ADDIS ABABA UNIVERSITY

ADDIS ABABA INSTITUTE OF TECHNOLOGY

SCHOOL OF ELECTRICAL AND COMPUTER ENGINEERING

Long Term Distribution Expansion Planning with the Consideration of Distributed Generation

(Case Study; Bishoftu Substation II)

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A Thesis Submitted to the School of Graduate Studies of Addis Ababa University in Partial Fulfillment of the Requirements for the Degree of Masters of Science in Electrical Power Engineering

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APPROVED BY BOARD OF EXAMINERS

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Declaration

I declare that this thesis is my original work and has not been presented for a degree in this or any other universities. All sources of materials used for this thesis have been fully acknowledged.

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Place: Addis Ababa Institute of Technology, Addis Ababa University, Addis Ababa

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

Dr Getachew Bekele ______________

Thesis advisor Signature

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LIST OF ACRONYMS

A	Ampere
AAC	All Aluminum Conductors
ACCI	Average Customer Curtailment Index
AENS	Average Energy Not Supplied Index
ANN	Artificial Neutral Networks
ASAI	Average Service Availability Index
ASUI	Average Service Unavailability Index
CAIFI	Customer Average Interruption Frequency Index
CAIDI	Customer Average Interruption Duration Index
CB	Circuit Breaker
DG	Distributed Generation
DIGSILENT	Digital Simulation of Electrical Network
DPEF	Distribution Permanent Earth Fault
DPSC	Distribution Permanent Short Circuit
DTEF	Distribution Temporary Earth Fault
DTSC	Distribution Temporary Short Circuit
DUR	Duration
EEA	Ethiopian Electrical Agency
EEP	Ethiopian Electric Power
EEPCO	Ethiopian Electric Power Corporation
EEU	Ethiopian Electric Utility
ENS	Energy Not Supplied Index
ES	Expert System
FRE	Frequency of Interruption
FC	Fuel Cell
G.C	Gregorian Calendar
GDP	Growth Domestic Product
Hrs.	Hours
HV	High Voltage
ICE	Internal Combustion Engines

ICS	Interconnected System
IEEE	Institute of Electrical and Electronics Engineering
km	Kilo Meter
Kv	Kilo Volt
Kva	Kilo Volt Ampere
KVRh	kilo volt ampere hour reactive
KW	Kilo Watt
KWh	Kilo Watt Hour
LV	Low Voltage
MCS	Monte Carlo simulation
mm	milli meter
MTBR	Mean Time Between Failures
MTTF	Mean Time to Failure
MTTR	Mean Time to Repair
MV	Medium Voltage
MVAr	Mega Volt Ampere Reactive
MW	Mega Watt
MWH	Mega Watt Hour
OPR	Operation
PCC	Point of Common Coupling
PEM	Proton Exchange Membrane
PF	Power Factor
PSO	Particle Swarm Optimization
PV	Photovoltaics
RTS	Reactive Tabu Search
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SOFC	Solid Oxide Fuel Cells

ABSTRACT

Nowadays, due to economic development of the country the electrical energy demand of Ethiopia increases by 30% yearly. But in order to satisfy customers' power demand the planning and expansion of power must be done using a proper load forecasting method.

This thesis is focused on demand forecasting of Bishoftu town and distribution expansion planning of Bishoftu substation II with the help of distributed generation. Historical energy demand data, historical energy growth rate, economic growth rate and distribution system's reliability related data were assessed from Ethiopian electric power corporation and Bishoftu city administration. To forecast the load from 2019 to 2029 extrapolation simulation approach is applied. From the results of demand forecasting, it is found that the energy demand and peak demand in 2028 will be 2,005,457.41 MWH and 401.64 MW respectively. But the existing peak demand of the town is 54.7MW and the current total capacity of the distribution system is 43.8 MW. The existing distribution network cannot meet not only the future demand but also the existing demand. So, improving the reliability of the existing system with the help of distributed generation is required to expand the system and to meet the future demand. The Substation has encountered frequent power interruptions. The interruptions are caused mainly by short circuit (SC), earth fault (EF) and planned outages for operation and maintenance purpose. The substation's System Average Interruption Frequency Index (SAIFI) and System Average Interruption Duration Index (SAIDI) are 199.92ints/yr and 264.22hrs/yr respectively. The reliability of the substation does not meet the requirements set by Ethiopian Electric Agency (EEA) which set (SAIFI =20 int/yr and SAIDI= 25hrs/yr).

Then three feeders of Bishoftu substation-II are selected for connecting DG due to high frequency and long duration of interruptions. Distributed generation is a generation of an electric power close to the load which has resources like mini hydro, photovoltaic Array (PV), fuel cells, wind generators and micro turbines. In this thesis, microturbine is selected based on availability of the resource, cost factors, and utilization area. The size of single DG is 3.71MW but the total capacity of DG 11.13MW is fed to the grid as backup when there is an interruption. A simulation study for reliability analysis is carried out using DigSilent software. With the presence of DG, the simulation result shows that the reliability indices improved SAIFI by 65.16% and SAIDI by 75.62%.

Keywords: extrapolation and simulation, elastic coefficient, distributed generation, reliability assessment, DIGSILENT POWER FACTORY, power demand forecasting, expansion planning

CHAPTER ONE

INTRODUCTION

1.1 Background

Bishoftu city is located in West Shewa, Oromiya, Ethiopia; its geographical coordinates are 9° 6' 0'' North, 37° 15' 0'' East. Bishoftu city is one of ranked city of Oromia region in population and economy, which is located at about 47km south east of Addis Ababa and 52 km North West of Adama. Bishoftu substation II is located at Bishoftu town which is the main substation to supply Bishaftu town and small towns near to Bishoftu including Dire town, Amerti, Minjar and partial load of Dukem town. And there are many industries supplied from the substation. The incoming line from Kality substation which is called Koka tap carrying 132KV is the input of the substation. Inside this substation there are three power transformers to convert the 132KV to 33KV and 15KV distribution voltage levels.

Figure 1.1 Overview of Bishoftu substation II

The capacity of these transformers is 1x25MVA; 132/15KV, 1X31.5MVA; 132/15KV and 1x16/8MVA; 132/33/15KV.

1.2 Statement of the Problem

Now a day, Ethiopian Government is going to change the country's economic status from the current least developed level to a medium income level. Expanding and strengthening of the electric power supply sectors is also one of the most emphasized economic dimensions.

Bishoftu city is located near to Addis Ababa and selected as industrial zone by Ethiopian Government. Due to that, the city is a suitable location for most of the industries in our country and hence considerable share of the electric power have to be supplied to the city. But there is a large gap between the customer needs and the power demand due to high frequency and long duration of electric power interruption in the city.

Therefore, an expansion planning of distribution system with the help of DG is required to meet the future power demand.

1.3 Objectives of Study

1.3.1 General Objective

The main objective of this thesis is to conduct long term demand forecasting and distribution network expansion planning of Bishoftu substation II with the help of DG to meet the future demand of 2028.

1.3.2 Specific Objectives

The specific objectives of the thesis are:

- To forecast the future power demand of the city
- To study the reliability problems of the present Bishoftu substation II.
- To identify possible solutions for those reliability problems.
- To compare the reliability indices before and after penetrating of DG.
- To estimate the cost of the designed system.
- Draw relevant conclusions from the result of the investigation and make recommendations to the concerned body.

1.4 Methodology and Techniques

The methods and techniques used to investigate demand forecasting and expansions planning of distribution system by integrating distributed generation are as follows:

Data Collection: Important information and data of the case study distribution substation have been collected from Ethiopian Electric Power (EEP), Ethiopian Electric Utility (EEU) and Bishoftu city administration.

Literature Review: Different literatures about demand forecasting and distribution expansion planning (like books, papers, articles, journals, Lectures and other materials) are reviewed.

Data Analysis; Based on the data collection; future demand is forecasted from 2019 to 2028 by using extrapolation simulation approach. The reliability of the system is analyzed before and after the injection of DG with the help of DIGSILENT Power Factory 15.1.7 Software.

1.5 Scope and Limitation

This thesis covers, forecasting future demand of Bishoftu city by using extrapolation simulation approach, studying the current power system reliability problems of the substation, their causes, percentage of improvements gained by penetrating distributed generators to the present Bishoftu substation-II. The reliability models have been developed in Dig Silent/Power Factory. The DG technologies have been limited to Synchronous Generator which is standard models available in Dig SILENT Power Factory 15.1.7.

1.6 Outline of the Thesis

This thesis is organized into five chapters.

Chapter one deals with a brief introduction of the thesis background, problem statement, objectives, description of methodology and techniques used in the thesis and the thesis outline.

Chapter two gives the details of the theoretical background and review of different literatures related to the study.

Chapter three describes demand forecasting and distributed generation integration issue and overall data collection and methodology.

Chapter four covers modeling and simulation of the case study distribution system and discussion of the results found.

Chapter five describes conclusion and recommendation of the thesis and also the further works expected to be done in the future.

CHAPTER TWO

THEORETICAL BACKGROUND AND REVIEW OF LITERATURES

2.1 Introduction

The distribution expansion planning is carried out to provide a distribution infrastructure that meets the electric power demand of customer needs in terms of capacity, quality and reliability in the most cost-effective manner. This entails the need to reinforce and develop the existing infrastructure in a phase wise manner so that infrastructure expansions are appropriate with the evolving electricity requirements. [1, 2, 3]

2.2 Demand Forecasting Techniques

A large number of demand forecasting methods have been developed and applied in the last several decades. According to Northcote-Green [4], forecasting divided into three basis categories (i.e. trending, multivariate and simulation methods). Trending methods involve extrapolating historical annual peak load on a small area basis, using curve fit or other extrapolation procedures. Multivariate technique is a method that extrapolates on the basis of other variables as well as annual small area peak load. Simulation approaches generally work with a land –use based method, predicting the type of customers (residential, commercial, industrial and other sectors).

Simulation approach [5]: The methodology of this approach is based on the historical electricity consumption and economic growth rate of different sectors. This method gives us more detail information about the energy consumption in industrial, agricultural and domestic sector.

Simulation forecasts are mainly relevant for areas where large developments are expected and when the forecast period is five years and above.

Elastic coefficient approach [5]: This approach can be applied to medium term and long-term load forecasting. Based on the relation between elastic coefficient and economic growth, electric load demand is modeled.

Trend extrapolation approach: The methodology of this approach is based on historical load consumption used in the past. This approach is used when there is lack of information, like economic growth rate of different sectors and historical loads [6,12].

End-use approach; The end-use approach gives the detailed description of how energy is used during the forecasting period. This method required a large amount of survey data and statistics. End-user models are often linked with econometric models. End-user forecasting can be highly accurate, particularly for residential demand forecasting method. [7, 8]

Econometric analysis; This type of approach uses historical load data to predict the future as the time series model (i.e. extrapolation model). Econometric analysis however, attempts to go beyond time series models by explaining the causes of the identified trends. Econometric models clearly explain the causal relationships between the dependent variable (either energy or power) and independent variables (i.e. economic growth rate e.g. GDP, technological features e.g. number and type of appliances; industrial processes, demography e.g. population or other variables e.g. weather).

The advantage of econometric forecasting is the ease of data analysis in which high and low scenario load forecasts can be derived and the logical basis on which they can be formed. This simply requires changes in the forecast rate of the input variables, e.g. economic growth rate GDP and electricity price. A faster economic growth will produce a higher load forecast whilst the imposition of price increases will reduce forecast levels of energy demand. Even if both econometric forecasting method and extrapolation techniques could predict changes in demand with equal accuracy, the econometric model would be more valuable since it might help in understanding why demand changing was occurring. [9,10,11]

The method used in this thesis is extrapolation simulation forecasting method. This method is higher accurate than other methods because it gives more detail information about the electric consumption in industrial, commercial, domestic and other sectors.

2.3 Related Works on Distribution Expansion Planning

Many approaches have been investigated and proposed to solve distribution expansion planning problem.

In Tung study [13]**,** elastic coefficient approach and simulation approach (direct forecasting approach) are used to forecast energy demand from 2007 to 2015. To calculate power flow of primary feeders of distribution network, backward-forward sweep load flow analysis method is used. At the same time, two different scenarios in distribution system planning are compared and analyzed. The basic objective of two scenarios is to minimize voltage drop and electricity losses. A number of small hydropower plants are connected to the network in scenario 2. Plan analysis of both scenarios is recommended that the existing system voltage would be improved from 10kV to 22kV.

In study of distribution expansion planning proposed by Hieu [14]: both exponential trend and simulation approach are used to forecast energy demand of Travinh city. Shunt capacitors are used in primary distribution network of Travinh city for power loss minimization and voltage improvement.

Duc [15,16] studied on demand forecasting for Phanthiet city during the period of 2008 to 2015. To improve voltage profiles and reduce power losses, two scenarios have proposed for the primary distribution system planning of Phanthiet city.

Scenario 1 is to upgrade the system along with capacitor addition and Scenario 2 is to upgrade the system with the help of distributed generation and capacitor placement.

Adiga S. Chandrashekara, et al [17], studied on a neuro-expert system for planning and load forecasting of distribution systems.

Jovanovic [18,19] studied on planning of optimal location and sizes of distribution transformers using integer programming. The solution solves the problem of MV network development in case when planned distribution transformers can be built in more than one location, and connects them to several MV feeders in several ways.

Even though so many researchs have been done on distribution expansion planning, most of them used capacitor and DG allocation for power loss minimization and voltage deviation improvement [13, 14, 15, 20 and 21].

In this thesis, Distributed Generation is allocated to enhance reliability of power in Bishoftu substation II.

2.4 Distributed Generation

Distributed Generation is a concept of installing small-scale electric power generation and installed near to the customer‘s site and used to increase the energy-demand. Usually, it is connected via power electronic converter or other power electronic devices to the distribution system [22]. There is not a common accepted definition of DG as the concept involves many technologies and applications. Different terms and definitions are used related to DG in different literature. For example, Anglo-American countries often use the term ‘embedded generation’, North-American countries use the term ‘dispersed generation’, and Europe and parts of Asia, uses the term ‘decentralised generation’ [23].

However, this definition is not compulsory as there are no universal agreements on the distributed generation definition. The main objective of distributed generation is supplying the electric power from point of generation close to the point of consumer.

2.4.1. Classification of Distributed Generation

Based on different criteria DGs can be classified in to different type. Among these, the two main criteria for DGs classifications are capacity or output power rating and the type of technology that involved in the power generation.

The classification of Distributed Generations depending up on capacity or output power rating is shown as follows.

Class	**DG Capacity**
Micro Distributed Generation	1W – 5KW
Small Distributed Generation	5kW – 5MW
Medium Distributed Generation	5MW – 50MW
Large Distributed Generation	50MW – 300MW

Another criterion for classification of DGs is the type of technology involved in the power generation. Therefore, distributed generation technologies are classified as renewable and non-renewable.

Renewables DG	**Non-renewables DG**
Solar	Internal Combustion Engines (ICE)
Wind	Combined Cycle
Geothermal	Combustion Turbine
Ocean	Microturbine
	Fuel Cell

Distributed generation technologies could also be grouped as dispatchable and non-dispatchable according to their dispatchability [24]. The key difference between the two categories is the controllability of electric power. The dispatchable resources, in general, have the energy stored, and could therefore be called upon at any given time to produce power.

This implies that dispatchable units such as conventional generator sets, fuel cells, and microturbines, can be controlled by a central intelligence and relied on to generate according to the needs of the power system.

The non-dispatchable resources, inherently do not have any control of the input energy for later use when needed. This means that these technologies generate as a function of intermittent availability of their energy source but not as a function of power system needs. From the foregoing it can adduced that non-renewable DG technologies are dispatchable but the renewable DG technologies consist of both dispatchable and non-dispatchable resources. Hydroelectric, biomass and geothermal are dispatchable resources, whereas, wind, solar and tidal waves would be classified as non-dispatchable resources – most renewable energy systems are non-dispatchable.

2.4.2 Types of Distributed Generation Technology

There are many types of distributed generation technologies. These are: Micro-turbine, Wind turbines, Gas turbine, Photovoltaic system (PV), Fuel cells, and other renewable resources.

1. Photo Voltaic Systems

Photovoltaic (PV) is the direct conversion of light energy received from the sun into an electrical energy (a photo voltage) to get electric power. Semi conducting materials are used to construct solar cells which are capable of transforming self-contained energy of photons into electricity when they are exposed to solar radiation. The cells are placed in an array that is either fixed or moving to keep tracking the sun to generate the maximum power. The photo voltaic effect is the electrical potential developed between two dissimilar semiconductor materials when their common junction is illuminated with radiation of photons. The photo voltaic cell, then, converts light directly into electricity. A material or device that has the capability of converting the energy contained in photons of light into an electrical voltage and current is said to be photovoltaic. PV systems are comfortable to environment since they are simple in designs and easy to use, not associated with emissions and it does not need any other fuel than solar light.[25]

The system generates DC voltage and then transferred to AC with the help of inverters. The design of such systems can be with and without battery storages. There disadvantage is they require large space.

2. Wind Turbine

Wind energy relies, indirectly, on the energy of the sun. A small proportion of the solar radiation received by the Earth is converted into kinetic energy, the main cause of which is the imbalance between the net incoming radiation at low latitudes and the net outgoing radiation at high latitudes. Wind turbines have ability of converting wind energy into electricity. The Earth's rotation, geographic features and temperature gradients affect the location and nature of the resulting winds [26]. The use of wind energy requires that the kinetic energy of moving air be converted to useful energy. As a result, the economics of using wind for electricity supply are highly sensitive to local wind conditions and the ability of wind turbines to reliably extract energy over a wide range of typical wind speeds.

In wind turbines, there are two conversion steps. The first one; the rotor takes the kinetic energy of the wind and convert it into mechanical energy in the shaft; and then the generator system converts this mechanical energy into electrical energy generation. However, wind energy can be exploited in many parts of the world; it is the most cost-effective in windy climates, where average wind speeds exceed 6.5 m/s [27]. Mostly, the generator system gives an AC output voltage which is dependent on the wind speed. As wind speed is not constant, the voltage generated must be transferred to DC and back again to AC with the help of inverters.

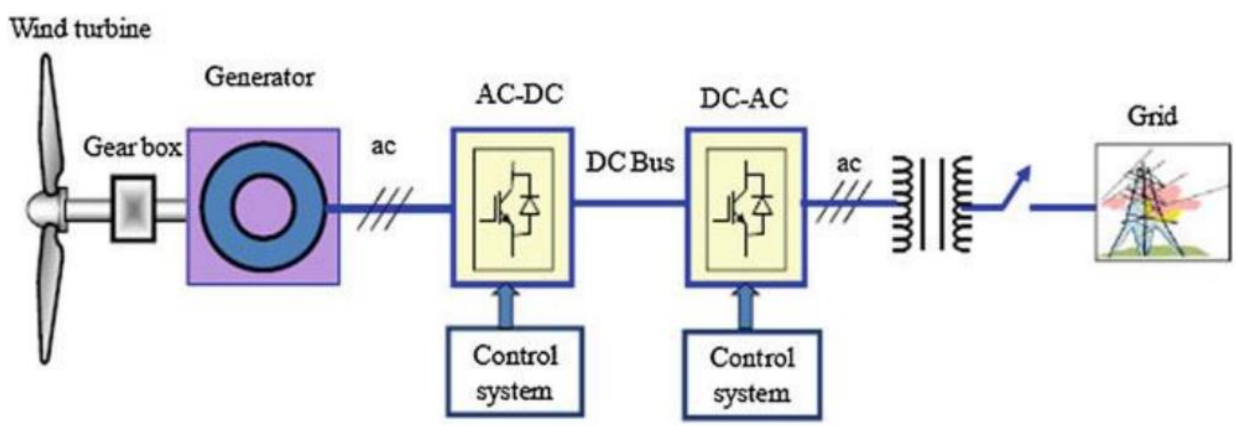

Figure 2. 1 Grid connected wind energy system

3 Microturbine

Micro-turbines are relatively small combustion turbines that burn liquid fuels or gaseous to drive an electrical generator.

The output voltage of micro-turbines should be converted to DC and then back to AC before connecting it to the grid or utility to have similar nominal voltage and frequency.

4 Fuel cells

Fuel cell is an electromechanical cell which converts chemical energy of fuel (i.e. hydrogen) and oxidizing agent (i.e. oxygen) into electricity, heat and water by using electrochemical reaction. Its principle of operation resembles a battery that is continuously charged with a fuel gas with high hydrogen content; this is the charge of the fuel cell together with air, which supplies the required oxygen for the chemical reaction [25]. The output produced from fuel is an induced DC voltage from a reaction of oxygen and hydrogen with the aid of an ion conducting electrolyte.

This DC voltage is converted to AC By using inverters and then is supplied to the grid or utility. The disadvantage of fuel cell is its high running cost. [28]

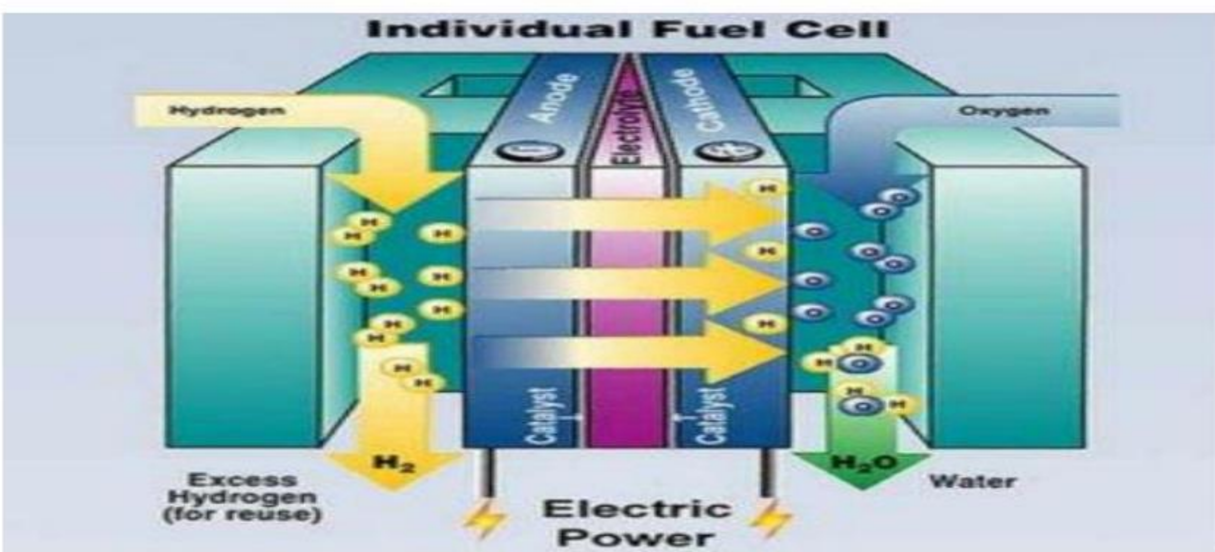

Figure 2.2: Fuel cell, [26]

Overall reaction: $2H_2$(gas) + O_2(gas) → 2 H_2O + energy

Fuel Cell has fewer losses and low emissions since it does not burn hydrogen and there are no moving parts during operations. Fuel cell (FC) efficiency is higher than 60% of other distributed generation, which is considered to be double that of conventional power generations [24].

2.5 Reliability Analysis Methods

There are two main approaches applied for reliability evaluation of distribution system. These are Simulation (Monte Carlo) method and analytical methods. The Analytical method is based on solutions of mathematical models. Reliability indices are usually evaluated by analytical approach based on failure mode assessment and the use of equations for series and parallel networks.

There are three common reliability indices used to describe the degree of service continuity namely, expected failure rate (λ), the average outage time(r), and the expected annual outage time (U), which are enough for the simple radial system. In distribution system whether the networks are radial or meshed, they are mostly operated radially and, this makes the assessment simple. The evaluation process becomes more sophisticated for parallel or meshed networks. [31]

2.5.1 Analytical Method

Reliability Evaluation of Power System using Markov Models; A Markov model is one of the method used in the quantitative reliability analysis, and that is comfortable to provide required concept about principle of reliability analysis. Simple mathematical formula can be used in this method to determine radial system reliability [32]. This method is known as duration-frequency technique, and the beginning point is the failure of the individual component. In a stationary Markov process, it basically operates with two central concepts:

- Failure frequency (λ) and
- Repair time (r).

It is assumed for example a component-wise reliability can only be in one of the following conditions;

1: Component is in operating or working state (in);

2: Component is out of service or it is in repair state (out).

This is shown in two state model diagrams in Figure 2.3, where (0 represents a component in down state and 1 refers component is in an operating state).

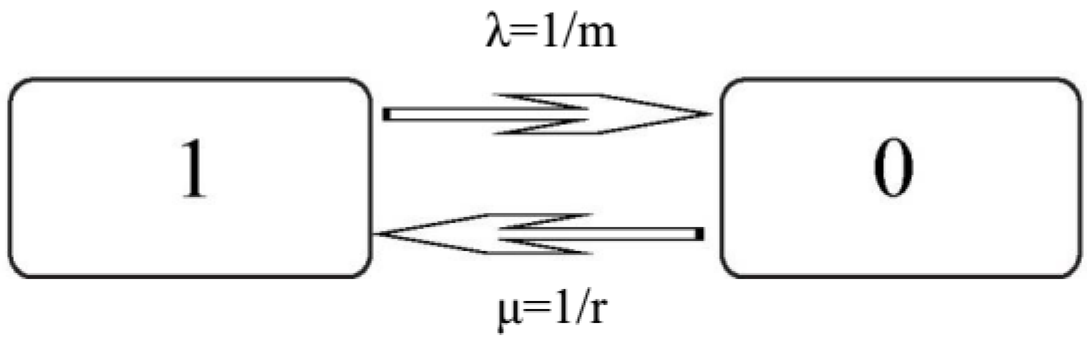

Figure 2.3: Transition diagram of component states [31,33]

$$\text{Where; } \lambda \text{ fault frequency } = \frac{\text{Number of outages on a component in a given period}}{\text{Total time the component is in operation}}$$

μ repair frequency and

r mean time to repair (MTTR)

The markov model is capable of giving a simple description of a component, which can be handled well with mathematical methods. This means that the system must be represented as a system which lacks memory of previous states with identifiable system states. Figure 2.4 shows, expected operational or working and failure time for a component which is known as state cycle. [34, 35]

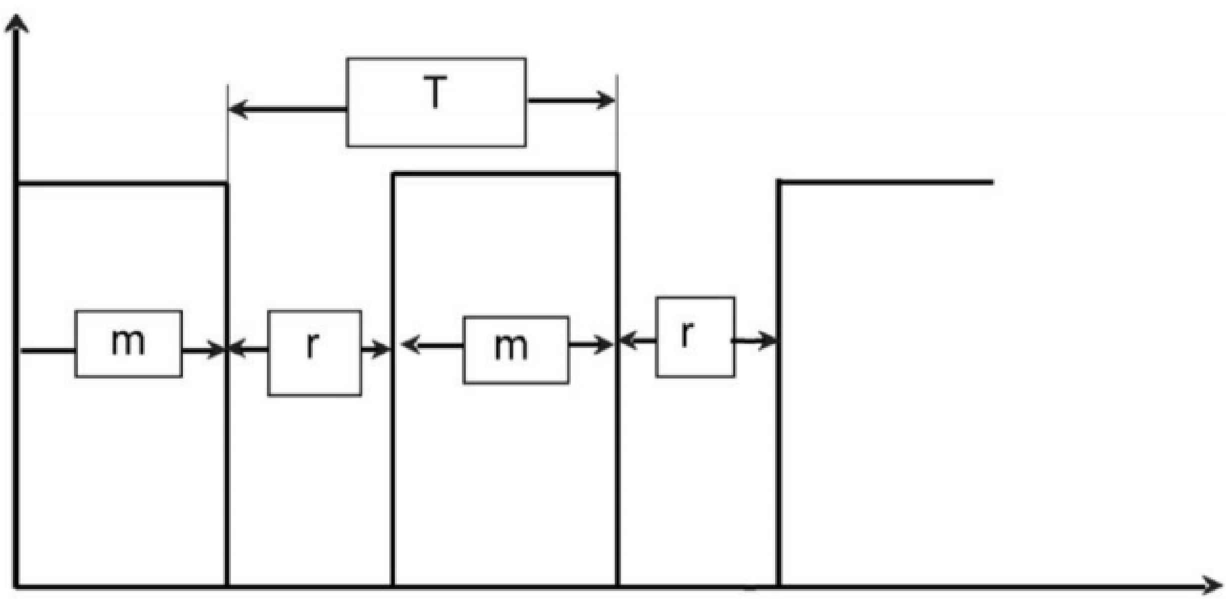

Figure 2.4: Average state cycle [31, 33]

Where, average function time m is given by, $m = 1/\lambda$

m =MTTF= mean time to failure

r=MTTR= mean time to repair; is given by, $r = 1/\mu$

m+r=MTBR, mean time between failures, $T = 1/f$

f =cycle frequency, $f = 1/T$

The following equations (2.1) and (2.2) show that the relationship of repair rate μ and the outage-time r and the corresponding probabilities of a component to be in working (Up) or in down state (P_1, P_0)

$$P_0 = \frac{r}{m+r} = \frac{\lambda}{\lambda+\mu} = \frac{r}{T} = \frac{f}{\mu} = \frac{\sum(\text{down time})}{\sum(\text{down time}) + \sum(\text{up time})} \qquad 2.1$$

$$P_1 = \frac{m}{m+r} = \frac{\mu}{\lambda+\mu} = \frac{m}{T} = \frac{f}{\lambda} = \frac{\sum(\text{up time})}{\sum(\text{down time}) + \sum(\text{up time})} \qquad 2.2$$

Where, f= λ. P_1=P_0 μ

P_0 = probability for a component to be in state 0 (down),

P_1 = probability of a component to be in state 1 (up) and

f = cycle frequency (frequency to be in or out).

Where f is the frequency of encountering a state, and is defined as the inverse of the cycle time:

$$f = \frac{1}{T} = \frac{\mu\lambda}{\lambda+\mu} \qquad 2.3$$

2.5.2 Monte Carlo Simulation Method

Monte Carlo simulation method is also known as numerical method. In this method, simulation of physical relationship is used to analyse the random behaviour of the system. Unlike analytical methods, the possible outcomes of this technique are not only average values but also the expected probability distributions of reliability indices. The method provides the possibility to be applied to a more complicated component models, e.g. including effects of component aging. But this has its own side effect. (i.e. increased computation time which makes the Markov models to be utilized much more often).

In addition to the analytical techniques, the simulation methods may also be used to estimate the output power and evaluate the reliability of a renewable generation system. Monte Carlo simulation consists of randomly sampling system states, testing them for acceptability and aggregating the contribution of loss of load states to the reliability till the coefficients of variation of these indices drop below pre-specified tolerances. [31, 36]

2.5.3 Reliability Assessment under Power Factory

The Power Factory's reliability assessment module provides two distinct calculation functions for network reliability analysis: known as network reliability assessment and voltage sag assessment. Network reliability assessment is used to determine expected interruption frequencies and annual interruptions costs, or to compare alternative network designs.

Voltage sag assessment: It is used to express the expected number of equipment trips due to deep sags.

2.6 Reliability Indices

Reliability indices are used as a means of measuring reliability of individual and the overall system.

There are many indices for measuring reliability.

A. Customer-Oriented Indices

These indices are directly related to customers. Some of these indices are listed below. They are defined in IEEE Standard 1366 [31, 36, and 37].

1. System Average Interruption Frequency Index (SAIFI): It is the ratio between the total number of customers interruption and the total number of customers served.

$$\text{SAIFI} = \frac{\text{Total number of customer interruptions}}{\text{Total number of customers served}} = \frac{\sum_i \lambda_i N_i}{\sum_i N_i} \qquad (2.4)$$

where λ_i is the failure rate at load point i, and N_i is the number of customers found at load point i.

2. Customer Average Interruption Frequency Index (CAIFI): This index is the total number of customer interruptions divided by the total number of customers affected.

$$\text{CAIFI} = \frac{\text{Total number of customer interruptions}}{\text{Total number of customers affected}} = \frac{\sum_i N_i}{\sum_i N_o} \qquad (2.5)$$

Where No is total number of customer interruptions and N_i is the number of customers found at load point i.

3. System Average Interruption Duration Index (SAIDI): It is the ratio between the total number of customer interruption durations and the total number of customers served.

$$\text{SAIDI} = \frac{\text{Total number of customer interruption durations}}{\text{Total number of customers served}} = \frac{\sum_i U_i N_i}{\sum_i N_i} \qquad (2.6)$$

Where U_i is the annual outage time at load point i and N_i is the number of customers at load point i.

4. Customer Average Interruption Duration Index (CAIDI) It is the average time needed to restore service to the average customer per sustained interruption. It is the ratio between the sum of customer interruption durations and the total number of customer interruptions.

$$\text{CAIDI} = \frac{\text{Sum of customer interruption durations}}{\text{Total number of customers interruption}} = \frac{\sum_i U_i\, N_i}{\sum_i \lambda_i\, N_i} = \frac{\text{SAIDI}}{\text{SAIFI}} \quad \textbf{(2.7)}$$

Where λ_i is the failure rate at load point i, U_i is the annual outage time at load point i and N_i is the number of customers at load point i.

5. Average Service Availability Index (ASAI): This index represents the fraction of time that the customers have power provided during one year.

$$\text{ASAI} = \frac{\text{Customer hours of available service}}{\text{Customer hours demanded}} = \frac{\sum_i N_i \text{X}8760 - \sum_i U_i\, N_i}{\sum_i N_i x 8760} \quad (2.8)$$

6. Average Service Unavailability Index (ASUI): This index is the complementary value to the average service availability index (ASAI).

$$\text{ASUI} = \frac{\text{Customer hours of unavailable service}}{\text{Customer hours demanded}} = \frac{\sum_i U_i\, N_i}{\sum_i N_i x 8760} = 1 - ASAI \quad (2.9)$$

B. Load or Energy-Oriented Indices

1. Energy Not Supplied Index (ENS): This index represents the total energy not supplied by the system. And it is given by

$$\text{ENS} = \textstyle\sum_i L_a(\text{i}) U_i \quad (2.10)$$

Where, $L_a(i)$ is the average load given by:

$$\text{L}_\text{a}(\text{i}) = \text{LP (i)} * \text{LF(i)} = \frac{\text{Ed(i)}}{\text{t}} \quad (2.11)$$

LP is peak load demand, LF is the load factor, and Ed is the total energy demanded in the period of interest t.

2. Average Energy Not Supplied Index (AENS): This index represents the average energy not supplied by the system.

$$\text{AENS} = \frac{\text{Total energy not supplied}}{\text{Total number of customers served}} = \frac{\sum_i L_a(\text{i}) U_i}{\sum_i N_i} \quad (2.12)$$

3. Average Customer Curtailment Index (ACCI): This index represents the total energy not supplied per affected customer by the system.

$$\text{ACCI} = \frac{\text{Total energy not supplied}}{\text{Total number of customers affected}} = \frac{\sum_i L_a(\text{i})U_i}{\sum_i N_o} \quad (2.13)$$

Where: L_a (i) is the average load, N_o is the number of customers affected.

In this thesis, SAIDI, SAIFI and ENS are taken for comparison of reliability indices after connecting DG.

2.7 Economics of Reliability Assessment

Both the utility and customers face interruption costs when power is interrupted. When a customer faces such interruption, there is an amount of money that the customer is willing to pay to evade the interruption. This amount is referred to as the customer cost of reliability. Assessing the interruption cost from the customer side is difficult for the utility.

So, to maximize the reliability, utility should balance their reinforcement the customer cost for poor reliability and cost for reliability improvement. Thus, the optimal level of reliability is said to be achieved when the sum of the customer cost and utility cost are minimum. [38].

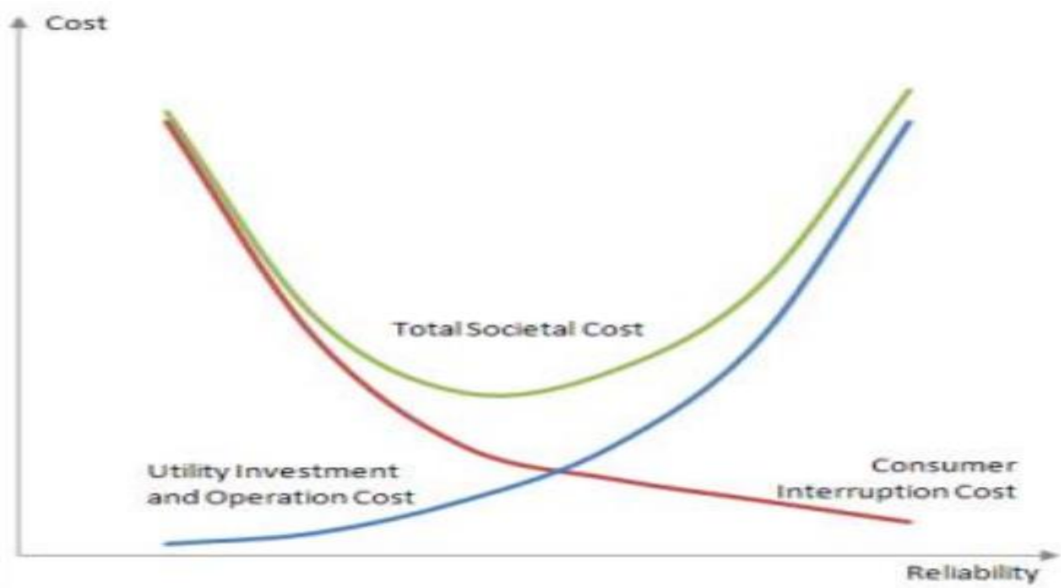

Figure 2.5: Reliability worth and reliability cost [26]

2.8. Review of Related Works on Reliability Improvement

Japinder Pal Singh Virk, Dr. Smarajit Ghosh, 2012, [34]. Tabu search technique is used for sizing and optimal placement of DG in distribution systems. Connection of Distributed Generation in a distribution system results in several benefits such as increased overall system efficiency. The effectiveness of the proposed method was demonstrated by a case study of a distribution network of RBTS bus 2. It was seen that connecting DG can reduce the customer interruption cost and therefore improve the system reliability.

Truptimayee Pujhari, (2009), [39]. In this paper Power system analysis was made without and with DGs in terms of total power loss and voltage profile of all the buses. The total power loss in with DG was reduced to 37% of total power losses in the system and the voltage profile of all the buses remained stable within the tolerable limits. The reliability indices EENS and ECOST are also reduced by about 29 %.

Francesc Xavier Bellart Llavall, 2011, [35]. This paper analysed the system with and without DG for different case studies and the following result was obtained for the corresponding SAIDI and CAIDI. SAIDI with DG was reduced by 50% and CAIDI by 42%.

Solomon Derbie, 2014, [36]: This thesis-work mainly focuses on the reliability problem of the existing power grid of Adama city and the smart grid has been proposed as a solution. Therefore, the appropriate sources of the system are selected to design the overall system. The simulation of the designed model shows that the application of smart reclosers can improve the overall system reliability from 50% to 75%.

Saifur Rahman, Manisa Pipattanasomporn, Virgilio Centeno, 2008, [33]. In this paper reliability worth assessment is undertaken. The installations of DG at supply point will barley improve system reliability. DG at further point will increase their role of improvement. As far the location is from the substation, the reliability system indices increase. The best location for the placement of the DG is at the end of the line where much improvement is achieved.

Tempa Dorji, 2009, [40]. It is found out that reliability indices (ENS, SAIDI and CAIDI) got improved as the DG is installed away from the substation, as the size of DG increased and the best location of DG is at the end of the line.

ABEBA DEBRU, 2016, [41]. This thesis-work focuses on reliability improvement of Addis Centre substation with Distributed Generation**.** When DG of 3.505 MW is applied at load point, which is 7.447 km from the supply point, the improvements are SAIFI=79.79%, SAIDI= 81.59 % and ENS= 85.87%. When DG of 3.505 MW is applied at load point, which is 8.696 km from the supply point, the improvements are SAIFI=91.8% SAIDI=91.94 % and ENS= 91.47%.

CHAPTER THREE

DATA COLLECTION AND ANALYSIS

3.1 Overall Methodology

The methodology used in this thesis is as follows.

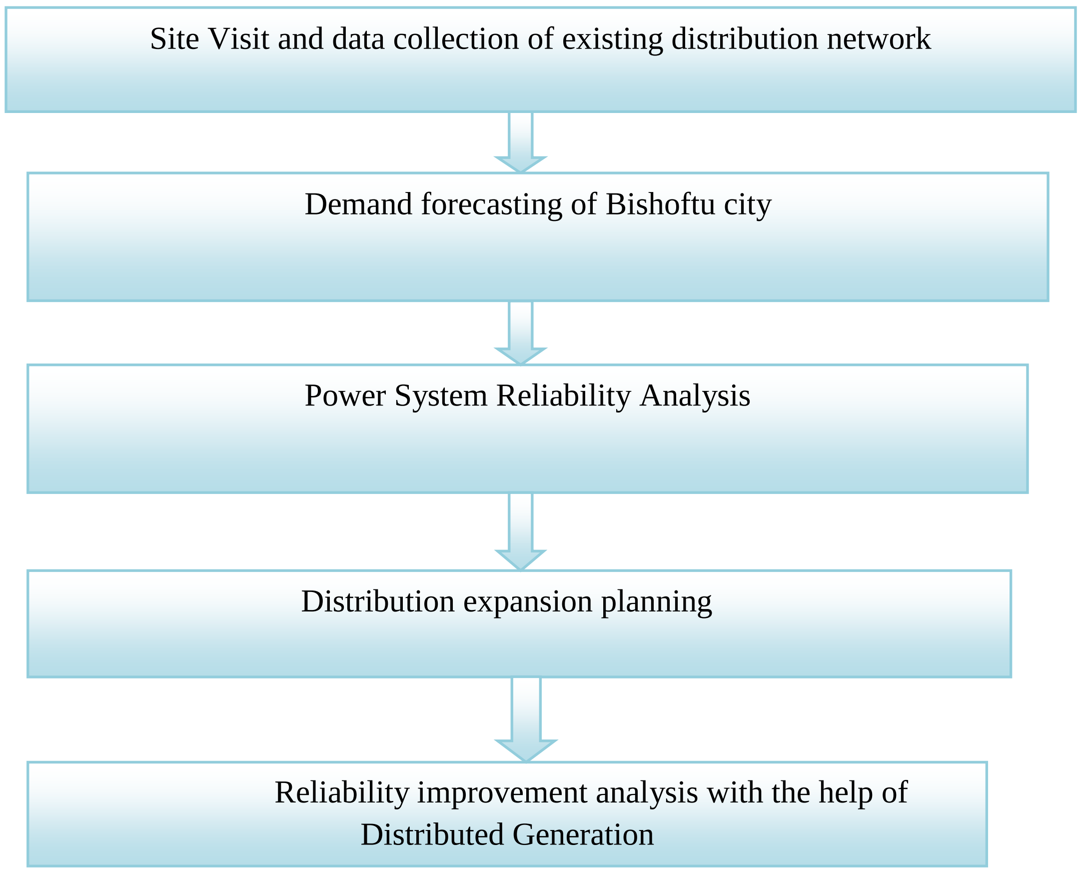

Figure 3.1: Overall methodology

3.2 Basic data of Bishoftu substation II

Bishoftu city is now supplied from national grid that is, interconnected system (ICS). EEPCO is a provider of electric power in the country. The network topology for Bishoftu substation II is radial. Figure 3.2 illustrates the current arrangement of the distribution substation of Bishoftu town.

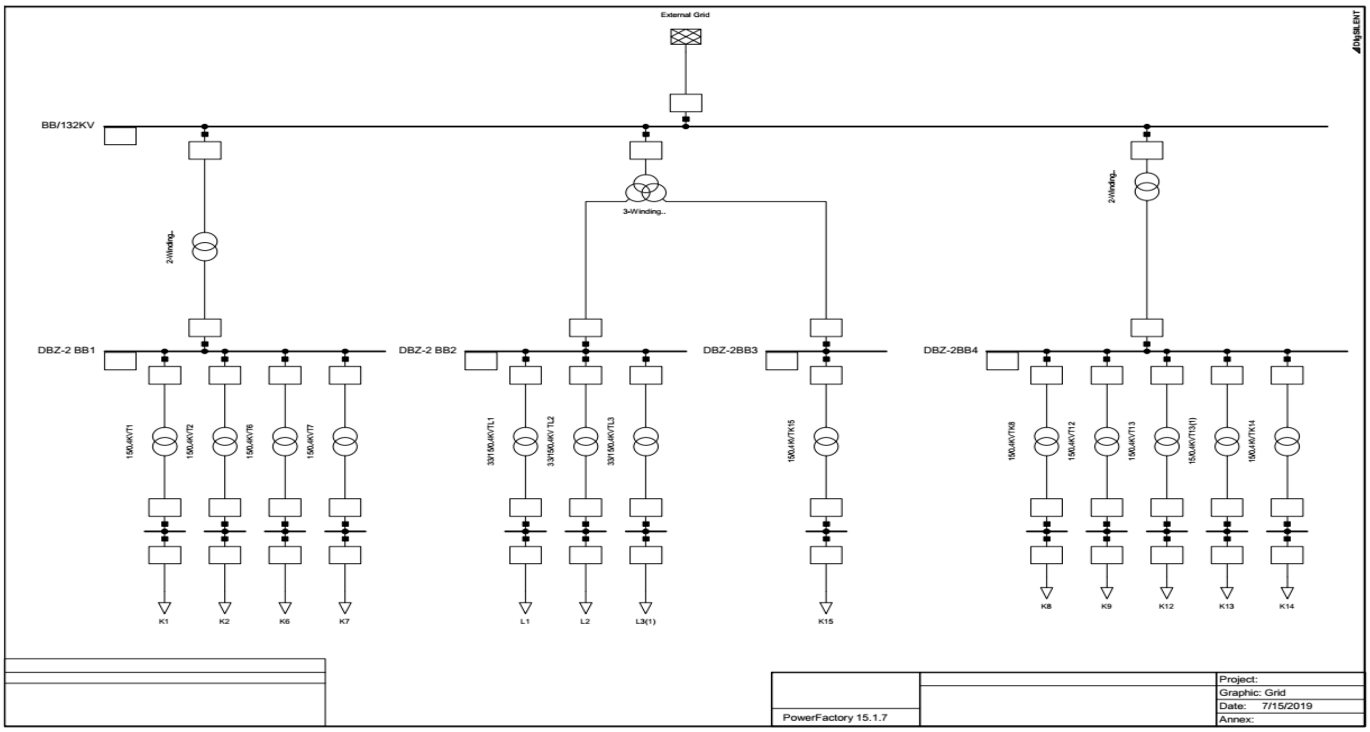

Figure 3.2 Single-line diagram of the substation

The substation has 13 feeders as shown in the above one line diagram and the data for the power transformer in the substation is given in Table 3.1.

Table 3.1 Power transformers of Bishoftu substation-II

Transformer Type	Number of transformers	Capacity (MVA)	Voltage Level (KV)
2 winding	2	16/20	132KV/15KV
3 winding	1	16/8/8	132KV/33KV/15KV

Table 3.2 contains the data about the 33kV feeder (bus bar 2) and 15kV feeder's data (bus bar1,3, and 4). Similarly, Table 3.3 contains the yearly average power and energy consumption of each feeder customers. The annual average energy is calculated using the recorded data from 2016/17 G.C to 2017/18 G.C.

Table 3.2: Basic data of Bishoftu substation II

Name of feeders	Customer type	Total number of customers	Total number of distribution transformers	Total capacity of distribution transformer (kVA)	Total length of feeder (km)	Conductor Size (mm)
	33KV feeders					
L1	Abisinia	12	2	2500	3.5	AAC95
L2	Eastern industry zone	18	3	3300	5.8	AAC95
L3	Arerti, Minjar&Chefedonsa	859	9	930	45	AAC95
	15KV feeders					
K1	Steely	21	2	2500	2.3	AAC95
K2	Steely	31	2	2500	2.3	AAC95
K6	Steely and partial Bisoftu town	3342	16	5650	34	AAC95
K7	Bisoftu town	80	58	10435	19	AAC50
K8	Industry zone partial Dukem town	9855	6	6390	14.5	AAC95
K9	Air force and partial Bishoftu	5141	65	21925	4.9	AAC95
K12	Abyssinia	11	2	3750	3.5	AAC95
K13	Abyssinia	21	2	3750	3.5	AAC50
K14	Abyssinia & dire town	1485	5	4350	54	AAC95
K15	East Africa Ziquala and partial Bishoftu town	3431	12	4020	24	AAC50
Total		26027	170			

The annual average energy is calculated using the recorded data from 2016/17 G.C to 2017/18 G.C.

Table 3.3 Yearly average power and energy consumption of each feeder bus bar

	Average Energy consumption		Average power consumption	
	Active KWh	Reactive KVRh	Active (MW)	Reactive (MVAr)
33 KV line BB1	7444666.67	947770.00	10.34	1.32
15 KV line BB2	13837260.00	7352760.00	8.65	4.55
15 KV line BB3	975000.00	392250.00	1.35	0.54
15 KV line BB4	6606779.17	4486230.00	9.18	6.23
Total	28863705.83	13179010.00	29.52	12.64

Based on Table 3.3, the power factor (pf) for the system can be calculated as:

$$Pf = \cos(\tan^{-1}(Q/P)) = \cos(\tan^{-1}(13179010/28863705.83)) = 0.91 \qquad (3.1)$$

Where

Pf = power factor

P= active power in (MW)

Q= reactive power in (MVAr)

$$\text{Annual Load Factor (LF)} = \frac{\text{Total Annual Energy}}{\text{Annual Peak Load} * 8760} \qquad (3.2)$$

Table3.4 Peak load data of Bishoftu substation II

Feeder name	Peak load in (A)	Peak load in (MW)	Connected average load (MW)	Voltage level (KV)
L1	293	2.47	1.49	33
L2	98	3.16	2.88	33
L3	248	5.477	2.36	33
K1	203	3.48	3.3	15
K2	205	3.52	3.16	15
K6	299	4.362	3.54	15
K7	39	2.86	2.6	15
K8	328	7.42	4.02	15
K9	255	5.63	3.36	15
K12	216	3.77	2.77	15
K13	342	4.55	4.46	15
K14	103	4.27	3.54	15
K15	304	3.71	3.525	15
Total		54.7	41.005	

3.3 Demand Forecasting of Bishoftu city

In this thesis extrapolation Simulation method is applied to forecast energy demand for Bishoftu city in the period of 2019 to 2028.

$$\mathrm{C_t} = \sum \mathrm{C_{ro}}\,(1+m_d)^{\mathrm{t}} + \mathrm{C_{io}}(1+m_i)^{\mathrm{t}} + \mathrm{C_{co}}(1+m_c)^{\mathrm{t}} + \mathrm{C_{slo}}(1+m_s)^{\mathrm{t}} + \mathrm{C_{oo}}(1+m_o)^{\mathrm{t}} \quad (3.3)$$

Where;

C_t= total forecasted energy sells of $\mathrm{t^{th}}$ year.

$\mathrm{C_{ro}}, \mathrm{C_{io}}, \mathrm{C_{co}}, \mathrm{C_{slo}}, \mathrm{C_{oo}}$= historical energy demand in residential, industrial, commercial, street light and other sectors respectively.

m_d, m_i, m_c, m_s, m_o = annual energy growth rate with the consideration of GDP in residential, industrial, commercial, street light and other sectors respectively.

t=number of years.

3.3.1 Energy Demand and Energy Growth Rate of Bishoftu City

Table 3.5 shows that the energy consumption in five sectors increases rapidly, from 2008 to 2018.

Table 3.5 Historical energy demand of Bishoftu city from 2008 to 2018 (MWH)

Year	Domestic	Commercial	Industry	Street light	Others	Total
2008	7263.83	6570.61	20993.567	83.97	292.49	35005.4
2009	9195.05	8276.61	32921.783	148.08	352.51	50894
2010	2397.72	3035.9	70033.237	87.05	34.47	75588.4
2011	2421.82	2663.01	73315.772	72.33	37.3	78510.2
2012	3419.26	2619.07	101895.16	134.47	54.86	108215
2013	14194.86	8323.85	106033.96	152.96	11560.18	129160
2014	23560.8	7792.45	120131.52	112.24	2763.71	152643
2015	18612.95	14452.66	105884.74	50.47	995.79	141345
2016	15685.57	13305.65	91624.709	67.07	1053.45	130720
2017	21891.07	17904.78	103656.76	107.82	683.29	1151115
2018	26164.2	21664.79	126461.25	120.11	750.94	175161.29

Table 3.6 shows that the average growth rate of energy consumption in residential sector and commercial sector were about 21.42% and 17.3% respectively. Industrial sector had the largest growth rate of energy consumption about 24.0%. The two sectors, Street light and others sectors were low growth rate about 14.1% and 11.6% respectively.

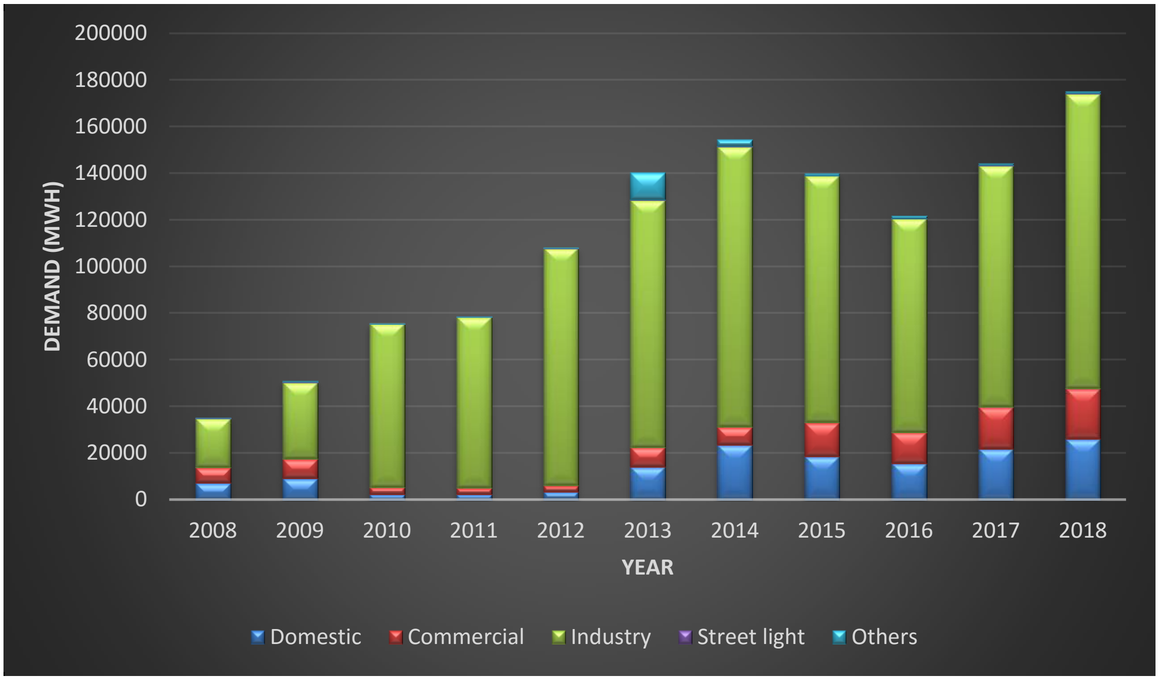

Figure 3.3:Energy demand of Bishoftu city from 2008 to 2018

Table 3.6 Energy growth rate from 2009 to 2018

Year	Domestic in (%)	Commercial in (%)	Industry in (%)	Street light (%)	Others in (%)
2009	26.6	25.97	56.8	76.35	45.4
2010	No data	No data	112.7	-41.2	45.4
2011	0.99	No data	4.69	-16.9	3.86
2012	29.17	-1.65	39	85.9	37.8
2013	75.9	21.7	4.06	13.75	19
2014	65.98	-6.38	13.3	-26.62	18.2
2015	-21.58	85.47	-11.86	-55	-7.4
2016	-18.66	-7.94	-13.47	32.9	-6.8
2017	39.55	34.57	13.13	60.46	42.86
2018	16.33	21	22	11.4	-84.7
Average	21.42	17.3	24.0	14.1	11.6

3.3.2 Current Socio-Economic Situation of Bishoftu City

According to statistical agency and growth and transformation plan of the country, the annual growth rate of a country was recorded and predicted in Table 3.7. Taking this value as a socio-economic growth of Bishoftu city [43].

Table 3.7 Average GDP growth rate in each sector

Sector	Industry	Commercial service	Others
Average GDP rate	20 %	11 %	8 %

Table 3.8 Average economic and energy growth rate

GDP (economic) growth rate				Energy growth rate				
Average growth rate (%)	Industry	Commercial service	Others	Industry	Commercial service	Domestic	Street light	Others
	20	11	8	24	17.3	21.42	14.1	11.6

Thus, elasticity factor of each sector is calculated with energy growth rate and GDP growth rate as follows.

Elasticity factor of industrial sector;

$$K_i = \frac{\text{Average energy growth rate industrial sector}}{\text{Average economic growth rate of industrial sector}} = \frac{24}{20} = 1.2 \qquad (3.4)$$

Elasticity factor of commercial sector;

$$K_c = \frac{\text{Average energy growth rate of commercial sector}}{\text{Average economic growth rate of commercial sector}} = \frac{17.3}{11} = 1.57 \qquad (3.5)$$

Elasticity factor of other sectors,

$$K_o = \frac{\text{Average energy growth rate of other sector}}{\text{Average economic growth rate of other sector}} = \frac{11.6}{8} = 1.45 \qquad (3.6)$$

Where, k_i represents elasticity factor of industrialization sector

K_c represents elasticity factor of commercial sector

K_o represents elasticity factor of other sectors

The new energy growth rate of each sector by considering economic growth rate is calculated as follows.

The new energy growth rate of industry sector;

$m_i = K_i$ x (Historical average energy growth rate of industry sector) =1.2 x24 =28.8 (3.7)

The new energy growth rate of commercial sector;

$m_c = K_c$ x (average energy growth rate of commercial sector) = 1.57x17.3= 27.16 (3.8)

The new energy growth rate of other sectors;

$m_o = K_o$ x (average energy growth rate of other sectors= 1.45x11.6=16.82 (3.9)

Table 3.9 Annual energy growth of each sector with the consideration of GDP

.

m_i (%)	m_c (%)	m_d (%) *	m_s (%) *	m_o (%)
28.8	27.16	21.42	14.1	16.18

(*) m_s and m_d which are annual energy growth rate of street light and domestic sectors respectively are predicted based on the past energy growth rate due to lack of economic growth data.

3.3.3 Forecasted energy sells in MWH from 2019 to 2028

The future energy sells of each sector is forecasted by using above equations (from 3.3 to 3.9).

Table 3.10: Forecasted energy sells in MWH from 2019 to 2028

Year	Domestic	Commercial	Industrial	Street light	Others	Total
2019	31768.57	27548.26	162882.09	137.045	877.248	223213.213
2020	38573.4	35030.36	209792.13	156.36	1024.8	284577.05
2021	46835.82	44544.6	270212.26	177.96	1196.56	362967.2
2022	56085.28	56358.44	348033.4	202.86	1397.58	462077.6
2023	67863.2	71575.15	448267	231.26	1632.37	589568.98
2024	82114.46	90900.44	577367.9	263.63	1894.89	752541.32
2025	99358.5	115443.56	743649.87	300.54	2237.62	960990.09
2026	120223.8	146613.32	957821	342.62	2601	1227601.74
2027	145470.8	186198.9	1233673.5	390.6	3038.02	1568771.82
2028	176019.65	236472.62	1588971.47	445.27	3548.4	2005457.41

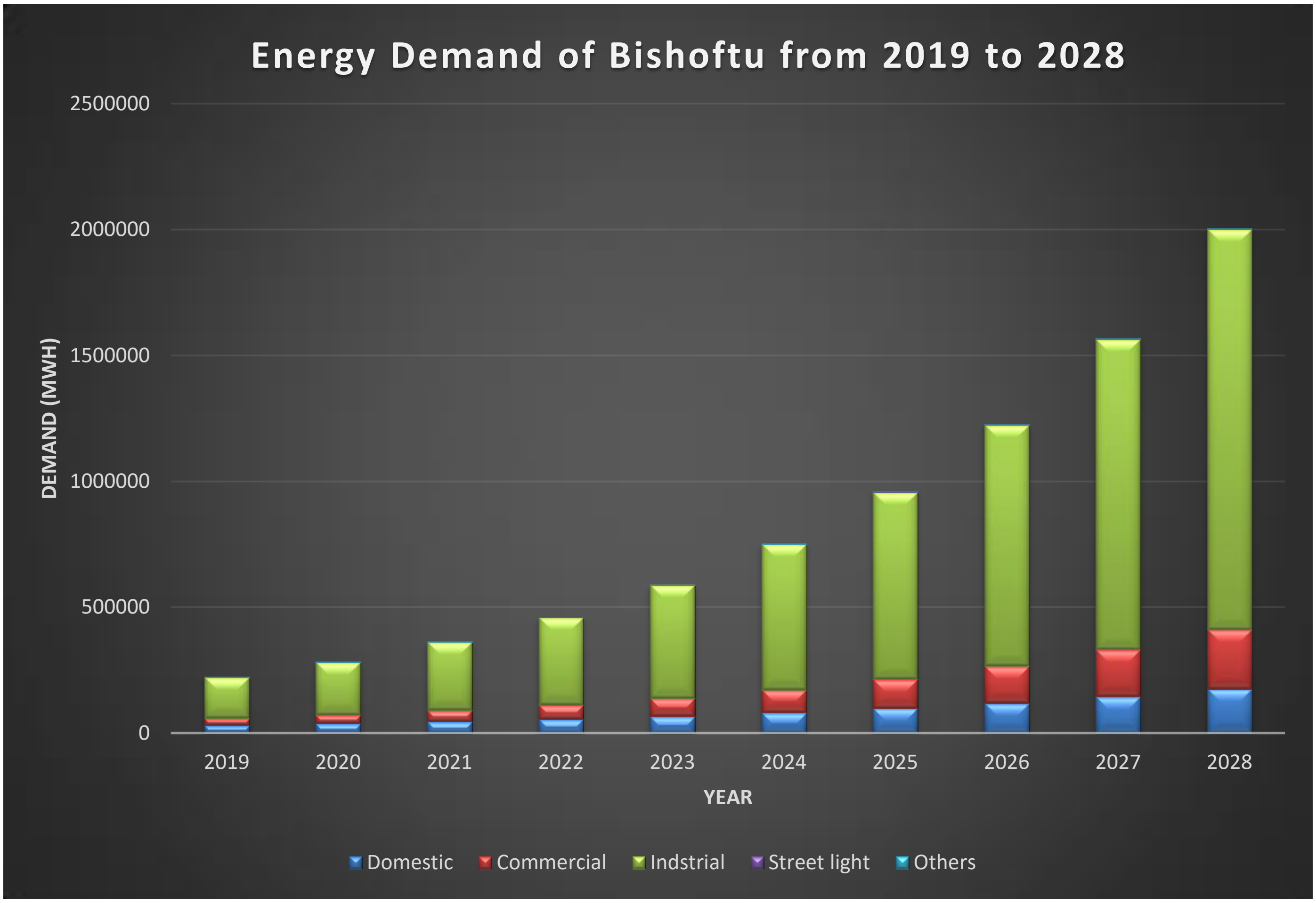

Figure 3.4: Forecasted energy demand of Bishoftu city from 2019 to 2029

Energy demand in 2018 =175161.29MWH and 2028 =2005457.41MWH

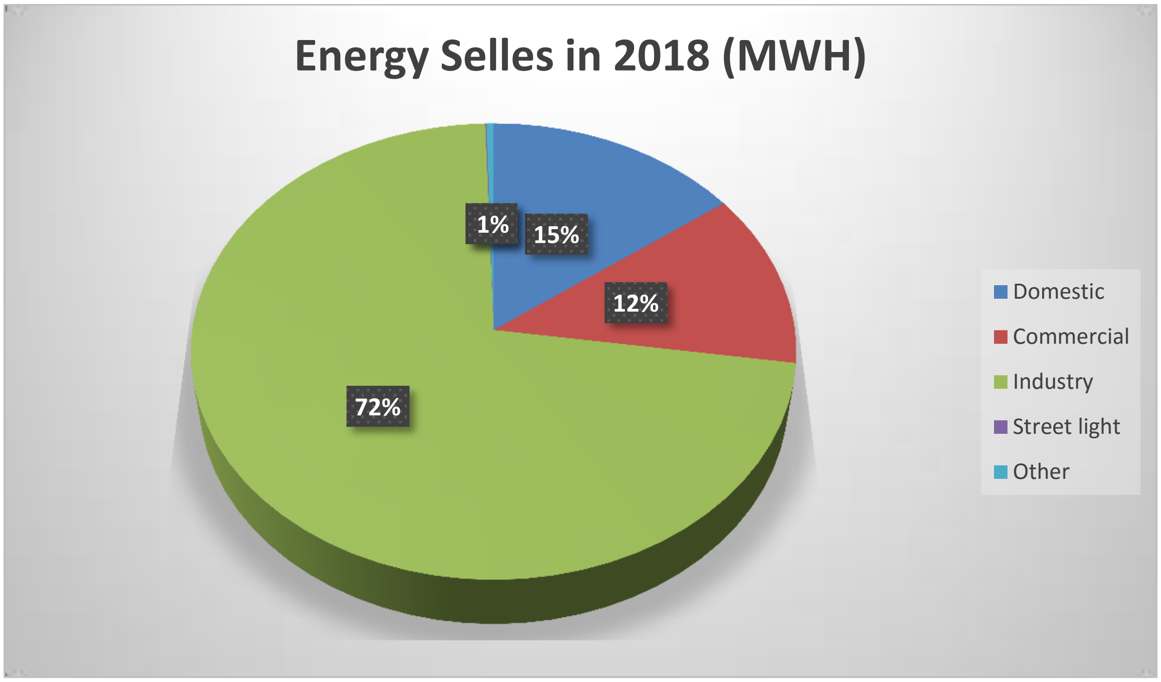

Figure 3.5: Energy demand in 2018

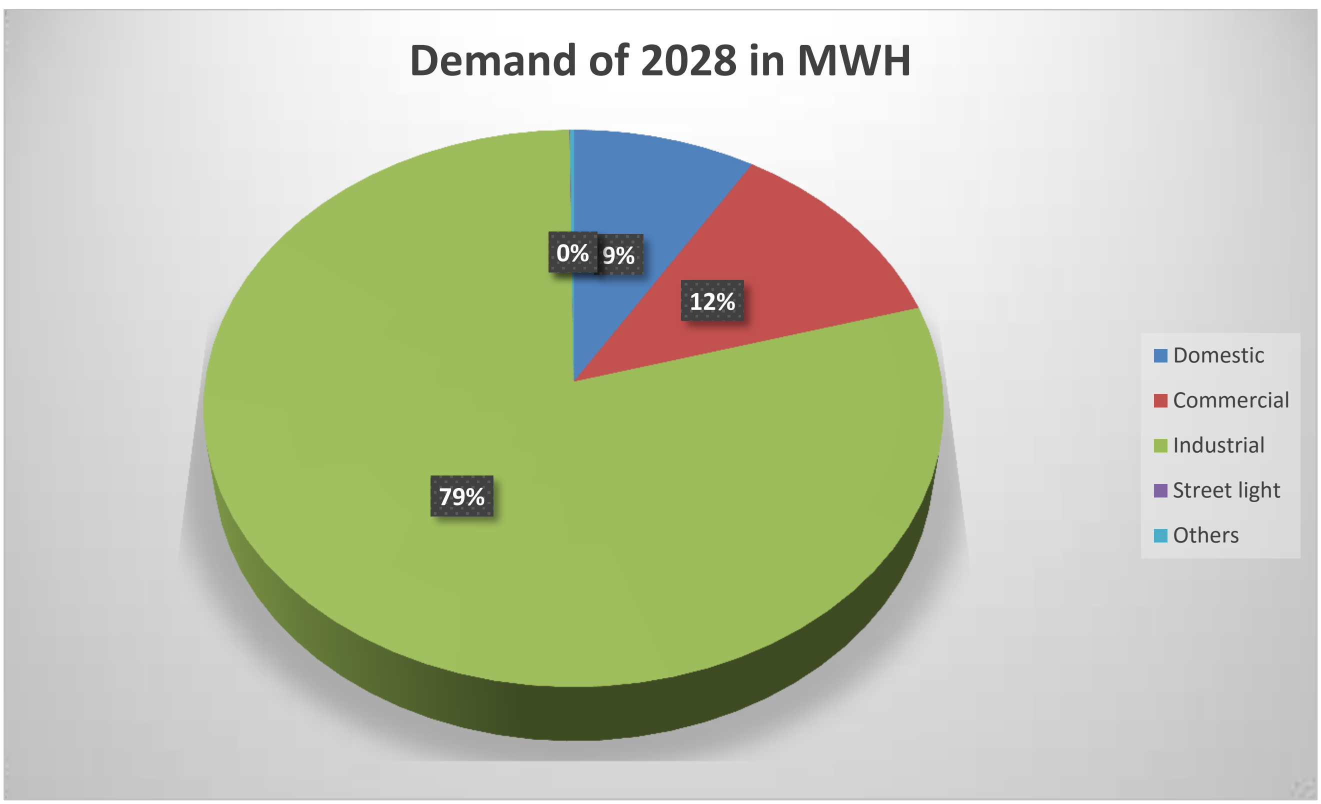

Figure 3.6: Energy demand in 2028

3.3.4 Peak Demand Forecasting

The total energy forecast calculated in table 3.10 is converted to the forecasted peak demand by using equation 3.2 and considering the utilities three years average load factor of 57%.

Table 3.11 Forecasted peak power demand

Year	Forecasted energy demand in (MWH)	Forecasted peak demand in (MW)
2020	284577.05	57
2021	362967.2	72.69
2022	462077.6	92.54
2023	589568.98	118.07
2024	752541.32	150.71
2025	960990.09	192.46
2026	1277601.74	255.87
2027	1568771.82	314.18
2028	2005457.41	401.64

Summary of Demand Forecasting

The existing peak power demand of bishoftu town is 54.7MW and the total capacity of the substation is 43.8 MW. From the data of existing network and the results of demand forecasting described in Table 3.11, the energy demand and peak demand in 2028 will be 2,005,457.41 MWH and 401.64 MW respectively.

It is clear that, the existing distribution network cannot meet not only the future demand but also the existing demand. So, it is necessary to expand the existing system by locating distributed generation.

3.4 Reliability Related Data̓s of Bishoftu Substation II

This section contains the compiled reliability related data that are collected from Bishoftu Substation II. Table 3.12 contains the frequency and duration of interruptions due to non-momentary and planned interruptions for the year 2017 GC

Table 3.12 Frequency and duration of interruptions of 2017

Name of feeder	Planned outage		Unplanned outage		Total	
	Duration (hrs.)	Frequency (int/yr.)	Duration (hrs.)	Frequency (int/yr.)	Duration (hrs.)	Frequency (int/yrs.)
L1	54.7	23	103.4	17	164.97	40
L2	21.97	8	31.26	5	53.23	13
L3	260.84	166	294.29	229	555.13	395
K1	32.93	14	32.26	17	65.19	31
K2	24.64	14	37.79	16	62.43	30
K6	20.09	8	7.08	5	27.17	13
K7	54.92	44	67.93	59	122.85	103
K8	272.68	247	387.44	236	660.12	483
K9	325.88	348	337.19	367	663.07	715
K12	20.47	13	11.16	4	31.63	17
K13	24.27	15	49.43	37	73.7	52
K14	149.86	110	236.13	133	385.99	204
K15	120.15	122	154.68	82	274.83	204
Total	1383.27	1132	1750.631	1207	3133.901	2339

Table 3.13 Frequency and duration of Interruption of 2018

Name of feeder	Planned outage		Unplanned outage		Total	
	Duration (hrs.)	Frequency (int/yrs.)	Duration (hrs.)	Frequency (int/yrs.)	Duration (hrs.)	Frequency (int/yrs.)
L1	23.86	1	1.5	1	25.36	2
L2	9.45	1	50.2	5	59.65	6
L3	247.7	105	309.78	161	557.48	266
K1	0.4	1	25.35	2	25.75	3
K2	0.4	1	25.35	2	25.75	3
K6	0.4	1	1.5	2	1.9	3
K7	1.8	6	1.5	2	3.3	8
K8	465.53	148	362.56	333	826.09	481
K9	471	146	465.25	117	936.25	263
K12	4.89	5	1.52	3	6.41	8
K13	1.04	2	0.25	1	1.29	3
K14	47.17	44	237.37	107	284.54	151
K15	81.38	41	127	44	208.38	85
Total	1357.91	502	1604.24	780	2962.15	1282

Table 3.14 The average frequency and duration of interruptions of 2017 and 2018

Name of feeder	Planned outage		Unplanned outage		Total	
	Duration (hrs/yr.)	Frequency (int/yr.)	Duration (hrs/yr.)	Frequency (int/yr.)	Duration (hrs/yr.)	Frequency (int/yr.)
L1	39.28	12	52.45	9	95.165	21
L2	15.71	4.5	40.73	5	56.44	9.5
L3	254.27	135.5	302.035	195	556.305	330.5
K1	16.52	7.5	28.805	9.5	45.47	17
K2	12.52	7.5	31.57	9	44.09	16.5
K6	10.245	4.5	4.29	3.5	14.535	8
K7	28.36	25	34.715	30.5	63.075	55.5
K8	369.105	197.5	375	284.5	743.105	482
K9	398.44	247	401.22	242	799.66	489
K12	12.68	9	6.34	3.5	19.02	12.5
K13	12.655	8.5	24.84	19	37.495	27.5
K14	98.515	77	236.75	120	335.265	177.5
K15	100.765	81.5	140.84	63	241.605	144.5
Total	1370.59	817	1677.4355	993.5	3048.0255	1810.5

Figure 3.7 shows that, the total average frequency and duration of interruption of two years (2017 and 2018).

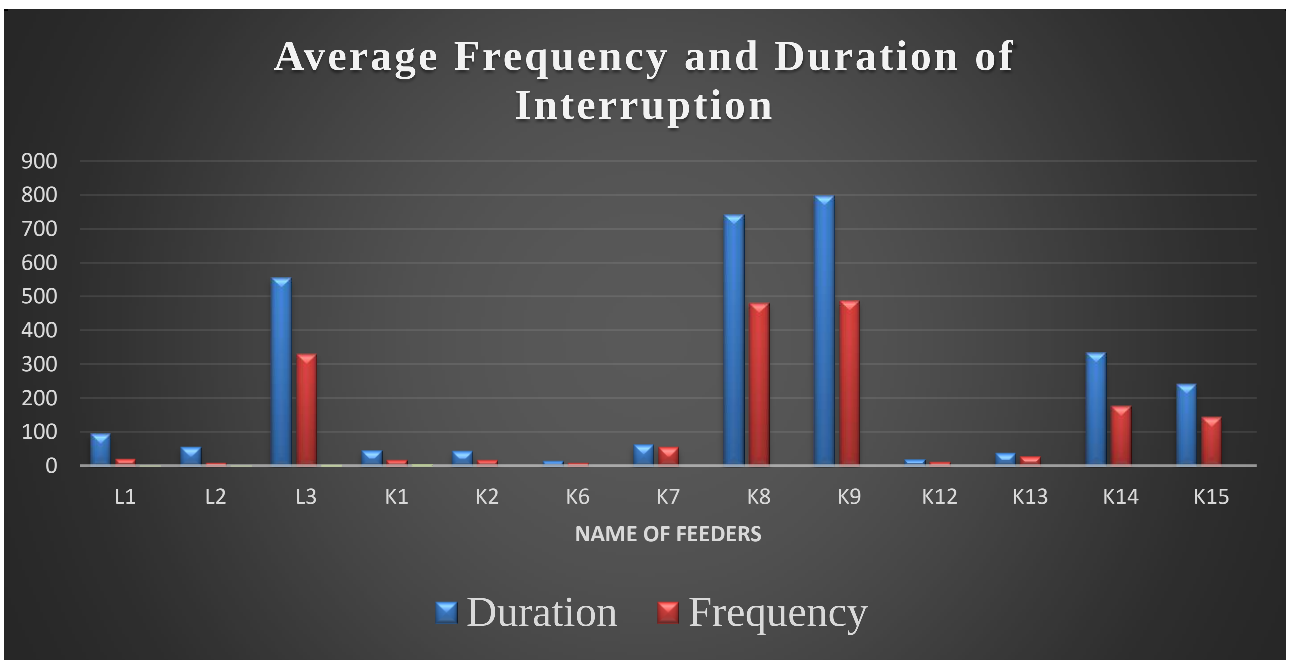

Figure 3.7 Average frequency and duration of interruption

From figure 3.7, feeders L3, K8, and K9 are the main feeders experiencing longer duration and high frequency of interruption. So, it is better to locate DGs at these feeders.

The main causes of frequency and duration of interruption for each fault is shown in Table 3.15.

Table 3.15 Causes of frequency and duration of interruption of different faults of 2017

Feeder	OPR		DTSC		DPSC		DTEF		DPEF		OTHERS	
	DUR (hrs)	FRE (int/yr)	DUR (hrs)	FRE (int/yr)	DUR (hrs)	FRE (int/yr)	DUR (hrs)	FRE (int/yr)	DUR (hrs)	FRE (int/yr)	DUR (hrs)	FRE (int/yr)
L1	54.57	23	69.29	10	0	0	0	0	0	0	41.11	7
L2	21.97	8	0.21	1	19.35	1	0	0	0	0	11.7	3
L3	260.8	166	5.41	63	113	51	48	63	94.5	39	33.5	13
K1	33	14	0	0	17.42	6	0.25	2	4.57	4	10.02	5
K2	24.64	14	0	0	16.04	7	0.22	2	11.5	3	10	4
K6	20.1	8	0	0	3.7	2	0	0	1.72	2	1.65	1
K7	55	44	3.35	21	24.6	10	0.3	7	24.2	13	15.5	8
K8	272.7	247	12.4	60	156	63	52	43	96	45	71.3	25
K9	326	348	7.54	84	164.6	105	31	93	89.3	56	45	29
K12	20.5	13	0.06	1	0	0	0	0	0	0	11.1	3
K13	24.3	15	0.6	4	5.14	2	1.12	8	28.1	8	14.5	15
K14	150	110	3.36	41	148.7	42	23.4	15	13.3	8	41	19
K15	120.2	122	14.6	32	98.3	23	10.7	11	8.6	6	22.4	10
Total	1319.8	1132	137.8	317	766.7	312	167	244	372	184	328.6	142

On Table 3.15 and Table 3.16, DPEF is distribution permanent earth faults, DPSC is distribution permanent short circuit, DTEF is distribution temporary earth faults, DTSC is distribution temporary short circuit, OPR is operational interruptions, FRE frequency of interruption and DUR is duration of interruption. Other faults include overload, blackout (total loss of power to an area) and so on. Based on Table 3.15 and Table 3.16, it is possible to analyse the percentage contributions of each cause of Interruptions for the total frequency and duration of interruptions of each feeder and the overall system.

Table 3.16 Causes of frequency and duration of interruption of different faults of 2018

Feeder	OPR		DTSC		DPSC		DTEF		DPEF		OTHERS	
	DUR (HR)	FRE (int/yr)	DUR (HR)	FRE (int/yr)	DUR (HR)	FRE (int/yr)	DUR (HR)	FRE (int/yr)	DUR (HR)	FRE (int/yr)	DUR (HR)	FRE (int/yr)
L1	23.86	1	0	0	0	0	0	0	0	0	1.5	1
L2	9.45	1	0.5	1	30.14	2	0.05	1	0	0	19.5	1
L3	247.7	105	1.67	8	28	22	81.2	43	84.8	41	114.1	47
K1	0.4	1	0	0	17.5	1	7.85	1	0	0	0	0
K2	0.4	1	0	0	17.5	1	7.85	1	0	0	0	0
K6	0.4	1	0	0	1.5	2	0	0	0	0	0	0
K7	1.8	6	0	0	1.5	2	0	0	0	0	0	0
K8	463.53	148	2.3	13	88.3	31	22	82	26.1	77	224	130
K9	471	146	75.2	18	63.4	18	82.4	25	106	22	138.3	34
K12	5	5	0	0	1	1	0	0	0	0	0.52	2
K13	1.04	2	0.25	1	0	0	0	0	0	0	0	0
K14	47.2	44	0.45	2	130.2	30	46.1	27	32.8	24	27.7	24
K15	81.4	41	2	6	63.1	9	0.45	2	13.4	2	48	25
Total	1358	502	82.3	49	441	120	248	182	263.2	166	573.6	264

Table 3.17: Percentage frequency and duration of each fault types for 2017

Feeder	OPR		DTSC		DPSC		DTEF		DPEF		OTHERS	
	DUR (%)	FRE (%)	DUR (%)	FRE (%)	DUR (%)	FRE (%)	DUR (%)	FRE (%)	DUR (%)	FRE (%)	DUR (%)	FRE (%)
L1	33.1	57.5	42	25	0	0	0	0	0	0	24.9	17.5
L2	41.3	61.53	0.4	7.7	36.35	7.7	0	0	0	0	21.95	23.09
L3	47	42	0.97	15.95	20.36	12.91	8.62	15.95	17.02	9.8	6.09	3.39
K1	50.5	45.16	0	0	26.72	19.35	0.38	6.45	7.01	12.9	15.39	16.14
K2	39.46	46.67	0	0	25.69	23.33	0.35	6.67	18.46	10	16.04	13.33
K6	73.94	61.53	0	0	13.65	15.38	0	0	6.33	15.38	6.08	7.71
K7	44.7	42.7	2.72	20.39	20	9.7	0.23	6.8	19.7	12.62	12.65	7.79
K8	41.3	51.14	1.87	9.1	23.61	13.04	7.86	8.9	14.53	9.31	10.83	8.51
K9	49.14	48.67	1.13	11.74	24.81	14.68	4.66	13	13.46	7.83	6.8	4.08
K12	64.71	76.47	0.2	5.88	0	0	0	0	0	0	35.09	17.65
K13	33	28.84	0.8	7.7	7	3.84	1.52	15.38	38.11	15.38	19.57	28.86
K14	39.48	45.26	0.88	16.87	39.18	17.28	6.16	6.17	3.5	3.3	10.8	11.12
K15	43.72	60	5.33	15.68	35.76	11.27	4	5.4	3.13	3	8.06	4.65
Total	43.33	48.37	4.44	13.63	24.77	13.54	5.4	10.51	12.2	8.15	9.86	5.8

Table 3.18: Percentage frequency and duration of each fault types for 2018

Feeder	OPR		DTSC		DPSC		DTEF		DPEF		OTHERS	
	DUR (%)	FRE (%)	DUR (%)	FRE (%)	DUR (%)	FRE (%)	DUR (%)	FRE (%)	DUR (%)	FRE (%)	DUR (%)	FRE (%)
L1	94	50	0	0	0	0	0	0	0	0	6	50
L2	15.84	16.67	0.82	16.67	50.52	33.33	0.08	16.67	0	0	32.73	16.67
L3	44.43	39.47	0.3	3	5.01	8.27	14.57	16.16	15.21	15.41	20.48	17.69
K1	1.55	33.33	0	0	68	33.33	30.45	33.34	0	0	0	0
K2	1.55	33.33	0	0	68	33.33	30.45	33.34	0	0	0	0
K6	21.05	33.33	0	0	78.95	66.67	0	0	0	0	0	0
K7	54.54	75	0	0	45.45	25	0	0	0	0	0	0
K8	56.11	30.77	0.276	2.7	10.68	6.44	2.66	17.04	3.16	16	27.114	27.05
K9	50.3	55.5	8.03	6.84	6.77	6.84	8.8	9.5	11.3	8.36	14.8	12.96
K12	76.28	62.5	0	0	15.6	12.5	0	0	0	0	8.12	25
K13	80.62	66.67	19.38	33.33	0	0	0	0	0	0	0	0
K14	16.57	29.14	0.158	1.32	45.76	19.86	16.2	17.88	15.9	6.45	15.9	23.114
K15	39	48.23	0.93	7.05	30.29	10.58	0.216	2.35	6.45	2.35	23.114	29.44
Total	45.84	39.15	2.77	3.82	15	9.36	8.37	14.2	8.88	12.94	19.14	20.53

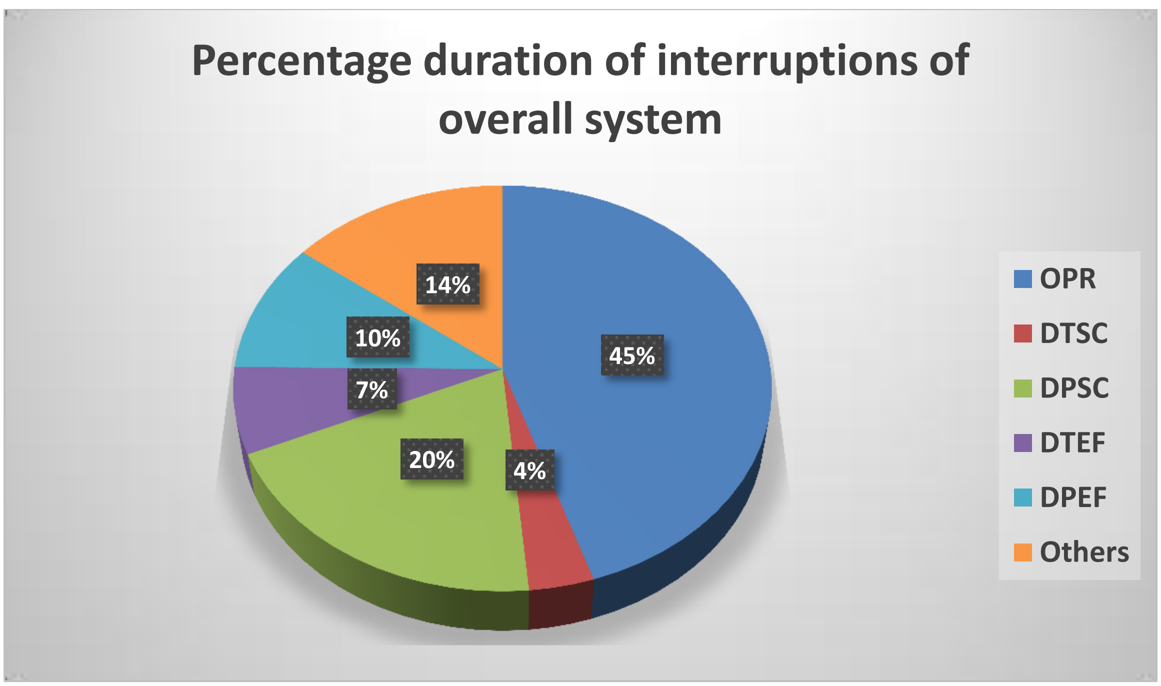

Figure 3.8 Percentage (%) duration of interruption s of the overall system

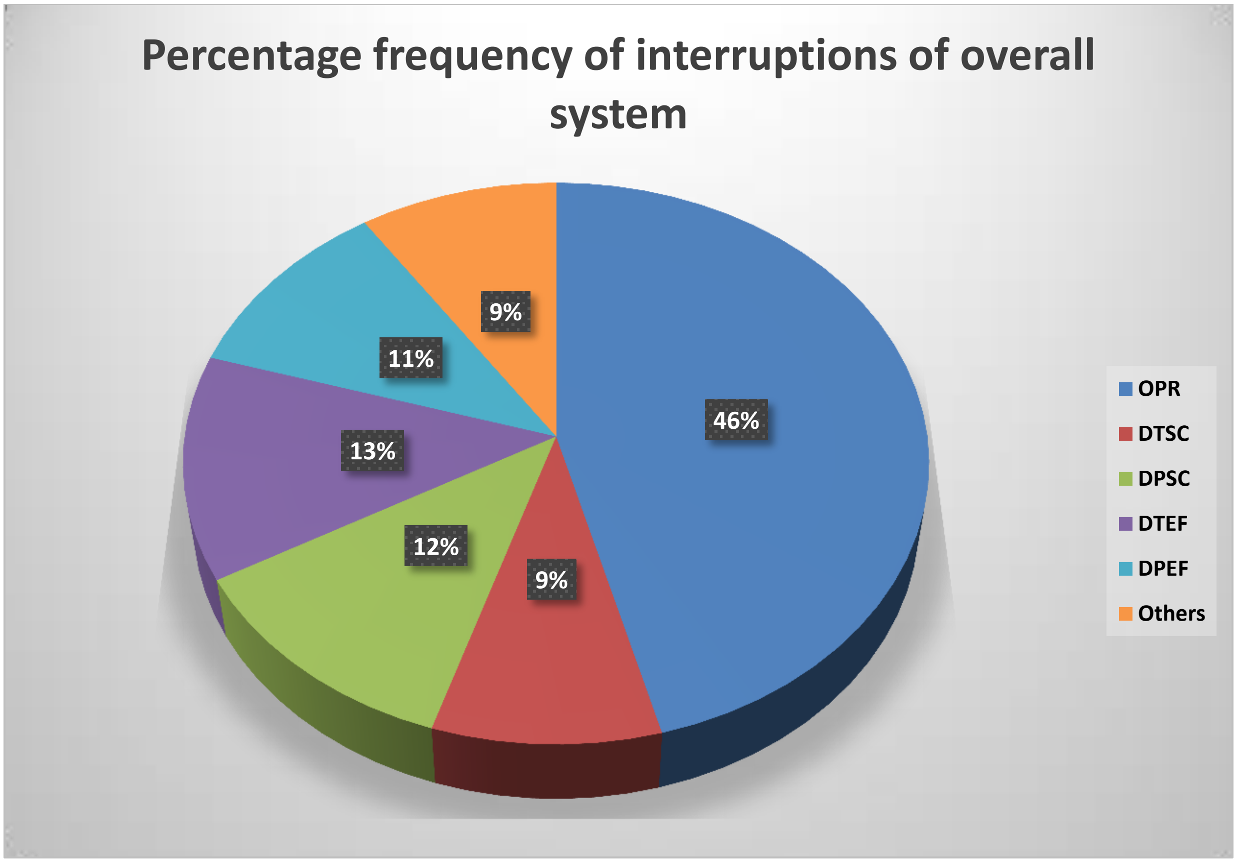

Figure 3.9 Percentage (%) frequency of interruption s of the overall system

In general, based on the analysis results illustrated in Figure 3.8 and 3.9, from the total frequency of interruption, 46% is occurred due to operational and maintenance tasks. Similarly, 45 % of the total duration of interruptions is caused by planned (operational) interruptions. This shows that the distribution technicians take more time to locate a fault occurred during maintenance since, as there is no automatic fault locating mechanisms.

3.5 Reliability Indices Calculation

The reliability indices of the existing substation can be calculated using equations (2.1) to (2.13), which are given in chapter two. Based on the data given in Table 3.12, 3.13 and 3.14, the reliability indices for the average of the two years can be calculated. Therefore, Table 3.19 shows the reliability indices of the average value of 2017 and 2018 of each feeder.

Table 3.19: Reliability indices of the average of 2017 and 2018)

Feeder	SAIFI(int/yr)	SAIDI(hr/yr)	CAIDI	ASAI	ASUI	ENS(MWh)	AENS(MWh /customer)
L1	20.89	77.2	3.69	0.978	0.022	567.038	0.023
L2	9.49	53.14	5.6	0.987	0.013	232.2	0.0095
L3	336.7	317.76	1.53	0.94	0.06	2923.294	0.12
K1	17.355	43.34	2.5	0.992	0.008	208.4992	0.0085
K2	16.03	41.52	2.6	0.994	0.006	203.4	0.0084
K6	8.027	15.07	1.87	0.999	0.001	81.502	0.0033
K7	57.22	59.49	1.04	0.98	0.02	350.16	0.014
K8	483.68	517.38	1.48	0.92	0.08	5326.1568	0.22
K9	514	560.55	1.479	0.89	0.11	4405.3624	0.18
K12	12.64	19.36	1.53	0.998	0.002	90.3	0.0037
K13	26.82	36.76	1.37	0.996	0.004	274.065	0.011
K14	170.9	266.4	2.14	0.952	0.048	428	0.017
K15	150.63	27.93	0.18	0.997	0.003	1515.8	0.06
System	199.92	264.22	1.7	0.968	0.032	16606	0.68

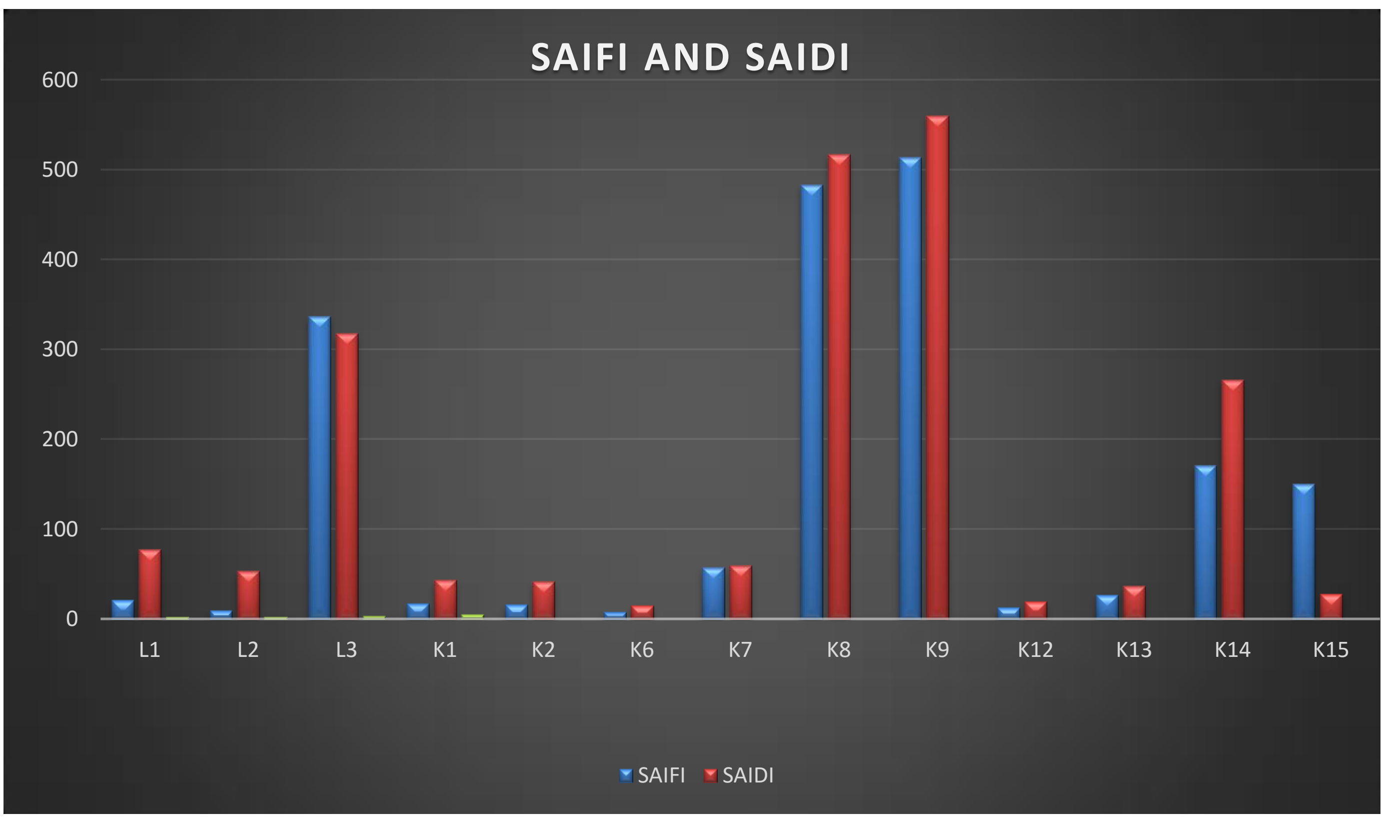

Figure 3.10 SAIFI and SADI of each feeder of existing system

Summary of the analysis

1. SAIFI of the overall system as shown in Table 3.19 is 199.92 int. /yr. As per Ethiopian Electrical Agency ‘s (EEA’s) standard, SAIFI should not exceed 20 interruption per customer per year, which indicates that the current value is above the acceptable value by large margin. And also, when we compare the calculated SAIFI value with German standard, it is much greater than the maximum limit [41]. This clearly indicates that there is serious reliability problem in the present Bishoftu substation II.
2. Table 3.19 shows SAIDI of the system are 264.22 hours per customer per year. This shows that every customer experience 264.22 Hr. Per year. This proves that there is great reliability problem in the existing Bishoftu substation II. As per (EEA), the SAIDI value should not exceed 25 hours per customer per year [21]. The permissible SAIDI value in Germany is 0.383 hours per customer per year [41].
3. ASAI: The power supply of the overall system is 96.8% available as shown in Table 3.19. However, this value is not still good enough since the ASAI value should be greater than 99.98% as per EEA’s standard [41].
4. ENS: It indicates the un-served or unsold energy of each feeder. For the overall system, the total unsold energy was 16,606 MWh.
5. AENS: The overall system has an AENS value of 0.683 MWh per customer.

In general, based on the data analysis the following points can be drawn:

1. The reliability of the Bishoftu substation II does not meet the requirements set by the regulatory body that is Ethiopian Electric Agency (EEA).
2. The reliability of Bishoftu substation II is not good enough as compared to the international reliability indices of best experienced countries.
3. There is high unavailability of services in the network.
4. There is also much loss of Unsupplied Energy due to both planned and unplanned outages in the present power grid of Bishoftu substation II

Table 3.20 shows the comparison of the most commonly used reliability indices

Table 3.20 SAIDI and SAIFI comparison [41]

Country	SAIFI (Int./Year/Customer)	SAIDI (Hr./Year/Customer)
United States	1.5	4
Australia	0.9	1.2
Denmark	0.5	0.4
France	1.0	1.03
Germany	0.5	0.383
Italy	2.2	0.967
Netherland	0.3	0.55
Spain	2.2	1.73
United Kingdom	0.8	1.5
Ethiopia	20	25
Bishoftu substation II	199.92	264.22

Table 3.21: EEPCO'S electricity tariff (Birr/kwh) [38, 41]

Residential	Active Energy Range (kWh)	Price Rate (Birr/kWh)
	0-50	0.2730
	51-100	0.3564
	101-200	0.4993
	201-300	0.5500
	301-400	0.5666
	401-500	0.5880
	Above500	0.6943
Commercial	0-50	0.6088
	Above 50	0.6943
Low Voltage Time of Day Industry @15kv		
Peak		0.7426
Off-peak		0.5354
High Voltage Industry @132KV		
Peak		0.4736
Off peak		0.3664

Based on EECO’s tariff (Table 3.21), the cost of ENS due to interruption for Bishoftu Substation II is calculated as,

$$\text{Cost of Energy} = \text{Power} * \text{Time} * \text{tariff for electricity}$$

By considering an average electric price of 0.5345 Birr/kWh, the total average cost of ENS because of power interruption per year for the substation’s outgoing feeders is 16,606,000KWH*0.5345Birr/kwh = 8,875,721.525Birr or 316,990.054 USD.

CHAPTER FOUR

DISTRIBUTION SYSTEM MODELLING, SIMULATION STUDIES AND RESULTS ANALYSIS

4.1 Introduction

This chapter describes the selection criteria and sizing of the proper DG technology for specific area and continues to reliability simulation of the current substation with and without DG. And analysis of the obtained result is also presented in the corresponding simulation. The selection of specific DG technology, its sizing, cost, reliability analysis using Dig Silent Power Factory Software and the improvement using DG are presented in detail.

4.2 Selection of DG Technology

The selection of a specific DG technology to a certain area depends on availability of resources, suitability to environment, and cost of DG technology. Different geographical areas have different resources, both renewable and non-renewables. For instance, the solar energy availability varies from place to place and the wind energy resources vary due to the difference of wind speed in different areas. DG technologies also differ in their negative and positive impacts they have on the surrounding environment. One of the impacts is emission level of gases such as, CO, CO2 and etc. to the environment.

Table 4.1 Emission and cost levels of different DGs

Technology	Emission Level	Cost
PV	No	Moderate
Fuel cell	Low	High
Wind turbine	No harmful emissions	Moderate
Diesel generator	High emission	Low
Microturbine	Low	Moderate

Even though, the PV systems and wind turbines are free energy sources with low cost and low emission level it is not conformable to implement in Bishoftu substation II due to unsuitability of installation site.

Depending up on the above factors, Micro turbine (synchronous generator) is the selected DG technology in this thesis which is available in Dig SILENT Power Factory 15.1.7 software.

4.3 Sizing and Placement of Microturbine

The DG units are located at feeders which faces longer duration and higher frequency of interruption. These feeders are K8, K9 and L3 there corresponding peak loads are 7.42, 5.63 and 5.477MW respectively.

There are no clear guidelines on selecting the size and number of DG units to be integrated in the distribution system. However, there are some factors that can be guiding the selection of DG unit size s.

To improve the system voltage profile and power system reliability and reduce power losses, it is sufficient to use DG units of total capacity in the range of 10-50% of the maximum peak load of the feeder. The DG unit size can affect system protection coordination schemes and devices as it affects the value of the short-circuit current during a fault.

The size of DG units selected for the case study had been medium size DG not exceeding peak load of the feeder which is 7.42MW 50% of that is 3.71MW. So, throughout the thesis, single DG refers to a capacity of 3.71MW but the total capacity of 3DGs is 11.13MW.

4.4 Reliability Analysis using Power Factory

Power Factory software is one of power system reliability analysis software. Equipment used in this analysis from the Power Factory are, lines, breakers, disconnectors, transformers, loads, DG technologies, external grid, busbars and so on. Every equipment has electrical and failure inputs. For example, a line is fed its ratings like, voltage and current ratings and the failure inputs are the interruption frequency and duration. The electrical and failure inputs given to each equipment's shown in Table 4.2. These failure data are obtained from different researches since EEPCO has no such data.

Table 4.2: Electrical and failure inputs

Equipment name	Repair duration (Hr.)	Interruption Frequency	Voltage level (kV)
Main Transformer	1.2	0.015 (1/a)	132
Distribution Transformers	2	0.015 (1/a)	15
Lines	0.8	18 (1/km*a)	15
External grid	0.12	0.675 (1/km*a)	132

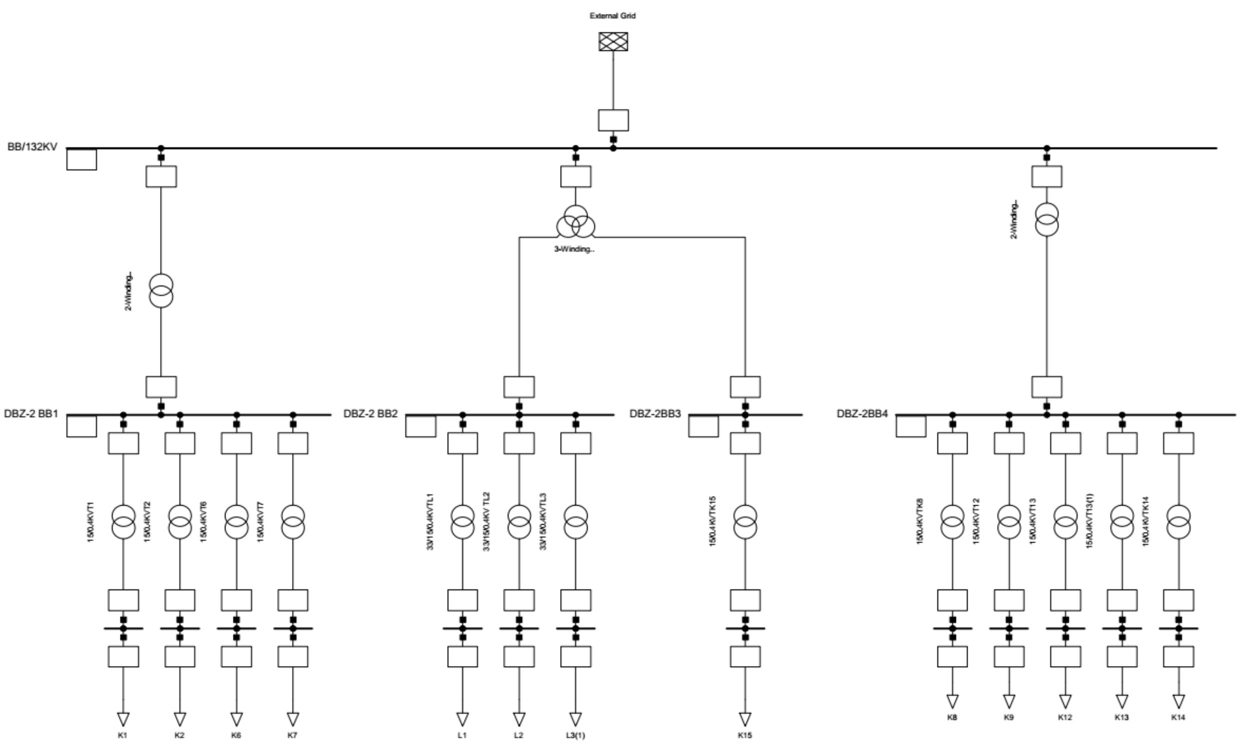

Figure 4.1: Single line diagram of Bishoftu substation II before DG injection

Base case reliability analysis

Table 4.3 shows, the base case reliability indices for the system before DG injection.

Table 4.3: Base case reliability indices

SYSTEM SUMMARY

| System Average Interruption Frequency Index	:	SAIFI	=	199.982331	1/Ca
| Customer Average Interruption Frequency Index	:	CAIFI	=	199.982331	1/Ca
| System Average Interruption Duration Index	:	SAIDI	=	264.22113	h/Ca
| Customer Average Interruption Duration Index	:	CAIDI	=	1.7051	h
| Average Service Availability Index	:	ASAI	=	0.9436002314	
| Average Service Unavailability Index	:	ASUI	=	0.0563997680	
| Energy Not Supplied	:	ENS	=	16605.653	MWh/a
| Average Energy Not Supplied	:	AENS	=	0.638	MWh/Ca
| Average Customer Curtailment Index	:	ACCI	=	0.000	MWh/Ca
| Expected Interruption Cost	:	EIC	=	0.000	M€/a
| Interrupted Energy Assessment Rate	:	IEAR	=	0.000	€/kWh

The system reliability indices are given in the output window of the software from this output it is observed that the existing substation have reliability problems since the indices given here are higher.

Reliability analysis with 2 DGs at K8 and K9

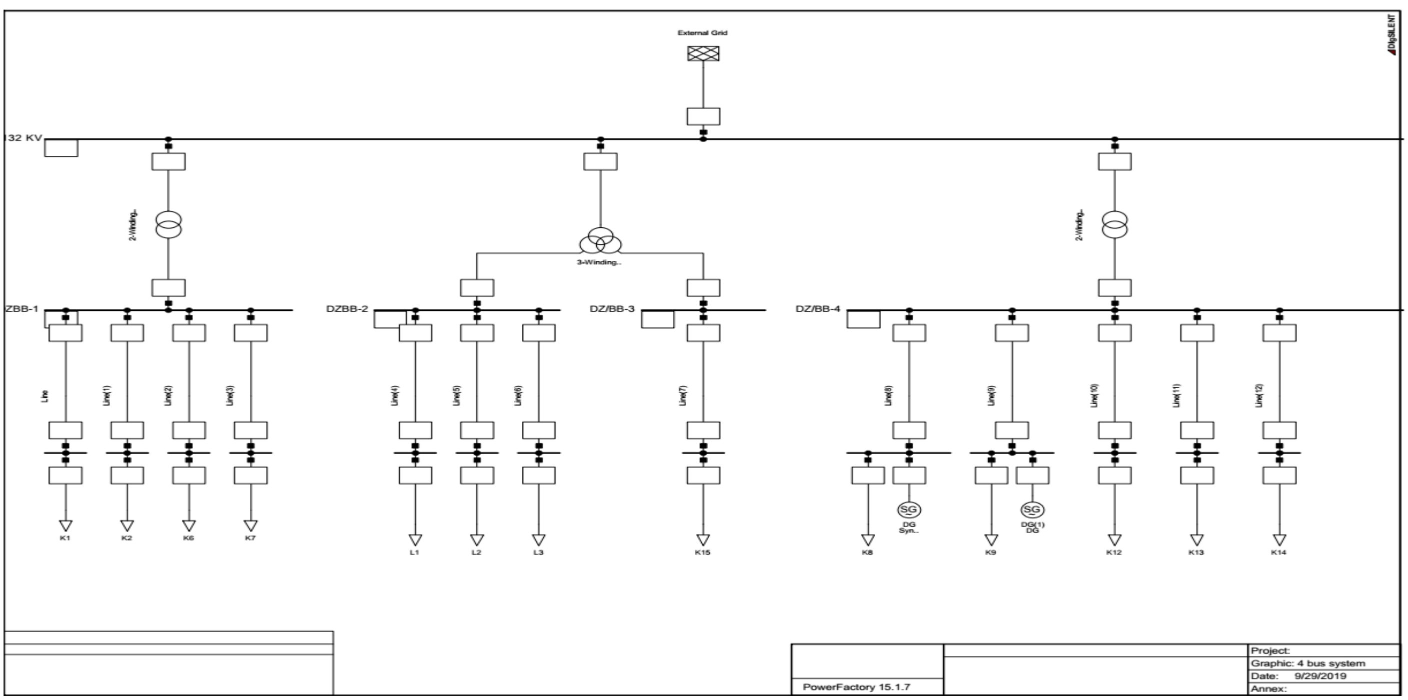

Figure 4.2: Diagram of Bishoftu substation II with two DGs

Table 4.4 shows, the reliability indices of the overall system after integrating 2 DGs at feeders K8 and K9 with a total capacity of 7.42 MW.

Table 4.4: Reliability indices with 2 DGs at feeders K8 and K9

SYSTEM SUMMARY

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System Average Interruption Frequency Index	: SAIFI	=	90.9983123	1/Ca
Customer Average Interruption Frequency Index	: CAIFI	=	90.0183123	1/Ca
System Average Interruption Duration Index	: SAIDI	=	96.33	h/Ca
Customer Average Interruption Duration Index	: CAIDI	=	1.058	h
Average Service Availability Index	: ASAI	=	0.9894682752	
Average Service Unavailability Index	: ASUI	=	0.0105317248	
Energy Not Supplied	: ENS	=	6784.109	MWh/a
Average Energy Not Supplied	: AENS	=	0.282	MWh/Ca
Average Customer Curtailment Index	: ACCI	=	0.000	MWh/Ca
Expected Interruption Cost	: EIC	=	0.000	M€/a
Interrupted Energy Assessment Rate	: IEAR	=	0.000	€/kWh

Annual energy saved = (ENS before DG – ENS after DG)

= (16,605.653Mwh – 6874.109Mwh)

=9,731.544MWH

Annual Cost saved =9,731,544kwh*0.5345Birr/kwh

=5.202million Birr

From the result in Table 4.4, SAIFI of the overall system has improved by 54.48% and SAIDI by 63.55%. In this case study, it is shown that the presence of DG on the substation has positive impact in the power system's reliability. That means the indices were reduced by the integration of DG to the overall system.

Reliability analysis with 3 DGs at K8 and K9 and L3

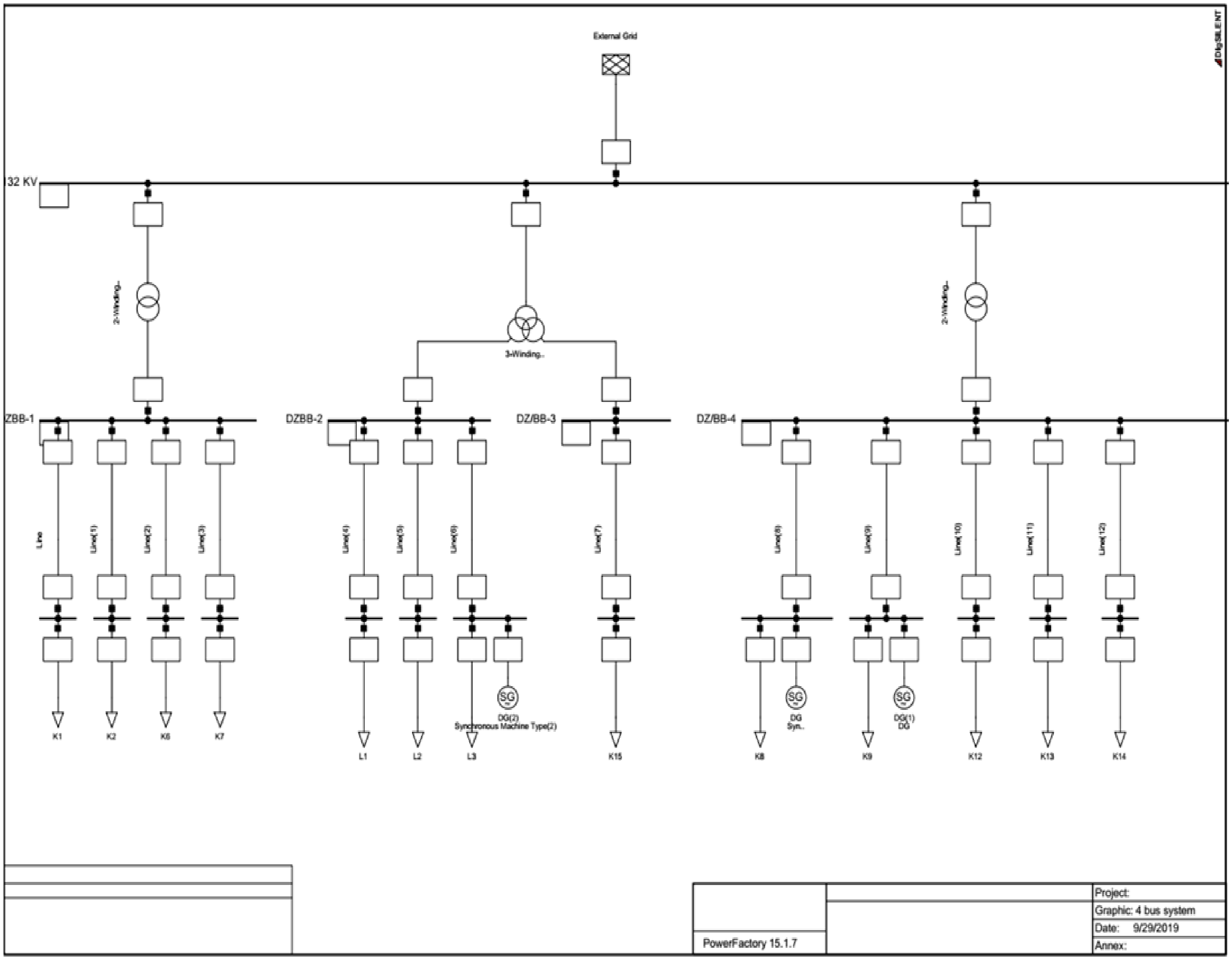

Figure 4.3: Diagram of Bishoftu substation II with three DGs

Table 4.5 shows the reliability indices of the overall system after integrating 3 DGs at feeders K8, K9 and L3.

Table 4.5: Reliability indices with 3DGs at feeders K8, K9 and L3

SYSTEM SUMMARY

System Average Interruption Frequency Index	: SAIFI	=	69.660398	1/Ca
Customer Average Interruption Frequency Index	: CAIFI	=	69.660398	1/Ca
System Average Interruption Duration Index	: SAIDI	=	64.41	h/Ca
Customer Average Interruption Duration Index	: CAIDI	=	0.920	h
Average Service Availability Index	: ASAI	=	0.9926682654	
Average Service Unavailability Index	: ASUI	=	0.0073317346	
Energy Not Supplied	: ENS	=	5358.320	MWh/a
Average Energy Not Supplied	: AENS	=	0.220	MWh/Ca
Average Customer Curtailment Index	: ACCI	=	0.000	MWh/Ca
Expected Interruption Cost	: EIC	=	0.000	M€/a
Interrupted Energy Assessment Rate	: IEAR	=	0.000	€/kWh
System energy shed	: SES	=	0.000	MWh/a

Annual energy saved = (ENS before DG – ENS after DG)

= (16,605.653Mwh – 5358.32Mwh)

=11,247.333MWH

Annual Cost saved =11,247,333kwh*0.5345Birr/kwh

=6.012 million Birr

As shown in Table 4.5, applying 3 DGs to K8, K9, and L3 with a total capacity of 11.13MW can improve the overall system's SAIFI=65.16% and SAIDI= 75.62%. This is large improvement because 3 DGs of 11.13MW are applied at three feeders which have a long duration and high frequency of interruption.

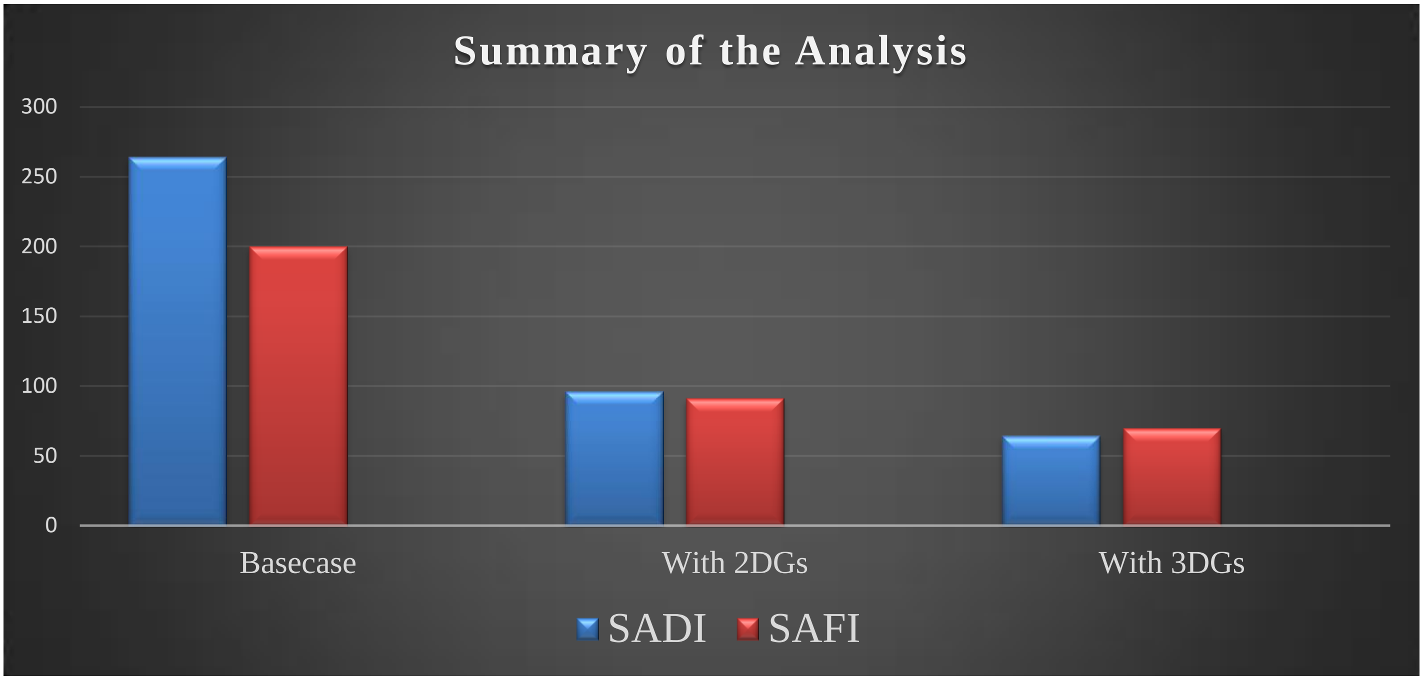

Figure 4.4: Summary of the analysis

4.5 Cost Estimation of DG Installation

After the end of the analysis, cost estimation of the obtained DG size can be followed. To estimate the total cost of DG, the DG technologies selected in this thesis was Microturbine owing to their low emission level and average limited cost.

Table 4.6 illustrates the equipment and installation cost of various sized microturbines [31]. From table 4.6, it is observed that the installed capital costs range from $2,500 to $4,300 per kW.

Table 4. 6 Equipment's and installation costs of microturbine

Description		System				
	1	2	3	4	5	6
Generator Capacity						
Nominal capacity (kW)	30	65	200	250	333	1000
Net capacity (kW)	28	61	190	240	320	950
Equipment costs						
Net capacity (kW)	$53,100	$112,900	$359,300	$441,200	$566,400	$1,188,600
Heat recovery	$13,500	$0	$0	$0	$0	$275,000
Fuel gas compression	$8,700	$16,400	$42,600	$0	$0	$164,000
Interconnection	$0	$0	$0	$0	$0	$0
Total equipment cost	$75,300	$129,300	$401,900	$441,200	$566,400	$1,627,600
$/Kw	$2,689	$2,120	$2,120	$1,840	$1,770	$1,710
Installation costs						
Labor/materials	$22,600	$28,400	$80,400	$83,800	$101,900	$293,000
Project & construction Mgmt.	$9,000	$15,500	$48,200	$52,900	$68,000	$195,300
Engineering and fees	$9,000	$15,500	$48,200	$52,900	$68,000	$195,300
Project contingency	$3,800	$6,500	$20,100	$22,100	$28,300	$81,400
Financing (int. during const.)	$700	$1,200	$3,700	$4,100	$5,100	$14,800
Total other costs	$45,100	$67,100	$196,400	$211,400	$259,900	$747,300
$/Kw	$1,611	$1,100	$1,035	$881	$812	$787
Total installed cost ($)	$120,400	$196,400	$598,500	$652,600	$826,300	$2,374,900
$/Kw	$4,300	$3,220	$3,150	$2,720	$2,580	$2,500

Here, the microturbine of 1000 kW was selected to estimate the cost of DG capacity of 3.71 MW and for the total of 11.13MW. The generators should be integrated to provide the modular packages of 11 MW unit comprised of eleven 1000 kW. Table 4.7 gives the cost estimation of 3.71 MW, 7.41MW and 11.3MW of DG capacity and the corresponding payback period.

Table 4.7 Cost of DG installation and payback period.

Generator Type	Capacity (MW)	Cost ($/kW)	Total Cost ($)	Total cost (ETB)	Payback Period (year)
Microturbine	1DG= 3.71	2,500	9,275,000	259,700,000	5
	2DGs = 7.42		18,550,000	519,400,000	8 year and 4 months
	3DGs = 11.13		27,825,000	779,100,000	11

CHAPTER FIVE

CONCLUSIONS, RECOMMENDATIONS AND FUTURE WORK

5.1 Conclusions

The research undertakes load demand forecasting, expansion planning and reliability improvement by integrating DG for the case of Bishoftu substation II.

The existing peak power demand of Bishoftu town is 54.7MW. Based on the data collection and the result of demand forecasting, the peak demand in 2028 will be 401.63MW. But the total capacity of the existing system is 43.8MW. It is clear that, the existing distribution network cannot meet not only the future demand but also the existing demand.

The substation reliability also does not meet the requirements set by Ethiopian Electric Agency (EEA). The average frequency of interruptions of the distribution system is 199.92 interruptions per customer per year and the average duration of interruptions is 264.22 hours per customer per year. There is high unavailability of electric power in the distribution network. There is much loss of unserved energy due to planned and unplanned outages. The average unsold energy is 16,606 MWh per year. The total average cost of unsold energy because of power interruption is around 8.976 million Birr per year.

To improve the distribution system reliability and to meet the future demand, three DGs are integrated in three feeders which have high frequency and long duration of interruption. The overall systems reliability also compared when DGs are connected to two feeders (K-8 and K-9) and when three DGs are connected to three feeders (L-3, K-8 and K9) which experience more interruptions.

As a result of two DGs, the overall system's reliability is improved SAIFI of the system by 54.48% and SAIDI of the system by 63.55%. But when three DGs were located, the overall system's reliability is improved SAIFI of the system by 65.16% and SAIDI of the system by 75.62%.

In general, connecting three DGs is better than connecting two DGs to improve the distribution system reliability and to meet the future demand.

5.2 Recommendations

Based on the results of this research the following suggestions are recommended for the concerned bodies. The utility has to develop economic growth-based energy demand forecasting methods. Distributed generation technology should be promoted by the power utility company not only for rural electrification but also for distribution systems even as a backup. Therefore, it is recommended that the Ethiopian Electric Utility (EEU) and Ethiopian Electric Power (EEP) or other stake holders like Ethiopian Electric Authority (EEA) should make awareness and encouragements to the government to promote the implementation of distributed generation in distribution sector.

It is difficult to identify each load point and the corresponding data of that load point. This made the analysis in this thesis to be difficult. So, I recommend to EEPCO to distinguish each load point and their corresponding failure data and to establish a better mechanism of supplying data for research purposes.

5.3 Future Work

The current study carried out demand forecasting by considering the historical energy growth rate and economic growth rate, but future work could include the population growth rate and other factors influencing long term load forecasting (like temperature, humidity etc.) in order to increase accuracy.

The network expansion of this study uses the connection of DG to improve reliability of the system, but using another distribution network expansion method (i.e. Network reconfiguration, using Smart grid technology for power system reliability and others) will be the future work to be focused on.

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APPENDIX

Appendix A: Power interruption data of 2017

Substation Name	Feeder Name	Region	DATE (G.C)	TIME of Interruption	Recovered TIME	DURATION TIME	Dur (Hr)	FAULT TYPE
D/Zeit No 2	K7	Central	3/1/2017	9:55	10:00	0:05	1:55	Operational
	K9			13:50	14:05	0:15	6:00	Operational
	K7			14:35	14:45	0:10	3:50	DTSC
	K9			19:47	19:50	0:03	1:12	DTSC
	L3			21:46	21:49	0:03	1:12	DTEF
	L3			21:54	21:58	0:04	1:26	DTEF
	K7		3/2/2017	8:10	8:15	0:05	1:55	DTSC
	L3			9:00	9:35	0:35	12:43	Unpridictable
	k9			9:55	10:10	0:15	6:00	Maintainance
	L1			14:45	10:30	5:45	18:00	DTSC
	K9			20:45	20:57	0:12	4:48	Maintainance
	K9			21:40	21:45	0:05	1:55	Maintainance
	K15		3/3/2017	1:00	7:00	6:00	0:00	Maintainance
	K7			6:35	6:50	0:15	6:00	DTSC
	K7			7:55	8:47	0:52	20:38	DTSC
	K5			10:40	11:05	0:25	9:50	Maintainance
	K9			11:27	11:29	0:02	0:43	DTSC
	K7			11:32	12:40	1:08	3:07	DTSC
	K9			12:50	17:30	4:40	15:50	DPSC
	TR 3			11:50	12:48	0:58	23:02	Maintainance
	TR 2			16:26	16:28	0:02	0:43	DTSC
	K9			19:28	19:40	0:12	4:48	Due to Fire
	K9		3/4/2017	9:24	9:26	0:02	0:43	oprational

	K9			12:10	12:41	0:31	12:28	oprational
	K7			12:33	13:01	0:28	11:02	Operational
	L3			12:38	14:17	1:39	13:12	Operational
	L3			14:28	14:58	0:30	12:00	Operational
	K9			16:56	17:49	0:53	21:07	DPSC
	K7		3/5/2017	8:04	8:11	0:07	0.12	DTSC
	L3			12:45	13:01	0:16	6:28	DPEF
	K9			15:29	13:35	0:06	2:24	DTSC
	K7			17:20	17:43	0:23	9:07	Operational
	K9			21:56	22:09	0:15	6:00	Operational
	K14		3/6/2017	6:33	6:40	0:07	2:52	DTSC
	K15			8:45	9:05	0:20	7:55	Operational
	K9			14:10	14:15	0:05	1:55	DTSC
	K7			14:46	16:25	1:39	13:12	DPSC & DPEF
	K9			17:02	17:13	0:11	4:19	Operational
	L3		3/7/2017	7:11	8:19	1:08	3:07	DPSC
	K7			13:39	13:54	0:15	6:00	DPSC & DPEF
	K9			14:52	15:23	0:31	12:28	DPSC
	K7			16:47	17:09	0:22	8:52	Operational
	K9			16:00	17:18	1:18	7:12	Operational
	K9		3/8/2017	8:38	8:40	0:02	0:43	Operational
	K9			9:40	9:44	0:04	1:40	DTSC
	K15			12:00	12:02	0:02	0:43	DTSC
	K9			12:10	12:12	0:02	0:43	DTSC
	K9			14:16	14:18	0:02	0:43	DTSC
	K9			14:40	14:42	0:02	0:43	DTSC
	K9			15:01	15:03	0:02	0:43	DTSC

	K7			19:42	20:04	0:22	8:52	DPSC & DPEF
	K9		9/3/2017	7:12	7:14	0:02	0:43	DTEF
	K9			8:30	8:35	0:05	1:55	DTSC
	K9			13:01	13:03	0:02	0:43	DTSC
	K9			14:00	14:43	0:43	17:16	DPSC
	K9			19:06	19:08	0:02	0:43	DTSC
	K9			19:27	19:29	0:02	0:43	DTSC
	L3		3/10/2017	7:20	7:22	0:02	0:43	DTSC
	K7			9:20	9:23	0:03	1:12	DTEF
	K7			13:53	16:22	2:29	11:31	Operational
	K9			13:53	16:39	2:36	14:24	Operational
	K9			17:38	18:08	0:30	12:00	DPSC
	K7		3/11/2017	7:57	7:59	0:02	0:43	DTSC
	K7			19:46	19:59	0:02	0:43	Operational
	K9			21:30	21:42	0:12	4:48	DPSC
	K9			21:47	22:05	0:18	7:12	DPEF
	L3		3/12/2017	8:40	8:42	0:02	0:43	DTSC
	K7			9:43	9:50	0:07	2:52	Operational
	K7			13:35	14:11	0:36	14:24	Operational
	K14			14:19	15:36	1:17	6:43	Operational
	K7			15:30	15:34	0:04	1:40	DTSC
	K9			16:24	17:22	0:58	23:16	DPSC
	L3			19:09	20:00	0:51	20:24	LDC
	K7			21:22	21:30	0:08	3:07	Due to Fire
	K7		3/13/2017	7:00	7:10	0:10	4:04	DTSC
	K9			7:12	7:14	0:02	0:43	DTSC
	L3			7:45	7:50	0:05	1:55	DTEF
	K9			9:25	9:27	0:02	0:43	DTSC
	K9			9:45	9:57	0:12	4:48	DPSC

	K15			14:50	16:00	1:10	4:04	Operational
	K9			17:15	17:16	0:01	0:28	DTSC
	K9			17:40	17:50	0:10	4:04	DTSC
	L3			18:30	18:32	0:02	0:43	DTSC
	K9		3/14/2017	8:26	8:56	0:30	0.5	Operational
	L3			10:41	11:25	0:34	13:40	Operational
	L3			12:10	13:39	1:29	11:31	DPSC
	K9			12:29	12:34	0:05	1:55	DTSC
	K9			14:00	15:38	1:38	15:07	DPSC
	K7			14:05	15:57	1:52	20:52	DPSC
	K9		3/15/2017	9:26	9:30	0:04	1:40	DTSC
	L3			19:05	21:14	2:09	3:36	LDC
	K9		3/16/2017	10:01	10:09	0:08	3:07	DTSC
	K9			13:50	14:32	0:42	16:48	DPSC
	L3			15:00	15:11	0:11	4:19	DPSC
	K15			18:25	18:29	0:04	1:40	DTSC
	L3		3/17/2017	10:25	12:08	1:43	17:16	Operational
	K9			11:15	11:38	0:23	9:07	Operational
	K7			14:55	17:18	2:23	9:07	Operational
	K15			15:13	15:40	0:27	10:48	Operational
	L3			15:22	19:25	4:03	1:12	DPEF
	K9			16:32	17:09	0:37	14:52	Operational
	K14			19:04	19:41	0:37	14:52	LDC
	L3			19:41	20:36	0:55	22:04	DPEF
	K6			21:55	22:56	1:01	0:28	DPSC & DPEF
	K7			21:55	22:57	1:02	0:47	DPSC & DPEF
	K15		18/2017	8:55	9:00	0:05	19:55	DTSC & DTEF
	K13			9:20	9:24	0:04	1:40	DLOL
	K15			9:50	9:52	0:02	0:43	DTSC

	L3			9:50	9:56	0:06	2:24	Operational
	K1 & K2			11:36	12:00	0:24	9:36	Operational
	K6			11:36	12:00	0:24	9:36	Operational
	K8			11:36	12:00	0:24	9:36	Operational
	K9			11:36	12:00	0:24	9:36	Operational
	K9			15:06	15:40	0:34	13:40	Operational
	K7			16:00	16:10	0:10	4:04	Operational
	L3			18:46	20:27	1:41	16:19	LDC
	K7			19:35	19:39	0:04	1:40	DTSC & DTEF
	K9		3/19/2017	5:00	5:04	0:04	1:40	DTSC
	K7			5:00	9:20	4:20	7:55	DPSC & DPEF
	K7			12:35	12:42	0:07	2:52	Operational
	K9			13:55	13:59	0:04	1:40	DTSC
	K7			15:13	16:13	1:00	0:00	Operational
	K9		3/20/2017	6:10	6:28	0:18	7:12	DPSC
	K7			8:35	9:32	0:57	22:48	DPSC
	L3			11:00	13:00	2:00	0:00	DPEF
	K9			16:10	17:17	1:07	2:52	DPSC
	K9		3/21/2017	1:00	1:57	0:57	22:48	DPEF
	K7			1:44	1:57	0:13	5:16	DPEF
	K9			2:30	8:42	6:12	4:48	DPEF
	K7			3:40	3:58	0:18	7:12	DPEF
	K7			6:51	10:41	3:50	19:55	LDC
	L3			10:41	14:53	4:12	4:48	LDC
	K15			14:53	15:12	0:19	7:40	LDC
	L3			16:00	16:02	0:02	0:43	DTSC
	K9			18:32	18:58	0:26	10:19	DPSC
	K7			18:38	18:58	0:20	7:55	DPEF
	K14			18:30	22:00	3:30	12:00	LDC

	L3			18:56	18:58	0:02	0.03	DTSC & DTEF
	K9			19:01	19:37	0:36	14:24	DPSC
	L3			19:05	19:34	0:29	11:31	DPSC
	L3			19:40	20:51	1:11	1..83	DPSC
	TR 3		3/22/2017	6:11	11:53	5:42	16:48	Maintainance
	K9			8:57	9:10	0:13	5:16	Maintainance
	K9			14:17	14:18	0:01	0:28	Operational
	L3			14:47	16:04	1:17	6:43	DPSC
	K7			17:00	17:02	0:02	0:43	DTEF
	L3			20:55	20:57	0:02	0:43	DTSC
	L3			21:00	21:49	0:49	19:40	DPSC
	K9		3/23/2017	3:00	6:00	3:00	0:00	DPSC
	K14			9:42	9:49	0:07	2:52	Operational
	L3			10:02	10:09	0:07	2:52	Maintainance
	K7			10:45	12:15	1:30	12:00	LDC
	K9			14:20	14:52	0:32	12:43	DPSC
	K7			16:00	16:10	0:10	4:04	Maintainance
	L3			16:52	18:45	1:53	21:07	DPSC
	K7			17:00	17:04	0:04	1:40	DTSC
	K13			18:02	18:11	0:09	3:36	DTSC
	L3			21:10	21:15	0:05	1:55	DTSC
	L3			22:00	22:25	0:25	10:04	DPSC
	K7		3/24/2017	4:00	9:07	5:07	2:52	DPEF
	K9			5:40	5:45	0:05	1:55	DTSC
	K9			7:28	8:27	0:59	23:31	LDC
	L3			7:29	8:27	0:58	23:16	LDC
	K9			9:23	9:53	0:30	12:00	DPSF
	K14			9:30	10:30	1:00	0:00	Operational
	K7			10:11	11:34	1:24	9:36	LDC

	L3			11:05	13:25	2:20	7:55	LDC
	K13			13:11	13:13	0:02	0:43	DLOL
	K13			14:57	15:00	0:03	1:12	DLOL
	K13			18:17	18:23	0:06	2:24	DLOL
	L3		3/25/2017	6:55	10:00	3:05	1:55	LDC
	K9			6:55	12:11	5:16	6:28	LDC
	K7			8:00	8:20	0:20	7:55	DPSC
	K1			12:46	12:48	0:02	0:43	DLOL
	K7			19:00	19:30	0:30	12:00	LDC
	K9		3/26/2017	7:30	8:44	1:14	5:31	DPSC
	L3			7:50	7:59	0:09	3:36	DTEF
	L3			9:53	12:02	2:09	3:36	LDC
	K14			12:02	14:51	2:49	19:40	LDC
	K9			16:53	16:56	0:03	1:12	DTSC
	K9			17:21	17:27	0:06	2:24	DTSC
	K7			18:35	19:07	0:32	12:43	LDC
	K15			19:07	20:27	1:20	7:55	LDC
	K9			19:32	19:36	0:04	1:40	DTSC
	L3		3/27/2017	8:23	8:25	0:02	0:43	DTSC
	K9			9:26	9:39	0:13	5:16	Operational
	K9			9:43	9:55	0:12	4:48	LDC
	K7			9:55	12:17	2:22	8:52	LDC
	L3			11:31	11:35	0:04	1:40	DTSC
	L3			12:17	12:45	0:28	11:16	Operational
	K9			14:23	14:30	0:07	2:52	DTSC
	L3			14:38	18:05	3:27	10:48	DPSC & DPEF
	K9			14:46	15:18	0:32	0.53	DPSC
	K7			17:16	17:31	0:15	6:00	Operational
	K9			19:33	20:13	0:40	16:04	LDC

	K9			21:40	21:49	0:09	3:36	Operational
	K7		3/28/2017	6:37	6:42	0:05	1:55	DTSC
	L3			11:27	11:53	0:26	10:19	Operational
	K9			14:05	14:06	0:01	0:28	DTEF
	K9			14:37	14:50	0:13	5:16	Operational
	K7			14:46	15:13	0:27	10:48	Operational
	L3			16:09	16:11	0:02	0:43	DTSC
	L3			16:16	17:24	1:08	3:07	DPSC
	K7			17:20	17:24	0:04	1:40	DTSC
	L3			19:13	20:06	0:53	21:07	DPSC & DPEF
	K7		3/29/2017	11:14	11:17	0:03	1:12	DTSC & DTEF
	K9			11:57	12:12	0:15	6:00	Operational
	K9			13:38	13:41	0:03	1:12	DTSC
	K9			13:42	14:20	0:38	15:07	DPSC
	K9			15:15	16:34	1:19	7:40	DPSC
	L3			17:10	17:35	0:25	10:04	Operational
	K15			19:38	19:39	0:01	4:04	Operational
	K7		3/30/2017	9:15	9:28	0:13	5:16	Operational
	K9			9:25	9:26	0:01	0:28	DTSC
	K8			10:15	10:17	0:02	0:43	DTSC
	K9			10:30	10:33	0:03	1:12	DTSC
	K9			10:46	11:15	0:29	11:31	DPSC
	K7			15:40	15:45	0:05	1:55	Operational
	K15			15:45	15:48	0:03	1:12	Operational
	K7			15:50	16:12	0:22	8:52	DLOL
	K7			16:42	16:47	0:05	1:55	Operational
	K13			22:10	22:14	0:04	1:40	DLOL
	K9		3/31/2017	10:43	11:25	0:42	16:48	DPSC
	K14			10:49	10:50	0:01	0:28	DTSC

	L1			10:57	13:38	2:41	16:19	Operational
	K7			13:45	13:40	0:55	22:04	Operational
	K7			17:06	20:28	3:22	8:52	LDC
	K9			17:46	17:48	0:02	0:43	DTSC
	L3			18:01	18:04	0:03	1:12	DTSC
	K7			21:35	21:40	0:05	1:55	DTSC & DTEF
	k13		4/1/2017	0:14	0:22	0:08	3:07	DTEF
	K7			8:22	8:24	0:02	0:43	DTSC
	K7			9:00	9:17	0:17	6:43	Maintainance
	L3			10:50	10:56	0:06	2:24	Maintainance
	K9			11:00	12:27	1:27	10:48	DPSC
	K9			16:05	17:35	1:30	12:00	DPSC
	L3			17:55	21:23	3:38	15:07	LDC
	L1			18:05	21:23	3:18	7:12	LDC
	K7		4/2/2017	7:07	7:10	0:03	1:12	DTSC
	K1			7:25	7:35	0:10	4:04	DTEF
	K9			9:30	13:40	4:10	4:04	LDC
	K9			17:30	17:35	0:05	1:55	DTSC
	K9			17:40	18:00	0:20	7:55	DPSC
	L1			18:10	21:35	3:25	10:04	LDC
	K2			18:10	18:20	0:10	4:04	DTEF
	K1			18:10	21:13	3:03	1:12	DPEF
	K15			18:40	21:35	3:25	3.42	LDC
	K2			20:55	21:13	0:18	7:12	Maintainance
	K7		4/3/2017	6:35	6:37	0:02	0:43	DTSC
	L3			7:15	17:05	10:05	1:59	LDC
	K8			7:20	17:05	9:45	18:00	LDC
	K7			9:00	9:15	0:15	6:00	Operational
	K9			10:02	10:04	0:02	0:43	DTSC

	K7			10:15	10:27	0:12	4:48	Operational
	K7			11:00	11:02	0:02	0:43	Operational
	K9			11:08	11:14	0:06	2:24	DTSC
	K9			11:54	13:20	1:26	10:23	DPSC
	K7			17:05	21:16	4:11	4:23	LDC
	K9		4/4/2017	7:30	9:47	2:17	6:47	LDC
	K14			9:42	16:20	6:22	8:47	LDC
	K7			13:00	13:08	0:08	3:11	DTSC & DTEF
	K7			14:47	14:51	0:04	1:35	DTSC & DTEF
	K9			16:20	19:20	3:00	0:00	DPSC
	K1		4/5/2017	8:55	11:20	2:25	3:36	Maintainance
	K2			8:55	11:20	2:25	3:36	Maintainance
	K6			8:55	11:20	2:25	3:36	Maintainance
	K7			8:55	11:20	2:25	3:36	Maintainance
	K8			8:55	11:20	2:25	3:36	Maintainance
	K9			8:55	11:20	2:25	3:36	Maintainance
	K13			8:55	11:20	2:25	3:36	Maintainance
	K14			8:55	11:20	2:25	3:36	Maintainance
	K8			11:40	11:45	0:05	1:59	DTSC
	K9			11:40	14:10	2:30	12:00	DPEF & DPSC
	K8			11:57	12:24	0:27	10:48	DPEF
	K9			14:56	15:05	0:09	3:36	DTEF
	K10			15:04	15:21	0:17	6:43	DPEF
	K11			16:24	16:29	0:05	1:55	DTEF
	K12			16:40	17:08	0:28	11:02	Operational
	K13		4/6/2017	5:28	6:42	1:14	5:31	DPEF
	K14			7:16	7:28	0:08	3:07	Operational
	K15			9:59	12:49	2:50	19:55	LDC
	K16			12:49	18:05	5:16	6:14	LDC

	K17			14:42	15:02	0:20	7:55	Operational
	K18			18:02	21:43	3:41	16:19	LDC
	K8		4/7/2017	6:39	6:50	0:11	4:19	DLOL
	K8			7:58	9:56	1:28	11:02	DLOL & DPEF
	L1			9:56	13:30	3:34	13:26	LDC
	K9			13:30	19:00	5:30	12:00	LDC
	K8			14:30	14:34	0:04	1:26	DTEF
	K14			16:50	16:52	0:02	0:43	DTEF
	K15			19:00	21:50	2:50	19:55	LDC
	K9			19:47	19:57	0:10	3:50	Operational
	K8		4/8/2017	6:17	12:44	6:27	10:48	LDC
	K14			8:56	8:59	0:03	1:12	DTSC
	K15			9:25	10:02	0:37	14:38	Operational
	K9			11:53	12:08	0:15	6:00	Operational
	L3			12:44	18:50	6:04	1:26	LDC
	K8			12:50	12:52	0:02	0:43	DTEF
	TRAFO 1,2&3			14:30	15:56	1:26	10:19	Due to Fire
	K15			11:04	11:16	0:12	4:48	Operational
	K8			19:00	19:01	0:01	0:14	Operational
	L1		12/9/2017	8:25	13:23	5:58	23:02	LDC
	K1 & K2			10:09	11:05	0:56	0.93	DPSC & DPEF
	K8			12:25	12:28	0:03	1:12	DTEF
	L3			13:26	19:06	5:40	15:50	LDC
	K8			13:53	13:54	0:01	0:14	DTSC
	K8			13:56	19:30	5:24	9:36	DPEF
	K15			14:00	14:01	0:01	0:14	DTSC
	K1			15:25	18:40	3:15	6:00	Maintainance
	K1			15:25	18:20	2:55	21:50	Maintainance
	K2			15:25	18:20	2:55	21:50	Maintainance

	K6			15:25	18:20	2:55	21:50	Maintainance
	K7			15:25	18:20	2:55	21:50	Maintainance
	K9			15:25	18:20	2:55	21:50	Maintainance
	K13			15:25	18:20	2:55	21:50	Maintainance
	K14			15:25	18:20	2:55	21:50	Maintainance
	K15			18:00	18:26	0:26	10:19	Operational
	K9		4/10/2017	8:23	9:17	0:54	21:36	Operational
	K15			8:23	11:47	3:24	9:36	Operational
	K7			11:00	11:08	0:08	3:07	Maintainance
	K8			12:40	13:14	0:34	13:26	DPSC
	K9			12:40	13:24	0:44	17:31	DPSC
	K8			13:40	14:50	1:10	3:50	Operational
	K8			16:55	16:57	0:02	0:43	DTSC
	L3		4/11/2017	6:40	9:00	2:20	7:55	LDC
	K14			6:40	9:00	2:20	7:55	LDC
	K8			6:55	6:58	0:03	1:12	DTEF
	K9			7:50	7:55	0:05	1:55	DTSC & DTEF
	K8			7:50	7:55	0:05	1:55	DTSC
	K8			8:35	8:55	0:20	7:55	Operational
	K8			11:15	11:36	0:21	8:24	Operational
	K8			12:18	13:20	1:02	0:43	DPSC
	K9			12:18	12:24	0:06	2:24	DTSC & DTEF
	K9			14:02	15:01	0:59	23:31	DPSC & DPEF
	K8			14:02	14:36	0:34	13:26	DPSC
	K8			16:20	16:30	0:10	3:50	DTSC
	K9			16:20	16:45	0:25	9:50	DPSC & DPEF
	K8			20:25	20:35	0:10	3:50	Maintainance
	K9			22:35	22:55	0:20	7:55	Maintainance

	K9		4/12/2017	10:25	10:40	0:15	6:00	Maintainance
	K9			11:00	11:50	0:50	19:55	DPSC & DPEF
	K8			11:00	11:02	0:02	0:43	DTSC
	K8			11:04	11:35	0:31	12:14	DPEF
	L3			13:14	13:16	0:02	0:43	DTEF
	L3			13:26	13:36	0:10	3:50	Operational
	L3			15:55	16:06	0:11	4:19	Operational
	K9			20:20	20:41	0:21	8:24	Operational
	K8		4/13/2017	7:40	7:45	0:05	1:55	DTSC
	K8			7:50	9:10	1:20	7:55	DPSC
	K9			13:44	14:00	0:16	6:14	Operational
	K9			20:00	20:03	0:03	1:12	DTEF
	K8			20:00	21:05	1:05	1:55	DPEF
	K9			20:30	20:54	0:24	9:36	DPSC
	L3		4/14/2017	7:00	15:42	8:42	16:48	LDC
	K8			8:05	8:07	0:02	0:43	DTSC
	K8			16:00	19:30	3:30	12:00	LDC
	K15			19:30	22:35	3:05	1:55	LDC
	K1		4/15/2017	5:40	8:41	3:01	3.01	DPSC
	K9			9:15	9:32	0:17	6:43	Operational
	K8			10:41	11:15	0:34	13:26	Operational
	K14			11:20	11:22	0:02	0:43	DTSC
	K14			11:42	14:14	2:32	12:43	DPSC
	K8			12:27	12:36	0:09	3:36	DTSC
	K9			12:42	12:56	0:14	5:31	DPSC
	K9			13:25	15:00	1:35	13:55	DPSC & DPEF
	K8			13:25	14:40	1:15	6:00	DPSC & DPEF
	TRAFO 1		4/16/2017	5:40	8:41	3:01	0:14	DPSC
	K7			7:56	8:00	0:04	1:26	DTSC

	K9			9:33	9:52	0:19	7:26	Operational
	K8			11:16	11:26	0:10	3:50	DTEF
	K8			14:55	16:06	1:06	2:24	Operational
	K9			22:53	23:04	0:11	4:19	Operational
	K8		4/17/2017	7:14	7:19	0:05	1:55	DTSC
	K8			8:35	8:42	0:07	2:38	DTSC
	K8			13:15	14:12	0:57	22:48	DPSC
	K9			13:15	14:16	1:01	0:14	DPSC & DPEF
	K9			17:46	17:48	0:02	0:43	DTSC
	K9			20:26	20:30	0:04	1:26	DTEF
	K8			20:26	20:30	0:04	1:26	DTSC
	K8		4/18/2017	5:20	8:49	3:29	11:31	DPSC
	K14			8:38	12:00	3:22	8:38	LDC
	K8			12:00	17:05	5:05	1:55	LDC
	K14			15:00	15:02	0:02	0:43	Operational
	L3			15:10	15:13	0:03	1:12	DTSC
	K9			17:05	22:12	5:07	2:38	LDC
	K8			18:27	18:42	0:15	6:00	Operational
	K8		4/19/2017	2:55	3:00	0:05	1:55	DTSC
	K8			4:40	4:55	0:15	6:00	DPSC
	TOTAL OUTGOING			8:55	10:08	1:13	5:02	LDC
	INCOMING			9:10	10:08	0:58	23:02	Unpridictable
	K8			11:22	11:27	0:05	1:55	DPEF
	K8			12:50	12:57	0:07	2:38	DTSC
	K9			12:50	12:57	0:07	2:38	DTSC & DTEF
	K8			13:19	15:10	1:51	20:24	DPSC
	K9			13:19	13:35	0:16	6:14	DPSC & DPEF
	L3		4/20/2017	8:18	14:00	5:42	16:48	LDC
	K8			8:30	13:08	4:38	15:07	LDC

	K15			9:42	9:51	0:09	3:36	Maintainance
	K7			13:08	18:00	4:52	20:38	LDC
	L1			14:00	18:00	4:00	0:00	LDC
	K8			13:55	14:40	1:25	9:50	DPSC
	K9			13:15	13:25	0:10	3:50	DTSC & DTEF
	K9			15:20	15:50	0:30	12:00	DPSC & DPEF
	K8			15:20	15:35	0:15	6:00	DPSC
	K1			18:00	20:45	2:45	18:00	LDC
	K15			19:00	20:45	1:45	18:00	LDC
	L3		4/21/2017	3:30	10:40	7:10	3:50	DPSC
	K9			7:05	7:30	0:25	9:50	LDC
	K8			7:45	8:30	0:45	18:00	DPSC
	K8			9:30	10:15	0:45	18:00	DPSC
	L1			13:30	18:40	5:10	3:50	LDC
	L3			14:05	14:08	0:03	1:12	DTSC
	K1 & K2			18:40	22:00	3:20	7:55	LDC
	L3		4/22/2017	7:20	14:20	7:00	7	LDC
	K8			14:20	19:00	4:40	15:50	LDC
	L3			15:41	16:00	0:19	7:26	Operational
	K14			15:51	15:55	0:04	1:26	DTSC
	K1 & K2			19:00	23:00	4:00	0:00	LDC
	TOTAL SHUTDOWN			20:20	23:00	2:40	15:50	Unpridictable
	K9		4/23/2017	7:02	13:00	5:58	23:02	LDC
	K14			13:00	18:10	5:10	3:50	LDC
	K9			17:27	17:34	0:04	1:26	Operational
	K1			18:10	22:07	2:07	2:38	LDC
	L3		4/24/2017	6:40	8:15	1:08	3:07	LDC
	K8			7:40	7:52	0:12	4:48	DPSC
	L1			8:15	9:23	1:08	3:07	LDC

	K8			8:29	8:42	0:13	5:02	Operational
	L3			9:23	12:46	3:23	9:07	LDC
	K8			11:36	11:42	0:06	2:24	DTSC
	K8			16:29	18:04	1:35	13:59	LDC
	K1			18:04	22:36	4:32	12:43	LDC
	K8		4/25/2017	6:48	6:53	0:05	1:55	DTSC
	K7			7:00	7:04	0:04	1:26	DTSC
	K8			7:22	8:10	0:42	16:48	LDC
	K9			8:05	8:09	0:04	1:26	DTEF
	K9			8:10	13:00	4:50	19:55	LDC
	K8			12:23	12:55	0:12	4:48	Operational
	L1			13:00	20:30	9:30	12:00	LDC
	K9		4/26/2017	16:20	16:24	0:04	1:26	DTSC
	L3		4/27/2017	2:26	2:30	0:04	1:26	DTEF
	L3			6:23	9:10	2:47	18:43	LDC
	K8			6:40	6:46	0:06	2:24	DTSC
	K8			7:56	7:59	0:03	1:12	DTSC
	K8			9:10	16:40	7:30	12:00	DPSC
	K14			16:40	18:00	1:20	7:55	Maintainance
	K2			18:00	21:00	3:00	0:00	LDC
	K9		4/28/2017	6:30	6:55	0:25	9:50	LDC
	K8			6:40	12:44	6:04	1:26	DPSC
	K14			6:50	14:54	7:04	1:26	DPSC
	K15			6:50	7:15	0:25	9:50	DPSC
	K9			10:45	11:07	0:12	4:48	DPSC
	K9			11:37	12:11	0:34	13:26	Maintainance
	K9			12:23	12:29	0:06	2:24	DTEF
	K9			12:29	15:31	4:02	0:43	DPEF
	K8			14:04	17:40	3:36	14:24	DPSC

	K14			15:10	17:35	2:25	9:50	DLOL
	K9			16:55	17:15	0:20	7:55	Maintainance
	K1			18:00	20:20	2:20	7:55	LDC
	K2			18:00	20:20	2:20	7:55	LDC
	L3		4/29/2017	6:30	13:17	6:47	18:43	LDC
	K8			5:45	9:13	3:28	11:02	DLOL
	K9			7:44	7:48	0:04	1:26	DTEF
	K14			11:06	11:26	0:20	7:55	Operational
	K13			13:17	17:42	4:30	12:00	DPSC
	L3			17:52	18:15	0:18	7:12	DPEF
	K14			19:04	19:25	0:21	8:24	DPSC
	K1			19:55	20:30	0:35	13:55	LDC
	K15			21:35	21:42	0:07	2:38	Operational
	K9		4/30/2017	6:29	13:25	6:56	6.93	LDC
	K8			6:42	6:56	0:14	5:31	DPSC
	K15			8:58	9:18	0:20	7:55	DPSC
	K:14			9:27	10:40	1:13	5:02	DPSC
	L3			11:06	11:51	0:45	18:00	DPSC
	K8			11:39	11:52	0:13	5:02	Operational
	K8			13:25	18:20	4:55	21:50	LDC
	K14			14:16	14:33	0:17	6:43	DPSC
	K9			16:09	16:55	0:46	18:14	Operational
	K1			16:40	17:50	1:10	3:50	DPSC
	K2			16:40	17:50	1:10	3:50	DPSC
	K9			19:50	20:29	0:39	15:36	Operational
	K8		5/1/2017	7:01	7:10	0:09	3:36	DPSC
	L3			10:30	15:34	5:04	1:26	LDC
	K9			11:24	11:29	0:05	1:55	DTEF
	K8			12:25	12:39	0:14	5:31	Operational

	K8			16:44	16:49	0:05	1:55	DTEF
	K1 & K2			15:34	18:00	2:26	10:19	LDC
	K9		5/2/2017	8:35	13:32	4:55	21:50	LDC
	K8			13:32	17:21	3:49	19:26	LDC
	L3		5/3/2017	8:12	12:38	4:26	10:19	LDC
	K8			9:05	9:48	0:43	17:02	DPSC
	K14			12:38	12:55	0:17	6:43	LDC
	K9			13:2	13:32	0:03	1:26	DTEF

	K8			15:57	16:07	0:10	3:50	DTSC
	K7		5/4/2017	6:28	13:00	7:32	12:43	LDC
	K9			13:00	19:30	6:30	12:00	LDC
	L3			16:56	16:58	0:02	0:43	DTEF
	L3			16:56	17:46	0:47	18:43	DTEF
	K8			17:10	17:46	0:36	14:24	DPSC
	K8			18:05	19:49	1:44	17:31	DPSC
	K14			18:45	19:08	0:23	9:07	DPSC
	K9			19:24	19:26	0:02	0:43	DTEF
	K15			19:25	19:28	0:03	1:26	Operational
	K15			19:30	19:49	0:19	7:26	DPSC
	K15			19:50	11:30	15:10	3:50	DPSC
	K8			19:51	8:10	12:19	7:26	DPSC
	K14			20:42	12:02	15:20	7:55	DPSC
	K9			20:44	21:07	0:23	9:07	Operational
	K9		5/5/2017	7:55	8:00	0:05	1:55	DTEF
	K8			9:35	9:40	0:05	1:55	DTEF
	K13			9:42	12:00	2:18	7:12	DPEF
	K14			9:42	12:02	2:20	7:55	DPSC
	K15			9:52	12:00	2:08	3:07	LDC

	K8			10:30	10:35	0:05	1:55	Operational
	K7			10:30	10:40	0:10	3:50	Operational
	L3			10:35	10:40	0:05	1:55	Operational
	K13			12:12	12:17	0:05	1:55	DTEF
	K13			12:17	12:47	0:30	12:00	DPEF
	K14			12:00	17:00	5:00	0:00	LDC
	K8			16:45	20:40	3:55	21:50	DPEF
	TRAFO 3			16:50	17:00	0:10	3:50	DTSC
	K9			17:10	17:20	0:10	3:50	DTSC
	K8		5/6/2017	1:50	9:25	7:35	13:55	DTSC
	K8			10:25	10:53	0:28	11:02	Maintainance
	K9			10:30	15:35	5:05	5.08	LDC
	L3			10:30	15:45	5:05	1:55	LDC
	K8			15:35	18:20	2:45	18:00	LDC
	K14			15:40	18:30	2:50	19:55	DPSC
	L3			18:55	19:30	0:35	13:55	DPSC
	K15			19:10	6:40	11:30	12:00	DTSC
	K1			23:45	23:50	0:05	1:55	DTEF
	K7		5/7/2017	6:40	9:40	3:00	0:00	LDC
	K15			6:40	9:40	3:00	0:00	LDC
	K8			9:42	9:40	0:28	11:02	Operational
	K8			9:42	9:55	0:13	5:02	LDC
	K7			9:40	11:20	1:40	7:55	DPEF
	K14			10:04	10:06	0:02	0:43	DTEF
	K14			10:10	14:37	4:27	10:48	DPEF
	K15			12:33	13:12	0:39	15:36	Operational
	K9			14:31	18:00	3:29	11:31	DPSC & DPEF
	K8			14:31	17:56	3:25	9:50	DPEF
	K15			14:31	16:26	1:55	18:00	DPSC

	K8			14:31	22:20	7:39	15:36	LDC
	K14			18:10	18:20	0:10	3:50	Operational
	L3			18:50	22:20	2:30	12:00	LDC
	TOTAL		5/8/2017	1:55	6:20	4:25	9:50	TOTAL SHUTDOWN FROM KOKA
	K9			6:55	8:52	1:57	22:48	DPSC
	K7			6:20	9:38	3:18	7:12	DPEF
	L3			10:30	14:30	4:00	0:00	LDC
	K9			11:03	12:09	1:06	2:24	Operational
	K8			14:30	18:07	3:37	14:38	LDC
	L3			14:44	14:46	0:02	0:43	DTEF
	K9			14:46	14:50	0:04	1:26	DTEF
	K9			16:04	16:30	0:26	10:19	Operational
	K15			16:53	16:23	23:30	12:00	DPSC
	L3			16:53	17:31	0:38	15:07	DPSC & DPEF
	K9		5/9/2017	7:46	12:30	4:44	17:31	LDC
	L3			12:30	18:37	6:07	2:38	LDC
	K14			13:42	13:52	0:10	3:50	Maintainance
	K8			17:45	18:08	0:23	9:07	Operational
	K15			17:45	17:46	0:01	0:14	DTSC
	K9			20:14	20:17	0:03	1:26	Operational
	K13		5/10/2017	2:59	3:53	0:44	17:31	Operational
	K15			8:20	17:30	9:10	3:50	DPSC
	K8			8:25	9:32	1:07	2:38	DPEF
	K14			8:36	16:45	8:09	3:36	DPSC
	K9			8:41	9:32	0:51	20:24	DPEF
	L3			13:40	18:49	5:09	3:36	DPSC & DPEF
	K8			13:55	14:09	0:14	5:31	Operational
	K7			14:09	14:11	0:03	1:26	Operational

	K15			16:06	19:18	2:12	4:48	DPSC
	K14			16:56	16:59	0:03	1:26	DTSC
	K14			17:12	17:30	0:18	7:12	DPSC
	K8			18:46	20:37	1:19	7:26	DPEF
	K8		5/11/2017	8:18	8:30	0:11	4:19	Operational
	K9			8:31	9:27	0:56	22:19	Operational
	L3			10:38	15:00	4:22	8:38	LDC
	K15			14:58	18:10	3:08	3:07	Operational
	K9			14:59	19:30	4:31	12:14	LDC
	L3			15:46	15:48	0:02	0.03	DTSC & DTEF
	K15			18:20	18:24	0:04	1:26	DTSC
	K8		5/12/2017	6:40	12:00	5:20	7:55	LDC
	K9			8:42	19:00	12:18	7:12	Operational
	K14			9:47	10:14	0:27	10:48	Operational
	TRAFO 3			10:42	10:52	0:10	3:50	DLOL
	K14			10:42	10:56	0:14	5:31	DLOL
	K9			11:04	11:18	0:14	5:31	Operational
	K8			14:06	14:30	0:24	9:36	Operational
	K15			16:48	16:54	0:06	2:24	Operational
	L3			17:47	18:15	0:28	11:02	Operational
	K9			17:47	18:06	0:19	7:26	Operational
	K8			19:29	20:51	1:22	8:38	LDC
	L3		5/13/2017	6:18	6:40	0:12	4:48	DPSC
	K9			9:23	10:16	0:53	21:07	Maintainance
	K14			9:37	9:47	0:10	3:50	Maintainance
	L3			10:44	10:55	0:11	4:19	Maintainance
	K14			15:15	16:50	1:35	13:55	DPSC
	K9			16:35	17:30	0:55	21:50	Maintainance
	K14			18:24	19:30	1:06	2:24	LDC

	L1			18:24	21:00	3:26	10:19	LDC
	TRAFO 3			20:00	20:05	0:05	1:55	DLOL
	K14			20:00	21:30	1:30	12:00	DLOL
	K14		5/14/2017	5:00	9:50	4:50	19:55	DPEF
	K8			10:00	11:10	1:10	3:50	Maintainance
	K9			12:00	12:30	0:30	12:00	Maintainance
	K9			14:30	14:35	0:05	1:55	DTSC
	K15			17:00	17:20	0:20	7:55	Maintainance
	K14		5/15/2017	1:30	2:30	1:00	0:00	Maintainance
	K9			8:39	9:39	1:00	0:00	Operational
	K14			10:18	10:25	0:07	2:38	Maintainance
	K9			11:16	11:42	0:26	10:19	Operational
	K14			11:25	11:36	0:11	4:19	Operational
	K8			13:44	14:00	0:16	6:14	DPSC
	K14			16:40	16:48	0:08	3:07	DTSC
	L3			18:04	18:18	0:14	5:31	Operational
	K14		5/16/2017	1:00	2:04	1:04	1:26	Maintainance
	K15			5:42	5:53	0:11	4:19	DPEF
	K9			7:44	7:48	0:04	1:55	DTEF
	K14			8:30	11:10	2:40	15:50	DPSC
	K8			9:35	9:57	0:22	8:38	Operational
	K9			11:57	12:00	0:03	1:26	DTEF
	K9			13:36	13:48	0:12	7:12	Operational
	K15			15:07	16:07	1:00	0:00	Operational
	K14			15:25	18:53	3:28	11:02	DPSC
	L3			15:25	18:58	3:33	13:12	DPSC
	K8		5/17/2017	15:20	15:34	0:14	5:31	Operational
	K9			16:45	16:49	0:04	1:26	DTEF
	K8			21:52	22:00	0:08	3:07	Operational

	TRAFO 2		5/18/2017	13:44	13:47	0:03	1:26	DLOL
	K9			13:44	14:54	1:10	3:50	DPSC & DPEF
	K14		5/19/2017	15:12	15:14	0:02	0:43	DTSC
	K14			17:14	17:50	0:36	14:24	Maintainance
	K8			20:45	21:00	0:15	6:00	Operational
	K9		5/20/2017	6:12	6:14	0:02	0:43	DTEF
	K8			9:20	10:46	1:26	1.43	Maintainance
	TOTAL			13:10	13:30	0:20	7:55	FROM SYSTEM
	K15			20:50	20:55	0:05	1:55	Maintainance
	K15			21:20	21:23	0:03	1:26	Due to Fire
	K9		5/21/2017	12:08	13:15	1:07	2:38	Maintainance
	K9			14:06	14:10	0:04	1:26	Operational
	K9			17:05	17:09	0:04	1:26	Operational
	K13			18:40	20:03	1:23	9:07	LDC
	K14			18:40	20:03	1:23	9:07	LDC
	K8			20:10	20:25	0:15	6:00	Operational
	K15		5/22/2017	9:25	9:28	0:03	1:26	DTSC
	L3			15:01	15:03	0:02	0:43	DLOL
	L3			18:37	19:08	0:31	12:14	Operational
	K8		5/25/2017	15:35	15:38	0:03	1:26	DTEF
	L3			18:08	18:10	0:02	0:43	DTSC
	K14			18:35	18:40	0:05	1:55	DTEF
	K14			18:40	21:30	3:50	19:55	DPSC
	K9			18:45	20:33	1:58	23:02	DPSC
	K1 & K2		5/26/2017	0:10	9:13	9:03	1:12	DPSC & DPEF
	K2			0:10	9:13	9:03	1:12	DPSC
	K7			10:09	11:45	1:36	14:24	DPEF
	K15			12:17	12:35	0:18	7:12	Operational
	K8			12:49	12:57	0:08	3:07	Operational

	K8			16:13	16:34	0:21	8:24	DPEF
	K9			16:14	16:35	0:21	8:24	DPEF
	K14			18:23	18:41	0:18	7:12	Operational
	K9		5/27/2017	8:27	8:32	0:05	1:55	DTEF
	K8			9:24	11:14	2:10	3:50	Operational
	K14			16:16	16:48	0:32	12:43	Operational
	K14			16:42	22:05	5:23	9:07	DPSC
	K13		5/28/2017	2:31	2:37	0:06	2:24	DTEF
	K9			8:45	8:48	0:03	1:26	Operational
	K9			9:10	9:38	0:28	11:02	Operational
	K14			10:38	10:47	0:09	3:36	Operational
	K14			14:25	14:56	0:31	12:14	Operational
	K15			8:30	8:33	0:03	1:26	DTSC
	L3			11:23	11:26	0:03	1:26	DTSC & DTEF
	L1			11:43	12:13	0:30	12:00	Operational
	K9			16:01	16:15	0:14	5:31	Operational
	K9			17:50	17:53	0:03	1:26	DTEF
	K10			5:44	5:51	0:07	2:38	DTSC
	TRAFO 2			5:44	5:50	0:06	2:24	DTSC
	K8			5:44	16:16	10:32	12:43	DPSC
	K9		5/30/2017	9:00	9:02	0:02	0:43	DTEF
	K14			9:08	9:11	0:03	1:26	DTSC
	K14			16:04	16:07	0:03	1:26	DTSC
	K14			16:07	16:16	0:09	3:36	DLOL
	K14			16:16	19:45	3:29	11:31	DLOL
	K13			16:46	16:50	0:04	1:55	DTEF
	K8			18:47	19:09	0:22	8:38	Operational
	K14			19:45	20:15	0:30	12:00	DPSC
	K8			20:41	20:59	0:18	7:12	Operational

	L3		5/31/2017	9:30	9:51	0:21	8:24	Operational
	K14			12:34	12:55	0:21	0.35	Operational
	K8			16:02	16:12	0:10	3:50	Operational
	K8			16:50	17:25	0:35	13:55	Operational
	L3			18:36	18:46	0:10	3:50	Operational
	K9			23:16	23:20	0:04	1:26	DTSC
	k8		6/2/2017	2:35	9:26	7:51	20:24	DPEF
	k9			2:35	9:11	7:36	14:24	DPEF
	l3			10:30	11:00	0:30	12:00	Operational
	k8			11:52	11:54	0:02	0:43	DTEF
	K9		6/3/2017	10:40	10:42	0:02	0:43	DTEF
	K14			10:41	10:45	0:04	1:26	DTSC
	K9			11:10	11:36	0:26	10:19	Operational
	K15			11:36	11:54	0:18	7:12	Operational
	K5			13:00	14:00	1:00	0:00	Operational
	TRAFO 2			12:56	13:08	0:12	4:48	DPSC
	K8			12:56	15:14	2:18	7:12	DPSC
	K5			14:37	15:14	0:37	14:38	Maintainance
	K10			14:37	15:14	0:37	14:38	Maintainance
	K9			15:38	16:02	0:24	9:36	Operational
	K9			21:26	21:45	0:19	7:26	Operational
	K8		6/6/2017	0:22	11:10	11:48	19:12	DPSC
	K9			10:20	11:10	0:50	19:55	DPSC
	L3			12:20	12:46	0:26	10:19	Operational
	K9			16:48	17:00	0:12	4:48	Operational
	K15			19:05	19:10	0:05	1:55	DTSC
	TRAFO 2		6/5/2017	6:11	6:15	0:04	1:26	DTSC
	K8			6:15	10:10	3:55	21:50	DPSC
	K13			6:15	6:26	0:11	4:19	DPEF

	K7			10:31	14:00	3:29	11:31	DPSC & DPEF
	K2			10:31	14:00	3:29	11:31	DPSC & DPEF
	K8			11:33	11:49	0:16	6:14	Operational
	K9			12:20	12:35	0:15	6:00	Operational
	K9			12:40	13:16	0:36	14:24	Operational
	K8			13:00	15:46	2:46	10:19	Operational
	L3			14:07	14:14	0:07	2:38	Operational
	K15			16:22	16:26	0:04	1:26	DTSC
	TRAFO 2			16:46	16:48	0:02	0:43	DTSC
	K9			16:46	19:31	2:45	18:00	DPSC & DPEF
	K8			17:08	17:45	0:37	14:38	Operational
	K15			18:22	18:54	0:32	12:43	Operational
	K8		6/6/2017	11:35	11:54	0:19	7:26	Operational
	K6			13:35	16:05	2:40	15:50	DPSC
	K8			15:00	15:02	0:02	0:43	DLOL
	K8			15:22	15:24	0:02	0:43	DLOL
	K9			16:30	16:32	0:02	0:43	DTSC
	K14			17:12	12:20	19:08	3:07	DPSC
	K9			17:20	10:42	16:22	8:38	DPSC
	TRAFO 2			17:20	17:22	0:02	0:43	DTSC
	L3		6/7/2017	9:30	10:20	0:50	19:55	Operational
	TOTAL		6/8/2017	10:40	11:20	0:40	15:50	FROM SYSTEM
	L3			11:52	12:50	0:58	23:02	LDC
	K14			12:00	12:50	0:50	19:55	LDC
	K9			17:50	18:10	0:20	7:55	Maintainance
	L1,K8 & K9			19:00	20:27	1:27	10:48	LDC
	K9			10:24	10:38	0:14	5:31	Operational
	L3			11:35	12:45	1:10	1.16	LDC
	K14			15:11	15:30	0:19	7:26	DPSC

	k9		6/9/2017	15:44	15:55	0:11	4:19	DPSC
	K8			15:58	18:23	2:55	21:50	DPSC
	L3			15:54	20:39	4:45	18:00	DPSC
	TOTAL			16:04	16:26	0:22	8:38	LDC
	K8			19:32	20:34	1:02	0:43	Operational
	K9			21:20	21:38	0:18	7:12	DPEF
	K13		6/10/2017	2:10	0:14	21:56	22:19	DPEF
	K9			2:17	2:30	0:13	5:02	DPEF
	K9			3:35	3:38	0:03	1:12	Operational
	L3			9:41	10:13	0:32	12:43	Operational
	K9			11:01	11:47	0:46	18:14	Operational
	K9			14:37	14:47	0:10	3:50	Operational
	K8			14:46	14:48	0:02	8:24	DTEF
	K9			14:50	15:33	0:43	17:02	DPSC
	K8			14:58	15:27	0:29	11:31	DPEF
	K9			15:49	18:20	2:31	12:00	DPSC
	L3			19:30	2:30	8:00	0:00	LDC
	K9			22:13	22:44	0:31	12:14	Operational
	K9		6/11/2017	8:49	9:30	0:41	16:19	Operational
	K9			15:30	15:48	0:18	7:12	DPSC
	K15			16:18	19:15	2:57	22:48	DPSC & DPEF
	K14			19:05	19:15	0:10	3:50	Operational
	L3			19:41	20:39	0:58	23:02	LDC
	K15			22:00	22:15	0:15	6:00	Operational
	L1		6/12/2017	5:06	5:13	0:07	2:38	DTSC
	K6			8:32	13:25	4:53	21:07	DPSC
	K8			9:40	9:45	0:05	1:55	Operational
	K9			9:43	12:10	2:27	10:48	DPEF
	L1			12:44	13:01	0:15	6:00	Operational

	K9			13:19	13:46	0:27	10:48	Operational
	K8		6/13/2017	7:16	7:27	0:11	4:19	DPEF
	K9			7:16	7:27	0:11	4:19	DPEF
	K8			7:44	9:37	1:53	21:07	DPEF
	K9			7:44	9:17	1:33	13:12	DPEF
	K9			15:26	16:30	1:14	5:31	Operational
	K9			20:03	20:06	0:03	1:12	DTEF
	K9			20:51	20:53	0:02	0:43	DTEF
	K8		6/14/2017	7:40	7:49	0:09	3:36	DTSC
	K8			9:59	10:03	0:04	1:26	Operational
	L3			12:30	12:33	0:03	1:12	DTSC
	K9			14:27	14:29	0:02	0:43	DTEF
	K9			16:34	16:44	0:10	3:50	Operational
	K8			17:15	17:31	0:16	6:14	Operational
	K9		6/15/2017	6:53	6:55	0:02	0:43	DTEF
	K9			16:56	17:06	0:10	3:50	Operational
	K9			18:04	18:46	0:42	16:48	Operational
	L3			19:04	21:17	1:47	18:43	Operational
	K9			19:14	19:16	0:02	0:43	DTEF
	K9			19:38	19:40	0:02	0:43	DTEF
	K9			21:27	21:33	0:06	2:24	Operational
	K9		6/16/2017	6:52	6:55	0:03	1:12	DTEF
	K9			7:02	7:06	0:04	1:26	DTEF
	K9			7:20	11:21	4:01	4.01	DPEF
	L3			13:35	13:38	0:03	1:12	DTSC
	K8			19:06	20:44	1:38	15:07	LDC
	K9		6/17/2017	6:52	6:54	0:02	0:43	DTEF
	K8			8:55	3:15	0:20	7:55	Operational
	L3			14:35	16:15	1:40	15:50	LDC

	K8			16:21	16:47	0:26	10:19	DPEF
	K9			16:21	16:47	0:26	10:19	DPEF
	K14			16:31	17:10	0:39	15:36	DPSC
	K8			16:50	17:11	0:21		DPEF
	K9			16:56	17:11	0:15		DPEF
	K8			17:17	17:43	0:26		DPEF
	K9			17:17	18:19	1:02		DPEF
	K9			18:46	21:28	2:42		LDC
	K14		6/18/2017	9:10	9:12	0:02		DTSC
	K9			10:08	10:10	0:02		Operational
	K8			11:20	13:30	2:10		LDC
	L3			11:35	12:10	0:45		Operational
	L3			13:02	13:04	0:02		DTSC & DTEF
	K8			14:10	14:40	0:30		Operational
	L3			16:50	16:51	0:01		DTSC
	K14			16:50	22:00	5:10		DPSC
	L3			19:26	20:22	0:56		LDC
	K14		6/19/2017	9:55	9:57	0:02		DTSC
	K14			9:57	12:44	2:47		DPEF
	K8			15:05	15:45	0:40		Operational
	K9			15:47	16:09	0:22		Operational
	L3		6/20/2017	9:20	9:33	0:13		Operational
	K13			11:05	11:07	0:02		DTEF
	K9			12:26	12:28	0:02		DTEF
	K15			13:23	13:26	0:03		DTEF
	K14			16:10	16:18	0:08		Operational
	L3			17:07	17:25	0:18		Operational
	K9			19:16	19:25	0:09		Operational
	K8		6/21/2017	8:05	8:07	0:02		DTEF

	K8			8:57	9:35	0:38		DPSC
	L3			11:10	11:52	0:42		Operational
	K9			11:54	12:00	0:06		DTSC
	K9		6/22/2017	11:24	11:43	0:21		Operational
	L3			13:33	13:36	0:03		DTEF
	L3			15:50	20:44	4:54		DTEF
	K8			16:16	16:51	0:35		Operational
	K9			16:20	16:24	0:04		DTSC
	K9			17:57	18:02	0:05		DTEF
	K9			18:26	20:09	1:43		DPEF
	K15			19:47	20:03	0:16		Operational
	K13			21:52	21:55	0:03		DTSC
	L3		6/23/2017	8:21	8:40	0:19		Operational
	L3			9:54	10:03	0:09		Operational
	K8			11:57	17:01	4:58		DPSC & DPEF
	L3			16:46	17:51	1:05		DPSC & DPEF
	K8			17:45	19:08	1:23		DPEF
	K9			17:45	18:44	0:59		DPSC & DPEF
	K9			19:56	20:00	0:04		DTSC & DTEF
	K8			19:56	20:00	0:04		DTSC & DTEF
	K9		6/24/2017	10:00	12:30	2:30		DPSC & DPEF
	K8			11:10	11:30	0:20		DPEF
	L3			14:05	14:40	0:35		Operational
	K8			14:15	16:20	2:05		Operational
	K9			14:30	17:20	2:50		DPSC
	K15			17:40	18:20	0:40		Operational
	K9			18:24	19:13	0:49		DPSC
	K8			18:33	20:51	2:18		LDC
	K9		6/26/2017	15:41	16:09	0:28		DPEF

	L3			15:48	16:20	0:32		Operational
	K8			19:06	19:17	0:11		Operational
	L3		6/27/2017	8:01	11:01	3:00		LDC
	K9			11:00	14:35	3:35		LDC
	K8			11:10	11:37	0:27		Operational
	K8			14:35	18:08	2:33		LDC
	K9			17:03	17:16	0:13		Operational
	K9			18:10	18:27	0:17		Operational
	K15			19:28	19:39	0:11		DPSC & DPEF
	K9			19:32	20:51	1:56		Operational
	L3			23:43	10:39	10:56		DPEF
	K9		6/28/2017	4:27	8:51	4:23		DPEF
	K15			4:32	5:11	0:39	14:24	DPSC
	K15			8:42	10:45	2:03	1:12	DPSC
	K9			9:45	10:23	0:38	15:07	Operational
	K8			11:44	11:57	0:13	5:02	DPSC
	L3			12:00	12:31	0:31	12:14	DTSC
	K8			14:55	14:58	0:03	1:12	Operational
	K9			16:40	16:55	0:15	6:00	Operational
	K8			16:41	16:55	0:14	5:31	DPSC
	K9			18:25	18:35	0:10	3:50	DTEF
	TRAFO 2			19:10	19:20	0:10	3:50	DTEF
	K13			19:20	20:02	0:42	16:48	DPEF
	L3		6/29/2017	7:40	10:25	2:45	18:00	LDC
	L3			11:40	11:50	0:10	3:50	Operational
	K15			12:12	12:14	0:02	0:43	DTSC
	K15			15:00	15:40	0:40	15:50	Operational
	K9			15:30	15:57	0:27	10:48	Maintainance
	K8			15:55	16:10	0:15	6:00	Operational

	K9			16:19	16:27	0:08	3:07	Operational
	L3			16:37	18:06	1:29	10:19	LDC
	K9		6/30/2017	8:10	8:11	0:01	0:14	DTEF
	K15			9:02	10:51	1:49	19:26	Operational
	K8			10:43	11:05	0:22	8:38	Operational
	K9			11:13	13:53	2:40	15:50	LDC
	K8			11:13	13:53	2:40	15:50	LDC
	K8			18:14	18:33	0:19	7:26	Operational
	L3			18:58	20:48	1:50	19:55	LDC
	K15			20:48	20:54	0:06	2:24	Operational
D/Zeit No 2	K8		8/3/2017	8:53	13:06	4:13	5:02	LDC
	K9			13:06	17:24	4:18	7:12	LDC
	K8			16:15	16:22	0:07	2:38	OPERATIONAL
	L3			17:24	21:15	3:51	20:24	LDC
	K8			18:58	19:03	0:05	1:55	LDC
	K8			19:54	20:15	0:21	8:24	OPERATIONAL
	K9			20:30	20:45	0:15	6:00	OPERATIONAL
	K14		8/4/2017	6:29	6:48	0:19	0.31	DPSC
	K8			8:11	12:45	4:34	13:40	OPERATIONAL
	K9			9:17	9:53	0:16	6:28	OPERATIONAL
	K9K			12:17	12:45	0:28	11:16	OPERATIONAL
	K8			13:00	17:35	4:35	13:55	OPERATIONAL
	TRAFO 2			13:40	13:47	0:07	2:38	DPSC
	L3			15:05	16:58	1:53	21:07	DLOL
	K8			17:15	17:35	0:20	7:55	OPERATIONAL
	L3		8/5/2017	7:45	7:49	0:04	1:26	DTEF
	K8			10:18	13:50	3:40	16:04	OPERATIONAL
	L2			10:18	13:50	3:40	16:04	OPERATIONAL
	K9			11:39	11:48	0:09	3:36	OPERATIONAL

	K9			15:20	15:24	0:04	1:26	DTEF
	K8			16:05	16:30	0:25	9:50	OPERATIONAL
	K9			16:36	17:38	1:02	0:43	OPERATIONAL
	L3			16:57	17:11	0:14	5:31	DTSC
	L3			17:52	18:07	0:15	6:00	OPERATIONAL
	K14			18:44	21:24	2:40	16:04	OPERATIONAL
	K8			20:15	20:19	0:04	1:26	OPERATIONAL
	K15			22:18	22:24	0:06	2:24	DTSC
	K15		8/6/2017	7:15	7:27	0:12	4:48	OPERATIONAL
	K9			8:18	12:00	3:42	16:48	OPERATIONAL
	K7			8:18	12:00	3:42	16:48	OPERATIONAL
	K8			10:32	10:52	0:20	7:55	OPERATIONAL
	L3			12:00	18:00	6:00	0:00	OPERATIONAL
	K14			14:12	14:24	0:12	4:48	OPERATIONAL
	K8			14:48	15:12	0:24	9:36	OPERATIONAL
	K14			17:41	17:44	0:03	1:12	DTSC
	K8			18:00	21:26	3:26	10:19	OPERATIONAL
	K15			18:55	8:47	12:52	20:38	DPSC
	L3			23:11	23:25	0:14	5:31	DTEF
	K9		8/7/2017	3:03	3:09	0:06	2:24	DTEF
	K14			3:28	3:35	0:07	2:38	DLOL
	K14			3:40	3:50	0:10	3:50	DTSC
	L3			8:55	13:00	4:05	1:55	OPERATIONAL
	K9			9:47	9:50	0:03	1:12	DTEF
	K9			9:55	10:43	0:48	19:12	DTEF
	K14			10:30	11:34	1:04	1:26	OPERATIONAL
	K14			12:10	12:43	0:33	13:12	DPEF
	K9			19:26	19:44	0:18	7:12	OPERATIONAL
	K8		8/8/2017	10:35	10:54	0:05	1:55	OPERATIONAL

	K8			11:27	12:11	0:10	3:50	OPERATIONAL
	L3			13:10	13:20	0:03	1:12	DTEF
	K9			13:10	14:21	0:03	1:12	OPERATIONAL
	L3			14:05	16:14	0:18	7:12	DTEF
	K8			16:11	16:14	0:03	1:12	DTEF
	L3			16:57	17:15	0:18	0:43	OPERATIONAL
	K9			19:15	19:33	0:18	0:43	LDC
	K8			19:33	20:20	0:47	18:43	LDC
	K15			20:00	20:10	0:10	3:50	OPERATIONAL
	K9			20:50	21:00	0:10	3:50	OPERATIONAL
	K8		8/9/2017	1:35	8:55	7:20	7:55	DPEF
	K9			8:45	8:55	0:10	0.16	DPSC
	K7			8:46	9:55	1:09	3:36	OPERATIONAL
	K15			9:52	11:30	0:38	15:07	OPERATIONAL
	K15			11:30	11:41	0:11	4:19	OPERATIONAL
	K9		8/10/2017	10:04	10:32	0:28	11:02	OPERATIONAL
	L3			10:55	12:45	1:50	19:55	OPERATIONAL
	K8			15:00	15:54	0:54	21:36	DPSC
	K15			15:10	15:20	0:10	3:50	OPERATIONAL
	K9			15:56	20:20	4:24	9:36	DPSC
	K15			17:32	17:51	0:19	7:26	OPERATIONAL
	K9		8/11/2017	10:52	12:07	1:15	6:00	OPERATIONAL
	K15			11:00	12:28	1:28	7:12	OPERATIONAL
	K9			14:04	14:06	0:02	0:43	DTSC
	L3			14:19	14:20	0:01	0:14	OPERATIONAL
	K9			15:30	16:13	0:43	17:02	OPERATIONAL
	K14			18:58	20:35	1:33	13:12	OPERATIONAL
	L1			18:58	20:35	1:33	13:12	OPERATIONAL
	K9			21:15	21:20	0:05	1:55	OPERATIONAL

	K8		8/12/2017	9:00	9:05	0:05	1:55	OPERATIONAL
	L3			10:57	11:05	0:08	3:07	OPERATIONAL
	K9			14:45	15:00	0:15	6:00	OPERATIONAL
	L3			18:35	20:48	2:13	5:02	OPERATIONAL
	K8			18:57	15:12	0:15	6:00	OPERATIONAL
	K15			19:47	20:00	0:13	5:02	OPERATIONAL
	K14		8/13/2017	2:13	10:39	8:26	10:19	DPSC
	L3			2:14	2:16	0:02	0:43	DTSC
	K8			13:49	14:04	0:15	6:00	OPERATIONAL
	K15			19:07	20:00	0:53	21:07	OPERATIONAL
	L3			23:21	23:30	0:09	3:36	DTEF
	L3		8/14/2017	7:48	8:06	0:18	7:12	DTSC
	K13			8:20	8:25	0:05	1:55	DLOL
	TOTAL			10:04	11:05	1:01	0:14	UNPRIDICTABLE
	K8			10:10	11:48	1:38	15:07	OPERATIONAL
	L3			14:46	15:15	0:29	11:31	DPSC & DPEF
	L3			15:55	17:27	1:32	12:43	DLOL
	K15			16:16	16:41	0:05	1:55	OPERATIONAL
	K14			17:26	17:31	0:23	9:07	OPERATIONAL
	K8			18:38	19:01	0:09	3:36	OPERATIONAL
	K8			19:08	19:17	0:30	12:00	OPERATIONAL
	K9			19:22	19:52	2:16	6:28	OPERATIONAL
	L3			19:52	21:08	1:08	3:07	OPERATIONAL
	K8		8/15/2017	14:17	15:25	1:08	3:07	OPERATIONAL
	K14			14:58	15:01	0:03	1:12	DTSC
	K14			16:00	17:37	1:37	14:38	DTSC
	L1			19:05	20:49	1:44	17:31	OPERATIONAL
	K15			21:34	21:46	0:12	4:48	OPERATIONAL
	K15		8/16/2017	9:16	10:58	1:47	18:43	OPERATIONAL

	K15			9:16	12:16	0:40	15:50	OPERATIONAL
	K15			15:49	16:00	0:40	15:50	OPERATIONAL
	K8			19:50	20:27	0:40	15:50	OPERATIONAL
	K14			19:51	21:38	0:33	13:12	DPSC
	K8			22:28	23:10	0:35	13:55	DTEF
	L3			22:30	23:10	0:40	15:50	DTEF
	K9			22:30	23:10	0:40	15:50	DTEF
	K14			22:37	23:10	0:33	13:12	DTSC
	K14		8/17/2017	10:26	11:30	0:04	1:26	OPERATIONAL
	L3			10:50	11:36	0:46	18:14	OPERATIONAL
	K8			11:35	11:52	0:17	6:43	LDC
	K9			14:05	14:18	0:13	5:02	OPERATIONAL
	K9			15:05	15:15	0:10	3:50	OPERATIONAL
	L3			15:30	19:20	3:50	19:55	DPSC
	K8			15:31	17:40	2:09	3:36	DPEF
	K14			15:36	19:20	3:44	17:31	DPSC
	K15			15:36	19:20	3:44	17:31	DLOL
	K8			19:00	9:57	15:57	22:48	DPSC
	K9		8/18/2017	9:41	10:15	0:34	13:26	OPERATIONAL
	K9			14:30	19:23	4:53	21:07	OPERATIONAL
	L1			14:30	15:49	5:19	7:26	OPERATIONAL
	K14			14:30	15:49	1:19	7:26	OPERATIONAL
	K15			16:04	16:16	0:12	4:48	OPERATIONAL
	K8			16:18	16:28	0:10	3:50	OPERATIONAL
	L3			19:00	20:09	1:09	3:36	OPERATIONAL
	K9			9:33	9:58	0:25	9:50	LDC
	K8			10:48	12:40	1:58	23:02	OPERATIONAL
	K14			11:56	12:10	0:14	5:31	OPERATIONAL
	L1			13:20	16:50	3:30	12:00	OPERATIONAL

	K14		8/19/2017	17:05	17:09	0:02	0:43	DTSC
	K9			18:01	18:20	0:19	7:26	OPERATIONAL
	L1			19:21	19:54	0:25	9:50	OPERATIONAL
	K9		8/20/2017	2:00	2:58	0:58	23:02	DTSC
	K8			2:05	2:58	0:53	1:55	DTSC
	K7			2:06	11:13	9:09	3:36	DPSC
	K14			2:08	2:59	0:51	20:24	DTSC
	K9			11:15	11:22	0:07	3:50	OPERATIONAL
	K14			11:40	11:44	0:04	1:26	DTSC
	K14			11:46	13:32	1:46	14:24	DTEF
	K9			15:56	15:59	0:03	1:12	OPERATIONAL
	K8			21:09	21:26	0:17	6:43	OPERATIONAL
	K9		8/21/2017	1:10	8:15	7:05	1:55	DPSC
	L3			1:12	12:30	11:28	11:02	DPSC
	K14			1:14	1:20	0:06	2:24	DPEF
	K15			1:15	9:35	8:20	7:55	DPSC
	K8			1:15	1:30	0:15	6:00	DTSC
	K8			1:26	7:45	6:11	4:19	DPSC
	L2			5:20	6:10	0:50	19:55	OPERATIONAL
	K8			8:35	9:45	1:10	3:50	OPERATIONAL
	K14			10:00	12:00	2:00	0:00	OPERATIONAL
	K8			14:20	14:35	0:15	6:00	OPERATIONAL
	K14		8/22/2017	23:50	8:00	8:10	3:50	DTSC
	L3			23:10	23:30	0:20	7:55	DTSC
	K9			7:58	7:59	0:01	0:14	DTEF
	K8			11:05	11:17	8:12	4:48	OPERATIONAL
	K9			12:07	12:13	0:06	2:24	OPERATIONAL
	K9			15:45	15:48	0:01	0:14	DTEF
	L3			16:41	16:51	1:00	0:00	OPERATIONAL

	K8		8/23/2017	9:47	9:53	0:06	2:24	OPERATIONAL
	K9			11:26	11:47	0:21	8:24	OPERATIONAL
	L3			16:42	16:45	0:03	1:12	DTEF
	K9			17:41	17:45	0:04	1:26	DTEF
	K14			22:50	23:07	0:17	0.28	DTSC
	K14		8/24/2017	1:19	10:43	9:14	5:31	DPSC
	K9			7:37	9:11	1:34	13:26	DLOL
	K9			13:05	13:16	0:11	4:19	DPEF
	K9			15:26	15:40	0:14	5:31	OPERATIONAL
	K9			19:47	19:50	0:03	1:12	OPERATIONAL
	K9		8/25/2017	1:35	3:21	1:46	18:14	DPEF
	K8			1:35	3:21	1:46	18:14	DPEF
	K14			6:45	6:51	0:06	2:24	DLOL
	K8			9:35	10:51	1:24	9:36	DPEF
	L3			10:02	10:03	0:01	0:14	DTEF
	K9			10:29	10:35	0:06	2:24	OPERATIONAL
	K9			15:29	15:31	0:02	0:43	DTEF
	K8			16:40	16:54	0:14	5:31	OPERATIONAL
	K9			19:05	19:22	0:17	6:43	OPERATIONAL
	L3		8/26/2017	8:12	8:15	0:03	1:12	OPERATIONAL
	K8			10:27	10:39	0:12	4:48	OPERATIONAL
	K14			11:57	12:00	0:03	1:12	DTSC
	K9			12:10	12:15	0:05	1:55	OPERATIONAL
	L3			20:21	21:15	0:54	21:36	OPERATIONAL
	K8		8/27/2017	12:41	12:57	0:16	6:14	OPERATIONAL
	K8			21:40	11:00	0:20	7:55	OPERATIONAL
	L3			8:10	8:12	0:02	0:43	DTSC
	K7			10:13	10:25	0:12	4:48	OPERATIONAL
	K8			15:04	15:15	0:11	4:19	OPERATIONAL

	K8		8/28/2017	17:42	18:34	0:52	20:38	OPERATIONAL
	L3			19:16	20:21	1:05	1:55	OPERATIONAL
	K9			19:57	20:12	0:15	6:00	OPERATIONAL
	K14		8/29/2017	6:47	10:48	4:01	0:14	DPSC
	K9			9:33	9:34	0:01	0:14	OPERATIONAL
	K9			10:24	10:50	0:26	10:19	OPERATIONAL
	K8			10:44	11:01	0:17	6:43	OPERATIONAL
	K9			14:38	15:15	0:37	14:38	OPERATIONAL
	K14			18:22	18:43	0:21	8:24	OPERATIONAL
	K9			19:57	20:15	0:18	7:12	OPERATIONAL
	K9		8/30/2017	8:06	8:09	0:03	1:12	DTEF
	K9			8:48	9:18	0:30	12:00	OPERATIONAL
	K9			11:24	13:10	2:46	18:28	OPERATIONAL
	K14			15:10	17:57	2:47	18:43	OPERATIONAL
	K9			17:00	17:13	0:13	5:02	OPERATIONAL
	K8			17:37	19:35	1:58	23:02	DLOL
	K9			18:06	19:10	1:04	1:26	DPSC
	L3			18:07	19:10	1:03	1:12	DPSC
	K14			18:21	10:16	0:55	21:50	DPSC
	L3		8/31/2017	8:00	13:15	5:15	6:00	LDC
	K9			13:15	17:47	4:32	12:43	LDC
	K14			14:50	15:00	0:10	3:50	OPERATIONAL
	K8			18:20	11:36	3:16	6:14	LDC
	L3		1/9/2017	7:13	11:36	4:23	9:07	LDC
	K9			8:37	8:39	0:02	0:43	OPERATIONAL
	K8			11:31	11:40	0:09	3:36	DTSC
	K15			11:36	15:36	4:00	0:00	LDC
	K8			13:03	13:07	0:04	1:40	OPERATIONAL
	K8			13:20	13:21	0:01	0:14	DTEF

	K8			15:36	19:00	3:24	3.4	LDC
	K14			15:48	16:15	0:27	10:48	OPERATIONAL
	L3			18:56	18:53	0:03	1:12	DTSC
	K8			23:50	23:56	0:06	2:24	DTSC
	K9			23:50	23:56	0:06	2:24	DTSC
	K9		2/9/2017	11:25	13:11	1:46	18:14	OPERATIONAL
	K8			14:20	15:30	1:10	3:50	OPERATIONAL
	K8			16:45	17:24	0:29	11:31	OPERATIONAL
	K14			17:37	17:39	0:02	0:43	DTSC
	L3			18:24	20:37	2:13	5:02	OPERATIONAL
	K8			19:24	20:00	0:31	12:14	OPERATIONAL
	K8			20:45	21:52	1:07	2:38	DPEF
	K8		4/9/2017	8:53	9:06	0:13	5:16	OPERATIONAL
	K8			8:06	13:00	3:54	21:36	LDC
	K9			9:00	19:30	9:30	12:00	OPERATIONAL
	K14			10:15	10:27	0:12	4:48	OPERATIONAL
	K14			12:53	13:00	0:07	2:52	OPERATIONAL
	K9			13:00	18:00	5:00	0:00	LDC
	L3			13:58	14:18	0:20	7:55	DTEF
	K14			18:00	21:44	3:44	17:31	OPERATIONAL
	K9			21:10	21:17	0:07	2:38	OPERATIONAL
	K15		5/9/2017	6:29	6:33	0:04	1:26	DTSC
	L3			7:23	13:16	5:49	19:26	LDC
	K9			10:47	11:23	0:36	14:24	OPERATIONAL
	K8			13:16	18:10	4:54	21:36	LDC
	K14			16:50	17:21	0:31	12:14	OPERATIONAL
	K15			18:10	22:40	4:30	12:00	LDC
	K8			20:04	20:11	0:07	2:38	OPERATIONAL
	K8			20:49	20:54	0:05	1:55	OPERATIONAL

	K9			21:30	21:50	0:20	7:55	OPERATIONAL
	L3			22:40	22:54	0:14	5:31	OPERATIONAL
	TRAFO 1		6/9/2017	4:00	17:40	13:40	15:50	OPERATIONAL
	K15			5:00	5:05	0:05	1:55	DTSC
	K8			7:08	7:18	0:10	3:50	DTSC
	K14			10:05	10:40	0:35	13:55	OPERATIONAL
	TRAFO 2			10:41	11:45	0:34	13:26	OPERATIONAL
	K9			13:41	13:47	0:06	2:24	OPERATIONAL
	TRAFO 2			17:00	17:43	0:40	15:50	OPERATIONAL
	K15			19:47	20:02	0:15	6:00	OPERATIONAL
	K14			19:47	20:02	0:15	6:00	OPERATIONAL
	K8		7/9/2017	6:28	6:28	0:03	1:12	DTEF
	K8			8:48	9:30	0:42	16:48	OPERATIONAL
	K15			9:13	9:23	0:10	3:50	DTEF
	K8			9:32	9:41	0:09	3:36	OPERATIONAL
	L3			11:52	11:57	0:05	1:55	DTSC
	L2			16:37	16:48	0:11	4:19	DTSC
	K8			18:22	21:14	2:52	20:38	LDC
	K8		8/9/2017	6:26	6:37	0:11	4:19	DTEF
	K9			6:26	6:37	0:11	4:19	DTEF
	K9			8:33	14:06	5:27	10:48	DTEF
	L3			14:06	19:14	5:08	3:07	OPERATIONAL
	K8			15:57	17:18	2:21	8:24	OPERATIONAL
	K9			16:25	16:30	0:10	3:50	DPEF
	K9			16:53	16:55	0:02	0:43	OPERATIONAL
	K8		9/9/2017	7:57	13:00	5:03	1:12	OPERATIONAL
	K15			8:49	9:04	0:15	6:00	DPSC
	K9			10:49	11:00	0:11	0.18	OPERATIONAL
	K9			13:00	15:20	2:20	7:55	OPERATIONAL

	K9			18:31	18:33	0:02	0:43	OPERATIONAL
	K8			19:40	19:57	0:17	6:43	OPERATIONAL
	L3		10/9/2017	8:00	12:46	4:46	18:14	OPERATIONAL
	L3			13:55	15:32	1:37	14:38	OPERATIONAL
	TRAFO 2			14:34	14:36	0:02	0:43	DTSC
	K8			14:34	14:58	0:24	9:36	DPSC
	K9			14:23	15:33	1:10	3:50	OPERATIONAL
	K8			18:45	20:16	1:31	12:14	OPERATIONAL
	K9			19:37	19:42	0:05	1:55	OPERATIONAL
	K14			20:16	21:36	0:20	7:55	DPEF
	K8			22:00	22:12	0:12	4:48	OPERATIONAL
	K14		11/9/2017	6:18	8:42	2:24	9:36	OPERATIONAL
	K14			9:55	10:15	0:20	7:55	OPERATIONAL
	K9			12:20	12:47	0:27	10:48	OPERATIONAL
	K9			14:11	14:19	0:08	3:07	OPERATIONAL
	K15			19:17	19:19	0:02	0:43	DTEF
	K9			22:20	22:40	0:20	7:55	OPERATIONAL
	K8		12/9/2017	3:15	3:20	0:05	1:55	DTSC
	K8			6:20	8:33	2:13	5:02	DPSC
	K8			9:40	9:42	0:02	0:43	OPERATIONAL
	K9			11:04	11:24	0:20	7:55	OPERATIONAL
	L3			13:00	13:02	0:02	0:43	DPSC
	K8			14:35	14:51	0:16	6:14	OPERATIONAL
	K9		9/13/2017	9:07	9:23	0:16	6:14	OPERATIONAL
	K8			15:09	15:56	0:47	18:43	DPEF
	L3			15:09	15:56	0:47	18:43	DPSC
	K9			15:29	16:42	1:13	5:02	DPSC
	L2			15:12	10:37	24:00 + 4:25	9:50	DPSC
	K9			20:26	20:51	0:25	9:50	DPSC

	K9			21:34	22:55	1:21	8:24	DPEF
	K8			21:36	21:55	0:19	7:26	OPERATIONAL
	K9		9/14/2017	2:00	2:18	0:18	7:12	DPSC
	K9			7:07	8:43	1:36	14:24	DPSC
	K8			10:48	10:55	0:07	2:38	DTSC
	K15			11:36	11:50	0:14	5:31	OPERATIONAL
	K9			19:46	20:13	0:37	14:38	OPERATIONAL
	K8			21:20	21:45	0:25	9:50	DPEF
	K8		9/15/2017	8:00	13:21	5:21	8:24	OPERATIONAL
	L3			8:16	8:33	0:17	6:43	DPSC
	K9			8:39	8:44	0:05	1:55	OPERATIONAL
	K9			10:54	11:12	0:24	9:36	OPERATIONAL
	K9			12:27	12:29	0:02	0:43	OPERATIONAL
	K9			13:21	13:42	0:21	8:24	OPERATIONAL
	K9			15:27	16:13	0:46	18:14	OPERATIONAL
	K15			16:44	17:00	0:44	17:31	OPERATIONAL
	K8			18:04	18:12	0:08	3:07	OPERATIONAL
	K8			21:15	21:25	0:10	3:50	OPERATIONAL
	K9		9/16/2017	10:40	10:59	0:19	7:26	OPERATIONAL
	K8			14:19	14:32	0:13	5:02	OPERATIONAL
	K15			15:03	15:32	0:29	11:31	OPERATIONAL
	K8			17:04	21:01	3:57	22:48	OPERATIONAL
	L3			18:38	21:14	3:36	1:26	OPERATIONAL
	K14		9/17/2017	6:44	10:00	3:16	3.26	DPSC
	K9			10:10	14:20	4:10	3:50	LDC
	K8			14:20	14:34	0:14	5:31	OPERATIONAL
	K8			18:20	19:19	0:59	0:00	DLOL
	L3			18:33	20:55	2:22	8:38	OPERATIONAL
	K8		9/18/2017	14:31	0:33	0:02	0:43	DTSC

	K8			14:42	15:04	0:22	8:38	DTEF
	L3			15:50	16:11	0:21	8:24	DPSC
	K8			19:26	20:26	1:00	0:00	OPERATIONAL
	K8		9/19/2017	5:14	7:49	2:35	13:55	DPSC
	K9			9:01	13:05	4:04	1:26	LDC
	K15			9:25	10:02	0:37	0:00	OPERATIONAL
	K8			13:05	14:11	1:06	2:24	LDC
	L3			18:17	22:20	4:03	1:12	LDC
	K9		9/20/2017	9:00	9:19	0:19	7:26	OPERATIONAL
	TRAFO 2			10:06	10:08	0:02	0:43	DTSC
	K8			10:06	11:47	1:41	16:19	DPSC
	K9			14:00	14:25	0:25	9:50	OPERATIONAL
	K8			15:37	15:54	0:17	6:43	OPERATIONAL
	L3		9/21/2017	15:25	15:27	0:02	0:43	DTSC
	K8			16:11	16:15	0:04	1:26	DTSC
	K9			17:54	18:10	0:16	6:14	OPERATIONAL
	K9			18:23	20:53	2:30	12:00	LDC
	K8		9/22/2017	8:05	8:07	0:02	0:43	DTSC
	K9			9:06	9:17	0:11	4:19	OPERATIONAL
	L3			11:59	12:03	0:04	1:26	DTSC
	K8			12:40	14:20	1:40	15:50	DPEF
	K14			14:37	15:31	0:54	21:36	OPERATIONAL
	L3			17:25	21:30	4:05	1:55	LDC
	K8			19:10	20:10	1:00	0:00	OPERATIONAL
	K8		9/23/201	6:20	6:23	0:03	1:12	DTSC
	K10			10:00	10:20	0:20	7:55	OPERATIONAL
	K8			10:42	10:52	0:10	3:50	OPERATIONAL
	K8			12:30	12:36	0:06	2:24	DTSC
	K8			18:23	21:23	2:00	0:00	LDC

	K9			20:25	20:36	0:11	4:19	OPERATIONAL
	K13			22:37	22:41	0:08	3:07	DTSC
	K8		9/24/2017	4:52	5:00	0:06	2:24	DTEF
	K15			9:05	10:36	1:31	12:14	OPERATIONAL
	K15			11:40	12:01	0:21	8:24	OPERATIONAL
	K8			11:44	11:50	0:06	2:24	DTSC
	K8			11:52	12:11	0:19	7:26	DPSC
	K8			17:10	17:53	0:43	17:02	OPERATIONAL
	L3			18:55	20:25	2:00	0:00	LDC
	K8			19:18	19:38	0:20	7:55	OPERATIONAL
	K15		9/25/2017	9:35	9:37	0:02	0:43	DTSC
	K8			10:34	10:36	0:02	0:43	DTSC
	K8			10:53	14:30	3:37	14:38	DPEF
	K9			13:04	13:22	0:20	7:55	OPERATIONAL
	K15			16:56	17:12	0:16	6:14	OPERATIONAL
	K8			18:38	20:38	2:00	0:00	LDC
	K9			19:09	19:30	0:21	8:24	OPERATIONAL
	L1		9/26/2017	10:20	10:37	1:17	6:43	OPERATIONAL
	L2			10:20	10:37	1:17	6:43	OPERATIONAL
	L3			10:20	10:37	1:17	6:43	OPERATIONAL
	K15			11:35	11:39	0:04	1:26	DTSC
	K9			14:01	15:06	1:05	1.05	OPERATIONAL
	L3			15:06	15:08	0:02	0:43	DTSC
	K15			18:44	20:22	1:36	1:26	LDC
	K9			20:03	20:43	0:40	15:50	OPERATIONAL
	K8		9/27/2017	8:18	8:24	0:06	2:24	DTSC
	K8			9:04	9:10	0:06	2:24	OPERATIONAL
	K9			10:40	10:46	0:06	2:24	DTSC
	TRAFO 2			11:50	11:52	0:02	0:43	DTSC

	K8			11:50	12:08	0:18	7:12	DPSC
	K8			12:41	12:43	0:02	0:43	DTSC
	K8			13:42	14:22	0:40	15:50	OPERATIONAL
	K14		9/28/2017	8:02	8:29	0:27	10:48	DPSC
	L3			12:10	12:14	0:04	1:26	DTSC
	L3			12:52	12:54	0:02	0:43	DTSC
	K8			18:45	12:54	0:34	13:26	OPERATIONAL
	TRAFO 2		9/29/2017	3:00	3:02	0:02	0:43	DTSC & DTEF
	K13			3:00	3:19	0:19	7:26	OPERATIONAL
	K9			9:10	9:45	0:30	12:00	DTEF
	K8			11:11	11:13	0:02	0:43	DPEF
	K8			11:14	12:30	1:16	6:14	OPERATIONAL
	K9			17:20	18:00	0:40	15:50	LDC
	K15			18:30	20:00	1:30	12:00	LDC
	K2			18:30	20:00	1:30	12:00	DPSC
	K8		9/30/2017	14:40	16:05	1:25	9:50	OPERATIONAL
	K9			16:16	16:56	0:40	15:50	OPERATIONAL
	K8			16:10	16:40	0:30	12:00	OPERATIONAL
	TRAFO 2		10/1/2017	15:46	15:50	0:06	2:24	DTSC
	K9			15:46	16:52	1:06	2:24	DPSC
	K14			18:40	20:40	2:00	0:00	LDC
	K8			20:08	20:15	0:46	18:14	OPERATIONAL
	K15		10/2/2017	7:33	8:19	0:46	18:14	OPERATIONAL
	K8			10:33	11:30	0:57	22:48	OPERATIONAL
	K9			10:57	11:30	0:33	13:12	OPERATIONAL
	K9			12:07	13:47	1:40	15:50	OPERATIONAL
	K8			12:33	14:51	2:18	7:12	OPERATIONAL
	K15			12:45	14:50	2:05	1:55	OPERATIONAL
	L3			13:10	15:25	2:15	6:00	OPERATIONAL

	TRAFO 3			14:09	14:11	0:02	0:43	DTSC
	K9			13:58	16:02	3:00	0:00	DPSC
	L3			17:08	17:25	0:17	6:43	OPERATIONAL
	K9		10/3/2017	9:04	9:18	0:14	5:31	OPERATIONAL
	K8			9:33	9:39	0:06	2:24	OPERATIONAL
	K8			9:57	10:02	0:05	1:55	DTSC
	K9			11:26	11:36	0:16	6:14	OPERATIONAL
	K15			12:00	12:09	0:05	1:55	DTSC
	K8			12:17	12:31	0:14	5:31	OPERATIONAL
	K15			12:46	13:45	2:59	23:31	OPERATIONAL
	K8			13:05	13:14	0:09	3:36	OPERATIONAL
	L3			13:07	13:52	0:45	18:00	DPEF
	K6			14:09	14:50	0:41	16:19	DPEF
	K14		10/4/2017	7:47	8:30	0:47	18:43	DPSC
	K15			7:54	8:05	0:11	4:19	OPERATIONAL
	K9			11:02	11:45	0:43	17:02	OPERATIONAL
	K8			11:30	12:16	0:46	18:14	OPERATIONAL
	K9		10/5/2017	4:00	4:17	0:17	0.28	DTEF
	K8			18:35	20:42	2:07	2:38	OPERATIONAL
	L3			19:39	19:45	0:06	2:24	OPERATIONAL
	K9		10/6/2017	6:47	7:35	0:48	19:12	LDC
	L3			9:04	9:21	0:17	6:43	OPERATIONAL
	K8			9:42	10:01	0:19	7:26	OPERATIONAL
	K8			10:30	10:37	0:07	2:38	OPERATIONAL
	K8			12:00	12:15	0:15	6:00	OPERATIONAL
	L3			16:44	17:10	0:54	21:36	OPERATIONAL
	K15			18:30	20:27	1:57	22:48	OPERATIONAL
	K9		10/7/2017	9:34	9:54	0:20	7:55	OPERATIONAL
	K9			10:51	10:52	0:02	0:43	DTEF

	K9			11:15	11:47	0:32	12:43	OPERATIONAL
	K8			12:10	16:19	0:09	3:36	OPERATIONAL
	K8			13:41	14:41	1:00	0:00	OPERATIONAL
	L3			15:53	17:10	1:17	6:43	DPEF & DPSC
	K14			18:15	19:10	0:55	21:50	DPSC
	K14			18:36	20:40	1:30	12:00	OPERATIONAL
	K9			20:06	20:30	0:24	9:36	OPERATIONAL
	K8			20:35	20:50	0:15	6:00	OPERATIONAL
	K8			0:12	0:14	0:02	0:43	DTSC
	K9		10/8/2017	10:40	11:10	0:30	12:00	OPERATIONAL
	L3			14:35	15:25	0:50	19:55	DPEF
	L3			15:27	16:00	0:33	13:12	DPEF
	TRAFO 2			18:30	18:35	0:05	1:55	DTSC
	K8			18:30	20:40	2:10	3:50	OPERATIONAL
	K13			18:35	19:20	0:45	18:00	DPEF
	K9			19:10	19:50	0:40	15:50	OPERATIONAL
	L3		10/9/2017	8:40	9:15	0:35	13:55	OPERATIONAL
	K9		10/9/2017	9:16	9:33	0:17	6:43	OPERATIONAL
	K8			9:50	9:55	0:05	1:55	OPERATIONAL
	K9			15:15	15:25	0:10	3:50	OPERATIONAL
	K9			18:22	18:40	0:18	7:12	OPERATIONAL
	K13			18:30	19:55	1:25	9:50	LDC
	K8			18:30	19:55	0:25	9:50	LDC
	K13		10/10/2017	9:22	9:38	0:16	6:14	OPERATIONAL
	K9			17:04	17:23	0:19	7:26	OPERATIONAL
	K13			20:12	20:29	0:17	6:43	DTEF
	K9			20:12	20:30	0:18	7:12	DTEF
	K8			20:12	21:40	1:28	11:02	DPSC & DPEF
	K9		10/11/2017	8:45	8:47	0:02	0:43	OPERATIONAL

	K14			9:43	10:03	0:20	7:55	OPERATIONAL
	L3			10:28	10:32	0:05	1:55	DTSC
	K14			14:31	15:12	4:01	0:14	OPERATIONAL
	K8			16:52	17:17	0:45	18:00	OPERATIONAL
	K9			16:57	17:01	0:56	22:19	OPERATIONAL
	K1			18:03	18:57	0:54	2:09	LDC
	K2			19:03	18:57	0:54	2:09	LDC
	K9			19:10	19:20	0:10	3:50	LDC
	K8		10/12/2017	13:21	13:24	0:03	1:12	DTSC
	K8			17:13	17:51	0:38	15:07	OPERATIONAL
	L3			18:23	20:29	2:06	2:24	LDC
	K15			20:29	20:31	0:02	0:43	DTSC
	L3		10/13/2017	6:00	6:14	0:04	1:26	DTSC
	L3			6:50	9:34	2:49	19:26	MAINTAINANCE
	K14			7:12	10:04	3:08	3.13	OPERATIONAL
	K8			16:40	17:04	0:24	9:36	OPERATIONAL
	K15			18:30	20:33	2:03	1:12	LDC
	K1			18:30	20:33	2:03	1:12	LDC
	K9			19:28	19:20	0:02	0:43	DTEF
	K9		10/14/2017	10:17	12:05	1:48	19:12	LDC
	K8			10:17	12:05	1:48	19:12	LDC
	L3			10:20	10:25	0:05	1:55	DTSC
	K14			18:12	20:20	0:08	3:07	LDC
	L3			20:24	21:07	0:43	17:02	OPERATIONAL
	L3		10/15/2017	10:20	10:31	0:11	4:19	OPERATIONAL
	K9			15:51	16:10	0:19	7:26	OPERATIONAL
	K9			17:24	17:52	0:26	10:19	DPSC
	L3			18:10	20:39	2:29	11:31	LDC
	K9		10/16/2017	8:45	9:15	0:30	12:00	OPERATIONAL

	K15			18:45	19:50	1:05	1:55	LDC
	K9		10/17/2017	7:55	7:58	0:03	1:12	DTEF
	K8			10:18	10:23	0:05	1:55	OPERATIONAL
	K8			11:20	12:25	1:05	1:55	OPERATIONAL
	K8			14:59	16:20	1:21	8:24	OPERATIONAL
	K15			15:25	16:20	0:55	21:50	LDC
	K9			18:12	20:43	2:31	12:14	OPERATIONAL
	K15			18:49	19:21	0:32	12:43	DTEF
	L3		10/18/2017	5:20	6:00	0:40	15:50	DTEF
	L3			8:55	13:18	4:23	9:07	OPERATIONAL
	K8			9:30	9:45	0:15	6:00	OPERATIONAL
	K9			11:54	13:33	1:39	15:36	OPERATIONAL
	K14			18:17	20:51	2:34	13:26	LDC
	K2			18:17	20:51	2:34	13:26	LDC
	K8		10/19/2017	6:30	12:30	6:00	0:00	LDC
	K1			6:30	12:30	6:00	0:00	LDC
	K9			11:21	11:23	0:02	0:43	DTSC
	K9			12:30	14:21	1:51	20:24	LDC
	K9			15:02	15:15	0:13	5:02	OPERATIONAL
	K15			18:00	21:20	3:20	7:55	LDC
	K9			20:30	20:54	0:24	9:36	OPERATIONAL
	K14		10/20/2017	4:20	4:22	0:02	0:43	DTSC
	L3			6:35	13:11	6:36	14:24	LDC
	K14			8:44	9:12	0:28	11:02	OPERATIONAL
	K1			10:32	13:09	2:37	14:38	DPSC
	K2			10:32	13:08	2:36	14:24	DPSC
	K1			13:48	15:22	1:34	13:26	DPEF
	K2			13:48	15:22	1:34	13:26	DPEF
	K9			14:49	16:06	1:17	6:43	OPERATIONAL

	K8			15:41	9:53	19:14	5:31	DPEF
	K14			18:08	20:56	2:48	19:12	OPERATIONAL
	K9			18:00	18:12	0:12	4:48	OPERATIONAL
	K9		10/21/2017	3:31	4:18	0:47	18:43	DPSC & DPEF
	K2			9:36	9:53	0:17	6:43	OPERATIONAL
	K9			15:44	16:40	0:56	22:19	OPERATIONAL
	K9			16:44	17:26	0:40	15:50	OPERATIONAL
	K8			17:00	17:27	0:27	10:48	OPERATIONAL
	K9		10/22/2017	6:38	7:38	1:00	0:00	OPERATIONAL
	K8			1:38	8:10	6:32	12:43	OPERATIONAL
	K9			17:45	18:23	0:38	15:07	OPERATIONAL
	K8			18:00	20:53	2:53	2.88	LDC
	L3		10/23/2017	18:20	20:45	2:25	9:50	LDC
	K9			19:00	19:20	0:20	7:55	OPERATIONAL
	L3		10/24/2017	8:30	8:32	0:02	0:43	DTSC
	K9			8:46	9:20	0:34	13:26	OPERATIONAL
	K15			10:12	10:32	0:20	7:55	OPERATIONAL
	K8			16:13	16:31	0:18	7:12	OPERATIONAL
	K8			16:51	16:56	0:05	1:55	OPERATIONAL
	K15			18:12	21:00	2:48	19:12	LDC
	K2			18:12	21:00	2:48	19:12	LDC
	L3			19:12	19:17	0:05	1:55	DTSC
	K8		10/25/2017	7:42	7:46	0:04	1:26	OPERATIONAL
	L3			9:30	9:35	0:05	1:55	DTSC
	L3			9:35	9:44	0:09	3:36	DTSC
	K8			9:37	9:39	0:02	0:43	LDC
	K15			12:35	12:37	0:02	0:43	LDC
	K9		10/27/2017	6:20	13:20	7:00	0:00	OPERATIONAL
	L3			14:15	15:10	0:55	21:50	OPERATIONAL

	K8			15:40	16:01	0:21	8:24	OPERATIONAL
	K14			18:08	21:08	3:00	0:00	OPERATIONAL
	L3		10/28/2017	6:28	12:28	3:00	0:00	OPERATIONAL
	K8			8:30	8:35	0:05	1:55	DTSC
	K8			18:07	20:30	2:23	9:07	LDC
	K9		10/29/2017	7:00	13:00	6:00	0:00	LDC
	L1			7:05	11:13	4:08	3:07	LDC
	K8			9:05	9:15	0:10	3:50	OPERATIONAL
	K6			13:00	17:00	4:00	0:00	OPERATIONAL
	K14			15:05	15:37	0:32	12:43	OPERATIONAL
	K15			15:45	16:00	0:15	6:00	OPERATIONAL
	L3			18:00	20:40	2:40	15:50	LDC
	K2			18:00	20:40	2:40	15:50	LDC
	TRAFO 3		10/30/2017	7:05	7:10	0:05	1:55	DTSC
	K14			9:10	10:04	0:54	21:36	LDC
	K8			9:10	13:41	4:31	12:14	OPERATIONAL
	K9			11:39	11:45	0:06	2:24	OPERATIONAL
	K12			14:32	15:07	0:33	13:12	OPERATIONAL
	K9			14:50	15:02	0:12	4:48	OPERATIONAL
	L3			16:06	16:07	0:01	0:14	DTSC
	K15			17:22	17:44	0:22	8:38	OPERATIONAL
	K15			18:30	21:04	2:34	13:26	OPERATIONAL
	K8			20:24	20:43	0:19	7:26	OPERATIONAL
	K8		10/31/2017	6:26	8:36	2:10	3:50	OPERATIONAL
	K8			9:04	9:09	0:05	1:55	DPSC
	L3			10:18	10:32	0:14	5:31	DTSC
	L3			10:56	11:13	0:17	6:43	OPERATIONAL
	K14			11:06	15:15	4:09	3:36	OPERATIONAL
	K8			12:50	13:01	0:11	4:19	DPSC

	K14			17:23	17:34	0:11	4:19	OPERATIONAL
	L3			17:54	20:46	2:52	20:38	OPERATIONAL
	K13			19:10	19:14	0:04	1:26	OPERATIONAL
	K8		11/1/2017	2:00	9:10	7:10	3:50	DPSC
	K8			9:21	9:50	0:29	11:31	DPSC
	K8			10:30	12:40	2:10	3:50	DPSC
	K14			12:35	12:50	0:15	6:00	OPERATIONAL
	K8			14:50	15:05	0:15	6:00	DPSC
	K8			15:20	16:51	1:31	1.51	DPSC
	L3			16:35	16:37	0:02	0:43	DTSC
	K1			16:10	16:51	0:41	16:19	OPERATIONAL
	K2			16:10	16:51	0:41	16:19	OPERATIONAL
	K6			16:10	16:51	0:41	16:19	OPERATIONAL
	K7			16:10	16:51	0:41	16:19	OPERATIONAL
	K8			17:06	18:10	1:04	1:26	DPSC
	K9			18:55	19:50	0:55	21:50	OPERATIONAL
	K8		11/2/2017	6:28	6:33	0:05	1:55	DTSC
	K9			6:40	7:14	0:34	13:26	LDC
	K8			7:53	11:21	3:28	11:02	DPSC
	K9			9:25	9:40	0:15	6:00	OPERATIONAL
	K9			11:25	11:57	0:32	12:43	LDC
	K6			11:25	11:57	0:32	12:43	LDC
	K15			15:00	15:05	0:05	1:55	OPERATIONAL
	L3			18:03	19:48	1:51	20:24	LDC
	L1			18:03	19:48	1:51	20:24	LDC
	K8			19:17	19:48	1:51	20:24	OPERATIONAL
	L9			21:29	21:53	0:31	12:14	OPERATIONAL
	K8		11/3/2017	11:34	11:50	0:16	6:14	OPERATIONAL
	K8			16:10	16:35	0:25	9:50	OPERATIONAL

	K8		11/4/2017	18:30	19:22	0:52	20:38	LDC
	L3			18:50	19:50	1:00	0:00	LDC
	K9			18:50	19:50	1:00	0:00	LDC
	K9		11/5/2017	13:55	13:58	0:03	1:12	DTSC
	K14			18:23	19:50	1:27	10:48	OPERATIONAL
	K15		11/6/2017	6:14	6:54	0:40	15:50	OPERATIONAL
	K8			9:33	9:55	0:22	8:38	OPERATIONAL
	K9			11:40	12:46	0:06	2:24	DTSC
	K15			12:35	12:45	0:10	3:50	OPERATIONAL
	K9			12:52	13:13	0:21	8:24	DTSC
	L3			16:46	16:50	0:04	1:26	DTSC
	K8			18:05	18:18	0:13	5:02	OPERATIONAL
	K8			18:21	18:29	0:08	3:07	OPERATIONAL
	K9			19:41	19:54	0:13	5:02	OPERATIONAL
	K8		11/7/2017	6:50	6:52	0:02	0:43	DTSC
	K15			9:08	9:14	0:06	2:24	DTSC
	K14			3:52	12:09	8:06	2:24	DPSC
	K8			10:00	11:08	0:58	23:02	OPERATIONAL
	L3			11:08	12:20	1:12	0:28	DPSC
	K9			14:09	14:31	0:22	8:38	OPERATIONAL
	K14			15:44	16:00	0:16	6:14	OPERATIONAL
	L3			16:35	16:43	0:08	3:07	DTEF
	K8			16:36	16:55	0:09	3:36	OPERATIONAL
	K8			10:10	19:40	0:20	7:55	OPERATIONAL
	K2			22:11	22:13	0:02	0:43	DTEF
	L3		11/8/2017	6:31	6:44	0:13	5:02	DPEF
	K15			8:30	8:45	0:15	6:00	OPERATIONAL
	K8			9:15	9:27	0:12	4:48	DPSC
	K9			10:42	10:52	0:04	1:26	DTSC

	K14			10:54	12:28	1:24	9:36	OPERATIONAL
	L3			11:10	11:17	0:07	2:38	OPERATIONAL
	K14			16:49	16:55	0:06	2:24	DTEF
	K8			20:28	20:41	0:23	9:07	DPSC
	K8			21:58	21:03	0:05	0.08	DTSC
	K9		11/9/2017	4:54	5:03	0:09	3:36	DPEF
	K8			7:14	7:26	0:12	4:48	DPSC
	L3			10:32	11:27	0:55	21:50	DPSC
	K9			10:05	11:16	1:09	3:36	OPERATIONAL
	L3			11:58	12:38	0:40	15:50	OPERATIONAL
	K15			15:34	15:50	0:21	8:24	OPERATIONAL
	K9			15:35	15:38	0:03	1:12	OPERATIONAL
	K8			9:57	13:00	1:03	1:12	LDC
	K15			14:00	14:05	0:05	1:55	OPERATIONAL
	L3			18:00	20:00	2:00	0:00	LDC
	K8			20:05	20:25	0:20	7:55	OPERATIONAL
	K9		11/11/2017	6:00	9:50	3:50	19:55	DPEF
	K8			6:55	7:05	0:10	3:50	DTSC
	L3			8:45	8:48	0:03	1:12	DTSC
	K9			10:28	11:48	1:20	7:55	DPEF
	L3			10:50	12:05	1:15	6:00	OPERATIONAL
	K15			14:10	14:20	0:10	3:50	OPERATIONAL
	L3			14:59	15:21	0:22	8:38	OPERATIONAL
	K15			16:07	16:10	0:03	1:12	OPERATIONAL
	K9			16:50	17:16	0:26	10:19	OPERATIONAL
	K8			13:16	19:56	1:40	15:50	LDC
	K9		11/12/2017	17:10	17:38	0:28	11:02	OPERATIONAL
	K9			21:30	21:39	0:09	3:36	OPERATIONAL
	K8		11/13/2017	7:07	8:53	1:46	18:14	DPEF

	K15			9:53	10:09	0:16	6:14	OPERATIONAL
	K7			14:14	15:27	1:13	5:02	MAINTAINANCE
	K13			14:12	17:30	3:18	7:12	MAINTAINANCE
	K14			14:38	15:27	0:49	19:26	MAINTAINANCE
	K12			16:16	17:30	1:14	5:31	OPERATIONAL
	K9			18:15	20:15	2:00	0:00	LDC
	K15			18:15	20:15	2:00	0:00	LDC
	K8		11/14/2017	10:15	12:08	1:53	21:07	DPSC
	L3			10:20	10:24	0:04	1:26	DTSC
	K7			10:53	12:19	1:00	0:00	DPSC
	L3			11:36	11:38	1:26	10:19	DTSC
	L3			13:43	13:45	0:02	0:43	DTSC
	L3			13:45	14:42	0:02	0:43	DPSC
	L3			19:13	19:43	0:47	18:43	OPERATIONAL
	K14		11/15/2017	8:33	9:07	1:04	1:26	OPERATIONAL
	K15			10:35	10:40	0:05	1:55	DTSC
	K14			11:23	11:25	0:02	0:43	DTSC
	L3			11:41	12:20	0:39	15:36	DPSC
	K7			11:55	11:59	0:04	1:26	DTEF
	K9			14:00	14:03	0:03	1:12	DTSC
	K8			15:00	15:18	0:18	7:12	OPERATIONAL
	K8			15:42	15:52	0:10	3:50	OPERATIONAL
	K15			18:01	18:14	0:13	5:02	OPERATIONAL
	K9			19:49	20:05	0:16	6:14	OPERATIONAL
	L3		11/16/2017	13:16	13:33	0:17	6:43	OPERATIONAL
	K9			19:04	19:10	0:06	2:24	OPERATIONAL
	K9			21:24	21:45	0:21	8:24	OPERATIONAL
	K9		11/17/2017	8:24	8:28	0:04	1:26	OPERATIONAL
	K8			9:06	9:15	0:09	3:36	OPERATIONAL

	L3			18:40	20:00	0:20	7:55	LDC
	L3		11/18/2017	8:10	8:15	0:05	1:55	DTSC
	K8			8:43	8:45	0:02	0.03	OPERATIONAL
	K8			10:04	12:10	2:06	2:24	LDC
	L3			10:26	10:30	0:04	0:43	OPERATIONAL
	K14			11:25	11:53	0:28	11:02	OPERATIONAL
	K14			12:35	12:38	0:03	1:12	DTSC
	L3			13:19	13:35	0:16	6:14	OPERATIONAL
	K14			18:20	20:00	1:40	15:50	LDC
	K9			19:20	19:25	0:05	1:55	OPERATIONAL
	K8		11/19/2017	6:20	7:00	0:40	15:50	DPSC
	K14			12:07	13:20	0:13	5:02	OPERATIONAL
	K9			12:30	13:10	0:40	15:50	OPERATIONAL
	K8			13:50	15:13	1:23	9:07	DPSC
	K15			14:10	14:16	0:06	2:24	OPERATIONAL
	L3			17:30	18:08	0:38	15:07	DPEF
	K9			18:29	19:38	1:09	3:36	LDC
	K8		11/20/2017	8:00	8:05	0:05	1:55	DTSC
	K8			11:25	11:27	0:02	0:43	OPERATIONAL
	K9			11:39	11:50	0:11	4:19	OPERATIONAL
	K8			12:40	13:34	0:54	21:36	OPERATIONAL
	K9			14:13	14:28	0:15	6:00	OPERATIONAL
	K15			18:35	19:20	0:55	21:50	LDC
	K15		11/21/2017	10:45	10:49	0:04	1:26	OPERATIONAL
	L3			13:27	15:03	1:36	14:24	DPEF
	K8			14:29	14:37	0:08	3:07	DPSC
	L3			16:52	17:01	0:11	4:19	OPERATIONAL
	K9			17:11	17:17	0:06	2:24	OPERATIONAL
	K8			14:42	14:53	0:11	4:19	DPSC

	K8			18:27	19:34	1:06	2:24	OPERATIONAL
	K9			18:51	19:18	0:16	6:14	OPERATIONAL
	L3			10:13	10:23	0:10	3:50	OPERATIONAL
	K9			10:44	11:12	0:28	11:02	OPERATIONAL
	K8			14:00	14:05	0:05	1:55	DTSC
	K8			18:56	19:14	0:20	7:55	OPERATIONAL
	K14		11/23/2017	12:32	12:38	0:06	2:24	DTSC
	K9			14:55	15:05	0:10	3:50	OPERATIONAL
	L3			18:45	20:18	1:33	13:12	LDC
	K9		11/24/2017	10:00	10:47	0:47	18:43	OPERATIONAL
	K15			10:00	10:48	0:08	3:07	OPERATIONAL
	K8			10:48	13:22	2:34	13:26	LDC
	K9			12:06	13:22	1:16	6:14	LDC
	L3			18:25	20:40	2:15	6:00	LDC
	K1 & K2		11/25/2017	10:26	11:15	0:49	19:26	DPSC
	K8			16:25	16:27	0:02	0:43	DTSC
	K9			16:25	16:27	0:02	0:43	DTSC
	K9			16:58	17:09	0:11	4:19	OPERATIONAL
	K14			18:00	20:10	2:10	3:50	OPERATIONAL
	L3		11/26/2017	6:30	7:30	1:00	0:00	OPERATIONAL
	K15			8:40	9:03	0:23	9:07	OPERATIONAL
	K9			9:20	9:55	0:35	13:55	OPERATIONAL
	K8			13:52	13:54	0:02	0:43	DTEF
	L3			14:30	14:50	0:20	7:55	OPERATIONAL
	K9			17:30	17:45	0:15	6:00	OPERATIONAL
	K9			18:43	20:26	1:43	18:00	OPERATIONAL
	K14		11/27/2017	18:51	18:57	0:06	2:24	DTSC
	K8		11/28/2017	8:24	8:41	0:17	0.28	OPERATIONAL
	K9			11:20	11:32	0:12	4:48	OPERATIONAL

	TOTAL BLACK OUT			12:30	17:45	5:15	6:00	TOTAL BLACK OUT FROM LDC
	K8		11/29/2017	5:54	6:01	6:01	0:14	DPSC
	K8			7:50	9:42	2:52	20:38	DPEF
	K8			8:00	9:00	1:00	0:00	DPEF & DPSC
	K14			9:20	13:00	3:40	15:50	LDC
	K15			13:00	22:02	9:02	0:43	LDC
	K9			14:43	22:02	7:45	18:00	OPERATIONAL
	K8		11/30/2017	10:45	15:30	4:45	18:00	LDC
	L3			10:45	16:00	5:15	6:00	LDC
	K9			15:30	18:30	3:00	0:00	LDC
	K14			18:05	21:40	3:35	13:55	LDC
	K6			16:00	21:40	5:40	18:00	LDC
	L1		12/1/2017	6:25	12:00	5:35	13:55	LDC
	K8			6:27	8:40	2:13	5:02	DPSC
	K15			6:25	12:00	5:35	13:55	LDC
	K8			12:00	18:00	6:00	0:00	LDC
	L2			12:00	18:00	6:00	0:00	LDC
	K9			14:18	15:25	1:07	2:38	OPERATIONAL
	K6			15:09	15:20	0:11	4:19	DTSC
	K9			18:00	21:14	3:14	5:31	LDC
	K8			19:25	19:39	0:14	5:31	OPERATIONAL
	K9		12/2/2017	6:36	7:45	1:09	3:36	LDC
	K8			8:49	9:03	0:14	5:31	OPERATIONAL
	L3			9:47	12:28	0:41	16:19	LDC
	K8			10:41	11:00	0:19	7:26	OPERATIONAL
	K9			12:10	12:15	0:05	1:55	OPERATIONAL
	K8			15:28	15:31	0:03	1:12	DTSC
	K15			16:31	16:36	0:05	1:55	OPERATIONAL
	K14			18:06	20:10	2:04	1:26	LDC

	K2			18:06	20:10	2:04	1:26	LDC
	K8		12/3/2017	18:20	20:05	1:45	18:00	LDC
	K9		12/4/2017	9:47	10:07	0:20	7:55	OPERATIONAL
	L3			18:05	19:42	1:37	14:38	OPERATIONAL
	K9			18:05	19:42	1:37	14:38	LDC
	K9		12/5/2017	10:04	10:09	0:05	1:55	DTEF
	L3			10:32	13:25	2:53	21:07	LDC
	K8			13:25	13:31	0:06	0:14	LDC
	K8			15:30	15:45	0:15	6:00	OPERATIONAL
	K14			18:26	20:30	2:04	1:26	OPERATIONAL
	K8		12/6/2017	4:57	4:59	0:02	0:43	DTSC
	K9			10:45	10:56	0:11	4:19	OPERATIONAL
	K8			19:16	19:32	0:16	6:14	OPERATIONAL
	K14		12/7/2017	5:29	5:32	0:03	1:12	DTSC
	K8			7:22	7:25	0:03	1:12	DTSC
	L3			9:50	10:00	0:10	3:50	OPERATIONAL
	K8			11:30	11:55	0:25	9:50	DPSC & DPEF
	L1			18:30	20:25	1:55	21:50	LDC
	K9			18:30	20:25	1:55	21:50	LDC
	K8		12/8/2017	11:21	13:09	1:48	19:12	LDC
	K9			14:00	14:47	0:47	18:43	OPERATIONAL
	K15			18:05	21:24	3:19	7:26	OPERATIONAL
	K15			21:24	22:34	1:10	3:50	DPSC
	K14			21:24	21:26	0:02	0:43	DTSC
	K14			22:24	22:34	0:10	3:50	OPERATIONAL
	K9		12/9/2017	11:05	12:48	1:43	17:02	LDC
	L3			18:02	20:44	2:42	16:48	LDC
	K8			19:10	19:20	0:10	3:50	OPERATIONAL
	K8		12/10/2017	6:05	6:08	0:03	1:12	DTEF

	K8			8:36	8:50	0:14	5:31	DTSC
	K9			9:10	9:15	0:05	1:55	DTSC
	L3			9:24	9:39	0:15	6:00	OPERATIONAL
	TOTAL BLACK OUT		12/11/2017	5:50	6:10	0:20	7:55	TOTAL BLACK OUT
	TOTAL BLACK OUT			6:17	11:42	5:25	9:50	TOTAL BLACK OUT
	L3			11:42	15:10	3:28	11:02	LDC
	K9			12:29	14:15	1:46	18:14	DPSC
	K7			11:42	14:45	3:03	1:12	DPEF
	K9			15:09	17:56	2:40	15:50	OPERATIONAL
	K8		12/12/2017	7:13	13:02	5:49	19:26	LDC
	K9			8:28	9:00	0:32	12:43	OPERATIONAL
	K14			13:02	18:32	5:30	12:00	LDC
	K9			15:05	15:14	0:09	3:36	DTSC
	k8		12/13/2017	4:43	4:47	0:04	1:26	DTEF
	k14			6:48	6:58	0:10	3:50	DPEF
	k9			8:31	8:39	0:08	3:07	DTSC
	k8			9:18	9:37	0:19	7:26	OPERATIONAL
	k9			17:30	18:00	0:30	12:00	OPERATIONAL
	k8			18:00	18:20	0:20	7:55	OPERATIONAL
	K15		12/14/2017	6:45	8:00	1:15	6:00	OPERATIONAL
	L3			6:45	8:30	1:45	18:00	OPERATIONAL
	K9			7:10	7:15	0:05	1:55	LDC
	K8			9:09	9:21	0:12	4:48	OPERATIONAL
	L3			10:05	13:10	3:05	1:55	LDC
	K9			17:20	17:40	0:20	7:55	OPERATIONAL
	K9		12/15/2017	11:56	12:02	0:06	2:24	OPERATIONAL
	K9			14:13	14:50	0:37	14:38	OPERATIONAL
	L3		12/16/2017	9:32	14:02	4:30	12:00	OPERATIONAL

	K8			11:02	18:00	6:58	23:02	OPERATIONAL
	K15			16:28	16:31	0:03	1:12	DTSC
	K14			16:46	16:48	0:02	0:43	DTSC
	K8			19:00	19:14	0:14	5:31	OPERATIONAL
	K8			20:10	20:28	0:18	7:12	OPERATIONAL
	K9		12/17/2017	0:46	8:25	7:41	16:19	DPEF
	K9			9:05	9:07	0:02	0:43	DTEF
	K9			10:30	13:10	2:40	15:50	OPERATIONAL
	K6			10:30	13:10	2:40	15:50	OPERATIONAL
	K9			14:18	14:40	0:22	8:38	OPERATIONAL
	K14			17:19	17:30	0:11	4:19	DPSC
	K9			18:19	18:40	0:21	8:24	OPERATIONAL
	K9			19:10	19:43	0:33	13:12	OPERATIONAL
	K8		12/18/2017	4:40	4:50	0:10	3:50	DTEF
	K8			8:03	8:05	0:02	0:43	DTSC
	K14			8:59	13:00	4:01	0:14	LDC
	K15			14:16	14:22	0:06	2:24	OPERATIONAL
	L3			17:37	20:33	2:56	22:19	LDC
	L2			17:37	20:33	2:56	22:19	LDC
	K8		12/19/2017	8:06	13:09	5:03	1:12	LDC
	K9			12:09	13:09	1:00	0:00	DPSC
	K9			13:04	18:13	5:09	3:36	OPERATIONAL
	K14			16:15	16:17	0:02	0:43	DTSC
	K14			16:34	18:17	1:43	17:02	DPSC
	K6			18:13	20:36	2:23	9:07	LDC
	K2			18:13	20:35	2:22	8:38	LDC
	K15			18:52	18:58	0:06	2:24	DTSC
	K9			19:09	19:39	0:30	12:00	OPERATIONAL
	K12			19:19	19:25	0:06	2:24	DTSC

	K12			19:14	20:02	0:48	19:12	OPERATIONAL
	K14			19:43	21:10	1:27	10:48	DTSC
	L3			23:40	23:47	0:07	2:38	DTEF
	L3		12/20/2017	6:55	7:06	0:11	4:19	DPSC
	K8			7:51	7:58	0:07	2:38	DTSC
	K1			10:50	11:08	0:15	6:00	OPERATIONAL
	K2			10:50	11:05	0:15	6:00	OPERATIONAL
	K15			14:51	15:10	0:19	7:26	OPERATIONAL
	K8			15:28	15:40	0:12	4:48	OPERATIONAL
	K15			18:27	18:39	0:12	4:48	OPERATIONAL
	K9		12/21/2017	1:10	8:15	7:05	1:55	DPSC
	L3			1:12	12:30	11:28	11:02	DPSC
	K14			1:14	1:20	0:06	2:24	DPEF
	K15			1:15	9:35	8:20	7:55	DPSC
	K8			1:15	1:30	0:15	6:00	DTSC
	K8			1:26	7:45	6:11	4:19	DPSC
	L2			5:20	6:10	0:50	19:55	OPERATIONAL
	K8			8:35	9:45	1:10	3:50	OPERATIONAL
	K14			10:00	12:00	2:00	0:00	OPERATIONAL
	K8			14:20	14:35	0:15	6:00	OPERATIONAL
	K14		12/22/2017	23:50	8:00	8:10	3:50	DTSC
	L3			23:10	23:30	0:20	7:55	DTSC
	K9			7:58	7:59	0:01	0:14	DTEF
	K8			11:05	11:17	8:12	4:48	OPERATIONAL
	K9			12:07	12:13	0:06	2:24	OPERATIONAL
	K9			15:45	15:48	0:01	0:14	DTEF
	L3			16:41	16:51	1:00	0:00	OPERATIONAL
	K8		12/23/2017	9:47	9:53	0:06	2:24	OPERATIONAL
	K9			11:26	11:47	0:21	8:24	OPERATIONAL

	L3			16:42	16:45	0:03	1:12	DTEF
	K9			17:41	17:45	0:04	1:26	DTEF
	K14			22:50	23:07	0:17	6:43	DTSC
	K14		12/24/2017	1:19	10:43	9:14	5:31	DPSC
	K8			19:00	19:14	0:14	5:31	OPERATIONAL
	K8			20:10	20:28	0:18	7:12	OPERATIONAL
	K14		12/24/2017	1:19	10:43	9:14	5:31	DPSC
	K9			7:37	9:11	1:34	13:26	DLOL
	K9			13:05	13:16	0:11	4:19	DPEF
	K9			15:26	15:40	0:14	5:31	OPERATIONAL
	K9			19:47	19:50	0:03	1:12	OPERATIONAL
	K9		12/25/2017	1:35	3:21	1:46	18:14	DPEF
	K8			1:35	3:21	1:46	18:14	DPEF
	K14			6:45	6:51	0:06	2:24	DLOL
	K8			9:35	10:51	1:24	9:36	DPEF
	L3			10:02	10:03	0:01	0:14	DTEF
	K9			10:29	10:35	0:06	2:24	OPERATIONAL
	K9			15:29	15:31	0:02	0:43	DTEF
	K8			16:40	16:54	0:14	5:31	OPERATIONAL
	K9			19:05	19:22	0:17	6:43	OPERATIONAL
	L3		12/26/2017	8:12	8:15	0:03	1:12	OPERATIONAL
	K8			10:27	10:39	0:12	4:48	OPERATIONAL
	K14			11:57	12:00	0:03	1:12	DTSC
	K9			12:10	12:15	0:05	1:55	OPERATIONAL
	L3			20:21	21:15	0:54	21:36	OPERATIONAL
	K8		12/27/2017	12:41	12:57	0:16	6:14	OPERATIONAL
	K8			21:40	11:00	0:20	7:55	OPERATIONAL
	L3			8:10	8:12	0:02	0:43	DTSC
	K7			10:13	10:25	0:12	4:48	OPERATIONAL

	K8			15:04	15:15	0:11	4:19	OPERATIONAL
	K8		12/28/2017	17:42	18:34	0:52	20:38	OPERATIONAL
	L3			19:16	20:21	1:05	1:55	OPERATIONAL
	K9			19:57	20:12	0:15	6:00	OPERATIONAL
	K14		12/29/2017	6:47	10:48	4:01	0:14	DPSC
	K9			9:33	9:34	0:01	0:14	OPERATIONAL
	K9			10:24	10:50	0:26	10:19	OPERATIONAL
	K8			10:44	11:01	0:17	6:43	OPERATIONAL
	K9			14:38	15:15	0:37	14:38	OPERATIONAL
	K14			18:22	18:43	0:21	8:24	OPERATIONAL
	K9			19:57	20:15	0:18	7:12	OPERATIONAL
	K9		12/30/2017	8:06	8:09	0:03	1:12	DTEF
	K9			8:48	9:18	0:30	12:00	OPERATIONAL
	K9			11:24	13:10	2:46	18:28	OPERATIONAL
	K14			15:10	17:57	2:47	18:43	OPERATIONAL
	K9			17:00	17:13	0:13	5:02	OPERATIONAL
	K8			17:37	19:35	1:58	23:02	DLOL
	K9			18:06	19:10	1:04	1:26	DPSC
	L3			18:07	19:10	1:03	1:12	DPSC
	K14			18:21	10:16	0:55	21:50	DPSC
	K8			19:40	22:00	2:20	7:55	LDC
	L3		12/31/2017	8:00	13:15	5:15	6:00	LDC
	K9			13:15	17:47	4:32	12:43	LDC
	K14			14:50	15:00	0:10	3:50	OPERATIONAL
	K8			18:20	11:36	3:16	6:14	LDC

long term distribution expansion planning with distributed generation

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