HAZARDS OF RUNNING OVERHEAD ELECTRICAL CABLES IN MINNA, NIGER STATE

BY

MUSA, Rabiu Kalamu

2014/1/49684TI

DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION
FEDERAL UNIVERSITY OF TECHNOLOGY
MINNA, NIGER STATE

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A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, NIGER STATE, IN PARTIAL FULFILMENT OF THE REQUIREMENTS OF THE AWARD OF BACHELOR OF TECHNOLOGY (B. TECH) IN INDUSTRIAL AND TECHNOLOGYEDUCATION.

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DECLERATION

I MUSA, RabiuKalamu, matriculation number 2014/1/49684TI an undergraduate student of the department of the department of industrial and technology education certify that the work embodied in this project is original and has not been submitted in part or full for any other diploma or degree of this or any other university.

Musa RabiuKalamu ……………………

2014/1/49684TI Signature and date

APPROVAL PAGE

This project has been read and approved as meeting the requirement for the award of B.Tech degree in Industrial and Technology Education, School of Science and Technology Education, Federal University of Technology, Minna.

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DEDICATION

This project is dedicated to Almighty Allah for sustaining my life despite all odds, who has endowed me with his divine grace, guidance and protection. To my parent Mr. Musa KalamuWakili and Mrs. Karimatuwakili for their moral and financial support all through the academic activities.

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My most sincere gratitude goes to my parents Mr. Musa KalamuWakili and Mrs. Karimatu Musa for their prayers, encouragement, tolerance, motivation and support both morally and financially. My sincere gratitude also goes to my ever-supportive brothers Musa Hamza kalamu, Musa BashiruKalamu and my little sisters Musa SharifatuKalamu, Musa SaudatuKalamu, I love you all.

Finally, I am also grateful to my friends and colleagues for all their support during my course of study in federal university of Technology Minna Niger State. I love you all.

ABSTRACT

This study is designed on hazards of running overhead electrical cables in Minna metropolis, Niger state. Three research questions and three null hypotheses were formulated to guide the study. A descriptive survey method was used for the study with a population of 50 AEDC management staff and 150 consumers of electricity in Minna metropolis of Niger State, which gives a total of 200 respondents. Frequency count, mean score method, standard deviation and t-test statistics were used for the data analysis. A response of 2.50 was used as an acceptable value for the mean respondents while the hypotheses were tested at 0.05 level of significance. Some of the findings were; damaged cables and equipment are hazardous, using wrong tool for a particular work, some on site chemicals are harmful, defective ladders and scaffolds are dangerous and electrical hazards can be made worse if the worker, location, or equipment is wet. It was recommended among others that; AEDC staffs should ensure that electrical cables are properly grounded before maintenance work is being carried out. Public awareness should be created by the government in collaboration with AEDC on the dangers associated with overhead electrical cables.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Study

The historical development of electricity supply in Nigeria can be traced back to the end of the 19th century when the first-generation power plant was installed in the city of Lagos state of Nigeria in 1898, after it was introduced in England (Niger power review 1985). The standard capacity of electricity in use at that particular time was 6kw because the power demand maximally at that time was less than 60kw. In 1946, the pattern of electricity development was in the form of individual electricity power undertaking scattered all over the towns. Some of the few undertaking for electricity supply was Federal Government bodies under the Public Works Department (PWD) to be in charge of the electricity supply in Lagos state. By 1950, in order to integrate electricity supply and make it effective, the Colonial Government passed the ECN ordinance no.15 of 1950. With this ordinance in place, the electricity department and all those undertakings which were controlled come under one body. A central body was established in 1950 by the Nigeria Government which transferred electricity supply and development to the care of Electricity Corporation of Nigeria (ECN). The ECN and the Niger Dam Authority (NDA) were merged to become the National Electric Power Authority (NEPA) with the effect from the 1st of April 1972.

During past three decade, researchers have had special concern on relationship between occurrence of hazard, living near overhead high voltage transmission power lines (Sher, 2010). Among different kind of hazards, all peoples in that kind of environment has been paid sensitive attention to avoid hazards (*Li et al*., 2016; Verkasalo, 2014). Many studies designed to assess this relationship in Sweden, Denmark, USA, UK, New Zealand, Canada, and others. There was controversy and these studies didn't lead to a common finding. Some of them confirmed living near overhead high-voltage transmission power lines as a risk factor which increases the chance of ALL occurrences almost two folds (Draper *et al*., 2015) and the others didn't support it (Tynes and Haldorsen, 2013; 2000). Even a meta-analysis yielded a pooled relative risk estimate of 1.46 (95% CI 1.05 to 2.04) which is indicating potentially low level of risk (Angelillo and Villari, 2011).

In Nigeria, Minna the Capital of Niger state, a mixture of overhead high-voltage transmission power lines of 123kv, 230kv and 400kv pass through some neighborhoods in different parts of the city. Researchers found that almost five hundred thousand people, 20 percent of total population of capital city, are living near these lines and exposed to extremely low frequency electric and magnetic fields. On the other hand, annual mortality rate of leukemia in Iran estimated 6.1 per 100000 for male and 5.2 per 100000 for female (Mousavi*et al*., 2009) which is near two-fold of all incidences in Sweden (Hjalmars and Gustafsson, 2015). Electrical risks are risks of death, electric shock or other injury caused directly or indirectly by electricity. Contact with energized overhead or underground electric lines can be fatal, whether they are carrying a voltage as high as 400,000 volts or as low as 230 volts.

Contact with overhead electric lines is not necessary to result in electric shock. A close approach to the line conductors may allow a ‘flashover’ or arc to take place. The risk of flashover increases as the line voltage increases. A person conducting a business or undertaking has the primary duty to ensure, so far as is reasonably practicable, workers and other people are not exposed to health and safety risks arising from the business or undertaking (Almond, 2011).

This duty requires the person to manage risks by eliminating health and safety risks so far as is reasonably practicable, and if it is not reasonably practicable to eliminate the risks, by minimizing those risks so far as is reasonably practicable.

A person conducting a business or undertaking has more specific duties under the WHS Regulations to manage electrical risks, including ensuring, so far as is reasonably practicable, that no person, plant or thing at the workplace comes within an unsafe distance of an overhead or underground electric line. This study is aimed to investigate into the hazard of running overhead electrical cables in Minna, Niger state.

1.2 Statement of the Problem

Every year, scores of workers lose their lives because of electrocutions caused by overhead power lines. Thousands more sustain injuries from related burns that cause unimaginable pain. Electricity can actually cook your body’s tissue from the inside out. The scars from such injuries won’t go away, but with careful planning and prevention, many future tragedies can. As soon as an electrical contact occurs, a worker’s life and the lives of family and friends change forever (Akintola, 2012). Depending on the

severity of injury, the worker must often go through a long recovery that may include surgeries, physical and occupational therapy and counseling. This doesn't begin to address the psychological, social and financial burdens placed on the worker's family. Regular power supply is the prime mover of technological and social development (Amie, 2011). There is hardly any enterprise or indeed any aspect of human development that does not require energy in one form or the other. The problems confronting the AEDC in Minna Metropolis are enormous, for instance Ajanaku (2010) stated that, the problem faced by AEDC system were shortage of trained supportive staff, trained administrative staff, and lack of supply of enough equipment.
Considering the fact that hydro power plants situated in Niger state generates over 1900MW of electricity, Minna the capital city of Niger state, is supposed to enjoy effective distribution of electricity supply in its metropolis and environs. But this expectation seems fetched.

The Indian Institute of Planning and Management (2006) state that there should be a continuous procedure for overhead electrical cables power supply in order to increase the development of the region thereby providing opportunities for security consciousness, provision of better health services and infrastructural facilities such as hospitals equipment, and computer education. This will serve as a benefit for the interest of the electricity board not to the customers alone because as the customers pay their dues which will be in turn to generate more funds to be used to maintain and upgrade the equipment used in supplying and distribute the electricity.

1.3 Purpose of the Study

The purpose of this study is to investigate the hazard of running overhead electrical cables in Minna, Niger state. Specifically, the study sought to determine:

1. The causes in running overhead cables in Minna, Niger state.
2. Level of awareness of hazards on running overhead electrical cables in Minna, Niger state.
3. Identify strategies for minimizing hazards of running overhead electrical cables in Minna, Niger state.

1.4 Significance of the Study

The study will be of great benefit to the State Government, AEDC Staffs, Society and Consumers

State Government: The finding of the study is of enormous benefit has the primary duty to ensure, so far as is reasonably practicable, workers and other people are not exposed to health and safety risks arising from the business or undertaking. This duty requires the individuals to manage risks by eliminating health and safety risks so far as is reasonably practicable, and if it is not reasonably practicable to eliminate the risks, by minimizing those risks so far as is reasonably practicable. The state government to manage electrical risks, including ensuring, so far as is reasonably practicable, that no person, plant or thing at the workplace comes within an unsafe distance of an overhead or underground electric line.

Consumers: The findings will be of great benefit to the consumers to take reasonable care for their own health and safety and to not adversely affect other people's health and safety. Consumers must co-operate with reasonable policies or procedures relating to health and safety at the workplace and comply, so far as they are reasonablyable, with reasonable instructions.

AEDC Staffs: It is hoped that the findings of this study will help the AEDCstaff and management, plant or structures that could be used for work must ensure, so far as is reasonably practicable, so that the plant or structure is without risks to health and safety. AEDC staffs must ensure that electrical equipment or installations must ensure they are designed and manufactured so that electrical risks are eliminated or, if this not reasonably practicable, minimized so far as is reasonably practicable.

Society: the findings will help the society to take reasonable care of their own health and safety and must take reasonable care not to adversely affect other people's health and safety. Theymust comply, so far as they are reasonably able, with reasonable instructions given by the AEDC staffs.

1.5 Scope of the Study

This study is to investigate into the hazard of running overhead electrical cables in Minna, Niger state. Specifically, the study is limited to overhead electrical cables in Minna, Niger state.

1.6 Research Questions

The following research questions are developed to elicit in from action that will proffer solutions to the research problem.

1. What are the causes of hazards in running overhead electrical cables in Minna, Niger state?
2. What is the level of awareness of hazard on running overhead electrical cables in Minna, Niger state?
3. What are the strategies to minimize hazards of running overhead electrical cables in Minna, Niger state?

1.7 Hypotheses

The following null hypotheses were formulated to guide the study and were tested at 0.05 level of significance.

Ho_1: There is no significant difference between the mean responses of AEDC staff and consumers on the level of awareness of hazard on running overhead electrical cables in Minna, Niger state.

Ho_2: There is no significant difference between the mean responses of AEDC staff and consumers on the causes of hazards of running overhead electrical cables in Minna, Niger state

Ho_3: There is no significant difference between the mean responses of AEDC staff and consumers on the strategies to minimize hazards of running overhead electrical cables in Minna,

CHAPTER TWO

2.0 LITERATURE REVIEW

The study was reviewed under the following sub-headings:

- Historical Background of Electricity Development in Nigeria
- Generation, Transmission and Distribution of Electricity Supply in Nigeria.
- Awareness of hazard on running overhead electrical cables
- Causes of hazards of running overhead electrical cables
- Effective ways to minimize hazards of running overhead electrical cables
- Related Empirical Studies
- Summary of Literature Reviewed

2.1 Historical Background of Electricity Development in Nigeria

The historical development of electricity supply in Nigeria can be traced back to the end of the 19^{th} century when the first-generation power plant was installed in the city of Lagos state of Nigeria in 1898, after it was introduced in England (Niger power review 1985). The standard capacity of electricity in use at that particular time was 6kw because the power demand maximally at that time was less than 60kw. In 1946, the pattern of electricity development was in the form of individual electricity power undertaking scattered all over the towns. Some of the few undertaking for electricity supply was Federal Government bodies under the Public Works Department (PWD) to be in charge of the electricity supply in Lagos state. By 1950, in order to integrate electricity supply and make it effective, the Colonial Government passed the ECN ordinance no.15 of 1950. With this ordinance in place, the electricity department and all those undertakings which were controlled come under one body. A central body was established in 1950 by the Nigeria Government which transferred electricity supply and development to the care of Electricity Corporation of Nigeria (ECN). The ECN and the Niger Dam Authority (NDA) were merged to become the National Electric Power Authority (NEPA) with the effect from the 1^{st} of April 1972. The actual merged did not take place until the 6^{th} of January 1973 when the first general manager was appointed. Despite the causes or problems faced by NEPA, the newly established authority (NDA) was responsible to construct and maintain Dam and other works on the River Niger to generate hydro-electricity, to improve navigation and give effective role in the nation's socio-economic development thereby steering Nigeria into a greater industrial society

(Manafa,1995). In addition, after Nigeria's independent in 1960, the Niger Dam Authority came into existence in Niger state located at kanji on River Niger in 1968 which became the first hydro-electric station for power generation in Nigeria. The arrangement then was that of the NDA which generated the electricity, and the ECN which distribute it to the consumers. By this, National Electric Power Authority (NEPA) by the decree no.24 in 1972 will be responsible for the generation and distribution of electricity supply at the same time in Nigeria because formerly, the ECN was mainly responsible for the distribution and sales of electric power to customers while NDA generated the electricity by building generating stations and running transmission lines.

The major factors for merging ECN and NDA together were:

1) Is to develop and maintain an efficient co-ordinate and economical system of electricity supply throughout the Federation.
2) The integration of ECN and NDA state that the monopoly of all commercial electric supply shall be enjoyed by NEPA to the exclusion of all other organizations in the country (Niger Power Review, 1998).

When NEPA began, the authority kept on expanding annually to meet the upsurge demand of the consumers. But with luck not being on our side, many of the Nigeria citizens have no access to electricity and to the ones, who have the access to electricity, were experiencing an irregular power supply (Madueme and Okoro 2004). This shortage syndrome, has made the Federal Government to embark on a serious power reform intending to review NEPA to make it to be well organized and effective in response to the continuous growing of electricity supply to the teeming populace which made NEPA in April 2005, was changed to Power Holding Company of Nigeria (PHCN) as a result of reformation of the power sector (Power Holding Company of Nigeria 2010). The reformation of the power sector was due to the inadequate effective electricity supply, incessant power outages, and high technical and non-technical loses present in the Nigeria electricity industry because it is believed that the reformation through the privatization of NEPA, will bring effective change or positive change for the distribution and transmission of electricity supply.

2.2 Electricity Generation in Nigeria

Despite Nigeria vast oil wealth, much of the country's citizens do not have access to uninterrupted supplies of electricity. Nigeria has approximately 5,900 (mw) as at 2006 of installed electric generating capacity. Power outages are frequent and the power sector operates below its estimated capacity. A fundamental reason offered is the low generating capacity of the Nigerian power sector relative to installed capacity. Consequently, the sector had to undergo some reforms to increase power generation, transmission and distribution. Among the reforms is the setting up of the National Electricity Regulatory Commission (NERC), unbundling of PHCN and entry of Independent Power Producers (IPP) among others (Omotosho, Alaoji, 2006). The reformation of the power sector by the Nigeria government has made an effort to increase power generation and also residential electricity demand in Nigeria. The Nigeria economy is heavily dependent on energy. Electricity is a vital source of energy used for a number of purposes that include industrial, commercial and household purposes. But on the other side, it leads to an increase in energy requirement due to its well noted significance in modern industries (Theraja, 2007). The electricity in discussion, stipulated from different sources in Nigeria. Such sources include Hydro-electricity (from water pressure), steam nuclear and geo-thermal energy, are sources of energy that produces electricity from heat energy (Sanni, 2010). Electricity generation is an integral part of transmission, and distribution which is very importance and better to understand when they are discussed together as a whole. But electricity is generated by generator converting the rotary motion of turbines into electricity which is the movement of electrons through metallic conductors. However, magnetism is the major factor in order to have effective change because when a conductor is allowed to pass through a magnetic field, current is in the conductor and the brushes are riding on the ship-rings to facilitate the collection of the current produced by the interaction between the magnetic field and the conductor. Since each side of the rotating coil cut across the magnetic field first in one way and on the order side, an alternating current (A.C) is induced in the conductors. The conductor is wound round a former which are better refer to as amateur conductors. It is the useful form of electricity that can be easily promote or transformed in to higher or lower voltages. A generator is important for the production of the larger amount of electricity by moving thousands of coils through an intense magnetic field. In a generator, the fixed coils are called the stator coils because it is wound round a stator and the revolving coils assembly which could cut across the fixed coils to produce current is known as the rotor coil because it is wound round a stator. The generator used to provide adequate power plants are operated at a constant frequency so that the alternating current cycles which is normally 50hz, should always be the same because an increase or decrease of the frequency can lead to increase or decrease of the electricity which may lead to failure of some part of the system and it will also affect the public and private consumers of the electricity negatively in the country. Although the situations is improving with the used of magnetic field strength output is changed to regulate the electricity output because our home and industries require enough capacity of energy (Sanni, 2010). For better understanding of electricity supply, this table below shows the total electricity generated in Nigeria through the number of power stations, power plant types, location state, age (years), installed units, installed capacity (mw), units available are represented in the table below. TheTotalInstalledCapacityofthecurrentlygeneratingplantsis7,876MW (Table 1), but the Installed available Capacity is less than 4,000MW as at December 2009. Seven of the fourteen generationstationsareover20yearsoldandtheaveragedailypowergenerationisbelow 2,700MW,whichisfarbelowthepeakload forecast of8,900MW forthecurrentlyexisting infrastructure. As a result, the nationexperiencesmassive load shedding.

2.2.1 Sources of Electricity Supply in Nigeria

The major Sources of electricity are the Hydroelectric Power which is produced from water when water pressure is used to produce electricity supply and the power plants used are called hydroelectric plants. Water power is produced from a large settlement of water called dam equipped with flood gate. The water coming from behind the dam is not allowed to come straight through the intake gate and also not allowed to flow to a large pipe called the penstock to the turbine. This is done in order not have difficulty or obstacles that are liable of causing any damage when they are accidentally allowed to flow directly without screening. The water pressure from a potential state, is allowed to fall from a height gaining kinetic energy which its flow into the penstock is controlled by the flood gate to drive the turbine upon which is units of generators coupled usually consisting of vertical shafts with the generator rotor located above and the turbine below it. But instantaneously, the turbine is energized by a set of battery to reach a frequency and the water pressure is allowed to continue the driving to 50Hz because it is easier to obtain the rotary motion in this form (Sanni, 2010).

Steam Energy: power from steam energy, is comprises of all electrical power that are thermally generated from heat as we have in coal, diesel etc. While the thermally energy is converted into steam energy which create pressure in a tube to drive rotors in a static magnetic field to cut across the magnetic flux for the induction of current to produce electricity as it has earlier been discussed in the generation of electricity.

Generalized block diagram of turbine generators.

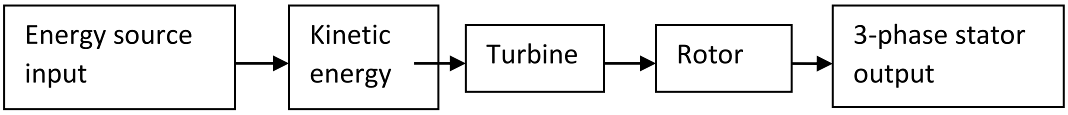

Fig.1

Energy-source input.

The type of energy input describes the type of generator. In a Hydro-system water is used as the source of energy, in Thermal the sources of energy are fuels such as coal, oil and gas. Finally, in a nuclear system, uranium is the source of energy.

Kinetic energy

The energy-input is processed appropriately to produce kinetic or mechanical energy. In a Hydro-system the water is forced through some large pipe, thereby producing water-current as kinetic energy. In Thermal and Nuclear system, the energy-input is respectively processed to produce steam-current as kinetic energy.

Turbine

This is a mechanical device akin to the shape of a propeller. The appropriate turbine is designed and manufactured to cope with the type of kinetic energy applied to turn the turbine.

Prime movers

A combination of energy-input, kinetic energy and turbine is known as a prime mover. A prime mover is an arrangement that provides mechanical power input to a generator.

Rotor

The turbine is mechanically coupled to the rotor of a three-phase generator, such that the rotor turns along with the turbine.

Stator

As the kinetic energy rotates the turbine-rotor coupled, a three-phase electrical power is delivered at the starter as output of the generator. The three-phase conductors are identified as the Red-phase (R-ø), Yellow-phase (y-ø) and Blue-phase (b-ø). In Nigeria electrical power is generated at 11kv per phase, at a frequency of 50Hz.

2.2.2Distribution of Electricity Supply

Electrical power distribution is defined by Patrick (1997) as the supply of electrical power from a substation to various local consumers. Note that a 415v. 3-ø, 3-wire distribution from a substation to a consumer is known as secondary distribution. There are two systems used in distributing electrical power. These are: underground and overhead. In Nigeria, overhead distribution system is adopted.

For instant a light-load consumer, the three aluminum conductors of the 415v, 3-ø in the substation, are carried on cement poles to a distribution point located in the vicinity of the consumer. At the distribution point the three phases are dropped with a feeder cable and terminated on a feeder pillar. From here the 415v.3-ø, 3-wire is fixed to a 415v/415v transformer. The transformer ensures restoration of any voltage loss due to the distribution distance from the substation. The output from the transformer is 415v.3-ø, 4-wires, the four wires being identified as R-ø, Y-ø, B-ø and neutral (N).

2.3 Awareness of Hazard on Running Overhead Electrical Cables

People are killed and injured each year by accidental contact with overhead electrical lines. Most of these accidents occur when cranes, excavators, tipper trucks, crane mounted lorries, mobile extendable machinery, scaffolding, ladders, farm machinery, concrete delivery trucks etc. come close to or touch live overhead lines. Such accidents are caused by failure to take all practicable precautions to prevent accidental contact with these lines. Recommended methods and procedures are set out in this booklet which, if adopted, will provide a positive approach to the elimination of these tragedies. Guard against working close to live overhead lines. if at all possible keep machinery well away (outside their reach). Plan the work in advance and stay safe. it is your responsibility to ensure that any machinery or equipment (e.g. ladders, cranes, scaffolding etc.) set up outside the ‘at risk zone’ is stable and that precautions are put in place to prevent them from falling into the ‘at risk zone’.

As with all work locations, there is an obligation under the Safety Health and Welfare at Work Act to provide a safe place of work for all employees. Itis the duty of the employer when employees are working near overhead lines to ensure that they are aware of the hazard. The General Application Regulations state in thatoverhead lines should be protected with suitable guards and barriers so as toprevent dangerous contact with a person, article, substance or any conducting material.

The nine Principles of Prevention which are also contained in the 1993 General Application Regulations contain requirements on the avoidance, evaluation and elimination of risk and the adaptation of the workplace to reduce the risk. This imposes duties on the contractor to protect his/her employees from the dangers associated with working near overhead lines. Under the Construction Regulations S.I. No. 481 of 2001, the Project Supervisor (Construction Stage) must specify the control measures for dealing with the particular risks referred to in the preliminary safety and health plan, which may also include other significant risks associated with the project. Working near high voltage power lines is one of the listed hazards and must be assessed and the controls specified in the health and safety plan. If danger exists in the work area due to overhead electrical lines running

(a) Over a site

(b) Near the site boundaries or

(c) Over access roads to the site

It is essential that the Contractor or person undertaking the work should consult with AEDC staff. This consultation should take place at the planning stages that the proposed work can be discussed in relation to any overhead electrical line that may exist on or near the proposed site. Such an approach will provide an adequate time span where the line can be switched out and earthed, but typically for only part of the day, or otherwise, i.e. that the line can be diverted or that other precautions.

If supply conditions permit the switching out of an overhead electrical line it becomes a matter of arrangement between the Contractor and the local AEDC. Ample advance warning concerning any requirement of this nature is essential to allow time for changes to be made in existing feeding methods; for informing customers whose supply or quality of supply would be affected by the switch-out, etc.

In many instances, such outages can be granted only for a short period, e.g. 2 to 3 hours, due to loss of supply to customers over the switch-out periods and, unfortunately, at times this option, is not available at all because of the necessityto maintain an un-interrupted supply to particular types of customers. In general, switching out the line is not a practical solution in situations where work in proximity to overhead lines is ongoing over a period of time. Where the switch out of an overhead line is granted, the contractor shall wait forconfirmation by AEDC that the line is switched out and not assume thatit is dead at a pre-arranged time.

Where diversion of the line is a practical option, contact with AEDCmust be made as early as possible, e.g. at the planning stage as suggested above. Time spans for the diversion of LV/l0kV/20kV lines can (be up to a few months due to way leave serving, work load, etc., and that for higher voltages lines can be as much as one year due to planningpermissionsubmissions, wayleaveserving,workload,etc. In certain circumstances it is impossible to design a suitable line diversion due to the lack of an alternative route. In addition, if the work in proximity to a line is of a particular nature, e.g. not involving the erectionof permanent structures over ground,alldiversionwould not be an appropriate orjustifiablemeansofdealingwiththeproblem. Generally, diversions of high voltage lines are not feasible.

Where switching out the line or diverting the line is not practicable, the precautions required to prevent accidents involving Live overhead lines depend on the nature of the work. There are three broad categories of work on site.

(a) Sites where there will be no work or passage of plant under a live line.

Here barriers are required to prevent close approach.

(b) Sites where plant will pass under a live line.

Here, defined passageways under the line must be made.

(c) Sites where work will be done beneath a live line.

Here further precautions must be taken in addition to the provision of barriers and passageways.

On sites where machinery or plant may accidentally come in contact with a live overhead line the Contractor should erect a barrier on the work side at a minimum distance from the line. The barrier should run parallel to the overhead at a minimum distance of 6 meters from the nearest conductor of a low voltage, 10kV, 20kV and 38kV lines. This distance should be increased to a minimum of 10 meters for voltage of

110kV, 220kV and 400kV. The distance should be measured from the outer conductor to the barrier and not from the center of the pole or mast. Consult AEDC staff to confirm the voltage of the line. These distances may be increased depending on the nature, frequency and duration of the work. The barrier should consist of fixed post fencing, steel drums painted red and white and filled with rubble, spaced 1.5metres apart or other means approved by a Health and Safety Authority Inspector. The barrier should be supplemented by notice boards indicating: “Danger live overhead lines", which should be spaced at intervals of not more than 20 meters apart along the route. Where a crane, tipper truck or other high equipment is operating in the vicinity of a live line then the barrier should be further supplemented. This can be done with a line of bunting or other approved means of highlighting the hazard at a minimum height of 3 meters immediately over the barrier, where movement of plant is necessary under a live overhead line the Contractor should erect wooden or other non-conducting material goal posts at the entrance to the passage on each side of the line. The goal posts should be in line with the protection barrier and the wooden crossbar should be set at a height determined in consultation with AEDC staffs. The passageway should be as narrow as possible and should not exceed 10 meters in width and should be fenced or have steel drums on either side. Two large warning notice boards indicating "Danger Live Overhead Lines"should be placed near the goal posts at each entrance to the passage. The goal posts should be marked in red and white stripes,

Akanmu, (2013) generally when work has to be carried out close toa live line, AEDC insists on the line being switched out for the durationof such work. In some situations, due to continuity of supply considerations, AEDC may be forced to permit work underneath a live line, but only afterdetailed consultation with them and with the understanding that strict safetyprecautions will be employed. it will be necessary for the Contractor to erect a safety barrier underneath the line. This barrier may be made of timber or an earthed steel net and placed at a height determined by AEDC. It must be erected under the supervisionof AEDC so as to avoid danger of contact with the overhead line. Generally, mobile and fixed cranes should be located in such a position thatloads cannot be slew over live lines. If there is a need to slew over power lines, always contact AEDCin advance to ensure that precautions are put in place before the slewing operation occurs, such below:

1. Ensure equipment operators and workers are aware of overhead and underground power line locations, specified exclusion zones and the height and reach of equipment being used.
2. Be aware that the layout of overhead cables may be altered by your electricity distributor.
3. Be aware that overhead cables can move and vary in height due to factors such as wind and temperature and adjust work practices accordingly (e.g. Are they sagging due to storm damage or have they been damaged by a vehicle?)
4. Equipment operators and workers should be made aware of the clearances that must be maintained (e.g. from power lines, poles and stay wires).
5. Use highly visible ground markers to highlight overhead cables. Contact your electricity distributor for advice on visual markers.
6. Establish aircraft landing strips and approach paths away from overhead cables.
7. Keep all crops and vegetation well clear of power poles and stay wires. Contact your electricity supplier if you suspect that vegetation near overhead cables or poles could expose people or property to electrical risk.
8. Ensure no damage occurs to poles, stay wires and overhead power lines when burning off.
9. Ensure you have clearly defined emergency procedures and ensure all workers are familiar with them in the event of contact with electricity.

2.4 Causes of Hazards of Running Overhead Electrical Cables

The leading cause of fatal electrical incidents while on the job is contact with power lines. Power lines kill an average of 133 workers per year. Half of these workers are between ages of 25 and 35.

Leading causes

The first step toward protecting yourself is recognizing the many hazards you face on the job. To do this, you must know which situations can place you in danger. Knowing where to look helps you to recognize hazards.

- Inadequate wiring is dangerous.
- Exposed electrical parts are dangerous.
- Overhead power lines are dangerous.
- Wires with bad insulation can give you a shock.

- Electrical systems and tools that are not grounded or double-insulated are dangerous.
- Overloaded circuits are dangerous.
- Damaged power tools and equipment are electrical hazards.
- Using the wrong PPE is dangerous.
- Using the wrong tool is dangerous.
- Some on-site chemicals are harmful.
- Defective ladders and scaffolding are dangerous.
- Ladders that conduct electricity are dangerous.
- Electrical hazards can be made worse if the worker, location, or equipment is wet.

Inadequate wiring hazards

An electrical hazard exists when the wire is too small a gauge for the current it will carry. Normally, the circuit breaker in a circuit is matched to the wire size. However, in older wiring, branch lines to permanent ceiling light fixtures could be wired with a smaller gauge than the supply cable. Let's say a light fixture is replaced with another device that uses more current. The current capacity of the branch wire could be exceeded. When a wire is too small for the current it is supposed to carry, the wire will heat up. The heated wire could cause a fire.

When you use an extension cord, the size of the wire you are placing into the circuit may be too small for the equipment. The circuit breaker could be the right size for the circuit but not right for the smaller-gauge extension cord. A tool plugged into the extension cord may use more current than the cord can handle without tripping the circuit breaker. The wire will overheat and could cause a fire.

The kind of metal used as a conductor can cause an electrical hazard. Special care needs to be taken with aluminum wire. Since it is more brittle than copper, aluminum wire can crack and break more easily. Connections with aluminum wire can become loose and oxidize if not made properly, creating heat or arcing.

Exposed electrical parts hazards

Electrical hazards exist when wires or other electrical parts are exposed. Wires and parts can be exposed if a cover is removed from a wiring or breaker box. The overhead wires coming into a home may be exposed. Electrical terminals in motors, appliances, and electronic equipment may be exposed. Older equipment may have exposed electrical parts.

Overhead Power linehazards

Most people do not realize that overhead power lines are usually not insulated. More than half of all electrocutions are caused by direct worker contact with energized power lines. Power line workers must be especially aware of the dangers of overhead lines. In the past, 80% of all lineman deaths were caused by contacting a live wire with a bare hand. Due to such incidents, all linemen now wear special rubber gloves that protect them up to 34,500 volts. Today, most electrocutions involving overhead power lines are caused by failure to maintain proper work distances.

Defective Insulation Hazards

Insulation that is defective or inadequate is an electrical hazard. Usually, a plastic or rubber covering insulates wires. Insulation prevents conductors from coming in contact with eachother. Insulation also prevents conductors from coming in contact with people.

Extension cords may have damaged insulation. Sometimes the insulation inside an overhead cable maybe damaged. When insulation is damaged, exposed metal parts may become energized if a live wire inside touches them. Electric hand tools that are old, damaged, or misused may have damaged insulation inside. If you touch damaged power tools or other equipment, you will receive a shock. You are more likely to receive a shock if the tool is not grounded or double-insulated.

Improper grounding hazards

When an electrical system is not grounded properly, a hazard exists. The most common OSHA electrical violation is improper grounding of equipment and circuitry. The metal parts of an electrical wiring system that we touch (switch plates, ceiling light fixtures, conduit, etc.) should be grounded and at 0 volts. If the system is not grounded properly, these parts may become energized. Metal parts of motors, appliances, or electronics that are plugged into improperly grounded circuits may be energized. When a circuit is not grounded properly, a hazard exists because unwanted voltage cannot be safely eliminated. If there is no safe path to ground for fault currents, exposed metal parts in damaged appliances can become energized.

Extension cords may not provide a continuous path to ground because of a broken ground wire or plug. If you contact a defective electrical device that is not grounded (or grounded improperly),

Electrical systems are often grounded to metal water pipes that serve as a continuous path to ground. If plumbing is used as a path to ground for fault current, all pipes must be made of conductive material (a type of metal). Many electrocutions and fires occur because (during renovation or repair) parts of metal plumbing are replaced with plastic pipe, which does not conduct electricity. In these cases, the path to ground is interrupted by nonconductive material.

A Ground Fault Circuit Interrupter, or GFCI

It is an inexpensive life-saver. GFCI's detect any difference in current between the two circuit wires (the black wires and white wires). This difference in current could happen when electrical equipment is not working correctly, causing leakage current. If leakage current (a ground fault) is detected in a GFCI-protected circuit, the GFCI switches off the current in the circuit, protecting you from a dangerous shock. GFCI's are set at about 5 mA and are designed to protect workers from electrocution. GFCI's are able to detect the loss of current resulting from leakage through a person who is beginning to be shocked. If this situation occurs, the GFCI switches off the current in the circuit. GFCI's are different from circuit breakers because they detect leakage currents rather than overloads.

Overload hazards

Overloads in an electrical system are hazardous because they can produce heat or arcing. Wires and other components in an electrical system or circuit have a maximum amount of current they can carry safely. If too many devices are plugged into a circuit, the electrical current will heat the wires to a very high temperature. If anyone tool uses too much current, the wires will heat up.

The temperature of the wires can be high enough to cause a fire. If their insulation melts, arcing may occur. Arcing can cause a fire in the area where the overload exists, even inside a wall.

In order to prevent too much current in a circuit, a circuit breaker or fuse is placed in the circuit. If there is too much current in the circuit, the breaker “trips” and opens like a switch. If an overloaded circuit is equipped with a fuse, an internal part of the fuse melts, opening the circuit. Both breakers and fuses do the same thing: open the circuit to shut off the electrical current.

If the breakers or fuses are too big for the wires they are supposed to protect, an overload in the circuit will not be detected and the current will not be shut off. Overloading leads to overheating of circuit components (including wires) and may cause a fire.

Overcurrent protection devices are built into the wiring of some electric motors, tools, and electronic devices. For example, if a tool draws too much current or if it overheats, the current will be shut off from within the device itself. Damaged tools can overheat and cause a fire.

Wet Conditions Hazards

Working in wet conditions is hazardous because you may become an easy path for electrical current. If you touch a live wire or other electrical component and you are well-grounded because you are standing in even a small puddle of water—you will receive a shock.Damaged insulation, equipment, or tools can expose you to live electrical parts. A damaged tool may not be grounded properly, so the housing of the tool may be energized, causing you to receive a shock. Improperly grounded metal switch plates and ceiling lights are especially hazardous in wet conditions. If you touch a live electrical component with an uninsulated hand tool, you are more likely to receive a shock when standing in water.

But remember: you don't have to be standing in water to be electrocuted. Wet clothing, high humidity, and perspiration also increase your chances of being electrocuted.

2.5 Effective ways to Minimize Hazards of Running Overhead Electrical Cables

Effective ways to minimize hazards of running overhead electrical cables is to plan and manage work near electric overhead power lines so that risks from accidental contact or close proximity to the lines are adequately controlled.

Safety that can be achieved by a combination of measures:

- Planning and preparation
- Eliminating the danger
- Controlling the access
- Controlling the work

Planning and preparation

The first step is to find out whether there is any overhead power line within or immediately next to the work area, or across any access route.

Information will be available from the local electricity supplier or Distribution Network Operator (DNO). If any overhead lines are found, you should assume that they are live unless proved otherwise by their owners.

If there are any overhead lines over the work area, near the site boundaries, or over access roads to the work area, consult the owners of the lines so that the proposed plan of work can be discussed.

Allow sufficient time for lines to be diverted or made dead, or for other precautions to be taken as described below.

Eliminating the danger

Danger can be eliminated by:

Avoidance – find out if the work really has to be carried out under or near overhead lines, and can't be done somewhere else. Make sure materials (such as bales or spoil) are not placed near overhead lines, and temporary structures (such as polytunnels) are erected outside safe clearance distances;

Diversion – arrange for overhead lines to be diverted away from the work area; or Isolation – arrange for lines to be made dead while the work is being done.
In some cases, you may need to use a suitable combination of these measures, particularly where overhead lines pass over permanent work areas.

If the danger cannot be eliminated, you should manage the risk by controlling access to, and work beneath, overhead power lines.

Controlling the access

Where there is no scheduled work or requirement for access under the lines, barriers should be erected at the correct clearance distance away from the line to prevent close approach. The safe clearance distance should be ascertained from the Distribution Network Operator (DNO). HSE guidance documents Avoidance of danger from overhead electric power lines and Electricity at Work: Forestry and Arboriculture also provide advice on safe clearance distances and how barriers should be constructed. Where there is a requirement to pass beneath the lines, defined passageways should be made.

The danger area should be made as small as possible by restricting the width of the passageway to the minimum needed for the safe crossing of plant. The passageway should cross the route of the overhead line at right angles if possible.

Controlling the work

If work beneath live overhead power lines cannot be avoided, barriers, goal posts and warning notices should be provided. Where field work is taking place it may be impractical to erect barriers and goal posts around the overhead lines - these are more appropriate for use at gateways, on tracks and at access points to farm yards.

The following precautions may also be needed to manage the risk:

Clearance – the safe clearance required beneath the overhead lines should be found by contacting the Distribution Network Operator (DNO);
Exclusion – vehicles, plant, machinery, equipment, or materials that could reach beyond the safe clearance distance should not be taken near the line;

Modifications – Vehicles such as cranes, excavators and tele-handlers should be modified by the addition of suitable physical restraints so that they cannot reach beyond the safe clearance distances, measures should be put in place to ensure these restraints are effective and cannot be altered or tampered with;

Maintenance – operators of high machinery should be instructed not carry out any work on top of the machinery near overhead power lines;

Supervision – access for plant and materials and the working of plant should be under the direct supervision of a suitable person appointed to ensure that safety precautions are observed.

If part of a vehicle or load is in contact with an OHPL, you should remain in the cab and inform the Distribution Network Operator (DNO) immediately (stick the number in a visible place in the cab and keep it on your mobile phone).

Warn others to stay away.

Try to drive clear. If this is not possible, and you need to leave the vehicle to escape fire, jump clear – do not dismount by climbing down the steps.

Never try to disentangle equipment until the owner of the line has confirmed that it has been de-energized and made safe.

Safety precautionary measures to minimize hazards of running overheads cables

The following practices can reduce electrical risk around overheads cables in the rural industry.

- Always aim to stay further away from overheads cables than the distance stipulated by the exclusion zone clearances – increasing distance from overheads cables is a simple way to minimize electrical risk.
- Work away from overheads cables, not towards them.
- Use maps or diagrams to show the location of overheads cables and safe operating areas and keep these safety aids up-to-date.
- Always lower machinery before relocating it.
- Carry out maintenance and check the height and reach of machinery well away from overheads cables.
- Don't locate machinery or equipment under overheads cables.
- Always use a safety observer whenever there is a risk of coming close to power line exclusion zones – use a safety observer in each work team.

- When working with metal pipes near overheads cables, don't lift them at right angles to the ground. Irrigation pipes are made in long lengths that easily cover the distance between the ground and overhead power lines. Because of this, store irrigation pipes well away from power lines.
- Regularly monitor work activities around overhead cables to ensure they are safe or whenever there is a change such as a new operator, machine or work activity. New operators need to be informed of your safety arrangements. New machinery could be bigger (e.g. longer spray booms, which needs to be factored in to your safe distances).

Review of Related Empirical Studies

Researchers since 2010 have continued to produce hedonic regression studies of the impact of transmission lines on property values. Hedonic regression is a statistical method for decomposing the price of real property, or some other good, into the prices of its component characteristics such as lot size, square footage, and age—even though these characteristics may not be unbundled in the marketplace. The assumption is that the prices of goods in the market are affected by their characteristics. To estimate the value of real property using a hedonic regression analysis, a researcher will identify the characteristics or independent variables that contribute to market value such as view, lot size and shape, topography, location, utility, and entitlements. By including proximity or view of an HVOTL as a variable in the regression, the researcher in theory can estimate the negative or positive contribution to price that the HVOTL has on the value of the property.

Corbin, and Hollins (2011) use a hedonic multiple regression model to study the price data for 1,251 homes sold between 2000-2009 over a 1.15-square-kilometer area of South London, United Kingdom. This study focuses on the effects of certain determinants including house characteristics, psychological and health conditions, aesthetic factors, and services—on residential property values. One of the factors considered is proximity to an HVOTL. The authors consider the distance to the nearest pylon as well as the distance to the centerline of the HVOTL. In the United Kingdom, transmission lines can be built on residential property and lines may pass directly over homes, so the authors also consider whether the plot or home is over sailed by a transmission line and whether a pylon is on the property. The authors claim this study is the first of its kind in that it analyzes the dynamic relationships or “cross elasticities” between these price determinants. For example, the authors measure the relationship between distance to a park and distance to an HVOTL and find that proximity to a park only had a positive effect for houses located away from HVOTLs.

This model shows that house values increaseby 0.03% when distance from the centerline ofthe HVOTL increases by 1%. This claim, however, must be interpreted with caution. Whilemost statistical studies of transmission line effectshave used distance bands to measure changes inprice impacts over various distances, the authorsin this study entered these multiple distance variables into the regression as continuous variables. Expressing distance as a continuous variable, however, constrains the regression and imposes the assumption that the distance effect decays everywhere at the same rate. While most of the literature focuses on theeffects of transmission lines on residential properties, especially single-family homes, Jackson, Pitts, and Norwood6 study the effects on bothcommercial and industrial properties. They usethe formal methods that have already been applied for decades to residential properties. Thestudy analyzes the effects of HVOTLs on the saleprices of commercial and industrial properties between 2005 and 2010 in Madison, Wisconsin, and other “generally urbanized areas” of Wisconsin using a combination of five regression models, a paired sales analysis, and interviews. Thesample size was 187 commercial and industrial properties, with a control group of 145 unencumbered properties, and a treatment group of 42 properties either encumbered by or in proximity to a transmission line of 138 kV or more. The authors did not consider a range of possible distances. Rather, they enter one variable for whether or not the property was within 500 feet of an HVOTL. Results from the regression analysis do not show any significant negative effects on sale price. In fact, the effects reported aregenerally positive, possibly because of increased transportation access available to encumbered properties. Other property types included in this study, including office, retail, hotels, apartments, restaurants, vacant land, and otherunspecified industrial properties, are analyzed with the paired sales method and no significant negative impact is found. These results are consistent with the findings of face-to-face and phone interviews with the parties involved in the transactions.

Bottemiller and Wolverton (2013) analyze sales data for the period between 2005 and mid-2007 in the areas surrounding Portland, Oregon, and Seattle, Washington. The transmission lines considered in this study range from 115 kV to 500 kV. The Portland sample includes 538 home sales, with 152 HVOTL-abutting sales and 386 non-abutting control sales. The Seattle study includes 568 home sales, with 153 abutting sales and

415 control sales. The authors use a multiple regression analysis and find small but statistically significant price effects. Portland homes abutting HVOTLs show a negative impact of 1.67% and Seattle homes show a negative impact of 2.43%. This study is a refinement of a two earlier studies by the same authors that found no significant price effects. A richer data set in this project allowed the authors to control for neighborhood and school district. The authors note that 25% of the Seattle homes have a mean price of about $1 million.

When the authors separately analyze the higher-end Seattle homes, they find a significant negative impact of 11.23%, which would translate to a $130,882 decrease in price for a typical home in the group. The price effect for a typical home inSeattle, on the other hand, is a mere 0.65% negative impact, which is not statistically significant. This suggests that nearly all of the 2.49% negative impact in the Seattle area is due to the high-end homes in the study. Bottemiller and Wolverton are conservative in their language and quick to acknowledge the limitations of this kind of study. They point out that the huge trees in the Northwest largely cover HVOTLs, so this study is not applicable outside the Northwest. The smaller lot sizes in Portland suggest thatthere is less room for trees and so the HVOTL are more visible. This could explain the higher negative impact for a typical home in Portland (1.67%) when compared to a typical home in Seattle (0.65%). The authors warn against generalizing these results beyond the respective geographical areas. Sims and Dent (2005) conduct a regression analysis of mid-priced homes sold in Blackwood, Scotland, between 1994 and 2010. The authors consider the sales of 620 properties, of which 483 have some view ofthe supporting pylons of a 275 kV transmission line running through the center of the neighborhood. Along with slight changes to the original 2005 data set, Sims and Dent add several variables. This study is the most ambitious of the fivestatistical HVOTL studies included in this review in its attempts to detect the subtleties of different view effects.

Using property characteristics determined using plot maps and physical observation, the authors consider, among many other possibilities, homes with one-fourth of a pylon visible from the front, homes with half a pylon visible from the front, homes with side views of an HVOTL, and homes with two pylons visible from the rear. They considered distance effects using 50-meter-wide distance bands. The authors find that a view of a pylon from the rear of the home has a significant priceimpact, which decreased with distance. The greatest negative impact resulted from a threefourths view of a pylon from the rear of the home. The value of a property within 100 meters of a pylon shows a 21% discount compared to a similar house 400 meters away. All of these negative price effects diminish with distance. A side viewof the HVOTL line, on the other hand, significantly increases value, presumably because of increased privacy. Sims and Dent argue that these findings suggest that implementing rights of way in the United Kingdom, as they exist in the United States, could mitigate effects from HVOTLs.

The authors echo Bottemiller and Wolverton in noting that the results from this kind of research are difficult to generalize. The literature generally estimates the impactsof existing HVOTLs on property, not their removal. Callanan (2014), however, uses a hedonic pricing model and a repeat salesanalysis to attempt to measure the length of time that any market resistance remains after transmission lines are removed. Callanan studies the low-income Newlands suburb of Wellington, New Zealand, in which two 110 kV lines were removed in the mid-1990s. A before-removal study included 330 homes sold between 1989 and 1995 and an after-removal study included 3,345 homes sold between 1995 and 2010. The author considers the distance from each line and the distance from each pylons well as various other property characteristics. Distance variables in this study are entered into the regression as continuous variables. Callanan explicitly criticizes the distance bands method, noting that price effects are often subtle and can be lost within the distance bands. Before removal, the analysis showed a negativeimpact of 27% for properties within 20 meters of the pylons; this impact decreases to 5% at 50 meters and is negligible at 100 meters. The lines themselves, rather than the pylons, did not have a significant negative impact. The model shows less than a 1% effect for homes directly under the line. After removal, the neighborhood as a whole, not just individual properties, improved in value, with a significant increase in sale prices in the three- to four-year period after removal. However, post-removal results were impeded by significant demographic changes in the study area and wide price swings in the New Zealand real estate market at the time. Therefore, the 27% figure must be interpreted with care. It is most likely an artifact of the close siting of towers allowed in New Zealand.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

This chapter described the procedure that was used in carrying out the study under the following sub headings, Research Design, Area of the study, Population, Instrument for Data Collection, and Validation of instrument, Administration of the Instrument, Method of Data Analysis, and Decision Rules.

3.1 Research Design

This study employed the descriptive survey method because it involves the use of questionnaire to help in determining the opinion of the respondents. Ogunjimi (2000) stated that a survey research as a descriptive study are plans, strategies and structured employed towards obtaining answers to research questions and hypothesis. He further added that it covers the outline of what the researcher intends to do up till the final analysis. In the same angle, this study seeks the opinion the AEDC management staff and the consumers of electricity toinvestigate into the hazard of running overhead electrical cables in Minna, Niger state

3.2 Area of the Study

This study was carried out in Minna Metropolis of Niger State.

3.3 Population

The target population of the study comprises of 200 management staff of AEDC and consumers of electricity within Bosso Local Government of Minna Metropolis of Niger State. AEDC management staff consists of 50 staff and the consumers of electricity in the chosen locality are 150 in MaikunkeleBosso Local Government of Minna Metropolis, Niger State, Nigeria.

3.4 Instrument for Data Collection

The instrument for data collection is a structured questionnaire developed by the researcher. The questionnaire consists of two sections A and B. B was further divided into 3sections as shown.

SECTION A: What is the level of awareness of hazard on running overhead electrical cables in Minna, Niger state?

SECTION B: What are the causes of hazards of running overhead electrical cables in Minna, Niger state?

SECTION C: What are the strategies to minimize hazards of running overhead electrical cables in Minna, Niger state?

3.5 Validation of Instrument

The instrumentwas validated by three lecturers in the Department of Industrial and Technology Education, Federal University of Technology Minna, for necessary correction.

3.6 Administration of the Instrument

The researcher will administer the questionnaires to the respondents with a research assistant.

3.7 Method of Data Analysis

The data used for this study were analyzed by using frequency count, mean, standard deviation. The hypotheses were tested at 0.05 level of significance to agree or disagree on the respondent's opinion on a particular item contained in the instrument, a cut-off point of 2.50 was used. The mean score of each item was computed by multiplying the frequency of each response mode with appropriate nominal value and divided by the sum obtained under each item with the number of the respondents to on item as show.

A four-point rating scale was used to analyze the responses as seen below.

Strongly Agree (SA) = 4 points

Agree (A) = 3 points

Disagree (D) = 2 points

Strongly Disagree (SD) = 1 points

The mean of 2.50 will be used as decision point for every questionnaire item. Consequently, any item with a mean response of 2.50 and above was considered to be agreed and any item mean score of 2.49 and below was considered disagreed.

For testing hypotheses at t-value of 0.05 level of significant was chosen. So any value that has its t-calculated less or equal to the value was considered accepted and above t-value was considered rejected.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSIONS

This chapter deals with results and discussions of data analysis with respect to the research questions and hypotheses formulated for the study.

Research Question 1

What is the level of awareness of hazard on running overhead electrical cables in Minna, Niger state?

Table 4.1:

Mean Responses of AEDC Management Staffs and the Consumers of Electricity on the level of awareness of hazard on running overhead electrical cables in Minna, Niger state

N_1 =50, N_2 = 150

S/No	Items	X_1	X_2	X_t	Remarks
1	Equipment operators and workers are aware of overhead and underground power line locations	2.56	2.54	2.6	Agreed
2	Be aware that the layout of overhead cables may be altered by your electricity distributor.	2.64	2.53	2.6	Agreed
3	Are they sagging due to storm damage or have they been damaged by a vehicle	2.78	2.88	2.8	Agreed
4	Equipment operators and workers should be made aware of the clearances that must be maintained (e.g. from power lines, poles and stay wires)	2.58	2.65	2.6	Agreed
5	highly visible ground markers to highlight overhead cables. Contact your electricity distributor for advice on visual markers.	2.60	2.68	2.6	Agreed

6	Establish aircraft landing strips and approach paths away from overhead cables	2.65	2.75	2.7	Agreed
7	Keep all crops and vegetation well clear of power poles and stay wires.	2.68	2.80	2.7	Agreed
8	Ensure no damage occurs to poles, stay wires and overhead power lines when burning off	2.70	2.90	2.8	Agreed
9	Ensure you have clearly defined emergency procedures and ensure all workers are familiar with them in the event of contact with electricity.	2.78	3.15	3.0	Agreed

Key:

N_1 = Number of AEDC management staff

N_2 = Number of Consumers of Electricity

X_1 = Mean of AEDC management staff

X_2= Mean of Consumers of Electricity

X_t = Average Mean of AEDC management staff and the consumers of electricity

Table 4.1: Shows that the respondents agreed with all the items with mean score ranging between **2.60** to **3.00** respectively, on the level of awareness of hazard on running overhead electrical cables in Minna, Niger state.

Research Question 2:

What are the causes of hazards of running overhead electrical cables in Minna, Niger state?

Table 4.2:

Mean Responses of AEDC Management Staffs and the Consumers of Electricity on the causes of hazards of running overhead electrical cables in Minna, Niger state.

N_1 =50, N_2 = 150

S/No	Items	X_1	X_2	X_t	Remarks
1	Inadequate wiring is dangerous	2.49	2.62	2.56	Agreed
2	Exposed electrical parts are dangerous	2.64	2.53	2.59	Agreed
3	Cables with bad insulation can give you a shock	2.57	2.73	2.65	Agreed
4	Electrical systems and tools that are not grounded or double-insulated are dangerous.	2.52	2.55	2.54	Agreed
5	Overloaded circuits are dangerous	2.60	2.68	2.64	Agreed
6	Damaged cables and equipment are electrical hazards.	2.63	2.44	2.54	Agreed
7	Using the wrong tool is dangerous	2.66	2.46	2.56	Agreed
8	Some on-site chemicals are harmful	2.53	2.67	2.60	Agreed
9	Defective ladders and scaffolding are dangerous	2.56	2.5	2.53	Agreed
10.	Electrical hazards can be made worse if the worker, location, or equipment is wet.	2.45	2.76	2.61	

Key:

N_1 = Number of AEDC management staff

N_2 = Number of Consumers of Electricity

X_1 = Mean of AEDC management staff

X_2= Mean of Consumers of Electricity

X_t = Average Mean of AEDC management staff and the consumers of electricity

Table 4.2: Shows that the respondents agreed with all the items with mean score ranging between **2.53** to **2.61** respectively, on the causes of hazards of running overhead electrical cables in Minna, Niger state.

Research Question 3:

What are the strategies for minimizing hazards of running overhead electrical cables in Minna, Niger state?

Table 4.3:

Mean Responses of AEDC Management Staffs and the Consumers of Electricity on the strategies to minimize hazards of running overhead electrical cables in Minna, Niger state.

N_1 =50, N_2 = 150

S/No	Items	X_1	X_2	X_t	Remarks
1	Always aim to stay further away from overheads cables than the distance stipulated by the exclusion zone clearances	2.65	3.10	2.88	Agreed
2	Work away from overheads cables, not towards them	2.78	2.35	2.57	Agreed
3	Use maps or diagrams to show the location of overheads cables and safe operating areas and keep these safety aids up-to-date.	2.91	2.21	2.56	Agreed
4	Electrical systems and tools that are not grounded or double-insulated are dangerous.	2.52	2.52	2.52	Agreed
5	Carry out maintenance and check the height and reach of machinery well away from overheads cables.	2.61	2.62	2.62	Agreed
6	Don't locate machinery or equipment under overheads cables	2.78	2.56	2.67	Agreed
7	Always use a safety observer whenever there is a risk of coming close to power line exclusion zones	2.59	2.51	2.55	Agreed
8	When working with metal pipes near overheads cables, don't lift them at right angles to the ground. Irrigation pipes are made in long lengths	2.54	2.57	2.56	Agreed

	that easily cover the distance between the ground and overhead power lines				
9	Regularly monitor work activities around overhead cables to ensure they are safe	2.58	2.52	2.55	Agreed

Key:

N_1 = Number of AEDC management staff

N_2 = Number of Consumers of Electricity

X_1 = Mean of AEDC management staff

X_2= Mean of Consumers of Electricity

X_t = Average Mean of AEDC management staff and the consumers of electricity

Table 4.3: Shows that the respondents agreed with all the items with mean score ranging between **2.53** to **2.61** respectively, on the strategies to minimize hazards of running overhead electrical cables in Minna, Niger state.

Hypotheses Testing

Hypotheses One

Ho_1: There is no significant difference between the mean responses of AEDC staff and consumers on the level of awareness of hazard on running overhead electrical cables in Minna, Niger state.

Table 4.4: t-test of the mean response of AEDC Management Staffs and the Consumers of Electricity on the level of awareness of hazard on running overhead electrical cables in Minna, Niger state.

S/N	RESPONDENTS	N	$\overline{X}$	d.f	t-cal	t-critical
1	AEDCStaffs	50	2.52	298	-0.24	1.98
2	Lecturers	250	2.85			

In table 4.4, the t-calculated (-0.24) does not exceed the t-critical of (1.98) necessary for acceptance of null hypotheses at 0.05 level for 298 degree of freedom, the hypotheses were accepted, hence there was no significant difference between the mean rating of students and lecturers on the level of awareness of hazard on running overhead electrical cables in Minna, Niger state.

Ho2: There is no significant difference between the mean responses of AEDC staff and consumers on the causes of hazards of running overhead electrical cables in Minna, Niger state.

Table 4.5: t-test of the mean response of AEDC Management Staffs and the Consumers of Electricity on the causes of hazards of running overhead electrical cables in Minna, Niger state.

S/N	RESPONDENTS	N	$\overline{X}$	d.f	t-cal	t-critical
1	AEDCStaffs	50	2.65	298	0.04	1.98
2	Lecturers	250	2.64			

In table 4.5, the t-calculated (0.04) does not exceed the t-critical of (1.98) necessary for acceptance of null hypotheses at 0.05 level for 298 degree of freedom, the hypotheses were accepted, hence there was no significant difference between the mean rating AEDC Management Staffs and the Consumers of Electricity on the causes of hazards of running overhead electrical cables in Minna, Niger state.

Ho3: There is no significant difference between the mean responses of AEDC staff and consumers on the strategies to minimize hazards of running overhead electrical cables in Minna,

Table 4.5: t-test of the mean response of AEDC Management Staffs and the Consumers of Electricity on the strategies to minimize hazards of running overhead electrical cables in Minna,

S/N	RESPONDENTS	N	$\overline{X}$	d.f	t-cal	t-critical
1	AEDCStaffs	50	2.65	298	-0.23	1.98
2	Lecturers	250	2.64			

In table 4.5, the t-calculated (-0.23) does not exceed the t-critical of (1.98) necessary for acceptance of null hypotheses at 0.05 level for 298 degree of freedom, the hypotheses were accepted, hence there was no significant difference between the mean rating AEDC Management Staffs and the Consumers of Electricity on the strategies to minimize hazards of running overhead electrical cables in Minna,

Discussion of the Findings

The discussion of the findings of the study was based on the items revealed and put together according to the research questions and hypothesis that both respondents agreed oninvestigating into the hazard of running overhead electrical cables in Minna, Niger State.

The findings in research question one revealed that the respondents agreed with all the items with mean score ranging between **2.60** to **3.00** respectively, on the level of awareness of hazard on running overhead electrical cables in Minna, Niger state. There is hardly any enterprise or indeed any aspect of human development that does not require energy. Akanmu, (2013) generally when work has to be carried out close to (within the ‘at risk zone) of a live line, AEDC insists on the line being switched out for the durationof such work. In some situations, due to continuity of supply considerations, AEDC may be forced to permit work underneath a live line, but only afterdetailedconsultation with them and with the understanding that strict safety precautions will be employed. it will be necessary for the Contractor to erect a safety barrier underneath the line. This barrier may be made of timber or an earthed steel net and placed at a height determined by AEDC. It must be erected under the supervisionofAEDCsoastoavoiddangerof contact with the overhead line. Generally, mobile and fixed cranesshouldbelocatedinsuchapositionthatloads cannot be sewn over live lines.

The finding also shows that the staffs have adequate knowledge and skills to determine faults in electrical installation. Hull (1991) has defined skill as the manual dexterity through the repetitive performance of an operator. Nandi (1998) indicated that knowledge and skill determine good repair works in any trade someone lays his/her hands on. He stressed, it further that it can be referred to adequately train the staff to improve in their vocations so that their services could be appreciated by the customers.

Good and conducive environment for the AEDC staff motivates or encourage the staff to concentrate on their desired works. Akinlabi (1992) stressed that, the facilities, workshops, tools, and materials contribute immensely to good working environment. If the environment is good and conducive, it is certain that the staff would get a desired course content of good working conditions.

The findings also indicate that when the total population using electricity is not captured and power is generated to only those that are captured, those not captured will ration it together with them: for all the consumers to have sufficient electricity supply, more substations should be built to boost the electricity to enhance effective distribution of electricity supply to all consumers at different rate because not all consumers require power at the same rate. Take for instance the industrial power supply at 415v and the domestic/residential power at 220v. In these ways and others, the distribution and transmission of electricity supply in Minna can be assessed (Theraja, 2007).

Findings from Table 2 of this study indicate that the major factor militating against the management of effective distribution of electricity supply: poor maintenance of equipment, our empirical study reveals that the generating units and their auxiliaries have become obsolete while poor maintenance culture of the organization has immensely contributed to the nagging erratic power failure in Nigeria. For instance, the Kainji Power Station commissioned in 1968 is yet to undergo a full turn around maintenance (TAM). The plant with an installed capacity of (760 MW) generates only (580 MW). Other power plants like Egbin (1320 MW) and Ijora with a combined capacity of 3153 MW also need routine repairs. Thebureaucratic corruption, the corruption perpetrated by the staffs of the Authority who may connive with the customers in order to evade payment of AEDC bills endangers AEDC performance. The AEDC officials pretending to act for the organization collected money from customers for supply of prepaid meter yet they refused to supply the meters and thus damaging the tone and image of the organization.

The paradox of this huge indebtedness is that government parasitical and agencies are notorious with the highest unpaid bills. The total indebtedness which stood at N12, 477,442,811.00 is very disturbing. This indebtedness has also been identified (Obadan, 2000) when he said: "AEDC was crippled by its customers' indebtedness; its privatization can start with the employment of private companies to collect tariffs on its behalf". There is no reason doubting the fact that prompt payment of AEDC bills may likely enhance regular power supply and reduce AEDC"s ineptitude as earlier identified in this paper. This will enable it to fund the (TAM) Turn around maintenance of its machines as when due.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Summary of the Study

Electricity among other sources of energy is the most predominant due to the significant role it plays in the modern life system. Although, there cannot be a proper development in this modern world without electricity, because it holds the key prompting to industrial growth of any nation, either in service industries, or production industries that manufacture goods.

Domestically, most equipment and appliances used to make life easier for us such as air-conditioner, fans, fridges, television sets, phone etc. are dependent on the electricity. It is difficult to point-out where electricity is not needed in one aspect or the other.

Therefore, this study is giving consideration to the long time perpetual power deficits in the country which arise from poor assessment of infrastructural, management of electricity distribution factors. The aim of this research work is to find out the Assessment of Factors Responsible for the Ineffective Distribution of Electricity Supply in Minna Metropolis of Niger State.

The related literature for the study was reviewed with some of the headings as;

1. Historical Background of Electricity Development in Nigeria.
2. Generation, Transmission, Distribution of Electricity in Nigeria.
3. Infrastructural Challenges Militating Against Effective Distribution of Electricity Supply.
4. Management Challenges Militating Against Effective Distribution of Electricity Supply.
5. Strategies for Improving Distribution of Electricity Supply in Minna Metropolis of Niger State.

A multistage survey research design method was used to develop the instrument of the study. The population for this study was the AEDC management staffs of 70 and non-management staff of 180 in Bosso Local Government of Minna Metropolis of Niger State. The instrument was analyzed using frequency count, mean score and standard deviation. The three research questions were fully answered. And the findings of this are highlighted based on the research questions.

5.2 Implication of the Study

The findings of this study obviously have certain implication on the Power Holding Company of Nigeria (AEDC) as the organization that is responsible for the Effective Generation, Transmission, and Distribution of Electricity Supply since it is the major or sole power producing company in Nigeria.

The findings of this study with regard to the approval of special technical staff salary scale and in-service training as motivation also have implication as this would enable staff to gain more practical knowledge from the special technical staff and equally increased the level of learning and understanding to perform effectively in Transmission, Distribution of Electricity Supply in Minna Metropolis of Niger State.

The findings of this study with regard to information and communication technology (ICT) facilities has its own implication, as the main purpose of (ICT) is to improve the quality of distribution, transmission and monitoring the process of generating power supply.

The implication on the Power Holding Company of Nigeria is that if effective measures are not taken to correct the Factors Responsible for the Ineffective Distribution of Electricity Supply, there will be no economic and social development because industries will not function effectively.

5.3 Conclusion

From the finding of this research work, it has made effort to establish the position that Assessment of Factors Responsible for the Ineffective Distribution of Electricity Supply in Minna Metropolis of Niger State has been carried out in order to increase in power generation, transmission, distribution in the metropolis for effective use and reliability maximally.

5.4 Recommendation

1. Training of AEDC staffs on the use of geographic information system (GIS).
2. There is also need for training and retraining of technical personnel in AEDC to learn the new technologies and maintenance of the existing equipment.

3. Replacement of old distribution equipment and facilities including constant servicing.
4. There should be adequate funding provided to the power sector in order to carryout maintenance work effectively when due to avoid the total collapse of the system.
5. Establishment of a GIS department in all the zone and district offices of AEDC throughout the country and a surveyor's/ GIS expert as the head of the department.
6. AEDC staffs should ensure that electrical cables are properly grounded before maintenance work is being carried out.
7. Public awareness should be created by the government in collaboration with AEDC on the dangers associated with overhead electrical cables.
8. Government should ensure that special routes or roads are being constructed for trucks and big vehicles.
9. AEDC management should ensure that their staffs adhere strictly to safety rules and regulations associated with overhead electrical cable installation and maintenance.
10. Government should ensure that buildings, machineries and or equipment are not built or mounted around overhead electrical cables.
11. The management and staffs of AEDC should ensure that there is prompt response to problems relating to overhead electrical cables.

5.5 Suggestions for further research

Based on the finding of the study, the following suggestions were made:

1. Assessing the Present State of Electricity Supply through Deregulation towards Achieving an Uninterrupted Power Supply in Minna Metropolis of Niger State.

2. The Impact of Industries in the Electricity Distribution Network Service Providers Service Target Performance Incentive Schemes in Minna Metropolis of Niger State.

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APPENDIX A

QESTIONNAIRE

DEARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION

SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION

FEDERAL UNIVERSITY OF TECHNOLOGY MINNA,

NIGER STATE

HAZARD OF RUNNING OVERHEAD ELECTRICAL

CABLES IN MINNA, NIGER STATE

INSTRUCTION:

Below is the respondents"

Personal information: please fill the appropriate information in the space provided by ticking (√)against the box to fill the gap as applicable to you in the space provided.

The questionnaire is for research purpose and your view will be treated confidentially.

AEDC Staff ☐

Electricity consumers ☐

Guide on how to respond to the questionnaire.

Use the following rating scale to indicate your opinion (√) the phrase that best your level of agreement to the items.

KEY TO RESPONSE OPTILONS

STRONGGLY AGREED	=SA
AGREED	=A
DISAGREED	=D
STRONGLY DISAGREED	=SD

SECTION A

What are the level of awareness of hazard on running overhead electrical cables in Minna, Niger state?

S/NO.	ITEMS	SA	A	D	SD
1	Equipment operators and workers are aware of overhead and underground power line locations				
2	Be aware that the layout of overhead cables may be altered by your electricity distributor				
3	Are they sagging due to storm damage or have they been damaged by a vehicle				
4	Equipment operators and workers should be made aware of the clearance that must be maintained(e.g. from powerlines, poles and stay wires)				
5	Highly visible ground markers to highlight overhead cables. Contact your electricity distributor for advice on visual markers.				
6	Establish aircraft landing strips and approach paths away from overhead cables.				
7	Keep all crops and vegetation well clear of power poles and stay wires.				
8	Ensure no damage occurs to poles, stay wires and overhead powerlines when burning off				
9	Ensure you have clearly defined emergency procedures and ensure all workers are familiar with them in the event of contact with electricity.				

SECTION B

S/NO.	ITEMS	SA	A	D	SD
1	Inadequate wiring is dangerous				
2	Exposed electrical parts are dangerous				
3	Cables with bad insulation can give you a shock				
4	Electrical systems and tools that are not grounded or doubleinsulated are dangerous.				
5	Overloaded circuits are dangerous				
6	Damaged cables and equipment are electrical hazards.				
7	Using the wrong tool is dangerous				
8	Some on-site chemicals are harmful				
9	Defective ladders and scaffolding are dangerous				
10	Electrical hazards can be made worse if the worker, location, or equipment is wet.				

SECTION C

S/N0	ITEMS	SA	A	D	SD
1	Always aim to stay further away from overheads cables than the distance stipulated by the exclusion zone clearances.				
2	Work away from overheads cables, not towards them.				
3	Use maps or diagrams to show the location of overheads cables and safe operating areas and keep these safety aids up-to-date.				
4	Electrical systems and tools that are not grounded or double-insulated are dangerous.				
5	Carry out maintenance and check the height and reach of machinery well away from overheads cables.				
6	Don't locate machinery or equipment under overheads cables.				
7	Always use a safety observer whenever there is a risk of coming close to power line exclusion zones.				
8	When working with metal pipes near overheads cables, don't lift them at right angles to the ground. Irrigation pipes are made in long lengths that easily cover the distance between the ground and overhead power lines.				
9	Regularly monitor work activities around overhead cables to ensure they are safe.				