Township Power Distribution Network in Nigeria-Problems and Suggestions

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Abstract

Electric power system plays a major role in the wide spread of industries and improvement of the standard of living. The distribution system is mainly concerned with conveyance of electrical energy to load centers at lower voltages. The Township Distribution Network (TDN) is mainly concerned with the way and manner in which lower voltage (415V) power is conveyed in the load centers. The approaches used in this work include review of TDN, physical inspection and examination of township distribution networks at four load centers. Structured interviews were conducted to electricity consumers, staff and management of the utility company. The problems facing TDN are overloaded substations, use of substandard conductors, poles and workmanship; illegal wiring, poor funding, lack of equipment, poor communication equipment, poor metering and billing, consumer attitude and many others. The paper recommends consumer participatory maintenance methods as strategies to compliment other reform activities currently been undertaken by the government.

Keywords: Power system, distribution, town, network, Nigeria, problems, strategies.

Introduction

Technology involves the use of knowledge of machines and process; skills and procedures in directing the great resources of nature for the benefits of mankind. In pursuing the goal, electric power system plays a major role as a converter and transporter of energy for the use and convenience of man. It will obviously encourage the wide spread of industries and probably contribute to improving the standard of living. Electricity is a modern society's most convenient and useful form of energy, without it the present social infra structure would not at all feasible. A unique versatile energy, weightless, invisible and it is transported instantly almost at the speed of light when switched on. The increasing per capita consumption of electricity throughout the world reflects a growing standard of living of the people. The electric power system is structured into generation, transmission and distribution to ease handling, administration, improve efficiency and effectiveness in the routing of power from production centers to load centers (Stevenson, 1982). In reality power system is quite complex. It has a number of power stations of different types, interconnected by a system of tie-lines, transmission lines, and distributions network to supply different types of loads to various consumers. Nigeria is a vast country with a total of 923,768 sq km of which 910,771 sq km or 98.6% of total area is land. The nation is made up of 36 states and the Federal Capital Territory (FCT). Furthermore, the vegetation cover, physical features and land terrain in the nation vary from flat open savannah in the North to thick rain forests in the south, with numerous rivers, lakes and mountains scattered all over the country. These national physical attributes present challenges for the effective provision of power needs to all nooks and crannies of the country. The National Electric Power Authority (NEPA) was established by decree no. 24 of 1st April 1972 and empowered to maintain an efficient supply of electricity to all nooks and crannies of the nation though it has failed to meet the purpose of its enactment (Oruye, 2001). The name was change to Power Holding Company of Nigeria to set a stage for the privatization of the electricity system in Nigeria. Due to abysmal power crises in the whole of Nigeria, the government made efforts through the National Council for Privatisation/Bureau for Public Service sector which has seen no investment or major government attention since the 1980s. The Nigerian Electricity Regulatory Commission (NERC) was formed through the Electric Power System Reform (EPSR) Act of 2005 and effectively ushered the privatization of electric power services in Nigeria and the unbundling of the defunct National Electricity Power Authority (NEPA)/Power Holding Company of Nigeria (PHCN) into six (6) Generating Companies (GENCO), one (1) Transmission Company

(TRANSCO) and eleven (11) Distribution Companies (DISCO). NERC's primary duty is protect the interests of consumers, issue licenses to operators/investors, set and review electricity tariffs and where possible promote competition. The Commission's main objective is to protect existing and future consumers' interests in relation to electricity generated and that conveyed by distribution or transmission systems. Consumers' interests include affordable tariffs and safe, reliable and available electricity supply, and the reduction of greenhouse gases to them. The thrust of this paper is therefore, the expectation to be met by the DISCOs.

Currently, the total installed capacity of the generating plants is 7,876 MW but the available capacity is less than 4,000MW. Seven of the fourteen generation stations are over 20 years old and the average daily power generation is below 2,700MW, which is far below the peak load forecast of 8,900MW for the currently existing infrastructure. (Sambo et al, 2007). As a result, the nation experiences massive load shedding. The current status of power generation in Nigeria is hindered by the challenges of inadequate generation availability, poor maintenance culture, poor funding of power stations, obsolete equipment, tools, safety facilities and operational vehicles, and low staff morale among others. The transmission system in Nigeria currently has the capacity to transmit a maximum of about 4,000 MW and it is technically weak thus very sensitive to major disturbances. Some of the problems at the transmission level are high line losses, vegetation encroachment, lack of fund to expand, update, modernize and maintain the network, vandalization of the lines, poor surveillance and security, inadequate working tools and vehicles for maintaining the network, lack of modern technologies for communication and monitoring, aged and over loaded transformers and lack of spare-parts for urgent maintenance among others.

In most towns in Nigeria, the distribution network is poor and the voltage profile is low, a situation that worrisome. The distribution system is mainly concerned with conveyance of electrical energy to load centers at lower voltages. It connects all the individual loads to the transmission lines at substation where voltage transformation and switching functions are performed. It is that part of an electric power system dedicated to delivering electric power to the end users. This distribution system can be divided into Intertown Distribution Network (IDN) and Township Distribution Network (TDN). The IDN involved the conveyance of 11kV and 33kV power network through vegetation towards load centers from town to town. Use of (High Tension (H.T) poles, longer spans and special right of way for the lines characterize the IDN. The TDN is mainly concerned with the way and manner in which lower voltage (415V, 3-phase) power is conveyed in the load centers i.e. towns (Nasar, 1990).

In a typical TDN, a 3-phase, 415V power from the secondary of a transformer is fed through feeder pillar and upriser cable to link the aluminum conductors mounted on the poles to convey power to consumer premises. To achieve this feat involves the use of substation, conductors, insulators, poles. service cables and meter. The substation is an assembly of apparatus that transform the characteristics of electrical energy from one voltage level (usually 11 and 33kV) to a lower level (Pabla, 2011). The components mainly found in the substations are transformer, feeder pillar, insulators, conductors and protective devices. Optimum utilization of the electricity can be ensured by an effective distribution system. To achieve this feat, wide varieties of items to be inspected for defects will include sagging, span, leaning poles, broken or slack guys, fuse units airbreak switches, anti climbing gaurds, safety notices, corroded joints, arcing on fuse gears/switches among others (Kurtz and Shoemaker, 1976)

The generated power as established earlier is not adequate. There are losses in the transmission network and even in the IDN. The little that is available for township distribution is not usually effectively managed. This paper therefore, examines the characteristics of the TDN and its associated problems.

Methodology

The approaches used in this work include review of TDN, direct patrol and inspection of overhead lines, physical inspection and examination of substations at four load centers. Structured interviews were conducted to electricity consumers, staff and management, fault men of the utility company –PHCN. Secondary data was equally obtained to establish what a standard TDN system should be. These efforts formed the basis for discussion presented in this paper.

Results and Discussion

The TDN derives its sources from the distribution transformer substation and so are the associated problems. The components worst affected are the transformers and the fuse ways in the feeder pillar. A total of 200 substations were physically inspected in four main load centers of Ado Ekiti (Ekiti State), Akure (Ondo State), Benin (Edo State) and Ibadan(Oyo State). The characteristics found in all substations are similar and one can rely on them to form a general opinion. Table 1 shows that virtually all the transformers overloaded while the fences are in poor conditions and

the environment quite unkept. The feeder pillar inspected are shattered as characterized by burnt terminals, fuses, hangers and use of copper rods in place of standard fuse wires. The effect is component failure (insulation, conductor, oil etc) and reduction in life cycle.

Table 2 shows that the pole structures are made of concrete pole and wooden poles installed usually by the roadside. It was discovered that the installations done in the sixties were with concrete poles, good span, good sag and standard conductors while extension works were mostly undersized wooden poles with poor sag. The use of sub standard pole makes the TDN prone to fault because the requirement of minimum size and preservative treatment were not met. Donald, 1978) suggested that the minimum circumference at 1.68m from butt should not be less than 50cm. Joints were poorly done while terminal were twisted instead of use of line taps since materials are largely improvised by consumers.

Table 3 shows the conductors are generally of low quality because of size. Undersized conductors of sizes as low as $8mm^2$ are available on the TDN. The extensions were done by electricians with materials provided by the consumers instead of utility company. Poor conductor size coupled with low quality wooden poles prevented proper tensioning of lines and hence the sag is ridiculously bad. Table 4 shows that servicing of buildings are done by electrician instead of utility company with some houses fed with two phases instead of one so that they would change to other phase in case of loss of phase, this is the cause of load imbalance in the TDN.

Meters are not promptly read while bills are prepared on monthly estimates, faults are not promptly cleared while the managements are mostly interested in collection of cash to meet set target instead of service provision which in itself is a guarantee to fund collection. Tables 5and 6 shows the responses from the interviews conducted to consumers and staff of Utility company-PHCN. Consumers desire uninterrupted supply of electricity to meet the challenges of good standard of living and even for commercial and industrial purposes. They are willing to pay their bills since grid electricity is far cheaper than use of generators (Akinsanya &Alake, 2012). The attitude of staff of PHCN lack commitment to service though they are poor motivated and the required tools, spares, and replacement parts, are not adequate. Modern communication equipment are not provided, Vehicles are not adequate while illegal wiring are not curbed.

The initial network has been bastardized by unsupervised extension services as characterized by use of sub standard poles, conductors and poor workmanship leading to leaning poles, bad sag, poor joints and flashovers. The effect of illegal wiring executed by saboteur on the TDN is visibly alarming. There are rampant cases of connection of too many services cables to one phase at the expense of other two phases leading to load imbalance, which stresses the conductor, insulator and oil in the transformer.

Other problems within the TDN include attitude of consumers, long period of power failure occasioned by deliberate and or forced outages, poor job planning, inadequate service materials, sabotage, unpatriotic staff activities and nonchalant attitude of the government.

In view of the identified condition of the TDN, a consumer participation maintenance scheme is hereby proposed as a strategy for improving the system. In this scheme, each town will be divided into sections to be headed by a maintenance officer ably supported by a consumer representative. All customers should be made to revalidate their connections and records with the power authority, gradual reallocation of phases to consumers will be carried out to ensure fair load balance and be documented.Intensive inspection of the sections should be done to identify undersize conductors, defective poles and other accessories which will be revamped, reconductored and rehabilitated to meet the standard requirements.

The Maintenance Officer (MO) should be very familiar with all the characteristics of his section and be charged duly for the behavior of network in the section. Typically, maintenance management by target where the officer's annual performance evaluation is tied to the efficient status of his section is suggested. The MO should be trained and skilled electrical person capable of identifying defects from direct and regular patrol of the section, formulating fault clearance plans and supervising line repair/replacement activities. His duty should be supported with patrol vehicle/motor cycle, replacement spares and skilled fault men. On weekly basis, he should submit record of the activities in the section to the Maintenance Engineer (ME) in the district office. The ME will be supervising the MO in all the sections. An independent inspector will be appointed to monitor the MO and the network behavior in the sections. The advantages of the scheme is that there will be proper job planning, prompt fault clearance and reduced outages because the scheme will eliminate saboteur, use of sub standard poles and conductors since maintenance officers will be more alive to responsibilities. The benefits of a well managed TDN include reduction in energy waste, less interruption to supply, improved economy, and stabilized development.

Conclusion

In the paper, efforts have being made to establish that the factors militating against the township Distribution Network system are overloaded substations, use of poor and substandard conductor, poles and workmanship; illegal wiring, bad staff habits, poor funding, lack of equipment, poor communication equipment, poor metering and billing, consumer attitude and many others. The paper their recommends supervised and improved maintenance method as strategies to compliment other reform activities currently been undertaken by the government.

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Table 1: Inspection of Substations

Items inspected	General Remarks
Fence	Poor
Transformer	Overloaded
Feeder pillar	Shattered
Fuses	Bad
Terminals	Burnt
Environment	Unkept
Conductors	Okay

Table 2: Inspection of Wooden poles

Items	General Remarks
Type	Wood
Height	Less than 8.3M
Girth	25-45cm
Treatment	Poorly done
Stay wire	Rarely used
Location	Roadside
Strength	Physically weak

Table 3: inspection of overhead Conductors

Items	General Remarks
Type	Aluminum
Size	8mm2-7omm2
Tensioning	Mostly poorly done
Sag	Visibly poor
Strength	Weak
Joint	Too many
Termination	Poor

Table 4: Inspection of house servicing

Items	General Remarks
Type	Mostly Single Phase
Cable	16mm2
Connection	Done by Electricians
Metering	Poorly done
Billing	Mostly on estimate
Efficiency	Poor
Load balance	No Consideration

Table 5: Responses from Consumers Interview

Subject	General Remarks
Power Supply	Epileptic
No of Phases	Single with illegal additional phase
Metering	Not done regularly
Billing	Monthly Estimate
Faults/Complaints	Poor response
Extension Services	Self
Sources of cable	Self
Illegal Wiring	Very Rampant
Possession of Generator	Yes
Report of fault	Casual
Willingness to settle Bill	Ready to pay
Energy Management	Poor
Consumer Desire	Uninterrupted power Supply

Table 6: Summaries of Responses from Staff Interview

Subject	General Remarks
Materials	Not usually available
Tools	Not Adequate
Patrol Vehicle	Not Adequate
Comm. Equipment	Old and Not Adequate
Staff Strength	Inadequate and Skewed
Staff Attitude	Lackadaisical
Staff Motivation	Available but insufficient
Management	Poor
Government Attitude	Poor Funding
Training and Retraining	Not adequate