Overview of Abuja Electricity Distribution Undertaking

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***Abstract*—Functional zone of a power system are the generating system, transmitting system, and distributing system and all these zones most have adequate infrastructures, facilities and security in order to perform efficiently. The extensive use of electricity has led to a high susceptibility to power failures. Electricity service interruptions from several causes could originate from the utility generation, transmission or distribution facilities. However, disturbances originating from the distribution system, account for the majority of consumers interruptions. Evaluation with view to assessing the distribution system performance will therefore require extensive statistical analysis. The motivation behind this paper is to establish a comprehensive overview of the field of analytical power system structure assessment techniques and to serve as input or bedrock for further research and development in the area of applicability**

Keywords—Distribution system, Tranmission, Infrastructure and District

I. INTRODUCTION

In recent years, the reliability and security of electricity supply in Nigeria have been significantly affected due to multifarious technical and operational constraints that hamper good supply arrangement and power system planning practices. The need for a reliable power supply in an effort towards achieving high level of socio-economic development in a nation cannot be over emphasized. Consequently, the apparent inability of National Electric Power Authority (NEPA) then, now Power Holding Company of Nigeria (PHCN), is to ensure continuous supply of electricity at the desired quality level and continue to have adverse impacts on socio-economic and orderly industrial growth of the country.

The reliability of an electric power supply system is the probability of providing the consumers with continuous service of satisfactory quality. Quality here implies that the customers are provided with supply whose frequency, voltage levels, and harmonics are within their acceptable tolerances. This can only be achieve with good planning and infrastructure on ground.

Although PHCN continually embarks on transmission re-inforcement and generating capacity addition within its limited resources, one cannot expect that such system expansion programmes will eliminate altogether the frequent power supply interruptions. In this regard, there is need to continually assess reliability indices at generation, transmission, and distribution levels. This paper is specifically aimed at assessing the electricity evolution and reliability of electricity supply to consumers at distribution levels using Federal Capital Territory, Abuja, as case study.

Abuja Electricity Distribution Company, known as Abuja Disco, serves central Nigeria from its base in Abuja, Nigeria's capital city in the Federal Capital Territory (FCT). Abuja Disco was established in 1997 following the transfer of the capital from Lagos to Abuja in 1991. Abuja Disco has a franchise for distribution and marketing of electricity in a service zone comprising Minna, Suleja, Lokoja and Lafia Districts. Despite past investments in expanding the electricity infrastructure, demand in the Disco's service zone far exceeds supply. Increasing population continues to add to that demand.

This paper is restructured into the following sections:

Section two reviews the Abuja distribution zone, section three details the architectural layout of the Abuja networks, section four the methodology involved and the preprocessing data while the last section draws the conclusion.

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Following the on-going deregulation of National Electric Power Authority (NEPA) now Power Holding Company of Nigeria (PHCN), eleven distribution companies have been created as depicted in Fig. 1. The Abuja Electricity Distribution Company (ADC) being one of the eleven distribution companies is presently responsible for the distribution of electricity to approximately 162,342/350,000 customers spread across Abuja Federal Capital Territory and several other districts within the geographical boundaries of Niger, Kogi and Nasarawa states.

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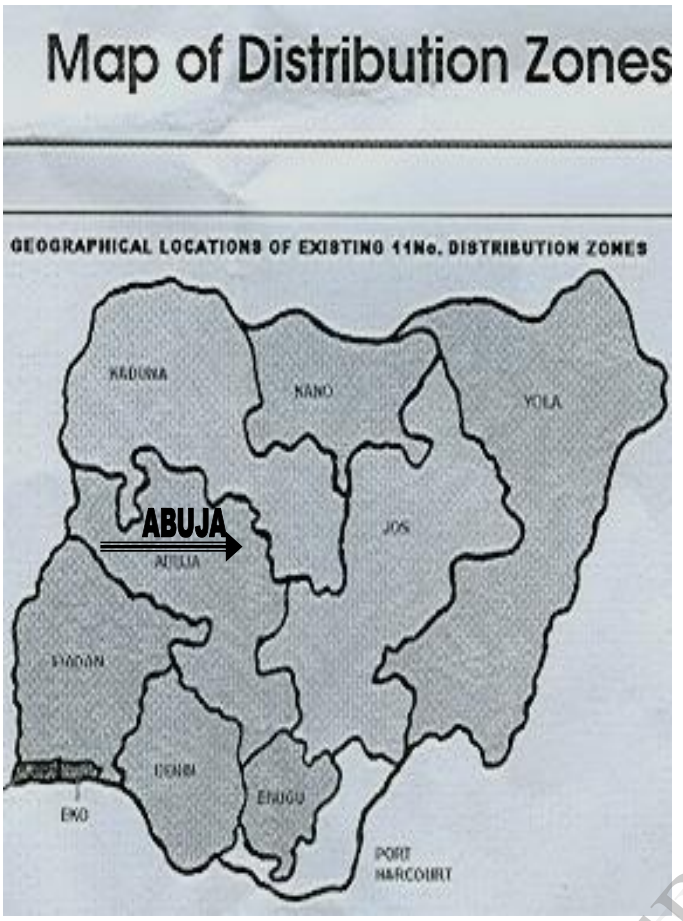

Fig. 1: Geographical coverage of Abuja Distribution Company

The Abuja distribution company owns and operates a transmission and primary distribution system operating at voltage levels 132, 33 and 11kV, respectively to supply its approximately 162,342 customers within Abuja metropolis. Load growth on the Abuja distribution company system averaged between 50% and 85% over the past six years and the summer system peak recorded in 2002 was 175GWh average monthly energy consumption. The ADC estimated that by the year 2010 monthly peak energy consumption will be approximately 325GWh. It is also established that over 75% of the total energy distributed by ADC is consumed in Abuja Federal Capital. Consequently, the bulk of investment on distribution network infrastructures is in the Federal Capital Territory as further highlighted in the next section.

A. Abuja ADC Territirial Area Networks

The Abuja ADC Territorial Area Network is supplied from the 330kV/132kV Katampe bulk transmission substation as shown schematically in Fig. 2. This is further stepped down to a number of 33kV/11kV primary and secondary feeder to meet the electricity needs of the territory of Abuja (the Federal Capital of Nigeria). It is noteworthy that the Territory covers an area of approximately 100 square km within the North Central geopolitical zone of Nigeria and has population of over 2 million as at last census.

Distribution and marketing activities start from the secondary side of 132/33/11kV transmission substation. The 33kV, 11kV and 0.415kV network infrastructures are therefore managed and controlled by the Abuja distribution company. Residential, commercial/industrial customers can get supply from the 33kV line via a 33/0.415kV distribution transformer of appropriate rating.

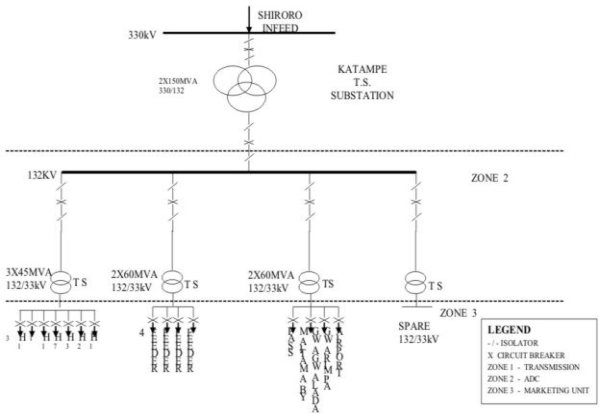

FIG. 2: Schematic diagram of 330/132kV transmission substation

Electricity distribution is characterized by long radial distribution lines with several injection substations at load centres. There are also very many tee-offs feeding distribution transformers as point loads for big customers and small isolated rural communities. The distribution network of Abuja is mixed. It comprises overhead and underground network outlay with the overhead network having over 75% share of its total kilometer length. The evolution of electricity districts covering Abuja metropolis is detailed in Fig. 3. Presently, Abuja territorial area network is split into WUSE, GARKI, KUBWA, KARU, and GWAGWA-LADA Districts as shown schematically in Fig. 4 with all the business units listed.

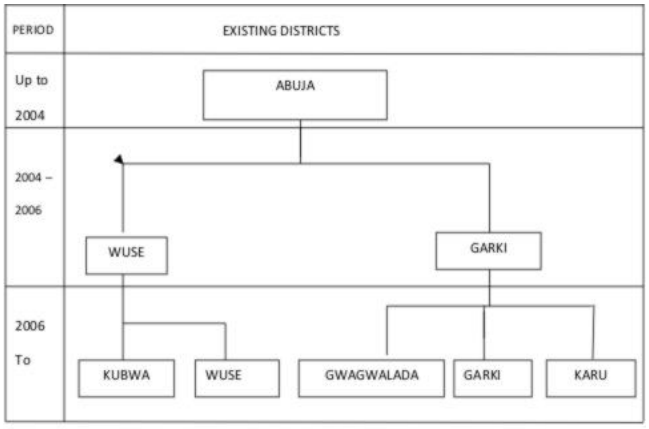

Fig 3: Evolution of electricity districts covering Abuja Metropolis

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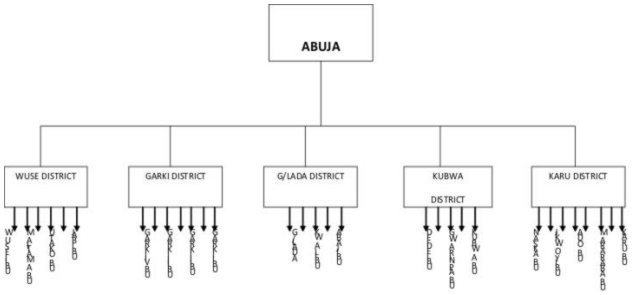

II. METHODOLOGY

Both qualitative and quantitative tools used in order to review issues concerning the continuity of electricity service experienced by customers. Service interruptions may be caused by event originating from the utility's generation, transmission or distribution facilities. However, event originating from the distribution system accounts for the majority of customers interruptions. Thus, distribution system need good quality of planning and infrastructure in order to have and achieved high standard of performances.

The procedures adopted here is to assess the infrastructure and characteristic layout planning of the Abuja distribution network in the five districts of Abuja.

A. Processed Data Collection

The data collected from the office of Head Technical, ADC undertaking covering the following:

- All the 33kV/11kV injection transformers with their rated capacities
- Overhead and underground cable km-route length.
- Customer population census registered, and
- Outage and duration for all the feeders within each district, as to see or assess and determine the level of their feeders performances regards good facilities structures on ground.
- he process field data collected are analysis and presented in tabular form as shown in table 1 to table 4.

Table 1: Summary of existing 33/11kV injection substation transformers in Abuja territorial area

District	33/11kV									
	2MVA	**2.5MVA**	**4.5MVA**	**5MVA**	**7.5MVA**	**15MVA**	**1MVA**	**0.7MVA**	**500kVA**	**SUB TOTAL**
Wuse	-	6	-	1	1	19	-	-	2	29
Garki	-	3	-	1	4	25	-	1	34	68
G/lada	-	5	-	-	6	2	2	-	-	15
Kubwa	-	3	-	2	1	6	-	-	-	12
Karu	-	2	-	-	1	3	2	-	-	8
Total	-	19	-	4	13	55	4	1	36	132

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Table 2: Total 33/11kV overhead and underground cable (km-route length) 2006 – 2007

Districts	Overhead cable		Underground cable	
	33kV	11kV	33kV	11kV
Wuse	125.33	122.42	25.023	35.2
Garki	167.21	160.62	3.275	191.67
G/lada	168.828	152.35	8.32	6.27
Kubwa	107.5	96.26	0.045	1.79
Karu	N/A	N/A	N/A	N/A

Table 3: Overhead and underground cable analysis

Districts	Number of Outage				Duration (Hours)			
	Over Head Cable		Underground Cable		Over Head Cable		Underground Cable	
	2006	2007	2006	2007	2006	2007	2006	2007
Wuse	68	79	23	19	104.73	88.45	166.06	147.14
Garki	181	167	88	75	285.51	301.06	183.47	209.02
G/Lada	187	105	2	0	747.46	169.22	18.19	0
Kubwa	110	50	0	0	177.45	208.52	0	0
Karu	NA	NA	NA	NA	NA	NA	NA	NA

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Table 4: Customers' population registered

Districts	2002	2003	2004	2005	2006	2007
Abuja	145,989	146,349	-	-	-	-
Wuse	-	-	58,458	58,458	26,150	26,344
Garki	-	-	90,292	91,069	27,678	28,858
G/Lada	-	-	-	-	30,514	31,023
Kubwa	-	-	-	-	34,000	35,013
Karu	-	-	-	-	40,104	41,104
Total	145,989	146,349	148,750	149,527	158,446	162,342

CONCLUSION

The data and the information presented in this paper are the true reflection of the Abuja Distribution Network characteristics and activities as from 2002 to 2007 respectively. With this support, operational efficiencies and communications are improved; thereby helping to reduce dispatching bottlenecks that can occur during high-volume outage condition. This in turn improved the performances and reliability of the system.

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