Overcoming The Threat of Natural Hazard in Electric Engineering Projects in Nigeria

EZECHUKWU O. A.[1], CHUKWUAGU M. I.[2], OGBOH V. C.[3]
[1, 2, 3] *Nnamdi Azikiwe University, Awka, Nigeria*

Abstract- This paper discusses the hydrological disaster in electrical engineering project using the conservation of electric charge and electric dipole to solve the problem of lightning strike which can caused by static electricity. The objective of conservation of electric charge and electric dipole is overall charge of this system is a pair of electric charges of two objects having same equal numbers of protons and electron within the two spheres but opposite sign separated by some typically small distance is called an electret.

Indexed Terms- Engineering planning, voltage collapse, static electricity, electric field, conservation electric charge, electric dipole.

I. INTRODUCTION

Electrical Engineer is someone who designs and develops new electrical systems that solve problems and tests equipment. The electrical engineering is area of electrical deals with design, development, installation and maintenance of electromechanical devices and machines such as electric motors, transformers [l]. It was noticed that in general the rate of fire incidence increased each year. This increase was attributed to several factors, rate of population growth and industrialization, unstable electricity, urbanization, negligence, illegal electrical connection etc. The cause of fire was categorized into domestic, industrial, vehicular, institutional, electrical, commercial, bush and others. Among these causes domestic fire accounted for 41% of the total number of fire incident in the in country. This study presents several recommendations to help prevent and mitigate fire incidents in Ghana [2]. The objective of the workshop, protection of electricity networks from natural hazards. The handbook encourages infrastructure owners and operators, emergency responders, regulators, government stakeholders, and industry groups to work together more closely to improve the resilience of critical electricity transmission infrastructure [3]. Wind storms such as hurricanes increase the outage rate of over-head transmission lines and hence can seriously affect the security of power systems. Therefore, it is very important to estimate the overhead transmission line outage rate for a power system that might be jeopardized by wind storms. The proposed method estimating the outage rate of overhead transmission lines in a regional power system based on both historical and simulated wind storms [4].

II. STAGES PROJECT MANAGAMENT IN ELECTRICAL ENGINEERING PROJECTS

Our approach to every project is, believing in keeping things simple, yet following good engineering practice. With proper system design and integration, you get a solution that;

- meets your needs,
- has reliable operation,
- meets your financial and technical goals,
- Is maintainable for future growth.

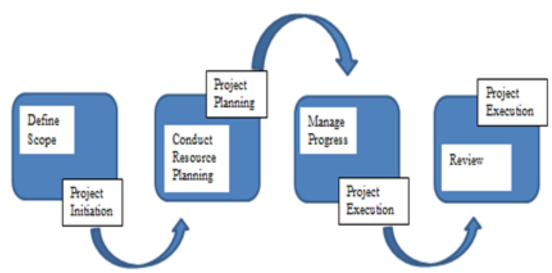

Figure 1: Stages of Electrical Engineering Projects

Every project is headed by a project manager and/or project engineer to ensure all development steps are followed from start to finish. Each phase has deliverables that are reviewed and approved by the client. Client approval is necessary before moving to the next phase.

A. Planning

A dedicated project manager works with the client to understand and to establish project milestones including:

Project objections,
- personnel,
- time-frames,
- budgets, operating expenses and costs
- Maintenance programs and training programs

B. Requirements

This is where our engineers work with the client to assemble the project requirements and data. Site visits are usually conducted and walk-throughs are done to convey ideas and to bounce ideas off one another.

A Requirements Specification is developed to guide the system design into the next phase. The following are clearly written and drawn out:

- functional data
- performance requirements
- physical layout,
- HMI operation.

C. Design

This is where a design is created to create an integrated system of hardware and software to meet all of the functional requirements. Drawings are completed as are design descriptions. Bid requests are obtained; evaluated and technical recommendations are made.

D. Review

This is where all parties review the technical, operational, and financial and development merits of the proposal. It gives the client an easy-to-understand review of the solutions and a chance to ask what-if questions before making a final decision.

E. Implementation

This is where all the hands-on development, fabrication and programming take place. System integration follows sound engineering practices and the project manager ensures progress follows the agreed upon strategy and timeline.

F. Commissioning

This is where our engineers and the client's operator work together check out and get a feel for the system - a test drive. A formal start-up takes the control system into operation and all equipment and communications are confirmed.

G. Support

After commissioning the system and all training and operational documents have been turned over to the client, ICS Engineering is capable of providing ongoing servicing including reliability Engineering studies and maintenance programs

III. HISTORICAL OVERVIEW OF NATURAL DISASTERS IN ELECTRICAL ENGINEERING PROJECT

In this research, we defined impact studies, as those which model the physical effect of changing climate on one or more element of energy supply system, such as a primary resource generation technology. We defined IAM as those which represent interactions between the wider electricity or energy system and some part of the earth system such as hydrology or climate [5].

Studies examining impacts of the changing variability of renewable resources, extreme weather event and combined hazard, inclusion of multiple climate feedback mechanism in IAMs, according for adaptation option and climate model uncertainty [7 8]. An earthquake is an instantly occurring and unpredictable natural event. The potential and effects of earthquakes and other are not only limited to the physical damage of power systems, but power quality disturbances may also take place. After the earthquake, the Turkey power system collapsed. In this study, the impact of the Marmara earthquake on the Turkish power system described and the Marmara earthquake blackout is examined in detail as regards the qualitative behavior of the power system [9].

The security of energy supply has become a major concern worldwide, given modern society's strong dependence on its adequate delivery not only does the functioning of industry, transportation, and communication and computer systems depend on a continuous energy supply, but our complete style of living I collapses, wars and natural disasters directly threaten energy supply, and important policy concerns are being implemented as countries look always to protect themselves [10].

IV. CAUSES OF VOLTAGE COLLAPSE AT EEDC

In most developed nations voltage collapse is quite minimal, as result of highly developed power system equipment that are used to detect and prevent voltage breakdown. The major factors that cause voltage collapse in developed nations are chiefly natural disaster that is earthquakes, flood disaster and other forms of hydrological factors. In recent times highly sensitive equipment like computers are used to monitor faults that could occurs within a distribution system. Faults that are likely to occur within a distribution grid system are; short circuits, transformer faults are faults due to transient over-voltage.

Voltage breakdown has a very high rate in third world countries as a result of undeveloped and poor power system equipment in generation, transmission and distribution of power.

African has the least rate of power supply worldwide their electrification schemes both rural and urban are fully or partially funded by the world-bank and other monetary bodies.

South Africa and Ghana has the most updated power system equipment African and this make them comparable to most developed nations worldwide. In EEDC voltage collapse are used by several factors, which can be categorized as Follows [11].

V. TYPES OF VOLTAGE BREAKDOWN

Voltage collapse falls under two categories, which are (1) physical and natural factors

A. NATURAL PHENOMENA

In Nigeria the major natural phenomena experienced by EEDC are hydrological disasters and) also seasonal changes.

B. HYDROLOGICAL DISASTER

1) FLOOD: floods are caused by factors like rainfall; changes in the sea level floods have affected EEDC in several ways. Between the years 2000 to 2018, there many recorded cases of flood disaster.
2) EFFCTS ON DAMS: hydro power involves the use of water to generate electrical energy. Hydroplanes coverts potential energy stored in water tro kinetic energy imparted to a turbine and finally converted tt> electrical energy.

C. EROSION

in highly erosion prone cities like Onitsha, Enugu, etc erosion has accounted for as about 3 to 5 per cent of c power failure within these areas, the major supply power station with seven generating units and a capacity of 30MW spread evenly within the east central states.

D. HUMIDITY

The humidity of a particular area affects power equipment like transformers, and cables etc

E. TEMPERATURE

Temperature affects powers system equipment in diverse ways. EEDC installations breakdown due to temperature increase and the need to cool of this equipment down by the use of water reservoirs for transformer, oil coolant fans etc.

F. WIND

Heavy forces are exerted on cables and transmission line by the effect of wind, such forces as static drag force, static lift force, random gust force giving rise to random amplitude oscillation, high frequency, low amplitude vortex excitation, low frequency, high amplitude, oscillation of twin conductors is taking into consideration in high tension transmission line installation at EEDC station like the NCC Oshogbo 330kV transmission lines.

G. THUNDER AND LIGHTNING

Most equipment used by EEDC the consumer level of between llkV and 240V have lightning arresters but thunder on the other hand affects EEDC poles and cables. During thunder strikes of heavy rainfall, EEDC substations turn of power supply so as to prevent the short circuit effect of the collapse of poles and cables.

H. Mathematical Model of Factor Affecting Electrical Engineering Project

Lightning striker suppose that two people standing Imile apart both see a flash of light after a period of time, the first standing at point A hears the thunder two seconds later, the second person standing at point 13 hears the thunder.

Speed sound is approximately at 1100 feet per seconds (1100Ft/Secs).
Where

a=1100
then,
$2a = 2\ x\ 1100 = 2200$ (1)
X292-y2b2= l (2)
2C=5280
C=2640
b2=C2- a2
b2=26402-11002
b2=5759,680

X2(1100)2-y25759,600=l(3)
X=2640
(2646)211002-y25759,600=l
-y25759,600 + -(2646)211002
y2=27,415,695

y=5236Ft
M=0.99 mile due N(North)

The approximately of distance lightning flash = 10 mile

Thunderstorm, miles to seconds between lightning and thunder. In a thunderstorm, the formula M=t56 given the approximate distance M, in mile. In a lightning strike. If you are 10 miles away from seeing the lightning flash, low long will take the sound of thunder to reach you.

M=t56

When
M=10
101=t56
t = 56x10
t = 56 sec

Solving for the distance travel of lightning strike.
S=dt
d = st
S=the speed of sound=1100Ft/sec
t=56 sec
d=1100x56
d=61,600Pt
d=61.6km Ft

This is mathematically predicted on distance travel of lightning striker

I. Electric Field

Lightning is an electric current spark that starts goes between a cloud and the ground or sometimes it goes between two clouds when the ground is hot, it heats the air above it. As the hot air rises water vapor cools and forms a cloud. Lightning is caused by a kind of electricity called STATIC ELECTRICITY comes from tiny invisible electric charges. There are positive charges and negative charges.

Too much positive changes or negative charges ‘in different things make static electricity. If the negative charges in the cloud or the positive the charges in the ground. When either is greater than the other there is an opposition that causes a reaction that result to a lightning strike or called static electricity.

J. Solution Equations

-Ve -Ve +Ve -We
Cloud X Cloud Attraction Ground X Ground Lightning Strike
Initial (i) Final (f)Initial (i) Final (F) Static Electricity
-Ve -Ve
Cloud X Cloud repulsion Ground X Ground Electric Field
Initial (i) Final (f)Initial (i) Final (f)
The conservation of electric charge
Coulomb'slaw=fe=K9192r2
Equivalently, the electric field from a point charge is given

E=K91r2 (4)
Electric field strength
F=EQ (5)

Where the force on a nearby charge
F = QE. (6)

As the distance r, between two charges become small, the electric field become dramatically large r. this creates huge repulsive force, which is the main reason why Fusion energy source haven't been developed yet.

K. Incoming Particle "the target"
We can use energy consecration and potential energy to figure out how close two particle will get to each other.
KEi-f Pei= Kef+PEf=Constant (7)
KEl= 12Mr2 (8)
We will ignore the kinetic energy of the other particle be because it held fixed.
PE= K9192r (9)
Initial potential energy =; Pei
= K9192ri (10)
Final potential energy –Pef
= K9192rf (11)

The initial distance between two charges and r_f is the final distance between two charges.

If result KE_f = 0 the conservation equation simplifies to this

Kei + Pei = KEi. (12)
12MV2i + K9192ri= K9192rf . (13)
Express r_r in terms of M,r, $V_($, K, 9, $9_;$ and n
MV2iri + K91922ri = K9192rf (14)
rf= 2riK9192MV2iri + 2K9192 (15)
rf= lMV2i (16)

L. Conservation of Electric Charge
Generally, the rate of change in charge density P within a volume of Integration V is equal to the area Integral over the current density through the closed surface S = dv. which is in turn equal to the net current I.

-ddtvPdv= dvjrds = Jdscos=l

Thus, the conservation of electric Charge, as expressed by the continuity equation,
given the result t.
l=dQdt(17)

The charge transferred between time t, and $t_f$is obtained by Integrating both side
Q=.titFJdt (18)

Where I is the net outward current through a closed surface and is the electric charge contorted within the volume defined by the surface.

M. Laws of Conservation of Electric Charge

- The net charge of an isolated system always remains constant.
- Total charges on a body are equal to the algebraic sum of all the charges present on it.
- If a system starts out with an equal number of positive and negative changes there nothings we can do to create an excess of one Kind of charge. In that system unless we bring in charge from outside the system.
- Finally charge can be created or destroyed, but only in positive-negative pairs.

N. Anemometer and Wind vane mill.
Anemometer is a device used to measure wind speed and direction and can help in determine the strength of a storm. The anemometer situating the wind vane on a horizontal plane allows it to measure activity regardless of wind direction. The placement of wind vane is highly enough to avoid wind interference from objects, buildings and project. We can station them at points in the direction from which wind is coming towards on the roof of a building or moving away from area.

If the wind is flowing from East, the arrow will point to the east and predict some weather changes with the wind direction, like the device rotates from West to east, this indicates the pressure is low and stormy weather is overhead. If directions from south to south - west, we can predict that warmer air is coming.

VI. ELECTRIC DIPOLE

An electric dipole deals with the separation of the positive and negative charges found in any electromagnetic system. A simple example of this system is a pair of electric charges of equal magnitude but opposite sign separated by some typically small distance (A permanent electric dipole is called electrets.

CONCLUSION

The conservation of electric charge and electric dipole to solve the problem of static electricity by separating the two charges between positive and negative so that the two charges will not build up towards one another by some typically small distance through them.

REFERENCES

[1] AKPOTURI. P. E and OMIDIH. L.A "introduction to engineering fundamental" first publish in 2002.

[2] Emmanuel, K. Adda, el at "Trend of fire out breaks in Ghana and ways to present these incidents", published on line may 9,2016.

[3] Halilyurdakulyigitguden, "protecting electricity network from natural hazards", co-operation in Europe.

[4] yangliu, shunbobei, yunhehau, "Overhead transmission line outages rate estimation under wind storms," IEEE, transactions on electrical and electronic engineering, 17 July 2018.

[5] Edmonton, calgary, kelouna, Vancouver," project management project lifecycle" ICS engineering inc

[6] yuanxin(amy) yang alcocer, Amanda robb, "Natural disaster" 2018. [7]. Brucknert el at " Energy system climate change 2014: Mitigation of climate charge contribution of working group III to the fifth Assessment report of the intergovernmental panel on climate change,2014.

[7] field cb el at "Techinical summary climate change 2014: impacts, adaptation, and vulnerbility contribution of working group II to the assessment report of the inter government panel on climate change technical summary.

[8] Bulentovral, ferdunDonmez,"The impacts of natural disasters on power systems anatomy of the marmaras earthquake blockout, Actapolytechnicalhunganca, vol 7 No 2, 2010.

[9] Hugh Rudrick, "impact of natural disasters on electrical supply" IEEE power and Energy magazine 9(2) 22-26 may 2011.

[10] IJ.Ekpechiuesunday A.," Voltage breaker down in transmssion line system", September 30, 1995.

[11] www.physicsclassroom.coni

[12] www.explainthatstuff.com

[13] www.discovermagazme.com

[14] www.sciencedisrect .com.