ADDIS ABABA UNIVERSITY

ADDIS ABABA INSTITUTE OF TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

STUDY AND EVALUATION OF THE RELIABILITY AND DESIGN OF POWER DISTRIBUTION SYSTEM : CASE STUDY ADDIS ABABA POWER DISTRIBUTION

BY

KIROS TESFAY

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APPROVAL BY BOARD OF EXAMINERS

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Declaration

I, the undersigned, declare that this MSc thesis is my original work, has not been presented for fulfillment of a degree in this or any other university, and all sources and materials used for the thesis have been acknowledged.

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Date of submission: _June, 2014_________________

This thesis work has been submitted for examination with my approval as a university advisor.

Dr.-Ing Getachew Biru ___________________

Advisor's Name Signature

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ABSTRACT

Electricity is produced and delivered to customers through generation, transmission and distribution systems. A stable and reliable electric power supply system serve customer loads without interruptions. Distribution systems deliver power from bulk power systems to customers. Distribution reliability primarily relates to equipment outages and customer interruptions.

Electric power interruption in Addis Ababa region distribution is becoming a day to day phenomenon. Even there are times that electric power interruption occurs several times a day, not only at the low voltage but also at the medium voltage distribution systems.

This thesis work attempts to thoroughly identify causes for power interruptions and customer dissatisfaction and discusses the design, reliability and operation and maintenance of Addis Ababa distribution system. Furthermore, based on load forecast for 25 years, a model distribution substation design have been carried out to help EEPCO use the model in its design practice, as many of the substations have been designed without considerations of future power load growth and are suffering from overload operation. The model design is carried out for the 250MVA, 132/33kV distribution substation for Addis Center distribution system to upgrade the existing 63MVA, 132/15kV distribution substation.

Distribution reliability indices such as SAIFI, SAIDI, CAIDI, and ASAI have been analyzed thoroughly on the Addis Ababa distribution substations (Addis Center) using on data collected from EEPCO. The analyzed and calculated distribution reliability indices values have been compared with standard benchmark values and comparison clearly indicates that Addis Ababa distribution system is extremely unreliable.

The values for SAIDI, SAIFI, CAIDI and ASAI are 23 minutes/year, 0.5 interruptions/customer, 112 minutes/year and 99.97% respectively in a Germany standard, whereas the corresponding values for the existing distribution system of Addis Center are 252 minutes/month, 3.65 interruptions/customer, 2280 minutes/month and 99.425% respectively.

In addition to the model design, the study discusses the measures to be taken in terms of operational and maintenance tasks to improve the serious reliability problem of Addis Ababa distribution system.

Key words: Power Distribution System, Voltage Drop, Distribution Substation Design, Feeders, Reliability Indices, Reliability Indices Analysis, Operation & Maintenance

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LIST OF ABBREVIATIONS

ADC	Addis Center
AENS	Average Energy Not Supplied Index
ANSI	American National Standards Institute
ASAI	Average Service Availability Index
ASUI	Average Service Unavailability Index
CAIDI	Customer Average Interruption Duration Index
CAIFI	Customer Average Interruption Frequency Index
CT	Current transformer
DC	Direct current
DPQ	Distribution Power Quality
EEA	Ethiopian Electric Agency
EEPCO	Ethiopian Electric Power Corporation
ENS	Energy not supplied
HRC	High Rupturing Capacity
I	Current
IEC	International Electro technical Commission
IEEE	Institute of Electrical and Electronics Engineers
KVAR	Kilovolt Ampere Reactive
KVA	Kilovolt Ampere
MW	Mega watt
MVA	Mega volt ampere
NEMA	National Equipment Manufacturers Association
P	Active power
PF	Power factor
PT	Potential transformer
Q	Reactive power
RMS	Root-mean-square (effective value)
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SOL	System over load
V	Volts
VAR	Volt ampere reactive

CHAPTER ONE
INTRODUCTION

1.1 Background

The power distribution system is made up of sub-transmission lines, power transformers, 33kV lines, 15kV lines, distribution transformers, LV Lines, etc. Distribution substations monitor and adjust circuits within the system. Currently Ethiopian Electric Power Corporation power system have 400kV, 230kV, 132 kV primary transmission systems and 66kV, 45kV as sub transmission system and 33kV and 15kV as distribution system. At all the 66 or 45kV substations power transformers of various ratings like 25 /12 /6.3/3MVA are installed for step down of voltage to 15kV for feeding to Distribution Transformers. The outgoing feeders are connected in radial fashion. Mostly 33kV and 15kV overhead conductors are used for feeding 60 to 70 distribution transformers on each 33kV and 15kV feeder. The voltage is then further reduced by distribution transformers to the utilization voltages of 380 volts three-phase or 220 volts single-phase supply required by most users.

Substations are fenced yards with switches, transformers and other electrical equipments. Once the voltage has been lowered at the distribution substation, the electricity flows to industrial, commercial, and residential centers through the distribution system. Conductors called feeders reach out from the distribution substation to carry electricity to customers. At key locations along the distribution system, voltage is lowered by distribution transformers to the voltage needed by customers or end-users.

Electric distribution system power quality is a growing concern. Customers require higher quality service due to more sensitive electrical and electronic equipments. The effectiveness of a power distribution system is measured in terms of efficiency, service continuity or reliability, service quality in terms of voltage profile and stability and power distribution system performance.

In the context of Ethiopia, electric power interruption is becoming a day to day phenomenon. Even there are times that electric power interruption occurs several times a day, not only at the low voltage but also at the medium voltage distribution systems.

The drop of the voltage, especially at the residential loads, is causing early failure of equipments, blackening of light bulbs, and decreased efficiency and performance of high-power appliances. Damage of electronic devices and burning of light bulbs have also occurred due to over voltages.

1.2 Problem Statement and Motivation

Ethiopian Government is currently making all rounded effort to change the country's economic status from the current least developed level to a medium income level. Of the many aspects of this effort, expanding and strengthening of the electric power supply sector is one among the most emphasized economic dimensions.

Since Addis Ababa is the capital city of the country and a preferred location for most of the industries in the country, considerable share of the electric power supply is directed towards the city. Due to this fact, Addis Ababa has already been the load center of Ethiopian electric power system. But, electric power interruption is becoming a day to day phenomenon. Even there are times that electric power interruption occurs several times a day, not only at the low voltage but also at the medium voltage distribution systems.

Considering this fact, in the thesis work, a comprehensive investigation of Addis Ababa's power distribution problems has been conducted. Based on the result of the investigation, design and performance improvement measures has been identified and considered which can be used as proto-type to be implemented for other areas.

Electrical power distribution is one among the major parts in power system. All aspects of power distribution system reliability and design improvement measures has been addressed that will lead to a detailed investigation of the general features of the power distribution problems of Addis Ababa and a recommendation with a complete design of power distribution system by including detailed assessment of the power distribution and making an economic analysis of the designed system.

1.3 Objectives

The main objective of this thesis work is to conduct a study and evaluation of the reliability and design of Addis Ababa power distribution system.

The specific objectives of this thesis work are:

- To investigate and identify the possible power distribution problems that affects the performance of the network
- To make a detailed analysis on the design and operation and maintenance practice of the existing power distribution system.
- To make a detailed reliability analysis of the existing distribution system
- To propose an improved power distribution design that helps to mitigate the identified power reliability problems.
- To make relevant conclusions and recommendations that can be of use for the performance improvement of the Addis Ababa distribution system.

1.4 Methodology

Due to the nature of the study, it is started by reviewing literatures related to the investigation of quality and reliability problems of power distribution systems. Recent and unpublished important information and data have been collected from Ethiopian Electric Power Corporation (EEPCO).

Interviews with respective professionals at substations have been considered. Previous recorded data have been gathered for detail assessment and investigation to come up with a clear solution of the problem at hand.

The collected data from the field work have been then analyzed and a model power distribution substation for Addis Center is designed.

Generally the following methodology has been followed in conducting the thesis work:

- Site visit
- Technical data collection from the Addis Ababa region distribution system
- To gather relevant data for the distribution system which helps to carryout reliability analysis
- For the purpose of analysis data from the following offices will be collected
  - ✓ Existing structure of Addis Ababa distribution system
  - ✓ Data’s on Addis Ababa substation
  - ✓ Data’s on planning and design of Addis Ababa distribution system (to check standards used)
  - ✓ Data’s on Addis Ababa distribution operation and management system
  - ✓ Data's from urban rehabilitation project
- Investigation of power distribution design problems and reliability problems for power distribution systems in the city
- Analysis of the technical and economic performance of the distribution system

This thesis work considered the primary distribution system and particularly the 15kV outgoing feeders. This is because the distribution system is the major contributor of the reliability problems in the power system.

1.5 Organization of the Thesis

The thesis is organized into six chapters which are briefly summarized below.

Chapter one presents the introduction, background, motivation and statement of the problem, objectives of the study and methodology followed in the thesis work. In addition, it provides the outline of the thesis.

The second chapter discusses about the theoretical background and literature review of the study topic, mainly on electric power distribution system design, power quality analysis, voltage drop, power loss, and reliability analysis of electric power distribution system.

Chapter three deals with the reliability evaluation of electrical power distribution system design. In this chapter all requirements that are needed for power distribution system design are discussed.

Chapter four presents detailed reliability analysis of the existing distribution system. In this chapter, detailed reliability evaluation done on the Addis Ababa's distribution system is discussed. Furthermore, it presents comparison of reliability indices with benchmarks and solutions for improving the reliability of distribution system.

Chapter five discusses with the solutions for improving the reliability of the distribution system. In this chapter, a design solution to Addis Center distribution substation, Operation and Maintenance and reliability improvement strategies to Addis Ababa distribution system are discussed in detail.

Discussions, conclusions and recommendations are incorporated under chapter six.

CHAPTER TWO

THEORETICAL BACKGROUND AND LITERATURE REVIEW

To obtain a full understanding of the performance of electric power distribution system and the problems associated with the reliability of the distribution system a literature review has been performed on the following areas:

- Electric power distribution system design
- Power quality analysis in an electric power distribution system
- Voltage drop in an electric power distribution systems
- Power loss in an electric power distribution system
- Reliability analysis of an electric power distribution system
- Current research progress on the power reliability problem

2.1 Electric Power Distribution System Design

In order to design the best electric power distribution system, information concerning the load profile and knowledge of the various types of electric power distribution systems that are applicable to the design of the electric power distribution system is a necessity. To this end, different electrical power distribution system designs have been researched.

The basic principles or factors requiring consideration during design of the power distribution system include [8]:

- Electric power distribution system standards
- Functions of electric power distribution system structure
- Life and flexibility of structure
- Locations of service entrance and distribution equipment, locations and characteristics of loads, locations of unit substations
- Density of customers (demand) and diversity factors of loads
- Sources of power; including normal, standby and emergency
- Continuity and quality of power available and required

- Energy efficiency and management
- Distribution and utilization voltages
- Bus and/or cable feeders
- Distribution equipment and control system
- Power monitoring systems
- Electric utility requirements

In the design of distribution system there are two standards applied in the world [9]:

- North American standards governed by ANSI and the IEEE
  - The standard secondary voltage level is 208/120 Volts and 190/110 Volts
- European standards governed by IEC
  - The standard secondary voltage level is 380/220 Volts and 400/230 Volts
- EEPCO is using standards set by IEC

2.2 Voltage Drop in an Electric Power Distribution System

The equipment connected to a utility system is designed to operate at a specific voltage level. It is difficult to supply power to each customer at a voltage exactly equal to what is written on the customer equipment nameplates. The main cause of this difficulty is that there is a voltage drop in each element of the power system [10]:

- Generation
- Transmission
- Distribution

One of the most important constraints on distribution system design is the voltage level of the customer intake point. In distribution system, the voltage drop is proportional to the magnitude of demand current and the entire impedance between the source and the customer.

Voltage drop in electric power distribution system can occur because of various factors. Few of them are mentioned as below [16].

1. Nature and type of load,
2. Design of electrical installations/equipments,

3. Layout of installations,
4. Poor maintenance of the system,
5. Undersize and lengthy service lines.

The voltage drop along a distribution feeder can be calculated in two methods [10]:

Approximate Method

$$V_{drop} = |V_S - V_R| = I \cdot R \cdot Cos\theta + I \cdot X \cdot Sin\theta \quad (2.1)$$

Where

V_{drop} = Voltage drop, line-to-neutral, V

V_R = Receiving end voltage, V

V_S = Source voltage, line-to-neutral, V

I = Line (Load) current, A

R = Circuit (branch, feeder) resistance, Ω

X = Circuit (branch, feeder) reactance, Ω

Cosθ = Power factor of load, decimal

Sinθ = Reactive factor of load, decimal

θ = angle between the voltage and the current

Exact Method 1

i. If sending end voltage and load PF are known.

$$V_{drop} = |V_S| + I\,R\,Cos\,\theta + I\,X\,Sin\,\theta - \sqrt{V_s^2 - (I\,X\,Cos\,\theta - I\,R\,Sin\,\theta)^2} \quad (2.2)$$

Where

V_{drop} = Voltage drop, line-to-neutral, V

V_S = Source voltage, line-to-neutral, V

I = Line (Load) current, A

R = Circuit (branch, feeder) resistance, Ω

X = Circuit (branch, feeder) reactance, Ω

Cosθ = Power factor of load, decimal

Sinθ = Reactive factor of load, decimal

θ = angle between the voltage and the current

ii. If the receiving end voltage, load current and power factor (PF) are known.

$$V_{drop} = \sqrt{(V_R \cdot Cos\theta + I_R)^2 + (V_R \cdot Sin\theta + I_X)^2} \tag{2.3}$$

Exact Method 2

If receiving or sending MVA and its power factor are known at a known sending or receiving voltage.

$$V_S^2 = V_R^2 + \frac{(Z \cdot MVA_R)^2}{V_R^2} + 2 \cdot Z \cdot MVA_R \cdot Cos(\gamma - \theta_R) \qquad \text{Or}$$

$$V_R^2 = V_S^2 + \frac{(Z \cdot MVA_R)^2}{V_S^2} + 2 \cdot Z \cdot MVA_S \cdot Cos(\gamma - \theta_S) \tag{2.4}$$

Where:

V_R = Receiving line-line voltage in kV

V_S = Sending line-line voltage in kV

MVA_R = Receiving three-phase, MVA

MVA_S = Sending three-phase, MVA

Z = Impedance between sending and receiving ends

γ = the angle of impedance Z

θ_R = Receiving end PF

θ_S = Sending end PF, positive when lagging

In electric power distribution system, voltage drop depends upon numerous factors. The type and nature of conductor, the size of conductor and the length of circuit are the few out of many. The supply conductor, if not of reasonable size, will cause excessive voltage drop in an electrical circuit. The voltage drop is in direct proportion to the circuit length. Proper starting and running of motors, lighting equipment, and other loads having inrush currents should be considered. The NEC recommends that the steady-state voltage drop in power, heating, or lighting feeder be no more than 3%, and the total drop including feeders and branch circuits be no more than 5% overall [16].

Poor performance of equipments, overheating, nuisance tripping of over current protective devices and excessive burnouts are the sign of unsatisfactory voltage at customer's terminals. When the voltage at the terminals of utilizing equipment deviates from the value of nameplate of electrical appliances, the performance and the operating life of the equipment is affected. The effect may be minor or prominent depending on the characteristics of the equipment and amount of the voltage drop deviation from the nameplate rating. Generally performance conforms to the utilization voltage limits specified in American National Standard Institute (ANSI) but it may vary for specific items of voltage sensitive equipment [16].

2.3 Power Loss in an Electric Power Distribution System

Distribution power loss refers to the difference between amount of energy delivered to the distribution system and the amount of energy consumed. The level of losses will be influenced by a number of factors, technical and operational, such as network configuration, load characteristics, substations in service, and power quality required. It is important to manage these factors by appropriate incentives and thus optimize the level of losses [10].

Power losses in distribution lines (feeders) can be divided into two categories

- Real power loss

$$P_{loss} = \sum_{i=1}^{n} |I_i|^2 \cdot R_i \tag{2.5}$$

- Reactive power loss

$$Q_{loss} = \sum_{i=1}^{n} |I_i|^2 \cdot X_i \tag{2.6}$$

Losses in distribution networks are divided into technical and nontechnical losses [10].

2.4.1 Technical Losses

Technical losses comprise of variable losses and fixed losses [10].

Variable losses (load losses) are proportional to the square of the current depending on the power distributed across the network. They are often referred to as copper losses that occur mainly in lines, cables, and copper parts of transformers. Variable losses can be reduced by [10]:

- Increasing the cross - sectional area of lines and cables for a given load;
- Reconfiguring the network, for example, by providing more direct and/or shorter lines to where demand is situated;
- Managing the demand to reduce the peaks on the distribution network;
- Balancing the loads on three - phase networks;
- Encouraging the customers to improve their power factors; and
- Locating the embedded generating units as close as possible to demand side.

Fixed losses (no-load losses) occur mainly in the transformer cores and take the form of heat and noise as long as the transformer is energized. These losses do not vary with the power transmitted through the transformer and can be reduced by using high - quality raw material in the core (e.g., special steel or amorphous iron cores incur lower losses). Another way to reduce fixed losses is to switch off transformers operating at low demand. Of course, this depends on the network configuration that enables the operator to switch some loads to other sources in the distribution network [10].

2.4.2 Nontechnical Losses

Nontechnical losses (commercial losses) comprise of units that are delivered and consumed, but for some reason are not recorded as sales. They are attributed to metering errors, incorrect meter installation, billing errors, illegal abstraction of electricity, and unread meters. Use of electronic meters will help reduce those losses since the accuracy is high. Also, incentives and obligation on participants should be as correct as possible to reduce the illegal abstraction of electricity. Figure 2.1 depicts a summary of types of distribution losses and the factors affecting them [10].

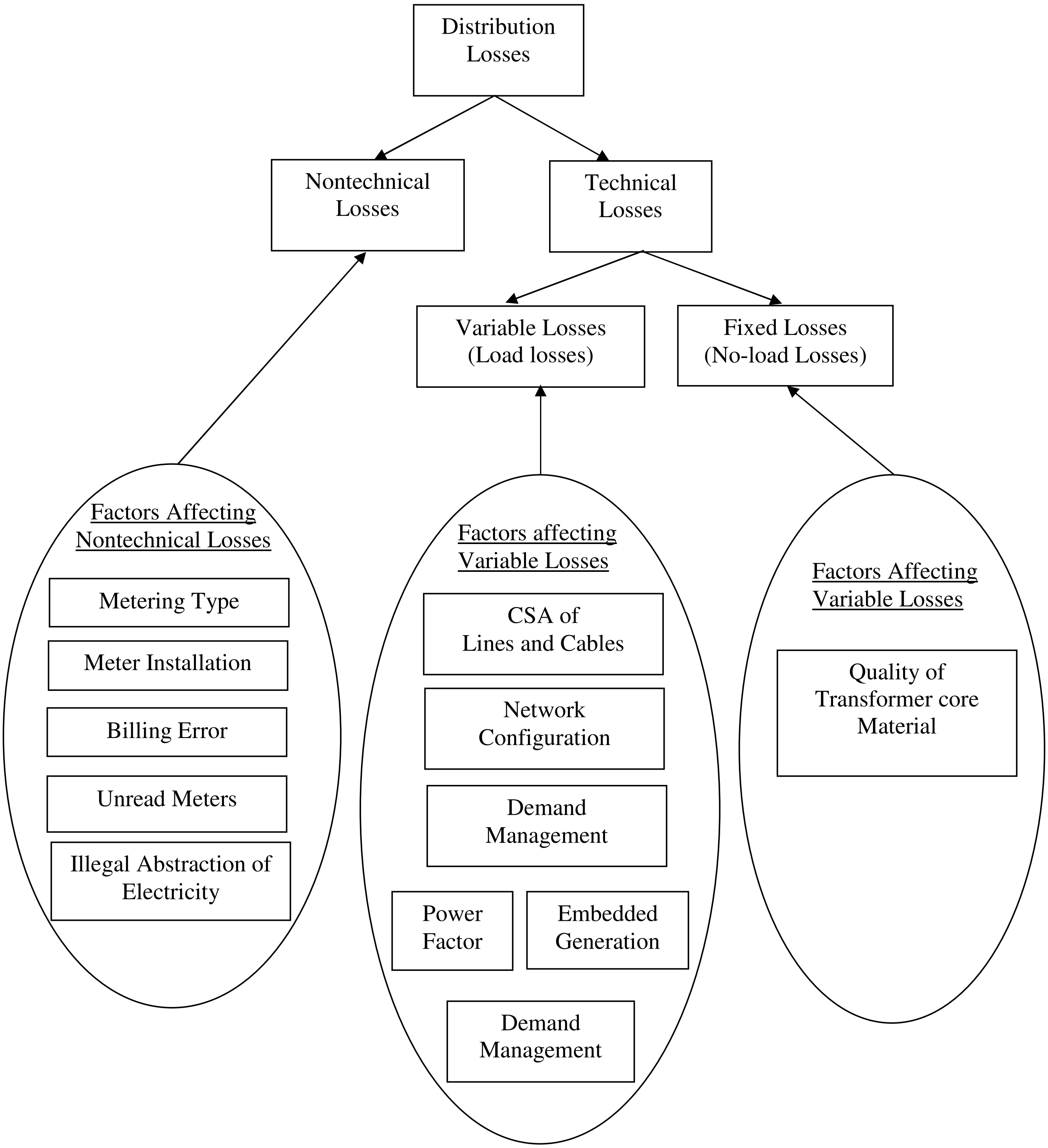

Fig 2.1 Types and factors affecting distribution losses [10]

2.4 Reliability Analysis of an Electric Power Distribution System

Reliability evaluation of a distribution system is associated with the continuity of supply of energy from the supply points to the individual customer load points. The basic parameters used to evaluate the reliability of a distribution system can be categorized as load point indices and system indices. The load point failure rate, the average outage time and the average annual outage time are the basic load point indices. The system indices can be obtained from these three load point indices and information on the number of customers and load connected at each load point in the system. The set of system reliability indices can be further classified into customer-oriented indices and load-oriented indices. Customer-oriented indices include the System Average Interruption Frequency Index (SAIFI), System Average Interruption Duration Index (SAIDI), Customer Average Interruption Duration Index (CAIDI), Index of Reliability (IOR), Customers Experiencing Multiple Interruptions (CEMI), and Customers Experiencing Longest Interruption Duration (CELID). Load-oriented indices include Average System Interruption Frequency Index (ASIFI) and Average System Interruption Duration Index (ASIDI) [26].

Most of the power interruptions of Addis Ababa distribution system are due to the result of failures in the secondary distribution system. A highly reliable generation and transmission system may still result in poor energy supply to the customers if the distribution system is unreliable. Therefore, distribution system reliability evaluation is important to ensure appropriate system reliability levels and to provide effective information for regulatory bodies to set proper benchmarks.

Analysis of past performance and prediction of future performance are two crucial factors of distribution system reliability evaluation.

Most distribution systems are radial in nature because of their low cost and simple design. Most low voltage distribution systems are operated radially. A radial system consists of a series of components between the substation and the load points. Failure of any of these components may result in outage at the load point(s). The duration of the outage depends on the protection and sectionalizing schemes used in the distribution system. The research work presented in this thesis is focused on analyzing a radial distribution system.

2.4.1 Reliability Evaluation

Reliability in power system can be divided in two basic aspects; system adequacy and system security. Adequacy relates to the capacity of the system in relation to energy demand and security relates to the dynamic response of the system to disturbances (such as faults). Since distribution systems are seldom loaded near their limits, system adequacy is of relatively small concern and reliability emphasis in on system security [17].

The two main approaches applied to reliability evaluation of distribution systems are [17]:

- Simulation methods based on drawings from statistical distributions (Monte Carlo)
- Analytical methods based on solution of mathematical models.

The Monte Carlo techniques are normally very “time” consuming due to large number of drawings necessary in order to obtain accurate results. The fault contribution from each component is given by a statistical distribution of failure rates and outage times [17].

2.4.2 Reliability Indices

The reliability of a distribution system can be described using two sets of reliability parameters. These are the load point reliability indices and the system reliability indices.

2.5.2.1 Load Point Indices

A distribution system provides power supply from a substation to individual customer load points. Three basic reliability indices can be used to describe the degree of service continuity. These are the load point average failure rate (λ), average outage time (r) and the average annual unavailability or average annual outage time (U). The average failure frequency is approximately equal to the average failure rate and indicates the number of failures a load point will experience during a given period of time. The average outage time is the average duration of failure at the load point. The average annual outage time is the average total duration of outage in a year experienced at the load point. It is the product of the average frequency of failure and the average outage time. These reliability indices are expected values and represent the long-run average values [26].

$$f_s = \sum_{i=1}^{12} \lambda_i \qquad \text{(Interruptions/year)} \qquad (2.7)$$

$$U_s = f_s r_i = \sum_{i=1}^{12} \lambda_i r_i \qquad \text{(Hours/year)} \qquad (2.8)$$

$$r_s = \frac{\sum_{i=1}^{12} \lambda_i r_i}{\sum_{i=1}^{12} \lambda_i} \qquad \text{(Hours)} \qquad (2.9)$$

Where

f_s = Interruption frequency [interruptions/year]

λ_i = Failure rate

r_i = interruption duration [hours/year]

r_s = average outage time

U_s = Annual downtime

2.5.2.2 System Reliability Indices

Systems reliability indices indicate the annual average performance of the network in terms of interruption frequency and duration. They are weighted by the number of customers or energy supplied

Quantitative reliability evaluation of a distribution system can be divided into two basic segments; measuring of the past performance and predicting the future performance [17].

Some of the basic indices that have been used to assess the past performance are [17]:

1. System Average Interruption Frequency Index (SAIFI)

   SAIFI indicates how often an average customer is subjected to sustained interruption over a predefine time interval. This index is average number of interruptions per customer served per year. It is determined by dividing the accumulated number of customer interruptions in a year by the number of customers served. A customer interruption is considered to be one interruption to one customer.

$$SAIFI = \frac{Total\ Number\ of\ Customer\ Interruption}{Total\ Number\ of\ Customers Served} = \frac{\sum \lambda_i N_i}{\sum N_T} \tag{2.10}$$

Where:

N_i = Total number of customers interrupted,

N_T = Total number of customers served

λ_i = No of interruptions

2. System Average Interruption Duration Index (SAIDI)

   SAIDI indicates the total duration of interruption an average customer is subjected for a predefined time interval. This index is the average interruption duration for customers served during a year. It is determined by dividing the sum of all customer interruption duration during a year by the number of customers served during the year.

$$SAIDI = \frac{Sum\ of\ Customer\ Interruption\ Durations}{Total\ Number\ of\ Customers\ Served} = \frac{\sum r_i N_i}{\sum N_T} \quad (2.11)$$

Where:

r_i = Restoration time, minutes

3. Customer Average Interruption Duration Index (CAIDI)

CAIDI indicates the average time required to restore the service. This index is the average interruption duration for customers interrupted during year. It is determined by dividing the sum of all customer sustained interruption duration by the number of sustained customer interruptions over a one year period.

$$CAIDI = \frac{Sum\ of\ customer \text{int} erruption duration}{Tota \ln umber of\ customer \text{int} erruptins} = \frac{\sum U_i N_i}{\sum \lambda_i N_i} = \frac{SAIDI}{SAIFI} \quad (2.12)$$

4. The Average Service Availability (Unavailability) Index (ASAI)

ASAI specifies the fraction of time that a customer has received the power during the predefine interval of time and is vice versa for ASUI. This is the ratio of the total number of customer hours that service was available during a given time period to the total customer hours demanded. This is sometimes known as the "Service Reliability Index". This is sometimes called the service reliability index. ASAI is usually calculated on either a monthly basis (730 hours) or a yearly basis (8,760 hours), but can be calculated for any time period. The ASAI is found as,

$$ASAI = \frac{Customer\ Hours\ of\ \ Available\ Service}{Customers\ Hour\ Demanded} * 100\%$$

$$ASAI = \left(1 - \left(\sum \frac{(r_i * N_i)}{(N_i * T)}\right)\right) * 100 \quad (2.13)$$

The complementary value to this index i.e. the Average Service Unavailability Index may also be used. This is the ratio of the total number of customer hours that service was unavailable during a year to the total customer hours demanded

$$ASUI = (100 - ASAI) * \% \quad (2.14)$$

5. Momentary Average Interruption Frequency Index (MAIFI)

$$MAIFI = \frac{Total\ Number\ of\ Customer\ Momentary\ Interruption}{Total\ Number\ of\ Customers\ Served} = \frac{\sum \mu_i N_i}{\sum N_i} \tag{2.15}$$

6. Energy not supplied (ENS)

   ENS specifies the average energy the customer has not received in the predefined time.

Past performance statistics provide valuable reliability profile of the existing system. However, distribution planning involves the analysis of future systems and evaluation of system reliability when there are changes in configuration, operation conditions or in protection schemes. This estimates the future performance of the system based on system topology and failure data of the components. Due to stochastic nature of failure occurrence and outage duration, it is generally based on probabilistic models. The basic indices associated with system load points are: failure rate, average outage duration and annual unavailability [17].

2.4.3 Reliability Cost/Worth

When an interruption is experienced by a customer, there is an amount of money that the customer is willing to pay to evade the interruption and this amount is referred to as the 'customer cost of reliability'. These costs include both tangible and intangible cost and also the opportunity cost. As such, to maximize the reliability, utility should balance their reinforcement cost for reliability improvement and the customer cost for poor reliability. Therefore, the optimal level of reliability is said to be achieved when the sum of utility cost and the customer cost are minimum.

2.5 Literature Review of Current Research Papers

Electric power is a vital element in any modern economy. The availability of a reliable power supply at a reasonable cost is crucial for the economic growth and development of a country. Electric power utilities throughout the world therefore endeavor to meet customer demands as economically as possible at a reasonable service of reliability. To meet customer demands, the power utility has to evolve and the distribution system have to be upgraded, operated and maintained accordingly [25]. To fulfill and meet customer demands currently the following researches are going on, on electric power distribution system:

Energy losses in distribution systems are generally estimated rather than measured, because of inadequate metering in these systems and also due to the high cost of data collection. These estimations are generally based on some rules of thumb. This paper presents the results of a joint investigation undertaken in collaboration with a local utility to study this issue. Based on data collected from feeders, true losses in some primary and secondary feeders are obtained. These losses are compared with the estimated losses obtained by the methods presently in use. In view of the large discrepancies observed between measured and estimated values, two new schemes for estimating losses in primary and secondary distribution networks have been developed. The measured values are used to highlight the reliability of the new estimation methods [21].

The distribution system is part of the electric power system that links the bulk transmission system and the individual customers. Approximately 80 percent of outages experienced by the customers are due to failures in the distribution system. It is therefore important to understand the impact of the outages on the customer outage costs and the system reliability.

The paper [26] evaluates various analytical and simulation techniques which incorporate varying degrees of complexity and data to evaluate the expected customer costs at the system and load level of a radial distribution system. A computer program based on time sequential Monte Carlo simulation has been developed. The results show that certain analytical techniques provide as accurate results as using a Monte Carlo simulation technique.

Paper [27] provides a framework for a predictive, condition-based, and cost effective maintenance optimization program for transmission and distribution systems. As system equipment continue to age and gradually deteriorate the probability of service interruption due to component failure increases. An effective maintenance strategy is essential in delivering safe and reliable electric power to customers economically.

The paper [27] explains on the key features of an integrated design flow and relevant tools for exceptional power distribution system design. Careful treatment is given to the practical factors that are inherent in the design and analysis of the power distribution system, including documentation, accuracy, throughput time, automation, flexibility, and integration, reuse, and change control. Furthermore, since some of these factors are competing, the new methods allow for real-time tradeoffs (e.g. between accuracy and throughput time). Examples and specific implementation recommendations will be presented for those who wish to employ similar methods within their own design groups [27].

With the advancements in information technology, electric utilities are capturing a significant amount of data and information about their distribution facility to support planning, design and operational work processes. A new method of describing the electric secondary distribution system by using transformer secondary circuit archetypes and load characterization based on customer consumption is presented. The proposed method has been implemented on a pilot area of the local electric utility, and the results validate its effectiveness. The proposed method is useful for energy loss calculations, voltage drop predictions, and optimization studies [28].

In this paper, an attempt has been made to enhance the loading of radial distribution by selection of proper conductor. The critical values of total real power load (TPL) and total reactive power load (TQL) for constant power are derived out for the sub-station voltage of 1.0 p.u. for 69-node radial distribution network. The proposed method will reduce the real and reactive power losses, improves voltage profile and enhances the loading capability of distribution network. The voltage deviation is reduced to ±10%.The superiority of the proposed method has been established by ±6% from ±10% taking results iteratively. Using network reconfiguration, loading is further increased [29].

This paper presents reliability evaluation techniques which are applied in distribution system planning studies and operation. Reliability of distribution systems is an important issue in power engineering for both utilities and customers. Reliability is a key issue in the design and operation of electric power distribution systems and load. Reliability evaluation of distribution systems has been the subject of many recent papers and the modeling and evaluation techniques have improved considerably [30].

In the current distribution system most of existing electrical infrastructure is becoming aged due to the delayed replacement of assets caused by distribution company's budget constraints. Bearing in mind these aspects, the authors have developed a technique for the evaluation of the distribution system reliability based on a Sequential Monte Carlo (SMC) which takes into account the role of equipment ageing. Real-world examples are provided to illustrate the effect of including ageing system failures into system and individual reliability indexes [31].

This paper presents a Monte Carlo simulation approach to reliability evaluation of one distribution system. Stochastic model of distribution system components with Weibull distribution and Markov model of components are used. A set of system related reliability indices were calculated using sequential Monte Carlo simulation. Monte-Carlo simulation was performed with full use of power restoration switches and full network load flow analysis. Load transfer was also considered to alleviate the overloading of distribution lines and transformers [32].

A Time sequential Monte Carlo simulation procedure is presented for reliability evaluation of distribution system. A stochastic system model to evaluate load point indices and reliability indices of a distribution system is developed in C^{++}. It considers random failures of different components within the system and its effect on the system. Developed simulation program is tested on feeder 1 of Bus – 2 of Roy Billinton Test System (RBTS) and set of system related indices are presented [33].

In paper [6], the results of a power quality survey in a distribution system are presented and discussed and the power quality indices are extracted based on IEEE and IEC Standards. In publications [11] – [14], a power quality analysis, mitigation design and simulation of power quality problem of a factory, an active filters for power quality improvement, a quality comparisons of an electric power distribution systems and a power quality problems, issues, related international standard, effect of power quality problem in different apparatuses and methods for its correction, are discussed.

In paper [7], the application of the method of experimental design to the analysis of electrical power distribution systems is discussed. The theory of experimental design allows us to construct and experimentally verify the qualitative model of a power distribution system in order to analyze significance of each component in distribution system modeling.

CHAPTER THREE

PERFORMANCE EVALUATION OF ADDIS ABABA DISTRIBUTION SYSTEM DESIGN

3.1 Power Distribution System Standards and Design Guidelines

Power distribution system standards and design guidelines are the minimums acceptable criteria's for the design of efficient, economical, durable, maintainable, and reliable electrical power supply and distribution systems. Clarifications of baseline design criteria, standards, policy, and guidelines are provided by Institute of Electrical and Electronics Engineers (IEEE), International Electro-technical Commission (IEC), National Electrical Code (NEC), American National Standards Institute (ANSI), National Electrical Manufacturers Association (NEMA), or International (ISO).

The most suitable solution for any single design of power distribution system will depend on the particular requirements of the facility. In addition to the standards and guide lines designers would use their judgment, experience, knowledge and local conditions as a guide during design to suit the particular installation requirements.

When designing and developing the distribution system for a particular area the following main points should be considered:

1) Service conditions
    - i. Type of loads to be served
    - ii. Density of customers
    - iii. Length of lines
    - iv. Points of supply
2) Electrical Design
    - i. Voltage of supply
    - ii. Voltage regulation at the customers
    - iii. Transformers and accessories
    - iv. Protection of electrical systems
    - v. Operation of the system

3) Mechanical design

   i. Poles and spans
   ii. Wires and clearances
   iii. Installation of transformers and substations
   iv. Supports and guying

4) The economics of the design

5) The availability of proven technology

6) The integration and compatibility with existing equipment, and

7) Equipment and installation compliance.

The main objectives of the distribution planning & design are:

- To enable the planning, design and construction of the Distribution System for a safe, reliable and economical operation confirming to the statutory acts, standards, regulations and codes.
- To facilitate the use of the distribution system by any user connected to or seeking connection with it.
- To specify technical conditions to be followed by the respective distribution standards for an efficient operation.
- To provide the required information to the users for connection, planning and development of their own systems and to make them compatible with the distribution system.

3.2 Existing Structure of Addis Ababa Electric Power Distribution System

The area chosen for this study is Addis Ababa distribution system. The power distribution system in the city includes twenty three substations. The primary distribution (medium voltage) levels Addis Ababa distribution substation with their voltage levels are shown in Table 3.1.

Table 3.1 Addis Ababa Distribution Substation with their Voltage Levels [42]

No	Substation Name	Voltage level (kV)
1	Aba Samuel	45/15
2	Addis Center	132/15
3	Addis East I	45/15
4	Addis East II	132/15
5	Addis North	132/15
6	Addis South	45/15
7	Addis West	45/15
8	Akaki I	45/15
9	Akaki II	45/15
10	Cotobie	132/45/15 132//15
11	Gafarssa	132/33/15 132/66/15 132/45/15
12	Geja	45/15
13	Kaliti I	132/45/15
14	Kaliti II	132/15 132/45/15
15	Kaliti North	132/15
16	Mekanissa	132/15
17	Nifas Silk	45/15
18	Sebeta-II	230/33
19	Sebeta	132/45/15 132/45/15 132/15
20	Woregenu	132/15
21	Gofa	132/15
22	Yesu	132/15
23	Sululta	132/33/15

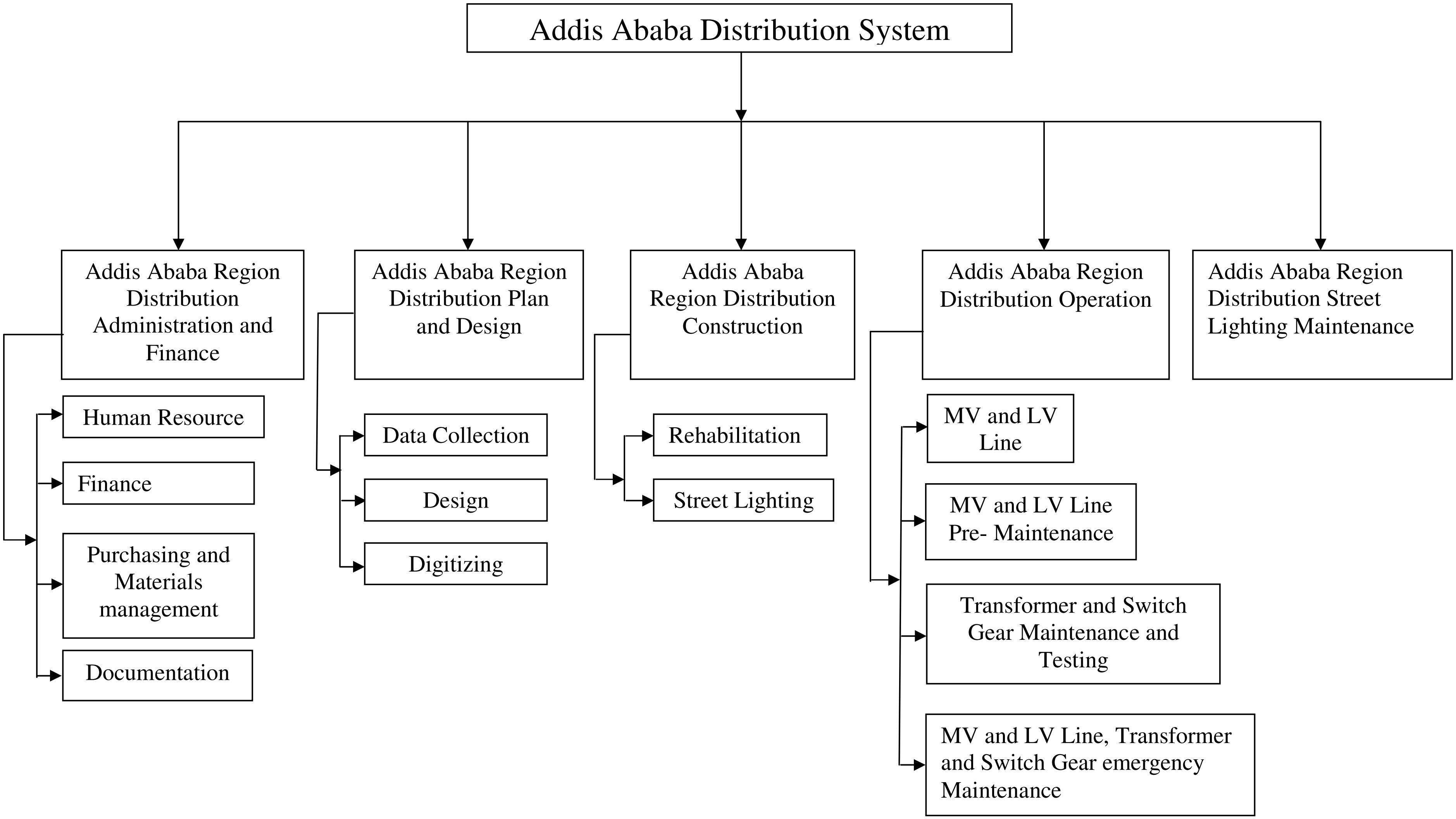

Fig 3.1 Existing structure of Addis Ababa power distribution system [43]

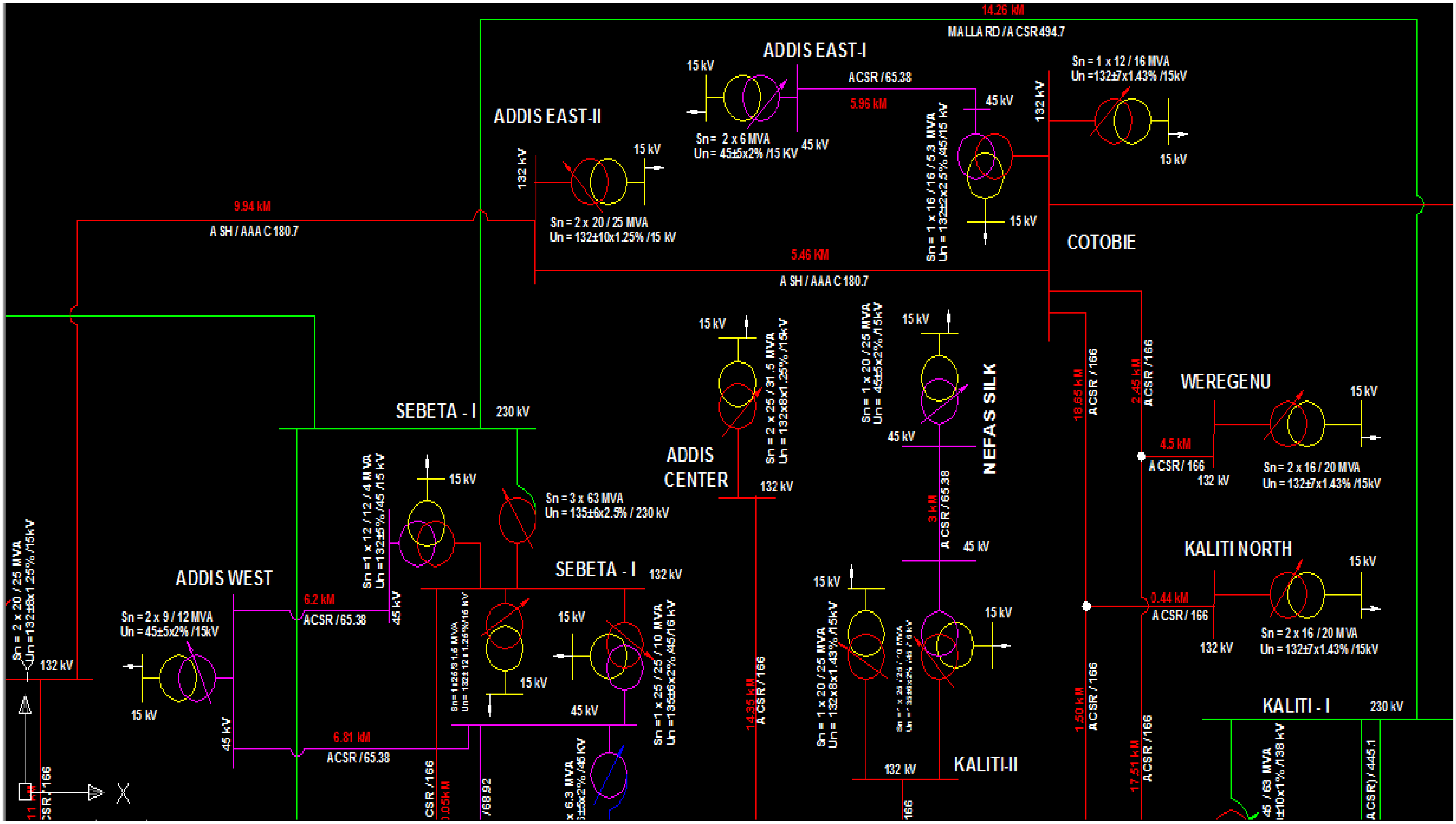

Fig 3.2 *Single line diagram of Addis Ababa's substation [43]*

3.3 Evaluation of the Planning and Design Practice of Addis Ababa Power Distribution System

There are various and yet interrelated factors affecting the planning and design of distribution system.

1. The nature of the load connected
2. The load density of the area served
3. The growth rate of the load
4. The need for providing spare capacity for emergency operations
5. The type and cost of circuit construction employed
6. The design and capacity of the substation involved
7. The type of regulating equipment used
8. The quality of service required
9. The continuity of service required

The design tasks include the design of an electrical distribution system for a given customer and facility. The electrical engineer must consider a proper design approaches that best fit the following overall goals.

1. **Safety**: the first important goal is to design a distribution system that is safe for the whole power equipment and people who are responsible for the electrical equipment.
2. **Minimum initial investment**: during the design of the distribution system, consideration should be given to the cost of installation.
3. **Maximum service continuity (sustainability):** in addition to sufficient capacity, service continuity is required for a continuously operating process. Service continuity can be increased by selecting highest quality electrical equipments, conductors and using the best installation methods.
4. **Maximum flexibility and expandability**: in many industrial manufacturing plants, domestic customers and commercial loads are periodically relocated or changed requiring changes in the electrical distribution system especially in developing countries like Ethiopia. Consideration of the layout and design of the electrical distribution system to accommodate these changes must be considered.
5. **Maximum electrical efficiency (Minimum operating costs):** electrical efficiency can generally be maximized by designing systems that minimize the losses in conductors, transformers and utilization equipment. Selecting equipment such as transformers with lower operating losses generally means higher first cost and increased floor space requirement: thus, there is a balance to be considered between the owner's utility energy

changes for the losses in the transformer or other equipment versus the owner's first cost budget and cost of money.

6. **Maximum power quality**: the power input requirements of all utilization equipment has to be considered including the acceptable operating range of the equipment and the electrical distribution system has to be designed to meet these needs.
7. **Minimum maintenance cost:** usually the simpler the electrical system design and the simpler the electrical equipment, the less the associated maintenance costs and operator errors. As electrical systems and equipment become more complicated provide greater service continuity or flexibility, the maintenance costs and the chance for operator error increases. The system should be designed with an alternate power circuit to take electrical equipment (requiring periodic maintenance) out of service without out dropping essential loads. Use of draw out type protective devices such as breakers and combination of starters can also minimize maintenance cost and out-of-service time.

The planning and design office of Ethiopian Electric Power Corporation prepares plans, designs, specifications, and cost estimates for the installation, maintenance, repair and expansion of distribution system.

Some of the major tasks of the planning and design office of distribution system are:

- Develops plans, specifications, and cost estimates for the installation, maintenance, repair and expansion of the electrical overhead and underground distribution system.
- Inspect the installation of electrical equipment and related facilities.
- Monitor the electric system performance.
- Develops a yearly planning and capital improvement study.
- Develop goals, objectives, policies, and priorities.
- Prepare studies, reports and recommendations pertaining to the overall electric system operation.
- Advise developers and contractors regarding technical requirements.
- Respond to emergency conditions and assist in restoring the electrical distribution system to normal operation.
- Respond to citizen complaints and questions.

- Coordinate the work of crews engaged in the operation and maintenance of structures, distribution lines and substations.
- Coordinate electrical distribution system, street lighting and traffic signal activities with other city departments, and with outside agencies.
- Supervise, train and evaluate assigned staff.
- Develop specifications for material purchases and construction standards.
- Recommend construction practices and procedures.
- Calculate customer loads for sizing transformer banks and services.
- Design underground facilities.
- Perform system planning studies.
- Meet with customers/contractors to identify and solve voltage and construction problems.
- Manage the maintenance and capital improvements of the distribution system, substations, and switch yards, sectionalizing devices, relays, and SCADA and communication systems.
- Perform system protection and coordination studies.

The planning and design of LV distribution system works for Ethiopian Electric Power Corporation is carried out by the help of the following Tables (3.2, 3.3, 3.4, 3.5, 3.6 and 3.7). In the LV design and planning the following factors are considered:

- ✓ Saturated areas will have an annual load growth of 2% per annum [43]
- ✓ Growing areas will have an annual load growth of 5% per annum [43]

The engineers are still performing planning and design Addis Ababa distribution network in accordance with the guideline [43]. The guideline has a number of tables giving the necessary information for the engineers to make a quick selection of equipment and material for the Addis Ababa distribution system. Though the engineers are using the guideline during the planning and design, but this is not seen on the ground most distribution transformers are loaded.

1. Selection of Transformers

The Tables (3.2, 3.3, 3.4, 3.5, 3.6 and 3.7) below help the engineers in planning and design office of EEPCO to make a quick decision of what size the transformer of the planned network should have. The selection should be made based on Tables 3.2, 3.3 and 3.4, meaning that the size of the transformer need to be upgraded as soon as one of the criteria's in Tables 3.2, 3.3 and 3.4 have not fulfilled [43] (i.e. by the load criteria, by the number of customers connected to a transformer, maximum distance to customer).

Table 3.2 Selection of Transformer by Load Criteria [43]

Transformer Capacity (kVA)	Present Peak Load	
	Saturated areas (kW)	Growing areas (kW)
100	0-63	0-41
200	64-126	42-82
315	127-198	83-129

Table 3.3 Selection of Transformers by Number of Customers Connected to the Transformer [43]

Transformer Capacity (kVA)	Present Peak Load	
	Saturated areas (kW)	Growing areas (kW)
100	120	80
200	250	160
315	390	260

Table 3.4 Selection of Transformers by Maximum Distance to Customer from Transformer [43]

Transformer Capacity (kVA)	Maximum Distance from the transformer (m)
100	200
200	290
315	360

2. Selection of Feeder Cables and Conductors

Engineers in planning and design office of EEPCO are using Table 3.5 for selecting feeder cables and conductor sizes for the distribution systems by considering transformer size and maximum distance from transformer to customers [43].

Table 3.5 Selection of Transformers by Maximum Distance to Customer from Transformer [43]

Transformer Capacity (kVA)	Selection of feeder cables and conductor cross section				
	Number of feeders (No.)	Feeder cables (mm^2)	Main lines (mm^2)	Branch lines (mm^2)	Short branch lines with small loads (mm^2)
100	1-2	3x70/35	ABC50(3P)	ABC25(3P)	ABC25(1P)
200	2-3	3x120/70	ABC95(3P)	ABC50(3P ABC25(3P)	ABC25(1P)
315	2-3	3x120/70	ABC95(3P)	ABC50(3P ABC25(3P)	ABC25(1P)

3. Selection of Service Conductor Drops

The conductor sizes of the service drops in the planning and design office of EEPCO are selected in accordance of Table 3.6.

Table 3.6 Selection of the ABC cables for service Drops [43]

Transformer capacity	Selection of service drop conductor	
	ABC cable for service drops (cross section in mm^2)	Remarks
Single phase loads	10 16	Selection is depending on the load
Three phase loads	10 16 25	Selection is depending on the load

4. Selection of Fuse Ratings

Fuses are over current devices designed to protect electrical circuit components. If a circuit develops too much amperes, they are designed to interrupt the flow of current in the circuit. Fuses self-destruct when they sense an overload in the circuit.

The criteria required to select a fuse rating in order to select a suitable fuse for use on the distribution system are:

i. Voltage and insulation level.
ii. Type of system.
iii. Maximum short circuit level.

iv. Load current.

The above four factors determine the fuse nominal current, voltage and short circuit capability characteristics.

The fuse ratings for distribution system are selected by the planning and design office of EEPCO in accordance Table 3.7.

Table 3.7 Selection of Fuse Ratings, Depending on Transformer Size & Number of Feeders [43]

Transformer Capacity (kVA)	Selection of Fuse Ratings		
	One Feeder (A)	Two Feeder (A)	Three Feeder (A)
100	160	63-100	–
200	–	100-200	100-160
315	–	160-300	100-300

The planning and design office of Ethiopian Electric Power Corporation follows the guidelines [43] to prepare plans, designs, specifications, and cost estimates for the installation, maintenance, repair and expansion of distribution system.

3.4 Evaluation of Operation & Maintenance Practice of Addis Ababa Power Distribution System

The main objective of maintenance is to ensure equipment reliability, to extend its life cycle and to maximize equipment availability in order to achieve and deliver acceptable quality power to the customer. Furthermore, it is expected that effective maintenance policies can reduce the frequency of service interruptions and the many undesirable consequences of such interruptions. Maintenance clearly impacts on component and system reliability, if too little is done, this may result an excessive number of costly failures and poor system performance and therefore, reliability is degraded.

Some attributes of a good maintenance program are:

- Upper management support and commitment to maintenance
- Frequent review of company standards, practices, methods and procedures (a well documented maintenance plan)
- Adequate staffing both qualitatively and quantitatively
- Expertise (experience and training)
- Adequate resources (tools, test equipment, vehicles, communications, etc)

- Management controls to ensure that company standards are followed and updated when necessary

3.4.1 Maintenance Strategies in Addis Ababa's Distribution System

Maintenance is an activity involved in maintaining a system or equipment to be in a good working order, to improve the reliability and sustainability of the system or equipment and to extend its life expectancy. Certain legislations, manufacturer guidelines, maintenance strategies and philosophies are compelled to conduct maintenance in distribution systems. Maintenance activities in Addis Ababa distribution system in most instances are not carried out as planned due to unplanned and unforeseen circumstances within the distribution system and most of the time only corrective maintenance is embarked, and this result not to meet the scheduled activities of preventive maintenance. The eventual ageing of the electrical network, the extent of damage experienced, conduction of repeatable repairs in the same areas and lack of maintenance leads to deterioration of the distribution network.

Types of electrical maintenance practices

1. Preventive maintenance
   i. Time based (periodic)
   ii. Condition based
2. Corrective maintenance
   i. Immediate
   ii. Deferred

3.5.1.1 <u>Preventive maintenance</u>

The concept of preventive maintenance is to reduce failure probabilities by maintenance before failure or significant degradation has occurred. This often translates into trying to avoid costs of corrective maintenance and other costs that belong to unexpected failures. But in Addis Ababa's distribution system preventive maintenance is seldom performed; in site visit it was found that most of equipment needs preventive maintenance in order to improve unexpected power interruption and failure of equipment. This preventive maintenance is highly required on transformer and related switch gears. Equipment like surge arrestors, drop out fuses and High Rupture Capacity (HRC) fuses are seemed to be uninspected.

It is categorized by time-based and condition-based maintenance. Periodic (time-based) maintenance as the name implies is performed at regular intervals. This is a good strategy in the case of a well identified ageing process for the component. The time intervals between maintenance should be based on failure with shorter intervals for the maintenance than for the expected time to failure. Condition based maintenance is performed based on an estimate of the components condition. One of the simplest forms of condition based maintenance is to prolong the first service interval of a periodical maintenance routine; this is based on the assumption that new equipment is in better condition compared to the older. Condition based maintenance is based on the knowledge of the condition of the equipment from routine or continuous monitoring (systematic inspections, measurements).

3.5.1.2 Corrective maintenance

Corrective maintenance is performed after fault recognition and is intended to put the component in a state it can perform a required function. The component is used until it fails. Corrective maintenance might be considered as the last resort and may be considered as the failure of the maintaining organization performing it. Corrective maintenance might be the right approach for a component group given that resources are focused on other, possibly more important assets. For equipment's with random occurring instant failures corrective maintenance might be the only option. One might consider redesign of the system for these kinds of failures. But it is quite likely these failures might be worth (living with) while focusing on other areas with better goals. It is also categorized by immediate and deferred maintenance.

3.4.2 Over view of Maintenance Trends in Addis Ababa Distribution System

Most of the failures in the distribution system are due to short circuits, earth fault, over load, black out, operation and system over load (i.e. when generated power is below the total demand other than black out. Maintenance is an activity involved in maintaining a system or equipment to be in a good working order. Some of the activities exist in the Addis Ababa distribution network that need maintenance are listed below:

- to change a link
- to change a drop out fuses
- to change a burn out transformer
- to change a broken conductor
- to change a broken tap
- to change a burn out pole
- to change a fallen pole
- to change a burn out arrestor

- to change a burn out cable on a transformer
- to change a unbalanced phase
- to open section
- to change a cable
- for substation maintenance
- to change a broken tap above a link
- to closed breaker
- to change a broken cable lag
- to meager a transformer

In Addis Ababa distribution system it is appropriate to say corrective maintenance is most practically performed. This is because HRC fuses are replaced apart from the ratings frequently to give an immediate relief for customers but failed back sooner. It is much mandatory to pay much more attention for routine preventive maintenance to improve random power interruption, sustainability of equipment and to deliver reliable and quality power to the premises. Maintenance is performed immediately as it is being regarded as an emergency; and the deferred maintenance might be scheduled for another period based on the priority of activities.

Unless and otherwise the design is revised corrective maintenance doesn't give a long lasting solution meaning exposed for repeated failures. Moreover, it results an exaggerated maintenance cost. Most of the failures are occurred in transformers and the fuse of the transformers and clearance problem from structures and trees.

Here is an example for this: the fuses of a transformer at Shola oxen market has been replaced twice in a month as a result of blowing due to overloading. As one can imagine how much costly the maintenance and unreliable power supply is for the customers, the other installation type of a transformer out of many is over loading. For a transformer over loading can be examined by the following data listed below, is totally out of design and apart from science.

Here are the data taken on a transformer.

- kVA = 200
- I_{rated} = 288A (maximum possible line current)
- Two out goings for the customer
  - ➢ Box 1: 400A,250A,350A (fuse ratings)
  - ➢ Box 2: 200A,200A,400A (fuse ratings)

Here besides over loading, the fusing devices are of different ratings and this leads to transformer failure.

In Addis Ababa electrical power distribution network preventive maintenance is included in the category of condition based preventive maintenance work. Conditioned maintenance work is not based on manufacturer's plate or policy. The equipment installed are not maintained depending on the manufacturer's service period rather it is depending on the absence and/or presence and somehow over aging of the components as per the site visit. While performing preventive maintenance work around Addis east I feeder II, the team members of the maintenance group usually inspects about 40 transformers in a day. While doing so, the team has observed that some transformers are without preventive and control equipment. Out of those 40 transformers checked out about 28 transformers were incomplete of all the following components or at least one of these:

- Arrestor
- Body ground
- Drop out fuse or at least a link
- Usage of inappropriate fuse- below and above rating

70% of the inspected transformers are incomplete and not yet in safe condition i.e. exposed for power failure and further more damages. It is wise to perform a professional based preventive maintenance work as per the manufacturer's instruction and performance period to avoid unnecessary power failures and to reduce maintenance cost. Especially in rainy season the lighting will cause surge power to the line and results equipment damage.

CHAPTER FOUR

RELIABILITY ANALYSIS OF THE EXISTING DISTRIBUTION SYSTEM

4.1 Data Collected from Addis Ababa Region Distribution

Data for Addis Ababa region distribution system (refer Appendix B) has been collected. The collected data are a recorded data that includes peak load, type of faults, frequency and duration of interruption of all medium voltage (15kV) outgoing feeders of the distribution system. The collected data is a recorded data for sixteen months.

The Addis Ababa region distribution has 23 substations, 105 outgoing feeders, around 465MW peak load, around 761,834 customers (i.e. industrial, commercial and residential). There are no feeders dedicated for industrial, commercial and residential customers separately. The collected data for Addis Ababa Region Substation are shown in Table 4.1. The frequency of interruption and duration of interruption for the Addis Ababa region distribution system for 12 Months are analyzed and interpreted as shown in Tables 4.2 and 4.3 and Figures 4.1 and 4.2 respectively.

Table 4.1 Addis Ababa Region Substation Data [42]

No	Substation	Lines			Transformer	Voltage level	Transformer. Cap.	Location
	Name	HV	MV	LV	QTY	kV	MVA	
1	*Aba Samuel*	0	2	3	1	45/15	3	Border of Addis Ababa
2	*Addis Center*	*3*	*0*	*11*	*2*	*132/15*	*31.5*	Addis Ababa
3	*Addis East I*	*0*	*3*	*7*	*2*	*45/15*	*6/6*	Addis Ababa
4	*Addis East II*	*4*	*0*	*7*	*2*	*132/15*	*20/25*	Addis Ababa
5	*Addis North*	*4*	*0*	*8*	*2*	*132/15*	*20/25*	Addis Ababa
6	*Addis South*	*0*	*3*	*7*	*2*	*45/15*	*6/6*	Addis Ababa
7	*Addis West*	*0*	*4*	*8*	*2*	*45/15*	*9/12*	Addis Ababa
8	*Akaki I*	*0*	*4*	*5*	*1*	*45/15*	*9/12*	Addis Ababa
9	*Akaki II*	*0*	*5*	*11*	*3*	*45/15*	*6/6*	Addis Ababa
10	*Cotobie*	*6*	*2*	*7*	*2*	*132/45/15*	*20/12/16*	Addis Ababa
						132//15	*16/20*	

11	Gafarssa	17	5	9	4	230/132	125/125	Border of Addis Ababa
					1	132/33/15	24/12/12	
					1	132/66/15	20/20/20	
					1	132/45/15	25/15/15	
12	Geja	0	2	3	1	45/15	9/12	Addis Ababa
13	Kaliti I	24	9	9	3	230/132	125/125	Addis Ababa
					3	132/45/15	22/22/7.5	
14	Kaliti II	3	2	8	2	132/15	20/25	Addis Ababa
					2	132/45/15	25/25/20	
15	Kaliti North	3	0	7	2	132/15	16/20	Addis Ababa
16	Mekanissa	4	0	7	2	132/15	20/25	Addis Ababa
17	Nifas Silk	0	3	5	1	45/15	20/25	Addis Ababa
18	Sebeta-II	9	0	5	2	400/230	250/250	Border of Addis Ababa
					1	230/33	20/25	
19	Sebeta	11	7	11	3	230/132	125/125	Addis Ababa
					1	132/45/15	25/25/10	
					1	132/45/15	12/12/4	
					1	132/15	40/50	
20	Woregenu	3	0	11	2	132/15	16/20	Addis Ababa
					1	132/15	12/16	
21	Gofa	3	0	7	2	132/15	20/25	Addis Ababa
22	Yesu	3	0	8	3	132/15	40	Addis Ababa
23	Sululta	3	0	13	2	400/230	250/250	Border of Addis Ababa
					2	230/132	125/125	
					1	132/33/15	20/25/25	

Table 4.2 Frequency of Interruption for Addis Ababa Distribution System

Month	Frequency of Interruption
February 2013	1357
March 2013	1511
April 2013	1581
May 2013	1647
June 2013	1365
July 2013	1539
August 2013	1932
September 2013	1996
October 2013	1388
November 2013	1809
December 2013	1940
January 2014	1881

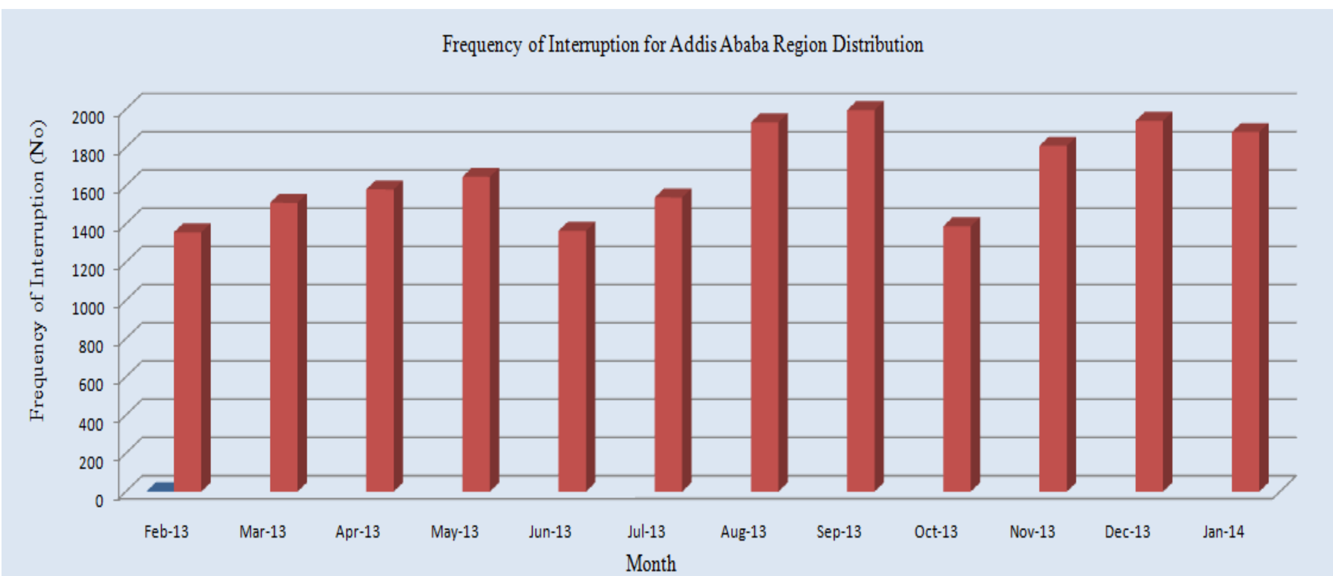

Figure 4.1 Frequency of Interruption for Addis Ababa Distribution System

An average of 1625 frequency of interruption per month occurs in the Addis Ababa region distribution substation.

Table 4.3 Duration of Interruption for Addis Ababa Distribution System

Month	Duration of Interruption (Hours)
February 2013	1330.67
March 2013	1556.73
April 2013	1000.71
May 2013	1270.45
June 2013	1181.04
July 2013	1922.73
August 2013	2534.2
September 2013	2577.67
October 2013	1906.73
November 2013	1953.08
December 2013	1877.8
January 2014	2123.77

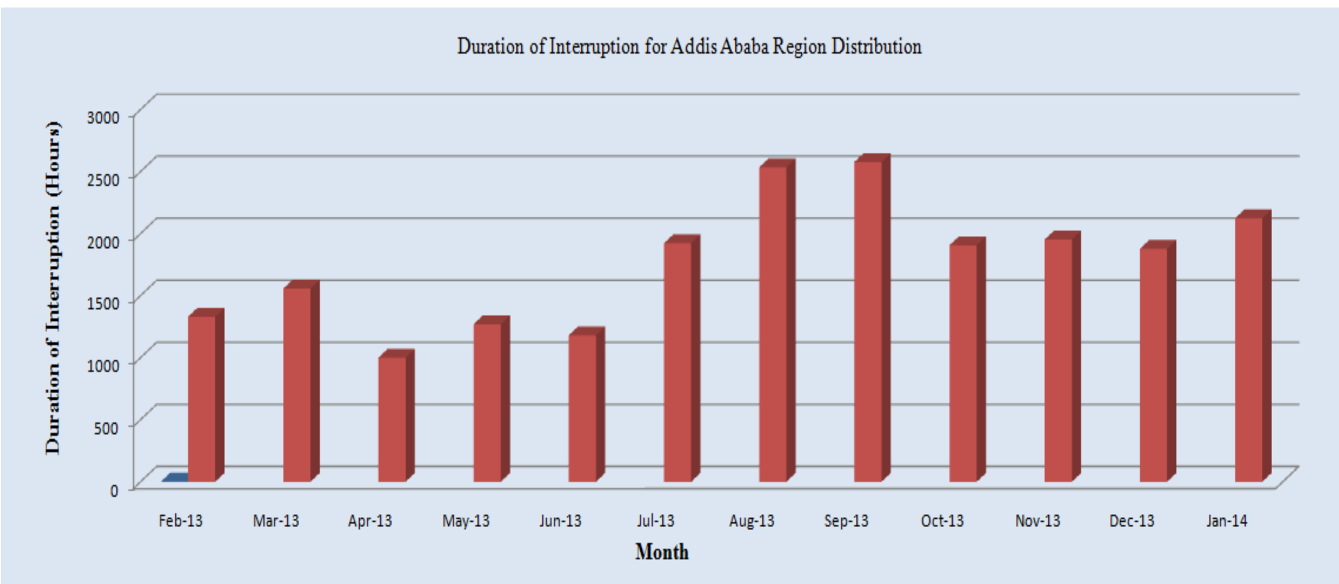

Figure 4.2 Duration of Interruption for Addis Ababa Distribution System

An average of 1769.63 hours duration of interruption per month occurs in the Addis Ababa region distribution substation.

4.2 Data Collected from Addis Center Substation

In this sub topic only data collected from Addis Center distribution substation is considered. The collected data is a recorded data that includes a peak load, type of fault, frequency and duration of interruption of the faults occurred on each of the eleven 15kV outgoing feeders. The collected sample data taken is a recorded data for five selected months. The selected months are September 2013, October 2013, November 2013, December 2013 and January 2014.

This distribution substation has only one 132kV radial incoming feeder from Kalitie substation. There are two power transformers having 31.5MVA each with 132/15kV, approximately around 93,386 with mixed customers (i.e. industrial, commercial and residential). Again for this substation there are no feeders dedicated for industrial, commercial and residential customers separately. There are 11 number of 15kV outgoing feeders. Data collected for this substation and typical for feeder 9 are shown in Table 4.4, 4.5 and 4.6 respectively.

Table 4.4 Data for Addis Center Distribution Substation [42]

Name of Substation	Lines			Transformer Quantity	Voltage Level (kV)	Transformer Capacity (MVA)	Total Substation Capacity (MVA)
	HV	MV	LV				
Addis Center	3	0	11	2	132/15	31.5	63

Table 4.5 Addis Center Substation and Feeders Data

No	Substation Name	Feeder Name	Voltage level (kV)	Feeder Load (A)	Feeder Load (MW)	Feeder Load (MVAr)	Feeder Load (MVA)	Number of Customers
1	Addis Center	ADC-16	15/0.4	215	4.90	2.43	5.6	8236
2	Addis Center	ADC-15	15/0.4	170	3.84	1.93	4.41	6512
3	Addis Center	ADC-14	15/0.4	190	4.31	2.15	4.93	7278
4	Addis Center	ADC-11	15/0.4	270	6.31	3.06	7.01	10343
5	Addis Center	ADC-10	15/0.4	210	4.91	2.38	5.46	8045
6	Addis Center	ADC-09	15/0.4	270	6.18	3.06	7.01	10343
7	Addis Center	ADC-08	15/0.4	220	5.01	2.49	5.71	8428
8	Addis Center	ADC-07	15/0.4	270	6.18	3.06	7.01	10343
9	Addis Center	ADC-05	15/0.4	150	3.38	1.7	3.9	5746
10	Addis Center	ADC-04	15/0.4	220	5.01	2.49	5.71	8428
11	Addis Center	ADC-03	15/0.4	250	5.72	2.83	6.5	9577
				0.44	**55.5**	**27.57**	**63**	**93386**

Table 4.6 Addis Center Feeder 9 Data [42]

No	Feeder Parameters	Unit	Details
1	Substation Name	Name	Addis Center
2	Feeder Name	Name	ADC-09 (Kolefe)
3	Voltage level	(kV)	15/0.4
4	Feeder Load	(A)	270
5	Feeder Load	(MW)	6.31
6	Feeder Load	(MVAR)	3.06
7	Feeder Load	(MVA)	7.01
8	Number of Customers	No	10343 Approximate
9	Total No of Distribution Transformers	No	41 Approximate
10	Total Length of Feeder	Km	(8-10) Approximate

Table 4.5 shows the share of load and number of customers by the feeders found in Addis Center substation and Table 4.6 show feeder parameters and data for feeder ADC-09 of Addis Center distribution substation.

4.3 Major Causes of Interruption in the Existing Distribution System

According to IEEE100-1992, an interruption to service is the isolation of an electrical load from the system supplying that load, resulting from an abnormality in that system. The abnormality in the system can either be a malfunction of a system component, a fault or a system operation due to maintenance or repair. Interruptions, independent from the cause, are generally undesired, as they leave energy unserved and customers without service. Most of the time, interruptions occur because the system is reacting to a fault. A fault or short-circuit is defined by IEEE100-1992 as an abnormal connection of relatively low impedance, whether made accidentally or intentionally, between two points of different potential [23], [25].

Over-loading, earth fault and short circuits are the major cause of interruptions in Addis Ababa distribution system. These major faults are classified in to two main categories: temporary and permanent faults. Temporary faults account for the majority of faults in distribution systems. Temporary faults can occur for many reasons, but may include tree or animal contact and weather as the main contributors. Temporary faults can be easily solved, with little or no intervention from the system itself. Many are self-clearing, such as a branch or animal contact which burn and fall off, conductors slapping together in severe wind or insulation flashover due to contamination. Lightning is also a temporary fault. Lightning arrester failure, on the other hand, can become a permanent fault. Other temporary faults are simply cleared once a trip from the substation is issued. Instantaneous reclosing de-energizes the line for a short duration of time, which allows the arc or contact path to disappear, which in turn eliminates the fault path. Once the circuit is re-energized, the system resumes normal operation. Permanent faults, on the other hand, are those that cannot be solved with reclosing action and will not self-clear. Equipment malfunction, cable failure, downed lines or persistent tree contact can all produce permanent faults. It is important to point out, that some tree contact can cause permanent faults, such as a tree falling on a line [23] [25].

There are many principal causes of electrical failure; such as dust and dirt accumulation, moisture, lose connections, and friction of moving parts, aging of conductors, clearance from trees and limbs and structures, equipment over loading, frequency and so on. An effective maintenance program should aim to minimize these effects by keeping equipment clean and dry, keeping connections tight.

4.3.1 Dirt and Dust Accumulation in Switching Stations

During site visit to some feeders it is observed that huge amount of dust was accumulated on coils in transformers and relays, circuit breakers, fuses, isolator switches, etc. This dust accumulation facilitates equipments to failure. A sample photograph of dust accumulation on a switch gear taken is shown in figure 4.3.

Figure 4.3 Sample photo taken for dust accumulation on switch gear [By Author]

4.3.2 Trees or Limbs and Structures (Clearance)

Trees and tree limbs are major cause of outages. They may fall on power lines regardless of weather conditions and in some cases may destroy a span of lines and tear down supporting structures. Trees and limbs can also increase the power lose besides power failure.

EEPCO is not making routine tree and vegetation maintenance on regular cycles to minimize the possible future interruptions. Distribution lines with good clearance experience fewer earthling faults and a significant improvement in electric reliability.

4.3.3 Lightning, Wind, Vehicles and Animals

Lightning often strikes transmission and distribution line towers, utility poles, wires, transformers and other electrical equipment, causing severe damage and loss of power. Lightning is attracted to the most direct path to the ground and usually searches for the highest object to serve as a conductor. Trees struck by lightning may also fall on lines, causing an outage.

There are preventive methods to protect lighting to electrical circuits. Some of them are arrestors/ electrodes buried underground. Arrestor is crucial to prevent over voltage flowing into a transformer due to lighting. These transformers may not be sufficiently working at summer/rainy season when lighting is common. So making preventive maintenance and installing all transformers with complete components can sufficiently decrease the rate of power failure/interruption in relation with lighting.

Strong winds can swing sagged power lines together and trigger a short circuit. Winds also blow tree limbs or entire trees onto power lines. Severe winds can destroy extensive sections of lines and utility poles. This is a problem in Addis Ababa's distribution system. A sagged 15kV over head distribution lines get toggled due to wind was observed in Addis East-I feeder-II.

The sagged distribution line may be easily reached with trucks. Traffic accidents involving utility poles are a common cause of power outages. Poles may be severely damaged, causing power lines to touch objects or collapse.

Animals periodically cause power outages by climbing onto or inside energized equipment. They can cause a short circuit that interrupts the flow of power to customers. The net stations and switching stations can be protected from animals but not the over head lines what one can do is giving a quick response for the power failure as much as possible.

4.3.4 Presence of Moisture and Loose Connection

Moisture and condensation in electrical equipment can cause oxidation, insulation degradation and connection failure. High humidity produces free condensation on the equipment which can result in short circuiting and immediate failure.

Electrical connections should be kept tight to recommended values. Creep or cold flow during load cycles is major cause of joint failure. Hardware on all electrical equipment should be checked for looseness resulting from vibration and normal device operation.

4.3.5 Usage of Equipment and Devices beyond their Ratings

Equipment used in electrical power distribution system must be installed depending on their name plate or their manufacturing policy. Manufacturers set the operating conditions like temperature, voltage and current level and medium of cooling and arc extinguishing. In this case study, some transformers are found to be over loaded due to many customers being installed on a single transformer covering wide area and/or HRC fuses being installed beyond the rating of the transformer. This over loading is mainly due to the improvement of the living standard of the customers.

Drop out fuse is a fusing element used on the 15kV side to protect the transformer from over voltage and over current. This fusing equipment has two functions.

- Used as an isolating link for maintaining a transformer without affecting other customers in another transformer on the same medium voltage level
- Used as a fuse for protecting a transformer whenever a surge happens on the high voltage side.

In this case study site observation, most of the transformers are not safely protected from surge of the high voltage.

4.3.6 High Rupturing Capacity (HRC) Fuses

These fuses are inserted in low voltage side of the transformer to protect the transformer from over current due to the fault happening anywhere in the low voltage side. But these fuses are not used based on the rating of the transformer. A sample circuitry diagram of the HRC fuse box with different current rating is shown in figure 4.4.

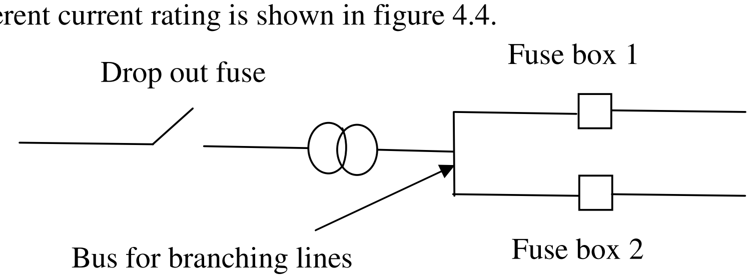

Fig 4.4 Circuitry diagram of the HRC fuse box and transformer [by Author].

- kVA = 200
- I_{rated} = 288.7A maximum possible line current

The HRC fuse ratings found installed are 300, 400 and 250 Amps

Random power interruption can be due to

1. Damage of transformer for the reason that fuses used are beyond the ratings required.
2. The other reason for random interruption is over loading of a phase for customers. The load required or consumed by customers may become beyond the rating of the fuse.
3. From the example above, the line current the transformer can provide is I= 288.7A, but the transformer is over loaded to provide a line current of 400A for one phase. The transformer is at risk as one can expect.

4.4 Types of Faults in Addis Center Outgoing Feeders

A sample average evaluation for frequency and duration of interruption for the months from September 2013 to January 2014 has been considered based on the number of interruptions is tabulated in table 4.7.

Table 4.7 Summary of Feeders Average Frequency and Duration Interruption for the Month from September 2013 to January 2014

No	Name of Substation	Feeder Name	Frequency and Duration of interruption												Frequency of interruption (No)	Duration of Interruption (Hr)
			EARTHFAULT		SHORT CIRCUIT		OVER LOAD		BLACK OUT		OPERATION		SOL			
			F	D (Hr)	F	D (Hr)	F	D (Hr)	F	D (Hr)	F	D (Hr)	F	D (Hr)		
1	ADC	ADC-16	0.8	0.03	1.2	0.42	2	3.29	2.2	3.40	1.6	3	0	0	8	10.14
2	ADC	ADC-15	6.2	1.81	6.8	9.7	0.8	0.65	2.4	4.24	6.4	19.49	0.2	0.3	23	36.19
3	ADC	ADC-14	9.8	13.51	8.6	15.12	2.4	0.98	2	4.04	3.2	5.28	0	0	26	38.93
4	ADC	ADC-11	0.8	0.39	1	0.09	2.4	2.94	2.2	3.98	2.2	6.12	0.2	0.15	9	13.66
5	ADC	ADC-10	9.4	3.315	5.2	14.49	1	1.35	2.4	4.09	4	6.86	0.2	0.07	22	30.17
6	ADC	ADC-09	6.2	2.86	4.8	10.43	12.2	8.72	2.4	5.28	5.8	8.99	1.4	1.44	33	37.73
7	ADC	ADC-08	1.2	0.50	1.4	4.01	0.2	0.52	2.4	5.19	1.6	2.63	0	0	7	12.84
8	ADC	ADC-07	9	4.26	4.8	6.37	3.6	1.92	2.4	3.25	5.4	7.79	0	0.68	25	24.26
9	ADC	ADC-05	0.2	0.01	0.4	1.18	1.4	1.75	2.4	3.32	1.4	0.84	0	0	6	7.10
10	ADC	ADC-04	4.2	0.91	3.6	6.45	1	1.11	2.4	3.15	3.8	6.50	0.6	0.72	16	18.85
11	ADC	ADC-03	6	0.87	4	13.91	1.2	0.87	2	2.80	5.4	10.88	0	0	19	29.33
Total			**53.8**	**28.47**	**41.8**	**82.16**	**28.2**	**24.10**	**25.2**	**42.74**	**41**	**78.38**	**2.6**	**3.36**	**192**	**259.20**

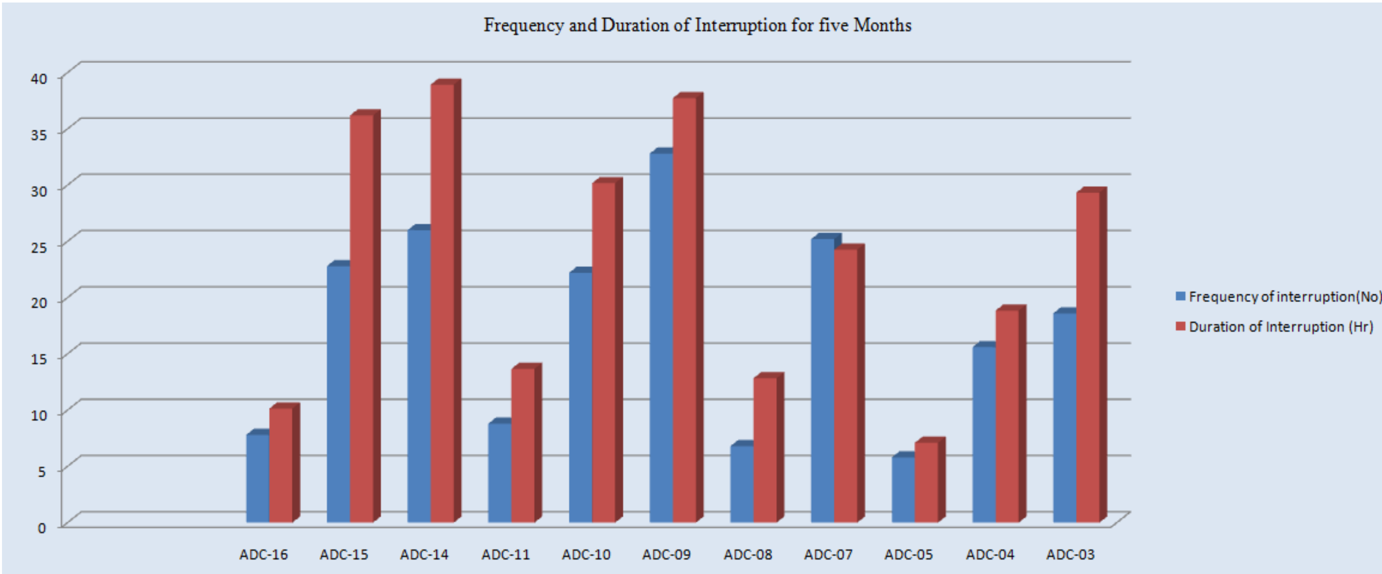

Figure 4.5 Average Frequency and Duration of Interruption for the Months of September 2013 to January 2014

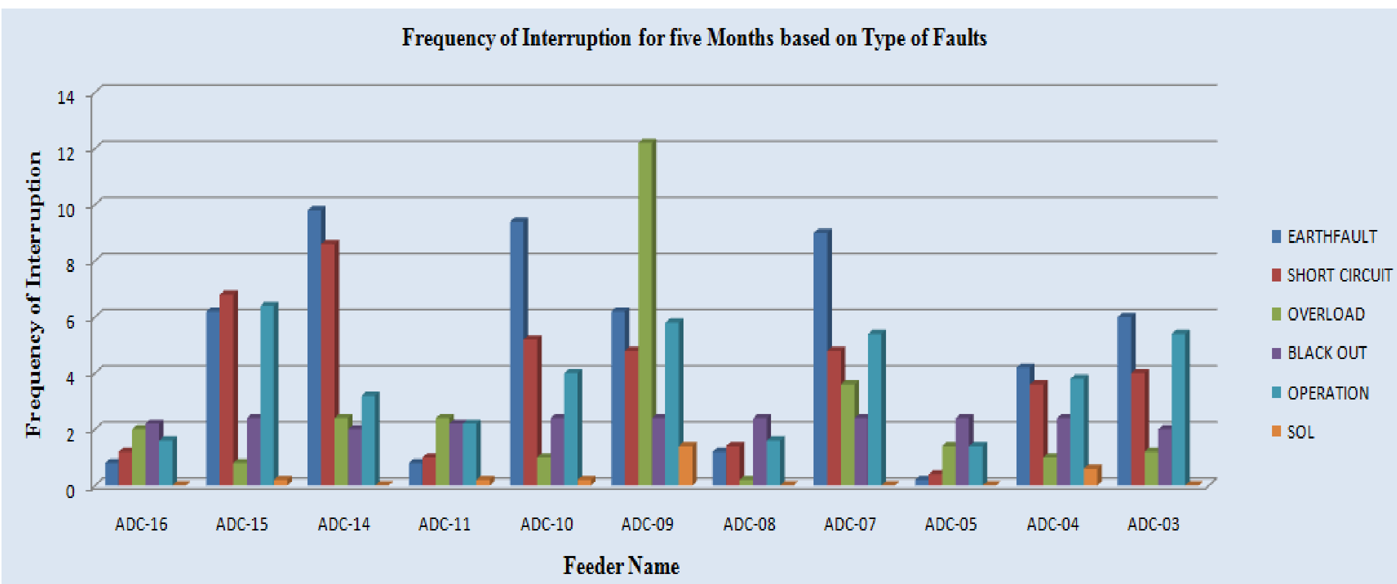

Figure 4.6 Average Frequency of Interruption for the Months of September 2013 to January 2014Based on Type of Faults

Figure 4.5 shows the average frequency and duration of interruptions for the months of September 2013 to January 2014 for the eleven feeders' of Addis Center distribution substation.

Figure 4.6 shows an average frequency of interruptions due to short circuit, earth fault, over load, black out, operation and system over load for the months of September 2013 to January 2014 for the eleven feeders' of Addis Center distribution substation.

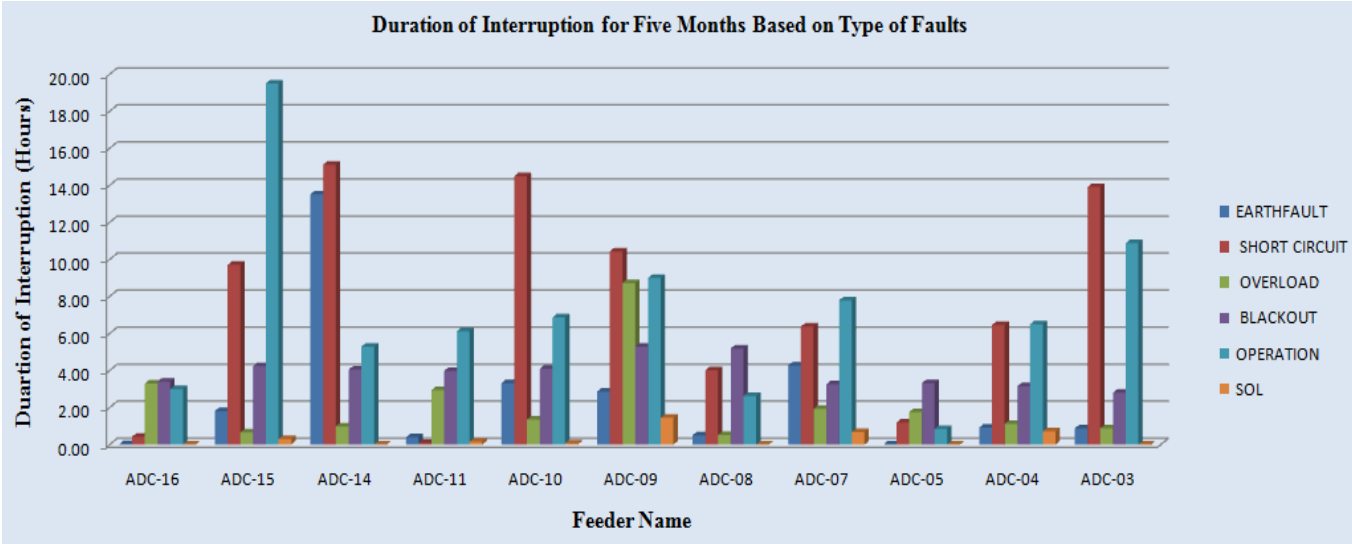

Figure 4.7 Average Duration of Interruption for the Months of September 2013 to January 2014 Based on Type of Faults

Figure 4.7 shows an average duration of interruptions in hours due to short circuit, earth fault, over load, black out, operation and system over load for the months of September 2013 to January 2014 for the eleven feeders' of Addis Center distribution substation.

Where

F = Frequency of Interruption (No)

D = Duration of Interruption (Hours)

SOL = System Over Load (When Generated Power is below the total demand other than Black out)

		F	D (Hr)
Distribution faults	Earth Fault	54	28.47
	Short Circuit	42	82.16
	Over Load	28	24.10
	Total	**124**	**134.72**
Others	Black out	25.2	42.74
	Operation	41	78.38
	SOL	3	3.36
	Total	**69**	**124**
Grand total		**192**	**259.20**
	% Distribution faults [F & D]	**64.35**	**51.98**
	% other faults [F & D]	**35.65**	**48.02**

From the analysis, it is observed that majority (64.35%) of the faults in Addis Ababa region distribution network are due to short circuit, earth fault and over load. The remaining faults are due to black out, operation and system over load (when generated power is below the total demand other than black out).

4.5 Reliability Indices Evaluation of Addis Center Distribution System

As one object of this thesis work is to provide a more adopted method for determining distribution network reliability, this part of the thesis work used IEEE1366 indices to evaluate the reliability indices of Addis Center distribution system. The availability of power for customers from this substation is performed on the medium voltage side of the customer transformers (15kV). The reliability is highly affected by outages occurred on the customer side secondary distribution lines which unable to collect data for analysis due to lack of resource, lack of organized data and advanced technology at the substation to view the performance of the customer side secondary distribution network. The causes occurred on the secondary sides of customer transformers that may affect the service reliability of the feeders:

i. HRC fuses on the transformer usually get blown for the reasons discussed in chapter three
ii. Distribution lines on the low voltage side may fail for different reasons such as lack of clearance from trees, use of lines below the rated limit etc.
iii. Damage of transformers due to different reasons.

The customer-oriented indices for Addis Center substation are calculated as follows:

4.5.1 System Average Interruption Frequency Index (SAIFI)

Reliability indices are normally calculated on either monthly or yearly basis; however, it can also be calculated daily, or for any other time period. In this thesis work reliability indices are calculated by considering monthly basis.

SAIFI indicates how often an average customer is subjected to sustained interruption over a period of time interval. This index is average number of interruptions per customer served. It is determined by dividing the accumulated number of customer interruptions in a period of time by the number of customers served. SAIFI is calculated by the following formula and are tabulated in tables 4.9 and are graphed in figure 4.8 respectively

$$SAIFI = \frac{Total\ Number\ of\ Customer\ Interrupti\ on}{Total\ Number\ of\ CustomersS\ erved} = \frac{\sum \lambda_i N_i}{\sum N_T} \quad (4.3)$$

Where:

N_i = Total number of customers interrupted,
N_T = Total number of customers served
λ_i = No of interruptions

Table 4.8 Frequency of Interruptions of Each Feeder for the Months of September 2013 to January 2014

No	Feeder	Customers No	September			October			November			December			January		
			Non Momentary	Planned (No)	Total (No)	Non Momentary	Planned (No)	Total (No)	Non Momentary	Planned (No)	Total (No)	Non Momentary	Planned (No)	Total (No)	Non Momentary	Planned (No)	Total (No)
1	ADC-16	8236	6	0	6	5	1	6	10	3	13	8	2	10	2	2	4
2	ADC-15	6512	13	8	21	12	6	18	27	7	34	10	6	16	20	5	25
3	ADC-14	7278	5	4	9	4	2	6	12	1	13	24	7	31	69	2	71
4	ADC-11	10343	5	2	7	1	1	2	8	3	11	18	3	21	1	2	3
5	ADC-10	8045	5	6	11	7	1	8	12	3	15	14	4	18	53	6	59
6	ADC-09	10343	26	3	29	28	5	33	27	9	36	41	9	50	13	3	16
7	ADC-08	8428	8	2	10	2	0	2	8	1	9	5	2	7	3	3	6
8	ADC-07	10343	18	6	24	19	4	23	19	4	23	24	7	31	19	6	25
9	ADC-05	5746	5	1	6	3	3	6	5	0	5	8	3	11	1	0	1
10	ADC-04	8428	11	4	15	13	3	16	18	3	21	12	3	15	5	6	11
11	ADC-03	9577	13	0	13	13	6	19	9	8	17	16	4	20	15	9	24

Table 4.9 SAIFI Value of Each Feeder for the Months of September 2013 to January 2014

No	Feeder Name	September	October	November	December	January
1	ADC-16	0.35	0.35	0.75	0.58	0.23
2	ADC-15	1.26	1.08	2.05	0.96	1.51
3	ADC-14	0.73	0.49	1.06	2.52	5.77
4	ADC-11	0.17	0.05	0.26	0.50	0.07
5	ADC-10	1.04	0.76	1.42	1.71	5.60
6	ADC-09	3.23	3.67	4.01	5.57	1.78
7	ADC-08	0.97	0.19	0.87	0.68	0.58
8	ADC-07	2.93	2.81	2.81	3.78	3.05
9	ADC-05	0.64	0.64	0.53	1.17	0.11
10	ADC-04	1.71	1.82	2.39	1.71	1.25
11	ADC-03	1.71	2.50	2.24	2.63	3.16
	Total	**14.74**	**14.36**	**18.39**	**21.81**	**23.10**

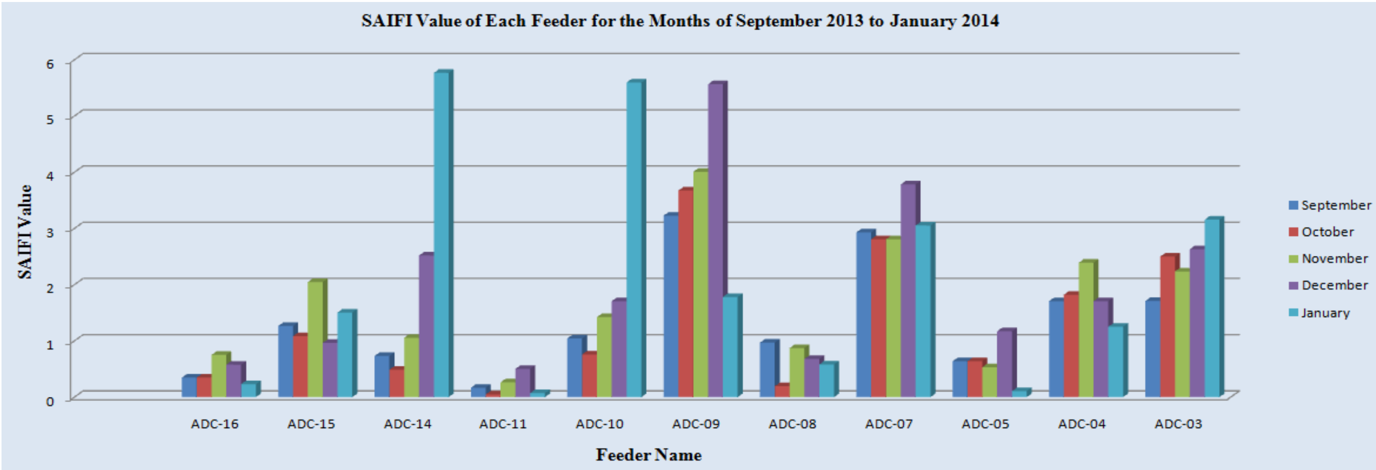

Figure 4.8 SAIFI Value for the Months of September 2013 to January 2014

The calculated frequency of interruptions of each feeder found in Addis Center distribution system for the months of September 2013 to January 2014 is tabulated in Table 4.8. It is observed that the customers connected to ADC-09 had a 3.65 probability of experiencing a power outage.

4.5.2 System Average Interruption Duration Index (SAIDI)

This index measures the total duration of an interruption for the average customer during a given period of time. SAIDI is normally calculated on either monthly or yearly basis; however, it can also be calculated daily, or for any other time period. In this thesis work reliability indices are calculated by considering monthly basis.

To calculate SAIDI, each interruption during the time period is multiplied by the duration of the interruption to find the customer-minutes of interruption. The customer-minutes of all interruptions are then summed to determine the total customer-minutes. To find the SAIDI value, the customer-minutes are divided by the total customers. SAIDI is calculated by Eq. (4.4) and the results are shown in Table 4.11

$$SAIDI = \frac{Sum\ of\ Customer\ Interruption\ Durations}{Total\ Number\ of\ Customers\ Served} = \frac{\sum r_i N_i}{\sum N_T} \qquad (4.4)$$

Where:

N_i = Total number of customers interrupted,

N_T = Total number of customers served

r_i = interruption duration

Table 4.10 Duration of Interruptions of Each Feeder for the Months of September 2013 to January 2014

No	Feeder Name	Customers No	September			October			November			December			January		
			Non Momentary	Planned (Hrs)	Total (Hrs)	Non Momentary	Planned (Hrs)	Total (Hrs)	Non Momentary	Planned (Hrs)	Total (Hrs)	Non Momentary	Planned (Hrs)	Total (Hrs)	Non Momentary	Planned (Hrs)	Total (Hrs)
1	ADC-16	8236	14.53	0	14.53	5.08	9.58	14.67	3.42	1.37	4.78	10.35	1.05	11.4	2.3	3	5.3
2	ADC-15	6512	31.37	55.37	86.73	24.97	10.57	35.53	11.43	16.52	27.95	5.25	10.52	15.77	10.47	4.5	14.97
3	ADC-14	7278	24.83	6.60	31.43	35.55	2.17	37.72	6.63	1.58	8.22	23.33	14.30	37.63	77.89	1.75	79.64
4	ADC-11	10343	17.00	5.75	22.75	0.83	3.67	4.50	6.52	16.35	22.87	12.70	4.23	16.93	0.67	0.60	1.26
5	ADC-10	8045	15.67	14.07	29.73	20.07	2.03	22.10	7.68	2.67	10.35	7.35	9.22	16.57	65.81	6.32	72.12
6	ADC-09	10343	46.88	3.20	50.08	24.48	7.62	32.10	14.35	23.63	37.98	51.28	6.43	57.72	6.67	4.08	10.75
7	ADC-08	8428	22.32	0.08	22.40	8.00	0.00	8.00	15.32	1.83	17.15	1.83	5.55	7.38	3.58	5.67	9.25
8	ADC-07	10343	25.73	4.43	30.17	17.67	9.83	27.50	15.25	5.08	20.33	10.15	12.00	22.15	13.58	7.58	21.17
9	ADC-05	5746	11.70	1.25	12.95	7.83	0.95	8.78	4.88	0.00	4.88	6.12	2.02	8.13	0.75	0.00	0.75
10	ADC-04	8428	19.38	5.07	24.45	12.68	13.08	25.77	12.25	2.08	14.33	16.62	2.85	19.47	0.80	9.42	10.22
11	ADC-03	9577	39.30	0	39.30	18.50	26.72	45.22	15.88	16.17	32.05	13.22	5.35	18.57	5.37	6.15	11.52
	Total	**93386**	**268.72**	**95.82**	**364.53**	**175.67**	**86.22**	**261.88**	**113.62**	**87.28**	**200.90**	**158.20**	**73.52**	**231.72**	**187.88**	**49.06**	**236.95**

Table 4.11 SAIDI Value of Each Feeder for the Months of September 2013 to January 2014

No	Feeder Name	September	October	November	December	January
1	ADC-16	50.35	50.81	16.57	39.49	18.36
2	ADC-15	313.33	128.37	100.97	56.96	54.07
3	ADC-14	153.20	183.83	40.05	183.42	388.17
4	ADC-11	32.64	6.46	32.81	24.30	1.81
5	ADC-10	169.21	125.77	58.90	94.28	410.43
6	ADC-09	334.57	214.43	253.74	385.56	71.81
7	ADC-08	130.25	46.52	99.72	42.93	53.79
8	ADC-07	220.93	201.40	148.91	162.22	2.58
9	ADC-05	82.67	56.07	31.17	51.92	4.79
10	ADC-04	166.95	175.94	97.87	132.92	69.76
11	ADC-03	310.19	356.89	252.97	146.54	90.90
	Total	**178.57**	**1546.48**	**1133.68**	**1320.55**	**1166.48**

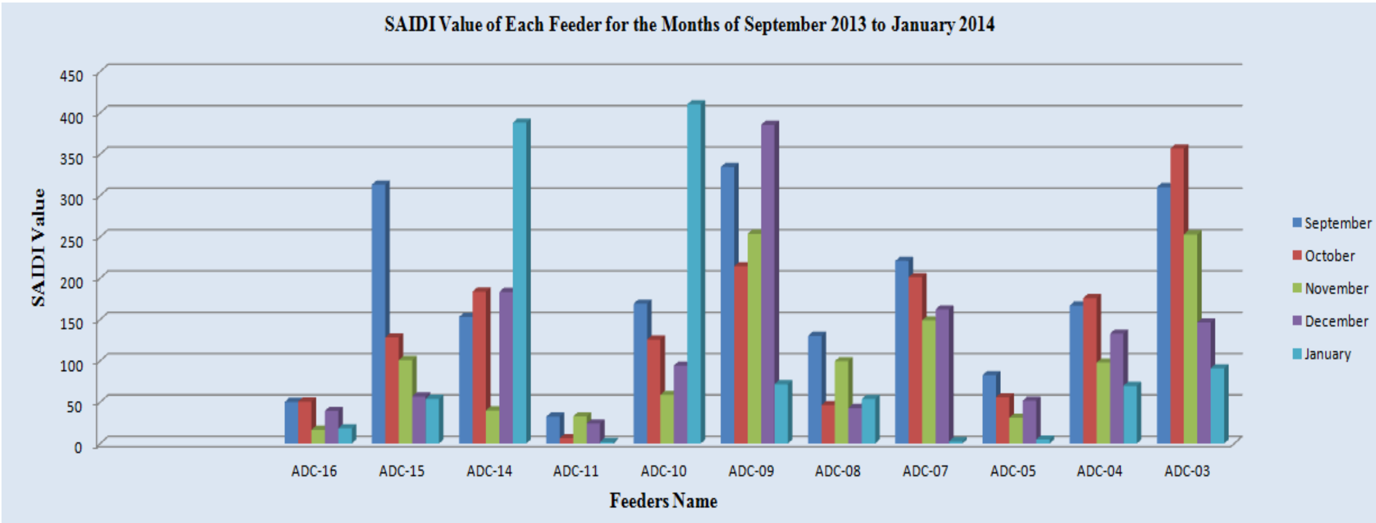

Figure 4.9 SAIDI Value for the Months of September 2013 to January 2014

The calculated duration of interruptions of each feeder found in Addis Center distribution system for the months of September 2013 to January 2014 is tabulated in Table 4.10. The average customer without power for feeder ADC-09 is 252 minutes per month.

4.5.3 Customer Average Interruption Duration Index (CAIDI)

Once an outage occurs, the average time to restore service is found from the Customer Average Interruption Duration Index (CAIDI). CAIDI indicates the average time required to restore the service. This index is the average interruption duration for customers interrupted during a period. CAIDI is calculated similar to SAIDI except that the denominator is the number of customers interrupted versus the total number of utility customers. CAIDI is calculated by equation (4.5) and is tabulated and graphed in Table 4.12 and Figure 4.10 respectively.

$$CAIDI = \frac{Sum\ of\ customer\ interruption\ durations}{Total\ number\ of\ customers\ interrupted} = \frac{\sum r_i N_i}{\sum N_i} = \frac{SAIDI}{SAIFI} \qquad (4.5)$$

Where

r_i = interruption duration

N_i = Total number of customers interrupted

Table 4.12 CAIDI Value of Each Feeder for the Months of September 2013 to January 2014

No	Feeder Name	September	October	November	December	January
1	ADC-16	14.53	14.67	4.78	11.40	5.30
2	ADC-15	86.73	35.53	27.95	15.77	14.97
3	ADC-14	31.43	37.72	8.22	37.63	79.64
4	ADC-11	22.75	4.50	22.87	16.93	1.26
5	ADC-10	29.73	22.10	10.35	16.57	72.12
6	ADC-09	50.08	32.10	37.98	57.72	10.75
7	ADC-08	22.40	8.00	17.15	7.38	9.25
8	ADC-07	30.17	27.50	20.33	22.15	21.17
9	ADC-05	12.95	8.78	4.88	8.13	0.75
10	ADC-04	24.45	25.77	14.33	19.47	10.22
11	ADC-03	39.30	45.22	32.05	18.57	11.52
	Total	**364.53**	**261.88**	**200.90**	**231.72**	**236.95**

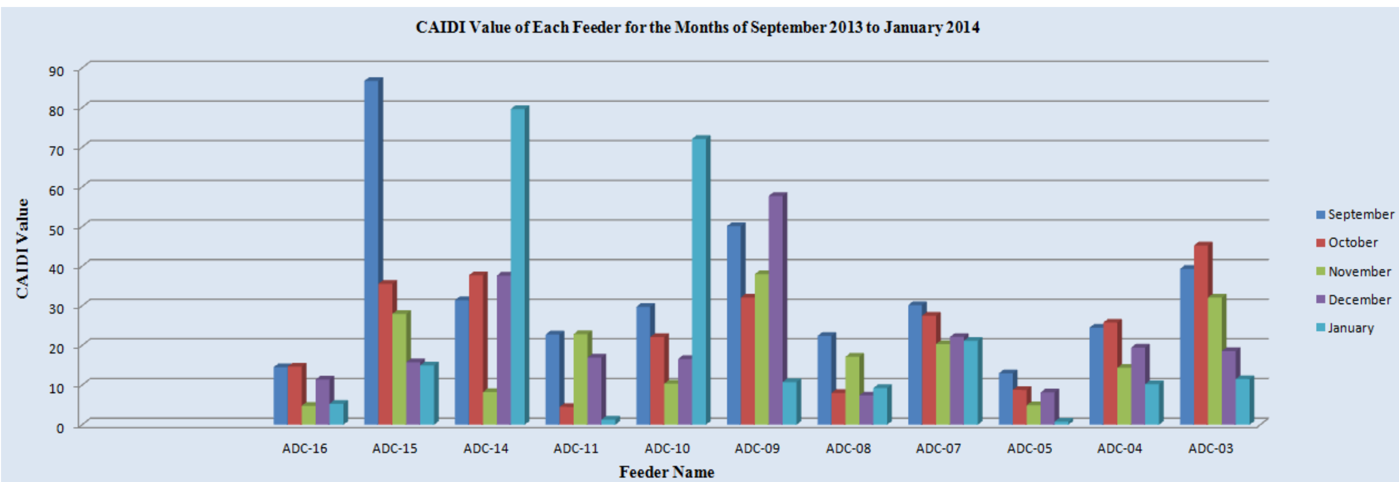

Figure 4.10 CAIDI Value for the Months of September 2013 to January 2014

The average customer that is interrupted is for feeder ADC-09 is 2280 minutes per month

4.5.4 The Average Service Availability Index (ASAI)

ASAI specifies the fraction of time that a customer has received the power during a predefined interval of time. This is the ratio of the total number of customer hours that service was available during a given time period to the total customer hours demanded. This is sometimes known as the “Service Reliability Index”. This is sometimes called the service reliability index. ASAI is usually calculated on either a monthly basis (730 hours) or a yearly basis (8,760 hours), but can be calculated for any time period. ASAI is calculated by equation (4.6) and is tabulated in Table 4.13.

$$ASAI = \frac{Customer\ \ Hours\ \ of\ \ Available\ \ Service}{Customers\ \ Hour\ \ Demanded} * 100\,\%$$

$$ASAI = \left(1 - \left(\sum \frac{(r_i * N_i)}{(N_i * T)}\right)\right) * 100 \qquad (4.6)$$

Where

r_i = interruption duration, hours

N_i = Total number of customers interrupted

N_T = Total number of customers served

T = Time period under study, hours

Table 4.13 ASAI Value of Each Feeder for the Months of September 2013 to January 2014

No	Feeder Name	September	October	November	December	January
1	ADC-16	99.89	99.88	99.96	99.91	99.96
2	ADC-15	99.28	99.71	99.77	99.87	99.88
3	ADC-14	99.65	99.58	99.91	99.58	99.11
4	ADC-11	99.93	99.99	99.93	99.94	100
5	ADC-10	99.61	99.71	99.87	99.78	99.06
6	ADC-09	99.24	99.51	99.42	99.12	99.84
7	ADC-08	99.7	99.89	99.77	99.9	99.88
8	ADC-07	99.5	99.54	99.66	99.63	99.65
9	ADC-05	99.81	99.87	99.93	99.88	99.99
10	ADC-04	99.62	99.6	99.78	99.7	99.84
11	ADC-03	99.29	99.19	99.42	99.67	99.79

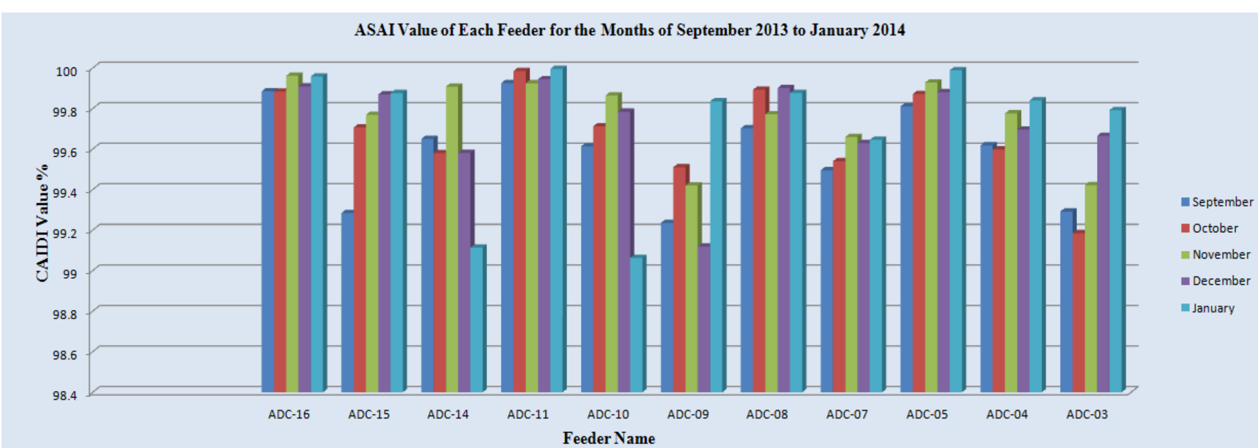

Figure 4.11 ASAI Value for the Months of September 2013 to January 2014

The complementary value to this index i.e. the Average Service Unavailability Index may also be used. This is the ratio of the total number of customer hours that service was unavailable during a time period to the total customer hours demanded. ASUI is calculated by the following formula and is tabulated and graphed in Table 4.14 and Figure 4.12 respectively.

$$ASUI = (100 - ASAI) * \% \tag{4.7}$$

Table 4.14 ASUI Value of Each Feeder for the Months of September 2013 to January 2014

No	Feeder Name	September	October	November	December	January
1	ADC-16	0.115	0.116	0.038	0.09	0.042
2	ADC-15	0.715	0.293	0.231	0.13	0.123
3	ADC-14	0.35	0.42	0.091	0.419	0.886
4	ADC-11	0.075	0.015	0.075	0.055	0.004
5	ADC-10	0.386	0.287	0.134	0.215	0.937
6	ADC-09	0.764	0.49	0.579	0.88	0.164
7	ADC-08	0.297	0.106	0.228	0.098	0.123
8	ADC-07	0.504	0.46	0.34	0.37	0.354
9	ADC-05	0.189	0.128	0.071	0.119	0.011
10	ADC-04	0.381	0.402	0.223	0.303	0.159
11	ADC-03	0.708	0.815	0.578	0.335	0.208

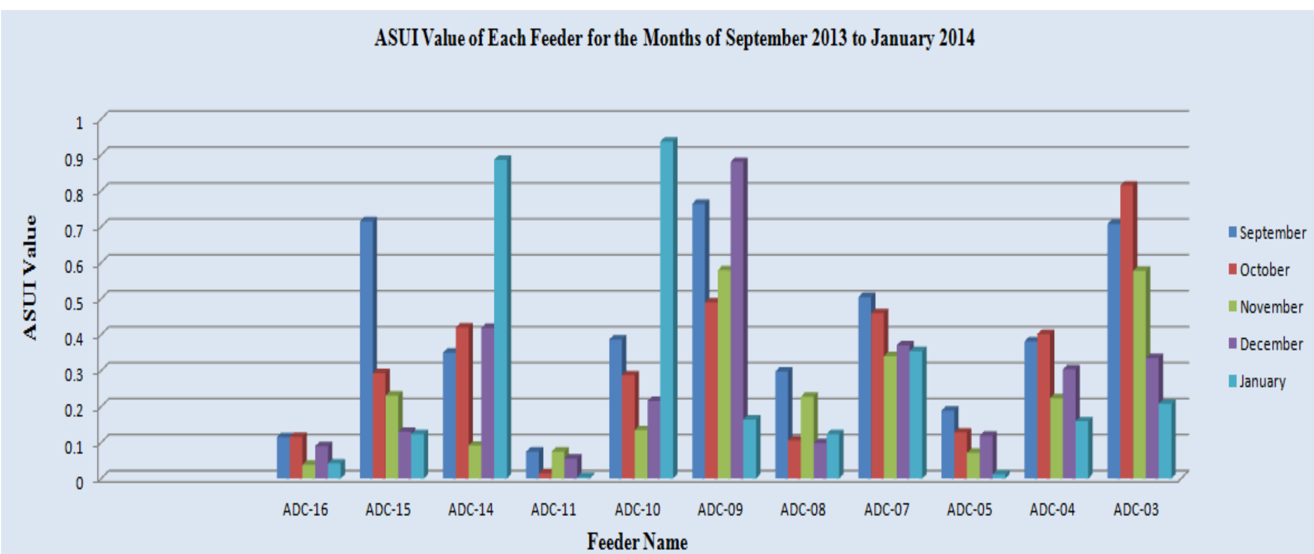

Figure 4.12 ASUI Value for the Months of September 2013 to January 2014

4.6 Comparison of Reliability Indices with Benchmarks

Reliability benchmarks are the standards against which analyzed or measured reliability is judged. The purposes of reliability benchmarks are to define minimum average reliability performance, by feeder type, for a distribution network and provide a basis against which a distribution network service provider's reliability performance can be assessed.

The benchmarks were calculated using the IEEE Guide for electric power distribution reliability indices – IEEE Standard 1366-2003.

Reliability analysis and calculations for the Addis Ababa distribution system had not been done for the indices (such as SAIFI, SAIDI, CAIDI, and ASAI).

A benchmark of SAIDI, CAIDI, SAIFI and ASAI for nine countries is shown in Table 4.15. From the calculation and analysis considered in reliability evaluation of Addis Center distribution system feeder ADC-09 has an average value of SAIDI=252 minutes, SAIFI=3.65 interruptions/customer, CAIDI=2280 minutes and ASAI=99.425 %.

A lower number for SAIDI, SAIFI and CAIDI index indicates better reliability performance; i.e., a lower frequency of outages or shorter outage duration. A higher SAIDI, SAIFI and CAIDI index number indicates worse performance. Comparing the average SAIDI, SAIFI, CAIDI and ASAI value of feeder ADC-09 of Addis Center distribution with the benchmarks shows that has worse performance.

Table 4.15 Benchmarks for Reliability Indices [47]

No	Country	SAIDI (Minutes/year)	SAIFI (Interruptions/Customer)	CAIDI (Minutes/outage)	ASAI (%)
1	United States	240	1.5	123	99.91
2	Austria	72	0.9	112	99.97
3	Denmark	24	0.5	70	99.981
4	France	62	1	58	99.97
5	Germany	23	0.5	50	99.9999
6	Italy	58	2.2	106	99.9991
7	Netherlands	33	0.3	75	99.97
8	Spain	104	2.2	114	99.968
9	UK	90	0.8	100	99.964
10	**(Addis Ababa) Ethiopia**	**252/month**	**3.65**	**2280**	**99.425**

A typical customer expects to have a power at all times. In reality a utility will be able to make power available between 99.9 and 99.999 percent of the time. To put it in another way, the average customer may be dissatisfied if there is no electricity for more than for 53 minutes a year. (Source: APPA distribution system reliability and operations survey report, by Alex Hofmann, Nov 2012, published by American Public power association)

Feeder ADC-09 of Addis Center distribution substation has a deviation of 0.574% (99.999-99. 425). Consequently, customers experienced life without electricity on average for about 3016.94 minutes per month.

4.7 Loss of Revenue due to Power Interruption in Addis Center Substation

A common approach used in quantifying the worth or benefit of electric service reliability is to estimate the customer costs associated with power interruptions. The customer interruption cost when an electric supply failure occurs depends on many factors. The absence of many of the data sets required in a detailed evaluation of the customer outage costs makes it difficult to estimate precise individual customer outage costs due to a specific failure event. This part of the Thesis work estimates only cost lost by the utility in Addis Center substation due to interruptions. The electric tariff category for EEPCO is shown in table 4.16.

Table 4.16 Electricity tariff Ethiopian Electric Power Corporation (EEPCO) Since July 8, 2006 [43]

No	Tariff Category & Block Identification	Monthly Consumption(kWh)	Birr/kWh)
1	Domestic		
	1st Block	0-50	0.273
	2nd Block	51-100	0.3564
	3rd Block	101-200	0.4993
	4th Block	201-300	0.55
	5$_{th}$ Block	301-400	0.5666
	6th Block	401-500	0.588
	7th Block	Above 500	0.6943
2	General		
	1stBlock	0 - 50	0.6088
	2nd Block	Above 50	0.6943
3	Low Voltage Time of Day Industry		
	Peak		0.7426
	Off - Peak		0.5453
4	High Voltage Time of Day Industry @ 15KV		
	Peak		0.5085
	Off - Peak		0.3933
5	High Voltage Industry @ 132KV		
	Peak		0.4736
	Off - Peak		0.3664
6	Street Lighting Tariff		0.4843

The cost of energy not supplied due to interruption for Addis Center Substation is calculated by using equation (4.7).

$$Cost\ of\ Energy = Power * time * tariff\ \ for\ electric \qquad (4.7)$$

By considering an average price of 0.6 Birr/kWh for electricity in EEPCO, the average energy not supplied and average cost of energy not supplied due to power interruption for single months at Addis Center outgoing feeders are calculated and tabulated in table 4.17.

Table 4.17 Average cost of energy not supplied due to power interruption for single month at Addis Center outgoing feeders

Item no.	Feeder Name	Peak Load (MW)	Duration of Interruption (Hr.)	Energy Not Supplied (MWh)	Cost of Energy not Supplied (Birr)
1	ADC-16	5.03	10.14	50.96	30575.00
2	ADC-15	3.97	36.19	143.85	86311.85
3	ADC-14	4.44	38.93	172.94	103766.08
4	ADC-11	6.31	13.66	86.26	51753.02
5	ADC-10	4.91	30.17	148.16	88897.90
6	ADC-09	6.31	37.73	238.17	142904.24
7	ADC-08	5.14	12.84	66.03	39619.40
8	ADC-07	6.31	24.26	153.18	91906.69
9	ADC-05	3.51	7.10	24.90	14941.10
10	ADC-04	5.14	18.85	96.95	58168.80
11	ADC-03	5.85	29.33	171.45	102869.11
Total				**1352.86**	**811713.18**

Therefore, the total average energy not supplied and average cost of energy not supplied due to power interruption for single months at Addis Center outgoing feeders are 1352.86 MWh and 811,713 Birr respectively.

The total average cost of energy not supplied due to power interruption per year for Addis Center outgoing feeders is 12*811,713 = **9.74 Million Birr**. By considering the Dollar Ethiopian Birr exchange rate (USD to ETB) as of 14 Mar 2014 as 1 USD = 19.3082 Ethiopian Birr. The equivalent cost in USD is 9.74/ 19.3082 = **504,448 USD**.

CHAPTER FIVE

SOLUTIONS FOR IMPROVING THE RELIABILITY OF THE DISTRIBUTION SYSTEM

As this thesis work concentrates to conduct a study on design, reliability and maintenance of Addis Ababa power distribution system so the proposed solution for improving the reliably of distribution system concentrates on giving solution to three major aspects of the distribution system:

1. Design solution to Addis Ababa distribution system
2. Operation and Maintenance improvement strategy to Addis Ababa distribution system
3. Reliability improvement strategy to Addis Ababa distribution system

5.1Design Solution for 132/33 kV Addis Center Distribution Substation

In the design of power distribution system all materials and workmanship shall be of the best standard and shall comply with the relevant legislation and Ethiopian Standards, or if such do not exist, with the relevant IEC or International Standard Organization (ISO) Standards.

The Addis Ababa distribution system is mainly made up of radial network which is making things worse in case of line tripping. So it is better to convert radial networks to ring network for better reliability.

Distribution transformers are without surge arrestors at the majority of locations. So, it is better the distribution transformer with their accessories are equipped with surge arresters. Various kVA ratings for distribution ranging from 100, 200, 315, 630 etc exists in Addis Ababa distribution. Ratings of distribution transformers need to be standardized to avoid spare inventory.

For better distribution reliability, low voltages feeders should be undergrounded. Loads or customers should be separated by specifying industrial, commercial and residential consumers.

There are no capacitor banks at substations and hence no compensation for the reactive power. Therefore, design of distribution system should include reactive power compensators i.e. capacitor banks.

It has been identified that the Addis Ababa region distribution substations are overloaded and it has to be expanded to accommodate the increasing demands. As Addis Center distribution substation is the focus of this Thesis work and is supplying large power to Addis Ababa region distribution system. A design of 132/33kV, 250MVA distribution substation for Addis Center is carried out to upgrade the existing 132/15kV, 63MVA capacity.

This distribution substation has only one 132kV radial incoming feeder from Kalitie substation. In the substation there are two power transformers having 31.5MVA each with 132/15kV. There are 11number of 15kV outgoing feeders. The current peak load of the substation obtained from the Load Dispatch Center found at Gergi is 55.5MW. From this data one can see that the substation is already reached the peak load.

In order to meet customers demand with greater capacity and reliability, it is necessary to upgrade the substation by designing the distribution substation with proper rating of distribution substation equipments.

EEPCO normally bases its Generation/Transmission expansion plan on load demand forecasts of 25 years planning horizon. The plan for the first 10 years is detailed where as for the remaining 15 years is just indicative [45].

Though currently there are two official forecasts used by EEPCO, namely the moderate, which presumes an annual average growth of 14% and the ambitious target of 17% [45]. In order to be more realistic, the World Bank's annual average growth rate of 6% of a power demand forecast have been used to estimate the capacity of the distribution substation. This estimated power demand forecast is tabulated in Table 5.1.

The power demand after 25 years will be approximately 224.72MW of active power and 249.68MVA by considering a power factor of 0.9. Therefore the power demand after 25 years will be approximately 250MVA.

Table 5.1 Power Demand forecast for Addis Center Substation

Year	MW
2014	55.5
2015	58.83
2016	62.36
2017	66.10
2018	70.07
2019	74.27
2020	78.73
2021	83.45
2022	88.46
2023	93.77
2024	99.39
2025	105.36
2026	111.68
2027	118.38
2028	125.48
2029	133.01
2030	140.99
2031	149.45
2032	158.42
2033	167.92
2034	178.00
2035	188.68
2036	200.00
2037	212.00
2038	224.72

5.1.1 Selection of Transformers

Transformer size/s must be selected according to the maximum expected load and possibility of future expansions. The size of transformer is selected from power ratings given by manufactures list to supply present and future loads.

As the power demand is large it is better to use a substation with 132/33kV and 50MVA capacity. Selection of five power transformers with 132/33kV and 50MVA each is very wise.

5.1.2 Selection of Transformer feeders

In order to select an appropriate cable for the primary and secondary transformers, it is necessary to know the following:

1. Size and type of load to be supplied
2. Permissible voltage drop
3. Prospective fault current
4. Circuit protection
5. Environmental conditions of installation.

5.1.2.1 Calculation of Current

In order to select the appropriate cable size, it is necessary to know the voltage and load current in Amperes or as MW or MVA. The rated current of the primary cable is calculated by equation (5.1) as follows.

$$I_{rated} = \frac{MVA}{\sqrt{3}*V} = \frac{50*10^6 VA}{\sqrt{3}*132*10^3 V} = 218.95A \qquad (5.1)$$

By considering a De-rating factor of 0.85, the standard current that flows through the primary cable is given by

$$I_{s\tan dard} = \frac{I_{rated}}{De\,rating\ factor} = \frac{218.95A}{0.85} = 257.59A$$

Table 5.2 shows that a 3x95 mm^2 single core unarmoured XLPE insulated PVC sheathed 600/1000V stranded copper conductors cable would be capable of carrying a load of 300 A.

The rated current of the secondary cable is also calculated by equation (5.2) as follows

$$I_{rated} = \frac{MVA}{\sqrt{3}*V} = \frac{50*10^6 VA}{\sqrt{3}*33*10^3 V} = 874.77A \qquad (5.2)$$

By considering a De-rating factor of 0.85, the standard current that flows through the secondary cable is given by

$$I_{s\tan dard} = \frac{I_{rated}}{De\,rating\ factor} = \frac{874.77A}{0.85} = 1.03\,kA$$

Table 5.2 shows that a 3x800 mm^2 single core unarmoured XLPE insulated PVC sheathed 600/1000V stranded copper conductors cable would be capable of carrying a load of 1086 A.

Table 5.2 Single core unarmoured XLPE insulated PVC sheathed 600/1000V stranded copper conductors [48]

Cable Size (mm^2)	Electrical Properties									Physical Properties		
	1φ Cable AC or DC			3φ Cable in Trefoil Formation				Impedance (Ω/km)		Nominal Diameters		Nominal Mass (kg/km)
	Current Rating		Voltage Drop per Amp per mV (mV)	Current Rating			Voltage Drop per Amp per mV (mV)					
	Ground (A)	Air (A)		Ground (A)	Duct (A)	Air (A)				D_1 (mm)	D_2 (mm)	
25	118	126	1.75	127	111	112	1.52	0.8767		5.95	11.91	366
35	156	156	1.27	153	132	141	1.1	0.6356		7	12.96	469
50	186	191	0.95	180	155	172	0.82	0.4745		8.15	15.15	632
70	232	246	0.67	221	190	223	0.58	0.3356		9.79	16.57	880
95	281	300	0.5	265	226	273	0.43	0.25		11.54	19.04	1160
120	324	349	0.41	301	256	318	0.36	0.2054		12.96	20.24	1413
150	370	404	0.35	338	287	369	0.3	0.1734		14.39	22.07	1734
185	424	463	0.3	381	323	424	0.26	0.1499		16.1	24.08	2145
240	498	549	0.25	442	372	504	0.22	0.1268		18.71	27.81	2725
300	566	635	0.23	499	419	584	0.2	0.1131		21.45	30.75	3375
400	651	742	0.21	565	472	679	0.18	0.1028		24.3	34.1	4395
500	740	835	0.19	634	532	778	0.17	0.0963		26.51	37.17	5299
630	836	953	0.18	718	603	892	0.15	0.089		33.15	43.62	6965
800	931	1086	0.17	792	689	1020	0.15	0.0852		37.7	49	9118
1000	1041	1216	0.16	856	741	1149	0.14	0.0819		42.25	53.45	11050

5.1.2.2 Permissible Voltage Drop Calculation

Permissible voltage drop is computed by calculating the highest current drawn by the load multiplied by an appropriate factor. The maximum voltage drop allowed by SANS 10142-1 during full load running condition is 5% [46].

The voltage drop may be calculated in two different ways:

1. Multiplying the current by the impedance of the length of the cable. Calculate the percentage voltage drop by reference to the phase to earth voltage.
2. Multiply the current by the length of cable, and then multiply the result by the volt drop per amp per meter as given in Table 5.2, or other relevant data for the type of cable.

The voltage drop is calculated by equation (5.3)

$$V_{drop} = \sqrt{3} * \left(\frac{Z}{km} \right) * I_{rated} * D \tag{5.3}$$

Where:

D is distance in km

From Table 5.2 the impedance per kilometer is 0.25Ω/km and considering a distance from Kaliti substation to Addis Center distribution substation is 14.35km, the voltage drop in the primary feeder is calculated as follows

$$V_{drop} = \sqrt{3} * \left(\frac{0.25}{km} \right) * 300A * 14.35km = 1868.12V$$

Percentage voltage drop = (1975.97/132000)* 100 = 1.41% is acceptable.

From Table 5.2 the impedance per kilometer is 0.0852Ω/km and considering an average distance from Addis Center distribution substation to the load is 9km, the voltage drop in the primary feeder is calculated as follows

$$V_{drop} = \sqrt{3} * \left(\frac{0.0852}{km} \right) * 1086A * 9km = 1442.36V$$

Percentage voltage drop = (1442.36/33000)* 100 = 4.37% is acceptable

5.1.2.3 Fault Current Calculation

Electric cables are designed to operate below a certain maximum temperature, this being dependent on the conductor material and the type and the thickness of the insulation. Cable selection for a particular installation must therefore be made on the basis of not exceeding these temperature limits.

For a power transformer with 132/33 kV with 50MVA rating, the short-circuit capacity is 1000MVA [IEC 60076-5]. The earth fault level is 100MVA, and it may be assumed that the fault should be cleared within a half second

.

The supply impedance seen from the primary side is given by equation (5.3)

$$Z_{Sys} = \frac{(V_P)^2}{S_{SC}} \tag{5.3}$$

$$Z_{Sys} = \frac{(132)^2}{1000} = 17.424\,\Omega$$

The short circuit current that can exist on the primary feeder is calculated by equation 5.4

$$I_{SC} = \frac{V_p}{\sqrt{3} * Z_{sys}} \tag{5.4}$$

$$I_{SC} = \frac{132}{\sqrt{3} * 17.424} = 4.37\ kA$$

Or the short circuit current that can exist on the primary feeder can be calculated by equation 5.5

$$I_{sc} = \frac{Short\ Circuit\ MVA}{\sqrt{3} * Voltage\ Rating} \tag{5.5}$$

$$I_{sc} = \frac{1000 * 10^6}{\sqrt{3} * 132 * 10^3} = 4.37\ kA$$

The short circuit current withstand capacity of the cable is calculated by equation 5.6

$$I_{sc} = \frac{K * A}{\sqrt{t}} \tag{5.6}$$

Where:

I_{sc} = Short circuit rating of cable (kA)

A = Cross-section of conductor (mm^2)

t = time to trip (in seconds)

K = A constant that depends on conductor material and temperature

= 115 A/mm^2 for PVC, Copper conductor

= 76 A/mm^2 for PVC, Aluminum conductor

= 115 A/mm^2 for Paper, Copper conductor

= 76 A/mm^2 for Paper, Copper conductor

= 143 A/mm^2 for XLPE, Copper conductor

= 92 A/mm^2 for XLPE, Aluminum conductor

$$I_{sc} = \frac{143 * 95}{\sqrt{0.5}} = 19.21\ kA$$

Therefore the cable can withstand the prospective short circuit current.

The cable earth fault current that can exist in the primary feeder is calculated by equation 5.7

$$I_{EF} = \frac{Earth\ Fault\ MVA}{\sqrt{3} * Voltage\ Rating} \tag{5.7}$$

$$I_{EF} = \frac{100 * 10^6}{\sqrt{3} * 132 * 10^3} = 437.39\, A$$

The cable earth fault current withstand capacity is calculated by equation 5.8

$$I_{EF} = \frac{K * A}{\sqrt{t}} \tag{5.8}$$

Where:

I_{EF} = Earth fault current (kA)

A = Cross-sectional area of earth path (mm^2)

t = Fault duration in seconds (0.5 second)

K = A constant that depends on earth path material

= 42 A/mm^2 for steel wire armour

= 24 A/mm^2 for lead sheath

= 143 A/mm^2 for Copper tape

= 76 A/mm^2 for Aluminum wire armour

$$I_{EF} = \frac{143 * 95}{\sqrt{0.5}} = 19.21\, kA$$

Therefore the cable can withstand the prospective earth fault current.

In many cases, the cable conductor size is larger than dictated by the full load current, and is chosen in order to withstand the prospective short-circuit current. The use of large conductors can be avoided by improving the speed of protection and in the case of earth fault current, by the use of sensitive earth fault protection.

The supply impedance transferred to the secondary side is given by equation (5.9)

$$Z_L = Z_{Sys} * \left(\frac{V_S}{V_P} \right)^2 \tag{5.9}$$

$$Z_L = 17.424 * \left(\frac{33}{132} \right)^2 = 1.089\ \Omega$$

The short circuit current that can exist on the secondary feeder is calculated by equation 5.10

$$I_{SC} = \frac{V_S}{\sqrt{3} * Z_{sys}} \tag{5.10}$$

$$I_{SC} = \frac{33}{\sqrt{3} * 1.089} = 17.5\ kA$$

Or the short circuit current that can exist in the secondary feeder is calculated by equation 5.11

$$I_{sc} = \frac{Short\ Circuit\ MVA}{\sqrt{3} * Voltage\ Rating} \tag{5.11}$$

$$I_{sc} = \frac{1000 * 10^6}{\sqrt{3} * 33 * 10^3} = 17.5 kA$$

The short circuit current withstand capacity of the cable is calculated by equation 5.12

$$I_{sc} = \frac{K * A}{\sqrt{t}} \tag{5.12}$$

Where:

I_{sc} = Short circuit rating of cable (kA)

A = Cross-section of conductor (mm^2)

t = time to trip (in seconds)

K = A constant that depends on conductor material and temperature

= 115 A/mm^2 for PVC, Copper conductor

= 76 A/mm^2 for PVC, Aluminum conductor

= 115 A/mm^2 for Paper, Copper conductor

= 76 A/mm^2 for Paper, Copper conductor

= 143 A/mm^2 for XLPE, Copper conductor

= 92 A/mm^2 for XLPE, Aluminum conductor

$$I_{sc} = \frac{143 * 800}{\sqrt{0.5}} = 162.79 kA$$

Therefore the cable can withstand the prospective short circuit current.

The cable earth fault current that can exist in the secondary feeder is calculated by equation 5.13

$$I_{sc} = \frac{Earth\ Fault\ MVA}{\sqrt{3} * Voltage\ Rating} \tag{5.13}$$

$$I_{EF} = \frac{100 * 10^6}{\sqrt{3} * 33 * 10^3} = 1.75kA$$

The cable earth fault current withstand capacity is calculated by equation 5.14

$$I_{EF} = \frac{K * A}{\sqrt{t}} \tag{5.14}$$

Where:

I_{EF} = Earth fault current (kA)

$$I_{EF} = \frac{143 * 800}{\sqrt{0.5}} = 162.79kA$$

Therefore the cable can withstand the prospective earth fault current.

In many cases, the cable conductor size is larger than dictated by the full load current, and is chosen in order to withstand the prospective short-circuit current. The use of large conductors can be avoided by improving the speed of protection and in the case of earth fault current, by the use of sensitive earth fault protection.

5.1.3 Distribution Substation Grounding Design

Safety and reliability are the two major concerns in the operation and design of an electrical substation. These concerns also pertain to the design of substations. To ensure that substations are safe and reliable, the substation must have a properly designed earthing (grounding) system. Earthing or grounding means connecting all parts of the apparatus (other than live part) to the general mass of earth by wire of negligible resistance. This ensures that all parts of the equipment other than live part shall be at earth potential (i.e., zero potential) so that the operator shall be at earth potential at all the time, thus will avoid shock to the operator. The neutral of the supply system is also solidly earthed to ensure its potential equal to zero.

The substation ground grid design is based on the substation layout plan. The following points serve as guidelines to start a grounding grid design [46]:

1. The substation should surround the perimeter and take up as much area as possible to avoid high current concentrations. Using more area also reduces the resistance of the grounding grid.

2. Typically conductors are laid in parallel lines. Where it is practical, the conductors are laid along the structures or rows of equipment to provide short ground connections.
3. Typical substation grid systems may include 4/0 bare copper conductor buried 0.3-0.5 m below grade and spaced 3-7 m apart in a grid pattern. The conductors should be securely bonded at cross-connections [46].
4. Ground rods may be installed at grid corners and junction points along the perimeter. They may also be installed at major equipment, especially near surge arresters.
5. The grid should extend over the entire substation and beyond the fence line [46].
6. The ratio of the sides of the grid meshes is usually 1:1 to 1:3 [46].

Conductors can be of various materials including copper, copper-clad steel, aluminum, or steel. Each type of conductor has advantages and disadvantages. Copper is the most commonly used material for grounding. Copper has high conductivity. Also, it is resistant to most underground corrosion because it is cathodic with respect to most other metals. It also has good temperature characteristics and thermal capacity [46].

5.1.3.1 Resistivity of a Soil

The earth's soil can be considered to be a pure resistance and thus is the final location that a fault current is dispersed. Soil resistance can contain a current up to a critical amount which varies depending on the soil and at this point, electrical arcs can develop on the surface of the soil that can electrify objects on the surface such as a person [46]. Table 5.3 shows a basic collection of soil resistivity depending on the moisture and type.

Table 5.3 Basic Range of Soil Resistivity Ref. IEEE Std, 80, Table 8 [46]

Type of Earth	Average Resistivity (Ω-m)
Wet Organic Soil	10
Moist Soil	100
Dry Soil	1000
Bedrock	10000

Table 5.3 shows that wet or even moist soil have very small resistances so it is beneficial to keep the grounding soil as damp as possible. In order to greatly reduce the shock current and increase the contact resistance between the soil and the feet of people in a substation, a thin layer of a

highly resistive protective surface material just as crushed rock (gravel) is spread above the earth grade at a substation.

5.1.3.2 Resistance of the Human Body

The internal resistance of a human body is approximately 300 Ω [46]. The body resistance including skin ranges from 500-3000 Ω [46]. For simplicity, IEEE Std 80-2000 represents the resistance of a human body from hand-to-feet and also from hand-to-hand, or from one foot to the other as

$$R_B = 1000\ \Omega$$

The following data are used in the Earth-Mat Design:

- For the initial design a rectangle of 250m x 200m is assumed by observing the actual site. The area occupied is

  $A = 50{,}000 m^2$

- Fault current ($I_{EF} = I_g$) = 100kA
- Fault duration = 0.5sec
- Soil resistivity = 100ohm-m
- Depth of burial = 0.5m
- Earth electrode = 40mm dia. hard-drawn copper wire, 3 m long
- Earth mat conductor = Copper Round
- X/R ratio is 10

5.1.3.3 Grid Current Calculation

A portion of the fault current will flow through the grounding grid to the earth. This is called the grid current and must be calculated. The maximum grid current, I_G is calculated by equation (5.15)

$$I_G = D_f * I_g \tag{5.15}$$

Where

I_G = maximum grid current/ asymmetrical fault current (A)

D_f = decrement factor for the duration of the fault (From Table 5.4)

$I_g = I_{EF}$ = rms symmetrical grid/fault current (A)

Table 5.4 Typical Values of Df Ref. IEEE Std 80-2000 [46]

Fault Duration, t_f	Decrement factor, D_f				
Seconds	Cycles at 50 Hz	X/R =10	X/R = 20	X/R = 30	X/R = 40
0.00833	0.4165	1.576	1.648	1.675	1.688
0.05	2.5	1.232	1.378	1.462	1.515
0.1	5	1.125	1.232	1.316	1.378
0.2	10	1.064	1.125	1.181	1.232
0.3	15	1.043	1.085	1.125	1.163
0.4	20	1.033	1.064	1.095	1.125
0.5	25	1.026	1.052	1.077	1.101
0.75	37.5	1.018	1.035	1.052	1.068
1	50	1.013	1.026	1.039	1.052

Using Table 5.4 for a fault duration of 0.5 seconds and the X/R ratio of 10, the decrement factor D_f = 1.2026.

The asymmetrical fault current is calculated as follows:

$$I_G = 1.026 * 100 = 102.6\,kA$$

5.1.3.4 Earthing Conductor Sizing

The cross-sectional area of earthing conductor is calculated based on the asymmetrical current and the material constants by equation (5.16)

$$A = \frac{I_G}{\sqrt{\left(\frac{TCAP * 10^{-4}}{t_c \alpha_r \rho_r}\right) \ln\left(\frac{K_o + T_m}{K_o + T_a}\right)}} \tag{5.16}$$

Where

I_G = Asymmetrical fault current (kA) = 102.6kA

A = conductor cross section (mm^2)

T_m = maximum allowable temperature (°C) = 1084°C

T_a = ambient temperature (°C) = 40°C

α_r = thermal coefficient of resistivity at reference temperature T_r (1/°C) = 0.00381(1/°C)

ρ_r = resistivity of the ground conductor at reference temperature T_r (μΩ-cm) = 1.78

t_c = duration of fault current (sec) = 0.5

K_o = equals 1/ α_0 or (1/ α_r) - T_r (°C) = 242

TCAP = thermal capacity per unit volume (J/cm^2·°C) = 3.42

Common values of α_r, K_0, T_m, ρ_r, and TCAP values can be found in Table 5.5.

The cross-section area of the earthing conductor is then calculated by equation (5.16) as follows

$$A = \frac{102.6}{\sqrt{\left(\frac{3.42*10^{-4}}{0.5*0.00381*1.78}\right)\ln\left(\frac{242+1084}{242+40}\right)}} = 216.34mm^2$$

The diameter of a conductor (d_c) can be calculated by equation (5.17)

$$d_c = 2\sqrt{\frac{A}{\pi}} \tag{5.17}$$

$$d_c = 2\sqrt{\frac{216.34}{\pi}} = 16.6mm$$

Table 5.5 Material constants Ref. IEEE Std 80-2000 [46]

Description	Material Conductivity (%)	α_r factor at 20°C (1/°C)	K_o at 0°C (0°C)	Fusing[a] temperature T_m(°C)	ρ_r at 20°C (μΩ-cm)	TCAP thermal capacity (J/cm^3*°C
Copper, annealed soft-drawn	100	0.00393	234	1083	1.72	3.42
Copper, commercial hard-drawn	97	0.00381	242	1084	1.78	3.42
Copper-clad steel wire	40	0.00378	245	1084	4.4	3.85
Copper-clad steel wire	30	0.00378	245	1084	5.86	3.85
Copper-clad steel rod[b]	20	0.00378	245	1084	8.62	3.85
Aluminum, EC grade	64	0.00403	228	657	2.86	2.56
Aluminum, 5005 alloy	53.5	0.00353	263	652	3.22	2.6
Aluminum, 6201 alloy	52.5	0.00347	2268	654	3.28	2.6
Aluminum-clad steel wire	20.3	0.0036	258	657	8.48	3.58
Steel-1020	10.8	0.0016	605	1510	15.9	3.28
Stainless-clad steel rod[c]	9.8	0.0016	605	1400	17.5	4.44
Zinc-coated steel rod	8.6	0.0032	293	419	20.1	3.93
Stainless steel, 304	2.4	0.0013	749	1400	72	4.03

5.1.3.5 Calculation of Grid Resistance

The ground resistance for a substation needs to be very low to minimize the ground potential rise and increase the safety of the substation. The ground resistance is usually 1 Ω or less for transmission and other large substations [46]. In distribution substations, the usual acceptable range is 1-5Ω [46]. Resistance primarily depends on the area to be occupied. Also resistance can be decreased for a given area by using ground rods and adding more grid conductors. If it is impossible to reach a desired ground resistance by adding more grid conductors and/or ground rods, the soil surrounding the electrode can be modified.

Considering a layout of 250mx200m with equally spaced conductors as shown in figure 5.1with spacing distance D=25m and a grid burial depth h = 0.5m.

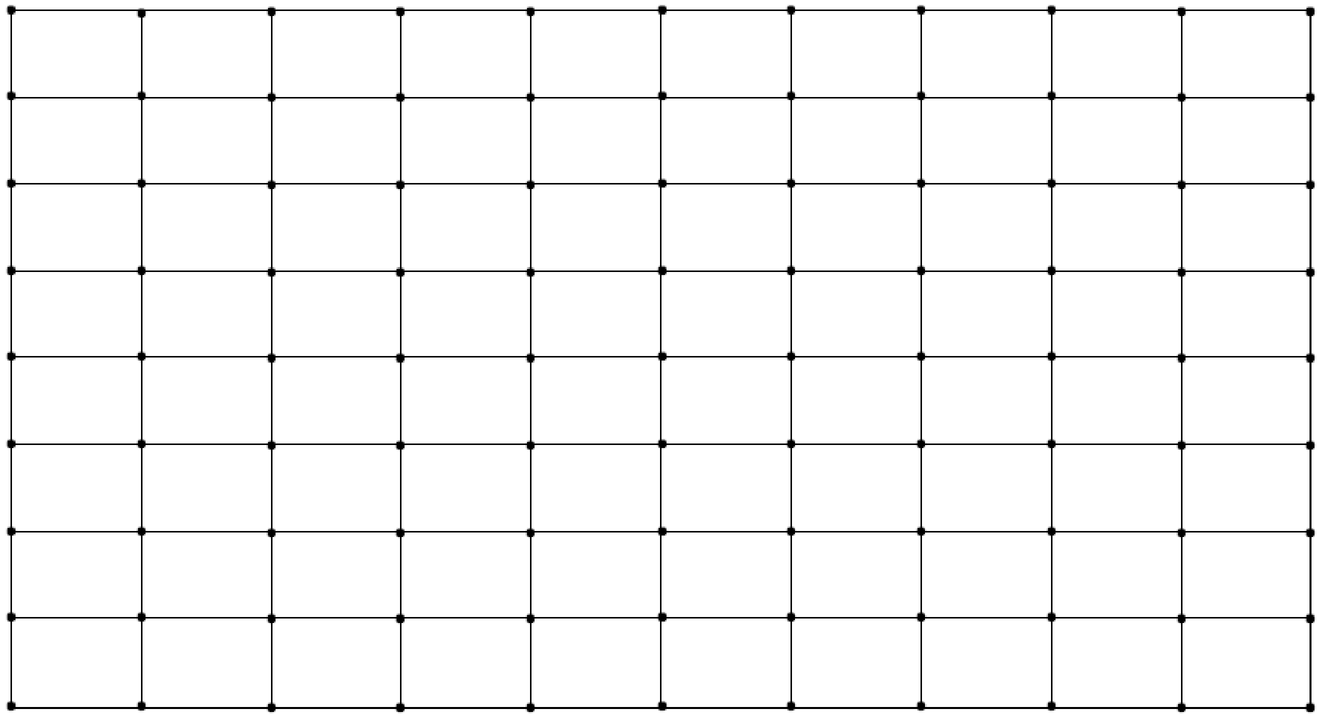

Figure 5.1 Rectangular Grid with 36 Ground Rods

The grid wire pattern is 9x11 and the grid conductor combined length (L_C) is

$$L_C = (9 \times 200) + (11 \times 250) = 4550\ m$$

There are 36 ground rods and 3m long are used as shown in Figure 5.1.

$$L_R = 36 \times 3 = 108\ m$$

The total length of buried conductor (L_T) is

$$\begin{aligned} L_T &= L_C + L_R \\ &= 4550 + 108 \\ &= 4658\ m \end{aligned}$$

Using the total length of buried conductor calculated in the previous step L_T = 4658 m and having the grid area A = 50,000 m^2, the substation grounding resistance (R_g) is calculated by equation (5.18) by considering moist soil.

$$R_g = \rho \left[\frac{1}{L_T} + \frac{1}{\sqrt{20A}} \left(1 + \frac{1}{1 + h\sqrt{20/A}} \right) \right] \tag{5.18}$$

Where

R_g = substation ground resistance (Ω)

ρ = soil resistivity (Ω-m) = 100 Ω-m

L_T = total length of buried conductor = 4658 m

A = area occupied by the ground grid (m^2) = 50,000 m^2

h = ground rod height = 3 m

$$R_g = 100\left[\frac{1}{4658} + \frac{1}{\sqrt{20 \times 50{,}000}}\left(1 + \frac{1}{1 + 3\sqrt{20/50{,}000}}\right)\right] = 0.216\,\Omega$$

5.1.3.6 Calculation of Permissible Touch and Step Potential

Permissible touch voltage is a form of touch voltage. Permissible touch voltages represent the highest possible touch voltages that may be encountered within a substation's grounding system. Permissible touch voltage is the basis for designing a safe grounding system, both inside the substation and immediately outside. In order for the grounding system to be safe, the permissible touch voltage has to be less than the tolerable touch voltage. Otherwise the substation ground grid design needs modification [46].

The permissible touch voltage can be calculated by equation (5.19)

$$E_{Permissile\ touch} = \frac{\rho \times I_G \times K_m \times K_i}{L_M} \tag{5.19}$$

Where

I_G = Asymmetrical fault current (kA) = 102.6 kA

ρ = resistivity of the earth (Ω·m) = 100 (Ω·m)

L_M = effective burial length (m)

K_m = geometrical spacing factor

K_i = irregularity factor

The geometrical spacing factor, K_m, for permissible touch voltage is calculated by equation (5.20) [46]

$$K_m = \frac{1}{2 \times \pi}\left[\ln\left[\frac{D^2}{16 \cdot h \cdot d} + \frac{(D + 2 \cdot h)}{8 \cdot D \cdot d} - \frac{h}{4 \cdot d}\right] + \frac{K_{ii}}{K_h} \cdot \ln\left[\frac{8}{\pi(2 \cdot n - 1)}\right]\right] \tag{5.20}$$

Where

D = spacing between parallel conductors (m)=25m

d = diameter of grid conductors (m) = 16.6mm

h = depth of ground grid conductors (m`) = 0.5m

K_{ii} = corrective weighting factor adjusting for the effects of inner conductors on the corner mesh =1

K_h = corrective weighting factor adjusting for the effects of grid depth =1.225

n = geometric factor

The corrective weighted factor K_h is calculated by equation (5.21) [46]

$$K_h = \sqrt{1 + \frac{h}{h_o}} \tag{5.21}$$

Where

h_0 = grid reference depth (h_0 =1)

$$K_h = \sqrt{1 + \frac{0.5}{1}} = 1.225$$

For ground grids with ground rods along the perimeter and throughout the grid, as well as in the corners, the corrective weighting factor, K_{ii} =1 [46].

The geometric factor n is calculated by equation (5.22) [46].

$$n = n_a \cdot n_b \cdot n_c \cdot n_d \tag{5.22}$$

Where

$$n_a = \frac{2 \cdot L_C}{L_P}$$

$$n_a = \frac{2 \times 4550}{900} = 10.111$$

n_b = 1 for square grids

n_c = 1 for square and rectangular grids

n_d = 1 for square, rectangular, and L-shaped grids

$n = 10.111 \times 1 \times 1 \times 1 = 10.111$

The irregularity factor K_i, is used in conjunction with n and it is calculated (5.23) [46]

$$K_i = 0.644 + 0.148 \cdot n \quad (5.23)$$

$$K_i = 0.644 + 0.148 \times 10.111 = 2.14$$

$$K_m = \frac{1}{2\times\pi}\left[\ln\left[\frac{25^2}{16\times0.5\times0.01666} + \frac{(25+2\times0.5)}{8\times25\times0.01666} - \frac{0.5}{4\times0.01666}\right] + \frac{1}{1.225}\cdot\ln\left[\frac{8}{\pi(2\times10.111-1)}\right]\right] = 1.08$$

For ground grids with ground rods along the perimeter and throughout the grid, as well as in the corners, the effective buried length L_M, is calculated by equation (5.24) [46].

$$L_M = L_C + \left[1.55 + 1.22\left(\frac{L_r}{\sqrt{L_x^2 + L_y^2}}\right)\right]L_R \quad (5.24)$$

Where

L_C = total length of conductor in the horizontal grid (m) = $(9\times200) + (11\times250) = 4550\ m$

L_P = peripheral length of grid (m) $= 2\cdot250 + 2\cdot200 = 900\ m$

L_x = maximum length of grid in the x-direction (m) = 11*250 = 2750 m

L_y = maximum length of grid in the y-direction (m) = 9*200 = 1800 m

L_r = total length of each ground rods (m) = 3 m

L_R = total length of all ground rods (m) = 38*3= 114 m

$$L_M = 4550 + \left[1.55 + 1.22\left(\frac{3}{\sqrt{2750^2 + 1800^2}}\right)\right]108 = 4717.52\ m$$

$$E_{Permissible\ touch} = \frac{100\times102.6\times2.176\times1.08}{4717.52} = 5.11V$$

If a grid system is designed for safe permissible touch voltages, the step voltages will be within tolerable limits. Step voltages are usually smaller than touch voltages because both feet are in series rather than parallel. Also, the body can tolerate higher currents through a foot-to-foot path because it doesn't pass through vital organs such as the heart. For the ground system to be safe, the step voltage has to be less than the tolerable step voltage [46].

The permissible step voltage is calculated by equation (5.25) [46]

$$E_{Permissile\ step} = \frac{\rho \times K_S \times K_i \times I_G}{L_S} \qquad (5.25)$$

The effective buried conductor length L_S is calculated by equation (5.26) [46]

$$L_S = 0.75 \times L_C + 0.85 \times L_R \qquad (5.26)$$

$$L_S = 0.75 \times 4550 + 0.85 \times 108 = 3504.3\, m$$

The step factor K_S for the step voltage is calculated by equation (5.27) [46]

$$K_S = \frac{1}{\pi}\left[\frac{1}{2 \times h} + \frac{1}{D+h} + \frac{1}{D}\left(1 - 0.5^{n-2}\right)\right] \qquad (5.27)$$

Where

D = spacing between parallel conductors (m)

h = depth of ground grid conductors (m)

n = geometric factor composed of factors n_a, n_b, n_c, and n_d

$$K_S = \frac{1}{\pi}\left[\frac{1}{2 \times 0.5} + \frac{1}{25+0.5} + \frac{1}{25}\left(1 - 0.5^{10.11-2}\right)\right] = 0.3435$$

Therefore the permissible step voltage is

$$E_{Permissible\ step} = \frac{100 \times 0.3435 \times 2.176 \times 102.6}{3504.3} = 2.19\, V$$

5.1.3.7 Calculation of Tolerable Touch and Step Potential

For a crushed rock surfacing layer (h_S) of 0.1m with surface layer resistivity of 1000 Ω-m, and with the soil resistivity of 100 Ω-m, the reduction factor (C_S) can be calculated by equation (5.28) [46].

$$C_S = 1 - \frac{0.09\left(1 - \frac{\rho}{\rho_S}\right)}{2h_S + 0.09} \qquad (5.28)$$

$$C_S = 1 - \frac{0.09\left(1 - \frac{100}{1000}\right)}{2 \times 0.1 + 0.09} = 0.72$$

For a 50 kg person, the tolerable step and touch potentials are calculated by using equations (5.29) and (5.30) respectively [46].

$$E_{Tolerable\ step} = (1000 + 6 \times C_S \times \rho_S)\frac{0.116}{\sqrt{t_S}} \tag{5.29}$$

$$E_{Tolerable\ step} = (1000 + 6 \times 0.72 \times 1000)\frac{0.116}{\sqrt{0.5}} = 872.48\,V$$

$$E_{Tolerable\ touch} = (1000 + 1.5 \times C_S \times \rho_S)\frac{0.116}{\sqrt{t_S}} \tag{5.30}$$

$$E_{Tolerable\ touch} = (1000 + 1.5 \times 0.72 \times 1000)\frac{0.116}{\sqrt{0.5}} = 341.12\,V$$

Once the permissible touch and step voltages are calculated, the results are compared with the tolerable touch and step voltages in order to see if the permissible touch and step voltage are below the tolerable touch and step voltages.

$$E_{Permissible\ touch} = 5.11\,V$$

$$E_{Tolerable\ touch} = 341.12\,V$$

Comparing the results, the permissible touch voltage is much lower than the tolerable touch voltage.

$$E_{Permissible\ step} = 2.19\,V$$

$$E_{Tolerable\ step} = 872.48\,V$$

Comparing the results, the attainable step voltage is much lower than the tolerable step voltage.

5.1.4 Selection of Circuit Breakers

Circuit breakers are a piece of electrical device that:

- Make or break a circuit either manually or by remote control under normal conditions.
- Break a circuit automatically under fault conditions.
- Make a circuit either manually or by remote control under fault conditions

Rated voltage, rated current and rated short-circuits breaking (interrupting) capacity of circuit breaker must be determined. Short circuit capacity of the circuit breaker must be above the maximum short circuit current exists in the location.

The ratings of 132 and 33 kV circuit breakers are indicated in Tables 5.6 and 5.7 respectively.

Table 5.6 Ratings of 132 kV Circuit Breaker

Description	Minimum Requirements
Type of Circuit Breaker	Outdoor Type
Rated Service Voltage	132 kV
Rated Maximum Voltage	145 kV
Type of Quenching Medium	SF_6
Rated Current	400A
Rated Short Circuit Current	31.5 kA
Number of Poles	3
Rated Frequency	50 Hz
Rated Short Circuit Making Current	63 kA
Short Circuit withstand current duration	0.5 Sec
Insulation level a) Power Frequency Withstand (kV RMS for 1 min) b) Impulse Withstand (1.2/50 μsec) kV Peak	 170 kV 650 kV

Table 5.7 Ratings of 33 kV Circuit Breaker

Description	Minimum Requirements
Type of Circuit Breaker	Outdoor Type
Rated Service Voltage	33 kV
Rated Maximum Voltage	36 kV
Type of Quenching Medium	SF_6
Rated Current	1250A
Rated Short Circuit Current	25 kA
Number of Poles	3
Rated Frequency	50 Hz
Rated Short Circuit Making Current	100 kA
Short Circuit withstand current duration	0.5 Sec
Insulation level a) Power Frequency Withstand (kV RMS 1 min) b) Impulse Withstand (1.2/50 μsec) kV Peak	 70 kV 170 kV

5.1.5 Selection of Surge Arrestors

The lightning arrester mainly differs in their constructional features. However they work with the same operating principle, i.e. providing low resistance path for the surges. They are mainly classified as:

1) Rod gap arrester

2) Metal Oxide without gap arrester

3) Horn gap arrester

4) Multi-gap arrester

5) Expulsion type lightning arrester

Selection of the proper ratings of a metal oxide arrester without gap is considered in this design; this is because currently EEPCO is using metal oxide without gap arresters.

The ratings of 132 and 33 kV circuit breakers are indicated in Tables 5.8 and 5.9 respectively.

Table 5.8 Ratings of 132 kV Surge Arrester

Description	Minimum Requirements
Type of Surge Arresters	Outdoor
Rated Service Voltage	132 kV
Rated Operating Voltage (U_r)	108 kV
Rated Continuous Operating Voltage (U_c)	84 kV
Nominal Discharge Current	10 kA
Rated Short-time Current	31.5 kA
Rated Frequency	50 Hz
Insulation level a) Power Frequency Withstand Voltage (kV RMS for 1 min) b) Impulse Withstand Voltage (1.2/50 μsec) kV Peak	 170KV 650KV
Residual voltage for a) Lightning current 8/20 impulse b) Step current 1/20 impulse of 10 kA c) Switching Current 30/60 Impulse of 500 A/1000 A	
High current 4/10 impulse withstand value	100 kA
Low current, long duration current impulse withstand (upper value)	1000 kA

Table 5.9 Ratings of 33 kV Surge Arrester

Description	Minimum Requirements
Type of Surge Arresters	Outdoor
Rated Service Voltage	33 kV
Rated Operating Voltage (U_r)	30 kV
Rated Continuous Operating Voltage (U_c)	21 kV
Nominal Discharge Current	10 kA
Rated Frequency	50 Hz
Maximum Short Circuit Rating	25 kA
Insulation level a) Power Frequency Withstand Voltage (kV RMS for 1 min) b) Impulse Withstand Voltage (1.2/50 µsec) kV Peak	 70 kV 170 kV
Residual voltage for a) Lightning current 8/20 impulse b) Step current 1/20 impulse of 10 kA c) Switching Current 30/60 Impulse of 500 A/1000 A	
High current 4/10 impulse withstand value	100 kA
Low current, long duration current impulse withstand (upper value)	1000 kA

5.1.6 Selection of Isolators

Isolator shall be designed such that in fully open position, it shall provide adequate electrical isolation between the contacts on all the three switches. Isolator shall be horizontal side opening, double side break rotating post type for use on a 132kV, 50 Hz, 3 - phase system. The isolator shall be motorized and also fitted with manual operation facility. All the three switches shall be arranged to ensure simultaneous operation of all switches by drive rods and operating handle for both manual and motor operation. Auxiliary dry contacts, five normally open and five normally closed shall be provided for electrical interlocks such that the isolator and associated 132 kV circuit breakers can be interlocked with each other. The contacts shall be rated to continuously carry at least 10Amps at voltages up to 500V dc/ac.

The ratings of 132 and 33 kV isolators, including their operating devices and auxiliary equipments are indicated in Table 5.10 and 5.11 respectively.

Table 5.10 Ratings of 132 kV Isolator

Description	Minimum Requirements
Rated Service Voltage	132 kV
Rated Maximum Voltage	145 kV
Rated Current	400A
Rated Short-time Current	25 kA
Number of Poles	3
Rated Frequency	50 Hz
Rated Maximum Withstand current	100 kA
Closing or Opening Time	≤ 30 Sec
Insulation level a) Power Frequency Withstand Voltage (kV RMS for 1 min) b) Impulse Withstand Voltage (1.2/50 µsec) kV Peak	 170KV 650KV

Table 5.11 Ratings of 33 kV Isolator

Description	Minimum Requirements
Rated Service Voltage	33 kV
Rated Maximum Voltage	36 kV
Rated Current	1250A
Rated Short-time Current	31.5 kA
Number of Poles	3
Rated Frequency	50 Hz
Rated Maximum Withstand current	100 kA
Closing or Opening Time	≤ 30 Sec
Insulation level a) Power Frequency Withstand Voltage (kV RMS for 1 min) b) Impulse Withstand Voltage (1.2/50 µsec) kV Peak	 70KV 170KV

5.1.7 Selection of Current Transformer (CT)

A CT is essentially a step up transformer which steps down a current to known ratio. The primary of this transformer consists of one or more turns of thick wire connected in series with the line. The secondary consists of a large no. of turns of a fine wire and provides for the measuring instruments and relays a current which is a constant fraction of current in the line. For example, protection devices and revenue metering may use separate CTs to provide isolation between metering and protection circuits, and allows current transformers with different characteristics (accuracy, overload performance) to be used for the devices. Current transformers are used for measurement of current and to provide secondary current for protection purposes.

The ratings of 132and 33kV current transformers are indicated in Tables 5.12 and 5.13 respectively.

Table 5.12 Ratings of 132 kV Current Transformer

Description	Minimum Requirements
Rated Service Voltage	132 kV
Rated Maximum Voltage	145 kV
Rated Primary Current a) for line feeder b) for transformer feeder	 800 - 400 - 200 800 - 400 - 200
Rated secondary currents	5 - 5 - 5
Short-time Current Ratings	25 kA
Rated Short Circuit Maximum Current	100 kA
Rated Frequency	50 Hz
Insulation level a) Power Frequency Withstand Voltage (kV RMS for 1 min) b) Impulse Withstand Voltage (1.2/50 μsec) kV Peak	 170 kV 650KV

Table 5.13 Ratings of 33kV Current Transformer

Description	Minimum Requirements
Rated Service Voltage	33 kV
Rated Maximum Voltage	36 kV
Rated Primary Current a) for line feeder b) for transformer feeder	 400 - 200 - 100 800 - 400 - 200
Rated secondary currents	5 - 5 - 5
Short-time Current Ratings	31.5 kA
Rated Short Circuit Maximum Current	60 kA
Rated Frequency	50 Hz
Insulation level a) Power Frequency Withstand Voltage (kV RMS for 1 min) b) Impulse Withstand Voltage (1.2/50 μsec) kV Peak	 70 kV 170 kV

5.1.8 Selection of Potential Transformer (PT)

PT is essentially a step down transformer and steps down the voltage to a known ratio. The primary of PT consists of a large number of turns of fine wire connected across the line. The secondary winding consists of a few turns and provides for measuring instruments and relays a voltage which is known fraction of the line voltage. It is connected right on the point where line is terminated. Voltage transformers are used for measurement of voltage and to provide secondary voltage for protection purposes and measurements.

The ratings of 132 and 33kV voltage transformers are indicated in Tables 5.14 and 5.15 respectively.

Table 5.14 Ratings of 132kV Voltage Transformer

Description	Minimum Requirements
Rated Maximum Voltage	145 kV
Rated Primary Voltage	132/√3 kV
Rated Secondary Voltage (second winding)	0.1/√3 kV
Rated Frequency	50 Hz
Insulation level a) Power Frequency Withstand Voltage (kV RMS for 1 min) b) Impulse Withstand Voltage (1.2/50 µsec) kV Peak	 170 kV 650KV
Power frequency withstand voltage secondary winding (kV RMS for 1 min)	2 kV

Table 5.15 Ratings of 33kV Voltage Transformer

Description	Minimum Requirements
Rated Maximum Voltage	36 kV
Rated Primary Voltage	33/√3 kV
Rated Secondary Voltage (second winding)	0.1/√3 kV
Rated Frequency	50 Hz
Insulation level a) Power Frequency Withstand Voltage (kV RMS for 1 min) b) Impulse Withstand Voltage (1.2/50 µsec) kV Peak	 70 kV 170kV
Power frequency withstand voltage secondary winding (kV RMS for 1 min)	2 kV

5.1.9 Design of Bus Bars

Bus bars are Cu/Al rods of thin walled tubes and operate at constant voltage. The bus-bars are designed to carry normal current continuously. The cross section of conductors is designed on the basis of rated normal current and the following factors:

- System voltage
- Position of sub-station
- Flexibility
- Reliability of supply and cost

Bus bar design must ensure easy and uninterrupted maintenance, avoiding any danger to the operating of operating personnel. It must be simple in design and must possess provision for future extension. Any fluctuation of load must not hinder its mechanical characters.

The buses should be coupled using a bus-coupler which facilitates load transfer while maintenance and fault conditions.

Consider the following data to determine the size of a bus-bar for Addis Center substation

Rated Load Capacity = 250MVA

Voltage = 132kV

The rated current (I_{rated}) of the bus-bar is calculated by equation 3.31

$$I_{Rated} = \frac{S}{\sqrt{3}V} = \frac{250}{\sqrt{3} \cdot 132} = 1.094\, kA \qquad (3.31)$$

So a bus-bar with a current rating of 1.25kA is selected for the 132 kV side.

Rated Load Capacity = 250MVA

Voltage = 33kV

The rated current (I_{rated}) of the bus-bar is calculated by equation 3.32

$$I_{Rated} = \frac{S}{\sqrt{3}V} = \frac{250}{\sqrt{3} \cdot 33} = 4.374\, kA \qquad (3.32)$$

So a bus-bar with a current rating of 5kA is selected for the 33kV side. The ratings of 132 and 33kV bus-bars are indicated in Tables 5.16 and 5.17 respectively.

Table 5.16 Ratings of 132kV Bus-bar

Description	Minimum Requirements
Type of Bus-bar	Copper
Rated Current	1.25 kA
Rated Insulation Voltage	1000 V
Rated Short Time Withstand Current	65 kA
Conductors a) Bar Dimensions b) Cross Sectional Area	 90 mm * 6 mm^2 540 mm^2
Resistance	(0.036 mΩ/m)
Reactance	(0.01 mΩ/m)
Impedance	(0.038 mΩ/m)
Voltage Drop (line to line at Power factor of 0.9)	(0.08 V/m)

Table 5.17 Ratings of 33kV Bus-bar

Description	Minimum Requirements
Type of Bus-bar	Copper
Rated Current	5 kA
Rated Insulation Voltage	1000 V
Rated Short Time Withstand Current	100 kA
Conductors a) Bar Dimensions b) Cross Sectional Area	 2 * 200 mm * 6 mm^2 2400 mm^2
Resistance	(0.0091 mΩ/m)
Reactance	(0.0025 mΩ/m)
Impedance	(0.0094 mΩ/m)
Voltage Drop (line to line at Power factor of 0.9)	(0.08 V/m)

5.1.10 Selection of Insulators

The insulators serve two purposes. They support the conductors (or bus-bars) and confine the current to the conductors. The most commonly used material for the manufacture of insulator is porcelain. There are several types of insulators, and their use in the sub-station will depend upon the service requirement. The main four types of insulators are as follows

- Pin Type Insulators
- Suspension Type Insulators
- Strain Insulators
- Shackle Insulators

As there are two types of insulators in EEPCO's power substation (Post-Type and Suspension) Insulators. The ratings of 132 and 33kV Post-Type Insulators are indicated in Tables 5.18 and 5.19 respectively.

Table 5.18 Ratings of 132kV Post-Type Insulator

Description	Minimum Requirements
Type of Insulators	Porcelain
Installation	Outdoor
Rated Service Voltage	132 kV
Rated Maximum Voltage	145 kV
Rated Frequency	50 Hz
Insulation level a) Power Frequency Withstand Voltage (kV RMS for 1 min) b) Impulse Withstand Voltage (1.2/50 μsec) kV Peak	 170 kV 650 kV

Table 5.19 Ratings of 33kV Post-Type Insulator

Description	Minimum Requirements
Type of Insulators	Porcelain
Installation	Outdoor
Rated Service Voltage	132 kV
Rated Maximum Voltage	145 kV
Rated Frequency	50 Hz
Insulation level a) Power Frequency Withstand Voltage (kV RMS for 1 min) b) Impulse Withstand Voltage (1.2/50 µsec) kV Peak	 170 kV 650 kV

The ratings of 132 and 33kV Suspension Insulators are indicated in Tables 5.20.

Table 5.20 Ratings of 132kV Suspension Insulator

Description	Minimum Requirements
Type of Insulators	Porcelain
Installation	Outdoor
Rated Service Voltage (String)	132 kV
Rated Maximum Voltage (String)	145 kV
Rated Frequency	50 Hz
Insulation level a) Power Frequency Withstand Voltage (kV RMS for 1 min) b) Impulse Withstand Voltage (1.2/50 µsec) kV Peak	 132 kV 130 kV

5.2Operation and Maintenance Improvement Strategies to Addis Ababa Distribution System

Maintenance is an activity involved in maintaining a system or equipment to be in a good working order, to improve the reliability and sustainability of the system or equipment and to extent its life expectancy.

In Addis Ababa distribution system it is appropriate to say corrective maintenance is most practically performed. It is much mandatory to pay much more attention for preventive maintenance to improve random power interruption, sustainability of equipment and to deliver reliable power to the customers.

The communication link between different departments of EEPCO's Addis Ababa region distribution is very weak and this has great influence on the quality of operation and maintenance. It takes substantial time for the complaints to reach the responsible teams too. To have good distribution system with higher reliability establishing an O&M management is a critical component. The management should bind the distinct parts of the program into a consistent entity. The O&M management should contain five very distinct functions like Operations, Maintenance, Engineering, Training, and Administration departments; the integration between the departments is as shown in Figure 5.2.

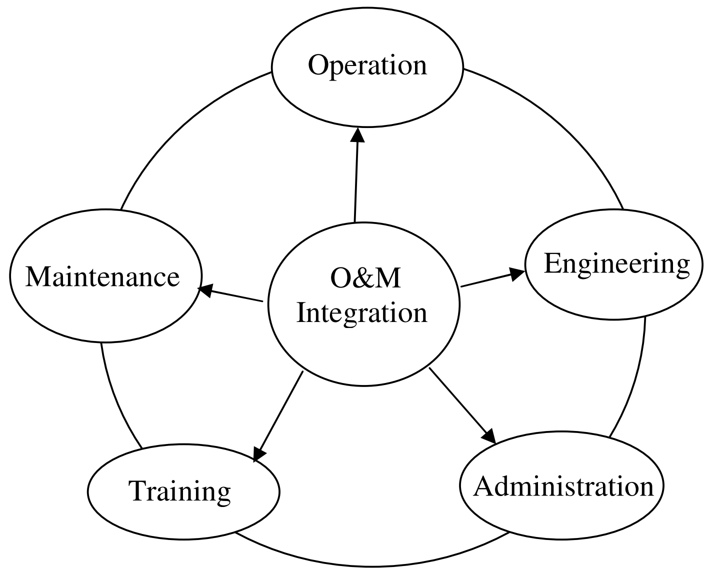

Figure 5.2 Block Diagram that shows O&M Integration to different Departments [41]

The Operations, Maintenance, Engineering, Training, and Administration Departments form a solid O&M organization. The roles and responsibilities for each of the departments are presented below:

1. The Operation Department is required to ensure effective implementation and control of operation activities, ensure efficient, safe, and reliable process operations and to ensure that operator knowledge and performance will support safe and reliable operation.
2. The Maintenance Department is designed to ensure effective implementation and control of maintenance activities, to control the performance of maintenance in an efficient and safe manner such that economical, safe, and reliable operation is optimized and to provide directions, when appropriate, for the performance of work and to ensure that maintenance is performed safely and efficiently.
3. The Engineering Department is designed to ensure effective implementation and control of technical support, to ensure proper design, review, control, implementation, and documentation of equipment design changes in a timely manner, to perform monitoring activities that optimize equipment reliability and efficiency and to ensure that engineer

support procedures and documents provide appropriate direction and that they support the efficiency and safe operations of the equipment.

4. The Training Department is designed ensure effective implementation and control of training activities, to ensure that plant personnel have a basic understanding of their responsibilities and safe work practices and have the knowledge and practical abilities necessary to operate the plant safely and reliably, to ensure the training facilities, equipment, and materials effectively support training activities and to develop and improve the knowledge and skills necessary to perform assigned job functions.
5. The Administration Department is designed to establish and ensure effective implementation of policies and the planning and control of equipment activities, to formulate and utilize formal management objectives to improve equipment performance, o monitor and assess station activities to improve all aspects of equipment performance, to ensure that positions are filled with highly qualified individuals and to achieve a high degree of personnel and public safety.

5.3Reliability Improvement Strategies to Addis Ababa Distribution System

Due to increase in dependence on electricity and the growth of sensitive loads in all customer sectors (residential, commercial and industrial), the utilities must strive to maximize reliability to ensure that customer requirements are satisfied while incurring the lowest possible cost. By knowing the root causes of faults, it is possible to take actions that will prevent faults from occurring, such as performing tree trimming and installing animal guards and surge arresters. Improving component performances by replacing existing components with comparable components that are less prone to failure, e.g., by replacing overhead networks with underground networks or by replacing aged components with new components. Keeping existing components and instead improve component performance by taking preventative maintenance actions, such as introducing and executing inspection and maintenance plans. Employing network structures that are less sensitive to component outages, e.g., meshed networks. Introducing permanent network solutions incorporating such options as automatic reclosing, manual and automatic feeder sectionalizing, automatic feeder fault locating, remote monitoring and control capabilities and emergency supplies from adjacent feeders. Generally there are two possible strategies for reducing frequency and duration of interruptions:

5.3.1 Reduction of the number of faults

The reduction of the interruption frequency is possible by decreasing failure rates of the network component. For example, the reduction of the number of faults in an overhead line can be reached by a tree trimming program, which ensures the clearance distance. This will reduce the failure rate, and increase the system reliability and reduce interruption. A reduction of the number of interruptions leads to lower interruption indices. In summary, the reduction of the number of faults causes a decrease of the frequency of interruptions and unavailability. In the following list, we can find the most important measures for reducing failure rates.

- Preventive maintenance
- Monitoring critical components
- Preventive replacement of components which have reached the end of their useful life
- Isolated or tree wires in overhead lines to prevent tree contact with the conductor
- Tree trimming and periodical trimming of the adjacent vegetation to prevent contact with the conductors
- Protection against animals contact with conductors

5.3.2 Reduction of Time of Interruption

The time of interruption is the time required to restore the power supply. A fault affected zone in the distribution network can be isolated from the healthy part of the network by disconnecting the affected sector. It is important that the switching actions of the restoring process are optimized in order to isolate the smallest possible section of network affected by the fault. This process does not reduce the time interruption in the fault affected zone, but it will provide a substantial improvement in the sector of the network that is not affected by the fault. Furthermore automated sectioning points will provide a more timely restoration of the power supply. If the restoration of the supply takes place in less than three minutes, the interruption is not considered as long interruption. Time reduction of the time processes lead to a reduction in the unavailability indices, but do not show effects on interruption frequency.

The following list shows some of the most important measures for reducing the time of interruption:

- Distribution network atomization
- System reconfiguration after the fault
- Fault current detection in order to localize the fault in the network
- Faster crew response due to the implementation of an outage management system, travel time coordination and an increased number of crews and dispatch centers

CHAPTER SIX

DISCUSSION, CONCLUSION AND RECOMMENDATION

DISCUSSION

This thesis has illustrated serious reliability problem of Addis Ababa distribution system and recommended possible ways of solutions for the problems identified. These have been done through detail gathered and analyzed data obtained from the distribution substations. This thesis work has discussed reliability, design and operation and maintenance of Addis Ababa distribution system.

Reliability and design practice for Addis Ababa distribution system

A study has been conducted thoroughly on the performance and design practice of the Addis Ababa distribution system to identify causes for power interruptions.

The thesis work has been conducted with field observation and data collection. The collected data are a recorded data that includes peak load, type of faults, frequency and duration of interruption of all medium voltage (15kV) outgoing feeders of the distribution system.

It is found that over-loading, earth fault and short circuits are the major cause of interruptions in the distribution systems. It was found that some transformers are over loaded and not yet protected from the faults. Most of the interruptions reside from the transformer and related accessories like HRC fuses, oil and drop out fuse. The other most frequent cause of outage is earth fault that arises due to trees and structures in touch with hot lines of 15kV lines (i.e. clearance problem) which is called transient earth fault.

It has been identified that the Addis Ababa region distribution substations are overloaded and it has to be expanded to accommodate the increasing demands. The power factor for the Addis Centre distribution substation is also low in general. This study recommends the use of regulators and compensators for reactive power correction.

From the analysis, it is observed that majority (64.35%) of the faults in Addis Ababa region distribution network are due to short circuit, earth fault and over load. The remaining faults are due to black out, operation and system over load (when generated power is below the total demand other than black out).

The thesis work discusses the performance, design, reliability and O&M of Addis Ababa distribution system thoroughly to identify causes for power interruptions and customer dissatisfaction. In this thesis work a detailed analysis on the performance and design practice of Addis Ababa distribution system have been carried out.

Reliability indices analysis for Addis Ababa distribution system

The frequency of interruption and duration for Addis Ababa region distribution system for 12 Months are analyzed and interpreted. Based the analyzed and interpreted frequency and duration of interruption a distribution reliability indices (SAIFI, SAIDI, CAIDI, and ASAI) calculation and analysis have been discussed thoroughly. The analyzed and calculated distribution reliability indices values have been compared with standard benchmark values.

From the calculation and analysis considered in reliability evaluation of Addis Center distribution system feeder ADC-09 has an average value of SAIDI=252 minutes, SAIFI=3.65 interruptions/customer, CAIDI=2280 minutes and ASAI=99.425 %. Whereas the corresponding values in a Germany standard are 23 minutes, 0.5 interruptions/customer, 112 minutes and 99.97% respectively.

A lower number for SAIFI, SAIDI and CAIDI indicates better reliability performance; i.e., a lower frequency of outages or shorter outage duration. A higher number indicates worse performance. Comparing the average SAIDI, SAIFI and CAIDI value of feeder ADC-09 of Addis Center distribution with the benchmarks is high this shows that feeder ADC-09 has worse performance.

A higher percentage (approaching to 100%) for ASAI indicates better reliability performance; i.e., a typical customer expects to have power at all times. A lower percentage indicates worse performance. Comparing the average ASAI value of feeder ADC-09 of Addis Center distribution with the benchmarks is low this shows that feeder ADC-09 has worse performance.

Operation and Maintenance Improvement Strategies for Addis Ababa Distribution System

Maintenance is an activity involved in maintaining a system or equipment to be in a good working order, to improve the reliability and sustainability of the system or equipment and to extent its life expectancy.

In Addis Ababa distribution system it is appropriate to say corrective maintenance is most practically performed. It is much mandatory to pay much more attention for preventive maintenance to improve random power interruption, sustainability of equipment and to deliver reliable power to the customers.

The communication link between different departments of EEPCO's Addis Ababa region distribution is very weak and this has great influence on the quality of operation and maintenance. It takes substantial time for the complaints to reach the responsible teams too.

The study has discussed the measures to be taken in terms of operation and maintenance tasks to improve the serious reliability problem of Addis Ababa distribution system.

Addis Center Distribution Substation Design

It has been identified that the Addis Ababa region distribution substations are overloaded and it has to be expanded to accommodate the increasing demands. A design of 250MVA, 132/33kV distribution substation for Addis Center distribution system is carried out to upgrade the existing 63MVA, 132/15kV distribution substation.

The design includes:

- Selection of Transformers
- Selection of Transformer feeders
- Earthing/Grounding
- Selection of Circuit Breakers
- Selection of Surge Arrestors
- Selection of Isolators
- Selection of Current Transformer (CT)
- Selection of Potential Transformer (PT)
- Design of Bus Bars
- Selection of Insulators

The study closes with relevant conclusions and strong recommendations that can be of use for the performance improvement of the distribution system.

CONCLUSION

The aim of this thesis is to identify causes of interruptions and suggest possible solutions to the Addis Ababa distribution system. Furthermore in this thesis work a study and evaluation of the reliability and design of Addis Ababa power distribution system is conducted. The collected data for Addis Ababa region distribution network was analyzed in detail to evaluate the reliability of the design, operation, maintenance and reliability of Addis Ababa region distribution.

From the substations fault record, it is concluded that most of the failures in the distribution system are due to short circuits, earth fault, over load, operation and system over load (i.e. when generated power is below the total demand other than blackout.

The Addis center feeder ADC-09 reliability indices (SAIDI, SAIFI, CAIDI and ASAI) for five months (September 2013 to January 2014) have been calculated, analyzed and results have been presented in this thesis. The calculated results for SAIDI, SAIFI, CAIDI and ASAI are compared with benchmarks which verified EEPCO's distribution grid is noncompliance with standards.

Furthermore, three potential solutions for the improvement of the reliability of the distribution system have been considered. The proposed solutions are design solution, operation and maintenance and reliability improvement strategy to Addis Ababa distribution system and have been further discussed in detail.

RECOMMENDATION

Based on this thesis work the following recommendations are drawn

- The corporation has to better focus on improving the customer's satisfaction by installing equipments based on their ratings.
- It is strongly recommend that EEPCO has to use proper rated HRC fuses to protect the transformers from overload-damage and to improve the maintenance operation.
- The corporation has little experience in documentation of performance data for the distribution feeders especially for secondary distribution network. It is therefore, strongly recommended that the corporation should improve data documentation, so that the reliability problems can be identified easily and solutions can be suggested as well.
- It is recommended to convert radial networks to ring network for improving reliability, at least for high-priority customers.
- It is recommended to maintain all design documentations for the distribution substations including single line diagrams, as these are not available currently. All feeders are missed therefore it is better the design should present single line diagrams for all feeders with their distribution transformer.
- For better distribution reliability it is also recommended to consider the use underground cables for low voltages feeders.
- It is also important to give due attention for preventive maintenance to improve random power interruption, sustainability of equipment and to deliver reliable power to the customers.
- As research done on the Addis Ababa distribution systems is limited, it is important to make subsequent detailed studies to solve the distribution problems:
    - ✓ on design aspect of the distribution system
    - ✓ technical and none technical losses
    - ✓ maintenance optimization for the distribution Systems
    - ✓ reliability study of the distribution system
    - ✓ distribution automation separately by different researchers

EFERENCES

[1] **Stephen W. Fardo, Dale R. Patrick,** Electrical Power Systems Technology, Third Edition, The Fairmont Press, Inc., United States of America, 2009

[2] **Anthony J. Pansini,** Guide to Electrical Power Distribution Systems, the Fairmont Press, Inc. 2005

[3] **W.L. Kling,** Intelligent Distribution Network Design; ISBN: 978-90-386-1974-3 Printed by JP Tamminga, Duiven, 2009

[4] **Turan Gonen,** Electrical Power Distribution System Engineering, United States of America, McGraw-Hill Series in Electrical Engineering, 1986

[5] **Lingyun Wang,** Feeder Performance Analysis with Distributed Algorithm, Virginia Polytechnic Institute and State University Blacksburg, Virginia, 2011

[6] **H. Mokhtari, et al,** Power Quality Survey in a Distribution System, Standard Procedures and Limitations, Sharif University of Technology, Azadi Ave., Tehran, Iran

[7] **Josnicjusz Nazarko,** Modeling of Electrical Power Distribution Systems by Application of Experimental Design, IEEE, University of Finance and Management, Bialystok, Poland, 2000

[8] **E.T.N,** Power Distribution Systems, Sheet 01004, 2011

[9] **Mustafa Aziz,** Modern Power Distribution Systems for Utilities, Haward Technology Middle East, QAF011 Rev. 04, (2006),

[10] **Abdelhay A., et al**, Electric Distribution Systems, John Wiley & Sons, Inc., Hoboken, New Jersey, 2011

[11] **Abera Jote,** Power Quality Analysis, Mitigation Design and Simulation of Ethiopian Sugar Factory: Case Study of Mathara, Addis Ababa Institute of Technology, Addis Ababa, Ethiopia, 201)

[12] **Bhim Singh, Kamal Al-Haddad,** a Review of Active Filters for Power Quality Improvement, IEEE TRANSACTIONS ON INDUSTRIAL ELECTRONICS, VOL. 46, NO. 5, 1999

[13] **R. C. Settembrini, et al,** Reliability and Quality Comparisons of Electric Power Distribution Systems, IEEE Consolidated Edison Co. of New York, Inc., 1991

[14] **S.Khalid1 & Bharti Dwivedi,** Intelligent Power Quality Issues, Problems, Standards & Their Effects in Industry with Corrective Means; ISSN: 2231-1963, International Journal of Advances in Engineering & Technology, ©IJAET Lucknow, India, 2011

[15] **Shah M. Mehryoon,** Analysis and Comparison of Power Loss and Voltage Drop of 15 kV and 20 kV Medium Voltage Levels in the North Substation of the Kabul Power Distribution System by CYMDIST, Russ College of Engineering and Technology, 2009

[16] **Hasham Khan,** Power Quality Improvement of Distribution System with Dispersed Generation Using Novel Algorithm for Detection and Control of Islanding Process, University of Engineering and Technology Taxila, 2009

[17] **Gerd Kjolle, et al,** an Analytical approach for Distribution System Reliability

Assessment, IEEE Transactions on Power Delivery, Vol. 7, No. 2, 2009

[18] **S. Herraiz, et al,** Application for Fault Location in Electrical Power Distribution Systems, Institute of Computer Science and Applications University of Girona, Girona, Spain, 2007

[19] **Nexant,** Performance Benchmarks for Electricity Distribution Companies in South Asia, USAID SARI/Energy Program, 2004

[20] **Goran Granić,** Energy Sector Study in BIH, BHP3-EES-TEPRP-Q-04/05 WB, Bosnia and Herzegovina, 2008

[21] **P. S. Nagendra Rao and Ravishankar Deekshit,** Energy Loss Estimation in Distribution Feeders, IEEE Transactions on Power Delivery, VOL. 21, NO. 3, JULY 2006

[22] **Departments of the ARMY, and the AIR Force,** Electrical Power Supply and Distribution, ARMY TM 5-811-1 AIR FORCE AFJMAN 32-1080, 1995

[23] **Doeg Rodriguez Sanabria,** Comparative Framework for Service Reliability in Electric Distribution Systems, MSc. Thesis, University Of Puerto Rico, Mayaguez Campus, 2005

[24] **Transmission and Distribution Committee,** IEEE Guide for Electric Power Distribution Reliability Indices, IEEE Std 1366™-2003, the Institute of Electrical and Electronics Engineers, Inc., 3 Park Avenue, New York, NY 10016-5997, USA, 2004

[25] **Tempa Dorji,** Reliability Assessment of Distribution Systems, Including a case Study on Wangdue Distribution System in Bhutan, MSc. Thesis, Department of Electrical Power Engineering, Norwegian University of Science and Technology, 2009

[26**] Binendra Shakya,** Repair Duration Effects on Distribution System Reliability Indices and Customer Outage Costs, MSc. Thesis, Department of Electrical and Computer Engineering, University of Saskatchewan Saskatoon, Saskatchewan, Canada, 2012

[27] **Joel Auernheimer,** New Methods for Power Distribution System Design and Analysis, Electronic Components and Technology Conference, IEEE0-7803-8365-6/04, 2004

[28] **John Z. Gibson, et al,** Electric Secondary Distribution Modeling and Load Characterization, IEEE 978-1-4244-1726-1/07, 2007

[29] **Smarajit Ghosh, Uttamjit Singh Chhatwal,** Enhancement of Loading of Radial Distribution Networks Using Optimal Conductor Size, International Journal of Computer and Electrical Engineering, Vol. 1, No. 2, June 2009

[30] **T. Lantharthong, N. Phanthuna,** Techniques for Reliability Evaluation in Distribution System Planning, World Academy of Science, Engineering and Technology, 2012

[31] **E. Ghiani, et al,** Distribution System Reliability Assessment Considering Equipment Ageing, Department of Electrical and Electronic Engineering, University of Cagliari, Italy, 2007

[32] **Srete Nikolovski, et al,** Reliability Assessment of Distribution Networks Using Sequential Monte Carlo Simulation, 18th International Conference on Electricity Distribution, Turin, 2005

[33] **Nisha R. et al,** Time Sequential Monte Carlo Simulation for Evaluation of Reliability Indices of Power Distribution System, Department of Electrical Engineering, PVG'sCOET and BSCOER, Pune University, Pune, India, 2012

[34] **Jianbiao,** Urban Distribution Network Planning and Design Specifications, China, 2007

[35] **Hui Zheng,** Investigation of Power System Blackouts and Reliability Improvement for Power Distribution Systems, Doctor of Philosophy, University of Texas at Arlington, 2007

[36] **Stephen W. Fardo, Dale R. Patrick,** Electrical Power Systems Technology, Third Edition, the Fairmont Press, Inc., United States of America, 2009

[37] **Anthony J. Pansini,** Guide to Electrical Power Distribution Systems, the Fairmont Press, Inc. 2005

[38] **W.L. Kling,** Intelligent Distribution Network Design; ISBN: 978-90-386-1974-3 Printed by JP Tamminga, Duiven, 2009

[39] **Turan Gonen,** Electrical Power Distribution System Engineering, United States of America, McGraw-Hill Series in Electrical Engineering, 1986

[40] **e.on Central Networks,** Primary Network Design Manual, Central Networks plc, 2007

[41] **Patrik Hilber,** Maintenance Optimization for Power Distribution Systems, Doctoral, 2008

[42] **EEPCO**, Ethiopian Electric Power Corporation, 2004

[43] **EEPCO**, Policy and Procedure for Distribution Plan and Design Sub Process, 2007

[44] **Council of European Energy Regulators ASBL.**, 4th Benchmarking Report on the Quality of Electricity Supply. Brussels, 2008

[45] **EEPCO**, Excerpts from the Power System Master Plan, 2007

[46] **Inna Baleva,** Substation Grounding, Department of Electrical and Electronic Engineering, California State University, Sacramento, 2012

[47] **Greg Rouse and John Kelly**, Electricity Reliability: Problems, Progress and Policy Solutions, Galvin Electricity Initiative, 2011

[48] **Powertech**, Cables Facts and Figures, Aberdare, 2007

[49] **Dwarka Prasad, H.C. Sharma**, Significance of step and Touch Voltages, International Journal of Soft Computing and Engineering (IJSCE) ISSN: 2231-2307, Volume-1, Issue-5, November 2011

APPENDIX A

Questionnaire on Addis Ababa power distribution network

The purpose of this document is to provide an outline of preliminary information that will be used by the thesis work done in the Department of Electrical and Computer Engineering, Addis Ababa Institute of Technology, Addis Ababa University.

1. Number of customers with their demand

Type	Number	Demand in (MW)
Residential		
Commercial		
Industrial		
Street lighting		

2 How many substations exist in Addis Ababa power distribution system? ____________________________

6. What is the total capacity of the substations existing in Addis Ababa's power distribution system in MVA? ________________________
7. How much is the existing peak load (demand) in Addis Ababa (in MW)? ____________
8. What types of primary distribution voltage levels exist in Addis Ababa's distribution network?
9. What standards for the distribution system EEPCO is using?
   a) IEEE and ANSI b) Institute of Electromechanical Commission (IEC)
10. What types of MV primary distribution network exist? (If possible put it in %)

a) Overhead network
b) Underground cable
c) Mixed network

11. What types of MV primary distribution network topology exist?
    a. Radial system
    b. Open ring system
    c. Closed ring system
    d. Dual ring system
    e. Multiradial system
    f. If other specify ___________________________________
12. Outgoing feeder profile
    a. Total feeder conductor length (km) ____________________________
    b. Feeder cross section area (mm^2) ____________________________
    c. Load (MVA) ____________________________
    d. Number of distribution transformers per feeder ___________________
13. What types of LV secondary distribution network exist? (If possible put it in %)
    a. Overhead network
    b. Underground cable

c. Mixed network

14. What types of LV secondary distribution network topology exist?
    a. Radial system
    b. Open ring system
    c. Closed ring system
    d. Dual ring system
    e. Multiradial system
    f. If other specify ___________________________________
15. What is the standard LV level exists in Addis Ababa's distribution system?
    a) 400/230 V b) 380/220 V c) 208/120 V d) 416/240 V e) 110/190 V
16. Which distribution system layout EEPCO is using?
    a) North American system b) European system c) If other specify _________________
17. What are the most causes of power interruptions in the Addis Ababa's power distribution system?
    ____
    ____
    ____
    ____
    ____
    ____
    ____
    ____
    ____
18. If you have any other requirements or comments please enter them here.

Thank you for taking the time to complete this questionnaire.

APPENDIX B

<u>Sample Feeder Fault Types in Addis Ababa Region Distribution for the Month of December 2013</u>

FEEDER NAME	DATE	INT. TIME	REC. TIME	DUR TIME	Dur(Hr)	TYPE OF FAULT	FAULT REASON
SEB-II-03	4/1/2006	9:50	9:55	0:05	0.083333	OPERATION	BYREQUEST
ADC-09	4/1/2006	0:10	2:20	2:10	2.166667	OPERATION	BYREQUEST
ADC-08	4/1/2006	5:45	8:10	2:25	2.416667	OPERATION	BYREQUEST
ADC-10	4/1/2006	5:45	8:10	2:25	2.416667	OPERATION	BYREQUEST
ADC-14	4/1/2006	5:45	8:10	2:25	2.416667	OPERATION	BYREQUEST
LEG-03	4/1/2006	6:50	6:52	0:02	0.033333	TRANSIENT	EARTHFAULT
COT-04	4/1/2006	7:25	9:50	2:25	2.416667	PERMANENT	SHORT CIRCUIT
GOFA-06	4/1/2006	7:45	7:47	0:02	0.033333	TRANSIENT	EARTHFAULT
KAL-I-F13	4/1/2006	9:30	12:20	2:50	2.833333	SOL	SOL
SUL-06	4/1/2006	9:30	12:30	3:00	3	SOL	SOL
KAL-II-02	4/1/2006	9:30	12:15	2:45	2.75	SOL	SOL
SUL-08	4/1/2006	11:00	12:35	1:35	1.583333	SOL	SOL
ADE-02	4/1/2006	11:00	12:20	1:20	1.333333	SOL	SOL
KAL-II-01	4/1/2006	11:00	12:20	1:20	1.333333	SOL	SOL
COT-33	4/1/2006	11:15	12:30	1:15	1.25	SOL	SOL
SUL-07	4/1/2006	11:15	12:35	1:20	1.333333	SOL	SOL
KAL-N-K2	4/1/2006	11:15	12:15	1:00	1	SOL	SOL
SEB-07	4/1/2006	9:55	9:59	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
ADC-09	4/1/2006	10:10	13:10	3:00	3	TRAFO	OVER LOAD
GEF-01	4/1/2006	11:50	13:10	1:20	1.333333	TRAFO	OVER LOAD
SEB-07	4/1/2006	10:15	10:20	0:05	0.083333	OUTGOING FEEDER	OVER LOAD
ADC-15	4/1/2006	10:25	10:27	0:02	0.033333	TRANSIENT	EARTHFAULT
GOFA-04	4/1/2006	10:50	10:52	0:02	0.033333	TRANSIENT	EARTHFAULT
LEG-03	4/1/2006	11:45	14:30	2:45	2.75	PERMANENT	SHORT CIRCUIT
LEG-03	4/1/2006	14:40	16:00	1:20	1.333333	OPERATION	BYREQUEST
ADC-15	4/1/2006	12:50	13:00	0:10	0.166667	OPERATION	BYREQUEST
LEG-08	4/1/2006	13:05	13:07	0:02	0.033333	TRANSIENT	EARTHFAULT
MEK-05	4/1/2006	14:45	14:55	0:10	0.166667	PERMANENT	SHORT CIRCUIT
ADC-16	4/1/2006	14:55	15:05	0:10	0.166667	OPERATION	BYREQUEST
SEB-II-03	4/1/2006	15:05	15:07	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-07	4/1/2006	15:50	15:54	0:04	0.066667	OUTGOING	OVER LOAD

						FEEDER	
ADE-05	4/1/2006	16:00	16:02	0:02	0.033333	TRANSIENT	EARTHFAULT
ADW-04	4/1/2006	16:20	16:22	0:02	0.033333	TRANSIENT	EARTHFAULT
GEF-02	4/1/2006	18:25	20:15	1:50	1.833333	TRAFO	OVER LOAD
GOFA-03	4/1/2006	18:35	20:40	2:05	2.083333	TRAFO	OVER LOAD
WER-08	4/1/2006	18:40	19:45	1:05	1.083333	TRAFO	OVER LOAD
SEB-09	4/1/2006	18:30	19:30	1:00	1	SOL	SOL
SEB-07	4/1/2006	18:30	19:25	0:55	0.916667	SOL	SOL
ADW-03	4/1/2006	18:30	20:00	1:30	1.5	SOL	SOL
MEK-06	4/1/2006	18:40	20:00	1:20	1.333333	SOL	SOL
MEK-01	4/1/2006	18:45	19:30	0:45	0.75	SOL	SOL
GOFA-06	4/1/2006	18:45	20:00	1:15	1.25	SOL	SOL
ADC-04	4/1/2006	19:25	19:29	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
ADC-09	4/1/2006	19:45	20:25	0:40	0.666667	OUTGOING FEEDER	OVER LOAD
BELLA-03	4/1/2006	20:00	21:00	1:00	1	PERMANENT	SHORT CIRCUIT
KAL-I-F3	4/1/2006	21:30	21:45	0:15	0.25	OPERATION	BYREQUEST
LEG-03	4/1/2006	22:45	22:47	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
LEG-08	4/1/2006	22:45	16:40	17:55	17.91667	PERMANENT	SHORT CIRCUIT
ADC-07	4/2/2006	5:29	8:10	2:41	2.683333	OPERATION	BYREQUEST
ADC-11	4/2/2006	5:29	8:10	2:41	2.683333	OPERATION	BYREQUEST
GOFA-05	4/2/2006	6:45	10:10	3:25	3.416667	PERMANENT	SHORT CIRCUIT
GOFA-05	4/2/2006	11:10	12:00	0:50	0.833333	OPERATION	BYREQUEST
WER-06	4/2/2006	6:55	6:59	0:04	0.066667	PERMANENT	SHORT CIRCUIT
SUL-01	4/2/2006	7:35	7:37	0:02	0.033333	TRANSIENT	EARTHFAULT
COT-33	4/2/2006	7:45	7:47	0:02	0.033333	TRANSIENT	EARTHFAULT
AKAK-I-02	4/2/2006	7:50	7:52	0:02	0.033333	TRANSIENT	EARTHFAULT
AKAK-II-06	4/2/2006	7:51	7:53	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
WER-06	4/2/2006	7:55	7:57	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
WER-04	4/2/2006	8:35	10:50	2:15	2.25	PERMANENT	EARTHFAULT
WER-05	4/2/2006	10:35	10:50	0:15	0.25	OPERATION	BYREQUEST
SEB-07	4/2/2006	8:35	8:37	0:02	0.033333	OUTGOING FEEDER	OVER LOAD
ADC-07	4/2/2006	8:40	8:42	0:02	0.033333	TRANSIENT	EARTHFAULT
WER-05	4/2/2006	9:05	9:07	0:02	0.033333	TRANSIENT	EARTHFAULT
KAL-N-K4	4/2/2006	9:15	9:40	0:25	0.416667	OPERATION	BYREQUEST
SEB-07	4/2/2006	10:00	10:04	0:04	0.066667	OUTGOING FEEDER	OVER LOAD

SEB-II-03	4/2/2006	10:05	10:07	0:02	0.033333	TRANSIENT	EARTHFAULT
BELLA-02	4/2/2006	10:35	11:10	0:35	0.583333	OPERATION	BYREQUEST
MEK-01	4/2/2006	10:40	10:50	0:10	0.166667	OPERATION	BYREQUEST
AKAK-II-07	4/2/2006	10:55	11:55	1:00	1	PERMANENT	SHORT CIRCUIT
AKAK-II-02	4/2/2006	11:25	11:55	0:30	0.5	OPERATION	BYREQUEST
ADC-05	4/2/2006	10:55	13:00	2:05	2.083333	TRAFO	OVER LOAD
LEG-03	4/2/2006	10:55	11:30	0:35	0.583333	PERMANENT	SHORT CIRCUIT
SUL-02	4/2/2006	11:20	11:22	0:02	0.033333	TRANSIENT	EARTHFAULT
ADN-01	4/2/2006	11:10	11:25	0:15	0.25	OPERATION	BYREQUEST
SEB-07	4/2/2006	11:20	12:00	0:40	0.666667	OUTGOING FEEDER	OVER LOAD
LEG-04	4/2/2006	12:10	12:55	0:45	0.75	OPERATION	BYREQUEST
ADW-04	4/2/2006	12:35	12:40	0:05	0.083333	OPERATION	BYREQUEST
GEF-01	4/2/2006	12:55	18:30	5:35	5.583333	PERMANENT	SHORT CIRCUIT
GEF-02	4/2/2006	12:55	18:30	5:35	5.583333	OPERATION	BYREQUEST
ADC-15	4/2/2006	13:10	13:12	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADN-03	4/2/2006	13:00	13:45	0:45	0.75	PERMANENT	SHORT CIRCUIT
ADN-03	4/2/2006	20:00	20:20	0:20	0.333333	OPERATION	BYREQUEST
GEF-02	4/2/2006	15:05	16:20	1:15	1.25	PERMANENT	SHORT CIRCUIT
GEF-02	4/2/2006	16:22	19:00	2:38	2.633333	OPERATION	BYREQUEST
GEF-01	4/2/2006	16:22	19:00	2:38	2.633333	OPERATION	BYREQUEST
AKAK-I-TTL	4/2/2006	15:30	15:32	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
GOFA-05	4/2/2006	15:40	15:42	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
AKAK-II-07	4/2/2006	15:45	15:47	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-07	4/2/2006	15:05	15:09	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
AKAK-II-06	4/2/2006	16:50	17:05	0:15	0.25	OPERATION	BYREQUEST
BELLA-05	4/2/2006	17:00	17:40	0:40	0.666667	OPERATION	BYREQUEST
SUL-01	4/2/2006	17:10	17:40	0:30	0.5	OPERATION	BYREQUEST
ADN-01	4/2/2006	17:10	17:40	0:30	0.5	OPERATION	BYREQUEST
KAL-N-K4	4/2/2006	17:20	17:22	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-II-03	4/2/2006	18:15	18:17	0:02	0.033333	TRANSIENT	EARTHFAULT
GOFA-04	4/2/2006	18:30	19:25	0:55	0.916667	SOL	SOL
SEB-06	4/2/2006	18:30	19:50	1:20	1.333333	SOL	SOL
ADW-06	4/2/2006	18:30	19:35	1:05	1.083333	SOL	SOL
SEB-03	4/2/2006	18:30	19:20	0:50	0.833333	SOL	SOL
LEG-04	4/2/2006	18:30	18:32	0:02	0.033333	TRANSIENT	SHORT CIRCUIT

LEG-08	4/2/2006	18:30	18:32	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
WER-08	4/2/2006	18:45	20:30	1:45	1.75	TRAFO	OVER LOAD
GEF-04	4/2/2006	18:45	20:30	1:45	1.75	TRAFO	OVER LOAD
ADN-06	4/2/2006	18:50	20:05	1:15	1.25	TRAFO	OVER LOAD
GEF-07	4/2/2006	18:45	18:49	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
SEB-07	4/2/2006	18:45	18:49	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
ADC-09	4/2/2006	18:50	20:05	1:15	1.25	OUTGOING FEEDER	OVER LOAD
GEF-07	4/2/2006	18:55	20:35	1:40	1.666667	OUTGOING FEEDER	OVER LOAD
SEB-04	4/2/2006	19:00	19:04	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
GOFA-05	4/2/2006	19:10	19:14	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
SEB-03	4/2/2006	19:40	19:44	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
SEB-02	4/2/2006	20:05	20:30	0:25	0.416667	TRAFO	OVER LOAD
ADC-09	4/2/2006	20:20	20:24	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
ADC-09	4/2/2006	20:30	21:00	0:30	0.5	OUTGOING FEEDER	OVER LOAD
GEF-07	4/2/2006	20:45	21:05	0:20	0.333333	OUTGOING FEEDER	OVER LOAD
MEK-05	4/2/2006	21:00	21:05	0:05	0.083333	PERMANENT	SHORT CIRCUIT
ADN-03	4/2/2006	21:35	22:15	0:40	0.666667	OPERATION	BYREQUEST
ADC-14	4/3/2006	4:20	6:25	2:05	2.083333	PERMANENT	SHORT CIRCUIT
WER-05	4/3/2006	5:30	5:32	0:02	0.033333	TRANSIENT	EARTHFAULT
COT-33	4/3/2006	5:30	5:32	0:02	0.033333	TRANSIENT	EARTHFAULT
AKAK-II-03	4/3/2006	6:35	8:10	1:35	1.583333	OPERATION	BYREQUEST
AKAK-II-07	4/3/2006	6:35	8:10	1:35	1.583333	OPERATION	BYREQUEST
GEF-07	4/3/2006	6:55	6:59	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
GEF-07	4/3/2006	7:00	7:04	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
SEB-II-03	4/3/2006	7:05	7:07	0:02	0.033333	TRANSIENT	EARTHFAULT
BELLA-03	4/3/2006	7:15	9:20	2:05	2.083333	PERMANENT	SHORT CIRCUIT
BELLA-01	4/3/2006	8:05	9:35	1:30	1.5	PERMANENT	SHORT CIRCUIT
ADN-02	4/3/2006	8:10	8:12	0:02	0.033333	TRANSIENT	EARTHFAULT
KAL-II-05	4/3/2006	8:20	8:50	0:30	0.5	PERMANENT	SHORT CIRCUIT
KAL-I-F13	4/3/2006	8:55	9:35	0:40	0.666667	PERMANENT	SHORT CIRCUIT

KAL-I-F13	4/3/2006	9:55	10:40	0:45	0.75	OPERATION	BYREQUEST
KAL-N-K4	4/3/2006	9:00	10:45	1:45	1.75	PERMANENT	SHORT CIRCUIT
NIF-01	4/3/2006	9:05	9:10	0:05	0.083333	OPERATION	BYREQUEST
GOFA-05	4/3/2006	9:10	9:30	0:20	0.333333	OPERATION	BYREQUEST
WER-09	4/3/2006	9:10	9:12	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
AKAK-II-07	4/3/2006	9:30	9:32	0:02	0.033333	TRANSIENT	EARTHFAULT
ADN-03	4/3/2006	9:35	9:37	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
AKAK-II-07	4/3/2006	9:50	10:10	0:20	0.333333	PERMANENT	SHORT CIRCUIT
WER-04	4/3/2006	10:05	10:07	0:02	0.033333	TRANSIENT	EARTHFAULT
COT-05	4/3/2006	10:07	10:35	0:28	0.466667	OPERATION	BYREQUEST
ADW-06	4/3/2006	10:15	10:17	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-07	4/3/2006	10:35	10:39	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
MEK-05	4/3/2006	10:35	10:45	0:10	0.166667	OPERATION	BYREQUEST
COT-03	4/3/2006	10:35	10:50	0:15	0.25	OPERATION	BYREQUEST
GOFA-03	4/3/2006	10:40	10:55	0:15	0.25	OPERATION	BYREQUEST
AKAK-II-07	4/3/2006	10:55	11:55	1:00	1	PERMANENT	SHORT CIRCUIT
AKAK-II-02	4/3/2006	12:40	12:50	0:10	0.166667	OPERATION	BYREQUEST
ADC-07	4/3/2006	11:00	12:05	1:05	1.083333	TRAFO	OVER LOAD
WER-08	4/3/2006	11:17	11:19	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
NIF-01	4/3/2006	11:34	12:05	0:31	0.516667	OPERATION	BYREQUEST
AKAK-I-03	4/3/2006	11:47	11:49	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADN-04	4/3/2006	12:20	12:40	0:20	0.333333	OPERATION	BYREQUEST
ADN-03	4/3/2006	12:40	12:42	0:02	0.033333	TRANSIENT	EARTHFAULT
MEK-05	4/3/2006	11:55	12:08	0:13	0.216667	OPERATION	BYREQUEST
GEF-01	4/3/2006	14:40	14:55	0:15	0.25	OPERATION	BYREQUEST
SEB-07	4/3/2006	13:20	13:24	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
GEF-04	4/3/2006	14:47	14:55	0:08	0.133333	OPERATION	BYREQUEST
SEB-03	4/3/2006	15:00	16:55	1:55	1.916667	PERMANENT	SHORT CIRCUIT
SEB-03	4/3/2006	19:00	20:15	1:15	1.25	OPERATION	BYREQUEST
ADC-15	4/3/2006	15:28	15:30	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADW-04	4/3/2006	15:35	15:45	0:10	0.166667	OPERATION	BYREQUEST
NIF-02	4/3/2006	15:55	15:57	0:02	0.033333	TRANSIENT	EARTHFAULT
NIF-03	4/3/2006	16:00	17:30	1:30	1.5	PERMANENT	SHORT CIRCUIT
NIF-03	4/3/2006	17:30	17:50	0:20	0.333333	OPERATION	BYREQUEST

AKAK-I-01	4/3/2006	16:30	16:45	0:15	0.25	OPERATION	BYREQUEST
SEB-II-03	4/3/2006	17:05	17:07	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
LEG-08	4/3/2006	17:20	17:22	0:02	0.033333	TRANSIENT	EARTHFAULT
GEF-04	4/3/2006	18:15	20:15	2:00	2	OUTGOING FEEDER	OVER LOAD
SUL-03	4/3/2006	18:30	18:32	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
WER-07	4/3/2006	17:50	20:20	2:30	2.5	OUTGOING FEEDER	OVER LOAD
GOFA-02	4/3/2006	18:54	19:25	0:31	0.516667	OUTGOING FEEDER	OVER LOAD
ADC-09	4/3/2006	19:05	19:09	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
GOFA-03	4/3/2006	19:25	20:40	1:15	1.25	TRAFO	OVER LOAD
LEG-08	4/3/2006	20:05	20:10	0:05	0.083333	PERMANENT	SHORT CIRCUIT
LEG-08	4/3/2006	21:24	21:32	0:08	0.133333	OPERATION	BYREQUEST
SUL-07	4/3/2006	21:10	21:12	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
MEK-05	4/3/2006	22:00	22:02	0:02	0.033333	TRANSIENT	EARTHFAULT
SUL-07	4/3/2006	23:30	23:32	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADN-02	4/3/2006	23:55	6:45	6:50	6.833333	OPERATION	BYREQUEST
ADN-06	4/3/2006	23:55	6:45	6:50	6.833333	OPERATION	BYREQUEST
MEK-TTL	4/4/2006	0:15	8:05	7:50	7.833333	OPERATION	BYREQUEST
GEF-07	4/4/2006	9:45	9:47	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEB-09	4/4/2006	5:00	6:35	1:35	1.583333	PERMANENT	SHORT CIRCUIT
SEB-09	4/4/2006	6:37	6:45	0:08	0.133333	OPERATION	BYREQUEST
ADC-07	4/4/2006	5:05	8:15	3:10	3.166667	OPERATION	BYREQUEST
WER-12	4/4/2006	5:10	7:20	2:10	2.166667	OPERATION	BYREQUEST
SUL-06	4/4/2006	6:10	6:40	0:30	0.5	OPERATION	BYREQUEST
BELLA-02	4/4/2006	6:45	6:47	0:02	0.033333	TRANSIENT	EARTHFAULT
ADN-06	4/4/2006	8:10	8:12	0:02	0.033333	TRANSIENT	EARTHFAULT
COT-02	4/4/2006	8:15	8:17	0:02	0.033333	TRANSIENT	EARTHFAULT
WER-04	4/4/2006	8:35	8:37	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
WER-08	4/4/2006	8:40	8:42	0:02	0.033333	TRANSIENT	EARTHFAULT
LEG-08	4/4/2006	8:55	8:57	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
GEF-02	4/4/2006	10:15	12:00	1:45	1.75	TRAFO	OVER LOAD
KAL-II-02	4/4/2006	10:45	12:05	1:20	1.333333	TRAFO	OVER LOAD
ADC-16	4/4/2006	10:50	12:47	1:57	1.95	TRAFO	OVER LOAD
SEB-09	4/4/2006	10:55	10:57	0:02	0.033333	OUTGOING FEEDER	OVER LOAD

ADW-04	4/4/2006	11:10	12:32	1:22	1.366667	SOL	SOL
COT-05	4/4/2006	11:45	12:20	0:35	0.583333	OPERATION	BYREQUEST
WER-09	4/4/2006	11:50	11:52	0:02	0.033333	TRANSIENT	EARTHFAULT
LEG-08	4/4/2006	14:50	14:52	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEB-II-TTL	4/4/2006	15:45	19:25	3:40	3.666667	PERMANENT	SHORT CIRCUIT
SEB-II-01	4/4/2006	15:45	16:00	0:15	0.25	PERMANENT	SHORT CIRCUIT
SEB-II-03	4/4/2006	15:45	16:05	0:20	0.333333	PERMANENT	SHORT CIRCUIT
GOFA-05	4/4/2006	16:05	16:07	0:02	0.033333	TRANSIENT	EARTHFAULT
MEK-05	4/4/2006	16:30	17:00	0:30	0.5	PERMANENT	SHORT CIRCUIT
MEK-05	4/4/2006	16:30	18:25	1:55	1.916667	OPERATION	BYREQUEST
ADW-02	4/4/2006	17:03	17:25	0:22	0.366667	OPERATION	BYREQUEST
ADN-02	4/4/2006	17:16	17:18	0:02	0.033333	TRANSIENT	EARTHFAULT
ADW-01	4/4/2006	19:35	20:05	0:30	0.5	SOL	SOL
GOFA-04	4/4/2006	19:35	19:40	0:05	0.083333	SOL	SOL
WER-08	4/4/2006	19:37	20:30	0:53	0.883333	TRAFO	OVER LOAD
GEF-01	4/4/2006	19:40	20:05	0:25	0.416667	TRAFO	OVER LOAD
GOFA-05	4/4/2006	19:42	20:40	0:58	0.966667	PERMANENT	SHORT CIRCUIT
ADW-03	4/4/2006	19:45	19:50	0:05	0.083333	TRAFO	OVER LOAD
WER-04	4/4/2006	19:53	19:55	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-04	4/4/2006	19:15	20:00	0:45	0.75	OUTGOING FEEDER	OVER LOAD
GOFA-05	4/4/2006	21:30	21:32	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-14	4/5/2006	0:00	8:10	8:10	8.166667	OPERATION	BYREQUEST
GEF-02	4/5/2006	6:15	10:40	4:25	4.416667	OPERATION	BYREQUEST
GEF-01	4/5/2006	9:45	10:36	0:51	0.85	OPERATION	BYREQUEST
SEB-II-03	4/5/2006	6:35	6:37	0:02	0.033333	TRANSIENT	EARTHFAULT
WER-05	4/5/2006	6:50	6:52	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-07	4/5/2006	7:05	9:05	2:00	2	OPERATION	BYREQUEST
WER-08	4/5/2006	7:15	7:17	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-03	4/5/2006	8:30	8:32	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEB-II-03	4/5/2006	8:45	12:15	3:30	3.5	OPERATION	BYREQUEST
SEB-II-03	4/5/2006	12:25	15:45	3:20	3.333333	OPERATION	BYREQUEST
ADC-07	4/5/2006	9:40	10:55	1:15	1.25	OUTGOING FEEDER	OVER LOAD
WER-06	4/5/2006	9:40	10:25	0:45	0.75	PERMANENT	SHORT CIRCUIT
KAL-II-04	4/5/2006	9:55	12:00	2:05	2.083333	TRAFO	OVER LOAD
SEB-09	4/5/2006	10:15	10:17	0:02	0.033333	TRANSIENT	SHORT CIRCUIT

ADC-03	4/5/2006	10:25	10:27	0:02	0.033333	TRANSIENT	EARTHFAULT
WER-07	4/5/2006	10:35	13:13	2:38	2.633333	TRAFO	OVER LOAD
LEG-03	4/5/2006	10:45	11:25	0:40	0.666667	OPERATION	BYREQUEST
ADN-05	4/5/2006	10:50	12:35	1:45	1.75	TRAFO	OVER LOAD
ADC-09	4/5/2006	10:55	12:35	1:40	1.666667	TRAFO	OVER LOAD
SEB-09	4/5/2006	10:55	10:59	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
KAL-N-K4	4/5/2006	11:00	11:55	0:55	0.916667	OPERATION	BYREQUEST
SEB-07	4/5/2006	11:00	11:04	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
GOFA-05	4/5/2006	11:17	11:19	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEB-09	4/5/2006	11:10	12:30	1:20	1.333333	SOL	SOL
GOFA-02	4/5/2006	11:30	12:15	0:45	0.75	SOL	SOL
ADW-03	4/5/2006	11:35	12:35	1:00	1	TRAFO	OVER LOAD
SEB-07	4/5/2006	11:45	11:49	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
GEF-01	4/5/2006	11:45	11:47	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
GEF-01	4/5/2006	14:10	15:15	1:05	1.083333	OUTGOING FEEDER	OVER LOAD
GEF-02	4/5/2006	12:10	13:20	1:10	1.166667	TRAFO	OVER LOAD
ADW-01	4/5/2006	12:10	13:20	1:10	1.166667	TRAFO	OVER LOAD
WER-09	4/5/2006	12:15	12:17	0:02	0.033333	TRANSIENT	EARTHFAULT
WER-06	4/5/2006	12:15	12:17	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-03	4/5/2006	12:20	12:25	0:05	0.083333	PERMANENT	SHORT CIRCUIT
ADC-09	4/5/2006	14:00	14:04	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
MEK-05	4/5/2006	13:20	13:30	0:10	0.166667	OPERATION	BYREQUEST
SEB-09	4/5/2006	13:25	13:29	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
ADN-06	4/5/2006	14:00	15:35	1:35	1.583333	PERMANENT	SHORT CIRCUIT
ADC-15	4/5/2006	15:33	15:35	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
COT-33	4/5/2006	15:45	15:47	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
MEK-06	4/5/2006	15:45	15:47	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEB-II-03	4/5/2006	16:10	16:12	0:02	0.033333	TRANSIENT	EARTHFAULT
LEG-08	4/5/2006	16:40	17:00	0:20	0.333333	OPERATION	BYREQUEST
KAL-II-05	4/5/2006	16:40	16:50	0:10	0.166667	OPERATION	BYREQUEST
WER-07	4/5/2006	16:50	16:52	0:02	0.033333	TRANSIENT	EARTHFAULT
COT-01	4/5/2006	17:35	18:00	0:25	0.416667	PERMANENT	SHORT CIRCUIT
ADW-06	4/5/2006	18:35	19:40	1:05	1.083333	SOL	SOL

SEB-07	4/5/2006	18:35	19:10	0:35	0.583333	SOL	SOL
ADC-09	4/5/2006	18:45	18:49	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
GEF-04	4/5/2006	18:45	20:00	1:15	1.25	TRAFO	OVER LOAD
WER-06	4/5/2006	18:45	19:35	0:50	0.833333	TRAFO	OVER LOAD
WER-06	4/5/2006	21:30	21:35	0:05	0.083333	OPERATION	BYREQUEST
SEB-04	4/5/2006	18:50	18:54	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
GOFA-04	4/5/2006	18:52	18:57	0:05	0.083333	OPERATION	BYREQUEST
GOFA-04	4/5/2006	20:20	20:25	0:05	0.083333	OPERATION	BYREQUEST
ADC-09	4/5/2006	19:05	19:10	0:05	0.083333	OUTGOING FEEDER	OVER LOAD
MEK-01	4/5/2006	19:07	19:58	0:51	0.85	PERMANENT	EARTHFAULT
MEK-01	4/5/2006	20:00	20:10	0:10	0.166667	OPERATION	BYREQUEST
SEB-04	4/5/2006	19:30	21:45	2:15	2.25	OUTGOING FEEDER	OVER LOAD
BELLA-04	4/5/2006	19:50	20:10	0:20	0.333333	OPERATION	BYREQUEST
ADN-06	4/5/2006	20:45	20:47	0:02	0.033333	TRANSIENT	EARTHFAULT
ADN-06	4/5/2006	21:10	21:45	0:35	0.583333	OPERATION	BYREQUEST
SUL-07	4/6/2006	11:10	11:12	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
WER-07	4/6/2006	11:15	13:30	2:15	2.25	OPERATION	BYREQUEST
BELLA-04	4/6/2006	11:15	11:40	0:25	0.416667	OPERATION	BYREQUEST
WER-04	4/6/2006	6:50	6:52	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADC-03	4/6/2006	8:00	8:02	0:02	0.033333	TRANSIENT	EARTHFAULT
LEG-08	4/6/2006	8:15	9:15	1:00	1	PERMANENT	EARTHFAULT
LEG-08	4/6/2006	11:10	11:20	0:10	0.166667	OPERATION	BYREQUEST
COT-33	4/6/2006	9:10	9:12	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADW-04	4/6/2006	9:25	9:27	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADC-07	4/6/2006	9:55	11:05	1:10	1.166667	PERMANENT	SHORT CIRCUIT
ADC-07	4/6/2006	11:20	11:25	0:05	0.083333	OPERATION	BYREQUEST
ADW-01	4/6/2006	10:05	12:10	2:05	2.083333	OPERATION	BYREQUEST
ADW-02	4/6/2006	10:05	12:10	2:05	2.083333	OPERATION	BYREQUEST
GEF-01	4/6/2006	13:40	14:05	0:25	0.416667	OPERATION	BYREQUEST
GEF-02	4/6/2006	13:55	15:00	1:05	1.083333	OPERATION	BYREQUEST
SEB-04	4/6/2006	14:30	14:45	0:15	0.25	OPERATION	BYREQUEST
COT-05	4/6/2006	14:55	15:05	0:10	0.166667	OPERATION	BYREQUEST
GEF-05	4/6/2006	14:55	16:20	1:25	1.416667	PERMANENT	EARTHFAULT
GEF-06	4/6/2006	14:55	16:20	1:25	1.416667	PERMANENT	EARTHFAULT
WER-08	4/6/2006	15:25	15:27	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
GOFA-03	4/6/2006	15:40	15:55	0:15	0.25	OPERATION	BYREQUEST

LEG-03	4/6/2006	14:55	17:25	2:30	2.5	PERMANENT	SHORT CIRCUIT
LEG-03	4/6/2006			0:00	0		
NIF-03	4/6/2006	15:00	17:25	2:25	2.416667	PERMANENT	SHORT CIRCUIT
AKAK-I-01	4/6/2006	16:05	16:07	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
LEG-04	4/6/2006	16:35	17:15	0:40	0.666667	OPERATION	BYREQUEST
MEK-01	4/6/2006	16:50	16:52	0:02	0.033333	TRANSIENT	EARTHFAULT
AKA-II-07	4/6/2006	17:15	18:50	1:35	1.583333	PERMANENT	SHORT CIRCUIT
WER-08	4/6/2006	19:00	23:05	4:05	4.083333	TRAFO	OVER LOAD
ADC-09	4/6/2006	19:25	10:50	15:25	15.41667	PERMANENT	SHORT CIRCUIT
GOFA-06	4/6/2006	19:45	20:55	1:10	1.166667	PERMANENT	SHORT CIRCUIT
GOFA-06	4/7/2006	6:50	11:00	4:10	4.166667	PERMANENT	SHORT CIRCUIT
WER-04	4/7/2006	7:35	7:37	0:02	0.033333	TRANSIENT	EARTHFAULT
BELA-02	4/7/2006	7:45	7:47	0:02	0.033333	TRANSIENT	EARTHFAULT
SUL-02	4/7/2006	7:55	7:57	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
GEF-04	4/7/2006	8:05	8:07	0:02	0.033333	TRANSIENT	EARTHFAULT
WER-07	4/7/2006	8:45	8:47	0:02	0.033333	TRANSIENT	EARTHFAULT
KAL-II-04	4/7/2006	9:45	11:00	1:15	1.25	SOL	SOL
KAL-I-F13	4/7/2006	9:45	11:05	1:20	1.333333	SOL	SOL
KAL-N-K7	4/7/2006	9:50	11:05	1:15	1.25	SOL	SOL
AKAK-II-07	4/7/2006	9:50	11:05	1:15	1.25	SOL	SOL
AKAK-I-03	4/7/2006	9:50	11:02	1:12	1.2	SOL	SOL
KAL-N-K4	4/7/2006	10:15	11:05	0:50	0.833333	SOL	SOL
KAL-I-F3	4/7/2006	10:15	11:05	0:50	0.833333	SOL	SOL
AKAK-II-02	4/7/2006	10:30	11:05	0:35	0.583333	SOL	SOL
KAL-II-06	4/7/2006	10:30	11:00	0:30	0.5	SOL	SOL
ADC-07	4/7/2006	11:00	11:05	0:05	0.083333	OUTGOING FEEDER	OVER LOAD
SEB-II-03	4/7/2006	11:00	12:10	1:10	1.166667	OPERATION	BYREQUEST
WER-06	4/7/2006	11:10	12:00	0:50	0.833333	PERMANENT	SHORT CIRCUIT
SEB-07	4/7/2006	11:25	11:27	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
WER-05	4/7/2006	11:50	11:52	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-07	4/7/2006	10:20	12:20	2:00	2	OUTGOING FEEDER	OVER LOAD
ADC-04	4/7/2006	12:55	13:20	0:25	0.416667	OPERATION	BYREQUEST
LEG-04	4/7/2006	13:20	18:20	5:00	5	PERMANENT	SHORT CIRCUIT
LEG-03	4/7/2006	18:00	18:25	0:25	0.416667	OPERATION	BYREQUEST

LEG-08	4/7/2006	18:00	18:25	0:25	0.416667	OPERATION	BYREQUEST
SEB-04	4/7/2006	13:45	13:47	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-04	4/7/2006	14:20	16:30	2:10	2.166667	PERMANENT	SHORT CIRCUIT
SUL-04	4/7/2006	14:22	14:55	0:33	0.55	OPERATION	BYREQUEST
SUL-07	4/7/2006	14:22	14:55	0:33	0.55	OPERATION	BYREQUEST
ADN-01	4/7/2006	14:26	18:00	3:34	3.566667	OPERATION	BYREQUEST
ADC-15	4/7/2006	14:30	16:35	2:05	2.083333	PERMANENT	SHORT CIRCUIT
GEF-04	4/7/2006	14:45	14:59	0:14	0.233333	OPERATION	BYREQUEST
KAL-II-04	4/7/2006	15:20	17:55	2:35	2.583333	PERMANENT	SHORT CIRCUIT
KAL-N-K4	4/7/2006	15:25	16:15	0:50	0.833333	PERMANENT	SHORT CIRCUIT
COT-05	4/7/2006	16:40	16:42	0:02	0.033333	TRANSIENT	EARTHFAULT
MEK-05	4/7/2006	16:10	16:12	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
GEF-02	4/7/2006	18:10	20:05	1:55	1.916667	TRAFO	OVER LOAD
WER-06	4/7/2006	18:30	19:15	0:45	0.75	OUTGOING FEEDER	OVER LOAD
WER-06	4/7/2006	23:30	23:35	0:05	0.083333	OPERATION	BYREQUEST
GOFA-03	4/7/2006	18:55	20:15	1:20	1.333333	TRAFO	OVER LOAD
AKAK-I-04	4/7/2006	18:40	20:05	1:25	1.416667	SOL	SOL
KAL-N-K2	4/7/2006	18:40	19:40	1:00	1	SOL	SOL
KAL-II-02	4/7/2006	18:45	19:40	0:55	0.916667	SOL	SOL
KAL-I-F13	4/7/2006	18:50	20:05	1:15	1.25	SOL	SOL
ADC-09	4/7/2006	19:05	19:07	0:02	0.033333	OUTGOING FEEDER	OVER LOAD
COT-33	4/8/2006	5:45	5:47	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
AKAK-II-03	4/8/2006	6:15	6:17	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-03	4/8/2006	6:30	6:32	0:02	0.033333	TRANSIENT	EARTHFAULT
LEG-08	4/8/2006	6:40	6:42	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEB-09	4/8/2006	6:57	6:59	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
NIF-02	4/8/2006	7:00	8:00	1:00	1	PERMANENT	SHORT CIRCUIT
NIF-03	4/8/2006	7:00	9:40	2:40	2.666667	PERMANENT	SHORT CIRCUIT
NIF-04	4/8/2006	9:10	9:40	0:30	0.5	OPERATION	BYREQUEST
NIF-01	4/8/2006	9:10	9:40	0:30	0.5	OPERATION	BYREQUEST
WER-08	4/8/2006	7:40	7:42	0:02	0.033333	TRANSIENT	EARTHFAULT
WER-09	4/8/2006	7:40	7:42	0:02	0.033333	TRANSIENT	EARTHFAULT
KAL-I-TTL	4/8/2006	7:30	10:40	3:10	3.166667	PERMANENT	EARTHFAULT
AKAK-I-TTL	4/8/2006	7:30	10:40	3:10	3.166667	PERMANENT	EARTHFAULT

KAL-II-06	4/8/2006	8:05	8:10	0:05	0.083333	OPERATION	BYREQUEST
KAL-II-03	4/8/2006	9:00	9:02	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
GEF-01	4/8/2006	9:05	9:07	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
GEF-04	4/8/2006	9:15	9:17	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADN-06	4/8/2006	9:20	9:22	0:02	0.033333	TRANSIENT	EARTHFAULT
AKAK-II-03	4/8/2006	9:25	9:27	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
AKAK-II-03	4/8/2006	9:30	9:32	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
LEG-08	4/8/2006	9:55	10:16	0:21	0.35	OPERATION	BYREQUEST
KAL-II-16	4/8/2006	10:50	12:10	1:20	1.333333	SOL	SOL
KAL-N-K5	4/8/2006	10:50	12:15	1:25	1.416667	SOL	SOL
MEK-05	4/8/2006	11:15	12:10	0:55	0.916667	SOL	SOL
AKAK-II-07	4/8/2006	11:15	12:15	1:00	1	SOL	SOL
GEF-01	4/8/2006	11:22	13:27	2:05	2.083333	TRAFO	OVER LOAD
COT-33	4/8/2006	11:40	11:42	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADW-01	4/8/2006	11:50	14:25	2:35	2.583333	PERMANENT	EARTHFAULT
SUL-02	4/8/2006	11:50	11:52	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
COT-33	4/8/2006	12:25	14:40	2:15	2.25	PERMANENT	SHORT CIRCUIT
ADN-01	4/8/2006	12:20	12:35	0:15	0.25	UNDER FRIQUANCY	BLACK OUT
ADN-02	4/8/2006	12:20	12:35	0:15	0.25	UNDER FRIQUANCY	BLACK OUT
ADN-03	4/8/2006	12:20	12:35	0:15	0.25	UNDER FRIQUANCY	BLACK OUT
ADN-04	4/8/2006	12:20	12:35	0:15	0.25	UNDER FRIQUANCY	BLACK OUT
ADN-05	4/8/2006	12:20	12:35	0:15	0.25	UNDER FRIQUANCY	BLACK OUT
ADN-06	4/8/2006	12:20	13:30	1:10	1.166667	UNDER FRIQUANCY	BLACK OUT
GEF-02	4/8/2006	12:20	12:45	0:25	0.416667	UNDER FRIQUANCY	BLACK OUT
GEF-04	4/8/2006	12:20	12:45	0:25	0.416667	UNDER FRIQUANCY	BLACK OUT
GEF-05	4/8/2006	12:20	12:45	0:25	0.416667	UNDER FRIQUANCY	BLACK OUT
GEF-06	4/8/2006	12:20	12:45	0:25	0.416667	UNDER FRIQUANCY	BLACK OUT
GEF-07	4/8/2006	12:20	12:45	0:25	0.416667	UNDER FRIQUANCY	BLACK OUT
WER-03	4/8/2006	12:20	12:45	0:25	0.416667	UNDER FRIQUANCY	BLACK OUT

WER-04	4/8/2006	12:20	13:47	1:27	1.45	UNDER FRIQUANCY	BLACK OUT
WER-05	4/8/2006	12:20	13:45	1:25	1.416667	UNDER FRIQUANCY	BLACK OUT
WER-06	4/8/2006	12:20	13:50	1:30	1.5	UNDER FRIQUANCY	BLACK OUT
WER-07	4/8/2006	12:20	13:50	1:30	1.5	UNDER FRIQUANCY	BLACK OUT
WER-08	4/8/2006	12:20	13:50	1:30	1.5	UNDER FRIQUANCY	BLACK OUT
WER-09	4/8/2006	12:20	13:45	1:25	1.416667	UNDER FRIQUANCY	BLACK OUT
WER-10	4/8/2006	12:20	13:00	0:40	0.666667	UNDER FRIQUANCY	BLACK OUT
WER-11	4/8/2006	12:20	13:00	0:40	0.666667	UNDER FRIQUANCY	BLACK OUT
WER-12	4/8/2006	12:20	13:00	0:40	0.666667	UNDER FRIQUANCY	BLACK OUT
MEK-01	4/8/2006	12:20	12:40	0:20	0.333333	UNDER FRIQUANCY	BLACK OUT
MEK-03	4/8/2006	12:20	12:40	0:20	0.333333	UNDER FRIQUANCY	BLACK OUT
MEK-05	4/8/2006	12:20	12:40	0:20	0.333333	UNDER FRIQUANCY	BLACK OUT
MEK-06	4/8/2006	12:20	12:40	0:20	0.333333	UNDER FRIQUANCY	BLACK OUT
GOFA-02	4/8/2006	12:20	13:55	1:35	1.583333	UNDER FRIQUANCY	BLACK OUT
GOFA-03	4/8/2006	12:20	13:55	1:35	1.583333	UNDER FRIQUANCY	BLACK OUT
GOFA-04	4/8/2006	12:20	13:45	1:25	1.416667	UNDER FRIQUANCY	BLACK OUT
GOFA-05	4/8/2006	12:20	13:45	1:25	1.416667	UNDER FRIQUANCY	BLACK OUT
GOFA-06	4/8/2006	12:20	13:45	1:25	1.416667	UNDER FRIQUANCY	BLACK OUT
KAL-N-K2	4/8/2006	12:20	17:58	5:38	5.633333	UNDER FRIQUANCY	BLACK OUT
KAL-N-K4	4/8/2006	12:20	17:58	5:38	5.633333	UNDER FRIQUANCY	BLACK OUT
KAL-N-K5	4/8/2006	12:20	17:58	5:38	5.633333	UNDER FRIQUANCY	BLACK OUT
KAL-N-K6	4/8/2006	12:20	17:58	5:38	5.633333	UNDER FRIQUANCY	BLACK OUT
BELLA-01	4/8/2006	12:20	13:30	1:10	1.166667	UNDER FRIQUANCY	BLACK OUT
BELLA-02	4/8/2006	12:20	13:30	1:10	1.166667	UNDER FRIQUANCY	BLACK OUT
BELLA-03	4/8/2006	12:20	12:43	0:23	0.383333	UNDER FRIQUANCY	BLACK OUT
BELLA-04	4/8/2006	12:20	13:30	1:10	1.166667	UNDER	BLACK OUT

						FRIQUANCY	
BELLA-05	4/8/2006	12:20	12:43	0:23	0.383333	UNDER FRIQUANCY	BLACK OUT
BELLA-06	4/8/2006	12:20	12:43	0:23	0.383333	UNDER FRIQUANCY	BLACK OUT
SEB-02	4/8/2006	12:20	12:45	0:25	0.416667	UNDER FRIQUANCY	BLACK OUT
SEB-03	4/8/2006	12:20	12:45	0:25	0.416667	UNDER FRIQUANCY	BLACK OUT
SEB-04	4/8/2006	12:20	12:45	0:25	0.416667	UNDER FRIQUANCY	BLACK OUT
SEB-05	4/8/2006	12:20	12:45	0:25	0.416667	UNDER FRIQUANCY	BLACK OUT
SEB-06	4/8/2006	12:20	12:45	0:25	0.416667	UNDER FRIQUANCY	BLACK OUT
SEB-07	4/8/2006	12:20	12:45	0:25	0.416667	UNDER FRIQUANCY	BLACK OUT
SEB-08	4/8/2006	12:20	12:45	0:25	0.416667	UNDER FRIQUANCY	BLACK OUT
SEB-09	4/8/2006	12:20	12:45	0:25	0.416667	UNDER FRIQUANCY	BLACK OUT
SUL-01	4/8/2006	12:20	12:42	0:22	0.366667	UNDER FRIQUANCY	BLACK OUT
SUL-02	4/8/2006	12:20	12:42	0:22	0.366667	UNDER FRIQUANCY	BLACK OUT
SUL-03	4/8/2006	12:20	12:42	0:22	0.366667	UNDER FRIQUANCY	BLACK OUT
SUL-04	4/8/2006	12:20	12:42	0:22	0.366667	UNDER FRIQUANCY	BLACK OUT
SUL-05	4/8/2006	12:20	12:42	0:22	0.366667	UNDER FRIQUANCY	BLACK OUT
SUL-06	4/8/2006	12:20	12:42	0:22	0.366667	UNDER FRIQUANCY	BLACK OUT
SUL-07	4/8/2006	12:20	12:42	0:22	0.366667	UNDER FRIQUANCY	BLACK OUT
SUL-08	4/8/2006	12:20	12:42	0:22	0.366667	UNDER FRIQUANCY	BLACK OUT
KAL-I-01	4/8/2006	12:20	18:10	5:50	5.833333	UNDER FRIQUANCY	BLACK OUT
KAL-I-02	4/8/2006	12:20	18:10	5:50	5.833333	UNDER FRIQUANCY	BLACK OUT
KAL-I-03	4/8/2006	12:20	18:10	5:50	5.833333	UNDER FRIQUANCY	BLACK OUT
KAL-I-04	4/8/2006	12:20	18:10	5:50	5.833333	UNDER FRIQUANCY	BLACK OUT
KAL-I-05	4/8/2006	12:20	18:10	5:50	5.833333	UNDER FRIQUANCY	BLACK OUT
KAL-II-01	4/8/2006	12:20	17:58	5:38	5.633333	UNDER FRIQUANCY	BLACK OUT
KAL-II-02	4/8/2006	12:20	17:58	5:38	5.633333	UNDER FRIQUANCY	BLACK OUT

KAL-II-03	4/8/2006	12:20	17:58	5:38	5.633333	UNDER FRIQUANCY	BLACK OUT
KAL-II-04	4/8/2006	12:20	17:58	5:38	5.633333	UNDER FRIQUANCY	BLACK OUT
KAL-II-05	4/8/2006	12:20	17:58	5:38	5.633333	UNDER FRIQUANCY	BLACK OUT
KAL-II-06	4/8/2006	12:20	17:58	5:38	5.633333	UNDER FRIQUANCY	BLACK OUT
ADW-01	4/8/2006	12:20	13:50	1:30	1.5	UNDER FRIQUANCY	BLACK OUT
ADW-02	4/8/2006	12:20	13:50	1:30	1.5	UNDER FRIQUANCY	BLACK OUT
ADW-03	4/8/2006	12:20	13:50	1:30	1.5	UNDER FRIQUANCY	BLACK OUT
ADW-04	4/8/2006	12:20	13:50	1:30	1.5	UNDER FRIQUANCY	BLACK OUT
ADW-05	4/8/2006	12:20	13:50	1:30	1.5	UNDER FRIQUANCY	BLACK OUT
ADW-06	4/8/2006	12:20	13:50	1:30	1.5	UNDER FRIQUANCY	BLACK OUT
ADC-03	4/8/2006	12:20	13:10	0:50	0.833333	UNDER FRIQUANCY	BLACK OUT
ADC-04	4/8/2006	12:20	13:10	0:50	0.833333	UNDER FRIQUANCY	BLACK OUT
ADC-05	4/8/2006	12:20	13:30	1:10	1.166667	UNDER FRIQUANCY	BLACK OUT
ADC-07	4/8/2006	12:20	13:25	1:05	1.083333	UNDER FRIQUANCY	BLACK OUT
ADC-08	4/8/2006	12:20	13:25	1:05	1.083333	UNDER FRIQUANCY	BLACK OUT
ADC-10	4/8/2006	12:20	13:10	0:50	0.833333	UNDER FRIQUANCY	BLACK OUT
ADC-11	4/8/2006	12:20	13:10	0:50	0.833333	UNDER FRIQUANCY	BLACK OUT
ADC-12	4/8/2006	12:20	13:10	0:50	0.833333	UNDER FRIQUANCY	BLACK OUT
ADC-15	4/8/2006	12:20	13:10	0:50	0.833333	UNDER FRIQUANCY	BLACK OUT
ADC-16	4/8/2006	12:20	13:25	1:05	1.083333	UNDER FRIQUANCY	BLACK OUT
NIF-01	4/8/2006	12:20	17:55	5:35	5.583333	UNDER FRIQUANCY	BLACK OUT
NIF-02	4/8/2006	12:20	17:55	5:35	5.583333	UNDER FRIQUANCY	BLACK OUT
NIF-03	4/8/2006	12:20	17:55	5:35	5.583333	UNDER FRIQUANCY	BLACK OUT
NIF-04	4/8/2006	12:20	17:55	5:35	5.583333	UNDER FRIQUANCY	BLACK OUT
NIF-05	4/8/2006	12:20	17:55	5:35	5.583333	UNDER FRIQUANCY	BLACK OUT
SEB-II-01	4/8/2006	12:20	13:50	1:30	1.5	UNDER	BLACK OUT

						FRIQUANCY	
SEB-II-02	4/8/2006	12:20	13:50	1:30	1.5	UNDER FRIQUANCY	BLACK OUT
SEB-II-03	4/8/2006	12:20	13:50	1:30	1.5	UNDER FRIQUANCY	BLACK OUT
AKAK-I-01	4/8/2006	12:20	18:00	5:40	5.666667	UNDER FRIQUANCY	BLACK OUT
AKAK-I-02	4/8/2006	12:20	18:00	5:40	5.666667	UNDER FRIQUANCY	BLACK OUT
AKAK-I-03	4/8/2006	12:20	18:00	5:40	5.666667	UNDER FRIQUANCY	BLACK OUT
AKAK-I-04	4/8/2006	12:20	18:00	5:40	5.666667	UNDER FRIQUANCY	BLACK OUT
AKAK-I-05	4/8/2006	12:20	18:00	5:40	5.666667	UNDER FRIQUANCY	BLACK OUT
AKAK-II-01	4/8/2006	12:20	18:00	5:40	5.666667	UNDER FRIQUANCY	BLACK OUT
AKAK-II-02	4/8/2006	12:20	18:00	5:40	5.666667	UNDER FRIQUANCY	BLACK OUT
AKAK-II-03	4/8/2006	12:20	18:00	5:40	5.666667	UNDER FRIQUANCY	BLACK OUT
AKAK-II-04	4/8/2006	12:20	18:00	5:40	5.666667	UNDER FRIQUANCY	BLACK OUT
AKAK-II-06	4/8/2006	12:20	18:00	5:40	5.666667	UNDER FRIQUANCY	BLACK OUT
AKAK-II-07	4/8/2006	12:20	18:00	5:40	5.666667	UNDER FRIQUANCY	BLACK OUT
LEG-04	4/8/2006	12:55	14:45	1:50	1.833333	PERMANENT	SHORT CIRCUIT
MEK-03	4/8/2006	13:05	19:10	6:05	6.083333	OUTGOING FEEDER	OVER LOAD
MEK-05	4/8/2006	13:05	15:10	2:05	2.083333	OUTGOING FEEDER	OVER LOAD
MEK-06	4/8/2006	15:10	19:10	4:00	4	OUTGOING FEEDER	OVER LOAD
SUL-02	4/8/2006	14:15	14:25	0:10	0.166667	OPERATION	BYREQUEST
COT-04	4/8/2006	14:35	15:10	0:35	0.583333	OPERATION	BYREQUEST
COT-04	4/8/2006	15:10	15:15	0:05	0.083333	OPERATION	BYREQUEST
ADN-06	4/8/2006	14:47	14:49	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-TTL	4/8/2006	15:55	17:55	2:00	2	OPERATION	BYREQUEST
WER-TTL	4/8/2006	15:55	18:05	2:10	2.166667	OPERATION	BYREQUEST
SEB-07	4/8/2006	16:40	18:52	2:12	2.2	PERMANENT	SHORT CIRCUIT
GOFA-05	4/8/2006	16:50	17:00	0:10	0.166667	OPERATION	BYREQUEST
GOFA-06	4/8/2006	12:10	12:12	0:02	0.033333	TRANSIENT	EARTHFAULT
NIF-01	4/8/2006	18:17	19:15	0:58	0.966667	TRAFO	OVER LOAD
WER-07	4/8/2006	18:25	19:15	0:50	0.833333	TRAFO	OVER LOAD
GEF-04	4/8/2006	18:27	20:16	1:49	1.816667	TRAFO	OVER LOAD

ADN-05	4/8/2006	18:45	20:00	1:15	1.25	TRAFO	OVER LOAD
ADW-03	4/8/2006	18:45	19:40	0:55	0.916667	TRAFO	OVER LOAD
WER-06	4/8/2006	19:15	20:00	0:45	0.75	TRAFO	OVER LOAD
ADW-02	4/8/2006	18:55	20:00	1:05	1.083333	TRAFO	OVER LOAD
ADC-09	4/8/2006	18:25	18:29	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
ADC-09	4/8/2006	18:35	20:02	1:27	1.45	OUTGOING FEEDER	OVER LOAD
KAL-N-K5	4/8/2006	18:40	18:44	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
KAL-N-K5	4/8/2006	18:45	19:10	0:25	0.416667	OUTGOING FEEDER	OVER LOAD
KAL-N-K5	4/8/2006	19:12	20:55	1:43	1.716667	OPERATION	BYREQUEST
ADW-02	4/8/2006	18:50	20:00	1:10	1.166667	TRAFO	OVER LOAD
KAL-II-01	4/8/2006	19:00	19:02	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
KAL-II-02	4/8/2006	19:00	19:02	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
KAL-II-03	4/8/2006	19:00	19:02	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
KAL-II-04	4/8/2006	19:00	19:02	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
KAL-II-05	4/8/2006	19:00	19:02	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
KAL-II-06	4/8/2006	19:00	19:02	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
COT-TTL	4/8/2006	19:00	19:02	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
KAL-II-05	4/8/2006	19:05	19:40	0:35	0.583333	OUTGOING FEEDER	OVER LOAD
KAL-II-05	4/8/2006	22:15	22:20	0:05	0.083333	OPERATION	BYREQUEST
SEB-04	4/8/2006	19:05	19:09	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
WER-06	4/8/2006	19:15	20:50	1:35	1.583333	TRAFO	OVER LOAD
WER-08	4/8/2006	20:10	20:12	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-II-03	4/8/2006	20:45	13:10	16:25	16.41667	PERMANENT	SHORT CIRCUIT
ADW-01	4/8/2006	21:55	21:57	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADW-02	4/8/2006	21:55	21:57	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
WER-08	4/9/2006	6:30	9:45	3:15	3.25	PERMANENT	SHORT CIRCUIT
ADN-02	4/9/2006	6:25	7:25	1:00	1	OPERATION	BYREQUEST
KAL-N-K4	4/9/2006	9:00	9:02	0:02	0.033333	TRANSIENT	EARTHFAULT
KAL-II-04	4/9/2006	9:15	10:40	1:25	1.416667	TRAFO	OVER LOAD
ADN-02	4/9/2006	9:25	10:15	0:50	0.833333	OPERATION	BYREQUEST
BELLA-04	4/9/2006	9:25	11:55	2:30	2.5	PERMANENT	SHORT

							CIRCUIT
BELLA-04	4/9/2006	15:30	15:35	0:05	0.083333	OPERATION	BYREQUEST
WER-09	4/9/2006	9:50	9:52	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-16	4/9/2006	9:50	12:50	3:00	3	TRAFO	OVER LOAD
SEB-07	4/9/2006	10:50	10:55	0:05	0.083333	OPERATION	BYREQUEST
SEB-09	4/9/2006	11:40	11:44	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
ADN-03	4/9/2006	11:45	13:00	1:15	1.25	OPERATION	BYREQUEST
GEF-04	4/9/2006	11:57	13:10	1:13	1.216667	OPERATION	BYREQUEST
KAL-N-K7	4/9/2006	12:20	12:55	0:35	0.583333	SOL	SOL
MEK-01	4/9/2006	12:25	12:30	0:05	0.083333	PERMANENT	SHORT CIRCUIT
MEK-03	4/9/2006	12:25	12:30	0:05	0.083333	PERMANENT	SHORT CIRCUIT
MEK-05	4/9/2006	12:25	12:45	0:20	0.333333	PERMANENT	SHORT CIRCUIT
SEB-04	4/9/2006	12:25	12:40	0:15	0.25	PERMANENT	SHORT CIRCUIT
SEB-05	4/9/2006	12:25	12:40	0:15	0.25	PERMANENT	SHORT CIRCUIT
SEB-02	4/9/2006	12:25	12:55	0:30	0.5	PERMANENT	SHORT CIRCUIT
SEB-03	4/9/2006	12:25	12:55	0:30	0.5	PERMANENT	SHORT CIRCUIT
SEB-06	4/9/2006	12:25	12:55	0:30	0.5	PERMANENT	SHORT CIRCUIT
SEB-08	4/9/2006	12:25	12:55	0:30	0.5	PERMANENT	SHORT CIRCUIT
SEB-09	4/9/2006	12:25	12:55	0:30	0.5	PERMANENT	SHORT CIRCUIT
ADW-01	4/9/2006	12:25	12:45	0:20	0.333333	PERMANENT	SHORT CIRCUIT
ADW-02	4/9/2006	12:25	12:55	0:30	0.5	PERMANENT	SHORT CIRCUIT
ADW-03	4/9/2006	12:25	12:55	0:30	0.5	PERMANENT	SHORT CIRCUIT
ADW-04	4/9/2006	12:25	12:55	0:30	0.5	PERMANENT	SHORT CIRCUIT
ADW-05	4/9/2006	12:25	12:45	0:20	0.333333	PERMANENT	SHORT CIRCUIT
ADW-06	4/9/2006	12:25	12:55	0:30	0.5	PERMANENT	SHORT CIRCUIT
GOFA-02	4/9/2006	12:25	12:50	0:25	0.416667	PERMANENT	SHORT CIRCUIT
GOFA-03	4/9/2006	12:25	12:40	0:15	0.25	PERMANENT	SHORT CIRCUIT
GOFA-04	4/9/2006	12:25	13:00	0:35	0.583333	PERMANENT	SHORT CIRCUIT
GOFA-05	4/9/2006	12:25	12:40	0:15	0.25	PERMANENT	SHORT

							CIRCUIT
GOFA-06	4/9/2006	12:25	12:50	0:25	0.416667	PERMANENT	SHORT CIRCUIT
SEB-II-03	4/9/2006	13:50	13:52	0:02	0.033333	TRANSIENT	EARTHFAULT
LEG-03	4/9/2006	14:50	15:05	0:15	0.25	OPERATION	BYREQUEST
BELLA-04	4/9/2006	14:55	15:05	0:10	0.166667	OPERATION	BYREQUEST
WER-04	4/9/2006	14:55	14:57	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-07	4/9/2006	15:25	15:29	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
SEB-02	4/9/2006	15:45	15:49	0:04	0.066667	PERMANENT	SHORT CIRCUIT
ADC-03	4/9/2006	16:35	17:00	0:25	0.416667	OPERATION	BYREQUEST
BELLA-04	4/9/2006	16:35	16:37	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADW-05	4/9/2006	16:35	16:37	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-09	4/9/2006	16:40	16:42	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADC-14	4/9/2006	16:50	19:10	2:20	2.333333	PERMANENT	SHORT CIRCUIT
ADC-14	4/9/2006	20:10	20:15	0:05	0.083333	OPERATION	BYREQUEST
WER-05	4/9/2006	17:15	17:17	0:02	0.033333	TRANSIENT	EARTHFAULT
ADN-06	4/9/2006	17:40	17:42	0:02	0.033333	TRANSIENT	EARTHFAULT
COT-04	4/9/2006	17:50	17:52	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-04	4/9/2006	18:05	18:07	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
KAL-II-04	4/9/2006	18:30	19:40	1:10	1.166667	SOL	SOL
KAL-II-04	4/9/2006	18:30	20:05	1:35	1.583333	SOL	SOL
KAL-II-07	4/9/2006	18:30	20:05	1:35	1.583333	SOL	SOL
NIF-01	4/9/2006	18:30	19:40	1:10	1.166667	SOL	SOL
AKAK-II-03	4/9/2006	18:30	20:10	1:40	1.666667	SOL	SOL
WER-08	4/9/2006	18:40	19:30	0:50	0.833333	TRAFO	OVER LOAD
ADW-01	4/9/2006	18:40	19:50	1:10	1.166667	TRAFO	OVER LOAD
GEF-04	4/9/2006	18:40	20:25	1:45	1.75	TRAFO	OVER LOAD
GOFA-04	4/9/2006	18:45	20:05	1:20	1.333333	TRAFO	OVER LOAD
ADW-04	4/9/2006	18:45	20:00	1:15	1.25	TRAFO	OVER LOAD
ADN-02	4/9/2006	18:50	20:05	1:15	1.25	TRAFO	OVER LOAD
SEB-09	4/9/2006	18:50	18:54	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
SEB-II-03	4/9/2006	19:00	20:05	1:05	1.083333	OUTGOING FEEDER	OVER LOAD
GEF-07	4/9/2006	19:00	20:50	1:50	1.833333	OUTGOING FEEDER	OVER LOAD
COT-01	4/9/2006	19:15	19:50	0:35	0.583333	OUTGOING FEEDER	OVER LOAD
GOFA-06	4/9/2006	19:30	19:40	0:10	0.166667	OPERATION	BYREQUEST
SEB-09	4/9/2006	19:35	19:37	0:02	0.033333	OUTGOING	OVER LOAD

						FEEDER	
SEB-02	4/9/2006	22:40	22:50	0:10	0.166667	OPERATION	BYREQUEST
ADC-11	4/10/2006	5:20	6:00	0:40	0.666667	OPERATION	BYREQUEST
ADW-05	4/10/2006	7:35	7:37	0:02	0.033333	TRANSIENT	EARTHFAULT
WER-04	4/10/2006	8:25	16:00	7:35	7.583333	PERMANENT	SHORT CIRCUIT
WER-04	4/10/2006	17:40	17:43	0:03	0.05	OPERATION	BYREQUEST
ADC-14	4/10/2006	8:50	8:52	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-14	4/10/2006	8:50	8:52	0:02	0.033333	TRANSIENT	EARTHFAULT
LEG-08	4/10/2006	9:05	9:07	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEB-07	4/10/2006	9:35	9:39	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
GOFO-05	4/10/2006	9:40	9:42	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
LEG-04	4/10/2006	9:45	10:00	0:15	0.25	OPERATION	BYREQUEST
SEB-06	4/10/2006	10:10	10:35	0:25	0.416667	PERMANENT	SHORT CIRCUIT
SEB-07	4/10/2006	10:10	10:35	0:25	0.416667	PERMANENT	SHORT CIRCUIT
SEB-08	4/10/2006	10:10	10:35	0:25	0.416667	PERMANENT	SHORT CIRCUIT
SUL-03	4/10/2006	10:40	10:42	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-09	4/10/2006	10:40	10:42	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-14	4/10/2006	10:55	10:59	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
ADC-09	4/10/2006	11:00	12:40	1:40	1.666667	TRAFO	OVER LOAD
ADC-14	4/10/2006	11:20	11:22	0:02	0.033333	OUTGOING FEEDER	OVER LOAD
SEB-09	4/10/2006	11:25	11:29	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
SEB-07	4/10/2006	11:30	11:34	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
KAL-N-K5	4/10/2006	13:25	14:05	0:40	0.666667	PERMANENT	SHORT CIRCUIT
KAL-II-05	4/10/2006	11:40	13:35	1:55	1.916667	OUTGOING FEEDER	OVER LOAD
GEF-04	4/10/2006	13:42	19:25	5:43	5.716667	PERMANENT	SHORT CIRCUIT
COT-04	4/10/2006	14:50	16:20	1:30	1.5	OPERATION	BYREQUEST
SEB-02	4/10/2006	15:30	15:45	0:15	0.25	PERMANENT	SHORT CIRCUIT
WER-12	4/10/2006	15:45	15:50	0:05	0.083333	OPERATION	BYREQUEST
LEG-08	4/10/2006	15:55	15:57	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
WER-03	4/10/2006	16:15	16:17	0:02	0.033333	TRANSIENT	EARTHFAULT
ADN-06	4/10/2006	16:50	16:52	0:02	0.033333	TRANSIENT	EARTHFAULT
ADN-01	4/10/2006	17:00	17:02	0:02	0.033333	TRANSIENT	EARTHFAULT

SEB-06	4/10/2006	18:35	19:30	0:55	0.916667	SOL	SOL
GOFA-06	4/10/2006	18:35	19:55	1:20	1.333333	SOL	SOL
KAL-II-05	4/10/2006	18:50	19:40	0:50	0.833333	SOL	SOL
WER-06	4/10/2006	18:40	20:40	2:00	2	TRAFO	OVER LOAD
ADW-03	4/10/2006	18:42	18:44	0:02	0.033333	TRAFO	OVER LOAD
SEB-04	4/10/2006	18:52	18:56	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
ADN-04	4/10/2006	18:52	18:56	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
NIF-01	4/10/2006	18:55	19:35	0:40	0.666667	OUTGOING FEEDER	OVER LOAD
ADC-05	4/10/2006	19:00	20:20	1:20	1.333333	OUTGOING FEEDER	OVER LOAD
ADW-02	4/10/2006	19:05	20:05	1:00	1	OUTGOING FEEDER	OVER LOAD
ADC-09	4/10/2006	19:00	19:04	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
GEF-07	4/10/2006	19:00	19:04	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
SEB-07	4/10/2006	19:05	19:09	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
SUL-03	4/10/2006	19:10	19:12	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-04	4/10/2006	19:10	20:20	1:10	1.166667	OUTGOING FEEDER	OVER LOAD
GEF-07	4/10/2006	19:10	21:40	2:30	2.5	OUTGOING FEEDER	OVER LOAD
SEB-09	4/10/2006	19:20	19:24	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
SEB-II-03	4/10/2006	20:05	22:15	2:10	2.166667	OUTGOING FEEDER	OVER LOAD
SEB-04	4/10/2006	20:30	20:32	0:02	0.033333	OUTGOING FEEDER	OVER LOAD
BELLA-02	4/10/2006	22:15	22:50	0:35	0.583333	PERMANENT	SHORT CIRCUIT
WER-12	4/11/2006	7:35	7:37	0:02	0.033333	TRANSIENT	EARTHFAULT
BELLA-02	4/11/2006	7:45	10:55	3:10	3.166667	OPERATION	BYREQUEST
GOFA-03	4/11/2006	8:05	8:07	0:02	0.033333	TRANSIENT	EARTHFAULT
MEK-06	4/11/2006	8:40	8:42	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-07	4/11/2006	8:50	8:54	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
SEB-II-03	4/11/2006	9:10	10:40	1:30	1.5	OPERATION	BYREQUEST
SEB-07	4/11/2006	10:20	10:22	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
KAL-II-02	4/11/2006	10:30	12:00	1:30	1.5	OUTGOING FEEDER	OVER LOAD
NIF-01	4/11/2006	10:30	13:50	3:20	3.333333	OUTGOING FEEDER	OVER LOAD
ADW-03	4/11/2006	10:35	10:37	0:02	0.033333	TRANSIENT	EARTHFAULT

COT-04	4/11/2006	10:50	10:52	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEB-09	4/11/2006	10:55	10:58	0:03	0.05	OUTGOING FEEDER	OVER LOAD
WER-07	4/11/2006	11:10	13:05	1:55	1.916667	TRAFO	OVER LOAD
ADC-07	4/11/2006	11:11	13:05	1:54	1.9	TRAFO	OVER LOAD
GEF-02	4/11/2006	11:20	11:55	0:35	0.583333	OPERATION	BYREQUEST
SEB-09	4/11/2006	11:28	11:32	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
AKAK-II-07	4/11/2006	11:35	11:37	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEB-II-03	4/11/2006	11:43	11:45	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEB-09	4/11/2006	11:55	12:35	0:40	0.666667	OUTGOING FEEDER	OVER LOAD
KAL-N-K5	4/11/2006	13:00	13:02	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEB-07	4/11/2006	15:25	15:29	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
SEB-II-03	4/11/2006	16:30	16:32	0:02	0.033333	TRANSIENT	EARTHFAULT
NIF-01	4/11/2006	16:35	16:37	0:02	0.033333	TRANSIENT	EARTHFAULT
KAL-II-05	4/11/2006	16:35	16:37	0:02	0.033333	TRANSIENT	EARTHFAULT
MEK-05	4/11/2006	16:35	17:05	0:30	0.5	OPERATION	BYREQUEST
WER-05	4/11/2006	16:55	16:57	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
WER-05	4/11/2006	17:45	17:47	0:02	0.033333	TRANSIENT	EARTHFAULT
GEF-02	4/11/2006	18:30	20:20	1:50	1.833333	TRAFO	OVER LOAD
WER-06	4/11/2006	18:35	22:06	3:31	3.516667	TRAFO	OVER LOAD
ADW-04	4/11/2006	18:40	19:55	1:15	1.25	SOL	SOL
SEB-09	4/11/2006	18:40	19:45	1:05	1.083333	SOL	SOL
ADC-09	4/11/2006	18:55	18:57	0:02	0.033333	OUTGOING FEEDER	OVER LOAD
ADW-01	4/11/2006	18:55	20:10	1:15	1.25	TRAFO	OVER LOAD
SEB-II-03	4/11/2006	19:00	19:02	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
GOFA-02	4/11/2006	19:00	20:05	1:05	1.083333	TRAFO	OVER LOAD
ADN-05	4/11/2006	19:05	19:55	0:50	0.833333	TRAFO	OVER LOAD
SEB-04	4/11/2006	19:20	19:24	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
COT-04	4/11/2006	19:30	20:05	0:35	0.583333	PERMANENT	SHORT CIRCUIT
COT-04	4/11/2006	20:10	20:25	0:15	0.25	OPERATION	BYREQUEST
ADC-09	4/11/2006	19:33	19:35	0:02	0.033333	OUTGOING FEEDER	OVER LOAD
LEG-04	4/11/2006	20:15	20:25	0:10	0.166667	OPERATION	BYREQUEST
COT-04	4/12/2006	2:58	4:50	1:52	1.866667	OPERATION	BYREQUEST
GEF-02	4/12/2006	3:20	3:22	0:02	0.033333	TRANSIENT	SHORT

							CIRCUIT
MEK-01	4/12/2006	3:45	4:05	0:20	0.333333	UNDER FRIQUANCY	BLACK OUT
MEK-03	4/12/2006	3:45	4:05	0:20	0.333333	UNDER FRIQUANCY	BLACK OUT
MEK-05	4/12/2006	3:45	4:05	0:20	0.333333	UNDER FRIQUANCY	BLACK OUT
MEK-06	4/12/2006	3:45	4:05	0:20	0.333333	UNDER FRIQUANCY	BLACK OUT
GOFA-02	4/12/2006	3:45	4:10	0:25	0.416667	UNDER FRIQUANCY	BLACK OUT
GOFA-03	4/12/2006	3:45	4:10	0:25	0.416667	UNDER FRIQUANCY	BLACK OUT
GOFA-04	4/12/2006	3:45	4:10	0:25	0.416667	UNDER FRIQUANCY	BLACK OUT
GOFA-05	4/12/2006	3:45	4:10	0:25	0.416667	UNDER FRIQUANCY	BLACK OUT
GOFA-06	4/12/2006	3:45	4:10	0:25	0.416667	UNDER FRIQUANCY	BLACK OUT
SEB-02	4/12/2006	3:45	4:15	0:30	0.5	UNDER FRIQUANCY	BLACK OUT
SEB-03	4/12/2006	3:45	4:15	0:30	0.5	UNDER FRIQUANCY	BLACK OUT
SEB-04	4/12/2006	3:45	4:15	0:30	0.5	UNDER FRIQUANCY	BLACK OUT
SEB-05	4/12/2006	3:45	4:15	0:30	0.5	UNDER FRIQUANCY	BLACK OUT
SEB-06	4/12/2006	3:45	4:15	0:30	0.5	UNDER FRIQUANCY	BLACK OUT
SEB-07	4/12/2006	3:45	4:15	0:30	0.5	UNDER FRIQUANCY	BLACK OUT
SEB-08	4/12/2006	3:45	4:15	0:30	0.5	UNDER FRIQUANCY	BLACK OUT
SEB-09	4/12/2006	3:45	4:15	0:30	0.5	UNDER FRIQUANCY	BLACK OUT
ADC-03	4/12/2006	3:45	4:00	0:15	0.25	UNDER FRIQUANCY	BLACK OUT
ADC-04	4/12/2006	3:45	4:00	0:15	0.25	UNDER FRIQUANCY	BLACK OUT
ADC-05	4/12/2006	3:45	4:00	0:15	0.25	UNDER FRIQUANCY	BLACK OUT
ADC-07	4/12/2006	3:45	4:00	0:15	0.25	UNDER FRIQUANCY	BLACK OUT
ADC-08	4/12/2006	3:45	4:00	0:15	0.25	UNDER FRIQUANCY	BLACK OUT
ADC-09	4/12/2006	3:45	4:00	0:15	0.25	UNDER FRIQUANCY	BLACK OUT
ADC-10	4/12/2006	3:45	4:00	0:15	0.25	UNDER FRIQUANCY	BLACK OUT
ADC-11	4/12/2006	3:45	4:00	0:15	0.25	UNDER FRIQUANCY	BLACK OUT

ADC-14	4/12/2006	3:45	4:00	0:15	0.25	UNDER FRIQUANCY	BLACK OUT
ADC-15	4/12/2006	3:45	4:00	0:15	0.25	UNDER FRIQUANCY	BLACK OUT
ADC-16	4/12/2006	3:45	4:00	0:15	0.25	UNDER FRIQUANCY	BLACK OUT
NIF-01	4/12/2006	3:45	4:25	0:40	0.666667	UNDER FRIQUANCY	BLACK OUT
NIF-02	4/12/2006	3:45	4:25	0:40	0.666667	UNDER FRIQUANCY	BLACK OUT
NIF-03	4/12/2006	3:45	4:25	0:40	0.666667	UNDER FRIQUANCY	BLACK OUT
NIF-04	4/12/2006	3:45	4:25	0:40	0.666667	UNDER FRIQUANCY	BLACK OUT
ADE-02	4/12/2006	3:45	4:40	0:55	0.916667	UNDER FRIQUANCY	BLACK OUT
ADE-03	4/12/2006	3:45	4:40	0:55	0.916667	UNDER FRIQUANCY	BLACK OUT
ADE-05	4/12/2006	3:45	4:40	0:55	0.916667	UNDER FRIQUANCY	BLACK OUT
COT-01	4/12/2006	3:45	4:40	0:55	0.916667	UNDER FRIQUANCY	BLACK OUT
COT-02	4/12/2006	3:45	4:40	0:55	0.916667	UNDER FRIQUANCY	BLACK OUT
COT-03	4/12/2006	3:45	4:40	0:55	0.916667	UNDER FRIQUANCY	BLACK OUT
COT-05	4/12/2006	3:45	4:40	0:55	0.916667	UNDER FRIQUANCY	BLACK OUT
AKAK-I-01	4/12/2006	3:45	4:40	0:55	0.916667	UNDER FRIQUANCY	BLACK OUT
AKAK-I-02	4/12/2006	3:45	4:40	0:55	0.916667	UNDER FRIQUANCY	BLACK OUT
AKAK-I-03	4/12/2006	3:45	4:40	0:55	0.916667	UNDER FRIQUANCY	BLACK OUT
AKAK-I-04	4/12/2006	3:45	4:40	0:55	0.916667	UNDER FRIQUANCY	BLACK OUT
AKAK-II-01	4/12/2006	3:45	4:40	0:55	0.916667	UNDER FRIQUANCY	BLACK OUT
AKAK-II-02	4/12/2006	3:45	4:40	0:55	0.916667	UNDER FRIQUANCY	BLACK OUT
AKAK-II-03	4/12/2006	3:45	4:40	0:55	0.916667	UNDER FRIQUANCY	BLACK OUT
AKAK-II-06	4/12/2006	3:45	4:40	0:55	0.916667	UNDER FRIQUANCY	BLACK OUT
AKAK-II-07	4/12/2006	3:45	4:40	0:55	0.916667	UNDER FRIQUANCY	BLACK OUT
KAL-II-01	4/12/2006	3:45	4:45	1:00	1	UNDER FRIQUANCY	BLACK OUT
KAL-II-02	4/12/2006	3:45	4:45	1:00	1	UNDER FRIQUANCY	BLACK OUT
KAL-II-03	4/12/2006	3:45	4:45	1:00	1	UNDER	BLACK OUT

						FRIQUANCY	
KAL-II-04	4/12/2006	3:45	4:45	1:00	1	UNDER FRIQUANCY	BLACK OUT
KAL-II-05	4/12/2006	3:45	4:45	1:00	1	UNDER FRIQUANCY	BLACK OUT
KAL-II-06	4/12/2006	3:45	4:45	1:00	1	UNDER FRIQUANCY	BLACK OUT
WER-03	4/12/2006	3:45	4:45	1:00	1	UNDER FRIQUANCY	BLACK OUT
WER-04	4/12/2006	3:45	4:45	1:00	1	UNDER FRIQUANCY	BLACK OUT
WER-05	4/12/2006	3:45	4:45	1:00	1	UNDER FRIQUANCY	BLACK OUT
WER-06	4/12/2006	3:45	4:45	1:00	1	UNDER FRIQUANCY	BLACK OUT
WER-07	4/12/2006	3:45	4:45	1:00	1	UNDER FRIQUANCY	BLACK OUT
WER-08	4/12/2006	3:45	4:45	1:00	1	UNDER FRIQUANCY	BLACK OUT
WER-09	4/12/2006	3:45	4:45	1:00	1	UNDER FRIQUANCY	BLACK OUT
WER-10	4/12/2006	3:45	4:45	1:00	1	UNDER FRIQUANCY	BLACK OUT
WER-11	4/12/2006	3:45	4:45	1:00	1	UNDER FRIQUANCY	BLACK OUT
WER-12	4/12/2006	3:45	4:45	1:00	1	UNDER FRIQUANCY	BLACK OUT
ADW-01	4/12/2006	3:45	4:50	1:05	1.083333	UNDER FRIQUANCY	BLACK OUT
ADW-02	4/12/2006	3:45	4:50	1:05	1.083333	UNDER FRIQUANCY	BLACK OUT
ADW-03	4/12/2006	3:45	4:50	1:05	1.083333	UNDER FRIQUANCY	BLACK OUT
ADW-04	4/12/2006	3:45	4:50	1:05	1.083333	UNDER FRIQUANCY	BLACK OUT
ADW-05	4/12/2006	3:45	4:50	1:05	1.083333	UNDER FRIQUANCY	BLACK OUT
ADW-06	4/12/2006	3:45	4:50	1:05	1.083333	UNDER FRIQUANCY	BLACK OUT
LEG-03	4/12/2006	3:45	4:40	0:55	0.916667	UNDER FRIQUANCY	BLACK OUT
LEG-04	4/12/2006	3:45	4:40	0:55	0.916667	UNDER FRIQUANCY	BLACK OUT
LEG-08	4/12/2006	3:45	4:40	0:55	0.916667	UNDER FRIQUANCY	BLACK OUT
GEF-02	4/12/2006	4:15	4:17	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
GEF-01	4/12/2006	6:20		17:40	17.66667	OPERATION	BYREQUEST
SEB-II-03	4/12/2006	6:55	6:57	0:02	0.033333	TRANSIENT	EARTHFAULT
GEF-02	4/12/2006	7:10	11:55	4:45	4.75	PERMANENT	SHORT

							CIRCUIT
KAL-N-TTL	4/12/2006	9:45	12:45	3:00	3	OPERATION	BYREQUEST
ADN-03	4/12/2006	7:05	9:10	2:05	2.083333	PERMANENT	EARTHFAULT
ADN-06	4/12/2006	7:05	7:07	0:02	0.033333	TRANSIENT	EARTHFAULT
GOFA-04	4/12/2006	7:45	7:47	0:02	0.033333	TRANSIENT	EARTHFAULT
KAL-II-06	4/12/2006	7:50	7:52	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-07	4/12/2006	8:10	8:14	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
SEB-07	4/12/2006	9:00	9:02	0:02	0.033333	OUTGOING FEEDER	OVER LOAD
KAL-II-04	4/12/2006	9:30	12:30	3:00	3	TRAFO	OVER LOAD
SEB-07	4/12/2006	9:45	9:49	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
SEB-09	4/12/2006	10:00	10:04	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
SEB-07	4/12/2006	10:10	11:10	1:00	1	OUTGOING FEEDER	OVER LOAD
SEB-07	4/12/2006	14:00	14:15	0:15	0.25	OPERATION	BYREQUEST
SEB-09	4/12/2006	10:28	10:30	0:02	0.033333	OUTGOING FEEDER	OVER LOAD
MEK-06	4/12/2006	10:30	10:32	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
AKAK-II-06	4/12/2006	10:35	10:37	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-09	4/12/2006	10:45	12:20	1:35	1.583333	OUTGOING FEEDER	OVER LOAD
AKAK-I-01	4/12/2006	10:50	16:40	5:50	5.833333	PERMANENT	SHORT CIRCUIT
ADW-06	4/12/2006	11:30	13:20	1:50	1.833333	TRAFO	OVER LOAD
LEG-03	4/12/2006	11:35	12:50	1:15	1.25	OPERATION	BYREQUEST
SEB-II-03	4/12/2006	11:40	11:42	0:02	0.033333	TRANSIENT	EARTHFAULT
ADN-01	4/12/2006	11:45	11:49	0:04	0.066667	TRAFO	OVER LOAD
KAL-II-06	4/12/2006	12:05	12:27	0:22	0.366667	OUTGOING FEEDER	OVER LOAD
ADC-09	4/12/2006	12:15	12:19	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
SEB-04	4/12/2006	12:15	12:17	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADW-01	4/12/2006	12:35	12:37	0:02	0.033333	TRAFO	OVER LOAD
SEB-09	4/12/2006	13:15	13:17	0:02	0.033333	OUTGOING FEEDER	OVER LOAD
SEB-II-03	4/12/2006	13:20	13:35	0:15	0.25	PERMANENT	SHORT CIRCUIT
SEB-02	4/12/2006	13:20	13:25	0:05	0.083333	OPERATION	BYREQUEST
SEB-04	4/12/2006	14:25	14:27	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-04	4/12/2006	14:30	14:58	0:28	0.466667	OPERATION	BYREQUEST
ADC-15	4/12/2006	14:30	14:58	0:28	0.466667	OPERATION	BYREQUEST
SEB-04	4/12/2006	15:23	15:25	0:02	0.033333	TRANSIENT	EARTHFAULT

GEF-03	4/12/2006	15:30	17:43	2:13	2.216667	PERMANENT	SHORT CIRCUIT
COT-05	4/12/2006	17:43	18:05	0:22	0.366667	OPERATION	BYREQUEST
GEF-03	4/12/2006	18:05	18:20	0:15	0.25	OPERATION	BYREQUEST
SEB-04	4/12/2006	15:00	17:47	2:47	2.783333	PERMANENT	EARTHFAULT
SUL-06	4/12/2006	16:00	16:02	0:02	0.033333	TRANSIENT	EARTHFAULT
MEK-03	4/12/2006	17:20	18:37	1:17	1.283333	PERMANENT	SHORT CIRCUIT
MEK-03	4/12/2006	18:37	18:40	0:03	0.05	OPERATION	BYREQUEST
COT-04	4/12/2006	17:53	17:55	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEB-02	4/12/2006	18:45	20:05	1:20	1.333333	OUTGOING FEEDER	OVER LOAD
ADW-02	4/12/2006	18:45	20:05	1:20	1.333333	OUTGOING FEEDER	OVER LOAD
COT-03	4/12/2006	18:45	20:20	1:35	1.583333	OUTGOING FEEDER	OVER LOAD
SEB-03	4/12/2006	18:45	18:49	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
ADW-03	4/12/2006	18:50	20:10	1:20	1.333333	OUTGOING FEEDER	OVER LOAD
WER-08	4/12/2006	18:55	19:10	0:15	0.25	OUTGOING FEEDER	OVER LOAD
GOFA-03	4/12/2006	18:55	20:05	1:10	1.166667	OPERATION	BYREQUEST
SEB-03	4/12/2006	19:00	19:04	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
GEF-04	4/12/2006	19:00	20:15	1:15	1.25	OUTGOING FEEDER	OVER LOAD
SEB-04	4/12/2006	19:15	19:25	0:10	0.166667	UNDER FRIQUANCY	BLACK OUT
KAL-II-04	4/12/2006	19:25	21:00	1:35	1.583333	UNDER FRIQUANCY	BLACK OUT
KAL-II-05	4/12/2006	19:15	19:30	0:15	0.25	UNDER FRIQUANCY	BLACK OUT
KAL-N-K7	4/12/2006	19:30	21:05	1:35	1.583333	UNDER FRIQUANCY	BLACK OUT
WER-06	4/12/2006	19:15	19:55	0:40	0.666667	UNDER FRIQUANCY	BLACK OUT
SEB-06	4/12/2006	19:30	20:05	0:35	0.583333	UNDER FRIQUANCY	BLACK OUT
SEB-03	4/12/2006	19:15	19:30	0:15	0.25	UNDER FRIQUANCY	BLACK OUT
KAL-N-K4	4/12/2006	19:15	19:30	0:15	0.25	UNDER FRIQUANCY	BLACK OUT
COT-05	4/12/2006	19:15	19:30	0:15	0.25	UNDER FRIQUANCY	BLACK OUT
KAL-II-05	4/12/2006	19:15	19:30	0:15	0.25	UNDER FRIQUANCY	BLACK OUT
KAL-II-01	4/12/2006	19:30	21:00	1:30	1.5	UNDER FRIQUANCY	BLACK OUT

WER-03	4/12/2006	19:35	20:55	1:20	1.333333	UNDER FRIQUANCY	BLACK OUT
KAL-II-02	4/12/2006	19:35	20:55	1:20	1.333333	UNDER FRIQUANCY	BLACK OUT
AKAK-I-03	4/12/2006	19:35	21:25	1:50	1.833333	UNDER FRIQUANCY	BLACK OUT
AKAK-II-03	4/12/2006	19:35	21:25	1:50	1.833333	UNDER FRIQUANCY	BLACK OUT
AKAK-II-07	4/12/2006	19:35	21:25	1:50	1.833333	UNDER FRIQUANCY	BLACK OUT
GEF-01	4/12/2006	19:15	19:45	0:30	0.5	UNDER FRIQUANCY	BLACK OUT
GEF-02	4/12/2006	19:15	19:45	0:30	0.5	UNDER FRIQUANCY	BLACK OUT
ADN-05	4/12/2006	19:15	19:50	0:35	0.583333	UNDER FRIQUANCY	BLACK OUT
ADW-06	4/12/2006	19:15	20:05	0:50	0.833333	UNDER FRIQUANCY	BLACK OUT
MEK-05	4/12/2006	19:15	19:30	0:15	0.25	UNDER FRIQUANCY	BLACK OUT
MEK-06	4/12/2006	19:30	20:15	0:45	0.75	UNDER FRIQUANCY	BLACK OUT
KAL-N-K5	4/12/2006	19:15	21:05	1:50	1.833333	UNDER FRIQUANCY	BLACK OUT
KAL-I-F13	4/12/2006	19:15	21:25	2:10	2.166667	UNDER FRIQUANCY	BLACK OUT
SEB-07	4/12/2006	19:50	19:54	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
ADN-03	4/12/2006	19:55	20:10	0:15	0.25	OPERATION	BYREQUEST
SEB-04	4/12/2006	20:15	20:19	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
ADC-10	4/13/2006	0:00	6:30	6:30	6.5	OPERATION	BYREQUEST
ADC-15	4/13/2006	0:00	6:30	6:30	6.5	OPERATION	BYREQUEST
ADN-06	4/13/2006	1:00	1:02	0:02	0.033333	TRANSIENT	EARTHFAULT
GOFA-03	4/13/2006	3:40	4:15	0:35	0.583333	OPERATION	BYREQUEST
GOFA-03	4/13/2006	7:45	8:25	0:40	0.666667	OPERATION	BYREQUEST
SEB-II-TTL	4/13/2006	6:15	17:00	10:45	10.75	OPERATION	BYREQUEST
ADW-02	4/13/2006	6:40	10:50	4:10	4.166667	OPERATION	BYREQUEST
ADW-04	4/13/2006	6:40	10:50	4:10	4.166667	OPERATION	BYREQUEST
ADC-10	4/13/2006	6:40	10:25	3:45	3.75	PERMANENT	SHORT CIRCUIT
GEF-02	4/13/2006	6:50	6:52	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
MEK-01	4/13/2006	6:55	6:57	0:02	0.033333	TRANSIENT	EARTHFAULT
MEK-05	4/13/2006	6:55	6:57	0:02	0.033333	TRANSIENT	EARTHFAULT
GEF-02	4/13/2006	7:05	7:07	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADN-06	4/13/2006	8:00	8:02	0:02	0.033333	TRANSIENT	EARTHFAULT

COT-33	4/13/2006	8:10	8:12	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADN-04	4/13/2006	8:10	8:12	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-09	4/13/2006	8:30	8:32	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
BELLA-04	4/13/2006	9:50	10:03	0:13	0.216667	OPERATION	BYREQUEST
ADC-04	4/13/2006	9:50	9:52	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-10	4/13/2006	10:13	11:15	1:02	1.033333	PERMANENT	SHORT CIRCUIT
ADC-10	4/13/2006	12:20	12:22	0:02	0.033333	TRANSIENT	EARTHFAULT
MEK-01	4/13/2006	11:10	12:10	1:00	1	OPERATION	BYREQUEST
MEK-03	4/13/2006	11:10	12:10	1:00	1	OPERATION	BYREQUEST
MEK-03	4/13/2006	11:10	12:40	1:30	1.5	OPERATION	BYREQUEST
KAL-N-K5	4/13/2006	13:55	13:57	0:02	0.033333	TRANSIENT	EARTHFAULT
KAL-II-04	4/13/2006	14:10	14:12	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
LEG-03	4/13/2006	14:28	17:17	2:49	2.816667	OPERATION	BYREQUEST
LEG-03	4/13/2006	17:17	19:10	1:53	1.883333	OPERATION	BYREQUEST
COT-33	4/13/2006	15:15	15:17	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEB-04	4/13/2006	13:15	15:25	2:10	2.166667	PERMANENT	SHORT CIRCUIT
GEF-02	4/13/2006	15:25	15:40	0:15	0.25	OPERATION	BYREQUEST
COT-04	4/13/2006	15:40	15:42	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
COT-04	4/13/2006	15:45	18:15	2:30	2.5	PERMANENT	EARTHFAULT
KAL-I-F13	4/13/2006	15:45	16:55	1:10	1.166667	OPERATION	BYREQUEST
ADW-05	4/13/2006	15:50	15:52	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-09	4/13/2006	15:55	15:57	0:02	0.033333	TRANSIENT	EARTHFAULT
COT-03	4/13/2006	16:20	16:30	0:10	0.166667	OPERATION	BYREQUEST
SEB-09	4/13/2006	17:00	17:02	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADN-02	4/13/2006	18:15	18:20	0:05	0.083333	OPERATION	BYREQUEST
LEG-03	4/14/2006	5:22	8:00	2:38	2.633333	OPERATION	BYREQUEST
ADN-05	4/14/2006	7:00	9:35	2:35	2.583333	PERMANENT	SHORT CIRCUIT
ADN-05	4/14/2006	14:50	14:58	0:08	0.133333	OPERATION	BYREQUEST
ADC-05	4/14/2006	7:00	8:00	1:00	1	PERMANENT	SHORT CIRCUIT
ADC-04	4/14/2006	7:15	7:17	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-10	4/14/2006	8:02	8:04	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
AKAK-II-06	4/14/2006	9:15	9:17	0:02	0.033333	TRANSIENT	EARTHFAULT
COT-33	4/14/2006	9:45	9:55	0:10	0.166667	OPERATION	BYREQUEST
ADE-02	4/14/2006	9:45	9:47	0:02	0.033333	TRANSIENT	EARTHFAULT
WER-06	4/14/2006	10:00	10:02	0:02	0.033333	TRANSIENT	EARTHFAULT

WER-09	4/14/2006	10:00	10:02	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-10	4/14/2006	10:05	10:07	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-II-03	4/14/2006	10:10	10:12	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-10	4/14/2006	10:15	10:20	0:05	0.083333	PERMANENT	EARTHFAULT
COT-33	4/14/2006	10:25	10:27	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-10	4/14/2006	10:45	11:35	0:50	0.833333	PERMANENT	SHORT CIRCUIT
SEB-07	4/14/2006	11:05	11:09	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
ADC-14	4/14/2006	12:07	12:25	0:18	0.3	OPERATION	BYREQUEST
GOFA-01	4/14/2006	12:15	12:17	0:02	0.033333	TRANSIENT	EARTHFAULT
GEF-02	4/14/2006	13:54	14:02	0:08	0.133333	OPERATION	BYREQUEST
ADN-03	4/14/2006	14:00	17:00	3:00	3	PERMANENT	SHORT CIRCUIT
NIF-03	4/14/2006	14:30		9:30	9.5	PERMANENT	SHORT CIRCUIT
WER-04	4/14/2006	14:33	14:35	0:02	0.033333	TRANSIENT	EARTHFAULT
ADE-02	4/14/2006	15:00	15:02	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-II-03	4/14/2006	16:00	16:10	0:10	0.166667	OPERATION	BYREQUEST
MEK-05	4/14/2006	15:55	15:57	0:02	0.033333	TRANSIENT	EARTHFAULT
SUL-03	4/14/2006	15:45	16:35	0:50	0.833333	OPERATION	BYREQUEST
SEB-07	4/14/2006	15:50	15:54	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
WER-05	4/14/2006	16:10	16:55	0:45	0.75	PERMANENT	SHORT CIRCUIT
WER-12	4/14/2006	16:15	16:17	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
GOFA-03	4/14/2006	16:45	16:47	0:02	0.033333	TRANSIENT	EARTHFAULT
WER-12	4/14/2006	17:10	17:25	0:15	0.25	OPERATION	BYREQUEST
ADN-04	4/14/2006	17:40		6:20	6.333333	PERMANENT	EARTHFAULT
SEB-07	4/14/2006	17:50	17:52	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADN-01	4/14/2006	18:25	20:55	2:30	2.5	PERMANENT	EARTHFAULT
GOFA-02	4/14/2006	18:43	20:55	2:12	2.2	TRAFO	OVER LOAD
WER-06	4/14/2006	18:45	19:40	0:55	0.916667	TRAFO	OVER LOAD
WER-06	4/14/2006	21:30	21:32	0:02	0.033333	OPERATION	BYREQUEST
GEF-02	4/14/2006	18:45	20:25	1:40	1.666667	TRAFO	OVER LOAD
ADW-04	4/14/2006	18:45	20:03	1:18	1.3	TRAFO	OVER LOAD
GEF-07	4/14/2006	18:55	18:59	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
GEF-07	4/14/2006	19:00	19:04	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
LEG-08	4/14/2006	19:05	21:00	1:55	1.916667	PERMANENT	SHORT CIRCUIT
SEB-04	4/14/2006	19:10	22:00	2:50	2.833333	OUTGOING FEEDER	OVER LOAD

MEK-01	4/14/2006	19:20	20:25	1:05	1.083333	OUTGOING FEEDER	OVER LOAD
GEF-07	4/14/2006	19:10	20:20	1:10	1.166667	TRAFO	OVER LOAD
GEF-07	4/14/2006	21:35	21:40	0:05	0.083333	OPERATION	BYREQUEST
SEB-07	4/14/2006	19:45	19:47	0:02	0.033333	OUTGOING FEEDER	OVER LOAD
SEB-03	4/14/2006	22:40	22:45	0:05	0.083333	OPERATION	BYREQUEST
COT-03	4/14/2006	23:00	23:05	0:05	0.083333	OPERATION	BYREQUEST
KAL-I-F13	4/15/2006	4:40	7:28	2:48	2.8	OPERATION	BYREQUEST
LEG-03	4/15/2006	5:33	9:15	3:42	3.7	OPERATION	BYREQUEST
LEG-08	4/15/2006	5:33	9:15	3:42	3.7	OPERATION	BYREQUEST
WER-04	4/15/2006	6:35	6:37	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-04	4/15/2006	6:55	6:57	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
COT-04	4/15/2006	7:40	11:10	3:30	3.5	PERMANENT	SHORT CIRCUIT
SEB-09	4/15/2006	7:45	7:47	0:02	0.033333	TRANSIENT	EARTHFAULT
GOFA-05	4/15/2006	7:50	7:52	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADW-03	4/15/2006	8:00	8:02	0:02	0.033333	TRANSIENT	EARTHFAULT
AKAK-II-06	4/15/2006	8:20	8:22	0:02	0.033333	TRANSIENT	EARTHFAULT
GOFA-03	4/15/2006	8:35	8:37	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-07	4/15/2006	9:20	9:24	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
SEB-07	4/15/2006	10:15	13:05	2:50	2.833333	OUTGOING FEEDER	OVER LOAD
SEB-09	4/15/2006	10:20	10:24	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
KAL-N-K7	4/15/2006	10:32	10:40	0:08	0.133333	OUTGOING FEEDER	OVER LOAD
NIF-01	4/15/2006	10:35	13:00	2:25	2.416667	OUTGOING FEEDER	OVER LOAD
ADC-09	4/15/2006	11:05	12:40	1:35	1.583333	OUTGOING FEEDER	OVER LOAD
ADC-11	4/15/2006	10:40	10:42	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-09	4/15/2006	11:00	11:04	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
SEB-03	4/15/2006	11:02	11:04	0:02	0.033333	TRANSIENT	EARTHFAULT
AKAK-II-03	4/15/2006	11:15	11:17	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-09	4/15/2006	11:20	12:10	0:50	0.833333	OUTGOING FEEDER	OVER LOAD
ADW-06	4/15/2006	11:30	12:55	1:25	1.416667	OUTGOING FEEDER	OVER LOAD
WER-08	4/15/2006	11:40	11:45	0:05	0.083333	OPERATION	BYREQUEST
COT-04	4/15/2006	11:42	11:44	0:02	0.033333	TRANSIENT	EARTHFAULT
LEG-03	4/15/2006	12:20	12:22	0:02	0.033333	TRANSIENT	EARTHFAULT
LEG-03	4/15/2006	13:20	14:52	1:32	1.533333	PERMANENT	SHORT

							CIRCUIT
LEG-03	4/15/2006	17:15	17:20	0:05	0.083333	OPERATION	BYREQUEST
COT-33	4/15/2006	14:10	14:12	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-07	4/15/2006	15:23	15:27	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
SEB-II-03	4/15/2006	15:30	15:32	0:02	0.033333	TRANSIENT	EARTHFAULT
BELLA-02	4/15/2006	15:50	18:00	2:10	2.166667	PERMANENT	SHORT CIRCUIT
ADC-09	4/15/2006	16:00	16:02	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-07	4/15/2006	16:00	16:04	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
ADC-14	4/15/2006	14:30	17:05	2:35	2.583333	PERMANENT	SHORT CIRCUIT
COT-03	4/15/2006	17:05	17:25	0:20	0.333333	OPERATION	BYREQUEST
LEG-03	4/15/2006	17:35	17:37	0:02	0.033333	TRANSIENT	EARTHFAULT
ADN-05	4/15/2006	18:35	19:58	1:23	1.383333	OUTGOING FEEDER	OVER LOAD
ADW-03	4/15/2006	18:35	19:45	1:10	1.166667	SOL	SOL
SEB-07	4/15/2006	18:35	19:45	1:10	1.166667	SOL	SOL
GEF-01	4/15/2006	18:35	20:10	1:35	1.583333	TRAFO	OVER LOAD
WER-07	4/15/2006	18:40	21:10	2:30	2.5	TRAFO	OVER LOAD
GOFA-04	4/15/2006	18:40	20:15	1:35	1.583333	TRAFO	OVER LOAD
ADC-09	4/15/2006	18:48	18:52	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
ADN-04	4/15/2006	18:50	18:55	0:05	0.083333	OUTGOING FEEDER	OVER LOAD
ADN-04	4/15/2006	21:02	21:05	0:03	0.05	OPERATION	BYREQUEST
SEB-04	4/15/2006	18:55	18:59	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
COT-01	4/15/2006	19:03	20:10	1:07	1.116667	TRAFO	OVER LOAD
NIF-01	4/15/2006	19:05	20:30	1:25	1.416667	OUTGOING FEEDER	OVER LOAD
ADC-09	4/15/2006	19:08	20:15	1:07	1.116667	OUTGOING FEEDER	OVER LOAD
ADW-01	4/15/2006	19:10	19:55	0:45	0.75	TRAFO	OVER LOAD
SEB-04	4/15/2006	19:10	20:35	1:25	1.416667	OUTGOING FEEDER	OVER LOAD
COT-04	4/15/2006	19:10	19:12	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
KAL-N-K5	4/15/2006	19:12	19:16	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
SUL-06	4/15/2006	20:05	20:07	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-09	4/15/2006	20:10	20:14	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
ADC-09	4/15/2006	20:48	20:52	0:04	0.066667	OUTGOING FEEDER	OVER LOAD
SUL-02	4/16/2006	0:10	1:05	0:55	0.916667	OPERATION	BYREQUEST

SUL-06	4/16/2006	6:40	6:42	0:02	0.033333	TRANSIENT	EARTHFAULT
AKAK-II-07	4/16/2006	6:45	6:47	0:02	0.033333	PERMANENT	SHORT CIRCUIT
ADW-01	4/16/2006	6:50	6:52	0:02	0.033333	TRANSIENT	EARTHFAULT
BELLA-05	4/16/2006	6:45	6:47	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADC-03	4/16/2006	7:05	7:07	0:02	0.033333	TRANSIENT	EARTHFAULT
SUL-06	4/16/2006	7:50	7:52	0:02	0.033333	TRANSIENT	EARTHFAULT
ADN-04	4/16/2006	7:50	7:52	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADC-07	4/16/2006	7:55	10:20	2:25	2.416667	PERMANENT	EARTHFAULT
ADC-09	4/16/2006	7:55	9:05	1:10	1.166667	PERMANENT	SHORT CIRCUIT
COT-33	4/16/2006	8:20	8:22	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADW-02	4/16/2006	8:05	8:07	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-07	4/16/2006	8:35	8:37	0:02	0.033333	OUTGOING FEEDER	OVER LOAD
GOFA-04	4/16/2006	7:50	8:45	0:55	0.916667	TRIP BREAKER	TRIP BREAKER
KAL-II-04	4/16/2006	9:00	9:02	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-07	4/16/2006	9:40	9:42	0:02	0.033333	OUTGOING FEEDER	OVER LOAD
SEB-09	4/16/2006	9:42	9:44	0:02	0.033333	OUTGOING FEEDER	OVER LOAD
NIF-01	4/16/2006	9:55	9:57	0:02	0.033333	OUTGOING FEEDER	OVER LOAD
SEB-09	4/16/2006	10:15	10:17	0:02	0.033333	OUTGOING FEEDER	OVER LOAD
ADN-03	4/16/2006	10:15	10:20	0:05	0.083333	TRIP BREAKER	TRIP BREAKER
SEB-05	4/16/2006	10:30	11:10	0:40	0.666667	OPERATION	BYREQUEST
LEG-03	4/16/2006	10:35	10:50	0:15	0.25	OPERATION	BYREQUEST
MEK-02	4/16/2006	10:38	10:50	0:12	0.2	OPERATION	BYREQUEST
NIF-01	4/16/2006	10:38	13:40	3:02	3.033333	TRAFO	OVER LOAD
SEB-07	4/16/2006	10:40	11:10	0:30	0.5	OPERATION	BYREQUEST
WER-06	4/16/2006	10:45	10:47	0:02	0.033333	TRANSIENT	EARTHFAULT
WER-09	4/16/2006	10:45	10:47	0:02	0.033333	TRANSIENT	EARTHFAULT
COT-04	4/16/2006	10:52	12:50	1:58	1.966667	PERMANENT	SHORT CIRCUIT
SEB-04	4/16/2006	11:05	11:07	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-05	4/16/2006	11:05	13:00	1:55	1.916667	TRAFO	OVER LOAD
SUL-01	4/16/2006	11:05	11:07	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-09	4/16/2006	11:11	12:10	0:59	0.983333	OUTGOING FEEDER	OVER LOAD
COT-33	4/16/2006	11:25	11:27	0:02	0.033333	TRANSIENT	EARTHFAULT
GEF-01	4/16/2006	11:40	11:55	0:15	0.25	OPERATION	BYREQUEST

SEB-04	4/16/2006	11:55	12:10	0:15	0.25	OPERATION	BYREQUEST
SEB-09	4/16/2006	12:25	12:27	0:02	0.033333	OUTGOING FEEDER	OVER LOAD
SEB-07	4/16/2006	12:25	12:27	0:02	0.033333	OUTGOING FEEDER	OVER LOAD
MEK-05	4/16/2006	13:45	13:47	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
COT-33	4/16/2006	13:35	13:37	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
WER-08	4/16/2006	13:35	13:37	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-07	4/16/2006	14:50	14:52	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SUL-01	4/16/2006	14:50	14:52	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEB-07	4/16/2006	15:25	15:27	0:02	0.033333	OUTGOING FEEDER	OVER LOAD
SEB-05	4/16/2006	16:00	16:02	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-09	4/16/2006	16:32	16:34	0:02	0.033333	TRANSIENT	EARTHFAULT
SUL-03	4/16/2006	16:50	16:52	0:02	0.033333	OPERATION	BYREQUEST
ADC-09	4/16/2006	16:50	16:52	0:02	0.033333	TRANSIENT	EARTHFAULT
SUL-02	4/16/2006	16:20	17:35	1:15	1.25	OPERATION	BYREQUEST
SEB-09	4/16/2006	18:40	20:10	1:30	1.5	OUTGOING FEEDER	OVER LOAD
GOFA-03	4/16/2006	18:40	20:20	1:40	1.666667	SOL	SOL
ADW-02	4/16/2006	19:00	20:10	1:10	1.166667	SOL	SOL
ADW-04	4/16/2006	18:50	20:18	1:28	1.466667	TRAFO	OVER LOAD
GEF-04	4/16/2006	18:57	20:03	1:06	1.1	TRAFO	OVER LOAD
SEB-04	4/16/2006	18:58	19:00	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
COT-04	4/16/2006	19:04	20:03	0:59	0.983333	PERMANENT	SHORT CIRCUIT
SEB-02	4/16/2006	19:15	20:35	1:20	1.333333	TRAFO	OVER LOAD
LEG-04	4/16/2006	18:15	18:17	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
AKA-II-06	4/16/2006	19:35	19:37	0:02	0.033333	TRANSIENT	EARTHFAULT
ADW-04	4/16/2006	20:40	20:42	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADN-01	4/16/2006	20:00	7:25	11:25	11.41667	TRIP BREAKER	TRIP BREAKER
COT-33	4/16/2006	22:25	22:27	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SUL-02	4/16/2006	22:25	22:40	0:15	0.25	OPERATION	BYREQUEST
BELLA-01	4/16/2006	23:25	2:10	2:45	2.75	OPERATION	BYREQUEST
LEG-08	4/17/2006	6:00	8:00	2:00	2	OPERATION	BYREQUEST
COT-33	4/17/2006	6:30	6:32	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
GEF-01	4/17/2006	6:40	10:10	3:30	3.5	OPERATION	BYREQUEST

KAL-N-K2	4/17/2006	7:20	7:22	0:02	0.033333	TRANSIENT	EARTHFAULT
ADN-06	4/17/2006	7:35	7:37	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-II-03	4/17/2006	7:50	7:52	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
LEG-08	4/17/2006	8:20	12:05	3:45	3.75	PERMANENT	SHORT CIRCUIT
COT-04	4/17/2006	8:25	8:27	0:02	0.033333	TRANSIENT	EARTHFAULT
COT-05	4/17/2006	8:25	8:27	0:02	0.033333	TRANSIENT	EARTHFAULT
ADW-02	4/17/2006	8:35	8:37	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-06	4/17/2006	8:40	8:42	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SEB-07	4/17/2006	8:40	8:42	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SEB-08	4/17/2006	8:40	8:42	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
COT-04	4/17/2006	8:55	8:57	0:02	0.033333	TRANSIENT	EARTHFAULT
SUL-01	4/17/2006	8:55	8:57	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-03	4/17/2006	9:05	9:07	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-06	4/17/2006	9:50	9:52	0:02	0.033333	TRAFO	OVER LOAD
SEB-07	4/17/2006	9:50	9:52	0:02	0.033333	TRAFO	OVER LOAD
SEB-08	4/17/2006	9:50	9:52	0:02	0.033333	TRAFO	OVER LOAD
SEB-09	4/17/2006	9:55	9:57	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SEB-09	4/17/2006	10:25	10:27	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
ADC-11	4/17/2006	11:00	11:02	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SEB-07	4/17/2006	11:00	15:50	4:50	4.833333	OUTGOING FEEDER	OVERLOAD
ADC-09	4/17/2006	11:05	14:10	3:05	3.083333	TRAFO	OVER LOAD
ADC-11	4/17/2006	11:15	11:17	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
KAL-II-02	4/17/2006	11:15	12:10	0:55	0.916667	TRAFO	OVER LOAD
SEB-09	4/17/2006	11:25	11:27	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
ADW-04	4/17/2006	11:35	12:28	0:53	0.883333	TRAFO	OVER LOAD
ADC-11	4/17/2006	11:40	12:10	0:30	0.5	OUTGOING FEEDER	OVERLOAD
GEF-04	4/17/2006	12:45	12:47	0:02	0.033333	TRANSIENT	EARTHFAULT
MEK-05	4/17/2006	12:55	14:40	1:45	1.75	PERMANENT	SHORT CIRCUIT
LEG-08	4/17/2006	13:15	15:45	2:30	2.5	PERMANENT	EARTHFAULT
BELLA-05	4/17/2006	14:20	14:25	0:05	0.083333	TRIP BREAKER	TRIP BREAKER
SUL-03	4/17/2006	14:20	14:22	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
BELLA-04	4/17/2006	14:25	14:27	0:02	0.033333	TRANSIENT	EARTHFAULT

BELLA-04	4/17/2006	15:15	15:45	0:30	0.5	PERMANENT	SHORT CIRCUIT
LEG-03	4/17/2006	15:50	18:20	2:30	2.5	PERMANENT	EARTHFAULT
WER-05	4/17/2006	16:20	16:22	0:02	0.033333	TRANSIENT	EARTHFAULT
WER-08	4/17/2006	16:30	16:32	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
WER-08	4/17/2006	16:45	16:47	0:02	0.033333	TRANSIENT	EARTHFAULT
MEK-06	4/17/2006	16:45	16:52	0:07	0.116667	OPERATION	BYREQUEST
ADC-07	4/17/2006	17:25	20:35	3:10	3.166667	PERMANENT	SHORT CIRCUIT
GEF-TOTAL	4/17/2006	11:35	11:35	0:00	0	TRANSIENT	
WER-07	4/17/2006	17:45	17:47	0:02	0.033333	TRANSIENT	EARTHFAULT
GEF-01	4/17/2006	18:25	20:15	1:50	1.833333	OUTGOING FEEDER	OVERLOAD
ADW-06	4/17/2006	18:45	20:35	1:50	1.833333	OUTGOING FEEDER	OVERLOAD
WER-08	4/17/2006	18:47	19:05	0:18	0.3	OUTGOING FEEDER	OVERLOAD
ADN-02	4/17/2006	18:55	20:05	1:10	1.166667	OUTGOING FEEDER	OVERLOAD
ADW-01	4/17/2006	18:55	20:10	1:15	1.25	OUTGOING FEEDER	OVERLOAD
MEK-02	4/17/2006	18:35	19:25	0:50	0.833333	SOL	SOL
KAL-I-F13	4/17/2006	18:55	20:05	1:10	1.166667	SOL	SOL
KAL-II-01	4/17/2006	18:55	20:42	1:47	1.783333	SOL	SOL
KAL-N-K2	4/17/2006	19:00	20:05	1:05	1.083333	SOL	SOL
AKA-I-03	4/17/2006	19:00	20:42	1:42	1.7	SOL	SOL
SEB-09	4/17/2006	18:45	18:47	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
ADC-09	4/17/2006	18:55	18:57	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SEB-04	4/17/2006	18:55	18:57	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
LEG04	4/17/2006	19:05	19:07	0:02	0.033333	TRANSIENT	EARTHFAULT
LEG-08	4/17/2006	19:05	19:07	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEB-04	4/17/2006	19:15	20:00	0:45	0.75	OUTGOING FEEDER	OVERLOAD
MEK-05	4/17/2006	19:20	19:25	0:05	0.083333	PERMANENT	SHORT CIRCUIT
SEB-09	4/17/2006	19:30	19:32	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SEB-07	4/17/2006	19:45	19:47	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SEB-04	4/17/2006	20:10	20:12	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SEB-04	4/17/2006	20:22	21:40	1:18	1.3	OUTGOING FEEDER	OVERLOAD

SUL-03	4/18/2006	6:25	7:05	0:40	0.666667	OPERATION	BYREQUEST
SEBII-03	4/18/2006	6:27	20:40	14:13	14.21667	PERMANENT	SHORT CIRCUIT
SEB-07	4/18/2006	6:27	8:50	2:23	2.383333	OPERATION	BYREQUEST
SEB-02	4/18/2006	6:27	8:50	2:23	2.383333	OPERATION	BYREQUEST
GEF-04	4/18/2006	7:00	7:02	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-03	4/18/2006	7:05	7:07	0:02	0.033333	TRANSIENT	EARTHFAULT
GEF-04	4/18/2006	7:20	7:22	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-09	4/18/2006	9:05	9:07	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADC-16	4/18/2006	9:15	14:05	4:50	4.833333	TRAFO	OVER LOAD
SEB-09	4/18/2006	9:30	9:32	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADN-04	4/18/2006	10:10	10:35	0:25	0.416667	OPERATION	BYREQUEST
SEB-02	4/18/2006	10:15	10:17	0:02	0.033333	TRANSIENT	
SEB-06	4/18/2006	10:15	10:17	0:02	0.033333	TRANSIENT	
SEB-07	4/18/2006	10:15	10:17	0:02	0.033333	TRANSIENT	
SEB-08	4/18/2006	10:15	10:17	0:02	0.033333	TRANSIENT	
ADC-11	4/18/2006	10:20	10:22	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
GEF-02	4/18/2006	10:25	12:30	2:05	2.083333	TRAFO	OVER LOAD
WER-06	4/18/2006	10:25	12:15	1:50	1.833333	TRAFO	OVER LOAD
SEB-09	4/18/2006	10:30	12:05	1:35	1.583333	SOL	SOL
SEB-07	4/18/2006	10:45	10:47	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
ADN-01	4/18/2006	10:45	13:15	2:30	2.5	TRAFO	OVER LOAD
ADC-11	4/18/2006	10:50	10:52	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
ADC-11	4/18/2006	10:55	12:15	1:20	1.333333	OUTGOING FEEDER	OVERLOAD
SEB-07	4/18/2006	11:15	11:17	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
ADW-04	4/18/2006	11:15	12:20	1:05	1.083333	TRAFO	OVER LOAD
AKA-II-06	4/18/2006	11:05	11:07	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADW-02	4/18/2006	12:15	13:50	1:35	1.583333	TRAFO	OVER LOAD
SEB-07	4/18/2006	13:10	13:12	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
GEF-04	4/18/2006	13:25	14:05	0:40	0.666667	TRAFO	OVER LOAD
SEB-09	4/18/2006	13:25	13:27	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
WER-08	4/18/2006	13:30	14:20	0:50	0.833333	PERMANENT	EARTHFAULT
WER-09	4/18/2006	13:30	13:32	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-09	4/18/2006	14:15	14:17	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
ADC-05	4/18/2006	14:40	14:42	0:02	0.033333	OPERATION	BYREQUEST

MEK-01	4/18/2006	14:55	14:57	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
GEF-01	4/18/2006	15:05	15:07	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-07	4/18/2006	15:05	15:07	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
GEF-04	4/18/2006	15:15	18:25	3:10	3.166667	TRAFO	OVER LOAD
SEB-07	4/18/2006	16:10	16:12	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SEB-09	4/18/2006	16:15	16:17	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
COT-03	4/18/2006	16:30	16:38	0:08	0.133333	OPERATION	BYREQUEST
SEB-04	4/18/2006	16:25	16:38	0:13	0.216667	OPERATION	BYREQUEST
BELLA-04	4/18/2006	16:50	16:52	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-07	4/18/2006	17:10	17:45	0:35	0.583333	OPERATION	BYREQUEST
LEG-03	4/18/2006	16:25	16:27	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
COT-03	4/18/2006	17:45	18:55	1:10	1.166667	PERMANENT	EARTHFAULT
COT-05	4/18/2006	17:45	18:56	1:11	1.183333	PERMANENT	EARTHFAULT
LEG-08	4/18/2006	18:25	18:27	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
GEF-01	4/18/2006	18:25	21:08	2:43	2.716667	TRAFO	OVERLOAD
AKAK-II-03	4/18/2006	18:30	20:25	1:55	1.916667	SOL	SOL
KALII-04	4/18/2006	18:30	20:25	1:55	1.916667	SOL	SOL
KAL-N-K7	4/18/2006	18:30	20:25	1:55	1.916667	SOL	SOL
ADW-03	4/18/2006	18:35	20:50	2:15	2.25	TRAFO	OVERLOAD
AND-05	4/18/2006	18:35	20:12	1:37	1.616667	TRAFO	OVERLOAD
GOF-02	4/18/2006	18:35	20:52	2:17	2.283333	TRAFO	OVERLOAD
ADW-02	4/18/2006	18:40	20:35	1:55	1.916667	TRAFO	OVERLOAD
WER-07	4/18/2006	18:40	21:30	2:50	2.833333	TRAFO	OVERLOAD
COT-03	4/18/2006	19:05	19:43	0:38	0.633333	TRAFO	OVERLOAD
COT-01	4/18/2006	19:43	20:20	0:37	0.616667	TRAFO	OVERLOAD
GEF-07	4/18/2006	18:35	21:55	3:20	3.333333	OUTGOING FEEDER	OVERLOAD
BEL-02	4/18/2006	18:40	20:37	1:57	1.95	PERMANENT	SHORT CIRCUIT
ADC-09	4/18/2006	18:35	18:37	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SEB-07	4/18/2006	18:40	18:42	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
GEF-07	4/18/2006	18:50	19:25	0:35	0.583333	OUTGOING FEEDER	OVERLOAD
ADC-09	4/18/2006	19:00	19:02	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SEB-04	4/18/2006	19:05	19:07	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
COT-02	4/18/2006	19:10	19:12	0:02	0.033333	OUTGOING FEEDER	OVERLOAD

COT-04	4/18/2006	21:30	7:35	10:05	10.08333	PERMANENT	SHORT CIRCUIT
LEG-08	4/18/2006	21:30	10:25	12:55	12.91667	PERMANENT	SHORT CIRCUIT
MEK-03	4/19/2006	2:00	2:39	0:39	0.65	OPERATION	BYREQUEST
COT-33	4/19/2006	6:30	6:32	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEBII-3	4/19/2006	6:50	6:52	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SEB-03	4/19/2006	6:55	8:15	1:20	1.333333	PERMANENT	SHORT CIRCUIT
GOF-06	4/19/2006	7:20	7:22	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADW-05	4/19/2006	7:20	7:22	0:02	0.033333	TRANSIENT	EARTHFAULT
BEL-05	4/19/2006	7:20	8:25	1:05	1.083333	PERMANENT	SHORT CIRCUIT
GOF-03	4/19/2006	8:00	12:20	4:20	4.333333	PERMANENT	EARTHFAULT
GOF-06	4/19/2006	8:40	8:42	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-09	4/19/2006	8:45	8:47	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
COT-04	4/19/2006	8:55	12:10	3:15	3.25	PERMANENT	SHORT CIRCUIT
ADN-04	4/19/2006	9:20	9:55	0:35	0.583333	OPERATION	BYREQUEST
COT-33	4/19/2006	9:30	9:32	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-04	4/19/2006	10:00	10:02	0:02	0.033333	TRANSIENT	EARTHFAULT
LEG-08	4/19/2006	10:45	12:22	1:37	1.616667	OUTGOING FEEDER	OVERLOAD
LEG-08	4/19/2006	13:05	13:17	0:12	0.2	OPERATION	BYREQUEST
SEB-09	4/19/2006	10:50	10:52	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SEB-09	4/19/2006	11:00	11:55	0:55	0.916667	OPERATION	BYREQUEST
GOF-03	4/19/2006	11:05	11:25	0:20	0.333333	PERMANENT	SHORT CIRCUIT
SEBII-3	4/19/2006	12:00	12:02	0:02	0.033333	TRANSIENT	EARTHFAULT
SUL-01	4/19/2006	11:25	14:15	2:50	2.833333	PERMANENT	EARTHFAULT
SUL-01	4/19/2006	14:47	14:50	0:03	0.05	OPERATION	BYREQUEST
GOF-05	4/19/2006	14:00	14:12	0:12	0.2	OPERATION	BYREQUEST
GOF-03	4/19/2006	14:17	15:25	1:08	1.133333	OUTGOING FEEDER	OVERLOAD
ADC-05	4/19/2006	17:50	17:52	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
LEG-04	4/19/2006	18:57	18:59	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
LEG-08	4/19/2006	18:57	18:59	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADN-06	4/19/2006	18:00	19:15	1:15	1.25	PERMANENT	SHORT CIRCUIT
SEB-07	4/19/2006	19:38	19:40	0:02	0.033333	OUTGOING	OVERLOAD

						FEEDER	
LEG-04	4/19/2006	20:20	20:22	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
LEG-08	4/19/2006	20:20	20:22	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
BEL-05	4/20/2006	0:00	8:55	8:55	8.916667	OPERATION	BYREQUEST
LEG-03	4/20/2006	5:00	9:30	4:30	4.5	OPERATION	BYREQUEST
LEG-04	4/20/2006	5:00	9:30	4:30	4.5	OPERATION	BYREQUEST
LEG-08	4/20/2006	5:00	9:30	4:30	4.5	OPERATION	BYREQUEST
ADC-07	4/20/2006	6:20	7:45	1:25	1.416667	OPERATION	BYREQUEST
ADC-09	4/20/2006	6:20	9:45	3:25	3.416667	OPERATION	BYREQUEST
NIF-03	4/20/2006	7:10	7:12	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEB-07	4/20/2006	8:45	8:47	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
BEL-03	4/20/2006	9:45	9:50	0:05	0.083333	OPERATION	BYREQUEST
BEL-03	4/20/2006	14:15	14:20	0:05	0.083333	OPERATION	BYREQUEST
NIF-01	4/20/2006	10:00	10:33	0:33	0.55	OPERATION	BYREQUEST
NIF-01	4/20/2006	10:35	10:45	0:10	0.166667	OPERATION	BYREQUEST
NIF-03	4/20/2006	10:35	10:45	0:10	0.166667	OPERATION	BYREQUEST
NIF-04	4/20/2006	10:35	10:45	0:10	0.166667	OPERATION	BYREQUEST
NIF-05	4/20/2006	10:35	10:45	0:10	0.166667	OPERATION	BYREQUEST
COT-33	4/20/2006	10:40	10:42	0:02	0.033333	TRANSIENT	EARTHFAULT
GEF-01	4/20/2006	10:55	11:05	0:10	0.166667	OPERATION	BYREQUEST
LEG-03	4/20/2006	12:00	12:35	0:35	0.583333	OPERATION	BYREQUEST
LEG-04	4/20/2006	12:35	12:37	0:02	0.033333	TRANSIENT	EARTHFAULT
LEG-04	4/20/2006	12:35	12:37	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
GEF-02	4/20/2006	12:55	14:10	1:15	1.25	PERMANENT	SHORT CIRCUIT
SEBII-3	4/20/2006	12:30	12:35	0:05	0.083333	OPERATION	BYREQUEST
SEBII-3	4/20/2006	14:10	14:25	0:15	0.25	OPERATION	BYREQUEST
ADN-06	4/20/2006	15:05	15:07	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-03	4/20/2006	15:45	16:15	0:30	0.5	PERMANENT	SHORT CIRCUIT
WER-09	4/20/2006	16:45	16:47	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
BEL-04	4/20/2006	16:50	16:52	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
WER-05	4/20/2006	17:05	17:07	0:02	0.033333	TRANSIENT	EARTHFAULT
SUL-04	4/20/2006	17:50	15:55	22:05	22.08333	PERMANENT	EARTHFAULT
LEG-04	4/20/2006	18:10	18:12	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
LEG-03	4/20/2006	18:15	18:17	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
WER-08	4/20/2006	18:25	18:35	0:10	0.166667	OPERATION	BYREQUEST

LEG-04	4/20/2006	22:20	22:22	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
LEG-08	4/20/2006	22:20	22:22	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
LEG-08	4/20/2006	20:50	20:52	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEBII-3	4/20/2006	21:35	21:37	0:02	0.033333	TRANSIENT	EARTHFAULT
WER-08	4/21/2006	2:45	2:47	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADN-06	4/21/2006	6:35	6:37	0:02	0.033333	TRANSIENT	EARTHFAULT
WER-06	4/21/2006	7:35	7:37	0:02	0.033333	TRANSIENT	EARTHFAULT
NIF-03	4/21/2006	7:45	7:47	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEB-02	4/21/2006	8:25	15:00	6:35	6.583333	PERMANENT	SHORT CIRCUIT
ADC-03	4/21/2006	8:25	8:27	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-07	4/21/2006	8:30	8:32	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEBII-03	4/21/2006	8:30	8:32	0:02	0.033333	TRANSIENT	EARTHFAULT
GEF-07	4/21/2006	9:05	9:07	0:02	0.033333	TRANSIENT	EARTHFAULT
BEL-02	4/21/2006	9:10	9:12	0:02	0.033333	TRANSIENT	EARTHFAULT
LEG-04	4/21/2006	9:15	9:17	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
BEL-01	4/21/2006	8:00	9:05	1:05	1.083333	PERMANENT	SHORT CIRCUIT
LEG-04	4/21/2006	9:50	11:20	1:30	1.5	PERMANENT	SHORT CIRCUIT
SEB-07	4/21/2006	10:00	10:02	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
AKAII-06	4/21/2006	10:30	10:32	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
NIF-01	4/21/2006	10:33	10:35	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SEB-07	4/21/2006	10:45	10:47	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
ADN-06	4/21/2006	11:10	11:12	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-07	4/21/2006	11:20	12:10	0:50	0.833333	OUTGOING FEEDER	OVERLOAD
SEB-07	4/21/2006	12:10	13:52	1:42	1.7	OUTGOING FEEDER	OVERLOAD
ADC-16	4/21/2006	11:45	13:50	2:05	2.083333	TRAFO	OVERLOAD
BEL-02	4/21/2006	14:50	14:52	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-04	4/21/2006	14:47	16:05	1:18	1.3	PERMANENT	SHORT CIRCUIT
SEB-02	4/21/2006	16:05	16:07	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SEB-07	4/21/2006	16:05	16:07	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SEB-08	4/21/2006	16:05	16:07	0:02	0.033333	OUTGOING	OVERLOAD

						FEEDER	
ADN-02	4/21/2006	16:05	16:07	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-15	4/21/2006	16:05	17:55	1:50	1.833333	PERMANENT	SHORT CIRCUIT
ADC-15	4/21/2006	18:55	19:55	1:00	1	OPERATION	BYREQUEST
ADC-04	4/21/2006	16:16	16:40	0:24	0.4	OPERATION	BYREQUEST
MEK-05	4/21/2006	16:05	16:07	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-14	4/21/2006	16:25	16:30	0:05	0.083333	PERMANENT	SHORT CIRCUIT
GOF-05	4/21/2006	16:30	16:32	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-04	4/21/2006	17:00	18:10	1:10	1.166667	PERMANENT	SHORT CIRCUIT
ADC-04	4/21/2006	18:10	18:22	0:12	0.2	PERMANENT	SHORT CIRCUIT
AKAI-02	4/21/2006	17:15	17:17	0:02	0.033333	TRANSIENT	EARTHFAULT
WER-08	4/21/2006	17:40	17:42	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
KALN-K2	4/21/2006	18:38	19:40	1:02	1.033333	SOL	SOL
AKAII-02	4/21/2006	18:38	19:58	1:20	1.333333	SOL	SOL
KALII-02	4/21/2006	18:38	19:52	1:14	1.233333	SOL	SOL
AKAII-07	4/21/2006	18:38	19:55	1:17	1.283333	SOL	SOL
KALII-01	4/21/2006	18:38	19:52	1:14	1.233333	SOL	SOL
MEK-02	4/21/2006	18:45	19:58	1:13	1.216667	SOL	SOL
GOF-03	4/21/2006	18:38	20:35	1:57	1.95	SOL	SOL
GEF-02	4/21/2006	19:00	20:25	1:25	1.416667	TRAFO	OVERLOAD
ADW-03	4/21/2006	19:15	20:20	1:05	1.083333	TRAFO	OVERLOAD
SEB-07	4/21/2006	19:20	20:22	1:02	1.033333	OUTGOING FEEDER	OVERLOAD
LEG-08	4/21/2006	19:35	20:40	1:05	1.083333	PERMANENT	EARTHFAULT
SEB-07	4/21/2006	20:40	20:42	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
LEG-04	4/21/2006	19:27	20:50	1:23	1.383333	PERMANENT	SHORT CIRCUIT
LEG-04	4/21/2006	20:52	21:05	0:13	0.216667	OPERATION	BYREQUEST
LEG-04	4/21/2006	21:05	21:15	0:10	0.166667	OPERATION	BYREQUEST
LEG-04	4/21/2006	21:17	21:45	0:28	0.466667	PERMANENT	SHORT CIRCUIT
LEG-04	**4/22/2006**	6:25	6:30	0:05	0.083333	PERMANENT	SHORT CIRCUIT
ADC-08	4/22/2006	4:30	5:10	0:40	0.666667	PERMANENT	SHORT CIRCUIT
ADC-14	4/22/2006	4:40	5:10	0:30	0.5	PERMANENT	SHORT CIRCUIT
GOF-06	4/22/2006	7:20	9:55	2:35	2.583333	PERMANENT	EARTHFAULT
MEK-05	4/22/2006	9:30	9:50	0:20	0.333333	OPERATION	BYREQUEST
ADN-06	4/22/2006	7:50	7:52	0:02	0.033333	TRANSIENT	EARTHFAULT

GOF-02	4/22/2006	7:55	7:57	0:02	0.033333	TRANSIENT	EARTHFAULT
ADW-05	4/22/2006	8:15	8:47	0:32	0.533333	PERMANENT	EARTHFAULT
SEB-07	4/22/2006	8:25	8:27	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
AKAII-06	4/22/2006	8:30	8:32	0:02	0.033333	TRANSIENT	EARTHFAULT
COT-33	4/22/2006	8:40	8:42	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEBII-03	4/22/2006	9:30	9:35	0:05	0.083333	OPERATION	BYREQUEST
SEB-07	4/22/2006	9:25	9:27	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
LEG-04	4/22/2006	9:45	9:47	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
AKAII-06	4/22/2006	10:00	10:02	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEB-07	4/22/2006	10:15	10:17	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
LEG-08	4/22/2006	10:50	10:52	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEB-07	4/22/2006	10:55	11:15	0:20	0.333333	OUTGOING FEEDER	OVERLOAD
SEB-07	4/22/2006	13:55	14:10	0:15	0.25	OPERATION	BYREQUEST
KALII-02	4/22/2006	11:15	12:15	1:00	1	TRAFO	OVERLOAD
WER-08	4/22/2006	13:25	14:05	0:40	0.666667	OPERATION	BYREQUEST
AKAII-06	4/22/2006	13:50	14:10	0:20	0.333333	OPERATION	BYREQUEST
SEB-09	4/22/2006	14:50	14:52	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
AKAII-06	4/22/2006	15:25	15:45	0:20	0.333333	OPERATION	BYREQUEST
GEF-01	4/22/2006	15:30	15:32	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEB-07	4/22/2006	15:50	15:52	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
GEF-01	4/22/2006	15:55	15:57	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADE-03	4/22/2006	15:55	15:57	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
AKAII-06	4/22/2006	16:40	16:42	0:02	0.033333	TRANSIENT	EARTHFAULT
NIF-03	4/22/2006	16:40	16:42	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-07	4/22/2006	16:55	16:57	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-14	4/22/2006	17:00	19:00	2:00	2	PERMANENT	SHORT CIRCUIT
ADC-03	4/22/2006	17:00	17:05	0:05	0.083333	PERMANENT	SHORT CIRCUIT
ADC-04	4/22/2006	17:00	17:05	0:05	0.083333	PERMANENT	SHORT CIRCUIT
ADC-05	4/22/2006	17:00	17:05	0:05	0.083333	PERMANENT	SHORT CIRCUIT
ADC-07	4/22/2006	17:00	17:05	0:05	0.083333	PERMANENT	SHORT CIRCUIT

ADC-08	4/22/2006	17:00	17:05	0:05	0.083333	PERMANENT	SHORT CIRCUIT
ADC-09	4/22/2006	17:00	17:05	0:05	0.083333	PERMANENT	SHORT CIRCUIT
ADC-10	4/22/2006	17:00	17:05	0:05	0.083333	PERMANENT	SHORT CIRCUIT
ADC-11	4/22/2006	17:00	17:05	0:05	0.083333	PERMANENT	SHORT CIRCUIT
ADC-15	4/22/2006	17:00	17:05	0:05	0.083333	PERMANENT	SHORT CIRCUIT
ADC-16	4/22/2006	17:00	17:05	0:05	0.083333	PERMANENT	SHORT CIRCUIT
ADC-09	4/22/2006	17:25	19:20	1:55	1.916667	PERMANENT	SHORT CIRCUIT
NIF-02	4/22/2006	16:40	17:25	0:45	0.75	PERMANENT	SHORT CIRCUIT
ADN-06	4/22/2006	16:55	18:45	1:50	1.833333	PERMANENT	SHORT CIRCUIT
SEB-07	4/22/2006	18:30	20:55	2:25	2.416667	TRAFO	OVERLOAD
GEF-04	4/22/2006	18:02	20:30	2:28	2.466667	TRAFO	OVERLOAD
WER-08	4/22/2006	18:55	19:20	0:25	0.416667	TRAFO	OVERLOAD
ADW-06	4/22/2006	18:55	20:41	1:46	1.766667	TRAFO	OVERLOAD
ADN-02	4/22/2006	18:58	20:03	1:05	1.083333	TRAFO	OVERLOAD
COT-02	4/22/2006	19:10	19:55	0:45	0.75	TRAFO	OVERLOAD
ADC-09	4/22/2006	20:17	20:50	0:33	0.55	TRAFO	OVERLOAD
COT-33	4/22/2006	17:55	17:57	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEB-04	4/22/2006	18:55	18:57	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
KALN-K5	4/22/2006	19:00	19:02	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SEBII-03	4/22/2006	19:05	19:07	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
LEG-08	4/22/2006	19:05	19:07	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
KALN-K5	4/22/2006	19:15	19:17	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
WER-07	4/22/2006	19:15	7:05	11:50	11.83333	PERMANENT	SHORT CIRCUIT
GEF-07	4/22/2006	19:15	19:17	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SEB-04	4/22/2006	19:15	19:17	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
LEG-08	4/22/2006	19:20	19:22	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
COT-05	4/22/2006	19:35	19:37	0:02	0.033333	TRANSIENT	EARTHFAULT
LEG-08	4/22/2006	19:45	21:15	1:30	1.5	PERMANENT	SHORT CIRCUIT
COT-05	4/22/2006	21:00	22:10	1:10	1.166667	OPERATION	BYREQUEST

ADC-09	4/22/2006	20:15	20:17	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
GOF-04	4/22/2006	21:20	21:33	0:13	0.216667	OPERATION	BYREQUEST
SEB-04	4/22/2006	21:30	21:32	0:02	0.033333	TRANSIENT	EARTHFAULT
AKAI TO ABASAMUEL	4/22/2006	21:15			0		
GEF-02	**4/23/2006**	0:10	5:56	5:46	5.766667	PERMANENT	SHORT CIRCUIT
COT-05	4/23/2006	4:40	6:25	1:45	1.75	OPERATION	BYREQUEST
KALI-F11	4/23/2006	4:50	5:50	1:00	1	OPERATION	BYREQUEST
ADC-05	4/23/2006	5:50	8:40	2:50	2.833333	OPERATION	BYREQUEST
LEG-04	4/23/2006	5:15	12:05	6:50	6.833333	OPERATION	BYREQUEST
LEG-08	4/23/2006	5:15	12:05	6:50	6.833333	OPERATION	BYREQUEST
SUL-02	4/23/2006	7:10	7:12	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SUL-03	4/23/2006	7:50	11:20	3:30	3.5	PERMANENT	SHORT CIRCUIT
SUL-04	4/23/2006	7:50	7:52	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
KALN-K2	4/23/2006	8:05	8:25	0:20	0.333333	PERMANENT	SHORT CIRCUIT
SEB-07	4/23/2006	8:10	8:12	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
AKAI-03	4/23/2006	8:10	11:00	2:50	2.833333	PERMANENT	SHORT CIRCUIT
MEK-01	4/23/2006	8:45	10:10	1:25	1.416667	PERMANENT	EARTHFAULT
SEBII-03	4/23/2006	9:50	9:52	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-14	4/23/2006	9:15	11:20	2:05	2.083333	PERMANENT	SHORT CIRCUIT
SEB-07	4/23/2006	9:45	10:20	0:35	0.583333	OUTGOING FEEDER	OVERLOAD
AKAI-04	4/23/2006	10:03	10:15	0:12	0.2	OPERATION	BYREQUEST
ADN-02	4/23/2006	10:35	10:37	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-09	4/23/2006	10:43	11:10	0:27	0.45	PERMANENT	SHORT CIRCUIT
KALII-04	4/23/2006	11:10	11:55	0:45	0.75	TRAFO	OVERLOAD
BEL-02	4/23/2006	11:10	11:50	0:40	0.666667	PERMANENT	SHORT CIRCUIT
BEL-02	4/23/2006	11:50	12:30	0:40	0.666667	PERMANENT	SHORT CIRCUIT
SEB-09	4/23/2006	11:20	12:15	0:55	0.916667	OPERATION	BYREQUEST
ADC-14	4/23/2006	11:25	12:27	1:02	1.033333	TRANSIENT	EARTHFAULT
ADC-14	4/23/2006	11:25	12:27	1:02	1.033333	TRANSIENT	SHORT CIRCUIT
ADN-01	4/23/2006	11:30	12:55	1:25	1.416667	TRAFO	OVERLOAD
ADC-14	4/23/2006	11:32	12:25	0:53	0.883333	PERMANENT	EARTHFAULT
SUL-04	4/23/2006	11:40	12:05	0:25	0.416667	PERMANENT	EARTHFAULT

SEBII-03	4/23/2006	11:55	11:57	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
LEG-08	4/23/2006	12:20	12:22	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
LEG-06	4/23/2006	12:35	12:37	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
LEG-08	4/23/2006	12:40	12:42	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
AKAI-04	4/23/2006	13:50	15:15	1:25	1.416667	OPERATION	BYREQUEST
SUL-04	4/23/2006	15:10	15:12	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADC-07	4/23/2006	15:50	17:30	1:40	1.666667	PERMANENT	EARTHFAULT
SEB-07	4/23/2006	16:25	16:27	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
GEF-02	4/23/2006	18:30	20:30	2:00	2	TRAFO	OVERLOAD
WER-06	4/23/2006	18:35	20:30	1:55	1.916667	TRAFO	OVERLOAD
GOF-04	4/23/2006	18:40	20:35	1:55	1.916667	TRAFO	OVERLOAD
ADW-04	4/23/2006	19:05	20:10	1:05	1.083333	TRAFO	OVERLOAD
KALN-K4	4/23/2006	18:40	20:10	1:30	1.5	SOL	SOL
SEB-04	4/23/2006	19:10	19:12	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
KALN-K5	4/23/2006	19:15	19:17	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
ADC-09	4/23/2006	19:20	19:22	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SEB-07	4/23/2006	19:30	19:32	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SEB-04	4/23/2006	20:35	20:37	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SEB-07	4/23/2006	20:50	20:52	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
WER-06	4/23/2006	20:55	20:57	0:02	0.033333	TRAFO	OVERLOAD
WER-07	4/23/2006	20:55	20:58	0:03	0.05	TRAFO	OVERLOAD
WER-08	4/23/2006	20:55	20:59	0:04	0.066667	TRAFO	OVERLOAD
WER-09	4/23/2006	20:55	21:00	0:05	0.083333	TRAFO	OVERLOAD
SEB-03	4/23/2006	21:45	21:47	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADN-06	4/23/2006	20:00	22:55	2:55	2.916667	PERMANENT	SHORT CIRCUIT
SUL-04	**4/24/2006**	3:40	5:44	2:04	2.066667	OPERATION	BYREQUEST
GEF-02	4/24/2006	4:35	10:20	5:45	5.75	PERMANENT	SHORT CIRCUIT
WER-12	4/24/2006	4:45	5:50	1:05	1.083333	OPERATION	BYREQUEST
ADW-03	4/24/2006	4:45	4:47	0:02	0.033333	OPERATION	BYREQUEST
SUL-03	4/24/2006	5:44	7:25	1:41	1.683333	OPERATION	BYREQUEST
COT-33	4/24/2006	6:15	6:17	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
LEG-03	4/24/2006	6:50	6:52	0:02	0.033333	TRANSIENT	SHORT

							CIRCUIT
WER-08	4/24/2006	6:55	6:57	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
LEG-06	4/24/2006	7:15	7:17	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
LEG-06	4/24/2006	7:15	7:17	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-02	4/24/2006	7:25	7:27	0:02	0.033333	TRANSIENT	EARTHFAULT
ADN-02	4/24/2006	7:30	7:32	0:02	0.033333	TRANSIENT	EARTHFAULT
GOF-04	4/24/2006	7:30	7:32	0:02	0.033333	TRANSIENT	EARTHFAULT
GOF-05	4/24/2006	7:30	7:33	0:03	0.05	TRANSIENT	EARTHFAULT
ADN-06	4/24/2006	7:30	7:35	0:05	0.083333	PERMANENT	SHORT CIRCUIT
SEB-04	4/24/2006	7:30	8:35	1:05	1.083333	OPERATION	BYREQUEST
WER-04	4/24/2006	7:58	8:00	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADN-06	4/24/2006	8:20	8:22	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-07	4/24/2006	8:20	8:22	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
GEF-04	4/24/2006	8:30	10:00	1:30	1.5	PERMANENT	EARTHFAULT
KALN-K2	4/24/2006	9:00	9:02	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEB-07	4/24/2006	9:05	9:07	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
ADC-14	4/24/2006	9:10	10:10	1:00	1	PERMANENT	EARTHFAULT
ADC-14	4/24/2006	10:10	10:14	0:04	0.066667	OPERATION	BYREQUEST
WER-08	4/24/2006	9:15	9:17	0:02	0.033333	TRANSIENT	EARTHFAULT
WER-06	4/24/2006	9:35	9:40	0:05	0.083333	OPERATION	BYREQUEST
WER-08	4/24/2006	9:40	9:42	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-09	4/24/2006	9:50	11:55	2:05	2.083333	OPERATION	BYREQUEST
GOF-04	4/24/2006	9:50	9:52	0:02	0.033333	TRANSIENT	EARTHFAULT
GOF-06	4/24/2006	9:50	9:53	0:03	0.05	TRANSIENT	EARTHFAULT
ADN-02	4/24/2006	9:55	10:20	0:25	0.416667	OPERATION	BYREQUEST
WER-09	4/24/2006	10:00	10:12	0:12	0.2	TRANSIENT	EARTHFAULT
WER-05	4/24/2006	10:20	10:30	0:10	0.166667	OPERATION	BYREQUEST
KALN-K5	4/24/2006	10:35	10:37	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADC-09	4/24/2006	10:40	10:55	0:15	0.25	OPERATION	BYREQUEST
KALII-01	4/24/2006	10:50	11:40	0:50	0.833333	TRAFO	OVERLOAD
COT-03	4/24/2006	10:55	10:57	0:02	0.033333	TRANSIENT	EARTHFAULT
COT-05	4/24/2006	10:55	10:58	0:03	0.05	TRANSIENT	EARTHFAULT
ADC-11	4/24/2006	9:10	11:00	1:50	1.833333	PERMANENT	SHORT CIRCUIT
ADC-14	4/24/2006	11:20	14:55	3:35	3.583333	PERMANENT	EARTHFAULT
ADC-14	4/24/2006	14:55	19:20	4:25	4.416667	PERMANENT	EARTHFAULT
ADW-01	4/24/2006	12:05	14:35	2:30	2.5	PERMANENT	EARTHFAULT
SEBII-03	4/24/2006	12:10	12:12	0:02	0.033333	TRANSIENT	EARTHFAULT

NIF-01	4/24/2006	12:05	12:07	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
NIF-02	4/24/2006	12:05	12:08	0:03	0.05	TRANSIENT	SHORT CIRCUIT
NIF-03	4/24/2006	12:05	12:09	0:04	0.066667	TRANSIENT	SHORT CIRCUIT
NIF-04	4/24/2006	12:05	12:10	0:05	0.083333	TRANSIENT	SHORT CIRCUIT
ADW-03	4/24/2006	13:22	13:24	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
KALN-K5	4/24/2006	13:40	14:28	0:48	0.8	PERMANENT	SHORT CIRCUIT
SEB-07	4/24/2006	13:45	13:47	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
COT-04	4/24/2006	14:17	14:19	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
WER-07	4/24/2006	14:25	14:45	0:20	0.333333	OPERATION	BYREQUEST
GOF-05	4/24/2006	15:30	15:47	0:17	0.283333	OPERATION	BYREQUEST
MEK-01	4/24/2006	16:00	16:45	0:45	0.75	OPERATION	BYREQUEST
MEK-03	4/24/2006	16:00	16:47	0:47	0.783333	OPERATION	BYREQUEST
COT-03	4/24/2006	16:15	16:17	0:02	0.033333	TRANSIENT	EARTHFAULT
COT-04	4/24/2006	16:15	16:18	0:03	0.05	TRANSIENT	EARTHFAULT
COT-33	4/24/2006	16:18	16:20	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
WER-04	4/24/2006	16:55	16:57	0:02	0.033333	TRANSIENT	EARTHFAULT
WER-08	4/24/2006	17:55	17:57	0:02	0.033333	TRANSIENT	EARTHFAULT
GEF-02	4/24/2006	18:32	18:34	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
WER-07	4/24/2006	18:42	20:45	2:03	2.05	TRAFO	OVERLOAD
GEF-02	4/24/2006	18:42	20:17	1:35	1.583333	PERMANENT	SHORT CIRCUIT
SEB-07	4/24/2006	18:46	18:48	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
ADW-01	4/24/2006	18:50	20:10	1:20	1.333333	TRAFO	OVERLOAD
ADW-03	4/24/2006	18:50	20:15	1:25	1.416667	TRAFO	OVERLOAD
NIF-01	4/24/2006	18:55	19:25	0:30	0.5	SOL	SOL
NIF-01	4/24/2006	19:25	20:36	1:11	1.183333	SOL	SOL
KALII-04	4/24/2006	18:55	20:10	1:15	1.25	SOL	SOL
GOF-02	4/24/2006	18:55	20:30	1:35	1.583333	TRAFO	OVERLOAD
SEB-04	4/24/2006	19:00	19:10	0:10	0.166667	TRAFO	OVERLOAD
KALN-K5	4/24/2006	19:20	19:22	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SEB-07	4/24/2006	20:05	20:07	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SUL-02	4/24/2006	20:20	20:22	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEB-07	4/24/2006	21:35	21:37	0:02	0.033333	OUTGOING FEEDER	OVERLOAD

NIF-02	4/24/2006	22:08	22:30	0:22	0.366667	OPERATION	BYREQUEST
NIF-03	4/24/2006	22:08	22:30	0:22	0.366667	OPERATION	BYREQUEST
WER-03	**4/25/2006**	3:40	4:55	1:15	1.25	OPERATION	BYREQUEST
ADN-03	4/25/2006	5:55	6:45	0:50	0.833333	OPERATION	BYREQUEST
ADN-04	4/25/2006	5:55	6:45	0:50	0.833333	OPERATION	BYREQUEST
ADW-04	4/25/2006	6:10	7:00	0:50	0.833333	OPERATION	BYREQUEST
MEK-01	4/25/2006	7:10	10:10	3:00	3	PERMANENT	SHORT CIRCUIT
SUL-04	4/25/2006	7:15	7:17	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
NIF-03	4/25/2006	8:10	8:12	0:02	0.033333	TRANSIENT	EARTHFAULT
GEF-07	4/25/2006	8:25	8:27	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEB-02	4/25/2006	8:00	8:45	0:45	0.75	PERMANENT	SHORT CIRCUIT
COT-04	4/25/2006	9:05	9:07	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEB-07	4/25/2006	9:10	9:12	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SEB-02	4/25/2006	10:10	10:15	0:05	0.083333	PERMANENT	SHORT CIRCUIT
ADN-05	4/25/2006	10:45	13:00	2:15	2.25	TRAFO	OVERLOAD
ADC-16	4/25/2006	10:40	12:45	2:05	2.083333	TRAFO	OVERLOAD
NIF-01	4/25/2006	10:35	14:45	4:10	4.166667	TRAFO	OVERLOAD
SEB-07	4/25/2006	10:40	10:42	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
WER-08	4/25/2006	10:50	10:52	0:02	0.033333	TRANSIENT	EARTHFAULT
WER-09	4/25/2006	10:50	10:53	0:03	0.05	TRANSIENT	EARTHFAULT
SEB-06	4/25/2006	11:10	11:12	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SEB-07	4/25/2006	11:10	11:13	0:03	0.05	OUTGOING FEEDER	OVERLOAD
SEB-08	4/25/2006	11:10	11:14	0:04	0.066667	OUTGOING FEEDER	OVERLOAD
KALN-K5	4/25/2006	11:10	11:12	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEB-02	4/25/2006	11:25	11:27	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
WER-08	4/25/2006	11:40	11:42	0:02	0.033333	TRANSIENT	EARTHFAULT
WER-08	4/25/2006	11:50	12:45	0:55	0.916667	OPERATION	BYREQUEST
AKAII-07	4/25/2006	11:55	11:57	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-07	4/25/2006	12:45	12:47	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
GEF-01	4/25/2006	13:00	13:02	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
WER-08	4/25/2006	13:30	13:32	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADN-05	4/25/2006	10:45	13:00	2:15	2.25	OUTGOING	OVERLOAD

						FEEDER	
SUL-06	4/25/2006	13:48	13:50	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
WER-08	4/25/2006	14:00	17:20	3:20	3.333333	PERMANENT	EARTHFAULT
WER-08	4/25/2006	19:10	19:13	0:03	0.05	OPERATION	BYREQUEST
SUL-06	4/25/2006	14:00	14:02	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEB-06	4/25/2006	14:20	17:03	2:43	2.716667	OPERATION	BYREQUEST
SEB-07	4/25/2006	14:45	17:05	2:20	2.333333	OPERATION	BYREQUEST
SEB-09	4/25/2006	15:35	15:50	0:15	0.25	OPERATION	BYREQUEST
MEK-06	4/25/2006	16:00	16:55	0:55	0.916667	OPERATION	BYREQUEST
GEF-02	4/25/2006	14:25	15:05	0:40	0.666667	PERMANENT	SHORT CIRCUIT
GEF-02	4/25/2006	18:55	19:00	0:05	0.083333	OPERATION	BYREQUEST
SUL-06	4/25/2006	14:35	15:45	1:10	1.166667	PERMANENT	EARTHFAULT
LEG-08	4/25/2006	15:05	15:30	0:25	0.416667	OPERATION	BYREQUEST
COT-05	4/25/2006	15:05	15:10	0:05	0.083333	OPERATION	BYREQUEST
AKAII-03	4/25/2006	15:10	15:12	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
WER-07	4/25/2006	15:50	15:52	0:02	0.033333	TRANSIENT	EARTHFAULT
SUL-02	4/25/2006	15:55	16:15	0:20	0.333333	OPERATION	BYREQUEST
SUL-06	4/25/2006	15:55	17:05	1:10	1.166667	PERMANENT	EARTHFAULT
AKAII-07	4/25/2006	16:05	16:07	0:02	0.033333	TRANSIENT	EARTHFAULT
GEF-07	4/25/2006	16:20	16:22	0:02	0.033333	TRANSIENT	EARTHFAULT
KALN-K5	4/25/2006	16:30	16:32	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
KALI-F11	4/25/2006	16:45	17:10	0:25	0.416667	OPERATION	BYREQUEST
AKAII-07	4/25/2006	16:50	16:52	0:02	0.033333	TRANSIENT	EARTHFAULT
ADN-06	4/25/2006	14:35	17:40	3:05	3.083333	PERMANENT	SHORT CIRCUIT
ADN-03	4/25/2006	15:55	17:20	1:25	1.416667	PERMANENT	SHORT CIRCUIT
WER-07	4/25/2006	17:45	17:47	0:02	0.033333	TRANSIENT	EARTHFAULT
WER-09	4/25/2006	17:45	17:47	0:02	0.033333	TRANSIENT	EARTHFAULT
ADN-06	4/25/2006	18:05	18:32	0:27	0.45	OPERATION	BYREQUEST
SUL-04	4/25/2006	18:15	19:25	1:10	1.166667	OPERATION	BYREQUEST
ADW-06	4/25/2006	18:52	20:25	1:33	1.55	TRAFO	OVERLOAD
SEB-02	4/25/2006	18:15	20:40	2:25	2.416667	SOL	SOL
AKAI-03	4/25/2006	19:15	20:45	1:30	1.5	SOL	SOL
AKAII-07	4/25/2006	19:15	20:55	1:40	1.666667	SOL	SOL
KALN-K7	4/25/2006	19:15	20:45	1:30	1.5	SOL	SOL
ADN-04	4/25/2006	19:53	20:10	0:17	0.283333	TRAFO	OVERLOAD
MEK-03	4/25/2006	19:55	20:03	0:08	0.133333	OPERATION	BYREQUEST
GOF-04	4/25/2006	19:55	20:30	0:35	0.583333	TRAFO	OVERLOAD
SEB-04	4/25/2006	19:00	19:02	0:02	0.033333	OUTGOING	OVERLOAD

						FEEDER	
KALN-K5	4/25/2006	19:10	19:12	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
GEF-01	4/25/2006	19:10	20:47	1:37	1.616667	TRAFO	OVERLOAD
WER-06	4/25/2006	19:20	20:40	1:20	1.333333	TRAFO	OVERLOAD
ADW-02	4/25/2006	19:25	20:10	0:45	0.75	TRAFO	OVERLOAD
SUL-08	4/25/2006	19:55	19:57	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADC-03	**4/26/2006**	6:37	8:15	1:38	1.633333	OPERATION	BYREQUEST
ADC-04	4/26/2006	6:37	7:30	0:53	0.883333	OPERATION	BYREQUEST
ADC-05	4/26/2006	6:37	7:30	0:53	0.883333	OPERATION	BYREQUEST
ADC-07	4/26/2006	6:37	9:45	3:08	3.133333	OPERATION	BYREQUEST
ADC-08	4/26/2006	6:37	7:30	0:53	0.883333	OPERATION	BYREQUEST
ADC-09	4/26/2006	6:37	8:40	2:03	2.05	OPERATION	BYREQUEST
ADC-10	4/26/2006	6:37	7:30	0:53	0.883333	OPERATION	BYREQUEST
ADC-11	4/26/2006	6:37	7:30	0:53	0.883333	OPERATION	BYREQUEST
ADC-14	4/26/2006	6:37	7:30	0:53	0.883333	OPERATION	BYREQUEST
ADC-15	4/26/2006	6:37	7:30	0:53	0.883333	OPERATION	BYREQUEST
ADC-16	4/26/2006	6:37	7:30	0:53	0.883333	OPERATION	BYREQUEST
MEK-05	4/26/2006	7:05	7:07	0:02	0.033333	TRANSIENT	EARTHFAULT
ADE-02	4/26/2006	7:40	7:42	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-02	4/26/2006	8:15	8:17	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
ADN-03	4/26/2006	9:55	9:57	0:02	0.033333	TRANSIENT	EARTHFAULT
LEG-03	4/26/2006	9:05	19:50	10:45	10.75	PERMANENT	SHORT CIRCUIT
WER-04	4/26/2006	9:35	9:37	0:02	0.033333	TRANSIENT	EARTHFAULT
WER-08	4/26/2006	9:35	9:37	0:02	0.033333	TRANSIENT	EARTHFAULT
BEL-04	4/26/2006	8:30	9:50	1:20	1.333333	PERMANENT	SHORT CIRCUIT
MEK-02	4/26/2006	9:50	9:52	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
WER-08	4/26/2006	10:05	10:07	0:02	0.033333	TRANSIENT	EARTHFAULT
WER-08	4/26/2006	10:15	10:17	0:02	0.033333	TRANSIENT	EARTHFAULT
ADN-06	4/26/2006	8:30	10:15	1:45	1.75	PERMANENT	SHORT CIRCUIT
ADN-03	4/26/2006	8:30	10:30	2:00	2	PERMANENT	SHORT CIRCUIT
KALII-05	4/26/2006	10:45	11:45	1:00	1	PERMANENT	SHORT CIRCUIT
COT-33	4/26/2006	11:05	11:07	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
WER-04	4/26/2006	11:05	12:30	1:25	1.416667	TRAFO	OVERLOAD
ADN-03	4/26/2006	11:15	12:30	1:15	1.25	TRAFO	OVERLOAD
SEBII-03	4/26/2006	11:10	11:12	0:02	0.033333	TRANSIENT	EARTHFAULT
WER-08	4/26/2006	11:15	11:17	0:02	0.033333	TRANSIENT	EARTHFAULT

WER-08	4/26/2006	11:30	11:32	0:02	0.033333	TRANSIENT	EARTHFAULT
NIF-02	4/26/2006	11:50	12:24	0:34	0.566667	OPERATION	BYREQUEST
NIF-03	4/26/2006	11:50	12:24	0:34	0.566667	OPERATION	BYREQUEST
ADC-07	4/26/2006	11:50	12:15	0:25	0.416667	OPERATION	BYREQUEST
WER-08	4/26/2006	11:55	12:25	0:30	0.5	PERMANENT	EARTHFAULT
KALN-K5	4/26/2006	11:55	14:25	2:30	2.5	PERMANENT	EARTHFAULT
WER-08	4/26/2006	12:50	14:20	1:30	1.5	PERMANENT	EARTHFAULT
WER-08	4/26/2006	14:20	14:45	0:25	0.416667	OPERATION	BYREQUEST
SEBII-03	4/26/2006	12:20	12:22	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
BEL-04	4/26/2006	12:25	15:40	3:15	3.25	PERMANENT	EARTHFAULT
ADC-09	4/26/2006	12:50	13:50	1:00	1	PERMANENT	SHORT CIRCUIT
MEK-05	4/26/2006	13:15	18:15	5:00	5	PERMANENT	SHORT CIRCUIT
GOF-03	4/26/2006	14:14	15:10	0:56	0.933333	OPERATION	BYREQUEST
AKAII-07	4/26/2006	14:50	14:52	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
WER-04	4/26/2006	15:00	15:52	0:52	0.866667	TRANSIENT	EARTHFAULT
ADC-03	4/26/2006	16:10	17:00	0:50	0.833333	PERMANENT	SHORT CIRCUIT
BEL-05	4/26/2006	16:20			0	PERMANENT	SHORT CIRCUIT
LEG-06	4/26/2006	16:28	18:15	1:47	1.783333	PERMANENT	SHORT CIRCUIT
NIF-01	4/26/2006	16:30	17:00	0:30	0.5	OPERATION	BYREQUEST
ADC-15	4/26/2006	17:03	17:05	0:02	0.033333	TRANSIENT	EARTHFAULT
AKAII-07	4/26/2006	17:05	17:20	0:15	0.25	OPERATION	BYREQUEST
LEG-08	4/26/2006	17:25	17:27	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADN-06	4/26/2006	16:20	17:55	1:35	1.583333	PERMANENT	SHORT CIRCUIT
GEF-04	4/26/2006	17:55	17:57	0:02	0.033333	TRANSIENT	EARTHFAULT
ADW-03	4/26/2006	18:58	20:15	1:17	1.283333	SOL	SOL
ADN-05	4/26/2006	19:05	20:00	0:55	0.916667	SOL	SOL
WER-08	4/26/2006	19:30	21:00	1:30	1.5	SOL	SOL
GOF-06	4/26/2006	19:30	20:26	0:56	0.933333	SOL	SOL
GEF-04	4/26/2006	20:25	21:20	0:55	0.916667	SOL	SOL
MEK-05	4/26/2006	18:48	18:50	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SEB-04	4/26/2006	18:48	19:00	0:12	0.2	OUTGOING FEEDER	OVERLOAD
WER-07	4/26/2006	18:58	19:25	0:27	0.45	OPERATION	BYREQUEST
ADC-03	4/26/2006	19:05	19:58	0:53	0.883333	PERMANENT	SHORT CIRCUIT
SEB-04	4/26/2006	19:05	19:07	0:02	0.033333	OUTGOING FEEDER	OVERLOAD

SEB-04	4/26/2006	19:07	21:45	2:38	2.633333	OUTGOING FEEDER	OVERLOAD
SEBII-03	4/26/2006	19:10	19:12	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
KALII-01	4/26/2006	19:27	20:25	0:58	0.966667	SOL	SOL
AKAI-04	4/26/2006	19:27	20:25	0:58	0.966667	SOL	SOL
KALN-K4	4/26/2006	19:27	20:25	0:58	0.966667	SOL	SOL
ADC-09	4/26/2006	19:30	19:32	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
GEF-07	4/26/2006	19:45	19:47	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SEB-02	4/26/2006	18:40	20:10	1:30	1.5	OPERATION	BYREQUEST
SUL-02	4/26/2006	20:45	20:55	0:10	0.166667	OPERATION	BYREQUEST
COT-33	4/26/2006	21:35	21:37	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
COT-33	4/26/2006	22:00	22:15	0:15	0.25	PERMANENT	SHORT CIRCUIT
BEL-04	4/26/2006	22:10	22:30	0:20	0.333333	PERMANENT	EARTHFAULT
BEL-04	**4/27/2006**	9:10	9:50	0:40	0.666667	OPERATION	BYREQUEST
SUL-08	4/27/2006	1:44	1:46	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SUL-08	4/27/2006	10:40	11:15	0:35	0.583333	OPERATION	BYREQUEST
SUL-07	4/27/2006	10:40	11:15	0:35	0.583333	OPERATION	BYREQUEST
ADC-09	4/27/2006	6:28	10:32	4:04	4.066667	OPERATION	BYREQUEST
ADC-03	4/27/2006	6:28	10:32	4:04	4.066667	OPERATION	BYREQUEST
ADN-02	4/27/2006	6:55	6:57	0:02	0.033333	TRANSIENT	EARTHFAULT
ADN-03	4/27/2006	8:00	8:02	0:02	0.033333	TRANSIENT	EARTHFAULT
WER-04	4/27/2006	8:05	8:07	0:02	0.033333	TRANSIENT	EARTHFAULT
ADW-02	4/27/2006	8:15	8:17	0:02	0.033333	TRANSIENT	EARTHFAULT
ADN-02	4/27/2006	8:20	8:22	0:02	0.033333	TRANSIENT	EARTHFAULT
KALN-K5	4/27/2006	8:35	8:37	0:02	0.033333	TRANSIENT	EARTHFAULT
AKAII-06	4/27/2006	9:10	9:12	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
GEF-04	4/27/2006	10:00	10:25	0:25	0.416667	OPERATION	BYREQUEST
LEG-03	4/27/2006	10:10	10:15	0:05	0.083333	OPERATION	BYREQUEST
LEG-03	4/27/2006	14:10	14:15	0:05	0.083333	OPERATION	BYREQUEST
COT-33	4/27/2006	10:15	10:17	0:02	0.033333	TRANSIENT	EARTHFAULT
GOF-03	4/27/2006	10:20	10:22	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADC-07	4/27/2006	12:05	12:20	0:15	0.25	OPERATION	BYREQUEST
GOF-02	4/27/2006	12:15	15:40	3:25	3.416667	OPERATION	BYREQUEST
ADN-04	4/27/2006	12:20	12:40	0:20	0.333333	OPERATION	BYREQUEST
SEB-07	4/27/2006	12:25	12:27	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
KALN-K5	4/27/2006	15:42	15:45	0:03	0.05	TRANSIENT	EARTHFAULT
WER-07	4/27/2006	16:05	16:07	0:02	0.033333	TRANSIENT	EARTHFAULT

GEF-01	4/27/2006	16:20	16:22	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
GOF-02	4/27/2006	16:30	18:20	1:50	1.833333	PERMANENT	EARTHFAULT
SEB-04	4/27/2006	17:45	17:55	0:10	0.166667	OPERATION	BYREQUEST
COT-33	4/27/2006	18:20	21:45	3:25	3.416667	PERMANENT	SHORT CIRCUIT
BEL-03	4/27/2006	20:00	20:15	0:15	0.25	OPERATION	BYREQUEST
SUL-03	**4/28/2006**	4:10	4:12	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
WER-04	4/28/2006	6:30	6:32	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
COT-33	4/28/2006	6:30	6:32	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEBII-03	4/28/2006	6:35	6:37	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
GEF-02	4/28/2006	7:00	7:02	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADN-02	4/28/2006	7:10	7:12	0:02	0.033333	TRANSIENT	EARTHFAULT
KALN-K5	4/28/2006	7:15	7:17	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
ADC-09	4/28/2006	7:10	7:15	0:05	0.083333	OPERATION	BYREQUEST
ADC-09	4/28/2006	7:16	7:20	0:04	0.066667	OPERATION	BYREQUEST
ADC-09	4/28/2006	7:21	7:45	0:24	0.4	OPERATION	BYREQUEST
BEL-02	4/28/2006	7:25	7:27	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-02	4/28/2006	7:30	8:10	0:40	0.666667	OUTGOING FEEDER	OVERLOAD
ADW-05	4/28/2006	7:40	8:40	1:00	1	OUTGOING FEEDER	OVERLOAD
COT-33	4/28/2006	8:15	8:17	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
WER-07	4/28/2006	8:25	12:40	4:15	4.25	PERMANENT	EARTHFAULT
WER-09	4/28/2006	8:25	8:27	0:02	0.033333	TRANSIENT	EARTHFAULT
COT-33	4/28/2006	8:25	8:27	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADN-06	4/28/2006	8:40	8:42	0:02	0.033333	TRANSIENT	EARTHFAULT
ADW-04	4/28/2006	8:55	9:25	0:30	0.5	OUTGOING FEEDER	OVERLOAD
ADC-07	4/28/2006	9:00	10:45	1:45	1.75	OUTGOING FEEDER	OVERLOAD
WER-08	4/28/2006	9:20	9:40	0:20	0.333333	OPERATION	BYREQUEST
ADW-01	4/28/2006	9:20	13:00	3:40	3.666667	TRAFO	OVERLOAD
ADW-04	4/28/2006	9:32	10:20	0:48	0.8	TRAFO	OVERLOAD
ADN-03	4/28/2006	9:35	16:35	7:00	7	TRAFO	OVERLOAD
NIF-01	4/28/2006	9:35	13:25	3:50	3.833333	TRAFO	OVERLOAD
GOF-02	4/28/2006	9:40	10:05	0:25	0.416667	OPERATION	BYREQUEST
KALII-05	4/28/2006	9:42	11:45	2:03	2.05	TRAFO	OVERLOAD
GOF-06	4/28/2006	9:50	10:58	1:08	1.133333	TRAFO	OVERLOAD

ADN-05	4/28/2006	9:20	11:55	2:35	2.583333	TRAFO	OVERLOAD
BEL-04	4/28/2006	10:05	11:17	1:12	1.2	TRAFO	OVERLOAD
BEL-04	4/28/2006	10:05	11:17	1:12	1.2	TRAFO	OVERLOAD
ADC-11	4/28/2006	10:10	10:12	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
ADW-06	4/28/2006	10:20	11:52	1:32	1.533333	TRAFO	OVERLOAD
GOF-04	4/28/2006	10:30	10:32	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-11	4/28/2006	11:38	11:40	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SEBII-03	4/28/2006	10:40	10:42	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADC-11	4/28/2006	10:45	11:15	0:30	0.5	OUTGOING FEEDER	OVERLOAD
ADC-11	4/28/2006	10:45	10:47	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
ADN-01	4/28/2006	10:48	10:50	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
ADN-01	4/28/2006	10:48	16:50	6:02	6.033333	OUTGOING FEEDER	OVERLOAD
GOF-05	4/28/2006	10:58	13:15	2:17	2.283333	TRAFO	OVERLOAD
ADC-14	4/28/2006	10:05	10:07	0:02	0.033333	TRANSIENT	EARTHFAULT
SEBII-03	4/28/2006	11:05	11:07	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADC-09	4/28/2006	11:15	12:45	1:30	1.5	OPERATION	BYREQUEST
ADC-14	4/28/2006	11:10	11:12	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
COT-01	4/28/2006	11:05	11:55	0:50	0.833333	PERMANENT	SHORT CIRCUIT
COT-02	4/28/2006	11:05	11:13	0:08	0.133333	PERMANENT	SHORT CIRCUIT
COT-03	4/28/2006	11:05	11:13	0:08	0.133333	PERMANENT	SHORT CIRCUIT
COT-04	4/28/2006	11:05	11:13	0:08	0.133333	PERMANENT	SHORT CIRCUIT
COT-05	4/28/2006	11:05	11:13	0:08	0.133333	PERMANENT	SHORT CIRCUIT
SEB-06	4/28/2006	11:30	12:45	1:15	1.25	SOL	SOL
MEK-06	4/28/2006	11:43	12:45	1:02	1.033333	SOL	SOL
SEB-05	4/28/2006	11:37	12:25	0:48	0.8	SOL	SOL
GEF-07	4/28/2006	11:32	11:34	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SEBII-03	4/28/2006	11:33	11:35	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-07	4/28/2006	11:35	11:37	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
ADW-04	4/28/2006	11:40	12:05	0:25	0.416667	OUTGOING FEEDER	OVERLOAD
GEF-07	4/28/2006	11:40	12:00	0:20	0.333333	OUTGOING FEEDER	OVERLOAD

GEF-07	4/28/2006	11:40	12:00	0:20	0.333333	OUTGOING FEEDER	OVERLOAD
ADC-07	4/28/2006	11:45	12:15	0:30	0.5	OUTGOING FEEDER	OVERLOAD
ADW-03	4/28/2006	11:45	16:40	4:55	4.916667	PERMANENT	EARTHFAULT
ADW-03	4/28/2006	17:15	17:35	0:20	0.333333	OPERATION	BYREQUEST
ADC-14	4/28/2006	11:45	12:00	0:15	0.25	PERMANENT	EARTHFAULT
COT-03	4/28/2006	11:55	12:15	0:20	0.333333	OUTGOING FEEDER	OVERLOAD
ADN-06	4/28/2006	11:55	16:10	4:15	4.25	OPERATION	BYREQUEST
ADW-04	4/28/2006	12:15	14:35	2:20	2.333333	OUTGOING FEEDER	OVERLOAD
SEBII-03	4/28/2006	12:30	13:05	0:35	0.583333	OUTGOING FEEDER	OVERLOAD
ADC-07	4/28/2006	12:35	13:05	0:30	0.5	OUTGOING FEEDER	OVERLOAD
ADC-03	4/28/2006	12:35	13:05	0:30	0.5	OUTGOING FEEDER	OVERLOAD
SUL-02	4/28/2006	12:40	12:42	0:02	0.033333	TRANSIENT	EARTHFAULT
ADW-02	4/28/2006	13:10	17:15	4:05	4.083333	TRAFO	OVERLOAD
GEF-02	4/28/2006	11:45	13:05	1:20	1.333333	OUTGOING FEEDER	OVERLOAD
GOF-03	4/28/2006	13:25	13:30	0:05	0.083333	OUTGOING FEEDER	OVERLOAD
GOF-05	4/28/2006	13:28	15:05	1:37	1.616667	OUTGOING FEEDER	OVERLOAD
GOF-05	4/28/2006	13:28	17:00	3:32	3.533333	OUTGOING FEEDER	OVERLOAD
COT-33	4/28/2006	13:30	13:32	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
KALII-02	4/28/2006	13:55	14:00	0:05	0.083333	OUTGOING FEEDER	OVERLOAD
ADC-07	4/28/2006	14:00	14:35	0:35	0.583333	OUTGOING FEEDER	OVERLOAD
ADN-04	4/28/2006	14:10	15:05	0:55	0.916667	OUTGOING FEEDER	OVERLOAD
KALII-05	4/28/2006	14:05	14:15	0:10	0.166667	OUTGOING FEEDER	OVERLOAD
KALII-05	4/28/2006	14:05	14:15	0:10	0.166667	OUTGOING FEEDER	OVERLOAD
GOF-03	4/28/2006	14:00	14:15	0:15	0.25	OUTGOING FEEDER	OVERLOAD
GOF-03	4/28/2006	16:00	16:05	0:05	0.083333	OPERATION	BYREQUEST
COT-33	4/28/2006	14:20	14:22	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
AKAII-02	4/28/2006	14:55	18:45	3:50	3.833333	PERMANENT	SHORT CIRCUIT
AKAII-03	4/28/2006	14:55	15:00	0:05	0.083333	PERMANENT	SHORT CIRCUIT

AKAII-06	4/28/2006	14:55	15:00	0:05	0.083333	PERMANENT	SHORT CIRCUIT
AKAII-07	4/28/2006	14:55	15:00	0:05	0.083333	PERMANENT	SHORT CIRCUIT
KALN-K4	4/28/2006	14:55	16:55	2:00	2	PERMANENT	SHORT CIRCUIT
ADC-09	4/28/2006	14:35	15:25	0:50	0.833333	OPERATION	BYREQUEST
ADN-03	4/28/2006	15:00	17:00	2:00	2	OUTGOING FEEDER	OVERLOAD
NIF-03	4/28/2006	15:10	15:15	0:05	0.083333	OPERATION	BYREQUEST
KALII-01	4/28/2006	15:35	17:10	1:35	1.583333	PERMANENT	SHORT CIRCUIT
ADE-03	4/28/2006	15:37	15:39	0:02	0.033333	TRANSIENT	EARTHFAULT
COT-04	4/28/2006	16:00	16:02	0:02	0.033333	TRANSIENT	EARTHFAULT
COT-05	4/28/2006	16:05	16:07	0:02	0.033333	TRANSIENT	EARTHFAULT
COT-04	4/28/2006	16:30	16:32	0:02	0.033333	TRANSIENT	EARTHFAULT
BEL-03	4/28/2006	16:50	17:50	1:00	1	PERMANENT	SHORT CIRCUIT
ADC-07	4/28/2006	17:00	17:05	0:05	0.083333	OPERATION	BYREQUEST
LEG-03	4/28/2006	17:05	17:10	0:05	0.083333	OPERATION	BYREQUEST
WER-07	4/28/2006	17:10	19:35	2:25	2.416667	PERMANENT	SHORT CIRCUIT
ADW-01	4/28/2006	17:15	21:35	4:20	4.333333	OUTGOING FEEDER	OVERLOAD
GOF-02	4/28/2006	17:25	19:15	1:50	1.833333	OUTGOING FEEDER	OVERLOAD
BEL-01	4/28/2006	17:25	18:00	0:35	0.583333	OUTGOING FEEDER	OVERLOAD
GEF-07	4/28/2006	17:45	18:50	1:05	1.083333	OUTGOING FEEDER	OVERLOAD
KALN-K4	4/28/2006	17:45	19:40	1:55	1.916667	OPERATION	BYREQUEST
KALII-06	4/28/2006	17:55	17:57	0:02	0.033333	TRANSIENT	EARTHFAULT
SEBII-03	4/28/2006	18:00	18:02	0:02	0.033333	TRANSIENT	EARTHFAULT
ADW-06	4/28/2006	18:05	20:30	2:25	2.416667	TRAFO	OVERLOAD
GOF-05	4/28/2006	18:35	18:37	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SEB-03	4/28/2006	18:40	18:42	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
SEBII-03	4/28/2006	18:40	19:25	0:45	0.75	OUTGOING FEEDER	OVERLOAD
ADN-06	4/28/2006	18:45	19:25	0:40	0.666667	OUTGOING FEEDER	OVERLOAD
ADN-06	4/28/2006	20:00	20:35	0:35	0.583333	OPERATION	BYREQUEST
SEB-03	4/28/2006	18:45	20:00	1:15	1.25	OUTGOING FEEDER	OVERLOAD
SEB-03	4/28/2006	18:45	10:00	15:15	15.25	PERMANENT	SHORT CIRCUIT
SEB-04	4/28/2006	18:45	18:47	0:02	0.033333	OUTGOING	OVERLOAD

						FEEDER	
GOF-05	4/28/2006	18:45	18:47	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
MEK-02	4/28/2006	18:50	18:52	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
MEK-02	4/28/2006	18:55	20:30	1:35	1.583333	OUTGOING FEEDER	OVERLOAD
MEK-02	4/28/2006	20:30	22:25	1:55	1.916667	OUTGOING FEEDER	OVERLOAD
SEB-04	4/28/2006	19:00	22:50	3:50	3.833333	OUTGOING FEEDER	OVERLOAD
GEF-07	4/28/2006	19:00	19:02	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
NIF-01	4/28/2006	19:05	19:35	0:30	0.5	OUTGOING FEEDER	OVERLOAD
NIF-01	4/28/2006	19:35	21:20	1:45	1.75	OUTGOING FEEDER	OVERLOAD
MEK-05	4/28/2006	19:05	19:07	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
GOF-05	4/28/2006	19:10	19:45	0:35	0.583333	OUTGOING FEEDER	OVERLOAD
LEG-04	4/28/2006	19:10	19:12	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
GEF-01	4/28/2006	19:20	20:25	1:05	1.083333	OUTGOING FEEDER	OVERLOAD
COT-02	4/28/2006	19:20	20:35	1:15	1.25	OUTGOING FEEDER	OVERLOAD
KALII-02	4/28/2006	19:25	19:50	0:25	0.416667	OPERATION	BYREQUEST
ADC-03	4/28/2006	19:30	19:32	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
LEG-04	4/28/2006	19:30	19:32	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
MEK-05	4/28/2006	19:30	20:10	0:40	0.666667	OUTGOING FEEDER	OVERLOAD
MEK-05	4/28/2006	20:10	22:25	2:15	2.25	OUTGOING FEEDER	OVERLOAD
GOF-02	4/28/2006	19:30	19:45	0:15	0.25	OUTGOING FEEDER	OVERLOAD
SEBII-03	4/28/2006	19:35	20:05	0:30	0.5	OUTGOING FEEDER	OVERLOAD
ADW-03	4/28/2006	19:30	20:50	1:20	1.333333	PERMANENT	EARTHFAULT
WER-06	4/28/2006	19:30	22:55	3:25	3.416667	OUTGOING FEEDER	OVERLOAD
BEL-04	4/28/2006	19:40	20:25	0:45	0.75	OUTGOING FEEDER	OVERLOAD
BEL-01	4/28/2006	19:35	19:37	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADC-11	4/28/2006	19:45	19:47	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
LEG-04	4/28/2006	19:45	20:15	0:30	0.5	OUTGOING	OVERLOAD

						FEEDER	
GEF-07	4/28/2006	19:50	20:45	0:55	0.916667	OUTGOING FEEDER	OVERLOAD
ADC-03	4/28/2006	19:50	20:55	1:05	1.083333	OUTGOING FEEDER	OVERLOAD
ADC-11	4/28/2006	20:03	20:30	0:27	0.45	OUTGOING FEEDER	OVERLOAD
ADC-11	4/28/2006	20:30	21:30	1:00	1	OUTGOING FEEDER	OVERLOAD
ADC-03	4/28/2006	20:05	20:30	0:25	0.416667	OUTGOING FEEDER	OVERLOAD
ADC-07	4/28/2006	20:07	20:09	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
ADC-07	4/28/2006	20:15	20:30	0:15	0.25	OUTGOING FEEDER	OVERLOAD
ADW-04	4/28/2006	20:20	20:22	0:02	0.033333	TRANSIENT	EARTHFAULT
SUL-01	4/28/2006	20:35	20:37	0:02	0.033333	TRANSIENT	EARTHFAULT
MEK-02	4/28/2006	20:40	20:42	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
LEG-04	4/28/2006	20:40	21:30	0:50	0.833333	OUTGOING FEEDER	OVERLOAD
LEG-03	4/28/2006	20:45	21:15	0:30	0.5	OUTGOING FEEDER	OVERLOAD
GOF-02	4/28/2006	19:55	22:15	2:20	2.333333	OUTGOING FEEDER	OVERLOAD
MEK-02	4/28/2006	20:50	21:15	0:25	0.416667	OUTGOING FEEDER	OVERLOAD
GEF-07	4/28/2006	20:58	21:30	0:32	0.533333	OUTGOING FEEDER	OVERLOAD
COT-02	4/28/2006	21:00	21:02	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
ADN-05	4/28/2006	21:05	22:15	1:10	1.166667	PERMANENT	SHORT CIRCUIT
COT-02	4/28/2006	21:30	21:32	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
KALN-K2	4/28/2006	21:35	21:50	0:15	0.25	OPERATION	BYREQUEST
ADW-02	4/28/2006	21:35	22:50	1:15	1.25	TRAFO	OVERLOAD
WER-08	4/28/2006	21:40	21:42	0:02	0.033333	TRANSIENT	EARTHFAULT
GEF-07	4/28/2006	21:50	22:15	0:25	0.416667	OUTGOING FEEDER	OVERLOAD
COT-02	4/28/2006	22:00	22:40	0:40	0.666667	OUTGOING FEEDER	OVERLOAD
KALN-K2	4/28/2006	21:35	21:50	0:15	0.25	OPERATION	BYREQUEST
ADW-02	4/28/2006	21:35	22:50	1:15	1.25	OUTGOING FEEDER	OVERLOAD
WER-08	4/28/2006	21:40	21:42	0:02	0.033333	TRANSIENT	EARTHFAULT
GEF-07	4/28/2006	21:50	22:15	0:25	0.416667	OUTGOING FEEDER	OVERLOAD
COT-02	4/28/2006	22:00	22:40	0:40	0.666667	OUTGOING	OVERLOAD

						FEEDER	
COT-33	4/28/2006	23:45	23:47	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
BEL-01	**4/29/2006**	3:00	13:55	10:55	10.91667	PERMANENT	SHORT CIRCUIT
ADC-04	4/29/2006	6:45	7:05	0:20	0.333333	PERMANENT	SHORT CIRCUIT
ADC-08	4/29/2006	6:45	10:03	3:18	3.3	PERMANENT	SHORT CIRCUIT
ADC-14	4/29/2006	6:45	10:03	3:18	3.3	PERMANENT	SHORT CIRCUIT
ADC-10	4/29/2006	7:05	7:07	0:02	0.033333	TRANSIENT	EARTHFAULT
WER-09	4/29/2006	8:00	8:02	0:02	0.033333	TRANSIENT	EARTHFAULT
COT-33	4/29/2006	8:40	8:42	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
GEF-02	4/29/2006	8:50	9:00	0:10	0.166667	OPERATION	BYREQUEST
GEF-02	4/29/2006	14:50	15:28	0:38	0.633333	OPERATION	BYREQUEST
LEG-03	4/29/2006	19:55	20:05	0:10	0.166667	OPERATION	BYREQUEST
KALI-F3	4/29/2006	8:05	9:40	1:35	1.583333	PERMANENT	SHORT CIRCUIT
KALI-F4	4/29/2006	8:05	8:07	0:02	0.033333	PERMANENT	SHORT CIRCUIT
KALI-F11	4/29/2006	8:05	8:08	0:03	0.05	PERMANENT	SHORT CIRCUIT
KALI-F13	4/29/2006	8:05	8:09	0:04	0.066667	PERMANENT	SHORT CIRCUIT
KALI-F3	4/29/2006	8:05	9:40	1:35	1.583333	PERMANENT	SHORT CIRCUIT
SEBII-03	4/29/2006	9:00	9:02	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
COT-04	4/29/2006	9:45	9:47	0:02	0.033333	TRANSIENT	EARTHFAULT
COT-05	4/29/2006	9:45	9:47	0:02	0.033333	TRANSIENT	EARTHFAULT
KALN-K2	4/29/2006	9:55	9:57	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
SEB-02	4/29/2006	10:05	10:10	0:05	0.083333	OPERATION	BYREQUEST
ADW-04	4/29/2006	10:50	11:05	0:15	0.25	PERMANENT	EARTHFAULT
LEG-03	4/29/2006	11:20	11:55	0:35	0.583333	PERMANENT	SHORT CIRCUIT
ADN-01	4/29/2006	10:15	12:05	1:50	1.833333	PERMANENT	SHORT CIRCUIT
SUL-06	4/29/2006	12:30	12:32	0:02	0.033333	TRANSIENT	EARTHFAULT
AKAII-07	4/29/2006	12:40	12:42	0:02	0.033333	TRANSIENT	EARTHFAULT
AKAII-07	4/29/2006	13:00	13:02	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-07	4/29/2006	13:20	14:25	1:05	1.083333	PERMANENT	SHORT CIRCUIT
AKAII-07	4/29/2006	13:20	13:22	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-04	4/29/2006	14:40	14:42	0:02	0.033333	OPERATION	BYREQUEST
ADC-09	4/29/2006	14:45	15:10	0:25	0.416667	OPERATION	BYREQUEST

GEF-07	4/29/2006	14:55	19:15	4:20	4.333333	PERMANENT	SHORT CIRCUIT
GEF-01	4/29/2006	16:00	16:02	0:02	0.033333	TRANSIENT	EARTHFAULT
LEG-08	4/29/2006	16:10	16:12	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
LEG-03	4/29/2006	16:20	16:22	0:02	0.033333	TRANSIENT	EARTHFAULT
ADE-03	4/29/2006	16:35	16:37	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADN-06	4/29/2006	15:45	16:50	1:05	1.083333	PERMANENT	SHORT CIRCUIT
SEB-03	4/29/2006	17:35	20:50	3:15	3.25	PERMANENT	SHORT CIRCUIT
KALN-K2	4/29/2006	18:20	20:30	2:10	2.166667	PERMANENT	EARTHFAULT
GOF-03	4/29/2006	19:00	19:10	0:10	0.166667	OPERATION	BYREQUEST
BEL-05	**4/30/2006**	6:47	7:30	0:43	0.716667	PERMANENT	SHORT CIRCUIT
BEL-05	4/30/2006	7:30	9:35	2:05	2.083333	PERMANENT	SHORT CIRCUIT
MEK-01	4/30/2006	7:00	7:02	0:02	0.033333	TRANSIENT	EARTHFAULT
ADW-01	4/30/2006	8:10	8:12	0:02	0.033333	TRANSIENT	EARTHFAULT
AKAII-06	4/30/2006	8:25	8:27	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
BEL-03	4/30/2006	9:00	9:40	0:40	0.666667	PERMANENT	SHORT CIRCUIT
ADC-14	4/30/2006	9:20	9:22	0:02	0.033333	TRANSIENT	EARTHFAULT
ADW-02	4/30/2006	10:20	10:22	0:02	0.033333	TRANSIENT	EARTHFAULT
ADW-03	4/30/2006	10:20	12:45	2:25	2.416667	PERMANENT	EARTHFAULT
ADC-14	4/30/2006	10:30	10:32	0:02	0.033333	TRANSIENT	EARTHFAULT
ADC-14	4/30/2006	10:32	14:50	4:18	4.3	PERMANENT	EARTHFAULT
MEK-05	4/30/2006	10:50	11:25	0:35	0.583333	OPERATION	BYREQUEST
ADC-10	4/30/2006	10:55	15:35	4:40	4.666667	PERMANENT	SHORT CIRCUIT
GOF-03	4/30/2006	12:10	12:12	0:02	0.033333	TRANSIENT	EARTHFAULT
SEB-03	4/30/2006	12:20	12:30	0:10	0.166667	OPERATION	BYREQUEST
ADC-09	4/30/2006	14:40	17:45	3:05	3.083333	PERMANENT	EARTHFAULT
MEK-01	4/30/2006	14:55	17:35	2:40	2.666667	PERMANENT	SHORT CIRCUIT
MEK-01	4/30/2006	18:05	18:40	0:35	0.583333	OPERATION	BYREQUEST
SEB-09	4/30/2006	15:00	15:05	0:05	0.083333	OPERATION	BYREQUEST
GEF-01	4/30/2006	15:20	15:22	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADC-10	4/30/2006	15:50	15:52	0:02	0.033333	TRANSIENT	EARTHFAULT
WER-08	4/30/2006	15:25	15:27	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
COT-05	4/30/2006	16:05	16:07	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
ADC-10	4/30/2006	16:15	16:40	0:25	0.416667	PERMANENT	EARTHFAULT

ADC-10	4/30/2006	16:40	17:50	1:10	1.166667	PERMANENT	EARTHFAULT
ADC-10	4/30/2006	17:50	22:25	4:35	4.583333	PERMANENT	EARTHFAULT
AKAII-07	4/30/2006	16:25	16:27	0:02	0.033333	TRANSIENT	SHORT CIRCUIT
WER-04	4/30/2006	16:25	16:27	0:02	0.033333	TRANSIENT	EARTHFAULT
WER-04	4/30/2006	16:30	16:55	0:25	0.416667	PERMANENT	EARTHFAULT
WER-05	4/30/2006	16:30	16:46	0:16	0.266667	PERMANENT	EARTHFAULT
WER-04	4/30/2006	17:05	17:07	0:02	0.033333	TRANSIENT	EARTHFAULT
KALI-F13	4/30/2006	17:10	18:25	1:15	1.25	PERMANENT	SHORT CIRCUIT
KALI-F13	4/30/2006	18:30	18:32	0:02	0.033333	OPERATION	BYREQUEST
KALN-K2	4/30/2006	17:10	19:50	2:40	2.666667	PERMANENT	SHORT CIRCUIT
KALN-K4	4/30/2006	17:10	19:50	2:40	2.666667	PERMANENT	SHORT CIRCUIT
KALN-K7	4/30/2006	17:10	19:50	2:40	2.666667	PERMANENT	SHORT CIRCUIT
KALN-K5	4/30/2006	17:10			0	PERMANENT	SHORT CIRCUIT
GOF-03	4/30/2006	17:15	17:17	0:02	0.033333	TRANSIENT	EARTHFAULT
WER-05	4/30/2006	18:25	18:27	0:02	0.033333	TRANSIENT	EARTHFAULT
SUL-01	4/30/2006	19:00	20:15	1:15	1.25	PERMANENT	SHORT CIRCUIT
SEB-04	4/30/2006	19:25	19:27	0:02	0.033333	OUTGOING FEEDER	OVERLOAD
BEL-04	4/30/2006	20:15	20:45	0:30	0.5	OPERATION	BYREQUEST
MEK-01	4/30/2006	20:45	21:45	1:00	1	PERMANENT	SHORT CIRCUIT
GOF-03	4/30/2006	18:45	20:45	2:00	2	OPERATION	BYREQUEST
ADC-15	4/30/2006	22:40	22:42	0:02	0.033333	TRANSIENT	EARTHFAULT