THE IMPACT OF ELECTRICITY DISTRIBUTION TRANSFORMER VANDALISM ON ELECTRICITY UTILITY BUSINESS IN KENYA: CASE STUDY OF KENYA POWER AND LIGHTING COMPANY LTD.

BY

MOSES YASSIN MAJIWA

UNITED STATES INTERNATIONAL UNIVERSITY

SUMMER 2014
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MOSES YASSIN MAJIWA

A Project Report Submitted to the Chandaria School of Business in Partial Fulfillment of the Requirement for the Degree of Masters in Business Administration (MBA)

UNITED STATES INTERNATIONAL UNIVERSITY

SUMMER 2014
STUDENT DECLARATION

I, the undersigned, declare that this is my original work and has not been submitted to any other college, institution or University other than USIU in Nairobi for academic credit.

Signed: ___________________________ Date ___________________________
Moses Yassin Majiwa (SID: 628324)

This Project Report has been presented for examination with my approval as the appointed supervisor.

Signed: ___________________________ Date ___________________________
Dr. Paul Katuse.

Signed: ___________________________ Date ___________________________
Dean, Chandaria School of Business.
The study was to determine the impact of vandalism of Electricity Distribution Transformers on the electrical utility business with specific focus to Kenya Power and Lighting Company Ltd (KPLC) which is the sole electricity distribution and retail firm in Kenya. It adopted a case study approach which was guided by three research questions namely;

1. Why are Electricity Distribution Transformers being vandalised in Kenya?
2. What is the impact of Electricity Distribution Transformer vandalism to electricity utility business in Kenya?
3. What are the strategic responses by the electricity utility business?

Descriptive research methodology was employed in the study which involved the observation of Electricity Distribution Transformer vandalism incidences over a period of time and making inferences on the impact of these incidences to the electricity utility business in Kenya.

The study targeted a population of 363 interviewees divided into two categories. The first category comprised of 300 members of the public randomly selected from three sub regions of Kenya Power and Lighting Company Ltd namely Nairobi North, Nairobi South and Nairobi West respectively which formed the Primary Sampling Units (PSU’s). The second category comprised of 63 members of staff of Kenya Power and Lighting Company Ltd from departments directly involved with the electricity distribution infrastructure.

A two stage cluster sampling technique was used to collect data using structured questionnaires. The first stage involved the extraction of data of incidences due to Electricity Distribution Transformer vandalism from the Incidence Management System (IMS) database over the period 2005 to 2009. The areas within each sub region with high concentration of Electricity Distribution Transformer vandalism incidences were then mapped out as the focus areas for this study. Three hundred (300) questionnaires were then administered randomly to participants in the focus areas. A total of 282 (94%) were successfully filled out and returned.

From the second category of the target population, questionnaires were sent via email to 63 members of staff of Kenya Power. A total of 42 questionnaires were received back
representing a response rate of 67%. The statistical analysis software SPSS was used to capture and analyse all the data. The results were then presented using frequency tables, graphs and figures.

The major findings of the study revealed that the main reason for Electricity Distribution Transformer Vandalism was to obtain oil as per 246 (87.1%) of the respondents. The second major reason was found to be to obtain copper windings as per 196 (69.6%) of the respondents. It was also established that Electricity Distribution Transformer Vandalism constitutes a great loss of revenue to Kenya Power as per 31 (73.9%) of the respondents from Kenya Power. In an effort to address the Electricity Distribution Transformer Vandalism problem, the study revealed that the number of electricity customers who desire to be involved in providing solutions to the Electricity Distribution Transformer Vandalism problem (65.96%) was higher than the number of those who are already involved (53.90%). The study also showed that Electricity Distribution Transformer vandalism had an impact on both policy and strategic planning directions of various departments within the electricity utility firm Kenya Power as per the response from 31 (73.8%) of the respondents from within Kenya Power.

In order to improve the study, it is recommended that further research be carried out to estimate the revenue loss per Electricity Distribution Transformer per month for every EDT vandalism incidence.
ACKNOWLEDGEMENT

It is a great honour for me to have the health and energy to be able to undertake this work and for that I return all the honour and glory to God for granting me good health and seeing me through this project work and all it challenges.

I am grateful to my supervisor Dr. Katuse, for having accepted to guide me through this project, your encouragement; counsel and guidance have been invaluable.

I owe my deepest gratitude to my family for the sacrifice they have had to make for my absence in their lives as I concentrated on completing this work.

I am indebted to my friends and colleagues, who participated in the survey, feel special to have been a part of this work.

This project work would not have been possible without the university according me the opportunity to undertake the project and my employer for the consent to carry out the project using the company as a case, thank you for your support and the many resources availed to me to ensure that I completed the project successfully.
DEDICATION

To my mother, the late Salome Nyasaka Majiwa (1928 to 4th June 2009).
<table>
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<tr>
<td>CI</td>
<td>Critical Infrastructure: Infrastructure whose prolonged disruption could cause significant economic dislocation or loss of life.</td>
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<tr>
<td>EDT</td>
<td>Electricity Distribution Transformer. These are oil immersed, air cooled outdoor type pole mounted single or three phase distribution transformers for 11kV or 33kV electricity distribution systems operated at 50Hz. These transformers have the following ratios and ratings:</td>
</tr>
<tr>
<td></td>
<td>- 11000V/250V: 5KVA, 15KVA and 25KVA</td>
</tr>
<tr>
<td></td>
<td>- 33000V/250V: 25KVA</td>
</tr>
<tr>
<td>Eskom</td>
<td>Electricity Supply Commission of South Africa</td>
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<tr>
<td>IMS</td>
<td>Incidence Management System, a corporate information management system for the management of electrical faults in the KENYA POWER distribution system</td>
</tr>
<tr>
<td>Kenya Power</td>
<td>The Kenya Power and Lighting Company Ltd</td>
</tr>
<tr>
<td>KPLC</td>
<td>The Kenya Power and Lighting Company Ltd</td>
</tr>
<tr>
<td>MSPND&amp;V2030</td>
<td>Ministry of State for Planning, National Development and Vision 2030</td>
</tr>
<tr>
<td>OECD</td>
<td>Organization for Economic Co-operation and Development</td>
</tr>
<tr>
<td>REP</td>
<td>Rural Electrification Program</td>
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SAIDI – System Average Interruption Duration Index (SAIDI). It is expressed in the form of number of average minutes per year.

\[ SAIDI = \frac{\sum r_i N_i}{N_T} = \frac{CMI}{N_T} \]

WHERE

- \( r_i \) is the restoration time for each sustained interruption
- \( N_i \) is the number of customers interrupted for each power outage greater than five minutes during a given period
- \( N_T \) is the Total Number of customers served for the affected area
- \( CMI \) is the Number of customer minutes interrupted

SAIFI – System Average Interruption Frequency Index (SAIFI). It is expressed in the form of number of outages per year excluding major events.

\[ SAIFI = \frac{\sum N_i}{N_T} = \frac{CI}{N_T} \]

WHERE

- \( N_i \) is the number of customers interrupted for each power outage greater than five minutes during a given period
- \( N_T \) is the Total Number of customers served
- \( CI \) is the Number of customers interrupted

SME – Small and Medium Enterprises

Transnet – a large South African rail, port and pipeline company, headquartered in the Carlton Centre in Johannesburg

UNIDO – United Nations Industrial Development Organisation
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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the Problem
Electricity Distribution Transformer (Research and Development Department of KPLC, 2012) vandalism remains the greatest challenge to the electrical utility business in Kenya today. The vice acts to slow down the extension of electrical services to more Kenyans when it causes the sole electricity distribution company Kenya Power and Lighting Company Ltd (KPLC) to focus more on curbing the vice than making effective plans for the expansion of electricity services. Besides slowing down development, it causes a lot of losses to both customers and businesses alike. If the problem is not addressed, the vision of making Kenya a middle income nation by the year 2030 will remain stunted as the nation highly depends on electricity for its growth and development (Ministry of State for Planning, National Development and Vision 2030 [MSPND and V2030], 2007).

Kenya is a key state in the Eastern African region in relations to the Electricity Infrastructure. Future development initiatives for the electricity infrastructure in the region have always put Kenya at the centre of these plans making Kenya a strategic nation in relations to the regional electricity infrastructure interconnectivity (East Africa Community Secretariat, 2005). This important role means that Kenya has to ensure reliability of its electricity infrastructure network to guarantee a regional interconnectivity without single point of failure. However, (Bompard, Napoli, & Xue, 2008) noted that such development initiatives only lead to vulnerability of these interconnected systems.

Critical Infrastructure Protection (CIP) is a subject that has gained a lot of prominence in the world in the last decade to the extent that many nations have integrated it into their national security strategies. Studies conducted by the Crisis & Risk Network (CRN) of the Centre for Security Studies based at the Swiss Federal Institute of Technology have identified three key CIP trends that is Critical Information Infrastructure Protection (CIIP) which involves Continued Focus on the Cyber security Dimension, Energy Infrastructure Protection which involves Expanding Governance and International Cooperation and Public-Private Partnerships (PPP) which entails New Relationships and Challenges (Center for Security Studies, 2008).
The first and third trends are outside the scope of this study and only the electricity energy infrastructure component shall be considered in the second trend.

These trends have largely influenced the concept of CIP and governments have come to recognize the significance of different elements of infrastructure to their economy to the extent that such infrastructure has been classified as “critical” (Moteff & Parfomak, 2004). This has made the place of such infrastructure so important to the extent that great national resources are invested for their protection. Most governments have given the subject great prominence at policy level and have established standing committees (Fedorowicz, 2007) to handle the activities related to CIP on a day to day basis. The main drivers for this have been the experiences from disasters and the constant threat of terrorism and the need for assurance of safety and reliability for business continuity.

Having noted the importance of critical infrastructure at the international stage, Kenya by virtue of its positioning within the regional economic block also needs to put serious considerations into the emerging trends on CIP. There are three main reasons as to why this is important;

Firstly, the Kenyan coast is the landing point of key international fibre optic cables some of which have been channelled inland through the Kenya Power high voltage transmission power lines. It is worth noting that this key information infrastructure links the Kenyan coast to the African hinterland and has the potential of becoming a key information carrier for East and Central Africa to the rest of the world.

Secondly, Kenya has positioned itself for a long time as the hub for electric energy infrastructure interconnectivity within the region the East African region. This is because it has a relatively stable energy regime and is therefore strategically positioned to link northern grid in Ethiopia to the Southern Grid in Tanzania to the Western Grid through Uganda (East Africa Community Secretariat, 2005)

Thirdly, Kenya has the most robust economy in the East African Region and is therefore key in the Regional economic integration.

The World Bank’s Africa Infrastructure Country Audit report of 2008 observes that Africa’s largest infrastructure deficit is found in the power sector. This can be measured in terms of generation capacity, electricity consumption, or security of supply that is the security of the distribution system (Foster, 2008).
An efficient and effective electricity network provides energy for industrial expansion while also permitting substantive improvements in living standards for the general public. As one of the main pillars of the national developmental plan as envisioned in Kenya Vision 2030, the national agenda for the electrical utility company Kenya power is therefore to ensure adequate provision of electricity through robust secure electricity infrastructure. With the infrastructure deficit however and the perennial security challenges it is evident that to be able to achieve this feat for contribution to national development, the electricity Utility company must address the challenges that bedevil these efforts and deal with them substantively.

In a report of the Anti-Vandalism Committee to the Management Committee of 6th December 2007, Kenya Power noted that in the period of almost four (4) years between January 2004 and November 2007, the company had lost KShs 399million as a result of equipment failure caused by Vandalism. Seventy per cent (70%) of these losses were recorded in Nairobi Region, while 25% were recorded in Mt. Kenya region, the remaining 5% is distributed between Coast and Western Kenya Regions (Anti-Vandalism Committee, 2007).

Latest indications are that the vice is intensifying and the vandals have been swift to evade every measure the company has put in place so far, making it a great economic and social problem that needs immediate attention. It can be observed that without knowing the real cause of the problem, the company may be engaging in treating the symptoms of the problem, hence the need to conduct a comprehensive study to identify the root cause and therefore recommend precise measures that may result in the end of the menace or make the management of the vice effective.

This study endeavours to determine the cause of the Electricity Distribution Transformer vandalism in Kenya so as to prescribe effective measures to curb the vice. By effectively curbing the vice the important corporate resources such as manpower and financial resources deployed in the management of the vice from year to year will be released for deployment in meaningful development and growth activities of the business and in essence for the benefit of the national development agenda.

1.2 Problem Statement
The UN office on drugs and crime in its June 2005 report established that Africa has a serious crime problem and that this crime problem is undermining development efforts
The report further recommends the inclusion of crime prevention strategies in development planning initiatives. Even though the sort of crimes covered in this report are the drug-based crimes, it is important to note some of the observations from the report that the many development challenges facing the continent is making the continent pay little attention to crime where as it is the same development challenges that are the social factors that have been found to be highly associated with high crime situations internationally.

There are many motives for crime and some are attributed to economic hardships such as fraud as pointed out by experts where executives would cheat as they face more pressure to meet revenue and earnings targets for their stake holders (Levisohn, 2009). In other instances like in the case of Palestinian workers in Israel in the 1990’s, where a relationship between economic hardship among the Palestinians increased crime rate in Israel (Herzog, 2005).

According to Herzog (2005) it would be logical to argue that economic hardship produces a stressful situation of shortage, which, in turn, may increase the chances of people turning to crime to provide for individual or family needs. This may explain why businesses may become a target for crime especially during recession as they provide easy reach for the resources targeted by the criminals (Bressler, 2009). According to Bressler (2009), crimes committed against business can be separated into two categories: those committed by employees against businesses and those committed by others. Bressler (2009) identifies vandalism as one of the crimes committed against a business by other persons outside the organization.

Although vandalism is identified as one of the crimes committed against a business by other persons outside the business, not much study has been dedicated to vandalism as a crime and especially vandalism of electricity infrastructure. However, the British Home Office Police Research Group contends that vandalism is a perennial problem and combating it has, over the years, absorbed the time and energy of an enormous number of people. The research group also admits that the extent of the problem is usually difficult to assess however the British Home Office Working Group on the Costs of Crime in 1987 received evidence that vandalism against public buildings and services cost £500 million (Barker & Bridgeman, 1994). Bressler (2009) portends that today, crime occurs more often and the scope of the criminal activities is widening. Moreover, the cost of crime
continues to escalate and this leads to diminishing profits and even collapse of the business.

Vandalism of infrastructure in service oriented industries is experienced by many service providers all over Africa especially in the water sector, Oil industry, telecommunications as well as in the electricity industry and this tends to degrade the quality of service as well as have great impact on the quality of life of the public in general.

The electricity distribution infrastructure consists of the primary substation, the distribution lines, the secondary distribution substations also known as Electricity Distribution Transformer (EDT) as well as the low voltage reticulation (KPLC Operations and Maintenance Department, 1994). Theft of electricity infrastructure occurs mainly in the distribution lines and in the electricity distribution transformer (KPLC Operations and Maintenance Department, 1994). Although the two components of the distribution system are mostly targeted, it is the theft that involves the electricity distribution transformer that is of much concern for this study because it is more difficult to replace in a short time and at the same time it causes high and wider loses both to the company and to the public in general. This is due to the fact that the theft in the electricity Distribution Transformer involves the destruction of the transformer itself in order to access the targeted components an act which amounts to vandalism (KPLC Operations and Maintenance Department, 1994).

In Kenya, vandalism of Electricity Distribution Transformers remains the single most challenging problem for the electricity utility company to date. Distribution transformer vandalism costs the electrical utility business millions of shillings in replacement costs, lost man-hours and lost revenues aside from the negative image it gives to the company (Corporate Communications Department of KPLC, 2007). Besides, customers are also affected due to loss of equipment/appliances, loss of business value, insecurity, and degradation of quality of life.

With the increase in the vice the financial costs associated with the vice are expected to continue to rise, more corporate management resources will be spent in addressing the vice this is at the expense of concentrating on improving service efficiency and extension of the services to more Kenyans (Njoroge, 2009). The overall effect is that the economic growth of the country will be greatly affected as the drive towards the national goal embedded in Kenya Vision 2030 gets dimmed.
The study contributes to the knowledge of the impact of vandalism on the economy as it interferes with the strategic plans of the power utility company thus slowing the electricity utility’s development of sufficient electricity infrastructure capacity to sustain the country’s growth in electricity access and yet this is a key ingredient in the development agenda of the nation. The study will also seek to make a contribution on the knowledge of how vandalism poses a great threat to national security thereby hindering national growth as it stifles entrepreneurship and the development of small and medium sized industries. Besides, the study will show how vandalism denies the company the much needed revenue which in turn affects the company’s capacity to service its existing customers adequately vide its mission of providing world class power that delights its customers and thereby affecting the quality of lives of the nation.

1.3 Purpose of the Study
The purpose of this study was to determine the impact of Electricity Distribution Transformer Vandalism on the electrical utility business in Kenya.

1.4 Research Questions
The study was be guided by the following three (3) research questions.

1.4.1 Why are Electricity Distribution Transformers being vandalised in Kenya?

1.4.2 What is the impact of Electricity Distribution Transformer vandalism to electricity utility business in Kenya?

1.4.3 What are the strategic responses by the electricity utility business?

1.5 Importance of the Study
The study sought to identify the key cause of the Distribution Transformer Vandalism and its impact on the electricity utility business in Kenya. This may be of great importance to three key institutions in the energy sector in Kenya;

1.5.1 The Kenya Power and Lighting Company Ltd
This will help the electricity utility business in determining the precise measures that can be applied to stop the menace as it is costly to both the electricity utility company, consumers and national development. Aside from identifying the key cause of the distribution transformer vandalism, the study will attempt to establish the link between the cause of distribution transformer vandalism and the corporate strategy of the sole
electricity utility company, Kenya Power. The purpose here will be to see how the menace has pre-occupied the company in focusing on measures of curbing the vice rather than its core growth strategy. By identifying this link, the study will help the company refocus its energies into growth strategies being sure that the measures meted against the identified cause of the problem will be effective.

1.5.2 The Energy Regulatory Commission
The Energy Regulatory Commission (ERC) is the regulator of the Energy sector in Kenya. As an overseer of the sector which encompasses the electrical energy, one of the main objectives of ERC is to protect the interest of consumers, investors and other stakeholders. The impact of distribution transformer vandalism will therefore be of great interest to the ERC as it certainly affects the very groups whose interests they seek to protect.

1.5.3 The Ministry of Energy
The Ministry of energy (MoE) is mainly charged with the formulation, advancement and development of policies that govern the energy sector. It is through the Ministry of Energy that the Government of Kenya manages its energy resources. Any aspects that impact on the elements of the energy sector will thus be of interest to the policy makers of the sector and therefore this study will be of great benefit to the Ministry of Energy given that electrical energy infrastructure are key ingredient of the national development framework underpinned in the Kenya Vision 2030.

1.6 Scope of the Study
The study focused on Kenya Power Operations in Nairobi Region since this is the area which is most prone to Electricity Distribution Transformer Vandalism.

The sampling units were divided into two categories viz; those internal to the company and those external to the company.

Those internal to the company were picked from the departments that are critical in the strategy formulation and implementation as regards the design of electricity distribution system, purchase of electricity distribution transformers, installation of electricity distribution transformers and maintenance of the electricity distribution system. The questionnaire was thus sent by email to a total of sixty three (63) members of staff and they were required to fill and send it back.
For those external to the company, the study adopted two stage cluster sampling approach in obtaining its data and information. The primary sampling units were the three sub-regions in Nairobi Region namely Nairobi North, Nairobi South and Nairobi West.

The secondary sampling units were then determined by using information from the Kenya Power Incidence Management System (IMS) database on most affected Electricity Distribution Transformer installations. The most affected installations helped the study in mapping the specific geographic areas within each sub-region where the research data was obtained. Structured questionnaires were used to collect the data from the identified geographic areas which have experienced high incidences of Electricity Distribution Transformer Vandalism. A total of one hundred (100) questionnaires were distributed to participants picked at random from each of the sub-regions making a total of 300 samples data.

In total, a sample size of 363 was targeted in the survey for the study, 300 in category one and 63 from category two of the interviewees.

1.7 Definition of Terms

1.7.1 Infrastructure
The basic facilities, services, and installations needed for the functioning of a community or society, such as transportation and communications systems, water and power lines, and public institutions including schools, post offices, and prisons (Dictionary, 2000).

1.7.2 Critical Infrastructure
“Critical infrastructures are organisations and facilities of major importance to the community whose failure or impairment would cause a sustained shortage of supplies, significant disruptions to public order or other dramatic consequences.” (Gordon & Dion, 2008).

1.7.3 Critical Infrastructure Protection
Refers to preventive security measures as well as concrete defence against immediate dangers or criminal prosecution after a crime has been committed against a critical infrastructure (Brunner & Suter, 2009).
1.7.4 **Electricity Distribution Transformer**
Electricity Distribution Transformer refers to a transformer with a primary voltage of equal to or less than 35 kV, a secondary voltage equal to or less than 600 V, a frequency of 55-65 Hz, and a capacity of 10 kVA to 2500 kVA for liquid-immersed units and 15 kVA to 2500 kVA for dry-type units. It is used for transformation of electrical energy from medium voltage to low voltage that can be used by consumers (US Department of Energy, 2006).

1.7.5 **Nairobi Region**
This is the operational area of KENYA POWER encompassing Nairobi city and its environs. It is divided into three sub-regions namely Nairobi North, Nairobi South and Nairobi West (Kenya Power and Lighting Company Ltd, 2009).

1.7.6 **Sabotage**
The intentional disruption of the Electrical power distribution system (US Congress Office of Technology Assessment, 1990).

1.7.7 **Vandalism**
Wilful or malicious damage to property, such as equipment or buildings (Scott, La Vigne, & Palmer, 2007).

1.7.8 **Incidence**
An occurrence in the electricity distribution network that causes an interruption in the distribution of electrical power (Kenya Power and Lighting Company Ltd, 1999).

1.8 **Chapter Summary**
This chapter has provided an introduction to the topic of research. The background of the problem has been presented in a clear and concise manner. The statement of the problem has also been presented in the chapter giving rise to the research questions that are to guide the research which have also been presented. The chapter has also defined the purpose of the study as well as give the justification for undertaking the study. A summary of the scope of the study has also been given in the chapter and finally, some of the terms used in the research report have been defined under the definition of terms.

The chapter two that follows shall cover the literature review on Electricity Distribution Transformers vandalism in Kenya. The literature review will encompasses what is known
about Electricity Distribution Transformer vandalism and any relevant studies on the subject or related materials that support the basis for this study.

Subsequently, in chapter three, a review of the Research Methodology that was used in the study of the impact of Electricity Distribution Transformer vandalism on electricity utility business has been discussed. The research design that was used has been presented and a justification for the chosen design given. The characteristics of the population and the sample size have also been reviewed. The data collection methods that were used have been outlined. Finally the chapter outlines the data analysis techniques that were used in analysing the collected data.

Chapter Four on the other hand presents the results of the study. The results presented are consistent with the research design that had been chosen and the research methodology that was adopted.

The last chapter in this report, chapter five discusses the results of the study as presented in chapter four. The results of the study are discussed in relation to the problem statement and research questions as were presented in chapter one. In the discussion of the results the significant findings are presented together with the interpretation of the results. A conclusion is then drawn from the discussion and recommending for further studies made.
CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

This chapter reviews the literature on Electricity Distribution Transformer vandalism and its impact on electricity utility business. The literature review was largely guided by the research questions and reviewed existing information that formed the foundation for the current work.

The literature reviewed focused on why electricity distribution transformers are vandalised, the various facets of vandalism and the factors motivating distribution transformer vandalism. Internal and external factors contributing to EDT vandalism were reviewed. The literature review also covered how the distribution transformer vandalism impacts on electricity utility business in Kenya. Finally, the literature review covered the strategies deployed by various actors in the management of electricity distribution transformer vandalism.

2.2 Reasons for Electricity Distribution Transformer Vandalism

In a Power Infrastructure Security report (Wei, Lu, Skare, Jafari, Rohde, & Muller, 2009) observed that current power transmission and Distribution systems (all over the world) were designed for performance and not security. These power systems are therefore increasingly being exposed to security threats both physical and otherwise. Although modern grids are designed with security consideration, major security challenges still face the existing power networks, this is in spite of the fact that provision of electricity is by far the greatest infrastructure challenge for Africa to meet its economic growth prospects (UNIDO, 2008).

In the United States of America’s the Department of Homeland Security (DHS) reported in its Daily Open Source Infrastructure report that copper cable thefts had accelerated after the increase in the cost of copper in the market from $1.29 per pound in early 2009 to a high of $3.79 per pound in June 2010 (US Department of Homeland Security, 2010). The report records that there were 17 incidents of copper thefts in a period of eight (8) months affecting one electrical utility firm United Illuminating Co. (UI) in Bridgeport, Easton, Fairfield, Orange and other Connecticut towns where the amount of copper cable stolen totalled about 6,000 feet. The other utility firm affected by infrastructure theft was
Connecticut Light & Power where thieves removed $60,000 worth of copper from a substation with an intention of disposing it off to scrap metal dealers.

Physical threats to electricity infrastructure are observed to be on the increase by electrical utilities across Africa especially in South Africa, Nigeria and even Kenya. The US Energy Information Administration (2005) in its country analysis of Nigeria notes that endemic blackouts are partially explained by the widespread vandalism and theft in the electricity infrastructure.

In South Africa, the main metals targeted by vandals are copper and aluminium (Yorke-Smith, 2010). Yorke-Smith (2010) notes that the South African Parliament took the issue of metal theft head on in August 2010, this was after the Democratic Alliance’s shadow deputy minister of public enterprises, Pieter van Dalen, highlighted the repercussions of this vandalism on the likes of Transnet and Eskom whose combined losses due to copper theft amounted to a loss increase of 38.1% in 2008/09 and replacement costs increasing by 57.4%. Yorke-Smith further reported that the Democratic Alliance party went ahead to recommend a nine step action strategy which included the empowerment of the focused group Non-Ferrous Theft Combating Committee (NFTCC) which was formed in 1993 to fight the theft of copper cables and other non-ferrous Metals (NFM) theft in the country, the committee comprises major role-players such as the South African Police Service (SAPS) and Eskom.

In Kenya on the other hand, not much study has been done or conducted in the area of theft of metals or acts of vandalism. Many of the reports of incidences of vandalism have largely been in the corporate news of telecommunication firms such as Telkom Kenya and Kenya Data Networks (KDN) in relation to telecommunication cable cuts or the Kenya Power in relation to vandalism of Electricity Distribution Transformers. It is not clearly known as to what motivates the vandalism of the electricity distribution transformers and therefore this study intends to investigate the factors that could partly explain the cause of electricity distribution transformer vandalism. They include perceived economic gains to be derived from parts of the distribution transformer, Economic sabotage and the possibility of the corporate strategy being a contributor to fanning the vandalism.
2.2.1 Economic Factors

2.2.1.1 To Obtain Oil
Kenya is a low income country and the poverty levels are high, because of this the cost of living becomes unbearable especially for the low income earners in the society and specifically those living in the slums in urban centres.

Due to the high costs of living, many slum dwellers often run informal businesses to earn themselves a living or supplement their daily income from other sources. Such businesses include open air preparation of food items such as French fries, deep fried fish etc. It is believed that such businesses provide fertile market for the transformer oil. This is because Transformer oil is stable at both high and low temperatures and is not susceptible to oxidation and therefore can be re-used over and over without depletion hence giving a higher margin to the small scale business people. However, studies have shown that the use of this oil is harmful to human health and can cause cancer (Ronneberg & Skyberg, 1988).

2.2.1.2 To Obtain Copper Windings
Copper thefts are occurring throughout the United States and are perpetrated by individuals and organized groups motivated by quick profits and a variety of vulnerable targets. The thieves threaten critical infrastructure by targeting electricity substations, cellular towers, telephone land lines, railroads, water wells, construction sites, and vacant homes for lucrative profits. The theft of copper from these targets disrupts the flow of electricity, telecommunications, transportation, water supply, heating, and security and emergency services and presents a risk to both public safety and national security (Federal Bureau of Investigations, 2008).

This scenario is replicated almost in toto throughout the world. Kenya experiences similar threats largely to its distribution transformers which more often than not are left as shells after the vandals remove the targeted copper windings.

2.2.2 Business Factors

2.2.2.1 Sabotage
Electric power system components have been targets of numerous isolated acts of sabotage in the United States. Several incidents have resulted in multimillion-dollar repair bills. In several other countries, sabotage has led to extensive blackouts and considerable
economic damage in addition to the cost of repair (US Congress Office of Technology Assessment, 1990).

In this research we shall investigate the potentiality of acts of sabotage being factors encouraging vandalism.

### 2.2.2.2 To Bring Down the Monopoly Firm

Since the late 1980’s, worldwide trends in electricity regulation have seen variants of what may be called “standard model” gradually implemented (Littlechild, 2003). This model is characterised by a combination of different aspects such as separation of the transmission company, privately owned and competing generation companies bidding into a pool, all or part of the retail market open to competition, privately owned transmission network with third party access with published terms, privately owned distribution network with 3rd party access with published terms and an independent regulatory body.

The model has been implemented both in developing and developed countries. And not all components are always there in full but vary from country to country.

The Kenyan scenario is a typical variant of this model and consist of the following:

i) **Generation:** The largest power generation company Kenya Electricity Generating Company Ltd (KENGEN) is a parastatal contributing over 75% of the power demand (KENGEN, 2009). Independent Power Producers (IPP’s) who command the generation of 25% of the power demand (Kenya Power and Lighting Company Ltd, 2009), and lately government owned Geothermal Development Corporation (GDC) (Ministry of Energy, 2004).

ii) **Transmission:** Separation of transmission function into a government owned entity known as the Kenya Electricity Transmission Company Ltd (KETRACO) (Kenya Power and Lighting Company Ltd, 2009).

iii) **Distribution:** A semi-private distribution network owned by KENYA POWER a public utility company with government majority shareholding (Kenya Power and Lighting Company Ltd, 2009). Retail of electricity done by power distributor KENYA POWER and an Independent regulator the Energy Regulatory Commission (ERC) that oversees the regulation of the entire energy sector including the electricity sub sector.
The electricity utility businesses in Kenya therefore remain in a semi-deregulated state since the many entities are largely owned by government. The firms are also monopolistic in nature due to historical business facts and the nature of the business that is infrastructure intensive.

It is therefore possible that part of the scheme of attacks against electrical power utility business is orchestrated by those intent on bringing down the monopolistic structure in Distribution and retail of electrical power to a halt.

2.2.2.3 To Obtain Business Advantage
Electrical utility businesses especially in Africa remain in a state of semi-deregulated since they are largely owned by government. The firms are also monopolistic in nature due to historical business facts and the nature of the business that infrastructure intensive (Onyango, Njeru, & Munga, 2011).

Since the 1990’s, it has been the desire of the world to see the electricity sector liberalised to offer opportunities to other players with a view to improve services and escalate electricity access (Bacon, 1999). However this has not been very successful due to the huge capital requirements for such ventures and the current ownership of national electricity infrastructure by existing electricity businesses.

Kenya Power is the sole firm charged with the transmission, distribution and retail of electrical energy in Kenya and this situation portends a monopolistic scenario despite the amendment of the Electric Power Act of 1997 to facilitate competition at all levels of generation, distribution and supply. This could be one of reasons why it is prone to vandalism related attacks to sabotage its activities to the advantage of potential business rivals.

2.2.3 Corporate Strategy Dimension

2.2.3.1 Review of Procurement System
The public procurement system in Kenya has been riddled with corruption prompting the government to initiate reforms in the sector in 2003 to introduce procurement standards and control procedures (Public Procurement Oversight Authority, 2007).
It will be of importance to investigate the impact of these reforms in the procurement of distribution transformers and ancillary equipment to determine whether the current procurement system contributes to the vandalism of transformers.

2.2.3.2 The High Scaled Extension of the Distribution Network

In 2003 when the new government of Kenya under the National Rainbow Coalition (NARC) party came to power, one of the key objectives was to revive the economy. This was to be guided by the Economic Recovery Strategy for Wealth and employment creation of 2003 (Ministry of Planning and National Development, 2003). One of the key pillars of this strategy paper was the development of electricity infrastructure and increase connectivity to the electrical grid. The Ministry of Energy therefore handed the sole power distributor Kenya Power a target of connecting 120,000 customers annually to be able to achieve this target. This target was later revised to 150,000 customers annually (Ministry of Energy, 2003) and eventually to 200,000 customers annually (Kenya Power and Lighting Company Ltd, 2009).

To be able to achieve this target, Kenya Power employed several strategic responses one of which was to engage external contractors for the design and construction of electricity distribution network. This was to help speed up the development of the distribution infrastructure as well as escalate connectivity of customers to the grid. The engagement of the contractors immediately bore fruits as Kenya Power saw rapid increase in the customer connectivity reaching the one millionth customer by the end of June 2008 when it ended the financial year with 1,063,388 customers in its roll (Kenya Power and Lighting Company Ltd, 2009).

On the other hand, the use of the external contractors by Kenya Power opened the avenue of having external personnel who the company has no direct control of to have almost unbound access to the electricity distribution network hence exposing it to potential additional risks such as EDT vandalism.

2.3 Impact of Electricity Distribution Transformer Vandalism

The immediate result of a successful Electricity Distribution Transformer Vandalism is power outage to the customers connected to the affected transformer. The same EDT vandalism would in some instances result into a transient fault that may affect the other portions of the electrical network, however, this is beyond the scope of this research
which shall be limited to the power outage affecting the customers in the vicinity of the vandalised EDT.

Power Outages have impacts that are both direct (the interruption of an activity, function, or service that requires electricity) and indirect (due to the interrupted activities or services). Examples of direct impacts include food spoilage, damage to electronic data, and the inoperability of life-support systems in hospitals and homes. Indirect impacts include property losses resulting from arson and looting and insecurity. Direct and indirect impacts can be characterized by whether they are quantifiable in monetary terms (economic impacts); relate to the interruption of leisure or occupational activities (social impacts); or result in organizational, procedural, and other changes in response to blackout conditions (organizational impacts) (US Congress Office of Technology Assessment, 1990)

On August 14, 2003, the largest power blackout in North American history affected an area with an estimated 50 million people and 61,800 megawatts (MW) of electric load in the states of Ohio, Michigan, Pennsylvania, New York, Vermont, Massachusetts, Connecticut and New Jersey, and the Canadian province of Ontario. Beginning a few minutes after 4:00 p.m. Eastern Daylight Time (16:00 EDT), the blackout left some parts of the United States without power for up to four (4) days. Though all of Ontario customers’ supply was restored within two (2) days, many customers responded to the Ontario Government’s appeal to reduce consumption by 50% during the following work week. The power supply was restored to normal and restored to all Ontario customers by August 22, 2003 (almost eight days after it started). Estimates of the total costs caused by the blackout in the United States ranged between $4 billion and $10 billion (U.S. dollars). In Canada, the gross domestic product was down 0.7% in August 2003, there was a net loss of 18.9 million work hours, and manufacturing shipments in Ontario were down $2.3 billion (Canadian dollars) (Hilt, 2006). Following this blackout, both American and Canadian authorities formed a task force whose mandate was to investigate the outage to determine its causes and why it was not contained, and develop recommendations to reduce the possibility and scope of future outages (Flack & Kolevar, 2006). Although this blackout was not caused by vandalism per se but it goes to demonstrate the impact of blackouts not only on human lives but onto the economy.
One of the key objectives of electric power utilities is to provide adequate electricity supply with reasonable level of reliability (Wacker & Billinton, 1989). However, power blackouts are a major impediment to this function. Wacker and Billinton (1989) found that unreliable power supply has a cost to the customer. They say that, to a customer, the cost of the blackout is related to the number and degree to which the activities that have been interrupted are dependent on electricity supply, the type of customer and the size of operation the customer is engaged in. As such the cost of power blackout can vary from as small as that of a small household to as large as that of a rapidly growing medium enterprise or a small industrial set up.

The customer interruption cost is defined as the economic losses consumers experience as a result of interruption of electric power service or power quality problems (Sullivan, Noland, Vardell, & Vijdani, 1996).

While not considering the nature of power interruption, Wacker and Billinton (1989) concluded that on average, a power outage that lasts 20 minutes has a cost of 0.22 Canadian Dollars to a residential customer, 131 Canadian Dollars to a commercial enterprise, 6185 Canadian Dollars to an industrial entity and 37308 Canadian Dollars to a large user per interruption. The longer the duration of the power outage, the higher the customer interruption cost would become.

Europe is one of the regions of the world which has in the recent past experienced an unprecedented degree of electricity supply security where the duration of unplanned power outage per market participant ranges from 15 minutes (Germany) to 465 minutes (Slovakia) per annum (Mogg, 2012). This is the level of electricity supply security that is enthused by every utility company including the Kenya Power who have since adopted the pursuit of “providing world class power that delights our customers” as its vision with a hope of reaching or surpassing such a status. The electricity supply reliability in Europe is however not guaranteed due to the market transformation in the region that is affecting the security of supply (Reichl, Schmidthaler, & Schneider, 2013). The factors affecting the electricity supply security in the European market are however known and controllable. This knowledge is important in the pursuit of world excellence in electricity supply services.

Reichl et al, 2013 argues that knowing the value of uninterrupted electricity supply is of paramount importance as it helps to balance between the benefits of electrical reliability.
improvement and infrastructure investment. In modelling the non-household consumer’s economic losses in the event of power outage, Reichl et al, 2013 assessed the direct outage costs, indirect outage costs and the macroeconomic consequences of a perceived long term change in the level of electricity supply. This was done and extrapolated to determine the outage costs at the national level in Austria. They concluded that efficient infrastructure investment decisions are possible only if the value of electricity supply security to the society is known. Furthermore, their research established that the effect of a simulated 12hor power outage in all of Austria were disturbing to nearly all households and non-household consumers where the households account for 22.9% of the electricity shortfall and for 5.9% of the total losses which amounts to 478 million Euros.

In South Africa, (Von Ketelhodt & Wöcke, 2008) noted that Small and Medium Enterprises (SMEs) were regarded as particularly important to the country at its current stage of development. The study targeted 2 900 of the 4 000 SMEs who were members of the Cape Town Chamber of Commerce and it was found that the impact of electricity crisis was quite extensively felt by these businesses, and most of these businesses reported loss of trade or productivity due to carrying the cost of overheads while not trading. The majority of the SMEs (89%) were heavily dependent on a stable supply of electricity, while 69% felt that they were severely impacted by the outages. An overwhelming majority (80%) also felt that they had lost business due to the lack of stable electricity supply. In South Africa, SME’s contributed between 45% to 50% of the country’s GDP and employ more than 50% of all formally employed people in that country (Business Owner, 2006). As the target key drivers of industrial growth in South Africa, the vulnerability of the SME sector to volatility in the macro-economic environment is of key concern, concluded (Von Ketelhodt & Wöcke, 2008). They further observed that more loses included damage to and loss to equipment in an old age home, failure of cold rooms which cost a fruit exporter economic loss, computer failure during critical software development process that led to the replacement of computers and loss of productivity. Other losses observed in the study included loss of international clients for a small manufacturing operation due to failure to meet deadlines. Others had to install generators in a cold room for food supplies, a cost that would have been used as capital for that business. The study concludes that unstable electricity supply threatens the survival of SME’s. The major impact of unstable electricity supply is on loss of revenue and customers due to downtime, failure to complete contracts on time and increase in
overheads as well as unanticipated loss of productivity. As such the study found that stable electricity supply is critical for the sustainability of SME’s which are major drivers of economic growth.

Nairobi is among prominent cities of Africa where electricity supply services have historically been considered reliable but have recently been in the news for blackouts (Burlando, 2010). Although his study focuses on the blackouts caused by power rationing, it is acknowledged that incidences of electricity Distribution Transformer Vandalism now also contribute to a substantial portion of these blackouts in Nairobi especially in the residential areas. In the study of a one month long power cut in Zanzibar, Burlando (2010) further found that the power cut caused a large decline in household income among those employed in occupations that require the use of electricity. Workers relying on artificial lighting reduced work hours by an average of 8%, or 40 minutes per day. Workers relying on power specialized power tools saw steeper declines, in the order of 35%, corresponding to 2.8 hours of work per day. Using birth records from a large maternity ward, he also documented a reduction in the average birth weight of children with in utero exposure to the blackout, and an increase in the probability of these children having Low Birth Weight.

2.4 Strategic Responses to Electricity Infrastructure Failures

2.4.1 Responses to Electricity Infrastructure Failure due to severe weather
Severe weather is the leading cause of power outages in the United States of America, where such an occurrence would result in closure of schools, shutting down of businesses and is an impediment to emergency services. To mitigate against this, the government adopted the resilience of the electric grid system as part of the nation’s defence against severe weather (President’s Council of Economic Advisers, U.S. Department of Energy, & Office of Science and Technology, 2013). Grid Resilience is thus becoming an important component in the strategies of mitigating against outages caused by severe weather in the wake of increasing uncertainties from climate change effects.

According to the report presented to the president of the United States, Grid Resilience has even become a core requirement for climate adaptation. It involves reconstitution and general readiness of the electric grid such as pole maintenance, vegetation management, use of mobile transformers and substations as well as mutual assistance groups (U.S. Department of Energy, 2010). The report outlines the priorities of Grid Resilience as risk
management, cost effective strengthening, increase of flexibility and robustness and to increase visualisation and situational awareness.

The major reason for the high involvement of the US administration to the mitigation of power outage is due to the impact of these outages to their economy. Between the years 2003 and 2012, there were 679 power outages caused by severe weather. These accounted for 58% of the power outages observed during that period. Eighty Seven percent of the power outages affects 50,000 customers or more (US DOE, Form OE 417). Furthermore, since 1980, the US has suffered 144 weather disasters whose damage cost reached or exceeded USD 1billion. The actual cost of the events have exceeded USD 1Million (US Department of Commerce, 2013). The US Department of Commerce report, 2013 estimates that the average annual costs of power outages caused by severe weather at between USD 18billion and USD 33Billion per year.

2.4.2 Fault Management

In Kenya, EDT vandalism would more often than not result in a power outage. The affected customers would traditionally notify the power utility firm Kenya Power through phone calls or via social networking tools of the power outage (KPLC Corporate Communications Department, 2010). In many instances the customers would not know the cause of the power outage and would only be complaining of the outage itself. It thus takes some time of investigation by the electrical utility technicians to actually establish the cause of the outage. In the event that the cause is identified as resulting from an EDT vandalism, the customers agony would commence as this signals the long wait for a resolution of the problem. This is because the resolution of such faults would involve the replacement of a vandalised EDT which would take more than 24 hours at the minimum (KPLC Operations and Maintenance Department, 2012).

It is always the objective of the power utility to reduce the outage time since such outages have great impacts on the bottom line of the business due to loss in sales as well as increase in maintenance costs which increase the operational costs among other effects. To effectively manage electricity distribution networks, power utility firms would always keep monitoring the network reliability indices. The System Average Interruption Duration Index (SAIDI) and System Average Interruption Frequency Index (SAIFI) are the two most commonly used indices (Power Systems Engineering Research Center, 2009). These reliability indices defined by the IEEE standards are used to evaluate the
impacts of faults on the power distribution performance (Power Systems Engineering Research Center, 2009) and they give the measure of the frequency of outages, the length it takes and how they impact on the electricity distribution system. The traditional method of power outage management involves fault detection, location and clearance of the fault (Power Systems Engineering Research Center, 2009). The time taken between a report of an outage and fault location is usually the greatest determinant of the overall time to be taken to clear the fault. The shorter the time taken to determine the cause of the fault the better. In instances where the electricity distribution system is not automated, the manual fault location method is applied for the detection and location of the fault. This method is more time intensive and aggravates the power outage effects on the customers. Kenya Power uses the Incidences Management System (IMS) to manage customer complaints related to power outages as well as the faults on the electricity distribution system. This is an information management system where when customers notice a power outage and call the power utility to register their power outage complaints, the complaint is entered into the IMS system and an automatic tracking number is generated. The customer is furnished with this number for tracking of the complaint resolution process. Once a complaint is recorded in the IMS system, all the electricity distribution network facilities that supply the customer are linked to the complaint. Further calls by customers affected by the same fault would automatically be associated to this fault for ease of management. Emergency desk controllers would also be able to view the complaints that have been reported through the IMS and dispatch technical personnel to go and investigate the cause of the faults and possibly clear them (KPLC Operations and Maintenance Department, 2000). In cases where the fault is caused by EDT vandalism, such an outage would last longer due to the processes required to resolve such a problem.

2.4.3 Willingness to Pay

In developing countries like Sweden, power outages for households might be seen to be a small problem since the outages are both few in number and short in duration (Carlsson & Martinsson, 2004). For example, Swedish households located in populated areas experienced an average of 0.08 planned power outages per year and 0.39 unplanned power outages per year in the period 1998 to 2001.

The Swedish electricity Distribution market is fully liberalised and is part of the Nordic wide market with various tariffs. In Kenya, which is the set up in our study, the market is largely a monopoly with tariffs managed by the industry regulator.
Carlsson & Martinsson (2004) conducted a contingent value study that aimed at estimating the Willingness to Pay (WTP) among Swedish households for the reduction of power outages with various characteristics such as duration and whether the outage is known beforehand or not. There were nine different types of outages that respondents were asked to state their WTP to avoid such outages. The study concluded that increasing dependence on electricity is a factor that points to the importance of studying the welfare effect of power outages. On the WTP, the study found that the WTP to avoid power outage has increased compared to the previous Swedish study conducted in 1996. It was however substantially lower than corresponding estimates in similar countries like Norway and the United States of America. The study also found that there is significant difference in WTP for planned and for unplanned outages with the uncertainty of the duration of the outage being a major determinant of the WTP. This means that the information about the expected length of an outage is very important to households. This in turn implies that the true value for the unplanned outages could probably be higher according to the study.

2.4.4 Alternative forms of basic supply of electricity

Alternative forms of basic energy supply are another method through which consumers try to manage power outages. Some consumers respond to power outages by equipping themselves with alternative forms of basic supply for their energy needs. The primary need of most consumers would be lighting, as such they may equip themselves with any form of energy that would supply them with that lighting. Such forms of energy may include candles, lanterns and the like. For SME’s and industrial consumers, the choice is between making do with the power outage or equipping the enterprise with a backup power supply system.

According to the Ikeja branch of the Manufacturers Association of Nigeria, in 1997, 65% of the working hours of the manufacturing companies in Lagos, Nigeria were lost to power outage (Adenikinju, 2003). This was mainly due to poor electricity supply. Electricity supply is both unstable and of very low quality (Adenikinju, 2003). Adenikiju (2003) further identifies five ways by which such firms may respond to unreliable electricity supply as choice of location, factor substitution, private provision, choice of business and output reduction. Out of the five, private provision has been most common approach among the Nigerian firms. The next alternative is to avoid altogether any business that is electricity insensitive. The study by Adenikiju (2003) also identifies...
power and voltage fluctuations as the major obstacle to the operation of the manufacturing firms in Nigeria.

In another study, adequate electricity was identified as one of the prerequisites of manufacturing productivity (Olayemi, 2012). However, in the Nigerian case, Olayemi (2012) says that the crisis is represented by power outage and persistent reliant on self-generating electricity.

In Kenya, one of the major causes of power outage is vandalism of electricity distribution infrastructure (KPLC Corporate Communications Department, 2007). The government of Kenya through the Ministry of Energy, Kenya Power and industry regulator, The Energy Regulatory Commission (ERC) have lobbied the Kenyan Parliament to put in place measures to manage energy infrastructure vandalism under the laws of Kenya (The Parliament of Kenya, 2012). However, these measures have not been successful given the prevalence of the problem. With the emerging trends world over of infrastructure vandalism, it is important to have these measures scaled up to be able to meet the challenges of the emerging threats to electricity utility infrastructure so as to enable the electricity utility business measure up to the world standards and offer anchorage to the essential electricity network interconnectivity that is essential for the business world of today.

Going by the trends of vandalism in Kenya, the perpetrators seem immune to the efforts to manage the menace as reports show increased activities by the Vandals (KPLC Operations and Maintenance Department, 2012). Indeed the state of affairs indicate that the vandalism attacks may be sporadic and far between with relatively minimal implications, however, this may only be providing training avenues for the vandals and in the near future it is not known the scales of attacks that these vandals may be capable of. To avert this possibility new frontiers need to be unveiled to manage the menace not only for this purpose but also to ensure that resources that would otherwise be used for development is not wasted in mitigating vandalism. This study will thus review the current mechanisms of managing the vice with a view to evaluating their weaknesses. This will then form the basis for making suggesting for more effective efforts.

2.4.5 Other Strategic Responses to Electricity Infrastructure Failure
The world is becoming a global village and the trend is expected to continue with the speed of global integration becoming accelerated more than ever before (Zhao, 2006).
This only means that Kenya being part of the global village must adopt world standards in its operations to ensure that its systems including electricity utility infrastructure protection mechanisms match the world standards. This is essential so as to facilitate electricity infrastructure interconnectivity to support global businesses with minimal or no interruption. Novel infrastructure protection mechanisms will thus be reviewed.

2.5 Chapter Summary

This chapter has reviewed the literature on the key subject of the study. The literature review was guided by the research questions. To begin with, published work on infrastructure vandalism in the world, Africa and indeed Eastern Africa specifically Kenya was reviewed. The review also covered the vandalism management strategies. Various materials were used in reviewing the literature and these included journals, books, government documents as well as company annual reports. The next chapter reviews the research methodology that was adopted in carrying out this study.
CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Introduction
This chapter presents the methodology and procedures that were used to carry out the study on the impact of Distribution Transformer Vandalism on Electricity Utility Business in Kenya. The research design chosen is presented here with justification of the choice in appropriateness for the study. The population and sampling techniques that was used are also discussed. Subsequently, the data collection methods that were used are also discussed and the research procedures presented. Finally the section addresses the data analysis methods that were used to analyse the data that had been collected. The methodology adopted was guided by the following research questions; Why Electricity Distribution Transformers are vandalised in Kenya? What is the impact of distribution transformer vandalism to electricity utility business in Kenya? What are the strategic responses by the electricity utility business?

3.2 Research Design
This study adopted a case study approach as the most appropriate method to be able to study the trend of distribution transformer vandalism and its impact on electricity utility business in Kenya. (Yin, 2003) defines a case study research method as an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used.

Distribution transformer vandalism has become a day to day phenomenon in the electricity utility business in Kenya and Kenya Power has lived with the consequence without really knowing the actual impact on its business. The study sought to look at the phenomena in its historical context. Case studies are usually based on an in-depth investigation of a single individual, group, or event to explore causation in order to find underlying principles. This therefore makes the method adopted greatly appropriate for the study of the impact of Electricity Distribution Transformer vandalism on electrical utility business in Kenya.

As opposed to experimental research approaches where the researcher uses samples and following a rigid protocol (strict set of rules) to examine limited number of variables, case
study methods involve an in-depth, longitudinal (over a long period of time) examination of a single instance or event, that is, the case. Case studies provide a systematic way of looking at events, collecting data, analysing information, and reporting the results. As a result of conducting the case study, a researcher ends up gaining a broad and deep understanding of the phenomenon and why it happened as it did. The case study may also expose some important aspects of the case that may need to be looked at in future research.

Case study approaches have therefore been found to be most useful where there is need to understand some particular problem or situation in great-depth (Noor, 2008).

3.3 Population and Sampling Design

3.3.1 Population

The Kenya Power has a total of 18,615 Electricity Distribution transformers in its national distribution network supporting a total of 1,267,198 customers countrywide (Kenya Power and Lighting Company Ltd, 2009).

Table 1: Kenya Power Customers per region

<table>
<thead>
<tr>
<th>REGION</th>
<th>CUSTOMERS</th>
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<tbody>
<tr>
<td>Nairobi</td>
<td>595,010</td>
</tr>
<tr>
<td>Coast</td>
<td>139,245</td>
</tr>
<tr>
<td>West Kenya</td>
<td>200,266</td>
</tr>
<tr>
<td>Mt. Kenya</td>
<td>127,390</td>
</tr>
<tr>
<td>KENYA POWER Customers</td>
<td>1,061,911</td>
</tr>
<tr>
<td>R.E.P. Customers</td>
<td>205,287</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>1,267,198</strong></td>
</tr>
</tbody>
</table>

Source: KPLC Annual Report and Financial Statements 2009

Thirty one per cent of all Kenya Power transformers (5814) are in Nairobi Region supporting 595,010 customers which is equivalent to 47% of all Kenya Power Customers. Nairobi Region of Kenya Power constitutes the region with the largest customer base amounting to about 47% of the total number of customers for the firm.

The customers in this region are served by 5814 electricity distribution transformers installed in the distribution network that encompasses the three sub-regions of the area. The transformers vary in sizes and types. The mounting structures are also different as some are ground mounted while others are pole mounted. It is mostly the pole mounted distribution transformers that are most vulnerable to vandalism. Besides, the susceptibility
is also restricted to the oil cooled type of transformers. The study will therefore be confined to the oil cooled pole mounted transformers that are vulnerable to vandalism.

From the year 2005 to 2009, the company reported 4027 incidences caused by electricity distribution transformer vandalism in which 1878 transformers were vandalised. For each transformer that is vandalised in Nairobi region, an average of 102 customers are affected directly due to loss of power, in the period of study therefore 192,196 customers have been directly affected by vandalism (KPLC Anti Vandalism Committee, 2007).

3.3.2 Sampling Design
Cluster sampling is a sampling technique in which the entire population of interest is divided into groups, or clusters, and a random sample of these clusters is selected. Care is taken to ensure that each cluster is mutually exclusive and together the clusters include the entire population. After selecting the clusters, then all units within the clusters are selected. No units from non-selected clusters are included in the sample (Saunders, 2009).

In this study, a two stage clustering technique was used, this refers to the random selection of a subset of units from each selected cluster.

The clusters were considered as the primary sampling unit (PSU’s) while the units within the clusters are the secondary sampling units (SSU’s). The main reason for using cluster sampling is that it is usually much cheaper and more convenient to sample the population in clusters rather than randomly. In some cases, constructing a sampling frame that identifies every population element is too expensive or impossible. Cluster sampling can also reduce cost when the population elements are scattered over a wide area like in the case of this study. Finally, in cases where the population is widely distributed geographically, and then cluster sampling is conducted, where the clusters consist of geographical areas, the technique reduces the number of areas that need to be visited. The smaller number of areas that need to be visited therefore reduce travel expenses and also make possible more efficient supervision of the fieldwork.

The target population for this study was divided into two categories that is those internal to the company and those external to the company.

The sample for the first category comprised three (3) persons from each of the following section/departments of the company; Distribution Department – as they are in charge of the development of the distribution network; Business Development – As they are
responsible for sourcing for electricity utility business from potential customers and preparing contracting schemes; Commercial Services Department – as they are involved in the revenue side of the business; Security department – As they are solely in charge of securing all company assets.; Corporate Communications and Public Relations department – As they are responsible for the image of the company to the public. ; Insurance department – as they are responsible for insuring company assets. Procurement Department – as they are the key department involved in the procurement of transformers

This accounted for a total of 21 members of staff of each of the departments from each of the three sub-regions making a grand total of 63 members of staff from within the company.

Participants of the second category were derived from members of the public in the geographic areas in Nairobi region covered by electricity distribution transformers that are most vulnerable to vandalism. The identification of the areas with most vulnerable Electricity Distribution Transformers was done through a process of mapping.

To be able to identify the centers where the data would be collected, the list of all Electricity Distribution transformers vandalized within the period of review were extracted from the Incidence Management System (IMS) using a query written in SQL (Structured Query Language).

The list of affected transformers was then grouped according to the sub region in Nairobi. Within each sub region, the affected transformers were listed with their corresponding frequency of vandalism attack per transformer. The transformers which had been attacked more than once were then picked out. The urban/market centers where these transformers were located were then identified and the information used to map out the centers where the data collection would be carried out.

Table 30 in Appendix IV gives the Electricity Distribution Transformers incidences data used in the sampling design process. It shows the frequency of vandalism and the number of Electricity Distribution Transformers affected and the resulting number of Electricity Distribution Transformers vandalism cases in Nairobi region.

The data used in the sampling design therefore accounted for 4027 Electricity Distribution Transformers incidences in the period under study.
Using the Electricity Distribution Transformers vandalism data presented in Table 30 in Appendix IV, the centres per sub-region listed in Table 2 below were identified as the geographic areas where data collection was carried out.

Table 2: Geographic areas where data collection was carried out

<table>
<thead>
<tr>
<th>S/No.</th>
<th>NAIROBI NORTH</th>
<th>NAIROBI SOUTH</th>
<th>NAIROBI WEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Baba Dogo</td>
<td>Bahati Estate</td>
<td>Ayany Estate Kibera</td>
</tr>
<tr>
<td>2.</td>
<td>Dandora</td>
<td>Buru Buru Phase 2</td>
<td>Baranaki Village</td>
</tr>
<tr>
<td>3.</td>
<td>Eastleigh</td>
<td>Donholm Estate</td>
<td>Dagoreti Market</td>
</tr>
<tr>
<td>4.</td>
<td>Gathanga Village</td>
<td>Embakasi</td>
<td>Gacui Market</td>
</tr>
<tr>
<td>5.</td>
<td>Gitambaya</td>
<td>Fedha Estate</td>
<td>Gatimu Village</td>
</tr>
<tr>
<td>6.</td>
<td>Githunguri</td>
<td>Isinya</td>
<td>Gichungo Village</td>
</tr>
<tr>
<td>7.</td>
<td>Githurai 44</td>
<td>Kaloleni Estate</td>
<td>Gikambura Estate</td>
</tr>
<tr>
<td>8.</td>
<td>Githurai Kimbo</td>
<td>Kamulu</td>
<td>Gimalu Estate</td>
</tr>
<tr>
<td>9.</td>
<td>Huruma</td>
<td>Kariobangi South</td>
<td>Ikinu Trading Center</td>
</tr>
<tr>
<td>10.</td>
<td>Ithanga Village</td>
<td>Kayole</td>
<td>Jonathan Ngeno Estate</td>
</tr>
<tr>
<td>11.</td>
<td>Kahawa Wendani</td>
<td>Kitengela Town</td>
<td>Kabete Market</td>
</tr>
<tr>
<td>12.</td>
<td>Kahawa West</td>
<td>Makadara Estate</td>
<td>Kaimba Village</td>
</tr>
<tr>
<td>13.</td>
<td>Kanyariri</td>
<td>Makongeni Estate</td>
<td>Kamba Trading Center</td>
</tr>
<tr>
<td>14.</td>
<td>Karia Market</td>
<td>Mihango Karagita</td>
<td>Kamiruthu Town</td>
</tr>
<tr>
<td>15.</td>
<td>Kariobangi</td>
<td>Mitaboni Market</td>
<td>Kangawa Village</td>
</tr>
<tr>
<td>17.</td>
<td>Karuri Township</td>
<td>Mukuru - South B</td>
<td>Kiambaa Trading Center</td>
</tr>
<tr>
<td>18.</td>
<td>Kasarani</td>
<td>Ofafa Estate</td>
<td>Kikuyu</td>
</tr>
<tr>
<td>19.</td>
<td>Kiamumbi</td>
<td>Plainsview Estate</td>
<td>Kisembe Estate</td>
</tr>
<tr>
<td>20.</td>
<td>Kihara Market</td>
<td>River Bank Estate</td>
<td>Kiserian Market</td>
</tr>
<tr>
<td>22.</td>
<td>Kirigiti</td>
<td>Syokimau</td>
<td>Lower Matasia Market</td>
</tr>
<tr>
<td>23.</td>
<td>Mathare</td>
<td>Tassia Estate</td>
<td>Muguga shopping center</td>
</tr>
<tr>
<td>24.</td>
<td>Mwiki Township</td>
<td>Tena Estate</td>
<td>Muthiga</td>
</tr>
<tr>
<td>25.</td>
<td>Ndenderu Township</td>
<td>Uhuru Estate</td>
<td>Muthumu Village</td>
</tr>
<tr>
<td>26.</td>
<td>Ndumberi Township</td>
<td>Umoja Innercore</td>
<td>Ngecha</td>
</tr>
<tr>
<td>27.</td>
<td>Nembu Market</td>
<td>Umoja Phase 1</td>
<td>Ngecha Village</td>
</tr>
<tr>
<td>28.</td>
<td>Riabai trading Center</td>
<td>Umoja Phase 2</td>
<td>Ngong Town</td>
</tr>
<tr>
<td>29.</td>
<td>Thimbingwa Village</td>
<td></td>
<td>Nyambare</td>
</tr>
<tr>
<td>30.</td>
<td>Uthiru Village</td>
<td></td>
<td>Nyathuna Market</td>
</tr>
<tr>
<td>31.</td>
<td>Waithaka</td>
<td></td>
<td>Ongata Rongai</td>
</tr>
<tr>
<td>32.</td>
<td>Wangige Market</td>
<td></td>
<td>Rituta Satellite</td>
</tr>
<tr>
<td>33.</td>
<td>Zimmerman</td>
<td></td>
<td>Rukuma Market</td>
</tr>
<tr>
<td>34.</td>
<td></td>
<td></td>
<td>Rungriri Market</td>
</tr>
<tr>
<td>35.</td>
<td></td>
<td></td>
<td>Ruthingiti Village</td>
</tr>
<tr>
<td>36.</td>
<td></td>
<td></td>
<td>Thogoto village</td>
</tr>
<tr>
<td>37.</td>
<td></td>
<td></td>
<td>Wanyee</td>
</tr>
</tbody>
</table>
Being a case study, clustered sampling was used as the best method of getting response from the target population.

3.3.2.1 Sampling Frame
A sampling frame is a list of elements from which the sample is drawn and is closely related to the population (Cooper & Schindler, 2003). The sampling frame for this study comprised the electricity distribution transformers that are most vulnerable to vandalism. These were accessed from IMS database of transformers that have experienced vandalism and are said to be most susceptible due to the high frequency of vandalism on such transformers. The specific population of transformers most vulnerable to vandalism were therefore drawn from this data and the target audience determined.

3.3.2.2 Sampling Technique
Data collection was conducted on two categories of population. The first category consisted of the people directly affected by Electricity Distribution Transformer Vandalism while the second group consisted of the employees of Kenya Power. For the first category of the population cluster sampling design was adopted. The transformers most vulnerable to vandalism had been clustered per sub-region, the geographic areas that had the highest concentration of most vulnerable transformers were chosen. The populations in these regions were then interviewed to collect the data.

3.3.2.3 Sampling Size
A sample is the part of the population that helps in drawing inferences about the population. Conducting research of the complete information about the population is not possible and it is time consuming and expensive. Thus, an appropriate sample size is needed so that inferences about the population can be made based on that sample (Lenth, 2001).

A sample size of 363 persons was used for the purpose of this study. Three hundred (300) persons in the first category of the target population and sixty three (63) persons in the second category of the target population. Table 3 below gives a summary of how the sample size was arrived at.
Table 3: Sampling size

<table>
<thead>
<tr>
<th>Sub-Region</th>
<th>Number of geographic zones within the sub region</th>
<th>Number of centres in the geographic zones</th>
<th>Number of interviewees per center</th>
<th>Sub Total</th>
<th>Rounded off to the nearest 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nairobi North</td>
<td>3</td>
<td>3</td>
<td>11</td>
<td>99</td>
<td>100</td>
</tr>
<tr>
<td>Nairobi South</td>
<td>3</td>
<td>3</td>
<td>11</td>
<td>99</td>
<td>100</td>
</tr>
<tr>
<td>Nairobi West</td>
<td>3</td>
<td>3</td>
<td>11</td>
<td>99</td>
<td>100</td>
</tr>
<tr>
<td><strong>TOTAL NUMBER OF INTERVIEWEES targeted</strong></td>
<td><strong>297</strong></td>
<td><strong>297</strong></td>
<td><strong>297</strong></td>
<td><strong>300</strong></td>
<td><strong>300</strong></td>
</tr>
</tbody>
</table>

To arrive at the sample size for the first category of the target population as indicated in Table 3 above, three geographic zones were selected per sub-region. Another three geographic centres from the selected zone were then chosen as the target area. At least eleven (11) participants were then drawn from each centre chosen. This resulted in approximately 99 participants per sub-region which can comfortably be rounded off to 100 participants per sub-region.

In the second category, the target population consisted of the sixty three (63) employees of Kenya Power in the departments that are most concerned with the design, installation and operations of Electricity Distribution Transformers.

### 3.4 Data Collection Methods
The study was based on primary data that is original data collected from first-hand experience for the specific purpose of this study (Hox & Boeije, 2005). Questionnaires were therefore used to obtain data from the population sample. The sample was divided into two categories comprising of those that are external to the organisation and those internal to the organisation. Questionnaires were used to collect data from those external to the organisation as well as those internal to the organisation. Appropriate guidelines were adopted to ensure a controlled data collection process that took into account ethical concerns.
3.5 Research Procedures
In order to ensure a successful study, a detailed and meticulous procedure was adopted. A questionnaire was designed to aid in the collection of data. In approaching the sample population, an official letter of introduction of the researcher to the sample population was done through an official cover letter.

The questionnaires were then pre-tested so as to gauge the expected response and the suitability or appropriateness of the data collection tools. The filled in questionnaires were collected and analysed, the results of the piloting was used in reviewing the questionnaire. This opened the way for the actual data collection.

3.6 Data Analysis
This study adopted the quantitative research methodology as it involves the study of historical events in the process of examining the relationships between and among variables. The analysis indicates the frequencies, means, standard deviations, and range of scores for the variables in the study.

The Statistical Package for Social Studies (SPSS) and Microsoft Excel tools were used to capture and analyse the data collected. The results are presented in chapter 4 using frequency tables, graphs and figures.

3.7 Chapter Summary
This chapter has reviewed the Research Methodology that was used in the study of the impact of Electricity Distribution Transformer vandalism on electricity utility business. The research design chosen has been presented and a justification for the chosen design given. The characteristics of the population and the sample size have also been reviewed. The data collection methods that were used have been outlined. Finally the chapter has outlined the data analysis techniques that were used in analysing the collected data.

The next chapter shall present the results of the study and as well as a discussion of the findings. The chapter will also present the interpretation of the results and the conclusions drawn from them.
CHAPTER FOUR

4.0 RESULTS AND FINDINGS

4.1 Introduction
This chapter presents the results and findings of the study. The first section presents the general information including respondent’s background information. The proceeding sections present the reasons for Electricity Distribution Transformer vandalism, the impact of Electricity Distribution Transformer vandalism and strategic responses to Electricity Distribution Transformer vandalism by the electrical utility. The report utilizes percentage ratios, crosstabs, tables and charts to present the results.

The target population for the study were divided into two categories. The study targeted three hundred (300) individual customers who form the first category and sixty three (63) internal staff members of the Electricity Utility Company Kenya Power who form the second category. A total of 282 valid questionnaires were filled and returned out of 300 expected from individual customers. This represents a 94% response rate which is a near perfect response. On the other hand, 42 out of 63 members of staff of Kenya Power responded to the questionnaire representing a 67 % response rate.

4.2 General Information

4.2.1 Respondents’ background information

4.2.1.1 Education level

Table 4 shows that, majority (43.62%) of the respondents had secondary school education as their highest level of education. This was closely followed by those who had college diploma/certificate (40.07%). These two levels jointly make up 83.69% of the respondents. The remaining 16.31% either had primary education (3.19%), bachelor’s degree (6.74%) or post graduate degree (1.42%).

<table>
<thead>
<tr>
<th>Education level</th>
<th>Frequency</th>
<th>Per cent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary school</td>
<td>9</td>
<td>3.19</td>
</tr>
<tr>
<td>Secondary school</td>
<td>123</td>
<td>43.62</td>
</tr>
<tr>
<td>College Diploma/certificate</td>
<td>113</td>
<td>40.07</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>19</td>
<td>6.74</td>
</tr>
<tr>
<td>Education level</td>
<td>Frequency</td>
<td>Per cent (%)</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>-----------</td>
<td>---------------</td>
</tr>
<tr>
<td>Post graduate degree</td>
<td>4</td>
<td>1.42</td>
</tr>
<tr>
<td>No Response to the question on education level</td>
<td>14</td>
<td>4.96</td>
</tr>
<tr>
<td>Total</td>
<td>268</td>
<td>100.00</td>
</tr>
</tbody>
</table>

### 4.2.1.2 Age category

Majority of the respondents involved in the study (44%) were aged between 26 – 35 years. This was followed by those aged between 19 and 25 years (24.3%).

![Age Categories Bar Chart]

**Figure 1**: the respondent’s age categories

### 4.2.1.3 Employment status

The study also sought to establish the employment status of the respondents. From Table 5 below it can be seen that an overwhelming majority (83%) were gainfully employed in one form or another. Of these, majority (43.62%) ran their own businesses while 38.65% were employed either in the NGO, private or public sector. A number of the respondents however did not respond to the question on employment category and these constituted 3.9% of the respondents.

### Table 5: Employment Categories of Respondents

<table>
<thead>
<tr>
<th>Employment Category</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Businessman/woman</td>
<td>42</td>
<td>14.89</td>
</tr>
<tr>
<td>Employed in the NGO sector</td>
<td>7</td>
<td>2.48</td>
</tr>
<tr>
<td>Employed in public sector</td>
<td>48</td>
<td>17.02</td>
</tr>
<tr>
<td>Employment Category</td>
<td>Frequency</td>
<td>Percentage (%)</td>
</tr>
<tr>
<td>-------------------------------------------------</td>
<td>-----------</td>
<td>----------------</td>
</tr>
<tr>
<td>Employed in private sector</td>
<td>54</td>
<td>19.15</td>
</tr>
<tr>
<td>Other forms of employment</td>
<td>2</td>
<td>0.71</td>
</tr>
<tr>
<td>Self Employed</td>
<td>81</td>
<td>28.72</td>
</tr>
<tr>
<td>Unemployed</td>
<td>37</td>
<td>13.12</td>
</tr>
<tr>
<td>No Response to the question on Employment Category</td>
<td>11</td>
<td>3.90</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>282</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>

### 4.2.1.4 Number of years of residence

The respondents were asked to state the number of years for which they had stayed in their present estate of residence. Majority (28.72%) had stayed for between 4 and 5 years. This was closely followed by those who had stayed for less than 3 years (20.92%).

**Table 6: Years spent at current place of residence**

<table>
<thead>
<tr>
<th>Number of years</th>
<th>Frequency</th>
<th>Per cent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 3 years</td>
<td>59</td>
<td>20.92</td>
</tr>
<tr>
<td>4 to 5 years</td>
<td>81</td>
<td>28.72</td>
</tr>
<tr>
<td>6 to 10 years</td>
<td>46</td>
<td>16.31</td>
</tr>
<tr>
<td>11 to 15 years</td>
<td>20</td>
<td>7.09</td>
</tr>
<tr>
<td>More than 15 years</td>
<td>17</td>
<td>6.03</td>
</tr>
<tr>
<td>No Response to the question on years spent in current residence</td>
<td>59</td>
<td>20.92</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>282</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>

### 4.2.1.5 Access to electricity

The respondents were asked whether they had access to electricity. An overwhelming majority said they had access to electricity while only a small percentage (7%) did not have access.

![Figure 2: the respondent’s access to electricity](image-url)
4.2.1.6 Electricity user category
The study sought to establish the category of users from among the respondents. Majority of the respondents (50.35%) were domestic users. This was followed by 17.38% who were non-customer users and 12.41% who were small consumers. A significant percentage of the respondents (14.41%) however did not respond to the question on electricity user category.

Table 7: Electricity user category

<table>
<thead>
<tr>
<th>Customer type</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic customer</td>
<td>142</td>
<td>50.35</td>
</tr>
<tr>
<td>Industrial</td>
<td>1</td>
<td>0.35</td>
</tr>
<tr>
<td>Large Commercial</td>
<td>1</td>
<td>0.35</td>
</tr>
<tr>
<td>Non customer - Non user</td>
<td>13</td>
<td>4.61</td>
</tr>
<tr>
<td>Non Customer - User</td>
<td>49</td>
<td>17.38</td>
</tr>
<tr>
<td>Small Consumer</td>
<td>35</td>
<td>12.41</td>
</tr>
<tr>
<td>No Response to the question on electricity user category</td>
<td>41</td>
<td>14.54</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>282</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>

4.2.2 Kenya Power Respondents’ background information
The respondents from Kenya Power formed the second category of the target population. The target population in this category consisted of those employees whose role is directly related to activities of the company concerned with the design, installation and operations of Electricity Distribution Transformers.

4.2.2.1 Role Category
Most of the respondents (25%) held the positions of standard officer and below and a similar percentage held position of senior officer. 22.5% were Chief officers, while only 12.5% were members of senior management.

Table 8: Respondents positions

<table>
<thead>
<tr>
<th>Role Category</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Officer and below</td>
<td>25.00</td>
</tr>
<tr>
<td>Senior officer</td>
<td>25.00</td>
</tr>
<tr>
<td>Chief Officer</td>
<td>22.50</td>
</tr>
<tr>
<td>Middle Management</td>
<td>15.00</td>
</tr>
<tr>
<td>Senior Management</td>
<td>12.50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>
4.2.2.2 Respondents’ departments

Majority of the respondents (36%) were from design and Construction departments. Other departments covered were: customer service (31%), insurance and risk management (14%), operations and maintenance (6%), Telecommunications, procurement, projects, marketing and quality control each with 3% of the total respondents.

Table 9: Respondents’ departments

<table>
<thead>
<tr>
<th>Division</th>
<th>Department</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial Services</td>
<td>Customer service</td>
<td>31.00</td>
</tr>
<tr>
<td>Distribution</td>
<td>Design &amp; Construction</td>
<td>36.00</td>
</tr>
<tr>
<td>Distribution</td>
<td>Fraud &amp; Quality Control</td>
<td>3.00</td>
</tr>
<tr>
<td>Distribution</td>
<td>Projects</td>
<td>3.00</td>
</tr>
<tr>
<td>Distribution</td>
<td>Operations &amp; maintenance</td>
<td>6.00</td>
</tr>
<tr>
<td>Supplies, Stores &amp; Transport</td>
<td>Procurement</td>
<td>3.00</td>
</tr>
<tr>
<td>Commercial Services</td>
<td>Marketing</td>
<td>3.00</td>
</tr>
<tr>
<td>IT &amp; Telecommunications</td>
<td>Telkom</td>
<td>3.00</td>
</tr>
<tr>
<td>MD&amp;CEO</td>
<td>Insurance &amp; risk management</td>
<td>14.00</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>100.00</td>
</tr>
</tbody>
</table>

4.3 Why are Electrical Distribution Transformers Vandalized in Kenya

The study sought to examine various issues that contribute to and sustain transformer vandalism. These included an exploration of major causes of vandalism, the uses of oil stolen from transformers and the type of persons who engage in transformer vandalism. The next subsections present the results in detail.

4.3.1 Major reasons for transformer vandalism

The respondents were asked to state whether a number of common reasons for vandalism constituted a major cause. From the respondents’ views, two major contributors to vandalism were identified as: to obtain oil (87%) and to obtain copper windings (69.6%). A large proportion of respondents felt the following were not major reasons: Economic sabotage (79.2%); destroy Kenya Power as a monopoly (89.5%); gain business advantage over Kenya Power (87.5%); and to create market for security devices (83.9%).

Table 10: Reasons for vandalism

<table>
<thead>
<tr>
<th>Reason for vandalism</th>
<th>Yes (%)</th>
<th>No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>To obtain oil</td>
<td>87.1</td>
<td>12.9</td>
</tr>
<tr>
<td>To obtain Copper Windings</td>
<td>69.6</td>
<td>30.4</td>
</tr>
<tr>
<td>Economic Sabotage</td>
<td>20.8</td>
<td>79.2</td>
</tr>
<tr>
<td>To destroy KENYA POWER as a monopoly</td>
<td>10.5</td>
<td>89.5</td>
</tr>
<tr>
<td>To gain business advantage over KENYA POWER</td>
<td>12.5</td>
<td>87.5</td>
</tr>
<tr>
<td>To create a market for security devices</td>
<td>16.1</td>
<td>83.9</td>
</tr>
</tbody>
</table>
4.3.2 Uses of vandalized transformer oil

From the preceding section, it was observed that the need to obtain oil was the highest contributor to transformer vandalism. This section examines the various possible uses of transformer oil. The respondents were required to rate on a scale of 1 – 5 the extent to which transformer oil was used for a number of stated possible uses. The results were as displayed in the table below.

Majority of the respondents (53.7%) felt that transformer oil was being used to a low extent for frying chips. Similarly, majority of the respondents felt that the oil was being used to a low extent as car fuel (41.1%) and to create market for security devices (74.1%). On the other hand, majority of the respondents felt that stolen oil was being used as brake fluid (47.3%), for medicinal purposes (53.9%) and as cooling agent in welding machines (75%).

<table>
<thead>
<tr>
<th>Level of use of vandalized transformer oil for:</th>
<th>Low (%)</th>
<th>Somewhat low (%)</th>
<th>Medium (%)</th>
<th>Somewhat high (%)</th>
<th>High (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frying chips</td>
<td>42.1</td>
<td>11.6</td>
<td>13.0</td>
<td>6.0</td>
<td>27.3</td>
</tr>
<tr>
<td>Car fuel</td>
<td>20.8</td>
<td>20.3</td>
<td>18.8</td>
<td>16.1</td>
<td>24.0</td>
</tr>
<tr>
<td>Brake fluid</td>
<td>15.6</td>
<td>12.9</td>
<td>24.2</td>
<td>28.5</td>
<td>18.8</td>
</tr>
<tr>
<td>Medicinal purposes</td>
<td>30.6</td>
<td>6.2</td>
<td>9.3</td>
<td>13.0</td>
<td>40.9</td>
</tr>
<tr>
<td>Cooling agent in welding machines</td>
<td>9.1</td>
<td>2.9</td>
<td>13.0</td>
<td>17.8</td>
<td>57.2</td>
</tr>
<tr>
<td>Create market for security devices</td>
<td>56.8</td>
<td>17.3</td>
<td>9.4</td>
<td>5.0</td>
<td>11.5</td>
</tr>
</tbody>
</table>

4.3.3 Categories of persons who engage in vandalism

The study sought to establish the type of persons who engage in transformer vandalism. Majority of the respondents felt that it was unlikely that cartels (56.4%) or small businesses (57.4%), were responsible. On the other hand, a great majority of the respondents (71.6%) felt that individuals from outside the area were likely to be responsible. Still, a majority of the respondents (58.4%) felt that individuals from the area are also likely to be responsible for transformer vandalism.
Table 12: Sources of Electricity Distribution Transformer Vandalism

<table>
<thead>
<tr>
<th>Source</th>
<th>Most unlikely (%)</th>
<th>Unlikely (%)</th>
<th>Not likely (%)</th>
<th>Likely (%)</th>
<th>Most likely (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cartels</td>
<td>45.7%</td>
<td>10.7%</td>
<td>6.6%</td>
<td>5.6%</td>
<td>31.5%</td>
</tr>
<tr>
<td>Small businesses</td>
<td>33.7%</td>
<td>23.7%</td>
<td>18.9%</td>
<td>11.6%</td>
<td>12.1%</td>
</tr>
<tr>
<td>Individuals in the area</td>
<td>19.3%</td>
<td>12.9%</td>
<td>9.4%</td>
<td>19.8%</td>
<td>38.6%</td>
</tr>
<tr>
<td>Individuals from outside the area</td>
<td>9.6%</td>
<td>8.0%</td>
<td>10.7%</td>
<td>14.4%</td>
<td>57.2%</td>
</tr>
</tbody>
</table>

4.4 What is the Impact of EDT Vandalism to Electrical Utility Business in Kenya

4.4.1 Frequency of transformer vandalism
The respondents (customers) were asked to state how frequent transformer vandalism was experienced in their area. Majority of the respondents (49.65%) said that they experienced vandalism frequently. It is quite interesting to note that only a tiny fraction (1.77%) said that they did not experience vandalism at all. A similar view is held by employees with an overwhelming majority (92.8%) saying that transformer vandalism was high.

Table 13: Customers’ rating of frequency of transformer vandalism

<table>
<thead>
<tr>
<th>Rating</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>5</td>
<td>1.77</td>
</tr>
<tr>
<td>Rarely</td>
<td>46</td>
<td>16.31</td>
</tr>
<tr>
<td>Occasionally</td>
<td>87</td>
<td>30.85</td>
</tr>
<tr>
<td>Frequently</td>
<td>100</td>
<td>35.46</td>
</tr>
<tr>
<td>Very frequently</td>
<td>40</td>
<td>14.18</td>
</tr>
<tr>
<td>No Response to the question on frequency of transformer vandalism</td>
<td>4</td>
<td>1.42</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>282</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>

Table 14: Kenya Power Staff rating of frequency of transformer vandalism

<table>
<thead>
<tr>
<th>Rating</th>
<th>Frequency</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>2</td>
<td>4.80</td>
</tr>
<tr>
<td>Constant</td>
<td>1</td>
<td>2.40</td>
</tr>
<tr>
<td>High</td>
<td>24</td>
<td>57.10</td>
</tr>
<tr>
<td>Very high</td>
<td>15</td>
<td>35.70</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>42</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>
4.4.2 Impact of transformer vandalism on respondents’ material well being
The respondents were asked to state their level of agreement with the statement “transformer vandalism affects my material wellbeing”. It was found that an overwhelming majority of the respondents (88.30%) felt that transformer vandalism affected their material wellbeing.

Table 15: Effect of EDT vandalism on Customers well being

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disagree</td>
<td>5</td>
<td>1.77</td>
</tr>
<tr>
<td>Neutral</td>
<td>18</td>
<td>6.38</td>
</tr>
<tr>
<td>Agree</td>
<td>142</td>
<td>50.35</td>
</tr>
<tr>
<td>Strongly agree</td>
<td>107</td>
<td>37.94</td>
</tr>
<tr>
<td>No Response to the question of effect of transformer vandalism on well being</td>
<td>10</td>
<td>3.55</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>282</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

4.4.3 Respondents’ Satisfaction with the life they lead
The study also sought to establish how satisfied the respondents were with the kind of life they lead. The respondents were asked to rate their level of satisfaction based on a five-point scale. It was established that a great majority of the respondents (67.1%) were satisfied with the kind of life they were leading.

Table 16: Respondents satisfaction with life they lead

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all satisfied</td>
<td>7</td>
<td>2.48</td>
</tr>
<tr>
<td>Not satisfied</td>
<td>81</td>
<td>28.72</td>
</tr>
<tr>
<td>Satisfied</td>
<td>89</td>
<td>31.56</td>
</tr>
<tr>
<td>Fairly satisfied</td>
<td>69</td>
<td>24.47</td>
</tr>
<tr>
<td>Very satisfied</td>
<td>22</td>
<td>7.80</td>
</tr>
<tr>
<td>No Response to the question on satisfaction with level of lifestyle</td>
<td>14</td>
<td>4.96</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>282</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>

4.4.4 Customer participation in curtailing transformer vandalism
This section examines the customers’ desired and actual participation in stamping out transformer vandalism.

4.4.4.1 Level of respondents’ involvement in the resolution of problem of transformer vandalism
The study sought to establish extent to which the respondents were involved in the resolution of the problem of transformer vandalism. From the results, it was observed that
majority of the respondents (53.9%) were largely involved in the resolution of the problem of transformer vandalism.

Table 17: Respondents involvement in prevention measures

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Per cent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not involved at all</td>
<td>18</td>
</tr>
<tr>
<td>Rarely Involved</td>
<td>38</td>
</tr>
<tr>
<td>Just involved</td>
<td>65</td>
</tr>
<tr>
<td>Somewhat involved</td>
<td>69</td>
</tr>
<tr>
<td>Highly involved</td>
<td>83</td>
</tr>
<tr>
<td>No Response to the question on involvement in prevention measures</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>282</strong></td>
</tr>
</tbody>
</table>

4.4.4.2 Level of desire to participate in actual resolution of the problem of vandalism

The study sought to examine the extent to which the respondents desired to get involved in the resolution of the problem of transformer vandalism. A great majority (65.96%) highly desired to get involved. This is slightly higher than the percentage of those who were actually involved (53.9%) as shown in the previous table (Table 17).

Table 18: Respondents desire of involvement in prevention measures

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Per cent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No desire at all</td>
<td>9</td>
</tr>
<tr>
<td>Somewhat desire</td>
<td>18</td>
</tr>
<tr>
<td>Just desire</td>
<td>55</td>
</tr>
<tr>
<td>Highly desire</td>
<td>62</td>
</tr>
<tr>
<td>Very highly desire</td>
<td>124</td>
</tr>
<tr>
<td>No Response to the question on level of desire to participate in resolving the problem</td>
<td>14</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>282</strong></td>
</tr>
</tbody>
</table>

4.4.4.3 Customer willingness to pay more

The respondents were asked to state the extent to which they were willing to pay more to meet the costs for enhanced transformer security. The results show a contrary view to their willingness to participate in resolving the problem of transformer vandalism. While majority of the respondents are willing to participate, majority still (48.23%) were not willing to pay for any additional costs to enhance transformer security. However, a significant percentage of the respondents 45.74% stated that they are willing to pay to fund initiatives that are geared towards the prevention of Electricity Distribution Transformer Vandalism.
Table 19: Respondents willingness to pay more to fund prevention measures

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Per cent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not willing at all</td>
<td>114</td>
</tr>
<tr>
<td>Just Willing</td>
<td>22</td>
</tr>
<tr>
<td>Willing</td>
<td>27</td>
</tr>
<tr>
<td>Highly willing</td>
<td>34</td>
</tr>
<tr>
<td>Very highly willing</td>
<td>68</td>
</tr>
<tr>
<td>No Response to the question on willingness to pay more to fund prevention measures</td>
<td>17</td>
</tr>
<tr>
<td>Total</td>
<td>282</td>
</tr>
</tbody>
</table>

4.5 What are the Strategic Responses by the Electricity Utility Business?
This section covers the response by Kenya Power to transformer vandalism. It examines employee perceptions on strategies adopted by Kenya Power to combat transformer vandalism.

4.5.1 Satisfaction with response time upon reporting of a vandalism incident
The respondents (customers) were asked to rate their level of satisfaction with the duration with which it took Kenya Power to respond to a reported incident of vandalism. A simple majority of the respondents (37.59%) were highly satisfied with Kenya Power response time. A similar percentage indicated that response time was just satisfactory. In contrast to the response by the customers, an overwhelming majority (78.57%) of Kenya Power staff believe that their response rate was fast (see Table 21).

Table 20: Customer perceptions of Kenya Power response to transformer vandalism

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Per cent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very dissatisfying</td>
<td>18</td>
</tr>
<tr>
<td>Somewhat Dissatisfied</td>
<td>42</td>
</tr>
<tr>
<td>Satisfactory</td>
<td>106</td>
</tr>
<tr>
<td>Somewhat satisfying</td>
<td>46</td>
</tr>
<tr>
<td>Very satisfying</td>
<td>60</td>
</tr>
<tr>
<td>No Response to the question on perceptions of Kenya Power response to transformer vandalism</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>282</td>
</tr>
</tbody>
</table>

Table 21: Perceptions of efficiency in attending to a report of transformer vandalism

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Per cent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slow</td>
<td>9</td>
</tr>
<tr>
<td>Fast</td>
<td>15</td>
</tr>
<tr>
<td>Relatively fast</td>
<td>14</td>
</tr>
<tr>
<td>Very fast</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>42</td>
</tr>
</tbody>
</table>
4.5.2 Manner Kenya Power handles Vandalism incidences
The study sought to establish the respondents’ views on the manner Kenya Power handled vandalism incidences. Majority (38.30%) were highly satisfied with the manner in which Kenya Power handled the incidences.

Table 22: Customer’s satisfaction with handling of EDT Vandalism cases

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Per cent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very dissatisfying</td>
<td>16</td>
<td>5.67</td>
</tr>
<tr>
<td>Somewhat dissatisfied</td>
<td>42</td>
<td>14.89</td>
</tr>
<tr>
<td>Satisfactory</td>
<td>103</td>
<td>36.52</td>
</tr>
<tr>
<td>Somewhat satisfying</td>
<td>47</td>
<td>16.67</td>
</tr>
<tr>
<td>Very satisfying</td>
<td>61</td>
<td>21.63</td>
</tr>
<tr>
<td>No Response to the question on satisfaction with how Kenya Power handles EDT Vandalism cases</td>
<td>13</td>
<td>4.61</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>282</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>

4.5.3 Kenya Power Customer service response after a vandalism incident
The respondents (customers) were asked to rate on a scale of 1 – 5 the appropriateness of customer service response after a vandalism incident. Majority (52.48%) felt that the customer service response was good. 33.33% rated the customer service response fair, while only 10.64% rated the response poor.

Table 23: Kenya Power’s response after a vandalism incident

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Per cent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very poor</td>
<td>8</td>
<td>2.84</td>
</tr>
<tr>
<td>Poor</td>
<td>22</td>
<td>7.80</td>
</tr>
<tr>
<td>Fair</td>
<td>94</td>
<td>33.33</td>
</tr>
<tr>
<td>Good</td>
<td>118</td>
<td>41.84</td>
</tr>
<tr>
<td>Very good</td>
<td>30</td>
<td>10.64</td>
</tr>
<tr>
<td>No Response to the question on Kenya Power’s response after a vandalism incident</td>
<td>10</td>
<td>3.55</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>282</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>

4.5.4 Likelihood of recommendation of Kenya Power by customers
To summarize customer perceptions on Kenya Power’s overall performance, the respondents (customers) were asked to rate the likelihood with which they would recommend Kenya Power as an efficient electric power supplier. Majority of the respondents (39.9%) rated their likelihood as “likely” – which is the midpoint of the five-
point likert scale. This was followed by those who rated it as highly likely (39.1%) and finally 21% rated it as highly unlikely.

![Likelihood of customers recommending Kenya Power as a service provider](image)

**Figure 3: Likelihood of customers recommending Kenya Power as a service provider**

4.5.5 The degree to which transformer vandalism affect the relationship between Kenya Power and its customers

The study sought to establish the extent to which transformer vandalism influences the relationship between Kenya Power and its customers. The respondents (employees) were asked to rate on a scale of 1 - 5 the extent to which transformer vandalism influenced the relationship between Kenya Power and its customers. All (100%) of the respondents felt that transformer vandalism highly affects the relationship between Kenya Power and its customers.

![EDT vandalism affects the relationship of Kenya Power and its customers](image)

**Figure 4: EDT vandalism affects the relationship of Kenya Power and its customers**
4.5.6 Level to which transformer vandalism contributes to revenue losses
The study also sought to examine the levels to which transformer vandalism contributed to revenue losses. Majority of the respondents (73.9%) stated that transformer vandalism contributes to revenue losses to a high extent.

Table 24: Level to which EDT vandalism contributes to revenue losses

<table>
<thead>
<tr>
<th>Level to which</th>
<th>Frequency</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very low</td>
<td>1</td>
<td>2.40</td>
</tr>
<tr>
<td>Low</td>
<td>2</td>
<td>4.80</td>
</tr>
<tr>
<td>Moderate</td>
<td>8</td>
<td>19.00</td>
</tr>
<tr>
<td>High</td>
<td>13</td>
<td>31.00</td>
</tr>
<tr>
<td>Very high</td>
<td>18</td>
<td>42.90</td>
</tr>
<tr>
<td>Total</td>
<td>42</td>
<td>100.00</td>
</tr>
</tbody>
</table>

4.5.7 Transformer Vandalism as a business risk
To determine to what extent transformer vandalism is a business risk to Kenya Power, the respondents were asked to state their level of agreement with the statement “transformer vandalism is a business risk”. An overwhelming majority (92.9%) agreed that transformer vandalism was indeed a business risk.

Table 25: Measure of EDT vandalism as a business risk

<table>
<thead>
<tr>
<th>Level to which</th>
<th>Frequency</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly disagree</td>
<td>2</td>
<td>4.80</td>
</tr>
<tr>
<td>Disagree</td>
<td>1</td>
<td>2.40</td>
</tr>
<tr>
<td>Agree</td>
<td>11</td>
<td>26.20</td>
</tr>
<tr>
<td>Strongly agree</td>
<td>28</td>
<td>66.70</td>
</tr>
<tr>
<td>Total</td>
<td>42</td>
<td>100.00</td>
</tr>
</tbody>
</table>

4.5.8 Level to which transformer vandalism contributes to national economic losses
The study also sought to examine the extent to which transformer vandalism contributes to national economic losses. An overwhelming majority of respondents (employees) (95.7%) believe that transformer vandalism contributes to national economic losses (Table 26).

Table 26: Level of contribution of transformer vandalism to national economic losses

<table>
<thead>
<tr>
<th>Level to which</th>
<th>Frequency</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>4</td>
<td>9.5</td>
</tr>
<tr>
<td>Moderate</td>
<td>2</td>
<td>4.8</td>
</tr>
<tr>
<td>High</td>
<td>19</td>
<td>45.2</td>
</tr>
</tbody>
</table>
4.5.9 Level to which transformer vandalism affects policy and strategic plans of departments

To examine the impact of transformer vandalism on company strategy, the respondents (employees) were asked to state the extent to which it influenced their policy direction and strategic plans. Majority of the respondents (71.5%) stated that vandalism had influenced their policy direction. Further, majority (73.8%) said that vandalism influenced the strategic plans of their departments.

Table 27: Level of EDT vandalism effects on departments’ policy and strategic plans

<table>
<thead>
<tr>
<th>Influence of transformer vandalism on respondents departments policy direction</th>
<th>No influence at all (%)</th>
<th>Minimal influence (%)</th>
<th>Moderately influence (%)</th>
<th>Highly influence (%)</th>
<th>Very highly influence (%)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>4.8</td>
<td>23.8</td>
<td>40.5</td>
<td>31.0</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Influence of transformer vandalism on respondents departments strategic plans</th>
<th>No effect (%)</th>
<th>Little effect (%)</th>
<th>Moderate effect (%)</th>
<th>High effect (%)</th>
<th>Very high effect (%)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>4.8</td>
<td>21.4</td>
<td>45.2</td>
<td>28.6</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

4.5.10 Effect of transformer vandalism on business operations

To further understand the strategic responses to vandalism, the respondents were asked to state the extent to which it had affected a number of business operations. Majority of the respondents stated that it had a very high effect on: loss of business opportunities (85.4%), corporate image (78.0%) and improvement of customer service (64.1%). To a moderate extent, vandalism affected: increase in new connections (34.1%), construction of new secondary substations (31.7%) and design of new schemes (25%).

Table 28: Effect of EDT vandalism on business operations

<table>
<thead>
<tr>
<th>Effect of transformer vandalism on</th>
<th>No effect (%)</th>
<th>Little effect (%)</th>
<th>Moderate effect (%)</th>
<th>High effect (%)</th>
<th>Very high effect (%)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss of business opportunity</td>
<td>2.4</td>
<td>2.4</td>
<td>9.8</td>
<td>24.4</td>
<td>61.0</td>
<td>100</td>
</tr>
<tr>
<td>Increase in new connections</td>
<td>17.1</td>
<td>12.2</td>
<td>34.1</td>
<td>17.1</td>
<td>19.5</td>
<td>100</td>
</tr>
<tr>
<td>Improvement in customer service level</td>
<td>15.4</td>
<td>10.3</td>
<td>10.3</td>
<td>25.6</td>
<td>38.5</td>
<td>100</td>
</tr>
<tr>
<td>Design of new schemes</td>
<td>15.0</td>
<td>15.0</td>
<td>25.0</td>
<td>22.5</td>
<td>22.5</td>
<td>100</td>
</tr>
</tbody>
</table>
Effect of transformer vandalism on

<table>
<thead>
<tr>
<th></th>
<th>No effect (%)</th>
<th>Little effect (%)</th>
<th>Moderate effect (%)</th>
<th>High effect (%)</th>
<th>Very high effect (%)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction of new</td>
<td>24.4</td>
<td>2.4</td>
<td>31.7</td>
<td>26.8</td>
<td>14.6</td>
<td>100</td>
</tr>
<tr>
<td>secondary substations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corporate image</td>
<td>2.4</td>
<td>14.6</td>
<td>4.9</td>
<td>4.9</td>
<td>73.2</td>
<td>100</td>
</tr>
</tbody>
</table>

4.5.11 Effectiveness of measures put in place to combat vandalism

The study also examined the effectiveness of various measures that had been put in place to combat vandalism. The respondents (employees) were asked to rate the level of effect in a scale of 1 – 5 with 1 being no effect and 5 being very high effect. Descriptive statistics were computed including mean, minimum, maximum and standard deviation. A mean rating of between 1 and 2.5 indicates little effect; a mean rating of between 2.6 and 3.5 indicates a moderate effect; while a mean rating lying between 3.6 and 5 indicates high extent.

From the table below, it was found that design (mean = 4.15), and transformer safety (mean = 3.62) and community policing (mean = 3.56) had a high impact in combating transformer vandalism. Further, it was found that security surveillance (mean = 3.35), anti-vandalism (mean = 2.90) and legislative intervention (mean = 2.64) had a moderate effect on transformer vandalism. From the standard deviations, it was observed that apart from design and transformer safety, the respondents (employees) held widely varying views on effectiveness of various measures (sd > 1.0). Thus there is need for a more in depth study to determine actual effectiveness of each of the measures so as to allow for prioritization.

Table 29: Effectiveness of measures to curb EDT vandalism

<table>
<thead>
<tr>
<th>Effective measures to combat vandalism</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legislative intervention</td>
<td>39</td>
<td>1</td>
<td>5</td>
<td>2.64</td>
<td>1.347</td>
</tr>
<tr>
<td>Transformer safety (locking, welding</td>
<td>39</td>
<td>1</td>
<td>5</td>
<td>3.62</td>
<td>0.963</td>
</tr>
<tr>
<td>etc)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community policing (Mulika Mwizi)</td>
<td>39</td>
<td>1</td>
<td>5</td>
<td>3.56</td>
<td>1.046</td>
</tr>
<tr>
<td>Design (safe locations)</td>
<td>39</td>
<td>2</td>
<td>5</td>
<td>4.15</td>
<td>0.875</td>
</tr>
<tr>
<td>Security surveillance</td>
<td>40</td>
<td>1</td>
<td>5</td>
<td>3.35</td>
<td>1.210</td>
</tr>
<tr>
<td>Anti-vandalism events (road shows,</td>
<td>39</td>
<td>1</td>
<td>5</td>
<td>2.90</td>
<td>1.252</td>
</tr>
<tr>
<td>tournaments etc)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.6 Chapter Summary

This chapter presented the results of the study. The results presented are consistent with the research design that had been chosen and the research methodology that was adopted.
CHAPTER FIVE

5.0 DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction
This chapter discusses the major findings obtained from the analysis of the data from the study. The chapter shall also present the conclusions drawn from the study as well as the recommendations both for the improvement of this study and for further studies. The first section of this chapter shall present a summary of the entire study including the purpose of the study, the research questions, the research methodology and the major findings based on the research questions. The second section shall present the discussion of the findings covering each research question. The third section of the chapter shall present the conclusions drawn from the study for each of the research questions. The final section shall present the recommendations for the improvement of the study as well as for further study also covering each of the research questions.

5.2 Summary
The purpose of this study was to establish the impact of Electricity Distribution Transformer vandalism on the electricity Utility Business in Kenya. The structure of the electricity utility business in Kenya is such that there is a regulating body, the Energy Regulatory Commission, Electricity Generating Firms, one Electricity Transmission firm and one Electricity Distribution firm the Kenya Power which also retails electricity to the customers. Kenya Power therefore sits at the bottom of the chain of the electricity utility business. The study focused on the distribution and retail of electricity segment since this is where the subject of the study, the Electricity Distribution Transformer, is found as a critical element of the electricity distribution infrastructure.

The study was guided by three research questions viz; Why Electricity Distribution Transformers are vandalised, what is the impact of Electricity Distribution Transformer Vandalism to the electricity business in Kenya and what the strategic responses are by the electricity utility businesses.

The importance of the study is drawn from the fact that with a single electricity distributor in Kenya, the entire electricity utility business is affected every time the electricity distribution system is affected. With the Electricity Distribution Transformers forming a very critical element of the electricity infrastructure that facilitates the supply
of electricity to the eventual customers, any interference with the electricity distribution transformers in the form of vandalism implies that electricity cannot reach the customer efficiently. In the process all players in the electricity utility business and customers alike are affected in one way or the other.

The research adopted a case study approach of Kenya Power. The target population was divided into two categories. The first category consisted of persons in areas most affected by electricity distribution transformer vandalism in Nairobi region while the second category consisted of 63 Kenya Power employees in the departments that are responsible for the formulation and implementation of strategic objectives for the electricity distribution transformers. For the first category of target population, the study utilised the incidences data from the Kenya Power corporate information system for Nairobi Region for the years 2005 to 2009 to determine the target population. The general population for the study was identified as the 192,196 customers affected by electricity distribution transformer vandalism incidences during this period.

The sample of this population targeted for the study was thus taken as 300 persons distributed in the three sub-regions of Nairobi Region. Clustered sampling was adopted as the technique for data collection using a specially prepared questionnaire. A trial run of the questionnaire was conducted on randomly picked customers that came for services at the Kenya Power headquarters at Stima Plaza banking hall.

Data collection assistants were used to present the questionnaires at designated urban centres in the three sub regions of Nairobi. A total of 282 valid questionnaires were completed representing a response rate of 94% for the first category of the sample population while 42 out of the 63 members of staff also completed and returned the questionnaires representing a response rate of 67% for the second category of target population.

The findings of the study in relation to the reason why electricity distribution transformers are being vandalised indicates that transformer oil and the copper windings are the highest motivators for vandals. It also emerged that the transformer oil is largely used for cooling welding machines and for medicinal purposes, though it was not clear how it is used for medicinal purposes. Besides, the detailed analysis of this aspect is outside the scope of this study. It also came out that most of the electricity distribution transformer vandalism is carried out by people from outside the locality and to an
appreciable extent by people from within the locality. In relation to the impact of electricity distribution transformer vandalism, beside the fact that it emerged that the rate of electricity distribution transformers was very high, it was also noted to be somewhat frequent. The greatest impact noted of this was loss of business opportunities for the sole electricity distribution firm and this was further confirmed by the fact that the electricity distribution transformer vandalism was observed to cause great economic loss to the economy of Kenya. In relation to the strategic responses by the electricity distribution company Kenya Power, it was observed that incorporating transformer location in the design of electricity distribution schemes was the most effective mitigation measure followed by observing the safety of the transformer by locking it or welding it onto its frame. Furthermore, community policing was also observed to have an impact in curbing the vice however to a smaller extent than the first two strategic measures. From the study it was not clear as to what the company loses on average per month for every electricity distribution transformer vandalised.

5.3 Discussion of Findings
This section discusses the research findings from the questionnaires as presented in chapter 4.0. The discussion is divided into three sections where each section discusses the data from the questionnaires in line with the research objectives.

5.3.1 Reasons for Electricity Distribution Transformer Vandalism
The research findings indicate that Electricity Distribution Transformer Vandalism occurs in low income residential zones of Nairobi where the social groups comprises largely of unskilled people who are mainly engaged in informal economic activities. This is consistent with segregation of residential areas in Nairobi as described by (K’Akumu & Olima, 2007). Such settlements are characterised by high levels of crime and therefore the revelation of the study that most of the EDT’s that are vandalised are located in these areas confirms the crime phenomena in these areas essentially due to weak security mechanisms in these areas and lack of advocacy mechanisms of the residents. As observed from the results of the study, 71.6% of the EDT vandalism is carried out by persons from outside the locality of the EDT, however, people from the locality of the EDT were also found to be involved to a large extent as observed by 58.4% of the respondents. This implies that the EDT vandalism incidences are majorly a hit and run activities where the perpetrators take advantage of the weak security systems, high level
of crime and other characteristics of the area that allow them to carry out the vice unhindered.

The other reason established as a contributor to the vandalism of the EDT is the target components in the EDT. Whenever an EDT is vandalised, it was established that the main targets are the oil and the copper windings with 87.1% of the respondents stating that the oil is the major target and 69.6% of the respondents placing the copper windings as the main attraction to vandalise the EDT. This corroborates similar reports in the US (FBI, 2008) of how copper theft threatens the infrastructure of the nation making systems such as tornado warning sirens inoperable due to the theft of the copper in such systems thus posing great danger to human lives. In the case in the United States of America, the incentive to target copper was the increase of its price in the market, however, in the Kenyan case, it was not clear why the copper was a major but it is believed to supply the informal industry market with cheap metal as raw materials for the informal industries. Other possible reasons for targeting copper are due to its high demand in the foreign markets to meet the international demand for copper which continues to rise. On the other hand, the oil obtained through this means is largely being used as coolant for welding machines in the informal industry sector as they seek to cut down on input costs to maximise their profits as observed by over 75% of those interviewed. The second use for the oil obtained from the EDT medicinal purposes as observed by over 53.9% of the respondents. It is however not clear how it is used for medicinal purposes and since that was beyond the scope of this study that aspect shall be left for future studies. There was also sufficient evidence from the study that the oil is used in the servicing of motor vehicles as brake fluid and for deep frying foods such as chips as observed by over 47.3% and 33.3% of the respondents respectively. All these driving targets for the vandalism of the EDT are economic in nature and are associated with the characteristics of the area in which this vice occurs.

Besides the above reasons, other minor reasons identified that drive the vandalism for EDT is Economic sabotage. Over 20.8% of the respondents identified this as a reason to vandalise the EDT’s. This is consistent with the observation by the US Congressional Office of Technology Assessment (1990) that electric power system components have been targets of numerous isolated acts of sabotage in the country (US). They also observed that several incidents have resulted in multimillion-dollar repair bills. They
further noted that in several other countries, sabotage has led to extensive blackouts and considerable economic damage in addition to the cost of repair.

5.3.2 The impact of EDT Vandalism to the electrical utility business in Kenya?
The study observed that majority of the areas affected by the EDT Vandalism is residential areas as seen in Table 2. The social groups in these areas comprises largely of unskilled people who are mainly engaged in informal economic activities. This is supported by the observed education levels where 91.84% of the respondents had secondary school education and above with the bulk of them accounting for 83.69% having either a secondary school certificate or diploma certificate. Over 62.77% of the respondents were engaged in either own business, self-employed or employed in the private sector.

The study revealed that the Frequency of EDT vandalism was quite high in these areas with 80.50% of the respondents from the first category admitting that EDT vandalism ranged from occasional to very frequent. In the second category on the other hand, 92.8% of the respondents classified the rate EDT vandalism in the high to very high categories.

That being the case, the study showed that EDT vandalism largely affected the material wellbeing of customers with 88.30% of the respondents confirming this fact. Studies have shown that electricity is essential for a high quality of life in places where a community has graduated from traditional sources of energy such as wood, kerosene and the like. Denial of supply of electricity for whatever reason for people who have become accustomed to it therefore results in a backlash in their livelihoods. This is consistent with the findings by Carlsson and Martinsson (2004) that households have over the years become more and more dependent on electricity because of an increased use of electronic items and because people work from their homes to a larger extent than before. Further to this, the US Congressional Office of Technology Assessment (1990) observed that power outages have both direct and indirect social impacts. They identified the direct social impact as the interruption of an activity, function or service that would require electricity. The direct impacts include food spoilage, damage to electronic equipment or data, the inoperability of life support systems in hospitals or homes, interruption of such social functions as missing ones favourite television program, ironing or interruption of leisure or activity. The indirect social impact includes property losses resulting from arson,
looting or theft as well as the need to pay for increased security. The interruption of the social welfare of customers also affects the productivity of the persons as well.

So for a nation that is looking to improve the quality of lives of its citizens like Kenya as espoused in the social pillar of The Kenya vision 2030 blueprint, the study is very instrumental to the extent that it reveals how this factor affects the population in areas that it is rampant.

The study identified EDT vandalism as a business risk with 92.9% of the respondents in the second category strongly agreeing to this. Furthermore 73.9% of the respondents from this category admitted that it contributes to revenue loss at Kenya Power while 85.7% of the respondents admitted that it contributes greatly to national economic losses. This is consistent with the findings by Adenikinju (2003) that the cost of electricity failures on the Nigerian manufacturing sector is quite high and firms incur huge costs on the provision of expensive back-up to minimise the expected outage costs. Similar observations were made by Von Ketelhodt & Wöcke (2008) who found that as the target key drivers of industrial growth in South Africa, the vulnerability of the SME sector to volatility in the macro-economic environment such as power outages or unreliable electricity supply is of key concern as it greatly affected their productivity thus impacting on their potential contribution to the GDP as anticipated. All these findings are also consistent with the observation by the US Congressional Office of Technology Assessment (1990) of what it termed the economic impacts of power outages as being either direct or indirect impacts that can be characterized by the ability to quantify them in monetary terms.

In a study of the importance of modern energy for micro-enterprises in rural Kenya it was found that access to electricity is a necessary condition for start-ups and development of Small and Medium Enterprises (Kirubi, 2006). The Small and Medium Enterprises (SME’s) that are reliant on electricity also were identified to be affected by EDT vandalism and since SME’s are also identified as great contributors to national development and the evidence from this study that such ventures get interrupted quite often due to vandalism implies that the potential for the SME’s in the affected areas to effective contribute to the economic wellbeing of the nation is greatly impacted. Indeed as revealed by the study, EDT vandalism contributes to a large extent to national economic losses through the effects it has on the individuals, SME’s as well as to the sole electricity
distribution company Kenya Power in form of loss of revenue as well as loss of business opportunities.

5.3.3 The Strategic Responses by the Electrical Utility Business?

The study sought to establish the effectiveness of the current measures put in place to curb EDT vandalism, and as observed, the rate of EDT vandalism is still very high with 80.50% of the respondents from category one and 92.8% of the respondents from category two holding this view. It is therefore evident that most of the current measures instituted to curb the vice may not be effective as to stop the EDT vandalism. As observed by the FBI (2008) the international demand for copper as raw material is driven by demand from developing countries which in effect are creating a trade platform for illegally acquired copper. This availability of the market for copper is one of the greatest incentives for the element to be targeted in the process of vandalising an EDT.

Measures that have been put in place such as the legislative intervention to criminalise copper theft and anti-vandalism events such as road shows, tournaments and the like have had minimal effect in deterring EDT vandalism as seen from the results of the study where these interventions scored a mean of 2.64 and 2.9 respectively on a scale of 5. From the study, the most effective mechanisms to curb EDT vandalism is in Designing of EDT to be located within areas with sufficient security along the electricity distribution network. This scored a mean of 4.15 on a scale of 5. This therefore means that future designs of the electricity distribution network have to combine both technical considerations with the safety of the EDT. The fact that the study revealed that EDT Vandalism incidences are influencing corporate policy and departmental plans is a good indicator that such interventions as change in design policy is likely to be effected. Other effective measures of curbing the vice involve securing of the EDT’s on its structure by welding it firmly on the platform, sealing all possible holes and locking it securely (mean of 3.62). This makes it difficult for the vandals to quickly bring down the transformer for their operation thus discouraging them from such transformer. The other aspect of the response by the electrical utility firm interrogated was the effectiveness of handling the post EDT vandalism in the event that such a case is reported, it emerged that the customers perception of the Kenya Power response was not satisfactory with 59.8% of the respondents being dissatisfied. Meanwhile the results of the study from the Kenya Power participants indicated an overwhelming satisfaction with the response to EDT vandalism with 78% of the respondents giving it a thumb of approval. The only explanation for this
disparity is that the Kenya Power participants are being loyal to the employer, however this does not augur well for the business because the customer is the one that sustains the business and there is a great relationship between customer satisfaction, customer loyalty and profitability. Kenya power may be the only electricity distribution and supply firm in the country but it is critical for its sustainability to ensure that the customers are satisfied as this is important for its continued survival in the business and also for the sustainability of the other players in the electricity business upstream such as the generators and the transmission companies. Even though the customers were not satisfied with the services of the Kenya Power after an EDT vandalism incident, the study however showed that they were willing to participate in collaborating with the Kenya Power to help in preventing EDT vandalism with 65.96% of the respondents highly willing to be involved. This indicates that Kenya Power still has room for strategic actions to prevent vandalism and this requires that they include the customers in their EDT vandalism prevention plans. On being required to pay in order to fund EDT Vandalism prevention programs, the respondents were categorically reluctant with 51.3% not willing to make payments to such ventures. This is in contrast to the Swedish consumers who were found to be willing to pay to avoid any power outage (Carlsson & Martinsson, 2004).

5.4 Conclusions

5.4.1 Why are Electricity Distribution Transformers being vandalized
The two major reasons for EDT vandalism is oil followed by the copper windings. Since there has not been any study conducted in this area before, this conclusion confirms the belief that has been publicly held about the target of EDT vandalism as well as dispel some of the beliefs. Furthermore, it is clear now that a large percentage of the vandals are from outside the locality of the transformer while in few instances persons from the locality of the EDT also participate in EDT vandalism. The relationship between the characteristics of the areas affected by EDT vandalism (low income settlements), the social groups in this areas (unskilled people who are mainly engaged in informal economic activities) as well as the location of the EDT’s (located in isolated places) is a major factor contributing to the growth or thriving of the vice.
5.4.2 What is the impact of EDT Vandalism to the electrical utility business in Kenya?

EDT Vandalism negatively impacts electricity customers by affecting their material wellbeing, denying them business opportunities as well as limiting efficient access to electricity for business start-ups and SME’s which are crucial for national development and growth of the nation. EDT vandalism also affects the Kenya Power by impairing the relationship with its customers, denying the company the much needed revenue while choking up resources that would otherwise be used for expansion of electricity access and improvement of services, this has a cascading effect on the other players in the electricity service chain as Kenya Power is the sole distributor and supplier of Electricity in Kenya as well as in retarding national development since electrical energy is a key component of the Kenya’s development blueprint.

5.4.3 What are the Strategic responses by the electrical utility business?

The strategic responses by the electricity utility firm Kenya Power has only acted to slow EDT vandalism but the rate and frequency of EDT vandalism is still very high in Nairobi region. Besides the strategic responses have left a big gap between the customers involved in helping to solve the EDT Vandalism problem and those who are willing to be involved in the solution process. This implies that the electricity utility company needs to refocus its energies in the management strategies to be more effective in managing the vice.

5.5 Recommendations

5.5.1 Recommendations for Improvement

5.5.1.1 Why are Electricity Distribution Transformers being vandalized

The two major motivators to EDT vandalism was found to be to obtain the oil in the transformer (87.1%) and secondly to obtain the copper windings in the transformer (69.6%). In interrogating further as to the use of the transformer oil obtained through the EDT vandalism, it was established that the major uses were as a cooling agent in the welding machines (57.2%) and secondly for medicinal purposes (40.9%). From a technical point of view, it is understandable why the transformer oil would predominantly be used as a cooling agent in welding machines since that is the same function is does in the transformer. However, it is more perplexing why the same oil would be appropriate for medicinal uses. To improve this study therefore, the researcher recommends that the
use of transformer oil for medicinal purposes be explored to establish how it is used, the properties that makes it suitable for such use and why it is preferred to the conventional medicines that would have otherwise been used.

5.5.1.2 What is the impact of EDT Vandalism to the electrical utility business in Kenya?
To improve the study, the researcher recommends that the role of a single distribution and supply company in the electricity business should be incorporated in this question so as to show the cascading effect of the potential threats to the sole firm on the other players in the market.

5.5.1.3 What are the Strategic responses by the electrical utility business?
The strategic responses are largely internal to the electricity distribution and supply firm where as the overall impact of the EDT vandalism is on national development, to improve the study therefore, the researcher recommends that the response of business concerns such as the national chamber of commerce as well as the national security system should be explored since it was identified that the factors fuelling the EDT vandalism are international trade especially of copper.

5.5.2 Recommendations for Further Studies
Further research should be carried out to estimate the revenue loss per Electricity Distribution Transformer per month for every EDT vandalism incidence considering all parameters at play such as direct and indirect costs and compare this to the costs expected to be incurred in managing the vice to establish a cost benefit scenario for investing in aggressive prevention measures.
REFERENCES

6.0 REFERENCES


APPENDIX I: Letter of authority to conduct research

United States International University

7th June, 2010

Chief Manager,
Human Resources and Administration,
Kenya Power & Lighting Company,
NAIROBI

Dear Sir,

RE: AUTHORIZATION TO COLLECT DATA AT KPLC

This is to confirm that Moses Majiwa is a student at United States International University (USIU) and is writing a research proposal on “Protection of Electrical Utility Infrastructure” (specifically transformer vandalism). Compilation of the data will contribute towards the fulfillment of his academic requirements. I recommend that you accord him the necessary assistance to enable him do the research in the institution.

Thank you.

Prof. Francis W. Wambalaba, Ph.D., AICP
Professor of Economics and
Director of Research & Programs Development
United States International University
P.O. Box 14634, Nairobi, Kenya, 00800
fwambalaba@usu.ac.ke
P.H. +254 20 3666115

c.c. Chief Manager,
Information Technology and Telecommunications

I have no objection.

Do note to H.R.

28.6.10
TO WHOM IT MAY CONCERN

RESEARCH APPROVAL – MOSES MAJWA

Reference is made to the subject matter mentioned above.

Kindly allow Moses Majwa, a member of staff, who is doing his MBA at USIU, to carry out a research project in the Company on “Protection of Electrical Utility Infrastructure”.

This authority not withstanding discretion must be exercised in the use of company information including business strategies and policy documents.

The Research Project should also not disrupt normal working hours and Company’s flow of work.

Yours faithfully,
For: KENYA POWER & LIGHTING CO. LTD.

Edward Onoña
For: HUMAN RESOURCE DEVELOPMENT MANAGER
APPENDIX II: Letter of introduction

7th January 2011

TO WHOM IN MAY CONCERN

Dear Interviewee,

I am a graduate student of the United States International University (USIU) in Nairobi undertaking a Master of Business Administration. As part of the requirements for this course, I am required to conduct a research in an appropriate area of study.

I have therefore chosen to study the impact of Transformer Vandalism on the electrical utility business in Kenya under the title "The Impact Of Distribution Transformer Vandalism On Electrical Utility Business In Kenya: Case Study Of KPLC". As part of the study, I intend to collect data for the research through a questionnaire as enclosed.

The information gathered through this process will form the foundation in understanding the complex and costly practice of distribution transformer vandalism and its effects on both the electrical utility business and to electricity customers in Kenya. You are therefore privileged to be part of this process in an endeavour to unravel the effects of the problem.

The information provided will strictly be confidential and will only be used for the purposes of this research. Under no circumstances will the information be used against you.

The questionnaire is designed to take as little of your time as possible.

As you answer the questions, kindly be as objective as possible.

Sincerely,

Moses Majiwa

Graduate Student
USIU-Nairobi
Tel: 2540737
Mobile: 0722 631 909
APPENDIX III: Questionnaire

A. Why Electricity Distribution Transformers are Vandalised

A.1 How frequent do you experience transformer vandalism
   a) Very frequent ☐
   b) Somewhat frequent ☐
   c) Frequent ☐
   d) Occasionally ☐
   e) Rarely ☐
   f) Never ☐

A.2 Approximately how long do the vandalism incidences last?
   <1 hour ☐ 1 - 2 hours ☐ 3 - 4 hours ☐ 5 - 8 hours ☐ >8 hours ☐

A.3 From the list below please select all the major reasons why transformers are being vandalised?
   i. To obtain oil ☐
   ii. To obtain copper windings ☐
   iii. Economic Sabotage ☐
   iv. To destroy KPLC as a monopoly ☐
   v. To gain business advantage over KPLC ☐
   vi. To create market for security devices ☐
   vii. Others (specify) __________________________

A.4 On a scale of 1 to 5 (where 5 represents high and 1 represents low) please select the levels to which the following best describes the use for oil from a vandalised transformer?

   i. For cooking (chips, fish etc) ☐ ☐ ☐ ☐ ☐
   ii. Mixed with diesel & used as car fuel ☐ ☐ ☐ ☐ ☐
   iii. Mixed with parafin & used as brake fluid ☐ ☐ ☐ ☐ ☐
   iv. Used for medicinal purposes ☐ ☐ ☐ ☐ ☐
   v. As a cooling agent in welding machines ☐ ☐ ☐ ☐ ☐
   vi. To create market for security devices ☐ ☐ ☐ ☐ ☐
   vii. Others (specify) ___________________________
A.5 How would you describe the rate of increase of transformer vandalism

a) Very high
b) High
c) Constant
d) low
e) Very low

A.6 On a scale of 1 to 5 (where 5 represents highest likely source and 1 represents lowest likely source) please select the levels to which the following best describes the likely sources of vandalism?

<table>
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<tr>
<th></th>
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<th>4</th>
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</tr>
</thead>
<tbody>
<tr>
<td>a) Cartels</td>
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<tr>
<td>b) Small businesses</td>
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<tr>
<td>c) Individuals in the area</td>
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<tr>
<td>d) People from outside this area</td>
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<tr>
<td>e) Others</td>
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</tbody>
</table>

(specify)__________________________________________________________

A.7 How would you rate your level of involvement in solving vandalism problem?

a) Highly involved
b) Somewhat involved
c) Just involved
d) rarely involved
e) Not involved at all

A.8 On a scale of 1 to 5 (where 5 represents highly desire and 1 represents no desire at all) how would you rate your desire to be involved in solving the vandalism problem?

<table>
<thead>
<tr>
<th></th>
<th>5</th>
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</tbody>
</table>

A.9 On a scale of 1 to 5 (where 5 represents very willing and 1 represents not willing at all) how would you rate your willingness to pay more for electricity to fund increased security of transformers.

<table>
<thead>
<tr>
<th></th>
<th>5</th>
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</tbody>
</table>
A.10 How would you rate KPLC response when a vandalism incidence has been reported?
   a) Very satisfying ☐
   b) Somewhat satisfying ☐
   c) satisfactory ☐
   d) Somewhat dissatisfied ☐
   e) Very dissatisfied ☐

A.11 Please rate the manner in which KPLC handles vandalism incidences?
   a) Very satisfied ☐
   b) Somewhat satisfied ☐
   c) satisfactory ☐
   d) Somewhat dissatisfied ☐
   e) Very dissatisfied ☐

A.12 Please rate KPLC Customer service response after a vandalism incidence?
   a) Very Good ☐
   b) Good ☐
   c) Fair ☐
   d) Poor ☐
   e) Very Poor ☐

A.13 How likely are you to commend KPLC as an efficient power supplier
   a) Very likely ☐
   b) Somewhat likely ☐
   c) Likely ☐
   d) Somewhat unlikely ☐
   e) Very unlikely ☐

A.14 In the space below, kindly suggest what you think should be done to curb vandalism?

__________________________________________________________
_________

B. Impact of Vandalism on Electricity Utility Business

B.1 On the whole how can you classify your satisfaction of the life you lead
   i. very satisfied ☐
   ii. fairly satisfied ☐
   iii. Satisfied ☐
   iv. not satisfied ☐
   v. not at all satisfied ☐
B.2 Do you agree that transformer vandalism affects your material wellbeing
   a) Strongly agree  
   b) Agree  
   c) Neutral  
   d) Disagree  
   e) Strongly disagree  

B.3 How would you rate the effect of transformer vandalism on your security as an individual?
   a) Highly affect  
   b) Affect  
   c) Moderately affect  
   d) Lowly affect  
   e) Does not affect  

B.4 How would you rate the effect of transformer vandalism on the life of your family?
   a) Highly affect  
   b) Affect  
   c) Moderately affect  
   d) Lowly affect  
   e) Does not affect  

B.5 How would you rate the effect of transformer vandalism on the life of the community?
   a) Highly affect  
   b) Affect  
   c) Moderately affect  
   d) Lowly affect  
   e) Does not affect  

B.6 How would you rate the effect of transformer vandalism on your job security?
   a) Highly affect  
   b) Affect  
   c) Moderately affect  
   d) Lowly affect  
   e) Does not affect  

B.7 How would you rate the effect of transformer vandalism on your freedom?
   a) Highly affect  
   b) Affect  
   c) Moderately affect  
   d) Lowly affect  
   e) Does not affect  

B.8 How does transformer vandalism affect your wealth creation capability?
   a) Highly affect  
   b) Affect  
c) Moderately affect  

d) Lowly affect  

e) Does not affect  

B.9 How would you rate the impact of transformer vandalism on your business?
   a) Very Highly impact  
   b) Highly impact  
   c) Moderately impact  
   d) Lowly impact  
   e) No impact  

B.10 How frequently does transformer vandalism interrupt your business?
   a) Very frequent  
   b) Frequent  
   c) Occasionally  
   d) Rarely  
   e) Never  

B.11 On a scale of 1 to 5 (where 5 represents very high losses and 1 represents no losses) how would you rate business losses in relation to transformer vandalism.

   5 4 3 2 1

C. Personal data
C.1 Gender  
   Male □ Female □
C.2 Age group:  
   15-18 □ 19-25 □ 26-35 □ 36-45 □ Over □

C.3 Level of Education: highest level attained
   a) Primary School  
   b) Secondary School  
   c) College Diploma/Certificate  
   d) Bachelor's Degree  
   e) Post Graduate Degree  

C.4 Marital status
   a) Single  
   b) Married  
   c) Divorced  
   d) Widow  
   e) Widower  

C.5 Your Occupation
   a) Unemployed  
   b) Self employed  
   c) Businessman/woman  

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d) Employed (private sector)  
  e) Employed (Public sector)  
  f) Employed (NGO)  
  g) Other (Specify) ________________________________________________________________

C.6 Please tell us where you live

Town: ____________________________

Estate: _____________________________

C.7 How many years have you lived in the area: <3 □ 4-5 □ 6-10 □ 11-15 □ □ >15

C.8 Do you have access to electricity? Yes □ No □

C.9 Which is your electricity User category?
  a) Non customer (non electricity user) □
  b) Non customer (electricity user) □
  c) Domestic customer (DC) □
  d) Small Commercial (SC) □
  e) Large commercial & industrial (C) □
  f) Commercial and Industrial (CI) □
  g) Other (specify) ____________________________

D. Strategic Responses by the Electricity Utility Business

D.1 How would you describe the rate of increase of transformer vandalism?
  a) Very high □
  b) High □
  c) Constant □
  d) Low □
  e) Very low □

D.2 How would you rate the influence of transformer vandalism on your departments’ policy direction?
  a) Very Highly influence □
  b) Highly influence □
  c) Moderately influence □
  d) Minimal influence □
  e) No influence at all □

D.3 How would you rate the influence of transformer vandalism on your departments’ strategic plans?
  a) Very Highly influence □
  b) Highly influence □
  c) Moderately influence □
d) Minimal influence

e) No influence at all

D.4 To what degree does transformer vandalism affect the relationship between KPLC and its customers

a) Very Highly affect
b) Highly affect
c) Moderately affect
d) Lowly affect
e) Does not affect at all

D.5 What is the average monthly revenue per distribution transformer?_______________

D.6 On a scale of 1 to 5, (where 5 represents highest rank and 1 represents lowest rank) please rate the contribution of transformer vandalism to revenue losses of the company

5 4 3 2 1

D.7 How would you rate the contribution of transformer vandalism to economic loss to the nation

a) Very High
b) High
c) Moderate
d) Low
e) No contribution at all

D.8 Transformer vandalism is an act of economic sabotage

a) Strongly agree
b) Agree
c) Neutral
d) Disagree
e) Strongly disagree

D.9 What proportion of the departments’ budget is taken up by provisions for transformer vandalism

<0.25 0.25-0.50 0.50 0.5-0.75 >0.75

D.10 On a scale of 1 to 5 (where 5 represents highest effect and 1 represents lowest effect) please rate the effect of transformer vandalism on the following;

5 4 3 2 1
D.11 How would you rate your efficiency in attending to the report of a vandalised transformer
a) Very fast
b) Relatively fast
c) Fast
d) Slow
e) Very slow

D.12 How would you rate your response to customers in the event of a transformer vandalism
a) Very satisfying
b) Somewhat satisfying
c) Satisfactory
d) Dissatisfying
e) Very dissatisfying

D.13 How would you rate the levels of transformer vandalism in Nairobi Region
a) Very High
b) High
c) Moderate
d) Low
e) Very low

D.14 Transformer vandalism is a business risk
a) Strongly agree
b) Agree
c) Neutral
d) Disagree
e) Strongly disagree

D.15 What proportion of the company’s budget is taken up by insurance against the risk of transformer vandalism
0%-25% ☐ 25%-49% ☐ 50% ☐ 51% - 74% ☐ >75% ☐

D.16 On a scale of 1 to 5 (where 5 represents highest effect and 1 represents lowest effect) please rate the effectiveness of the following company measures on curbing transformer vandalism?
a) Legislative intervention (Energy Act, 2006)

b) Transformer Safety (locking, sealing)

c) Community Policing (Mulika mwizi)

d) Design (siting in safe locations)

e) Security surveillance

f) anti-vandalism events (tournaments, road shows etc)

D.17 In your assessment, what proportion of the whole company management’s time is spent on issues associated with vandalism

- 0%-25%
- 25%-49%
- 50%
- 51%-74%
- >75%

E. Personal data

E.1 Designation:______________________________________________

E.2 Section:______________________________________________

E.3 Department:______________________________________________

E.4 Division:___________________________________________________

E.5 How many years have you worked in your current position?

- <3
- 4-5
- 6-10
- 11-15
- >15

E.6 How many years have you worked in KPLC: <3

- 4-5
- 6-10
- 11-15
- >15
APPENDIX IV: Tables

Table 30: Number of transformers per Frequency of attack in Nairobi Region

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<th>Number of transformers</th>
<th>Number of Incidences</th>
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