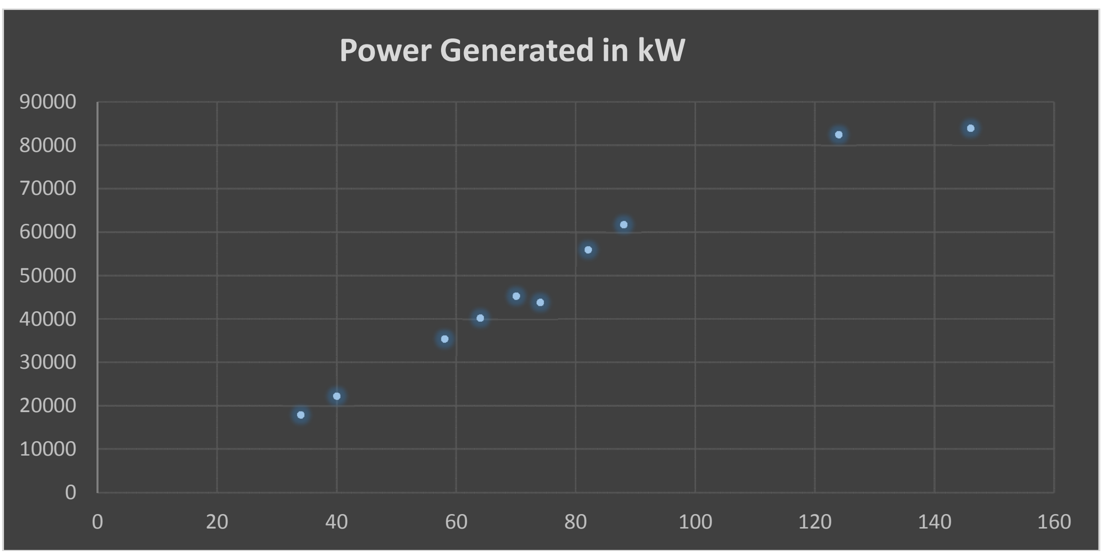


Fig. 3.4:Power generated from the modelled Hydro-Electric Power Generating Plant,Unit 2b



. Discharge rate cubic metre/sec

Figure 3.5: Characteristics of the power generated from the modelled Hydro-Electric Power Generating Plant and the discharge rate, Unit 2

POWER GENERATED FROM THE MODELLED HYDRO-ELECTRIC POWER GENERATING PLANT UNIT 3

POWER GENERATED FROM THE MODELLED HYDRO ELECTRIC POWER GENERATING PLANT

S/N	Density of water	Discahrge rate	Acc (g) x Turbine Eff	Hs	h	h1	hs-h-h1	Power Generated in kW
1	1000	92	9.025	97	6	0.264	90.736	75338.1008
2	1000	40	9.025	68	6	0.264	61.736	22286.696
3	1000	128	9.025	70	6	0.264	63.736	73627.8272
4	1000	74	9.025	72	6	0.264	65.736	43901.7876
5	1000	86	9.025	112	6	0.264	105.736	82066.9964
6	1000	64	9.025	76	6	0.264	69.736	40279.5136
7	1000	70	9.025	78	6	0.264	71.736	45319.218
8	1000	124	9.025	80	6	0.264	73.736	82517.9576
9	1000	82	9.025	82	6	0.264	75.736	56048.4268
10	1000	88	9.025	84	6	0.264	77.736	61737.9312

Table 3.3: The result of the power generated from the modelled Hydro-Electric Power Generating Plant, Unit 3

Discharge rate (cubic metre/sec)

Figure 3.6: Characteristics of the power generated from the modelled Hydro-Electric Power Generating Plant and the discharge rate, Unit 3a

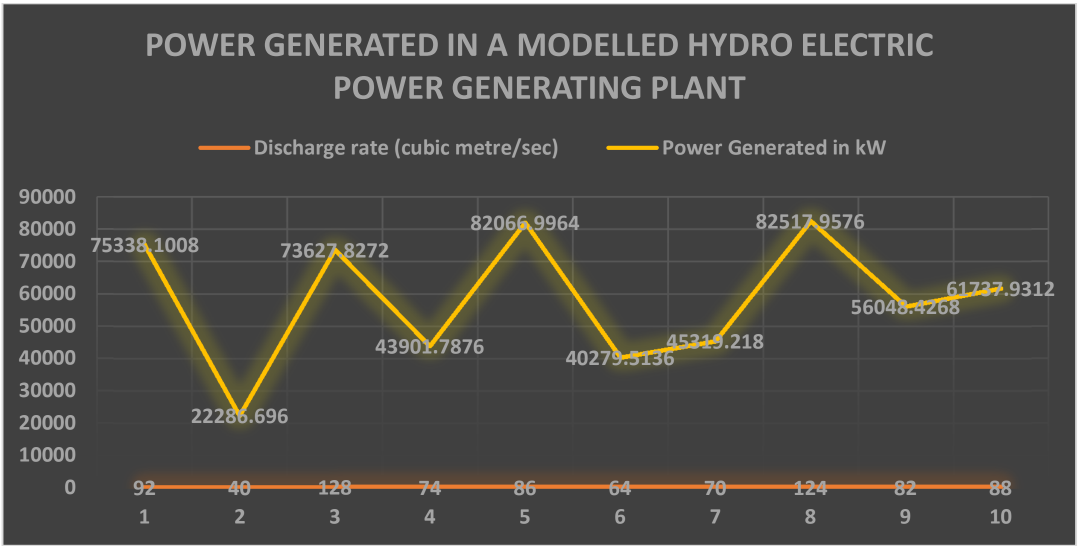


Figure 3.7: Characteristics of the power generated from the modelled Hydro-Electric Power Generating Plant and the discharge rate, Unit 3b

CONCLUSION

The incessant electric power supply problems which has destroyed the existence of processing and production industries in Nigeria is a pointer to the fact that there is great need a great need for fault evaluation and reliability studies of electric power system. This power problem resulted to incessant planned, forced and unplanned outages. In addition, it has resulted to erratic and unreliable supply of electricity in the country. As said earlier, it has grounded many activities and has destroyed many industrial processes. It has reduced productivity and has increased unemployment rate in the country to over 40million (this figure is over 70% of Nigerian youths). It has led many of the youths in the country to crime. It has led to the deaths of many innocent people in the country. This research work therefore analyzed the problems facing Akure Distribution System Network. The research work also evaluated the occurrence of faults and outages in the Distribution Network Area for a period of 8 years (2010 -2017.The research work also established a model for the establishment of Hydro Electric Power Generating Plant in the country. When the results of this research work are utilized, it will be easy to established efficient Hydro Electric

Power Plant in the country. The efficiency and the efficiency of the modelled power plant can be increased using the established model.

RECOMMENDATION

In order to meet the increasing demand for electricity in Akure Distribution Network and in other parts of the country, the following recommendations have been made.

1. Though the total installed generating capacity in the country is 6,367MW, the country is only able to generate 3,500 MW because most facilities have been poorly managed and the reliability of the generating, transmission and distribution system been very low due to high failure rates of equipment, large energy losses, corruption among government officials and poor protection of power system. Hence, Increase in generated power is necessary because the Energy Commission of Nigeria has shown that electricity demand in the country will rise from the present 9,437MW to 15,730 MW by the year 2015. Therefore additional Power Stations should be established in the country.
2. There is a need to install more transformers and distribution lines close to the consumers, this will reduces losses along the 132kV, 33kV and 11kV lines and increase efficiency.
3. Decentralization of the energy system in Nigeria should be treated with serious attention and cordial treatment.
4. Solar Photovoltaic System should be installed in every house hold in the country.
5. Also, New Distribution transformer Sub Stations should be installed, this will reduce excess load on distribution transformers. As a result, transformers breakdown, constant failures and outages which have become very frequent in the country will be reduced.
6. There should be provision for adequate Planning and Construction of more transmission and distribution lines in order to improve the performance of power system.
7. Maintenance of existing generating plant, transmission line and distribution systems should be improved.
8. The grounding system of all distribution transformers must be adequate. The lightning Arresters must be sensitive. All D-Fuses

and G & P Fuses must work according to the required specifications. Otherwise such device must be replaced

9. The transmission and distribution aspects of electricity in Nigeria, excluding the generation aspect, should be privatized. In exactly the same way as it is being done in the developed countries. That means the Federal Government should withdraw the sales of Egbin Thermal Power Plant, Afam Power plc, Kainji Hydro-Electric plc, Sapele Power plc, Shiroro Hydro-Electric plc and Ughelli Power plc and return them back to the Federal Government in the Country.
10. The present privatization of the electrical generating stations in the country is a wrong method of privatization. Instead, individual or organization who is/are interested in electric power generation should establish his/her generating plant and supply excess power generated to the national grid.

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