STATUS OF ELECTRICAL POWER DISTRIBUTION NETWORK OF POWER HOLDING COMPANY OF NIGERIA, LAGOS STATE METROPOLIS.

BY

OLORUNFEMI ADEDOYIN VICTOR.

2007/1/27265BT

DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION

FEDERAL UNIVERSITY OF TECHNOLOGY

MINNA.

September 2012

STATUS OF ELECTRICAL POWER DISTRIBUTION NETWORK OF POWER HOLDING COMPANY OF NIGERIA, LAGOS STATE METROPOLIS.

BY

OLORUNFEMI ADEDOYIN VICTOR.

2007/1/27265BT

A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION

SCHOOL OF SCIENCE AND SCIENCE EDUCADITON

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF TECHNOLOGY (B.TECH) IN INDUSTRIAL AND TRECHNOLOGY EDUCATION

September 2012

CERTIFICATION

I OLORUNFEMI ADEDOYIN VICTOR with matriculation no. 2007/1/27265BT

An undergraduate student of the department of industrial and technology education school of science and science education federal university of technology, minna certify that the work embodied in this project is original and has not been submitted in part of full for any other diploma or degree of this or any other university.

…… …….

Name signature

APPROVAL PAGE

This project has been read and approved as meeting the requirement of the award of B.Tech degree in industrial and technology education, school science and science education federal university of technology, minna.

……. ……

Project supervisor Sign & Date

…… ……

Head of department Sign & Date

…… ……..

External Examiner Sign & Date

DEDICATION

This project work is dedicated to my parent Mr. and Mrs. J.B Adedoyin for there divine providence, love, guidance and blessing upon my life. Also to my brothers for there love, care and support and to my friends.

ACKNOWLEDGMENTS

My sincere appreciation goes to the giver and sustainer of life, almighty God for his divine protection through the successful completion of my studies in the federal university of technology minna. I wish to express profound acknowledgment to my project supervisor Mallam S.A Musa for his assistance, follow up and his attention as been great success and i pray that God will continue to bless him and his family.

Sincere gratitude goes to our head of department Dr. E.J Ohize, prof. G.D Momoh, Dr. A.S Ma'aji, prof K.A Salami, Dr. B.N Atsumbe, Mr. T.M Saba project coordinator, Mr. E. Raymond, Mallam abdulahi Kagara, Mallam Abudkadri for their contribution and fatherly advise toward my academic success. And I pray that God will continue to bless you and your family. And to Engr. Umar Bello, Engr. Biodun Mathew of PHCN Lagos. May God bless them all. I also acknowledge my parent, uncles, brothers, sisters and my friends for been there for me at all times. For prayer, moral support encouragement and financial supports may God bless and reward you all in earth and in heaven.

TABLE OF CONTENTS

CHAPTER II

REVIEW OF RELATED LITERATURE

CHAPTER III

RESEARCH METHODOLOGY

CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

CHAPTER V

SUMMARY, CONCLUSION AND RECOMMENDATION

LIST OF TABLES

Abstract

Industries are established with the objective of maximizing profits. This objective seems to be achieving in power distribution Network. Base on this, the study was focused on status of electrical power distribution of power holding company of Nigeria. Lagos state district specifically, the study investigates into the power distribution Network, Negative effects and the techniques for resolving power distribution Network. Four research questions and three hypotheses were formulated to guide the study. The null hypotheses were tested at. 05 level of significance. The survey method of research design was for this project. Sixty three (63) items questionnaire was developed and used to elicit the responses of the respondents. The persons identified as the population of the study were the maintenance personnel and the operator's personnel of Lagos state district. A total of sixty (60) respondents which consist of thirty five (35) maintenances personnel and twenty five (25) operator personnel were used for the study. Data obtained were analyzed using frequency count, mean, standard deviation and t – test statistics. The finding reveals that there is no proper maintenance of workshop equipment by instructor and safety precaution is not observed in the injection substation for increase in efficiency and activity to be carried out regularly. The study recommend that maintenance and operator personnel should be motivated, experience workers should be put in charge of substation and equipment, facility used in power distribution should be adequately maintained by the instructors and apprentice in other to improve work standard and to prolong their life span and suggestion were made to guide further research.

CHAPTER ONE

INTRODUCTION

Background of the study

Electrical power distribution network involve all processes and methods use in the effective and efficient distribution of power in a giving society or a country. It also entails all considerations put in place in order to achieve a simple, reliable, flexible and maintainable power system with in-built cost effectiveness. It involves the process by which electrical power is conveyed from generating station to the consumer premises. The process may in general be divided into two-district parts: transmission and distribution, there are various source of power generation ranging from hydroelectric, fuel fired (steam), solar, gas turbine and nuclear power station.

Electrical transmission is done when generated electricity has been stepped up to a considerable level for high voltage transmission and the same time synchronization. Distribution of electricity is the last state which governs the task of conveying electric power to the consumer premises, takes the largest Percentage in the overall investing cost (Gonen and McGraw, 2001). Distribution system can be divided into sections, feeders, distributors via distribution transformer, which serves certain allocated areas. From the sub-distributors various tapings are made using service main. These exist some sophisticated protection devices provided for each and every section of generation, transmission and distribution of electric power to avoid or sense fault occurrence, high voltage loss, system collapse and even protection over the static equipment involved an example is a transformer. These protection devices also help in speeding up the repair time and in maintenance scheduled. In so many cases, alternative supply path are available, so that consumers do not experience any interruption in supply of any form.

A distribution circuit normally uses primary or main feeders and lateral distributors, which described its configuration. The main feeders originate at the substations and passer through the major load centers. Distributions connect individual load points to the main feeder via distribution transformers. a main feeder is constructed using single, parallel or single circuit main feeder and are define as radial distribution system (Brown, 1996). The radial system configurations are commonly in Nigeria due to their simple design and general low cost. These systems have a set of series components between the substations load points. The failure of any of this component causes outage of the load point; meanwhile, using extensive protection and sectionalizing scheme reduce the outage duration and member of customer affected due to component failure. The sectionalizing equipment provides a convenient means of isolating the faulted section. The supply can then be restored to the healthy section, maintaining the service to some load points while; the faulted component is being repaired. In some system, there's provision for alternative path to supply in case of failure. Fuse element or equipment is usually provide on the radial system of distribution, therefore faults on radial system or distribution transformer are normally cleared by this equipment and however, service on the main feeder acts to clear the fault. the faulted lateral distribution is then isolated and supply is restored to the rest of the system by closing the circuit breaker (Bodude, 2008).

Power holding company of Nigeria plc Ikeja happens to be one of the largest districts in Lagos zone; this is due to hard space of zonal personnel that handle every subject mainly faults and protection of 132, 33 and 11kv transmission line or transformer and distribution is their area of concern. The distribution level comprises mainly the following departments:

a. operation and maintenance department (o & m)

b. planning and construction department (p & c)

c. protection, control and meeting department (p c & m).

the operation and maintenance department (o & m) as the name tagged are in charge of all operation in the distribution network, which includes monitoring of network frequency, daily fault report, daily power supply (mostly homely) to consumer are keeping of all products involving daily fault, outage time, rectification and restoration time which are stored in necessary log books. their function also include effective communication with all the engineers or personnel in the site for keeping them informed with the present situation or needed at preplanned maintenance schedule. In fact this is department where all data referred to, in this project were gotten. Planning and construction department (p &c) however, are to function when new site are to be develop or extension has to be made in to relieve the existing ones. They carried out plan, survey and come up with quality of materials to be employed. What is called sanction is raised at this department after planning and survey, which contained the qualities of material to be needed for the project that will also indicate the overall material cost (Bodude, 2008).

Protection, control and metering department (p c & m) is the most important department in terms of protection equipment involved at distribution level; in fact, this department is the backbone of the district functions. it consist of power engineer, technologist and technicians working as a team to maintain stability, reliability and provide protection to all the equipment in distribution system like testing it, insulation test, continuity test, excitation test e.t.c on 11kv/415v distribution transformer and calibration of relay's to corresponds to be required supply voltage in accordance with the circuit breakers. in addition, protection also made for

every feeder be it overhead or underground through necessary ampere of fuses and communication system while the a.c is down to avoid what is called system collapse.

There are other department in this district like administrative, and meeting under which there are sub like records, Welfare and establishment. the word “reliability” means the ability of a system to perform a required or desired function under stated conditions for a given period, this discipline can encompass the area the following activities; system failure analysis, operational observed, data bases, text, methods, and safety reliability. And reliability play’s an important role in the economic and social aspect of life. The need for design, operational cost reduction is highly competitive market and more are reasons that give reliability more attentions or significance. Reliability consideration now occupies an important place in entire engineering of compiler system and electrical system application has generally included mechanical, chemical, and electrical systems. During the last decades, it has become self evident that to minimize the probability of failures human factor must be taken into account. Human error has also figured prominently in Maritimes, aerospace and electrical power industries. Human reliability analysis (HRA) practitioners employ systems engineering and behavioral sciences model and techniques in an effort to quantify the human performance; basic research conducted in experimental psychology, and the behavioral science has supplied the building blocks upon which contemporary analysis and qualification techniques are built. Many of the major HRA technique have gathered data from there basic discipline and then provides mechanism of estimating failure probabilities, throughout the year, qualifications technique proliferated review of literature yield approximately 38 HRA techniques (Lewis, 2003).

One major difference between performance reliability analysis (PRA) and human reliability analysis (HRA) is the fact that no complete source of data exists for human failure

rates. Early efforts documented, in past years the coolest reliability data for use by human factor professionals. at that time no one was referring to him or herself as an HRA practitioner, most recently, efforts as been made to collect and store probabilistic data for HRA. in data base such as nuclear regulator commission (NRC) sponsored technique for human error prediction. (THERP) handbook (swain and Guttman, 2003) and the nuclear computerized library for assessing reactor reliability (NUCLARR). as these database develop, they will become major sources that are databases containing failure rate information for decision base errors (DBEs). Currently, the risk impact of DBEs is neither well identified nor qualified. Expectation exists in the application of the confusion n matrix approach used in the Oconee PRA and in the matrix approach employed by Wakefield in the PRA for three Mile Island (TMI unit 1). The confusion approach matrix identifies the potential for confusion on the part of the operator because of the similarity of event signature.

mirror modification of data based on operations data, such as the NRC sponsored licensed even report (LER) system and nuclear power reliability data system (NDRDS) or the US department of energy (DOE), unusual occurrence reporting system (UORS), could provide an excellent source of human failure rate from nuclear power plant similarly, the federal aviation data base on new misses for use in PRA simulators studies conducted in either training simulators or research simulator have similar potential to provide failure rate estimates.

Statement of the problem:

According to Bodude (2003), Lagos state power sector has high energy losses in terms of power distribution. it has been in able to deliver an interrupted power supply, to the major part of the state because there are no backup lines. And this is due to poor distribution network in Lagos

state and inadequate supply of electricity to consumers. And this is not good at all. consequently, Lagos state have been mainly do with alternative sources of power supply like generators, candles, paraffin lanterns, rechargeable lanterns etc which can be either term to be an expensive alternative in other to operate their equipment for effective production and as a result, it affects the price of goods and services produced and also industrialization can only be achieved if there is effective power supply because power is the heart beat of the nation (Bodude, 2008).

Nigeria is trying to generate 6000MW of electricity and to be distribute an over the nation. the faulty equipment and load distribution network will render effective plans useless. Therefore there will be need to carry out reliability analysis of power distribution network by power holding company of Nigeria in Lagos state.

Purpose of the study

The main purpose of this study is to determine the status of electrical power distribution network in Lagos state and specification to find out:-

1. The current state of electricity distribution in Lagos state
2. The condition of facilities used in power distribution network in Lagos state
3. The factor hindering the performance of power distribution network in Lagos state.
4. Strategies for standardizing the activities of power distribution network in Lagos state.

Significance of the study

The study will assist the management of power holding company of Nigeria (PHCN), the entire people of Lagos state and the Government.

The study will help the management of power holding company to improve their facilities, equipment and tools which will prolong the life span of the equipments. When all these things are in order, power distribution will be improved.

the society will enjoy good electricity supply when the management improves their power distribution network, better the power generation to the community and equal power distribution to all citizens.

The government will benefit from this too, it will up-lift the socio-economic, cultural, political standard of the Lagos state government. This will help to better planned the increments vision 20:20:2: of the federal government and in achieving one of the seven point agenda of the present government.

Scope of the study

The project is all about the reliability analysis of power distribution network in Lagos state. And it is going to be.

1. Based on looking into the current state of electricity distribution, condition of facilities and equipment used in power distribution.
2. Also considering the factors hindering the performance and strategies of standardizing the activities of power distribution in Lagos state.

Assumption of the study

During the process of this research the following assumption were made:-

1. It was assumed that the sub-station in the area of study will be sufficient to obtain relevant information, data necessary for ensuring the research question.

2. Respondents were considered to provide valid authentic information for the research work.
3. it is also assumed that possible solution will be provided to the problem at the end of the research work.

Research questions

The study seeks to provide consumer to the following questions;

1. What is the current state of electricity distribution in Lagos state.
2. What are the conditions of facilities used in power distribution network in Lagos state.
3. What are the factor hindering the performance of power distribution network in Lagos state.
4. What are the strategies for standardizing the power distribution network in Lagos state.

Hypotheses

The following hypotheses were formulated and tested at 0.05 Level of significant;

HO1 There is no significant difference between the mean responses of operators and maintenance staff with regard to the current state of electricity distribution in Lagos state.

HO2 There is no significant difference between the mean responses of operator and maintenance staff with regards to condition of facilities used in power distribution network in Lagos state.

HO3 There is no significant difference between the mean responses of operators and maintenance staff with regard to strategies for standardizing the power distribution

network in Lagos state.

CHAPTER TWO

REVIEW OF RELATED LITERATURES

This chapter review related literatures on reliability analysis of power distribution network in Lagos state district. The literature of this study has been reviewed under the following subheadings.

1. The principle of power system reliability in Nigeria.
2. Maintenance of electrical facilities in power distribution network
3. Need for power system reliability
4. Factors hindering the performance of power distribution network
5. Status on power distribution network
6. Strategy for standardizing power distribution network system

The Principle Of The Power System Reliability In Nigeria

Power system reliability has been an area of active research for sometimes now. In simple terms, reliability is the ability of a network to deliver uninterrupted power of prescribed quality to its consumers. Hierarchically, power system comprises three distinct parts: generation, transmission and distribution. This research was carried out by this set of people Enrico Carpaneto, Alessandra Mosso, Andrea Ponta, Emiliano Roggero (2001).

Distribution systems are responsible for delivering for power to the customer's doorstep. As a result, most outage/failure would result in direct impact on the customers. Traditionally, utility have focus more on improving reliability of the generation and the transmission capacities. However, the advent of deregulation and the subsequent regulatory action have changed the

utility perspective. Increased use of fast switching equipment involving power-electronics circuit has made the load more sensitive to disturbances in power supply.

In addition to the above factors, growing energy requirement for customer tend to overload the already stressed network making it all the more necessary to analyze the network in term of ability to serve customers round the clock. Thus, distribution area reliability is an area that is gaining important and utility are now focused on improving their performance in achieving greater customer satisfaction while ensuring that cost of operating the network are kept under control.

This module aim at introducing the concept of distribution system reliability, Before dealing with reliability in more detail, we look at some of the fundamental concept of distribution system; also discussed in the module are some common cause for outage in a distribution system; some standard reliability used by the industry and example to illustrate their use.

Fundamentals of distribution systems

Broadly, distribution system can be divided into three distinct regions they are (layout, system topology and types of interruption).

Substation acts as the termination point for transmission networks. They comprise of large power transformer that step down voltage that are of typical transmission system (generally above 69kv) to lower voltage in the 5-35 Kv. Substation also comprise protective equipment like disconnect switches, circuit breakers and relay both on the transmission and the distribution side along with device like lighting arrestors and surge protectors (Emiliano, 2001). Apart from these are measuring devices like the potential transformer, current transformer, regulating equipment

like capacitors banks that regulate the power factor. It may be noted here that, distribution system reliability generally refers to reliability of the system that is downstream of the substation. Hence in most of the work in this area, substation is modeled as ideal sources. The reason for this is largely because substations have complicated arrangements relative to the distribution system which is largely radial. Hence they require separate and detailed analysis. Also, it has been well established in the literature that the reliability of the system determine by including substation is not very different from reliability determine by treating them as separate entities from the distribution system.

i. The primary distribution system comprises of long 3-phase and 1-phase feeder that feed the secondary distribution networks. Feeder can other be over head line or underground cables. Over head lines are supported by a wood pole that is mounted with insulators to hold the lines. Under ground cable are connected in elbows and splices. Also include are protective devise like fuse, reclosers and circuit breakers. Switches and sectionalizes are devices that are used to isolate faulted areas thus help restore power to at least few customers while repair is carried out.

ii. Secondary distribution network typically have pole-mounted or pad-mounted transformers that step-down the voltage to feed costumer load points. Customers are generally connected to a the nearest transformer using short lines or cables. A typical system would comprise of 4-10(or more) substation with one or more feeders branching out from each of them. Each of these feeders consists of many line segments along with score of other component mentioned above. Thus, it can be understood that distribution systems have numerous component that are large geographical regions with varying load and weathers (Peng, 1999).

2. Unlike transmission systems that are largely networked, the distribution system are mostly radial. In a radial system, the power flow is unidirectional e.i. there is a single source of power with multiple load connected to it along with various feeders. Outage at any one of the locations results in an interruption to all the down stream customers. Despite comparatively less reliable due to a multitude of components connected in series, this configuration is preferred because it is economically and operationally less cumbersome. Issues like protection coordination are simpler to handle in such systems. These networks are largely use in rural areas and residential location and organization like hospitals, manufacturing industries require high levels of reliability. Any loss of supply can be extremely critical if not damaging. In order to achieve high reliability level, redundancy is built into the system. By redundancy we mean configurations that are called networkers, looped or meshed. In these systems, the load points are connected to multiple sources but at any point in time, only a single source feed the load. Whenever a failure occurs, sectionalizing with are operated to restore service. The networks are critically complicated in operation and are more capital intensive. For extremely critical load, it is often a combination of sources and feeder paths that can serve the loads through fundamentally only one of them is operational at a particular time (Peng, 1999).

An interruption is loss of power supply to the customer. The affect of an interruption is variable. Primarily, it depends on load at that particular instance of time and the type of customer interrupted. To a domestic user, an interruption means resetting of clock or having to go without air-condition on a summer day. To an industrial or a commercial establishment, this would mean crashing computer to lost production worth millions. Interruptions are classified based on the duration as:

An interruption the last for duration less than five minutes is considered as a temporary interruption. These are generally flickers cause by open-close action of recloser due to trees brushing a live conductor, switching of heavy load etc. apart from being a nuisance these interruption are more of concern of automate load and processes involving computer controlled equipment.

An interruption that is greater than or equal to five minute is termed as a permanent interruption. These are faults that are not self-clearing and require the crew to get to the location of the fault to repair and restore the system. The duration mention above is standard but not universal. Some utilities define interruptions longer than one minute as a permanent or sustained. Thus, it is important to know the definition of an interruption before doing any analysis on a particular system.

Having developed an idea of how distribution system are organized and are operated it is important to understand some of the most common causes of failure. Every component has a specific useful life. Thus even operating under ideal conditions, a component tends to wear-out and fail. Ageing is perhaps the most important factor resulting in equipment failure and customer interruption. It can be easily perceive that any equipment that is older than another is more likely to fail and hence has a greater probability of failure.

Due to increased customer demands say during peak summer months; the loading on the equipment is increased. This increases the operation temperature of the equipment resulting in case of protective equipment like recloser tend to make them prone to failure due mechanical wear out that occurs in the moving parts. Another important factor that influences the useful life of a component is its environment (Tolbert, 2001). Dusty and moist climate in general increases

the tendency to fail. Adverse condition of weather increases the chances of failure. Equipment tends to fail more often than not during events like lightning and wind storms.

Trees are one of the largest contributors to failure in distribution systems. Every year utilities spend a large portion of their investment to prevent tree and vegetation grow from getting into power lines. Apart from causing outage due to faults arising from part of tree touching the lines, growth of trees into the line can cause increased momentary interruption resulting from reclose operations attempting to clear the faults, increase inline losses and in some cases even forest fire that are catastrophic. Thus it is increasingly becoming important that utilities maintain the 'right of way' and in some even beyond.

Increased animal activity near power equipment often results in outage that is hard to prevent. Animals like squirrel and bird often get trapped near power line resulting in faults and interruption that are generally sustained. Other common cause include snakes, ants, termite etc. no matter how sophisticated power system gets, there is always the human factor involved in operating it. Failure may arise due to many reason some of them intentional while the others unintentional. While the intentional ones like maintenance are after schedule and informed to the customer, things like dig-ins, accidents and switching error etc are unintentional and lead to failures.

Maintenance Of Electrical Facilities In Power Distribution Network

A. The Visual Inspection Annually with Binoculars: (Tolbert, 2001). The visual inspection should include the following items they are:

I. Oil level: check the oil level on bushing equipment with side gauge or other types of oil indicators and add oil as necessary. Low oil-level with no sign of an external leak

may indicate a leak in the bushing which may require replacement of the bushing as field correction would be difficult to accomplish. The oil level o bushing without oil-indicators is not normally checked unless there is evidence of leakage.

II. Porcelain: check for chips, cracks, and contamination. Minor chips may be painted with an insulating varnish to obtain a glossy finish which will shed dirt and moisture. Superficial cracks that do not affect the mechanical or electrical strength of the bushing may be seal with insulating varnish or epoxy. Bushing with major chips or cracks which appreciably decrease the creep age distance should be replaced. The surface of the porcelain should be cleaned as needed to remove dirt, oil and other deposits that may reduce the flashover value.

III. Maintenance tests: common maintenance test are power factor, RIV (radio-in-fluencies voltage), dc insulation resistance, and testing oil or compound for moisture. Description of these various tests follow: Tolbert *et al* (2001)

i. Power-factor double Tests: the power-factor test is the most effective known field test procedure for the early detection of bushing contamination deterioration. This test also provides measurement of ac test current which is directly proportional to bushing capacitance. Bushing may be tested by one or more of four methods depending on hye type of bushing and power factor-test set available. For more complete detailed instruction on the method of test and test procedure, please see appropriate power factor procedure instruction book. The four test methods are as follows:

The GST (grounded specimen test): this test measure the insulating quality of the insulation between the current carrying and center conductor and the mounting flange of a bushing. The application of such a test necessary to bushing out of the apparatus such as spare bushing or

bushing which have been isolated from connected windings and interrupters. The test is performed by energizing the bushing conductor and grounding the flange. Large variation in temperature has a significant effect on power –factor reading on certain type of bushings. For comparative purposes, reading should be taken at the same temperature, or correction should be applied before comparing reading taken at different temperatures.

The hot gard test: this test measure the insulation between the current carrying or center conductor and the bushing bus, but not sufficient to withstand test potential. Both the bushing and the draw-lead, winding and but are energized at the same test potential, but only the current and losses of the bushing are measured.

The UST (ungrounded-specimen test): this test measure the insulation between the current-carrying or center conductor and the capacitance tap, power-factor tap, and /or ungrounded flange of a bushing. This test may be applied to any bushing in or out of apparatus which is either equipped with capacitance or power-factor taps or the flange of which can be isolated from the grounded tank in which the bushing is installed. The insulation regulation resistance between the tap or insulate flanges and ground should be 0.5 meg-ohms or better. While in this case, anything that is attached to the bushing (such as contact assemblies or transformer windings) would also be energized; only the insulation of the bushing between the center conductor and the ungrounded tag or flange would be measured. In the case of bushings equipped with capacitance taps, a supplementary test should always be made on the insulation between the tap and the flange (Burke, 1999).

The hot-collar test: this test measures the condition of a specific small section is bushing insulation between an area is the upper porcelain rain shed and the current-carrying and center

conductor. It is performed by energizing one or more electrodes (collars) placed around the bushing porcelain with the bushing center conductor grounded. This test is used to supplement the three test described above or impractical. Hot-collar test are effective in locating cracks in porcelain, deterioration or contamination of insulation in the upper section of a bushing, low compound or liquid level, or voids in compound, often before such defects are noticeable with the tests outlined in subparagraphs a.,b., and c.

When bushing with capacitance or potential tap (92KV and above) are tested by the ungrounded test specimen method, it is recommended practice to include a separate power-factor test on the tap insulation as well. The exception to this is general electric company type of bushing built prior to 1932, which have tap outlet designed to operate at less than 100 volts. On all other capacitance or potential taps, tests are performed at some voltage from 2 to 5kv. The procedure is to energize the tap with the bushing center conductor and flange grounded. The power factor of a capacitance or potential tap will generally be of the order of 1.0 percent or less. Routine tap are not normally recommended for bushing rated 69kv and performed when questionable ungrounded specimen test procedure is as outlined above for capacitance taps. in such cases, the maximum permissible test potential should be limited to the follow table. The power factor of the power-factor tap insulation for the above mentioned bushings will generally be of the order of 1.0 percent or less. The principal exception to this is the Ohio brass, type l bushing. The inherent properties of the fibrous-Bakelite material used for the tap insulator have resulted in power factor up to 10 percent for apparently satisfactory taps.

The tabulation of factor power factors and power-factors limits in table 2 are as publishing by the manufacturers or otherwise listen by them. Please note, however, that many bushing have the factor power factor listed on the nameplate. In such cases, field measurement, particularly

ungrounded specimen test, should compare with and the bushing be rated on the bases of nameplate power factors.

B. General: all high-voltage bushing should be inspected periodically to interval of not over 3-5 years “kuntz”(1999). The inspection should include power-factor test for all bushings rated above 115 kv. Lower voltage bushing should also be tested if there is reason to suspect they may be deteriorated. Bushing showing signs of deterioration should be tested at interval of 6 month to 1 year remove from service if the tests show a dangerous condition.

   i. Terminal caps end connectors: check for tightness to avoid poor contact and resultant heating

   ii. Capacitance taps and power: factor test electrodes.- check to determine proper grounding for bushing with a grounded capacitance tap and for power factor test electrodes. Examine for proper gasketing to prevent entrance of moisture.

   iii. Cement: Check for crumbling or chipped and repair as required.

   iv. Gaskets: Check gaskets for deterioration looseness, and leaking. Loose gaskets should be replaced or painted with general electric lacquer or other suitable oil proof sealer, and tightened. Finding a loose gasket or seal may mean that moisture has entered the bushing and check should be made to determine if present. The bushing should be dry out if necessary.

   v. Metal pad: Check and paint as necessary. Examine structural parts such as clamping rings and washers, for cracks or breaks.

   vi. Solder seals: Check for cracks and leaks and as necessary.

Need For Power System Reliability

The economic, social and political climate in which the electric power supply industry now operates has changed considerably during the last few decades. Carvalho, on the periods between 2000 and end of 2002's, planning for the construction of generating plant was relative uncomplicated, lead time were relative small and cost was relatively stable. This situation changed in the mid 2005's inflation growth patters their combine efforts introduced considerable uncertainty in predicting future demand.

Now that the communication sector is growing fast in Nigeria, what safe guards the effective communicational considerable or economical airtime to the customer is a need to have in place it maintain "high 9's" reliability on electric power system. The same attention in the power electric reliability effect should also be giving to other sector like banking, industry, schools as well as commercial because power outage is less reliable or low quality power supply has its effect on different angels to all these sectors mention above. The 24th annual international telecommunication energy conference (INTELEC) held in September 29- October 3, 2002 in Montreal showcases the latest development is energy system and related power processing divine and circuits. The theme of this conference is "reliability "energy the driving force behind dependable (Burke, 1999).

Bob Boruer, president, Emerson power network north American said reliability does not demand a strategic power reserve architecture that keeps telecommunication and other critical system up and running 24hrs + 7days a week. with the rapidly growing convergence of various services from telecommunication to manufacturing, the big question is that do they really in the way of back-up reserve time to maintain the high reliability that expected in the power system in this

country after varuose finding? Said Egineeer makoju, PHCN managing director during a vita to egbin thermal station in may 2007.

Moreover, Farah Saheed, an industry analyst at frost and Sullivan based in USA, as advance they are technologies (and any other aspect) with experts in power protection an analyst. Then what do we think will be happening in a third world country like Nigeria with newly licensed mobile telecommunication (GSM) operator like MTN, GLO and AIRtel? Which for every switching to the switching center installed at least two generating plant connect in hot redundancy form, for continuous power supply to the switching station in order to hit the target of very effective and reliable communication services in Nigeria. Presently about six thousand (60,000) generating plant has been imported due to random power outage in the country according to MTN marketing in Lagos state. I believe by the end or conclusion in network expansion, nothing less than a hundred thousand (100,000) more generation plant would be needed, which we should realized the economic effect of the station.

Power protection and analyst expect in USA realizes the significant/ need of reliability to the economy, put up and present paper base on these priority topics at INTELEC conferees mentioned earlier.

1. Power outage: causes and prevention
2. Status analysis of an AC voltage.
3. Distribution power architecture in the context of cost effective data center.
4. Consideration on rectified sizing.

The only way in which all these competing and diverse uncertainty be weighted together in an objective and consistence fashion is by the use of qualitative reliability evaluation techniques.

The result can then be related to the economic aspect of system planning and operation, the impact of which is playing an increasing role in present and future power system development.

In addition, the industry is capital intensive; it play a major role in economic and social well being of a nation and indeed, quality life. Government licensing bodies are expressing representative and environmental conservation group are expressing their concern in a way that present reliability techniques, concept and models to be developed, utilized and scrutinized.

Factors Hindering The Performance Of Power Distribution Network

The following may hinder the performance of electricity network:

i. lack of competent and necessary technical skill the industry
ii. maintenance to electrical infrastructure at distribution level
iii. staffs are not motivated
iv. good relationship between maintenance staff and operator staffs
v. inadequate supervision of maintenance programme
vi. Vandalism and theft.

The lack of competent and necessary technical skill within industry as a whole is widely recognized, and is even catered for in the quotas application to the immigration act, and by means of government regulation.

There are several factors that compound the risk associated with the lack of component and necessary technical skills:

1. widespread (local and global) tendency towards" emergency" or "breakdown" maintenance, instead of proactive and preventative maintenance – the vicious cycle of chasing one's tail or putting out fires.
2. Risk to person and property in challenging environments and initially non receptive communities.

Status On Power Distribution Network

Brown,Nguyen,Burke (2000). The discussion of any quantitative reliability evaluation in various lead to a discussion of data available and the data require backing such studies. Valid and useful data are expensive to collect them. Its sometimes arrange as to which one come first: reliability data or reliability methodology. Some do not collect data because they have nothing to do with it. Consequently, they do not conduct reliability studies because no data available. It should be clear in our mind that data collection and reliability evaluation interrelates and therefore is iterative.

When collecting data, it should be remembered that an unlimited amount of data could be collected. It is undesirable to collect, analyze and store more data than as require for the purpose intended. it is therefore essential to identify how the data will be used before deciding what data to collect.

In conception terms, data can be for one or both of these two reasons, assessment of part performance and/ or prediction of future system performance; hence collection of data is

therefore essential as it form this input to relevant reliability model s techniques and equations. Data should therefore reflect and respond to the factors that affect system reliability and available it to be modeled and analyze. This means it should relate to system behavior processes involve i.e. failure process and restoration process.

The quantity of data and evaluate indices depends on two Important factors; confidence and relevance. The quality of the data and then the confidence of information comply by operation and maintenance personnel. It is obvious that they should be made fully aware of the future use to which the data will be put and the important it will contribute in later development of the system.

The problem indicates in the impossibility to compare and / or substantial the result obtain from various methods reality was recognized by subcommittee Application probability method (APM) which in 2000, published the reliability test system (RST). This is reasonably comprehensive system containing generation, transmission and load data; this will enable the different result obtained by different people to be compared. the RTS is use extensively in application on generation and transmission. except distribution since the RTS does not have any distribution defined for it. The RTS not only provide consistent vehicle for describing the various application, it also enable a comprehensive understanding of the system to be derived and present (Burke, 1999).

Strategies For Standardizing Power Distribution Network System

Competitive maintenance: a clear knowledge of the risk facing electrical networks, the proper application of consultants and contractor and a positively defined scope of work is essential in establishing an effective and competitive maintenance strategy (i.e contract and program). It is

suggested that the contract between the contractor and service-provider (employer) is the single most important managerial component of maintenance by contractors (and consultants). The nature of this contract should ideally be arrived at through consideration of all factors mentioned above, based on robust debate between the consultant and the service- provider.

Every class of equipment has its unique complexities. And these should inform the process of contract selection. Standard form contract should not be accepted merely "because we always use this form of contract" or "because this is our procurement department's standard contract". The clear establishment of the scope of works should immediately indicate the nature of contract i.e. weather it is a contract for provision of goods and their installation, or an engineering contract (possibly geared towards services), and the species (e.g. priced contract with activity schedule, price contract with bill of quantities, cost reimbursable contract etc.). it may be true that simpler maintenance task (such as tree pruning or servitude clearance) can easily be catered for in standard-form contract with a bill of quantities, but this certainly not the case with complex equipment (i.e transformation maintenance).

The contract should ideally:

1. Maintenance and operators personnel should be motivated.
2. Adequate information and communication technology.
3. Allocate the financial risk fairly and as the situation demands
4. Be logical and allow for consistence interpretation of the pricing (i.e. independent renderers interpreter the scope identically and quote for their services accordingly)
5. Avoid the use of "additional works" clauses whereby work not included in the scope of the original contract can be included post award though the exercise of a discretion

6. Be concise and not contain extensive peculiar conditional clauses in note renders and be written in plain language
7. Safety device should nit be removed without permit
8. Constant maintenance of transformer and other equipment
9. Avoid the temptation to have the contractor inspect the equipment he is to maintain, in order to establish the nature of the maintenance (this can be construed as a conflict of interests)- where appropriate, contractors most do, not determine what is to be done
10. Clearly indicate work procedures, hierarchy of authority for approval of works and variations, and contain a project executive Seagram with functionaries and role-players clearly identified
11. Contain technical specification closely vetted for approval for relevant by the service provider, free of co price and trademark infringement, not favoring one contractor or supplier of goods above another – there must be ownership from within i.e. the service-provider must factually accept the technical specification (as produced by the consultant).

Access: one of the most challenging issues is the ability of service-provider in providing planned and timeout access of adequate duration to the site of works. Inadequate and uncoordinated access render all attempts as effective project management practically impossible negative effects morale, introduces in scope interpretation, affects quality of workmanship and raise costs for all parties concerned i.e. service-provider, contractors and the consultant.

Responsible person: it is beneficial to instruct the contractor to obtain responsible person status for several of its employees, by having the appropriate person's complete module 1,2,3,4 and 7 of the occupational health and safety Act high voltage regulations this permit an authorize person from the service provider to hand over equipment for safe maintenance to the contractor, thereby

partially alleviating the problem of provision of access to the works site. An additional advantage is that this process force rigid adherence to a permit-based system regarding access to work i.e. solid legal record-keeping. Works procedures: there is often temptation to instruct a contractor to follow the entrenched works procedures of the service-provider. This should be avoid where it is clear that the contractor is a (an OEM , and/ or b) clearly competent and experienced, with a good track record (it is suggested that this should almost always be the case, yet consultant and service-provider must be aware that the skill shortage is not limited to the service-provider).

Clerk of work: the use a clerk of work, independent and impartial, affiliated to the consultant through a contractor of independent contractor is invaluable in controlling scheding, auditing of required works, the quality of the work and evaluation and certification of payment claims the contractor.

Short term contacts: maintenance contract is less than two years in duration and are not feasible as time to set up the work and obtain all relevant approval and access to site can be of the order of six to mine months (in worst-case scenarios).

The discussion on risk and realities emphasize the immediate need for maintenance, the lack of in-house personnel with relevant skill and experience to perform it, and several other risks associated with such maintenance. A clear need for appropriate maintenance (and to a lesser extent, reactive and emergency maintenance) is significant. It is recommended that the appointment of contractor and consultants should be carefully considered, in order to ensure that:

1. Adequate training and re-training for the maintenance and operators personnel.
2. Report any defective tools, equipments machines to supervisor

3. Proper procurement processes are followed through all contracts administered and executed at all times (this include the appointment of all parties and actual works)
4. Consultant do not in essences become employees of service-provider but remain as agent relatively unfettered in the exercise of their right and duties i.e. remaining impartial in the efficient management.
5. Contractors are not subsumed into the service- provider and as a consequence attract the accompanying addition official routine (of the service-provider)
6. Consultant and contractors have a clearly defined resource to assist the consultant in project management i.e. coordination between departments and personnel with the service-provider
7. Consultant statistic of electrical power consumed.
8. The service-provider allocates appropriate resources to permit the contractor to exercise its brief effectively and economically.

CHAPTER THREE

METHODOLOGY

This chapter describes the procedure use in this study; they include research design of the study, population, sample, instrument for data collection, validation for the instruction, administration for the instrument, method of data analysis, and description rules respectively.

Research design:

In caring out this study, the survey design was used. The survey design is considered for this design because of the type of information needed for this investigation. In support of this (Nwodin, 1991) started that a research design is a plan which specifies how data relating to a giving problem should be collected and analyzed. This study seeks the opinion of operators and maintenance personnel in power distribution network in aja in Lagos state.

Area of study:

This study was carried out in substation in Aja distribution Lagos state. It carries two areas in the distribution section:

1. The operator section.
2. The maintenance section.

Population:

The target population was of this study was 60 people. The study includes the operator and the maintenance personnel.

Sample and sampling techniques

Random sampling was adopted for the study. 35 maintenance staff and 25 operator staff were randomly selected.

s/No.	Name of personnel	Number
1	Operator	25
2	Maintenance	35
	Total	60

Table 1 distribution of the respondents (operator and maintenance personnel)

Instrument for data collection

The instrument was a structured question developed by the research for this study. The questionnaire was divided into five sections.

Section A contain personnel data

Section B contains (16) items which deals with the state of electricity in Lagos state.

Section C contains 14 items which deals with the condition of facility use in the distribution network in Lagos state.

Section D contains 16 items which deals with the factors hindering the performance of power distribution network in Lagos state.

Section E contains 17 items which deals with the strategies for standardizing the power distribution in Lagos state.

Validation of instrument

The instrument for this research wad design by researcher and was validated by lecturers from the department of Industrial and Technology Education to determine it face and content validity. The information by the validators determines the final instrument that was used for the study.

Administration of instrument

The researcher administered the questionnaire to the respondent personality and with the help of research assistance from each section. The administered questionnaire was collected back immediately.

Method of data analysis

To analyze the collected data, frequency count, mean, standard deviation and t-test statistic were used. Mean was used to answer the research questions while the standard deviation and T-test were used to testify the null hypothesis formulation at 0.5 level of significant in order to determine if there is any significant different between operators and maintenance with regard to the research questions relevant for used are in appendix.

Decision rule

To determine the acceptance level, a mean score of 2.50 is computed in line with four point rating scale. Any item that attract up to 2.50 and above was considered agreed and any item below 2.49 was disagreed. The acceptance level for the hypothesis testing is base on the degree of freedom ($df = n^1 + n^2 - 2$) of 58 degree which give a t-table value at

0.5 level of confidence of = 1.98. Therefore any item with t- calculation value less than 1.98 was accepted while those equal or greater than 1.98 were rejected.

CHAPTER FOUR

PRESENTATION AND ANALYSIS OF DATA

This chapter deals with the presentation and analysis of data with respect to the research question and hypotheses formulated for this study, the result of data analysis for the research questions were presented first, followed by those of the hypotheses tested for the study.

Research question 1

What is the state of electricity distribution in Lagos state?

Table 2

Mean responses of operators and maintenance staff with regard to the current state of electricity distribution in Lagos state.

$N_1 = 35, N_2 = 25$

S/N	ITEMS	X_1	X_2	X_t	REMARK
1.	There is normal supply of electricity	2.38	2	2.19	Disagreed
2.	Electricity distribution are in good condition	2	1.56	1.78	Disagreed
3.	There is always full voltage supply in Lagos state.	2.23	1.72	1.98	Disagreed
4.	There is power supply on all part of Lagos state	2.32	1.64	1.98	Disagreed
5.	There are enough transformers for power distribution	2.15	1.92	2.04	Disagreed
6.	Adequate security of facilities in industries	2.29	1.96	2.13	Disagreed

Continuation from table 2

7.	There is proper maintenance of workshop equipments by instructor	2.09	1.8	1.95	Disagreed
8.	There is adequate distribution of electricity	2.09	1.8	1.95	Disagreed
9.	Routine maintenance is usually observed	2.06	1.4	1.73	Disagreed
10.	Electricity in Lagos is very reliable	2.09	1.96	2.03	Disagreed
11.	Costumers enjoy electricity supply in Lagos state	2.03	1.92	1.98	Disagreed
12.	broken down equipment are made available Unattained to for a long time.	2.38	2.563	2.47	Disagreed
13.	there is constant power failure in Lagos state	2.63	3.52	3.08	Agreed
14.	power is been restored back in shortage period Of time.	2.32	2.4	2.36	Disagreed
15.	safety equipment are made available in the industry	2.15	1.96	2.06	Disagreed
16.	Electricity supply is within 220 – 240V range.	2.18	2	2.09	Disagreed

key

N_1 = Number of maintenance $\overline{X_1}$ = mean of maintenances

N_2 = number of operators $\overline{X_2}$ = mean of operators

X_t = average mean operators and maintenance staff

The data presented in table 1 show that the respondents disagreed with the all items with mean scores ranging between 1.73 – 3.08. Except item 13 mean score of 3.08 was agreed.

Research Question 2

What are the conditions of facilities used in power distribution Network on Lagos?

Table 3

Mean responses of operators and maintenance staff with regard to the condition of facilities used in power distribution network in Lagos state.

$N_1 = 35, N_2 = 25$

S/N	ITEMS	X_1	X_2	X_t	REMARK
17.	The electricity poles are in good condition	2.23	2.08	2.2	Disagreed
18.	Maintenance of facility are regularly done for efficiency and durability	2.09	1.88	1.99	Disagreed
19.	Most of the facilities used are usually improvised	2.32	2.4	2.36	Disagreed
20.	Facilities used by the distribution section are obsolete	1.8	2.04	1.92	Disagreed
21.	Facilities and equipment are adequately secured from vandalization	2.06	2.28	2.17	Disagreed
22.	Aluminum wire are in tension	1.83	2.0	1.92	Disagreed

Continuation from table 3

23.	Concrete poles are used for high tension pole (HT)	2.38	2.4	2.59	Agreed
24.	Concrete pole are used for low tension pole (LT)	2.75	2.28	2.515	Agreed
25.	The underground cable in good condition	2.09	1.8	1.945	Disagreed
26.	Transformers maintenance are carried out regularly	0.00	1.72	0.86	Disagreed
27.	The poles are planted very well	2.69	2.92	2.805	Agreed
28.	Safety device are in place	2.00	2.16	2.65	Agreed
29.	Energy meters are constantly read	1.89	1.84	1.865	Disagreed
30.	Wire on the poles well tighten	1.86	1.92	1.89	Disagreed

Key

N_1 = Number of maintenance $\overline{X_1}$ = mean of maintenances

N_2 = number of operators $\overline{X_2}$ = mean of operators

X_t = average mean operators and maintenance staff

The data presented in table 3 shows that the respondents agreed with item 23, 24, 27, and 28 with mean score ranging between 2.515 – 2.805, and disagreed with items 17,18,19,20,21,22,25,26,29 and 30 with mean score ranging between 0.86 – 2.43 respectively.

Research question 3

What are the factors hindering the performance of power distribution network in Lagos state?

Table 4

Mean responses of operators and maintenance staff with regard to the factors hindering the performance of power distribution network in Lagos state.

$N_1 = 35, N_2 = 25$

S/N	ITEMS	X_1	X_2	X_t	REMARK
31.	Staffs are not motivated	2.83	3.8	3.315	Agreed
32.	Inadequate information and communication Technology	3.00	3.68	3.34	Agreed
33.	Good relationship between maintenance staffs and operator staffs	2.75	3.4	3.075	Agreed
34.	Staffs are not well remunerated	2.78	3.28	3.03	Agreed
35.	Distribution section is not well equipped	2.89	2.96	2.925	Agreed
36.	Low education background of maintenance Staff	3.12	2.84	2.98	Agreed
37.	Unavailable spare parts	3.18	3.08	3.13	Agreed
38.	Indiscipline and ignorance on the part of users	3.15	3.4	3.275	Agreed
39.	Maintenance work is left for technicians	2.58	2.76	2.67	Agreed

Continuation from table 4

40.	Poor training and re-training of staffs	2.86	3.16	3.01	Agreed
41.	Shortage of skilled and power	2.78	3.12	2.95	Agreed
42.	Inadequate supervision of maintenance Programmed	3.06	3.28	3.17	Agreed
43.	Co-ordinal relationship between PHCN staffs and Consumers	2.8	2.44	2.62	Agreed
44.	Lack of information of electrical equipment gadgets	3.06	3.28	3.17	Agreed
45.	Improper inventory of tools and equipment	2.98	3.28	3.13	Agreed
46.	Maintenance staffs are not involved in purchasing spare parts.	3.00	3.48	3.24	Agreed

Key

N_1 = Number of maintenance $\overline{X_1}$ = mean of maintenances

N_2 = number of operators $\overline{X_2}$ = mean of operators

X_t = average mean operators and maintenance staff

The data presented in the table 4 shows that the items with mean scores ranging between 2.62 – 3.34. The respondents agree with all the factors hindering the performance of power distribution network.

Research question 4

What are the strategies for standardizing the power distribution network in Lagos state?

Table 5

Mean responses of operators and maintenance staff with regard to strategies for standardizing the power distribution network in Lagos state.

$N_1 = 35, N_2 = 25$

S/N	ITEMS	X_1	X_2	X_t	REMARK
47.	Maintenance operators personnel should be motivated	3.58	3.64	3.61	Agreed
48.	Adequate training re-training for the maintenance and operators personnel	3.49	3.36	3.425	Agreed
49.	Spare parts should be available in distribution section	3.49	3.36	3.425	Agreed
50.	There should be adequate supervision of operators and Maintenances programs.	3.4	3.52	3.46	Agreed
51.	Adequate information and communication technology	3.32	3.4	3.36	Agreed
52.	Provide adequate founds for the establishment of effective Electrical industries program	3.4	3.6	3.5	Agreed
53.	Distribution section should be fully equipped	3.46	3.32	3.39	
54.	Provision of efficient fire fighting equipment	3.32	3.56	3.44	Agreed
55.	Experience workers should be put in-charge of new ones	3.46	3.48	3.47	Agreed
56.	Repot any defective tools, equipments and machines to Supervisor	3.2	3.28	3.24	Agreed

Continuation from table 5

57.	Warning signals should be promptly attended to	3.23	3.36	3.24	Agreed
58.	Safety device should be removed with permit	3.00	3.36	3.295	Agreed
59.	Safety poster should be properly put in place	3.4	3.24	3.32	Agreed
60.	Fire extinguishers should be routinely serviced	3.46	3.16	3.31	Agreed
61.	Constant maintenance of transformers and equipment	3.52	3.44	3.48	Agreed
62	Constant statistic of electrical power consumed	3.49	3.52	3.505	Agreed
63.	Energy meter should be placed in each household	3.52	3.48	3.5	Agreed

Key

N_1 = Number of maintenance $\overline{X_1}$ = mean of maintenances

N_2 = number of operators $\overline{X_2}$ = mean of operators

X_t = average mean operators and maintenance staff

Table 5 revealed that all items were agreed with a mean score ranging between 3.06 – 3.61. this means that respondents believe that all the suggested ways could be adopted to standardizing network in Lagos state?

Hypothesis 1

There is no significance difference between the mean responses of operators and maintenance staff with regards to the current state of electricity distribution in Lagos

Table 6

t – test analysis of the respondent regarding the current of electricity distribution in Lagos state.

S/N	ITEMS	SD_1	SD_2	t	REMARK
1.	There is normal supply of electricity	0.68	0.7	2.1	S
2.	Electricity distribution are in good condition	0.76	0.5	2.71	S
3.	There is always full voltage in Lagos state	0.8	0.73	2.57	S
4.	There is power supply in all part of Lagos	0.95	0.48	3.64	S
5.	There is enough transformer for power distribution	0.69	0.85	1.12	NS
6.	Adequate security of facilities in industry	0.7	0.67	1.85	NS
7.	There is proper maintenance of workshop equipment by inspector	0.74	0.4	1.96	NS
8.	There is adequate distribution of electricity	0.74	0.7	1.55	NS
9.	Routine maintenance is usually observed	0.68	0.49	4.37	S
10.	Electricity in Lagos is very reliable	0.65	0.72	0.72	NS
11.	Customer enjoy electricity in Lagos state	0.78	0.69	0.58	NS
12.	Broken down equipments are made available Unattained to for a long time.	0.73	0.95	0.8	NS
13.	There is constant power failure in Lagos state	0.9	0.64	4.48	S
14.	Power is been restored back shortage period of time	0.75	0.8	0.4	NS
15.	Safety equipment are made available in the industry	0.77	0.45	1.21	NS
16.	Electricity supply is within 220-204v range	0.74	0.57	1.07	NS

Key

$\overline{X_1}$ = mean of maintenances SD_1 = standard deviation of maintenance

$\overline{X_2}$ = mean of operators SD_2 = standard deviation of operator

T = t-test calculated, NS = Not significant, S = significant.

Table 6 reveals that items 1,2,3,4,9,13 were rejected indicating that there is a greater than t-critical value of +/- 1.98 at .05 level of significance. While items 5,6,7,8,10,11,12,13,14,15 and 16 were accepted indicating that there is no significant deference between the respondents hence null stated is accepted.

Hypothesis II

There is no significant difference between the mean responses of operators and maintenance staff with regard to condition of facilities used in power distribution network in Lagos state.

Table 7

T – test analysis of the respondent regarding tot the condition of facilities used in power distribution network in Lagos state.

S/N	ITEMS	SD_1	SD_2	t	REMARK
17.	The electricity pole are in good condition	1.19	0.98	0.86	NS
18.	Maintenance of facility are regularly done for efficiency and durability	0.81	0.52	1.23	NS
19.	Most of the facilities used are usually improvised	0.75	0.8	0.4	NS

Continuation from table 7

20. Facilities used by the distribution section are obsolete	0.89	0.88	1.04	NS
21. Facilities and equipment are adequately secured from vandalization	0.68	1.22	0.82	NS
22. Aluminum wire are in tension	1.03	0.9	0.68	NS
23. Concrete poles are used for high tension pole (HT)	0.84	0.8	0.1	NS
24. Concrete pole are used for low tension pole (LT)	0.94	0.45	2.58	S
25. The underground cable in good condition	1.00	1.02	1.1	NS
26. Transformers maintenance are carried out regularly	2.28	0.45	-4.35	NS
27. The poles are planted very well	0.71	0.8	-1.15	NS
28. Safety device are in place	0.93	1.03	-1.62	NS
29. Energy meters are constantly read	1.12	0.84	0.2	NS
30. Wire on the poles well tighten	1.13	0.85	-0.24	NS

Key

$\overline{X_1}$ = mean of maintenances SD_1 = standard deviation of maintenance

$\overline{X_2}$ = mean of operators SD_2 = standard deviation of operator

T = t-test calculated, NS = Not significant, S = significant.

Table 7 reveals that item 27 were rejected indicating that there is a significant difference between the option of operators and maintenance staff. The t-calculated are greater than a-critical value of ±1.98 at .05 level of significance. While the tests were accepted indicating that there is no significant difference between the respondent hence null hypothesis stated is accepted.

Hypothesis III

There is no significant difference between the mean responses of operators and maintenance staff with regard to strategies for standardizing the power distribution network in Lagos state.

Table 8

t- Test analysis of the respondent regarding to the strategies for standardizing the power distribution network in Lagos state.

S/N	ITEMS	SD_1	SD_2	t	REMARK
31.	Maintenance and operators personnel should be motivated	0.73	0.48	-0.39	NS
32.	Adequate training re-training for the maintenance and operators personnel	0.85	0.48	0.76	NS
33.	Spare parts should be available in distribution section	0.61	0.56	0.86	NS
34.	There should be adequate supervision of operators and maintenances programs	0.49	0.5	-0.93	NS
35.	Adequate information and communication technology	0.86	0.57	-0.44	NS
36.	Provide adequate founds for the establishment of effective electrical industries program	0.49	0.49	-0.56	NS
37.	Distribution section should be fully equipped	0.65	0.62	0.85	NS
38.	Provision of efficient fire fighting equipment	0.75	0.5	-1.49	NS
39.	Experience workers should be put in-charge of new ones	0.74	0.5	-0.13	NS
40.	Repot any defective tools, equipments and machines to				

Supervisor	0.89	0.61	-0.42	NS
41. Warning signals should be promptly attended to	0.93	0.48	-0.71	NS
42. Safety device should be removed with permit	0.99	0.72	-0.55	NS
43. Safety poster should be properly put in place	0.69	0.59	0.97	NS
44. Fire extinguishers should be routinely serviced	0.61	0.47	2.16	NS
45. Constant maintenance of transformers and other Equipment	0.61	0.5	0.56	NS
46. Constant statistic of electrical power consumed	0.65	0.5	-.021	NS
47. Energy meter should be placed in each household	0.7	0.5	0.26	NS

Key

$\overline{X_1}$ = mean of maintenances SD_1 = standard deviation of maintenance

$\overline{X_2}$ = mean of operators SD_2 = standard deviation of operator

T = t-test calculated, NS = Not significant, S = significant.

Table 8 reveals that item 44 were rejected indicating that there is a significant difference between the option of operators and maintenance staff. The t-calculated are greater than a-critical value of ±1.98 at .05level of significance. While the tests were accepted indicating that there is no significant difference between the respondent hence null hypotheses stated is accepted.

Major Findings

The following are the principle finding of this study: they are highlighted base on the research questions

1. There is no proper maintenance of workshop equipment by instructors.

2. There is no enough transformers for power distribution
3. Broken-down equipments are not made available unattained for a long time.
4. Safety equipments are not made available in the industry
5. Customer didn't enjoy the electricity supply in Lagos state.
6. Electricity distribution are not in good condition

B. the condition of facilities used in power distribution in Lagos state are as follows

1. Most of the facilities used are usually improvised
2. Aluminum wires are not in tension
3. Facilities used by the distribution section are not obsolete
4. Transformer maintenance are not carried out regularly
5. Energy meters are not constantly read
6. The underground cables are not in good condition.
7. Facilities and equipment are not adequately secured from vandalization.

C. The factors hindering he performance of power distribution in Nigeria is as follow:

1. Staffs are not motivated
2. Lack of information of electrical equipment gadgets
3. Distribution section is not well equipped
4. Poor training and re-training of staff
5. Maintenance staffs are not involve in purchasing spear parts
6. Unavailable of spear parts.

D. the strategies for standardizing the power distribution in Lagos state are as follows:

1. Maintenance and operators personnel should be motivated.
2. Adequate training and re-training for the maintenance and operators personnel
3. Provide adequate fund for the establishment of effective electrical industries programmes.
4. Distribution section should be fully equipped

5. Provision of efficiency fighting equipment
6. Safety poster should be properly put in place
7. Experience workers should be put in-charge of new ones
8. Adequate information and communication technology

Discussion of findings

This is organizing base on the research question for the study.

Base on the data collected on the research question (1) revealed that, the current state of electricity can be improved. The result of the study identified that, there is no proper maintenance of workshop equipment by instructors; transformers are not enough for power distribution; broken down equipments are not made available unattained for a long time; safety equipment are not the available in the industry; electricity distribution are not in good condition; customer didn't enjoy the electricity supply in Lagos state and safety precaution must be observed in the injection substation for increase in efficiency and activity to be carried out in the substation. According to Odusanya, and Bodude. (2002), that safety is the state of been safe from danger of accident, serious physical harm or some other form of injury. It is the state in which every one in the substation would want to maintain at any time hence certain rules and precautions in the PHCN must be applied. Finally the study reveals that preference is always given to adequate securities of facilities in substation, regular inspection of facilities should be carried out regularly. According to Odusanya and Bodude (2002), state that adequate securities must be provided for the substation and regular inspection must be done; broken down equipments must be made available unattained for a long period of time; safety equipment most

made available in the industry and by doing all this things the power distributions will be improved and customer will enjoy the electricity supply in Lagos state.

The analysis in the research question 2 reveals that tools and equipments are not adequately secured from vandalization; most of the facilities used are not improvised and transformer maintenance is not carried out regularly. And this study makes us understand that most of the facilities used for the distribution sections are not in tension. Usman (1991) he express that tools facility and equipment are expensive. Therefore security arrangement should be made available for them. The analysis of the result used in table 2 also shows that most of the facilities used by the staff are usually not improvised. The result further reveals that facilities used by PHCN are not obsolete; the transformers maintenance is not carried out regularly. Therefore, it cause problem for effective work to be done in the substation. And finally, the result shows that maintenance of the facilities is not regularly done for effective and durability.

The analysis in table (3) reveals that inadequate information and communication technology, staffs are not motivated and distribution section is not well equipped. And this study make us understand that there is inadequate information and communication technology; maintenance staffs are not involve in purchasing spare parts, staff are not motivated and unavailable of spare parts. This is according to Okoro, (1993) and Nnaji, (1995) contributed to the cause and problem of power distribution as poor tanning and re-training of staff and shortage of skill and power.

The analysis of the result also reveals that there is lack of information of electrical equipment gadgets. In addition the finding reveals that maintenance staff is not involve in the

purchasing spear parts. All these mention above can hinder the performance of power distribution network.

Findings in table (4) reveals that there should be adequate supervision of operators and maintenance programmers, the table revealed that constant maintenance of transformer and other equipment should be carried out regularly; maintenance and operator personnel should be motivated; adequate training and re-training for the maintenance and operators personnel; and this study make us to understand that adequate funds for the establishment of effective electrical industries programmes should be organized for the instructors; distribution sections should be fully equipped; provision of efficient fire fighting equipment; safety posters should be properly put in places; experience workers should be put in-charge of new ones and adequate information and communication technology. According to the national policy on reliability analysis of power distribution network there goals are:

- To provide constant statistic of electricity to the society
- To give training and impart necessary skill to the workers in the industries.
- To provide adequate funds for establishment of effective electrical programmes

Bodude (2008) said that the power distribution network should be well organized to meet the standard of the society. And he also said that experience workers should be put in charge of new ones and substation should properly organized and equipment well arranged and also safety should be embedded in any work to be carried out.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Summary of the study

The main purpose of this is to determine status of electrical power distribution network, the current state of electricity distribution, condition of facilities used in power distribution network and factors hindering the effective performance of power distribution network in Lagos state.

Related literatures were reviewed in the study under the following sub-heading: the principle of the power system reliability in Nigeria, maintenance o f electrical facility in power distribution network, need for power system reliability, factors hindering the performance of power distribution network, reliability data on power distribution network and strategies for standardizing power distribution network system.

Appropriate statistical tool such as mean, standard deviation were used to analyze the data using twenty five (25) operator standards and thirty five (35) maintenance in the substation with a total of sixty (60) respondents.

Questionnaire was used as instrument for data collection and was analyzed according to each research questions, a descriptive survey research was the research design adopted. Four research question were formulated and tested at .05 level of significance.

Base on the finding of this study as highlighted it was observed that substation should be properly organized for adequate used of power facility. The substation should be accorded the same statues as obtained in power distribution unit and their curriculum should be organized to

meet the standard of electricity distribution , among other , recommendation, implications, conclusion and suggestion for further research where fully discussed in chapter V

Implication of the study

The finding of this study shows that the current stature of power distribution is that, there is no proper maintenance of the workshop equipment by management which will affect the efficiency of work to be done. This implies that there are needs for proper maintenance of equipment for work to be done effectively.

The findings of this study also showed the conditions of facility used in power distribution network are obsolete. This has serious problem on the power distribution network and unless the potential instructors are trained and well-equipped, the effects of their poor performance will be lack of good supply of electricity.

Another area of finding of this study shows factors hiding the performance of power distribution network. It emphasized that adequate experience and staffs are not motivated. Also, the study further revealed that poor training and retraining of staff and maintenance staff are not involve in purchasing spare parts. The study also stated that inadequate information and communication technology. The implication of this is that it will hinder that power distribution network.

The findings revealed on strategies for standardizing the power distribution network shows that injection sub-station should be standardized. The study further revealed that the curriculum of power distribution should be well organized to meet up the standard. The implication of this is that power distribution needs to be updated to meet today's complexity of technological advancement.

Conclusions

The finding of this study are clear and concise answer to various research questions and hypotheses stated to determine reliability analysis of power distribution network of power holding company in Lagos state district so as to ascertain the development of power distribution network. It can be conclude that the ways and manner of electricity is been supply needed to standardized. It is also evident from the finding that several factors hinder the performance of power distribution. Also several strategies for standardizing the power distribution network in Lagos state could be adopted.

Recommendations

Base on the finding of this study, the following recommendations are made:

1. Equipment and instructional facilities used in power distribution should be adequately maintained by the management, in order to improve work standard and to prolong their life span.
2. Adequate training and re-training for maintenance and operators personnel should be organized.
3. Maintenance and operators personnel should be motivated.
4. Experience workers should be put in-charge of substation.
5. Provide adequate funds for the establishment of effective electrical industries seminar for the workers.
6. Spare parts should be available in distribution section.

Suggestion for further research

The following suggestion were made base on the study

1. Mechanism for improving the performance of power distribution network in Lagos state
2. Strategies for effective management of power distribution networks in Lagos state.

References

Allan R. billinton R. (2005), *"power system reliability and its assessment- part 3 distribution systems and economic considerations"* ISBN 0-471-69736-2

Alessandra M.; Enrico C; andrea P & Emiliano R (2001) *"comparison of reliability and availability evaluation techniquies for distribution network systems" ,* retrieved on 30/7/2009, from http://www.ee.iastate.edu/-jdm/ee453/comparison reliability. html annual international telecommunication energy conference (INTELEC) helg in September 29 – October 3, 2002 in montreal

billiton R. & Peng W (1999) *"training distribuiotn system rel;aiibiility evaluation using moute carlo simulation"* IEEE transactions on power systems, retrieved on 28/7/2009, from http://www.ee.iastate.edu/-jdm/ee653/distributionreliabilitypredictive.ppt.

billinton R & Peng W. (2000) *"a generalized method for distribution system reliability evaluation"* IEEE WESCANEX'95 processings

Bodude A. (2003), *" strategies for standardizing power distribution network system"* for power holding company of Nigeria plc, by Engr. Bodude first published in November 2003, tond publishers Ltd.

Brown E; Gupta S; Christie D; S Venkata S. & Fletcher R, (1996) *"distribution system reliability assessment using heirachical markvn modeling"* IEEE transaction on power delivery. Retreieved on 30/7/2009, from http://www.ee.aistate.edu/-jdm/ee753/distributionsystem.html

Brown R.E, Nguyem H.V & Burke J.J (1999) "*A systematic and cost effective method to improve distribuition system reliability"*. IEEE power Engineering society Summer Meeting

brown R.E, Nguyem H.V & Burke A. (2000), "*power distribution system reliability planning using a fuzzy knowledge – Based approach:"*, IEEE trans, on power delivery

Carvalho D. (2000 – 2001) "*electric power application on planning for the construction of generating plant was relative uncompleted"*. http://www.glatmos.com/industries.html.

Gerd K, & Kjell S, (2000), "RELRAD. *"An analytical approach for distribution system reliability assessment"* IEEE transaction on power delivery, retrieve on 28/7/2009, from http://www.ee.aistate.edu/-jdm/ee353/RELRAD. an analytical approach.html

Gonen T. & McGraw Hill (2000) "*Electric power disrtibuition system Engineering"* from Wikipedia, the free encyclopedia.

Kuntz, P.A. (1999) *"optimal reliability centered maintenance scheduling in electric power distribution system"* Ph D, Thesis of UOW

Lewis T. (2003) *"distribuiotn system reliability evaluation".* IEEE tutorial course – power system reability distribution evaluation ISSN 1436 – 4522.

Lyman T. & Smith K. (2005), *"component reliability assessment using quantitative and qualitative Data "* retrieved on 28/7/2009 from http://www.ee.aistate.edu/component relaibility assesment usiong quanlitative.

Lyman T.; Smith K. & benner G. (2006*) "comparison of alternative techniques for the reliability assessment of distribuiotn system"* third international conference on probabilistic method Applied to Electric power systems.

Swain B. & Guttman R (2003), *"zone branch reliability methodology for analyzing industrial power system",* IEEE Transactions on industry applications.

Tolbert L.M., Radmer D.T., Wang Z (2001) force on impact of maintenance strategy on the reliability, risk and the probability application subcommittee. *"The present status of maintenance strategy and the impact of maintenance on reliability"*. Retrieved on 28/7/2009 from http://www.ee.aistate.edu/-jdm/ee453/. The present strategy of maintenance and impact.

Ying and Lennert S. and Ron N. (2000) "*Evaluating the effect of protection system on reliability altimate distribution system"* Power system computation conference.

APPENDIX B

QUESTIONNAIRE

FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, NIGER STATE

SCHOOL OF SCIENCE AND SCIENCE EDUCATION

DEPARTMENT OF INDUSTRIAL AND

TECHNOLOGY EDUCATION

QUESTIONNAIRE FOR RELIABILITY ANALYSIS OF POWER DISTRIBUTION NETWORK OF POWER HOLDING COMPANY OF NIGERIA LAGOS STATE DISTRICT

PART 1

SECTION A

INTRODUCTION: please complete this questionnaire faithfully as possible and sincerely tick [ ] the column the best represents your perception about the topic. The questionnaire is just for research purpose and your view will be treated confidential.

Personal data

Name of industries……..

Maintenance personnel ☐

Operators' personnel ☐

INTRODUCTION: A (four) 4-point rating scale is used to indicate your opinion, tick the word which best describe your agreement as show below:

Strongly agree (SA)

Agree (A)

Disagree (D)

Strongly disagree (SD)

PART II

SECTION B

What is the current state of electricity in Lagos state?

S/N	ITEMS	S.D	A	D	S.D
1	There is normal supply of electricity				
2	Electricity distribution are in good condition				
3	There is always full voltage in Lagos state				
4	There is power supply in all part of Lagos				
5	There is enough transformer for power distribution				
6	Adequate security of facilities in industry				
7	Regular inspection of facilities				
8	There is adequate distribution of electricity				
9	Routine maintenance is usually observed				
10	Electricity in Lagos is very reliable				
11	Customer enjoy electricity in Lagos state				
12	Broken down equipments are made available unattained to for a long time				
13	There is constant power failure in Lagos state				
14	Power is been restored back shortage period of time				
15	Safety equipment are made available in the industry				
16	Electricity supply is within 220-204v range				

PART III

SECTION C

What are the conditions of facility use in power distribution in Lagos state?

S/N	ITEMS	S.A	A	D	A.D
1	The electricity pole are in good condition				
2	Maintenance of facility are regularly done for efficiency and durability				
3	Most of the facilities used are usually improvised				
4	Facilities used by the distribution section are obsolete				

5	Facilities and equipment are adequately secured from vandalization				
6	Aluminum wire are in tension				
7	Concrete poles are used for high tension pole (HT)				
8	Concrete pole are used for low tension pole (LT)				
9	The underground cable in good condition				
10	Transformers maintenance are carried out regularly				
11	The poles are planted very well				
12	Safety device are in place				
13	Energy meters are constantly read				
14	Wire on the poles well tighten				

PART IV

SECTION D

What are the factors hindering the performance of power distribution network in Lagos?

S/N	ITEMS	S.A	A	D	S.D
1	Staffs are not motivated				
2	Inadequate information and communication technology				
3	Good relationship between maintenance staffs and operator staffs				
4	Staffs are not well remunerated				
5	Distribution section is not well equipped				
6	Low education background of maintenance staff				
7	Unavailable spare parts				
8	Indiscipline and ignorance on the part of users				
9	Maintenance work is left for technicians				
10	Poor training and re-training of staffs				
11	Shortage of skilled and power				
12	Inadequate supervision of maintenance programmed				
13	Co-ordinal relationship between PHCN staffs and consumers				
14	Lack of information of electrical equipment gadgets				
15	Improper inventory of tools and equipment				
16	Maintenance staffs are not involved in purchasing spare parts				

PART V

SECTION F

What are the strategies for standardizing the power distribution network in Lagos state?

S/N	ITEMS	S.A	A	S.D	D
1	Maintenance and operators personnel should be motivated				
2	Adequate training re-training for the maintenance and operators personnel				
3	Spare parts should be available in distribution section				
4	There should be adequate supervision of operators and maintenances programs				
5	Adequate information and communication technology				
6	Provide adequate founds for the establishment of effective electrical industries program				
7	Distribution section should be fully equipped				
8	Provision of efficient fire fighting equipment				
9	Experience workers should be put in-charge of new ones				
10	Repot any defective tools, equipments and machines to supervisor				
11	Warning signals should be promptly attended to				
12	Safety device should be removed with permit				
13	Safety poster should be properly put in place				
14	Fire extinguishers should be routinely serviced				
15	Constant maintenance of transformers and equipment				
16	Constant statistic of electrical power consumed				
17	Energy meter should be placed in each household				

Appendix C

Formulae and calculation

Mean $\bar{X} = \frac{\sum fx}{\sum f}$

$\bar{X}$ = mean

$\sum$ = The sum

X = the score

F = the frequency by each point in the scale

Standard deviation

$$SD = \sqrt{\frac{\sum f(x - \bar{x})}{\sum f}}$$

$\bar{X}$ = mean

$\sum$ = the sum

X = the score

F = the frequency by each point in the scale

T –test formula

$$\frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{S^2{}_1}{N_1} + \frac{S_2{}^2}{N_2}}}$$

$\bar{X}_1$ = maen score of maintenance personnel

$\bar{X}_2$ = mean score of operator personnel

$S_2{}^1$ = variation of maintenance personnel

$S_2{}^2$ = variation of operator personnel

N_1 = number of maintenance personnel.

N_2 = number of operator personnel

Hypothesis 1

Item 1, standard deviation of maintenance personnel

X	F	Fx	$x-\bar{x}$	$(x-\bar{x})^2$	$F(x-\bar{x})^2$
4	2	8	1.63	2.6569	5.3138
3	11	33	0.63	0.3969	4.3659
2	20	40	-0.37	0.1369	2.738
1	2	2	-1.37	1.8769	3.7538
Total	35	83			16.1715

$$\bar{X} = \frac{\sum fx}{\sum f} \qquad S_1^{\,2} = \frac{\sum f(x-\bar{x})^2}{\sum f} \qquad SD_1 = \sqrt{\frac{\sum f(x-\bar{x})^2}{\sum f}}$$

$$\bar{X} = \frac{83}{35} \qquad S_2^{\,1} = \frac{16.1715}{35} \qquad SD_1 = \sqrt{\frac{16.1715}{35}}$$

$$\bar{X} = 2.37 \qquad S_2^{\,1} = 0.46 \qquad SD_1 = 0.68$$

Hypothesis 1

Item 1, standard deviation for operator personnel

X	F	Fx	x- $\bar{x}$	(x- $\bar{x}$)^2	F(x- $\bar{x}$)^2
4	1	4	1.5	2.25	2.25
3	3	9	0.5	2.25	0.75
2	16	32	-0.5	2.25	2.5
1	5	5	-1.5	2.25	11.25
Total	25	50			13.25

$$\bar{X} = \frac{\sum fx}{\sum f} \qquad S_2^{\,2} = \frac{\sum f(x-\bar{x})^2}{\sum f} \qquad SD_1 = \sqrt{\frac{\sum f(x-\bar{x})^2}{\sum f}}$$

$$\bar{X} = \frac{50}{25} \qquad S_2^{\,2} = \frac{13.25}{25} \qquad SD_2 = \sqrt{\frac{13.25}{25}}$$

$$\bar{X} = 2.5 \qquad S_2^{\,1} = 0.53 \qquad SD_1 = 0.72$$

T – calculated = $\dfrac{\bar{x}_1 - \bar{x}_2}{\sqrt{\dfrac{S^2{}_1}{N_1} + \dfrac{S_2{}^2}{N_2}}}$

$= \dfrac{2.38 - 2.00}{\sqrt{\dfrac{0.68}{35} + \dfrac{0.72}{25}}}$

$= \dfrac{0.483}{\sqrt{0.01948 + 0.0288}}$

$= \dfrac{0.483}{\sqrt{0.4828}}$

$= \dfrac{0.483}{0.23}$

$= 2.1$