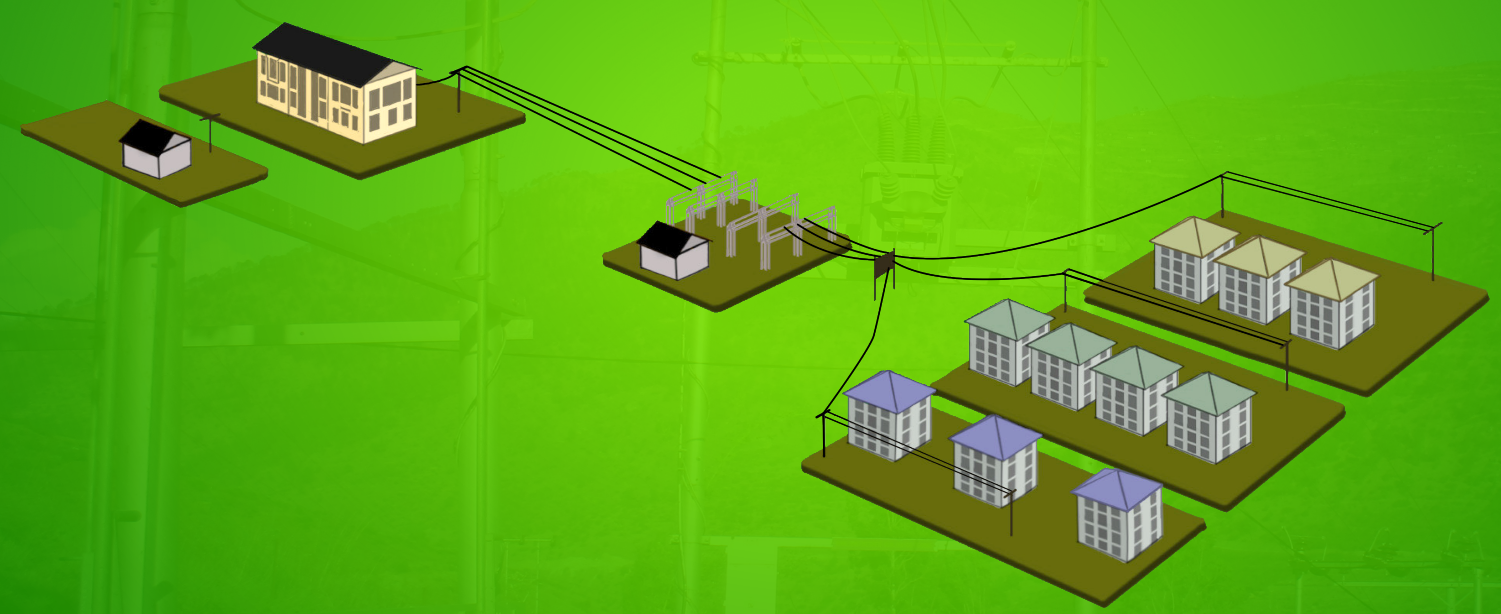
BHUTAN POWER CORPORATION LIMITED
(An ISO 9001:2015, ISO 14001:2015 & OHSAS 18001:2007 Certified Company)
P.O. Box : 580, Yarden Lam
Thimphu, Bhutan (Registered Office)
Website: www.bpc.bt

DISTRIBUTION SYSTEM MASTER PLAN (2020-2030)

LHUENTSE DZONGKHAG



Distribution and Customer Services Department
Distribution Services
Bhutan Power Corporation Limited

2019

DISTRIBUTION SYSTEM MASTER PLAN (2020-2030) LHUENTSE DZONGKHAG

Distribution and Customer Services Department
Distribution Services
Bhutan Power Corporation Limited

2019

FOREWORD

The Distribution System Master Plan (DSMP) identifies, prioritizes and opts for adequate and optimal distribution system expansion and augmentation programs to meet the expected electricity growth and demand development in the Country. This timely formulation of DSMP is in line with the stated corporate strategic objective of providing affordable, reliable and quality services to customers and will enable to traverse the changing technological, regulatory and social constraints for the time horizons considered.

The DSMP has been finalized after a series of consultative discussions with all the relevant stakeholders to obtain a shared outcome. In particular, adequate efforts have been taken to ensure that the DSMP aligns and integrates with the stated plans and programs of the Royal Government of Bhutan (RGoB) for the energy sector.

Based on the expected demand development for the time horizons considered, the DSMP outlines the road map for the implementation of optimized distribution network expansion programs and projects in stages with the expected investment required and financial commitments. The DSMP will be updated on a regular basis to incorporate changing business imperatives and contexts to ensure its relevance.

Appreciation goes to all the officials of the Distribution Services for formulating and coming out a comprehensive document that is timely which will serve as a blueprint for the Distribution Services to build a robust distribution system that will go a long way in contributing towards realization of BPC's objectives of providing a reliable electricity supply to its valued customers.

(Sonam Tobjey)
Chief Executive Officer

Preparation, Review & Approval of the Document

Prepared by:	Distribution & Customer Services Department, Distribution Services, Bhutan Power Corporation Limited, Thimphu.	**GM, DCSD**
Reviewed& Vetted by:	Management, Bhutan Power Corporation Limited, Thimphu. (18th September, 2020 – Meeting No. 584)	**CEO, BPC**
Approved by:	Board Tender & Technical Committee (BTTC), Bhutan Power Corporation Limited, Thimphu. (8th October, 2020 – 23rdBTTC Meeting)	**Chairman, BTCC**

Table of Contents

List of Tables

List of Figures

Abbreviations

BPC: Bhutan Power Corporation Limited

ESD: Electricity Services Division

DSMP: Distribution System Master Plan

GIS: Geographical Information System

SLD: Single Line Diagram

ETAP: Electrical Transient and Analysis Program

IS: Indian Standard on Transformers

IEC: International Electro-technical Commission

IP: Industrial Park

DT: Distribution Transformer

TSA: Time Series Analysis

LRM: Linear Regression Method

MV: Medium voltage (33kV, 11kV and 6.6kV)

DDCS: Distribution Design and Construction Standards

kVA: Kilo Volt Ampere

W: Watt

kWh: Kilo Watt Hour

RMU: Ring Main Unit

ARCB: Auto Recloser Circuit Breaker

ISD: Intelligent Switching Device

FPI: Fault Passage Indicator

Definitions

Asset Life: The period of time (or total amount of activity) for which the asset will be economically feasible for use in a business.

Balanced system: A system is said to be balanced when all phase conductors carry approximately the same current. For delta systems, this applies to two-phase conductors, and for three-phase star systems, this applies to three-phase conductors.

Contingency plan: Power that is needed when regularly used electric generating units are not in service, such as during short-term emergencies or longer unplanned outages, and during periods of scheduled maintenance when the units must be shut sown. Short-term backup power is generally called emergency power. Long-range backup power is often provided for in reserve sharing agreements.

Capacity: Also known as the power or capability of an electric generating plant. 1) Facilities and place to serve electric customers. 2) The total amount of electrical energy a power line is able to transport at any given time (Measured in kVA).

Clearance: The clear distance between two objects measured surface to surface. For safety reasons, proper clearance must be maintained between power lines and the ground, buildings, trees, etc.

Critical Value: The value of the random variable at the boundary between the acceptance region and the rejection region in the testing of a hypothesis.

Distribution line: That part of the electrical supply system that distributes electricity at medium voltage (33kV, 11kV& 6.6kV) from a transformer substation to transformers or other step-down devices service customer premises, which finally supply power at the voltage required for customer use.

Distribution loss: Energy losses in the process of supplying electricity to the consumers due to commercial and technical losses.

Distribution system: The portion of the transmission and facilities of an electric system that is dedicated to delivering electric energy to an end-user.

Energy: Delivered power measured in kilowatt-hours (kWh).

Generating station: A plant wherein electric energy is produced by conversion from some other forms of energy.

Grid: A system of high-voltage transmission and power-generating facilities that is interconnected with a number of other bulk power supply agencies on a regional basis. A grid enables power to be transmitted from areas having a surplus to areas experiencing a shortage. A grid also eliminates some duplication of costly facilities in a given region.

Investment: the action or process of investing money for certain activities with return and profit.

Lines (electrical supply) - Those conductors used to transmit or deliver electric energy and their necessary support or containing structures.

Linear Regression Method: In **statistical modeling**, regression analysis is a set of statistical processes for **estimating** the relationships between a **dependent variable** (often called the 'outcome variable') and one or more **independent variables.**

Load: 1) A device, or resistance of a device, to which power is delivered in a circuit. 2) The measure of electrical demand placed on an electric system at any given time.

Load forecasting: The methods used in determining a system's short and long-term growth in peak load and kilowatt-hour sales by consumers.

Load Growth: The increase in the demand of power required over time.

Marginal Value: Just barely adequate or within a lower Limit.

On line - Term generally used to indicate when a generating plant and transmission line is scheduled to be in operation. When an operational plant and line is not on line, it is said to be "down."

Outage - Interruption of service to an electric consumer.

Overload - Operation of equipment in excess of normal, full-load rating, or of a conductor in excess of rated ampacity that, when it persists for a sufficient length of time, would cause damage or dangerous overheating. A fault, such as a short circuit or ground fault, is not an overload.

Optimization: the action of making the best or most effective use of a situation or resource.

Pad-mounted equipment- General term describing enclosed equipment, the exterior of which enclosure is at ground potential, positioned on a surface-mounted pad. Example: underground transformers and junction boxes.

Peak demand - The maximum amounts of electricity used by a utility customer at any given time during the year. The peak is used to measure the amount of electric transmission, distribution, and generating capacity required to meet that maximum demand, even if it occurs infrequently and only for very short durations.

Peak load - The greatest amount of electricity used during a time period by the consumers in a utility's system.

Power - The time rate of electric energy in a device or circuit, measured in watts.

Power factor - A measurement of efficiency in the use of electricity. For example: a 100% power factor would be like a horse pulling a wagon on rails directly forward with no resistance. If the horse turns and pulls at a right angle to the rails, he may pull just as hard, but his efforts will not move the car. This would be a zero percent power factor. Now, if he pulls at a 45-degree angle to the rails, he will pull the car, but not with as high efficiency as if he were pulling straight down the rails. In the use of electricity, not every kilowatt generated translates into equivalent horsepower efficiency.

Power grid - A network of generation, transmission and distribution system that are interconnected

Power quality - The extent to which a utility system is able to maintain its delivery of electric energy within the tolerable limits of voltage and without outages or other problems with affect a customer's equipment use.

Power supply - Source of current and voltage.

Reliability - A measure of a utility's ability to deliver uninterrupted electric service to its customers.

Substation - An electrical facility containing switches, circuit breakers, buses, and transformers for switching power circuits and transforming power from one voltage to another, or from one system to another.

Time Series Analysis: The statistical techniques used when several years' data are available to forecast the load growth.

1. Executive Summary

Bhutan Power Corporation Limited is mandated to provide affordable, adequate, reliable and quality electricity services to the customers through transmission and distribution network established across the country. Towards realizing the mission, vision and destination statement of BPC as outlined in the Corporate Strategic Plan (2019-2030), there is a need to carry out comprehensive studies of the distribution system to address the system deficiencies as the ground realities are different triggered by technological advancement and economic growth.

The existing distribution networks were modeled and accordingly, the technical evaluation is carried out adopting the generally accepted load forecasting framework i.e. Time Series Analysis in conjunction to Linear Regression Method, the power requirement for next ten (10) years are forecasted. Subsequently, the network capability and the system gaps are identified with proposed distribution system planning. The investments are proposed (based on the priority matrix) to address the system inadequacies with the intent to improve the Customer Services Excellence, Operational and Resource Optimization Excellence, Innovation and Technology Excellence and Business Growth Excellence.

The single to three phase distribution network conversion across the country is reproduced in this report based on the studies carried out by BPC "Technical and Financial Proposal on Converting Single Phase to Three-Phase Power Supply in Rural Areas".

The details on the distribution grid modernization are outlined in Smart Grid Master Plan 2019 including the investment (2020-2027). The identification of the system deficiencies and qualitative remedial measures which would require system automation and remote control as per the existing and projected load are only outlined in this report.

Similarly, the system study beyond the Distribution Transformers had to be captured during the annual rolling investment and budget approval.

The ETAP tool is used to carry out the technical evaluation and validate the system performances. Finally, necessary contingency plans, up gradation and reinforcement plans are proposed as annual investment plans based on the outcome of the simulation result.

2. Introduction

The system study is intended to improve the power distribution system in Bhutan by formulating a comprehensive, national level and district wise DSMP (2020-2030) till 2030 that provides measures for renewing and reinforcing power distribution facilities. BPC's distribution system has grown in size and complexities over the years. While many network additions and alterations carried out so far were as per the recommendations of the Druk Care Consultancy Study Report (2006), the ground realities are evermore different now than anticipated during the study. There is a need to explore opportunities for optimizing the available resources and develop a master plan for future investments.

Some of the prominent driving factors required for the development of the master plan includes but not limited to reliable power supply to the customers, reduction of distribution losses, network capability with the anticipated load growth, optimization of the resources and to develop annual investment plan.

BPC has never carried out comprehensive system studies to improve the distribution system and optimize the available resources. The recurring investment plans (annual) is based on the on-site and field proposals without any technical evaluation being carried out which could have resulted in preventable and excessive investments. Therefore, proper planning is necessary to improve the system for optimal usage of resources.

It is also intended that this master plan is to provide general guidance in preparing long-range system planning. The analysis indicates where up-grades are most likely to be economical and provides insight into the development of a practical transition from the existing system to the proposed long-range system. Based on this analysis, recommendations are made for improving system performance and increasing system capacity for expansion. Periodic reviews of the master plan will be required to examine the applicability of the preferred plan considering actual system developments.

3. Objectives of the Master Plan

The objective(s) of the DSMP (are):

3.1 To carry out the system study of the existing distribution network, forecast and come out with the comprehensive ten (10) years strategic distribution plan;

3.2 To provide affordable and adequate electricity, reduce losses, improve power quality, reliability, optimize the resources and gear towards excellent customer services; and

3.3 To come out with annual investment plans.

4. Scope of the Distribution System Master Plan

Formulation of detailed DSMP (2020-2030) of the Dzongkhag for renewal, reinforcement, and extension of the power distribution system up to DT.

5. Methodology and Approach

In order to better understand the existing distribution system and postulate the credible investment plans; standard framework and procedures had been adopted. However, in the absence of any standardized procedures in BPC for planning of distribution system, the following customized procedures detailed in **Section 5.1** through **Section 5.5** and as shown in **Figure 1** are considered to suit BPC's requirement for developing the DSMP.

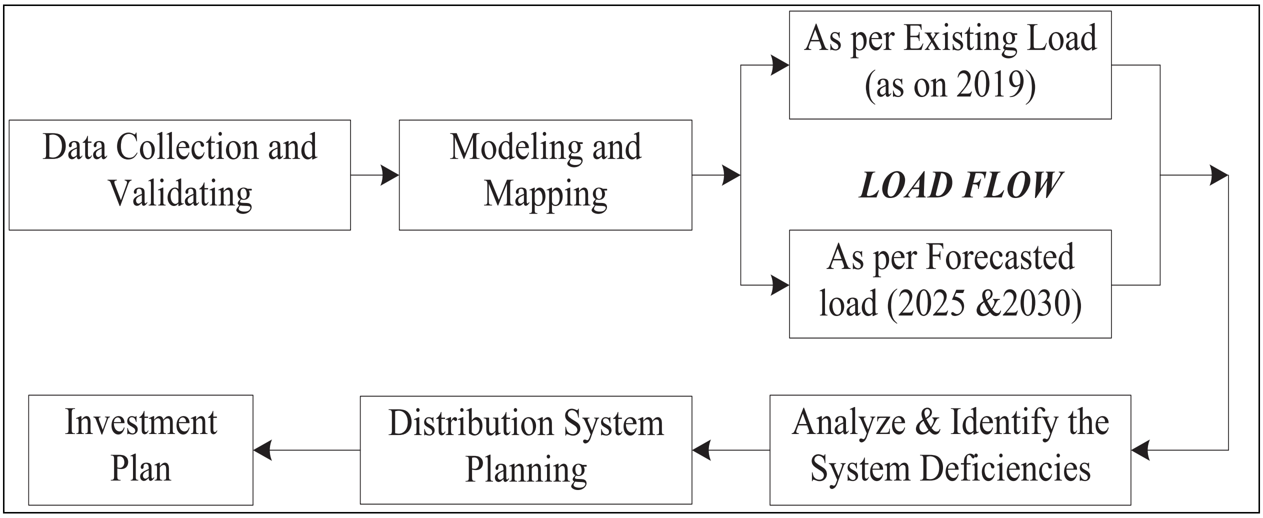


Figure 1: Block diagram for distribution system planning for thematic studies

5.1 Data Collection and Validation

In order to carry out the detailed studies with greater accuracy, complete and reliable data for the existing distribution infrastructure is required. Therefore, intensive field investigation was carried out during the months of April and May (2020) to validate the information that was collected. The information required for the studies does not confine to the BPC's internal distribution network but also the developmental activities of the cross-governmental sectors. The power arrangement requirements from these developmental activities were also used to forecast the power demand. The data validation on the distribution system includes the review of all the power sources, medium voltage lines and transformers with that of GIS data of Environment and GIS Division and SLD submitted by respective ESDs which is attached as **Annexure-1.**

5.2 Modeling and Mapping

The feeder wise distribution lines and transformers were modeled and mapped in ETAP tool and the base case was developed for the existing distribution network. The technical parameters for the lines and transformers were considered based on IS 2026, IEC 60076 (Detailed parameters attached as **Annexure-2)** to develop the base model. Modeling and Mapping detail is attached as **Annexure-1.**

5.3 Analysis and Identification of System Deficiencies

The existing distribution system model was analyzed in the ETAP involving balanced load flow to figure out the network capabilities against the set distribution standards. The load growth was projected using the commonly adopted methodology that is LRM in conjunction to TSA which is based on the historical data and accordingly the behavior of the distribution system was analyzed, and the system deficiencies were identified. The details on load forecast methodology is attached as **Annexure-3.**

5.4 Distribution System Planning

Necessary deterministic and probable distribution system planning methods are proposed to address the system gaps focusing on reduction of losses, improving the reliability and power quality. Accordingly, any contingency plans, up gradation and reinforcement plans are proposed along with the investment plans incorporating best fit technology.

5.5 Investment Plan

The approved investment plans (from 2020 to 2024) have been validated based on the outcome of the system studies and accordingly, the yearly investment plans are outlined as per the priority matrix as detailed in **Section 9.**

6. Existing Electricity Distribution Network

6.1 Overview of Power Supply Sources

The power supply to eight (8) Gewogs (Jarey, Tsenkhar, Minjey, Medtsho, Menbi, Kurtoe, Khoma and Gangzur) of Lhuentse Dzongkhag is from 33/11 kV Tangmachu substation which is sourced from 132/33kV Kilikhar substation.

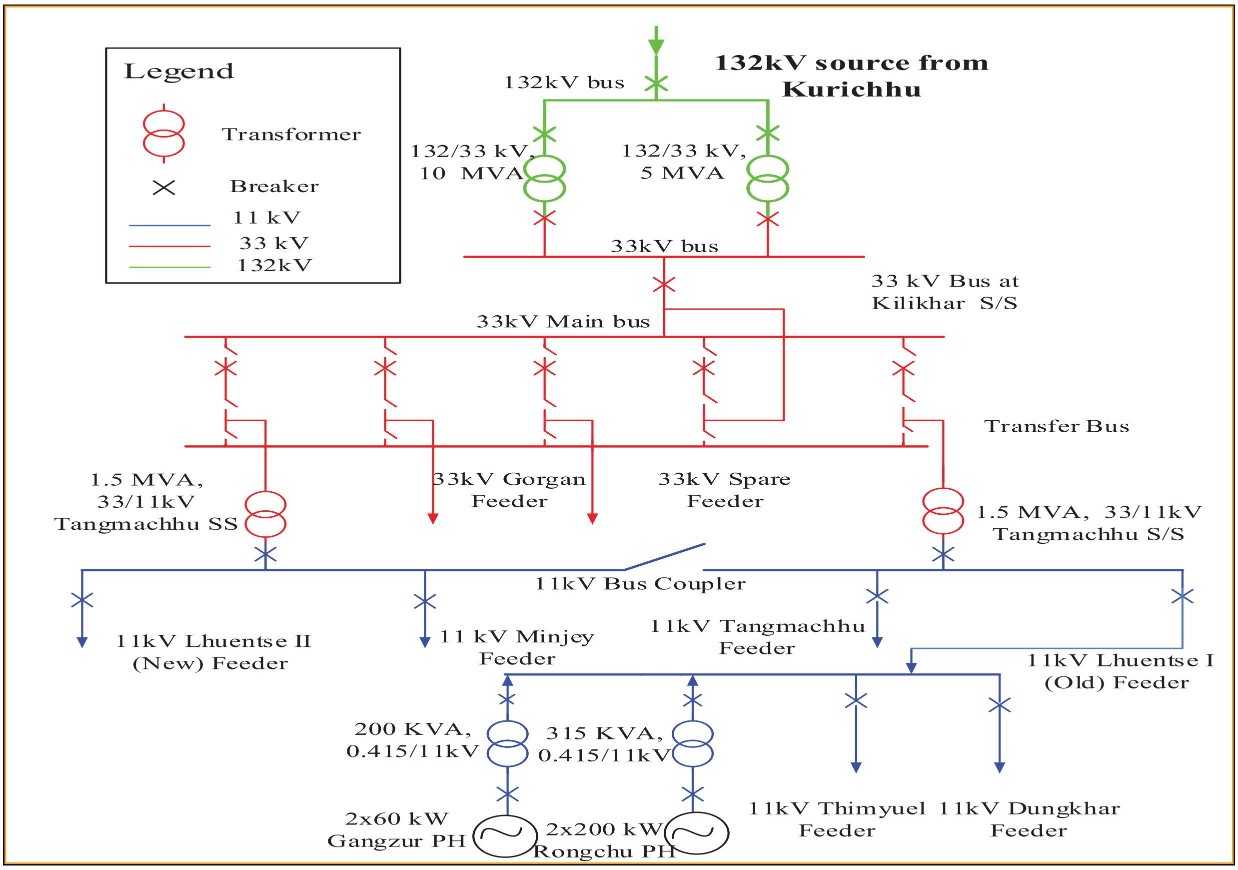


Figure 2: Electricity distribution schematic diagram

The power supply to Kilikhar substation is transmitted from 60 MW KHP at 132kV. Additionally, Lhuentse Dzongkhag has 2x100 kW Mini-Hydel at Rongchu and 2x60 kW Micro-Hydel at Gangzur. The generations from the micro and mini hydels are synchronized and injected into the grid. The overall power distribution network of the Dzongkhag is illustrated in the schematic diagram shown in **Figure 2**.

The Tangmachu substation has four (4) numbers of 11kV outgoing feeders (i.e. 11kV Old Lhuentse, 11kV New Lhuentse, 11kV Tangmachu and 11kV Minjey feeders) and a 33kV outgoing feeder (i.e., 33 kV Gorgan feeder).

6.2 Electricity Distribution Lines

The quantity of MV and LV lines infrastructure operated and maintained by the Division is summarized in **Table 1**.

Table 1: MV and LV line infrastructure details

Sl. No.	33 kV (km)		11 kV (km)		Total MV Length (km)	LV line (km)		Total LV Length (km)
	OH	UG	OH	UG		OH	UG	
1	100.59	-	188.13	0.105	**288.82**	510	-	**510.00**

The total MV line length is 288.8 2km and the total LV line length is 510 km. The ratio of LV to MV line length is 1.76:1 which reflects a high proportion of power distribution through LV network. While the ratio of LV to MV line length would vary according to the site conditions, as a general thumb rule, network ratio of 1.2:1 (LV to MV) should be maintained for optimum initial capex and the running and maintenance costs. The MV distribution network is mainly through 33kV and 11kV overhead lines.

6.3 Distribution Transformers

The number of distribution transformers at various kVA rating levels operated and maintained by the Division is tabulated in **Table 2.**

Table 2: Total numbers of transformers, installed capacity and customers

Source	Capacity (MVA)	Name of Feeder	Feeder Length (km)	DTs (Nos.)	Connected (kVA)	Customers (Nos.)
33/11kV Tangmachu Substation	2x1.5	33kV Gorgan Feeder	100.59	96	3026	1736
		11kV Menji Feeder	28.93	10	530	328
		11kV Tangmachu Feeder	34.19	18	1166	575
		11kV Lhuentse I (Old) Feeder	100.10	81	2470	1512
		11kV Lhuentse II (New) Feeder	25.02	8	1199	438
Total			**288.82**	**213**	**8391**	**4589**

As of July 2020, there were 213 distribution transformers with a total capacity of 8,391.00 kVA. As can be inferred from **Table 2,** the installed capacity of the transformer per customer is 1.83 kVA.

7. Analysis of Distribution System

Based on the model developed in ETAP for the existing feeder wise distribution network, analysis of the system was carried out by considering the forecasted load growth from 2020-2030. The quality of power, reliability and energy loss of the existing network were assessed and accordingly the augmentation and reinforcement works are proposed which shall be the integral part of the investment plan. The assessment of MV lines, DTs, power sources, reliability of the power supply and energy & power consumption pattern are presented from **Section 7.1** through **Section 7.4**.

7.1 Assessment of Power Sources

The assessments of the capabilities of the power sources were exclusively done based on the existing (2019-2020) and forecasted load. The source capability assessment had to be carried out to ascertain the adequacy of the installed capacity against the existing load and the forecasted load. The source capability assessment had been carried out bifurcating HV and MV substations as detailed below.

7.1.1 HV Substation (132/33/11kV)

There are no HV substations under the administration of the Dzongkhag.

7.1.2 MV Substation (33/11 kV)

The Tangmachu substation recorded a peak load of 1.34 MW as of July 2020 against the installed capacity of 2.40 MW (3MVA @ 0.85 pf). It is forecasted to reach 2.84MW slightly more than the installed capacity. The demographical stats of Lhuentse are one of the least and therefore with sparse population, it is not expected to experience significant growth in the Dzongkhag. Therefore, the installed capacity would be adequate to meet the power requirement of the customers till 2030.

7.2 Assessment of MV Feeders

Feeder wise planning is necessary to ensure that the power delivery capacity, power quality and reliability requirements of the customers are met. In distribution system, capacity assessment of existing MV feeders is important to ensure that feeders are adequate to transmit the peak demand of the load connected to the feeders. Particularly, the capacity assessment of the feeders enables identification of feeders that require reinforcement and reconfiguration works.

The behavior of the MV feeders are assessed based on the existing and forecasted load, feeder wise energy loss, reliability, and single to three-phase line conversions which are outlined vividly in **Section 7.2.1** through **Section 7.2.4**. Further, recognizing that the asset life of the distribution system is thirty years (30), our system should be able to handle the load growth (peak demand) for next 30 years. Therefore, it is equally important to consider the asset life of the system in addition to the assessment of the system in different time horizons.

As evident from above **Table 2,** the 33kV Gorgan has the longest circuit length (100.59km) and highest number of DTs (81) installed with maximum customers (1737) connected to the feeder followed by 11kV Lhuentse (Old) feeder.

7.2.1 Assessment of MV Feeder Capacity with Load

The feeder wise peak power consumption was compiled based on the historical data. The array of daily and monthly peak demand was sorted to obtain the annual peak demand. The feeder-wise peak demand recorded at the source is presented in **Table 3** and the corresponding feeder-wise annual load curve is presented in **Figure 3.**

Table 3: Historical feeder wise peak power demand

Power Source	Name of Feeder	Peak Load (MW)					
		2014	2015	2016	2017	2018	2019
2x1.5MVA, Tangmachu Substation & 0.415/11 kV, 350kVA, Rongchu Micro-Hydel	33kV Gorgan Feeder	0.56	0.58	0.59	0.59	0.61	0.61
	11kV Tangmachu Feeder	0.26	0.31	0.50	0.53	0.53	0.55
	11kV Minjey Feeder	0.14	0.14	0.15	0.17	0.17	0.17
	11kV Lhuentse Feeder-I (Old)	0.63	0.65	0.66	0.67	0.72	0.75
	11kV Lhuentse Feeder-II (New)	0	0	0	0	0.32	0.33

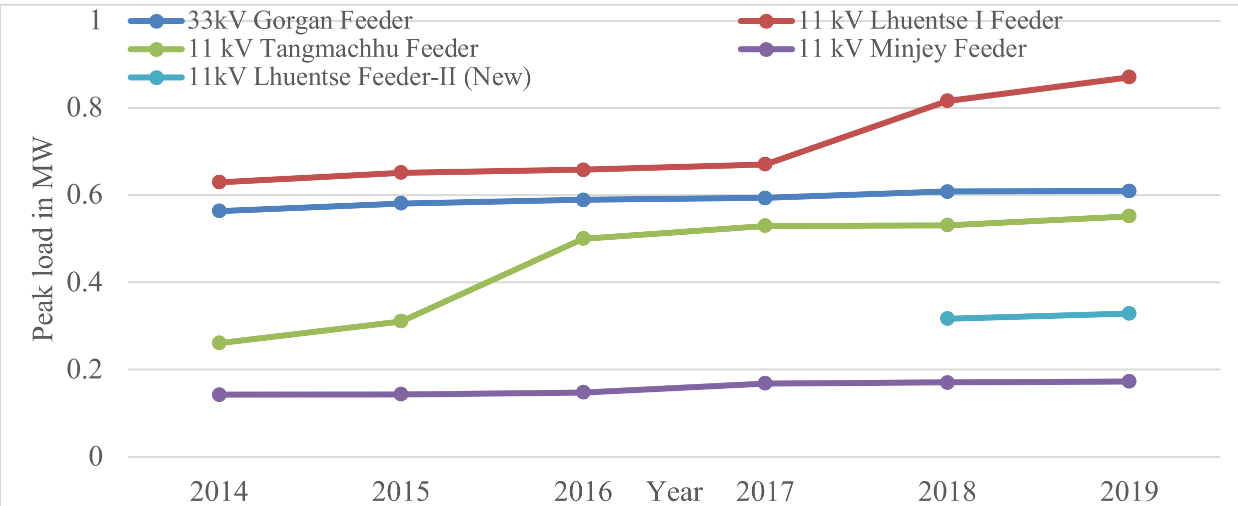


Figure 3: Peak Load (MW) of Tangmachu substation outgoing feeders

As can be inferred from **Figure 3,** the peak load of 11kV Tangmachu feeder has increased drastically from the year 2015-16 which could be due to construction activities in Takila. Similarly, the 11kV Lhuentse (Old) feeder saw similar trend from 2017 onwards due to establishment of power consuming activities like stone crushers, query and other commercial activities. As the 11kV Lhuentse Feeder-II (New) was constructed recently, it doesn't have any peak load data prior to 2018.

The assessment of the feeder is carried out based on the following aspects:

a) System study: Existing load
b) System study based on forecasted load: 2025 & 2030 scenario
c) System study: Without Mini/Micro Hydels

a) System Study (Existing Load)

Based on the peak load (2019-2020) and the thermal capacity of the line, the load flow and accordingly the assessment of the feeder was carried out. The simulation result shows no abnormality and the ampacity of the feeders will be within the range with the existing as well with the forecasted load. The thermal capacity of the different conductor sizes is as shown in **Table 4.**

Table 4: Thermal loading of ACSR conductor at different voltage levels

Sl. No.	ACSR Conductor Type	Ampacity of Conductor	MVA rating corresponding to the Ampacity
33 kV Voltage Level			
1	RABBIT	193	11.031
2	DOG	300	17.146
3	WOLF	398	22.748
11 kV Voltage Level			
1	RABBIT	193	3.677
2	DOG	300	5.715
3	WOLF	398	7.582

Ampacity (thermal loading) of the lines have been calculated based on IS 398 (Part-II): 1996 for maximum conductor temperature 85°C for ACSR conductors considering an ambient temperature of 40°C.

It is forecasted that the maximum peak load of the feeder would reach around 1MW for 11kV Tangmachu feeder by 2030. Therefore, the thermal loading capacities of the feeders will be within the permissible range.

b) System Study with Forecasted Load (2025 and 2030)

The peak power demand from 2014-2019 has been considered to forecast the peak power demand for the next 10 years (2020-2030) as shown in **Table 5** and **Figure 4** adopting the commonly practiced methodology of LRM and TSA with the help of ETAP. The detailed simulation result is attached as **Annexure-4.**

Table 5: Feeder wise load forecast (2020-2030)

Name of Feeder	Forecasted Load (MW)										
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
33kV Gorgan Feeder	0.62	0.63	0.64	0.65	0.66	0.67	0.68	0.69	0.70	0.70	0.71
11 kV Lhuentse I Feeder (Old)	0.76	0.78	0.81	0.83	0.85	0.88	0.90	0.92	0.95	0.97	0.99
11 kV Tangmachu Feeder	0.58	0.64	0.70	0.76	0.82	0.88	0.94	1.01	1.07	1.13	1.19
11 kV Minjey Feeder	0.18	0.18	0.18	0.18	0.18	0.19	0.19	0.19	0.19	0.19	0.20
11 kV Lhuentse II Feeder (New)	0.34	0.35	0.37	0.38	0.39	0.40	0.41	0.43	0.44	0.45	0.46

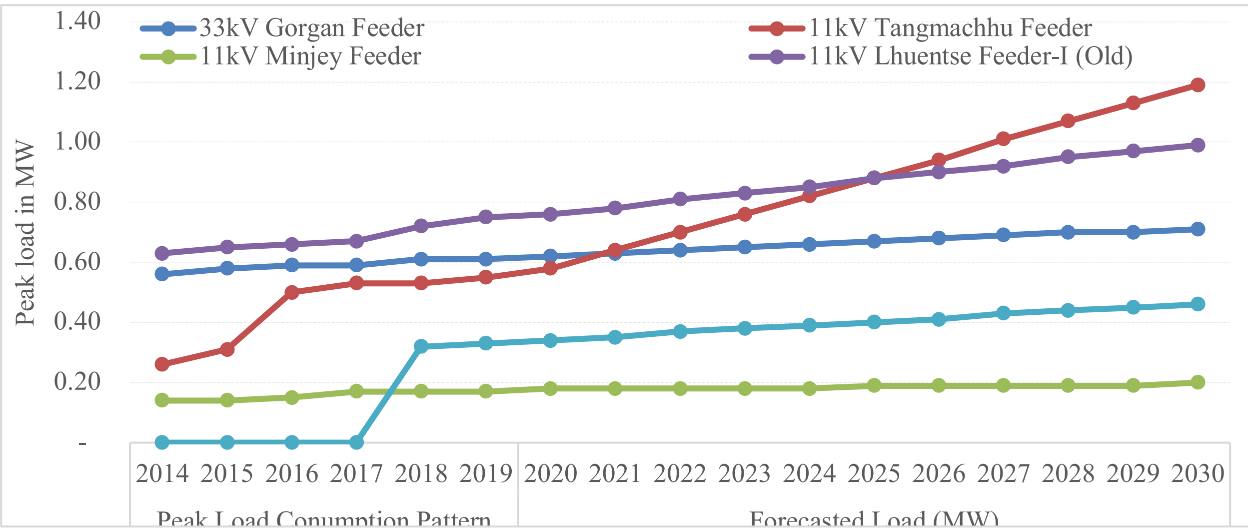


Figure 4: Plot of feeder wise peak power demand forecast

The simulation results for the feeders with marginal and critical voltage profile is tabulated in **Table 6** which is based on 2025 & 2030 forecasted load.

Table 6: Voltage profile of the feeders

Feeder Name	2025 Load (MW) and Voltage (%)			2030 Load (MW) and Voltage		
	Load	Bus	End	Load	Bus	End
33kV Tangmachu Bus	**1.68**	**100**		**1.90**	**100**	
33kV Gorgan	0.60	100	99.35	0.64	100	99.3
11kV Tangmachu Bus	**1.07**	**98.08**		**1.25**	**99.73**	
11kV Old Lhuentse	0.53	98.08	93.38	0.60	99.73	92.41
11kV New Lhuentse	0.13	98.08	96.48	0.14	99.73	95.92
11kV Minjey	0.18	98.08	97.46	0.19	99.73	97.06
11kV Tangmachu	0.24	98.08	97.68	0.31	99.73	97.21
Gangzur MHPP (120kW) to New Lhuentse	0.120	100	97.12	0.29	100	96.65
Rongchu MHPP (200kW) to Old Lhuentse	0.200	100	95.57	0.40	100	94.88

As is evident from above table, except for 11kV Lhuentse (Old) feeder the voltage profile would be within the acceptable range (±10%). The 11kV Lhuentse (Old) feeder would experience a marginal voltage dip with the 2030 loading. However, making use of the tap changer at Tangmachu substation and DT, the voltage profile would improve up to 94.70%.

c) System study (2025 and 2030 scenario) without Mini/Micro Hydels

The simulation results for the feeders with marginal and critical voltage profile is tabulated in **Table 7** which is based on 2025 & 2030 forecasted load and inclusive of when mini/micro power plants are non-operational.

As is evident from **Table 7,** the voltage profile would remain within acceptable range (±10%) and system would behave similar to that when the mini/micro hydels are operational except for 11kV Old Lhuentse feeder. The marginal variance may be due to the fact that the power generated by the two hydels are comparatively low when compared to that of the grid and as a result the system performance is not expected to alter significantly.

Table 7: Voltage Profile of the feeders without Mini/Micro Hydels

Feeder Name	**2025 Load (MW) and Voltage (%)**			**2030 Load (MW) and Voltage**			
	Load (MW)	**Bus V (%)**	**End V (%)**	**Load (MW)**	**Bus V (%)**	**End V (%)**	**Remarks**
33kV Tangmachu Bus	**2.24**	**100**		**2.536**	**100**		With use of tap changers in Tangmachu SS and at DTs, the voltage profile would be within the acceptable range.
33kV Gorgan	0.601	100	99.35	0.641	100	99.3	
11kV Tangmachu Bus	**1.626**	**97.28**		**1.877**	**96.8**		
11kV Old Lhuentse	0.849	97.28	89.67	0.963	96.8	88.16	
11kV New Lhuentse	0.369	97.28	94.46	0.418	96.8	93.57	
11kV Minjey	0.176	97.28	96.66	0.188	96.8	96.13	
11kV Tangmachu	0.232	97.28	96.88	0.308	96.8	96.27	

Resizing the trunk line of 11kV Lhuentse (Old) feeder from Rabbit to Dog was also explored and simulation result shows that there would be marginal voltage profile improvement from 92.51% to 92.58% which clearly indicates that it may not accrue significant voltage profile improvement by re-sizing the conductors.

It is also important for BPC to explore the best fit technology (e.g. installing AVR/voltage boosters) to improve the voltage profile rather than proposing to up-grade the entire conductor size which would be inconvenient to implement as it will involve frequent power interruptions.

7.2.2 Energy Loss Assessment of MV Feeders

Energy losses in the distribution network are inherent as the power transmission and distribution system are associated with the transformers and lines. However, it is crucial to maintain the energy loss at an optimal level by engaging in timely improvement of the distribution infrastructures and not reacting to the localized system deficiencies. The objective of the energy loss assessment is to single out the feeder (s) with maximum loss (es) and put in additional corrective measures to minimize to the acceptable range.

To carry out the assessment, the energy sales, purchase and loss is as tabulated in **Table 8** and as shown in **Figure 5.**

Table 8: Energy sales, purchase and loss trend

Sl. No.	Particulars	2015	2016	2017	2018	2019	Average
1	**Energy Requirement (MU)**						
i)	Purchase from GenCos as per TD bill	3.94	3.91	4.48	5.66	5.46	
ii)	Mini/Micro Hydel Generation	0.68	0.78	0.39	0.01	0.30	
iii)	Diesel Generation						
	Total	**4.62**	**4.70**	**4.87**	**5.66**	**5.76**	
	% growth over previous year	- 4.81%	1.62%	3.58%	16.43%	1.73%	3.71%
2	**Energy Sales (MU)**						
i)	**LV Total**	**4.20**	**4.66**	**4.53**	**4.83**	**4.99**	
ii)	Medium Voltage	0.00	0.00	0.00	0.00	0.00	
iii)	High Voltage	0.00	0.00	0.00	0.00	0.00	
	Total Energy Sales	**4.20**	**4.66**	**4.53**	**4.83**	**4.99**	
	% growth over previous year	0.69%	10.68%	-2.64%	6.56%	3.44%	3.75%
	Energy Loss (1-2)	**0.42**	**0.01**	**0.07**	**0.15**	**0.13**	**0.156**
	Total Loss (%)	**9.07%**	**0.96%**	**6.91%**	**14.8%**	**13.36%**	**9.02%**

Source: Adapted from Power Data Book 2019, BPC

Note: LV Customer: Domestic (Rural & Urban), Rural Cooperatives, Rural Micro-Trades, Rural Community Lhakhangs, Religious Institutions, Commercial, Industrial, Agriculture, Institutions, Street Lighting, Powerhouse auxiliaries, and Temporary connections.

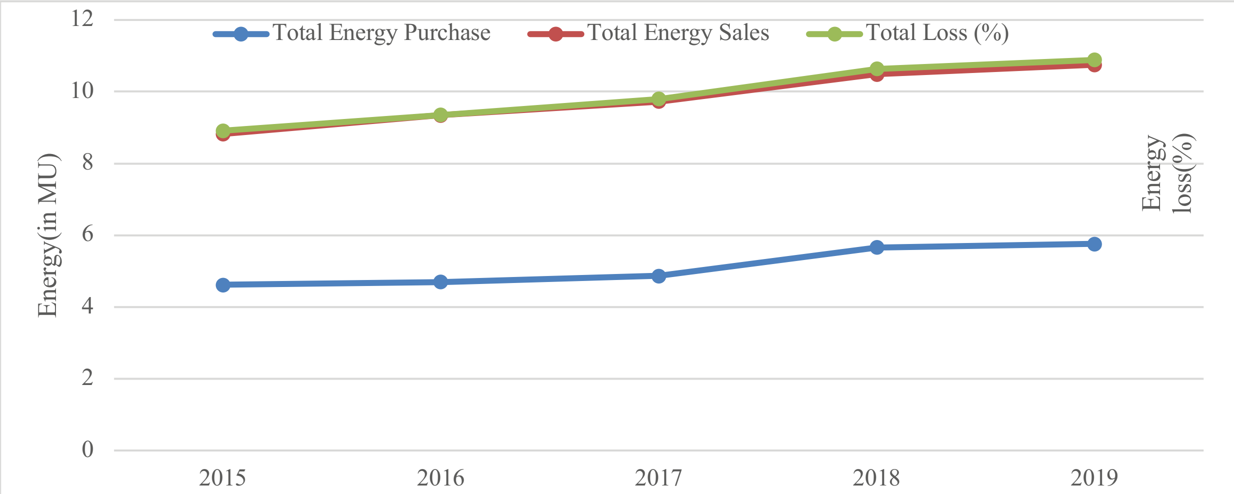


Figure 5: Energy sales, purchase and loss trend

As evident, the energy requirement has increased steadily over the year @ 3.71 % and so is the energy consumed @ 3.75 % on the average from the year 2015-2019.

Generally, the system loss (MV & LV) is 8.9% and any loss more than this for the distribution network would require in-depth study. An independent study carried out by 19 ESDs for 38 feeders in 2017 (two feeders each in ESD with more loss) showed that average of 6.84% is due to technical loss. The study also showed that loss pattern was never consistent because of variant characteristics of distribution network and loading pattern. The average loss index of Lhuentse (2015-2019) is 9.02% (0.156 million units on average) indicating that loss is within the acceptable range of the company. However, in the previous two years (2018 &2019), the average loss is 13.14% which is relatively high. Therefore, the Division office needs to carry out the study and develop strategies to reduce the loss. The feeder wise energy loss for 2019 is as tabulated in **Table 9** and **Figure 6.**

Table 9: Feeder wise energy loss (2019)

Sl. No.	Name of Feeder	2019		
		Energy Purchase (MU)	Energy Sales (MU)	Energy Loss (%)
1	33kV Gorgan feeder	1.73	1.49	13.57%

Sl. No.	Name of Feeder	2019		
		Energy Purchase (MU)	Energy Sales (MU)	Energy Loss (%)
2	11kV Old Lhuentse feeder	1.44	1.19	17.50%
3	11kV New Lhuentse feeder	0.67	0.57	14.17%
4	11kV Tangmachu feeder	1.40	1.27	9.14%
5	11kV Minjey feeder	0.52	0.47	11.33%
	Total	**5.76**	**4.99**	**13.37%**

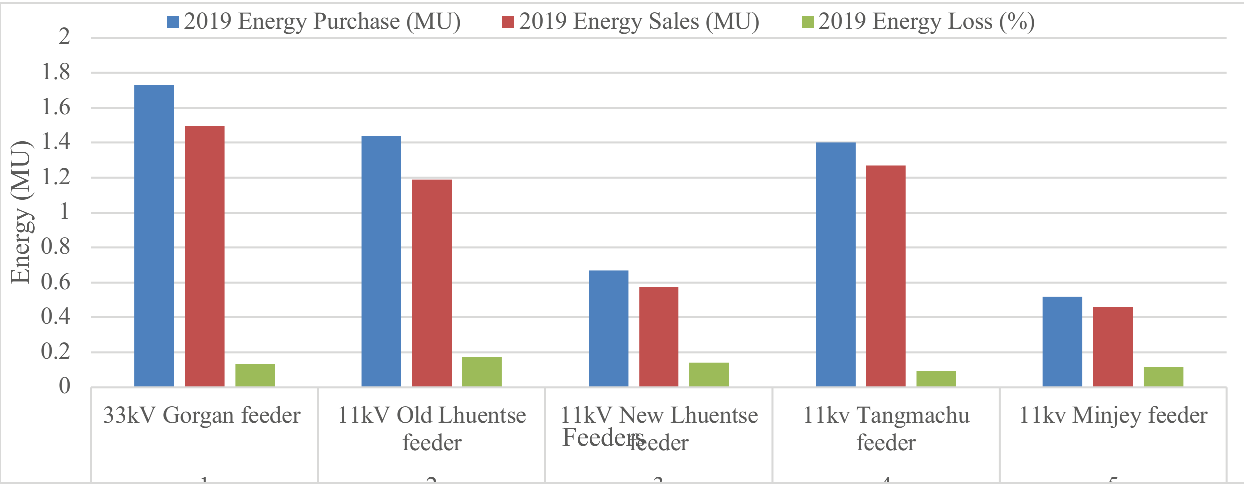


Figure 6: Feeder wise energy loss

It is evident that the losses contributed by every feeder are almost equal.

As the system study is till DT, the technical loss obtained through the ETAP software tool is for MV lines including the DT and doesn't account the loss due to LV network and transmission system. The simulation result shows only 1.79 % loss out of 9.02% as technical loss due to MV lines, DT and rest (7.23%) is due to LV and commercial loss. The feeder wise MV and DT technical loss is as shown in **Table 10.**

Table 10: Feeder wise power loss (Technical)

Sl. No.	Feeder Name	Total Load (MW)	Loss (MW)	Loss (%)
1	33kV Gorgan feeder	0.387	0.003	0.77%

Sl. No.	Feeder Name	Total Load (MW)	Loss (MW)	Loss (%)
2	11kV Old Lhuentse feeder	0.403	0.008	1.99%
3	11kV New Lhuentse feeder	0.225	0.005	2.22%
4	11kV Tangmachu feeder	0.162	0.002	1.23%
5	11kV Minjey feeder	0.17	0.004	2.35%
Overall (Total)		**1.340**	**0.024**	**1.79%**

7.2.3 Reliability Assessment of the MV Feeders

Today's emphasis in the power sector has shifted to providing reliable power supply as electricity itself is positioned as one of the essential needs. However, improving reliability comes with its inherent costs as it involves embracing additional preventive and corrective measures leading to substantial up-front capital investment. Any major reliability improvement strategies need to be adopted only after carefully understanding the costs involved and the benefits that will be accrued from implementing such strategies. Failure rate, repair time and restoration time are some important parameters defining reliability. Reducing the values of one or more of the above parameters can improve reliability considerably.

In addition to ensuring that the MV feeders have the required capacity, it is also very important to ensure that the MV feeders are reliable. In order to assess the reliability of the distribution system, the historical data was referred. The yearly (2017-2019) feeder reliability indices summary is compiled as tabulated in **Table 11** and details used to derive such summary is attached as **Annexure-5**. The interruptions with less than five minutes were omitted from the computation. The actual records (both within and beyond ESDs control) were considered to compute the actual representation of the reliability indices. The average reliability indices viz a viz SAIFI & SAIDI compiled from 2017-2019 are 2.50 & 8.13 respectively which indicates that the power supply to the customers of Lhuentse Dzongkhag is exceptionally reliable.

Table 11: Feeder wise reliability indices (2017-2019)

Sl. No.	Feeder	2017		2018		2019		Average	
		SAIFI	SAIDI	SAIFI	SAIDI	SAIFI	SAIDI	SAIFI	SAIDI
1	33kV Gorgan Feeder	0.62	0.49	0.30	0.16	0.33	0.17	**0.42**	**0.27**
2	11 kV Old Lhuentse Feeder	1.40	3.58	0.11	0.01	3.22	12.27	**1.58**	**5.29**
3	11 kV Tangmachu Feeder	0.14	0.27	0.97	-	-	0.14	**0.37**	**0.14**
4	11 kV Minjey Feeder	-	-	0.27	0.43	0.09	0.01	**0.12**	**0.15**
5	11 kV New Lhuentse II Feeder	-	-	-	-	0.04	6.85	**0.01**	**2.28**
	Total	**2.16**	**4.34**	**1.65**	**0.60**	**3.68**	**19.44**	**2.50**	**8.13**

Source: Adapted from monthly system performance report of DCSD, BPC
Notes:
(a) ***SAIFI*** *(System Average Interruption Frequency Index) = (Total no. of customer interruption per year)/ (Total no. of customers served)*
(b) ***SAIDI*** *(System Average Interruption Duration Index) = Σ (Total interruption duration per year)/ (Total no. number of customers served)*
(c) The interruption due to scheduled outages, momentary outages less than five minutes and outages due to failure of the grid are not taken into account.

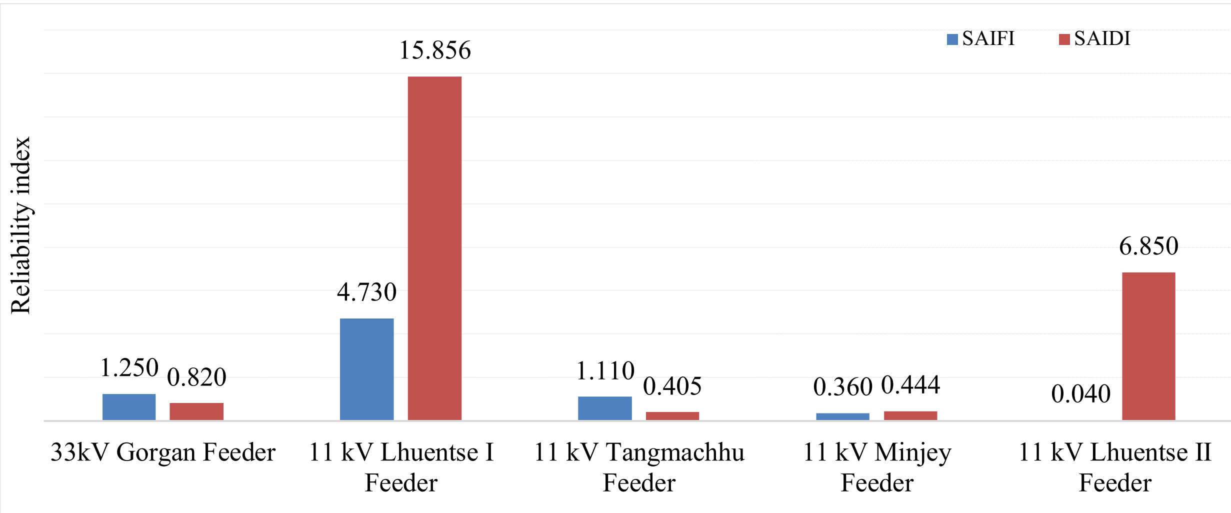


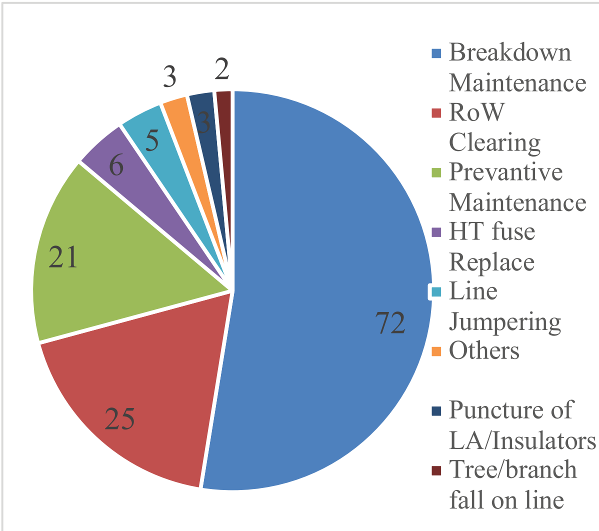
Figure 7: Graphical representation of reliability indices

As seen in **Table 11** and **Figure 7**, the 11 kV Old Lhuentse feeder has the highest interruption and duration index. The feeder has sustained more interruptions compared to other feeders which could be due to feeder passing through dense forests, tough terrains and has more spur lines.

To get a better understanding of the reliability index, the detailed root cause analysis for the feeders are carried and the inputs are as shown in **Table 12.**

Table 12: The root causes

Root Causes	Frequency	Distribution (%)
Breakdown Maintenance	72	52.55%
RoW Clearing	25	18.25%
Preventive Maintenance	21	15.33%
HT fuse Replace	6	4.38%
Line Jumpering	5	3.65%
Others*	3	2.19%
Puncture of LA/Insulators	3	2.19%
Tree/branch fall on line	2	1.46%



**Interruptions due to fire/landslide/animals*

The power outages are mainly due to shutdown undertaken for carrying out the breakdown and preventive maintenances, RoW clearing and HT fuse replacements. The breakdown maintenances are attributed due to damage of the equipment resultant to heavy fault or non-functional of the distribution lines and substations and its accessories. It is also evident that the interruptions are mostly of transient in nature caused by trees/branches/bamboos touching the lines momentarily, lightening & storm and heavy faults blowing off the HT fuses.

In order to improve the reliability, it is recommended to increase the frequency of ROW clearing, to monitor the health of the equipment and carry out timely preventive maintenance based on the root cause analysis portrayed in **Table 12.**

Reliability of the lines and substations can also be enhanced through training of line staff. They need to be equipped with the knowledge, skills, and the confidence to operate and maintain the distribution infrastructure. For instance, the linemen of the ESDs need to develop the confidence to change DO fuses online using hot sticks instead of the usual practice of taking shut down of the whole feeder. However, having the right tools, equipment, and especially spares (of appropriate specifications) is a prerequisite. Although it is not possible to quantify the reliability indices that can be achieved with preventive and corrective measures in place, the proposed contingency plans would significantly improve the power quality.

Although it is not possible to quantify the reliability indices that can be achieved with preventive and corrective measures in place, the proposed plans would however significantly improve the power reliability to the customers.

7.2.4 Single Phase to Three Phase Conversion

BPC during the RE expansion programs considered for low-load remote and rural homes with two of the three phases of the MV designed with single phase transformers. However, with the adoption of mechanized agricultural machineries, the requirement of three phase power to cater these loads is gaining an importance even in the rural areas. Therefore, R&DD, BPC in 2017 has carried out the "Technical and Financial Proposal on Converting Single Phase to Three Phase Supply" to come out with the alternatives for providing three-phase power supply where there are single phase power supplies. It was reported that while all the alternatives required the third conductor of the MV system to be extended on the existing poles following three proposals along with the financial impact were proposed:

a) Alternative -I

It was proposed to replace all the single-phase with three-phase transformers and this option as contemplated as not feasible as replacement by three phase transformers and distribution boards will lead to idle storage of single phase transformers of BPC.

b) Alternative -II

It was proposed to utilize the existing single-phase transformers to form three-phase transformations along with additional purchase of three-phase transformers and additional pole structures. Further, single phase transformers of identical make, type and rating can be only used to make three-phase power available.

c) Alternative -III

Option 3 is found to be techno-commercially viable alternative as the lines can be easily upgraded to three-phase by constructing third conductor on existing pole structures. The transformer can be up- graded from single phase to three-phase as and when the demand for 3-phase supply comes. The line up-gradation across the country would amount to Nu. 96.67 million (Detail in **Annexure-6**) excluding the cost of three-phase transformers which have to be procured on need-basis, rather than one-time conversion in general.

The total single phase line length required to be converted to three-phase in the Dzongkhag is 99.56km and the estimate for such conversion would require Nu. 12.32 Million.

As the single phase to three-phase network conversions is a demand driven planning, conversions works shall be carried out based on the demand from the customers which would be more techno-commercially viable alternatives. Therefore, considering the anticipatory conversion requirement, the conversion of networks is proposed in the later stage of the DSMP.

7.3 Assessment of the Distribution Transformers

7.3.1 Distribution Transformer Loading

The DTs are one of the most critical equipment of the distribution network and assessment of loading pattern along with the remaining asset life are crucial to ascertain the adequacy and performance of the transformer. The capability evaluation is based on historical peak load loading pattern and forecasted peak load growth of the feeder.

As per the peak loading pattern, some of the existing transformer capacities would not be adequate to cater the forecasted load growth for next ten (10) years. Accordingly, the capacities of the transformers need to be up-graded and such proposal is tabulated in **Table 13**. The individual DT loading details used to derive the summary is attached as **Annexure-7**.

Table 13: List of overloaded distribution transformers

Sl. No.	Transformer Name/Location	Capacity (kVA)	Existing Loading 2019		Loading (%)		Remarks
			(kVA)	%	2025	2030	
11kV Old Lhuentse Feeder							
1	Khoma School	16	7.36	46.01%	104.98%	118.86%	Load not expected as of 2025
2	Namgong	25	12.47	49.86%	113.76%	128.81%	Load not expected as of 2025
3	Tabee SS	25	9.89	39.56%	90.26%	102.19%	Load not expected as forecasted
4	Ambrangchu	25	21.63	86.52%	197.39%	223.49%	Replace within 2025
5	Chengling	25	21.11	84.46%	198.12%	224.31%	Replace within 2025
6	Wayway	16	6.35	39.68%	90.52%	102.49%	Load not expected as of 2025
7	Tabkhang	16	7.5	46.88%	106.94%	123.09%	Load not expected as of 2025
8	Chusa /Wamdrang	25	9.82	39.28%	89.63%	101.48%	Load not expected as of 2025
11kV Minjey Feeder							
9	Upper Jalang	25	24.19	96.75%	102.40%	108%	Replace within 2030
11kV New Lhuentse Feeder							
10	Old NHDCL Colony	63	56.16	89.15%	155.40%	178.65%	Replace with higher capacity
11	Tongkulung	63	40.89	64.91%	113.15%	130.09%	Load not expected as of 2025

Assuming that the load growth of the rural homes is not expected to grow similar to that of urban dwellings, it is strongly recommended to closely monitor the actual load growth and accordingly plan remedial measures for those transformers although some of the transformers would get overloaded as per the forecasted load. Nevertheless, considering the actual site-specific growth rate and judgment of the field offices, it is recommended that arrangements be made for the up-gradation of eleven (11) transformers as tabulated in **Table 13**. However, cross-swapping the existing transformers prior to procurement of new transformers would mean that, only four (4) transformers would require procurement.

7.3.2 Asset life of Distribution Transformers

The DTs are one of the most critical equipment of the distribution network. Therefore, assessment of existing loading pattern together with the remaining asset life is crucial to ascertain its capabilities to cater the projected load growth. The life cycle of transformer and its mapping provides the clear information for its optimal utilization and development of an asset replacement framework.

Although, as listed in **Table 14**, the DTs had already outlived the asset life, proper evaluation and testing should be required to find out the actual performance of the DTs and informed decisions can be made on the continuous use of the transformers. The life of the asset has been calculated from the year transformer is put into use.

Table 14: List of outlived distribution transformers

Asset Code	DT Location Name	Capacity (kVA)	MFD	2019	2025	2030
1501997	Jabee Army Camp SS	100	1995	24	30	35
1500510	Thinleypang SS	16	1993	26	32	37

7.3.3 Replacement of Single Phase Transformer

As discussed in the “Single Phase to Three Phase Conversion” of the distribution network it will be more economical and technically feasible to convert the single to three phase transformers on need basis. Total of Nu. 283.00 million is estimated for replacing the entire single transformer including the distribution board. The detailed work out is produced as **Annexure-8.**

There are 74 single phase transformers in the Dzongkhag and the estimate for up-grading all the single to three-phase transformers would require Nu. 15.46 Million. As the conversion from single to three-phase transformer is demand base, the plan has been distributed in ten year-span.

7.4 Power Requirement for Urban Areas by 2030

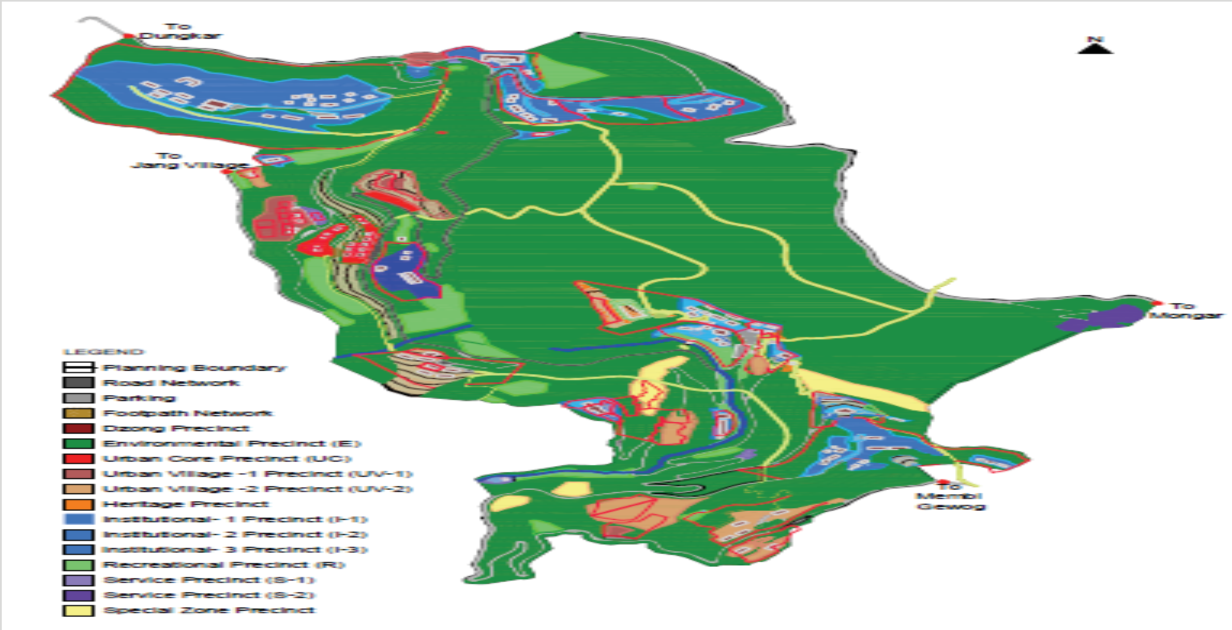


Figure 8: Lhuentse town with various located precinct area

The Dzongkhag's Thromde stretches from Dzong till Tongkangla-BPC colony area. As the town is located in steep slopes, the Ministry of Work and Human Settlements had planned only for light structural construction and other smaller recreational activities. Therefore, depending upon the degree of activities planned, the town would not require huge electrical infrastructure and power.

Nevertheless, in order to meet the additional load, it is proposed to install 500kVA PSS in 2021. **Figure 8** shows the various precincts under the Municipal area. The PSS was proposed owing to space constraint in Lhuentse town.

8. Distribution System Planning until 2030

The distribution network of the Dzongkhag has a radial topology with significant risk of high interruptions (fault in one location would mean that the entire customer in the network would experience the outage). Having alternate routes, sources or any contingency plan would significantly improve the reliability and power quality. In order to have robust and hard-lined distribution network, there is a need for good contingency plans with adequate sources to reduce the downtime. However, any provision to improve the power system would incur additional capital cost in addition to recurring additional preventive and corrective costs.

Therefore, to meet the system shortfalls against the set standard and to keep abreast with the forecasted load growth, proper distribution system planning is required which are detailed from **Section 8.1** through **Section 8.4.**

8.1 Power Supply Source

8.1.1 HV substation

The Dzongkhag doesn't have any HV substation under its administration.

8.1.2 MV Substation

As detailed in **Section 7.1.2,** Tangmachu MV substation would be adequate to meet the existing and forecasted power demand.

8.2 MV Lines

The detail MV line assessment made in **section 7.2** shows that the MV lines would be adequate to cater the existing as well as the future load till 2030.

8.3 Distribution Transformers

As detailed in **Section 7.3.1,** the DTs of Ambrangchu, Chengling, Upper Jalang and Old NHDCL Colony would be required to up-grade as it is forecasted to get overloaded. Further, to meet the increasing load of Lhuentse town, it would require installing additional 500kVA PSS.

8.4 Switching and Control

Switching and control system is required to take care of the system during faulty situations which ultimately is going to take care of the failure rate, repair and restoration time. This in turn would improve the reliability, safety of the equipment and online staff, optimizes the resource usage and more importantly the revenue generation will be enhanced. In order to capture the real time data and information, it is inevitable to have automated and smart distribution system. The feeders which are more susceptible to faults are identified with proposed restorative measures through the studies. With the exception of tripping of breakers in the sending end substations, existing distribution network is neither automated nor smart to detect the faults and respond in real-time manner. The automation and smart grid components are detailed in Smart Grid Master Plan 2019.

8.4.1 Intelligent Switching Devices

As per the detailed reliability assessment of individual feeders in **Section 7.2.3**, the 11kV Lhuentse (Old) feeder is more susceptible to power interruptions as evident from the historical data. There are ARCB and LBS installed in this feeder. However, to further improve the reliability of the feeder, it proposed to revive the ARCBs, install sectionalizers and FPIs in the strategic locations.

In order to improve reliability and power quality of the 11kV Lhuentse (Old) including other feeders, it is proposed to have technology in place to respond to fault and clear it accordingly rather than through ex-post facto approach. Therefore, it is proposed to enhance the existing switching and control system by having latest suitable and user-friendly technology (automatic). The coordinated arrangement of Intelligent Switching Devices (ISD) like ARCBs, Sectionalizers and FPIs would significantly improve the control and operation mechanism of the network. **Figure 9 & Table 15** shows the list of proposed switching devices for easing operation and maintenance and for improving the reliability of the power supply for the Dzongkhag.

However, the quantum and location of the devices to be installed shall be based on the Smart Grid Master Plan 2019.

Table 15: List of switching equipment

Sl. No.	Name of Feeder	ARCBs		FPIs		
		Existing (nos.)	Proposed (Nos.)	Existing (nos.)	Proposed (Nos.)	Proposed Location
1	33kV Gorgan Feeder	3	0	0	0	

Sl. No.	Name of Feeder	ARCBs		FPIs		
		Existing (nos.)	Proposed (Nos.)	Existing (nos.)	Proposed (Nos.)	Proposed Location
2	11 kV Old Lhuentse I Feeder	1	0	0	10	Khoma, Tabee, Ney
3	11 kV Tangmachu Feeder	0	0	0	0	
4	11 kV Minjey Feeder	0	0	0	0	
5	11 kV New Lhuentse II Feeder	0	0	0	0	
	Total	**4**	**0**	**0**	**3**	

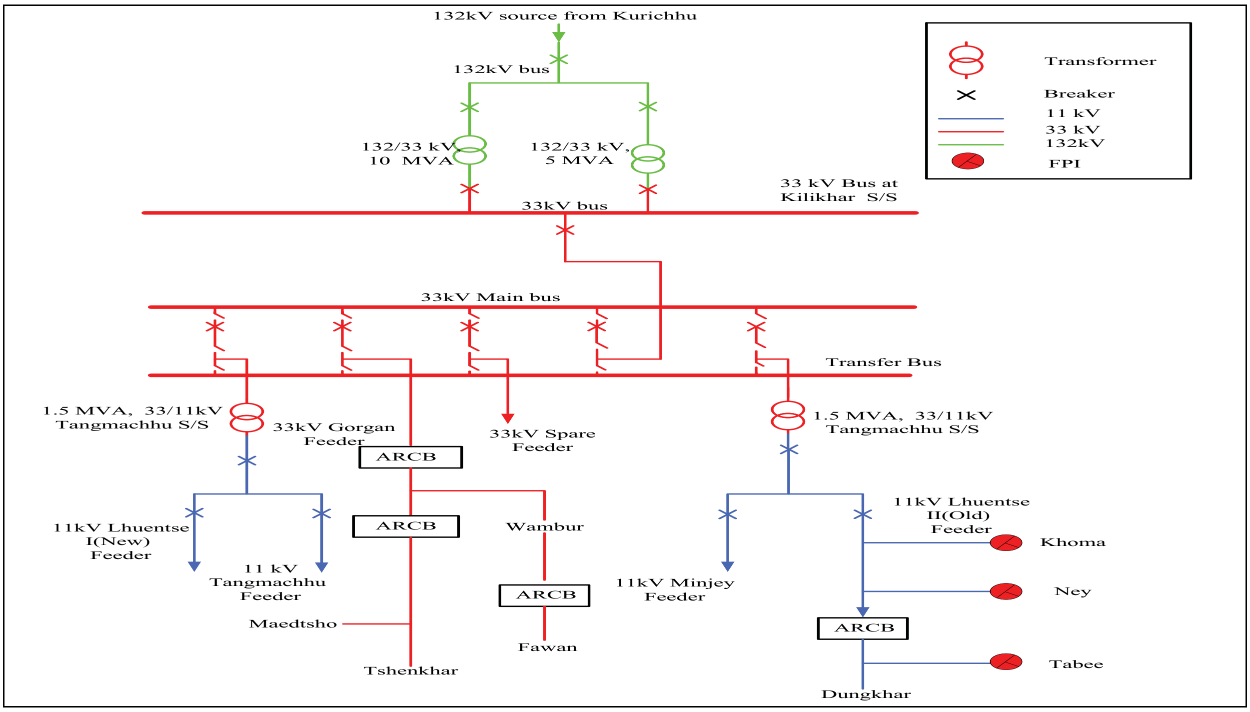


Figure 9: Switching equipment for distribution network

8.4.2 Distribution System Smart Grid

The distribution grid modernization is outlined in Smart Grid Master Plan 2019 including the investment (2020-2027). The DMS, ADMS, DSCADA features along with their components and functionalities, the timeline for the programs and the cost estimates of the smart grid are lucidly reflected. Therefore, this report exclusively entails the identification of the system deficiencies and qualitative remedial measures which would require system augmentation and reinforcement as per the existing and projected load.

9. Investment Plan

In accordance to the above mentioned contingency plans targeted to improve the power quality, reduce losses and improve reliability indices of the Dzongkhag, investment proposal is developed. The investment plan has been confined to power supply sources, MV lines, DTs, switching and control equipment and RoW. The proposed/approved (2020-2024) investment plan and any new investment plans have been validated and synced with the system studies carried out. The annual investment plan (2020-2030) has been worked out based on the priority parameters set out as shown in **Figure 10.**

How important is the task?			
	Highly Important	Action: Do First **I**	Action: Do Next **II**
	Important	**Action: Do Later III**	No Action: Don't Do **IV**
		More Urgent	**Urgent**
How urgent is the task?			

Figure 10: Priority Matrix

The matrix gives us the basis on the prioritization of the investments to be made in the ten-year schedule as every activity cannot be carried out at a time. The activities which have to be carried out due to load growth, developmental activities and retrofitting of obsolete/defective switchgears and equipment will have the highest level of importance and urgency. These activities have to be prioritized and invested in the initial years which are grouped in the first quadrant (Do First).

Similarly, there are certain activities although might be very important but not so urgent can be planned in the later stage of the year (Do Next). These activities can be but not limited to improving the reliability, reducing losses and reconfiguration of lines and substations to reduce the losses and improving the power quality. The activities which are not so important but are highly urgent have to be also planned in later stage of the period.

According to the investment prioritization matrix framework, the yearly investment plan along with the cost estimation is derived and is consolidated in **Table 15** as an investment plan. The cost estimates have been worked out based on the BPC ESR-2015 and annual inflation is cumulatively applied to arrive the actual investment cost for the following years.

In the span of next 10 years (2020-2030), the total projected investment required to build adequate infrastructure and deliver the quality power to the customers of Lhuentse Dzongkhag is Nu. 36.60 million (Nu 3.66million per year).

Table 16: Investment Plan till 2030

Sl. No.	Activities	Investment Plan (Million Nu.)											Total
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	
1	**MV Lines**												**-**
2	**Distribution Transformers**	-	3.00	1.40	-	-	-	-	-	-	-	-	**4.40**
2.1	Installation of 500kVA (11/0.415kV) PSS in Lhuntse town		3.00										**3.00**
2.2	Up-rate 11/0.415kV, 25kVA DT of Ambrangchu to 63 kVA			0.30									**0.30**
2.3	Up-rate 11/0.415kV, 25kVA DT of Upper Jalang to 63 kVA			0.30									**0.30**
2.4	Up-rate 11/0.415kV, 25kVA DT of Chengling to 63 kVA			0.30									**0.30**
2.5	Up-rate 11/0.415kV, 63 kVA DT of Old NHDCL Colony to 125 kVA			0.50									**0.50**
3	**Others**												
3.1	Conversion of single to three-phase line		1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	**12.30**
3.2	Replacement of single phase by three phase transformers		1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	**15.50**
	Total		**8.78**	**5.58**	**2.78**	**2.78**	**2.78**	**2.78**	**2.78**	**2.78**	**2.78**	**2.78**	**36.6**

10. Conclusion

Based on the inputs from the Divisional office, validated data, assessment of the existing distribution network, and the reliability analysis, recommendations are made for system modifications and improvements. Costs associated with each recommendation are presented in several phases so that work may continue at a pace that is determined by fund availability and the capacity of the office to execute the work. An attempt is made to prioritize the recommendations; however, there will undoubtedly be adjustments in the order and priority by which the investments will be actually implemented.

The third option which would be the least-cost alternatives for converting the single to three phase distribution networks where all the MV lines will have to be converted to three phase and replacing the single phase by three phase transformers on need basis.

Although the report entails the identification of system deficiencies and reinforcement required, for automation and smart operation of the distribution network, the smart grid infrastructure development with functionalities are detailed in “Smart Grid Master Plan 2019”. Therefore, the DSMP-Smart Grid Master Plan-Hybrid is necessary which can be amalgamated during the rolling out of annual investment and budget approvals.

Proportion of LV is higher in comparison to MV line length; accordingly, the independent study carried out by BPC in 2017 showed that large portion of loss is due to LV and DT. Therefore, similar system study beyond DT has to be carried out in order to capture the entire network and strategize to develop the blue print.

11 Recommendation

Sl. No.	Parameters	Recommendations
A. Power Supply Sources		
1	HV Substations	No HV substations under the administration of the Dzongkhag/Division.
2	MV Substations	The 33/11kV Tangmachu substation would be adequate to cater the load requirement.
B. MV Lines		
1		
C. Distribution Transformers		
1	Distribution Transformers	As reflected in **Section 7.3.1** of this report, it is proposed to regularly monitor the loading pattern especially of the urban transformers. It is desired to load the transformers less than 85% so as to ensure that transformer is operated at maximum efficiency. As the system study is restricted to DTs, the loads need to be uniformly distributed amongst the LV feeders to balance the load.
2	Single to Three Phase Transformers	As reported in the "Technical and Financial Proposal on Converting Single Phase Power Supply to Three Phase in Rural Areas", it is recommended to replace the single to three phase transformers on need basis.
D. Switching and Control Equipment		
1	Switching and Control Equipment	It is recommended to install Intelligent Switching Devices (ISD) like ARCBs, Sectionalizers and FPIs as proposed which would reduce the downtime for clearing faults. 1) Install FPI, Sectionalizes and ARCBs at various identified locations. 2) Installation of 11kV& 33kV RMUs at various identified locations.
E. others		
1	Investment Plan	As reflected in **Section 9** of this report, overall investment plan as proposed is recommended.
2	Review of the DSMP	Practically the projections will hold only true in the nearest future therefore, it is strongly recommended to review the DSMP in 2025 (after five years) or if need be as and when situation demands.
3	System Studies beyond DT	It is observed that distribution of electricity is more through LV than MV & HV and the scope of DSMP terminates at DT. However, it is equally important to carry out similar system studies for LV networks till meter point. Due to time constraint and non-availability of required LV data, it is recommended to carry out the studies on LV network including the DTs. Nevertheless, with the entire distribution network captured in the GIS and ISU, the system studies should be carried out including the LV network in

Sl. No.	Parameters	Recommendations
		the future.
4	Customer Mapping	One of the important parameters required especially for reaffirming the capability of the DTs is by examining customer growth patterns. Therefore, it is recommended to consistently update the customers via customer mapping process carried out annually.
5	Right of Way	RoW should be maintained as per the DDCS 2016. However, increased frequency of RoW clearing in the problematic sections of the line and in fast growth sub-tropical forest is recommended.
7	Asset life of DTs	The asset life of DTs needs to be gathered to enable development of asset replacement framework. However, it is recommended to regularly monitor the health of the transformers which have already outlived their lives.
8	Overloading of DTs	As per the load forecast, some of the rural DTs might overload. While the probability of realizing such an event is quite low. It is, however, recommended that the DTs that have already exhausted its statutory life (25 years and above) be regularly monitored.
9	New extension through 33kV network	The power carrying capacity of 33kV system is almost 3-fold compared to that of 11kV system. Therefore, any new extension of lines may be done through 33kV system (based on fund availability and practical convenience).
10	Reliability	In order to improve the reliability of the feeder/network, it is recommended that fault should be located within short period of time there by reducing the restoration time and the number of customers affected. In this regard, the following initiatives are recommended: 1) To install ISDs (communicable FPIs, Sectionalizers & ARCBs); 2) To explore with construction of feeders with customized 11kV & 33kV towers; and 3) To increase the frequency of Row clearing in a year.

12. Annexure

Annexure-1: MV Line Details and Single Line Diagram.

Annexure-2: IS 2026, IEC 60076 (Technical parameters for Distribution Lines and Transformers).

Annexure-3: The details on load forecast methodology.

Annexure-4: Detailed Simulation Results.

Annexure 5: Feeder Wise Reliability Indices.

Annexure-6: Material Cost for Upgrading single phase (11 kV and 33 kV) Lines to three-phase.

Annexure 7: Distribution Transformer loading.

Annexure-8: Material Cost of three-phase (3Φ) Transformers.

13. References

1. The FWPL and CPL from TD, BPC as of 2018.
2. BPC Power Data Book 2018.
3. BPC Distribution Design and Construction Standards (DDCS)-2016.
4. BPC Smart Grid Master Plan (2019-2027).
5. BPC National Transmission Grid Master Plan (2020 & 2030).
6. BPC Operation and Maintenance Manual for Distribution System (2012).
7. BPC Corporate Strategic Plan (2019-2030).
8. Population and Housing Census of Bhutan 2019.
9. The Structural Plan (2004-2027) for every Dzongkhag.
10. Lhuentse City Development Strategy (2008).
11. Industrial Parks (Department of Industry).
12. BPC Electrical Schedule of Rates 2015.

14. Assumptions

1. All the distribution network was considered as Balanced System (Restriction with the existing ETAP Key);
2. All DTs considered as lump load and depending upon the type of load connected to the feeder, ratio of 80% (static load) to 20% (industrial feeders) were assumed;
3. The voltage level of ±10% is given as critical value which is indicated by red color while simulating and voltage level of ±5% is given as marginal value which is indicated by pink color while simulating.
4. The typical inbuilt value of X/R ratio of ETAP tool was considered for all the transformers;
5. Dimensions and parameters of some cables/UG cables are customized in the library as per the requirement;
6. The technical parameters which are required for analysis of the distribution network have been considered as per the set standard of DDCS.

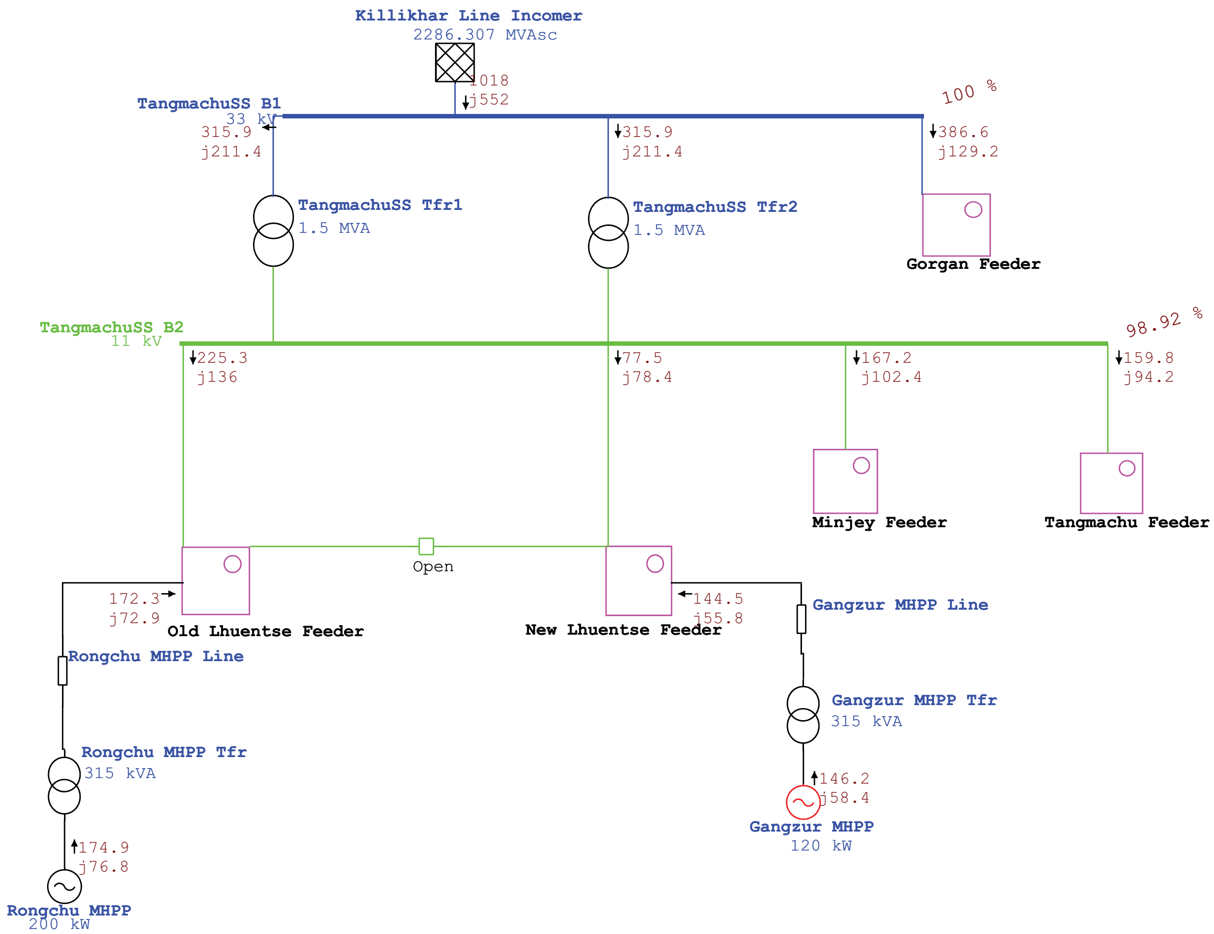
15. Challenges

Sl. No.	Parameters	Challenges	Opportunities/Proposals
1	Software Tool (ETAP)	a) Only one key & off-line Key b) Balanced Load Flow c) Limitations of No. of buses (1000)	a) Can opt for on line key with fewer more modules especially to carry out the technical evaluation of un-balanced load flow system. This would be more applicable and accrue good result for LV networks.
2	Data	a) No recorded data (reliability & energy) on the out-going feeders of MV SS	a) Feeder Meters could be install for outgoing feeders of MV substations to record actual data (reliability & energy)
		b) Peak Load data of DTs which were recorded manually may be inaccurate due to timing and number of DTs.	b) In order to get the accurate Transformer Load Management (TLM)/loading, it is proposed to install DT meters which could also have additional features to capture other required information.
		c) No proper feeder and DT wise Customer Mapping recorded	c) Customer Information System (CIS) of the feeder/DT would enable to have proper TLM and replacement framework.
3	Manpower	a) Resource gap in terms of trained (ETAP) and adequate engineers (numbers)	a) Due to lesser number of trained engineers in the relevant fields (software), engineers from other areas were involved.

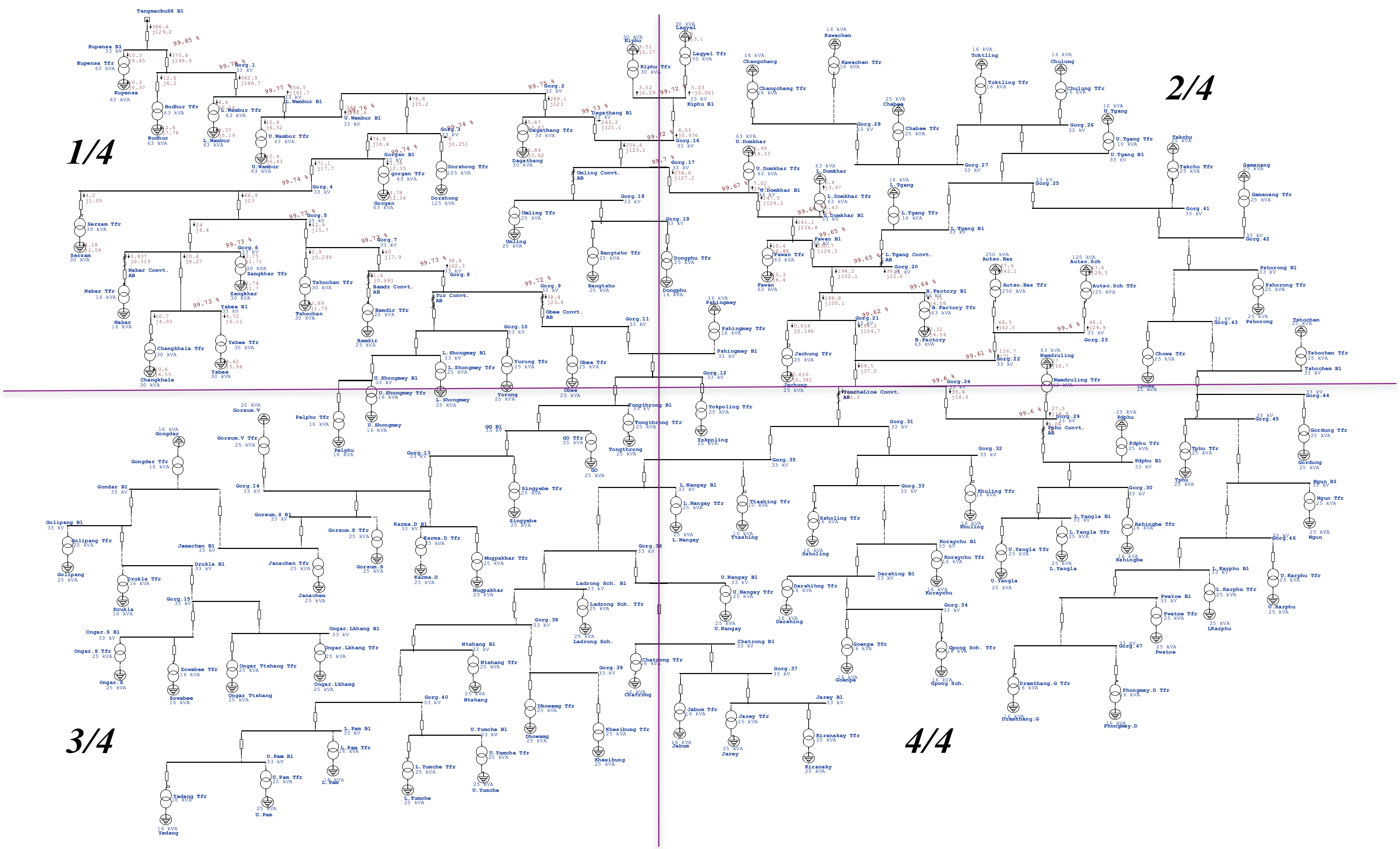
12.Annexures

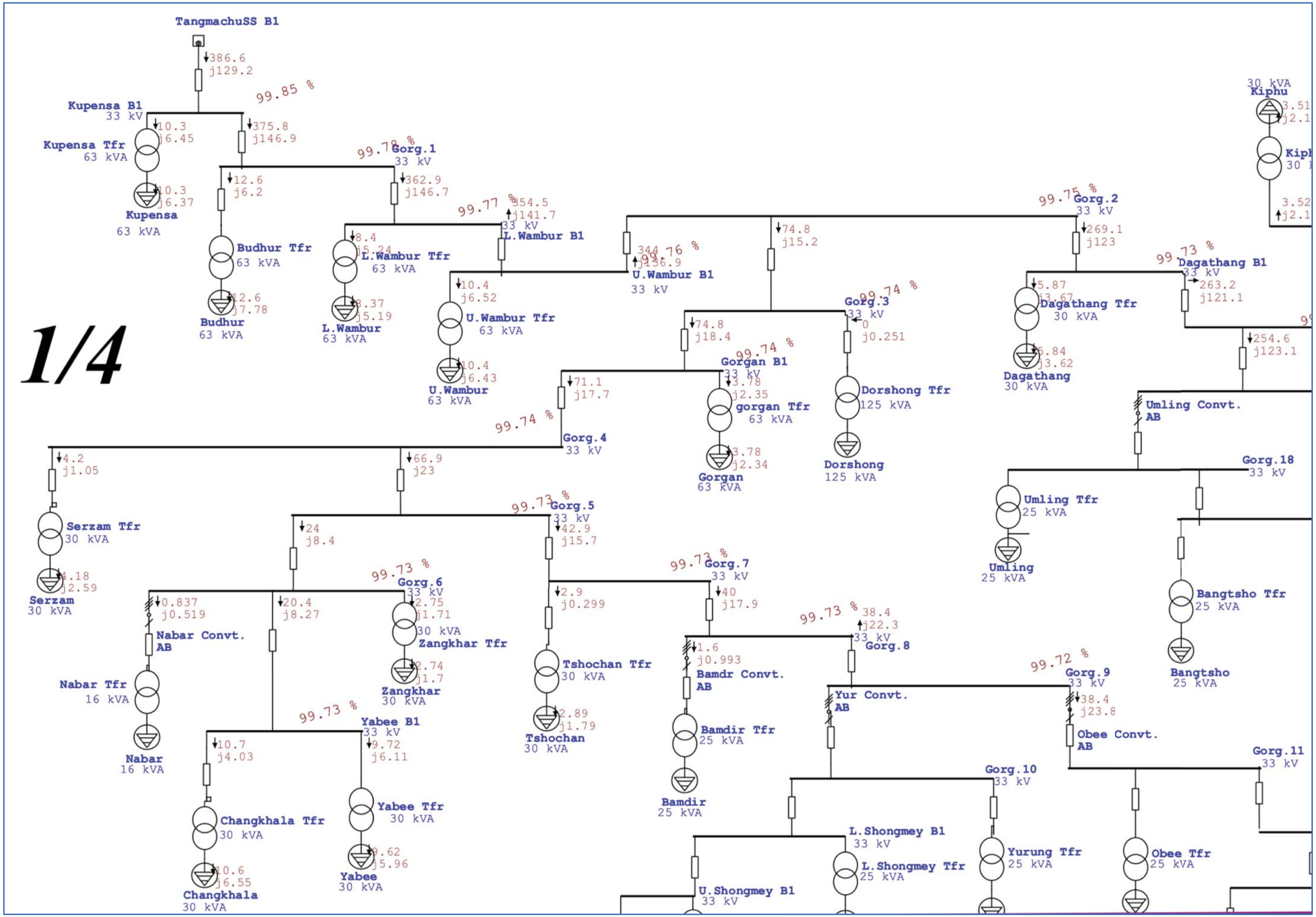
Annexure-1: MV Line Details and Single Line Diagram

One-Line Diagram - OLV1 (Load Flow Analysis)

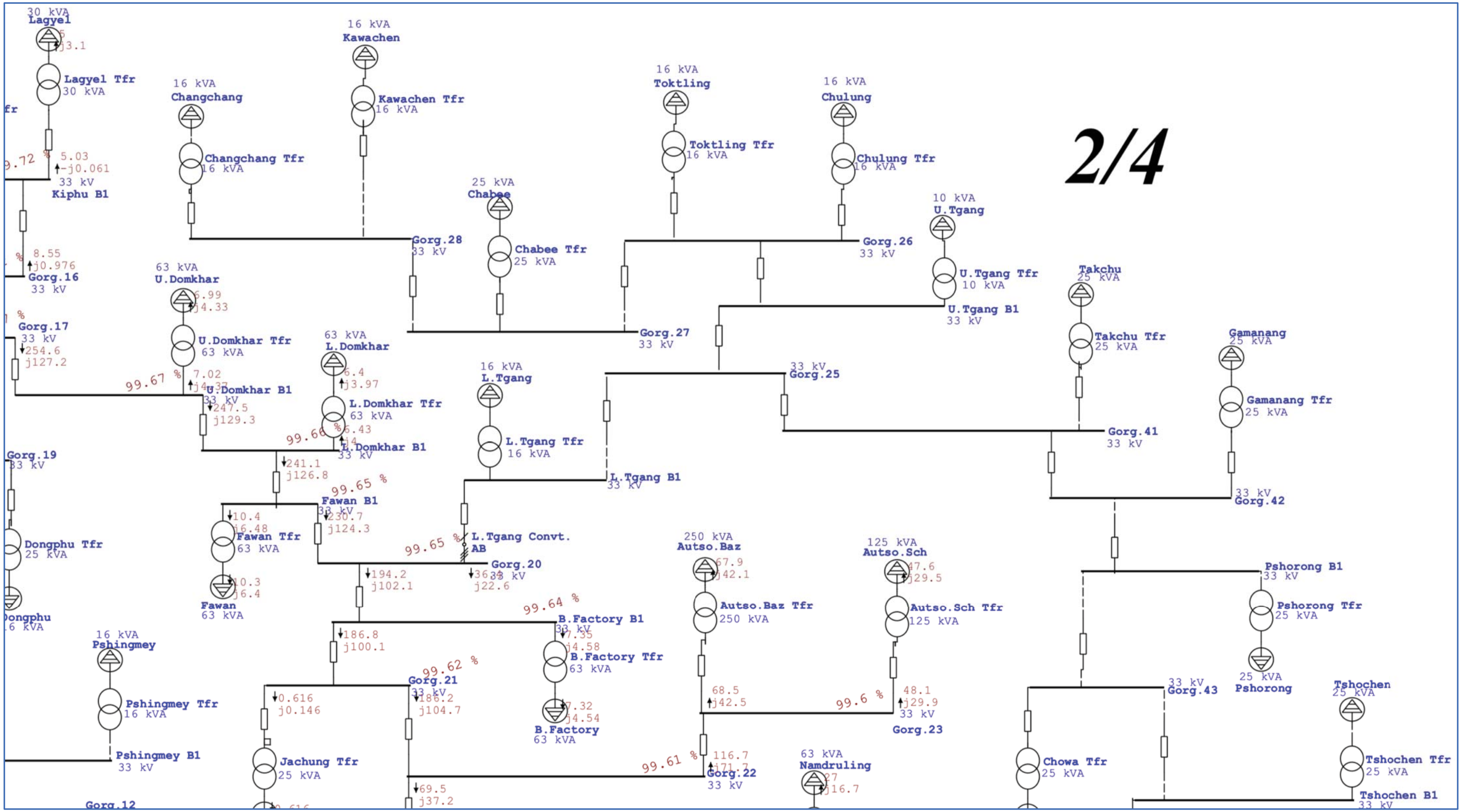


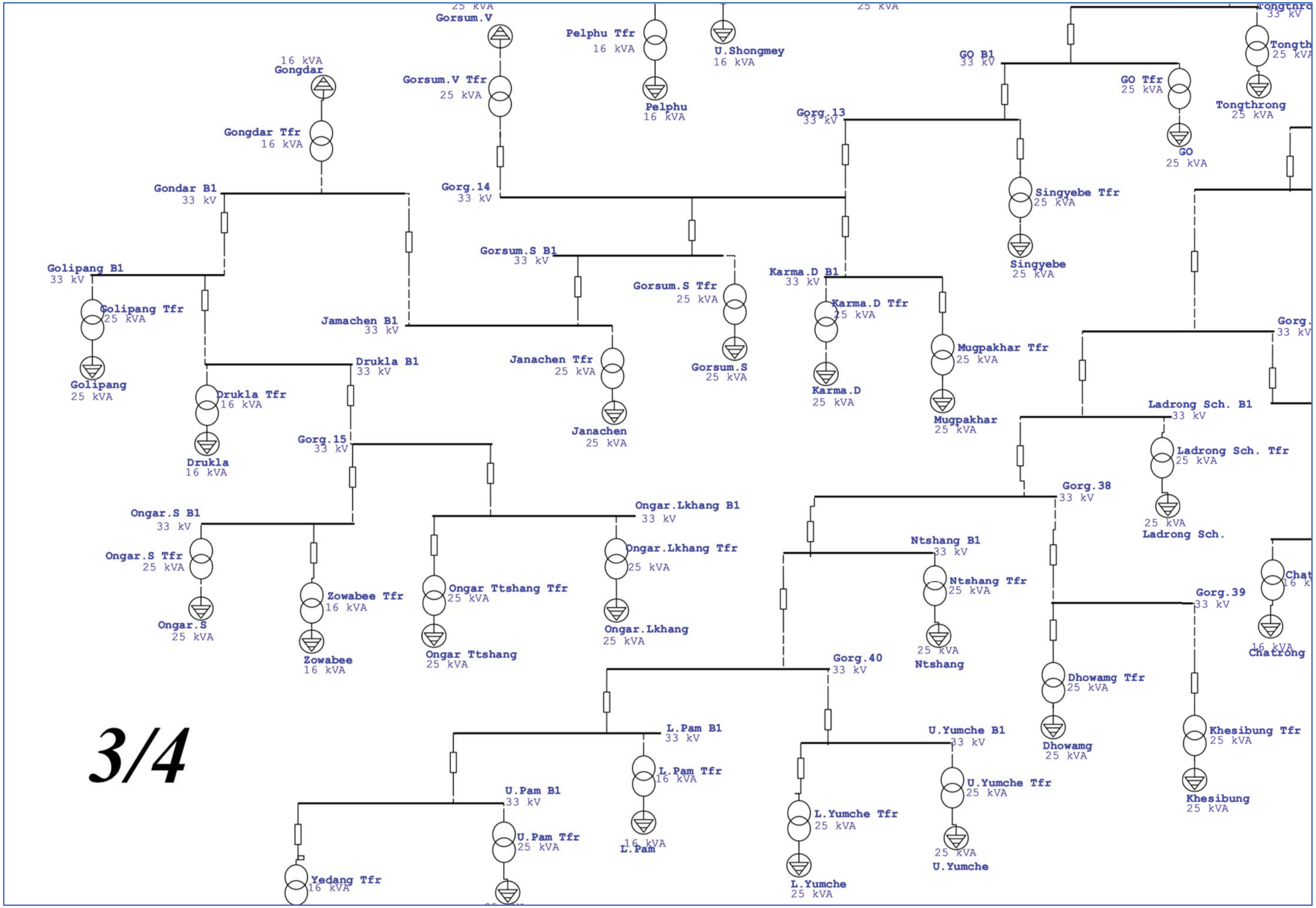
One-Line Diagram - OLV1=>Gorgan Feeder (Load Flow Analysis)

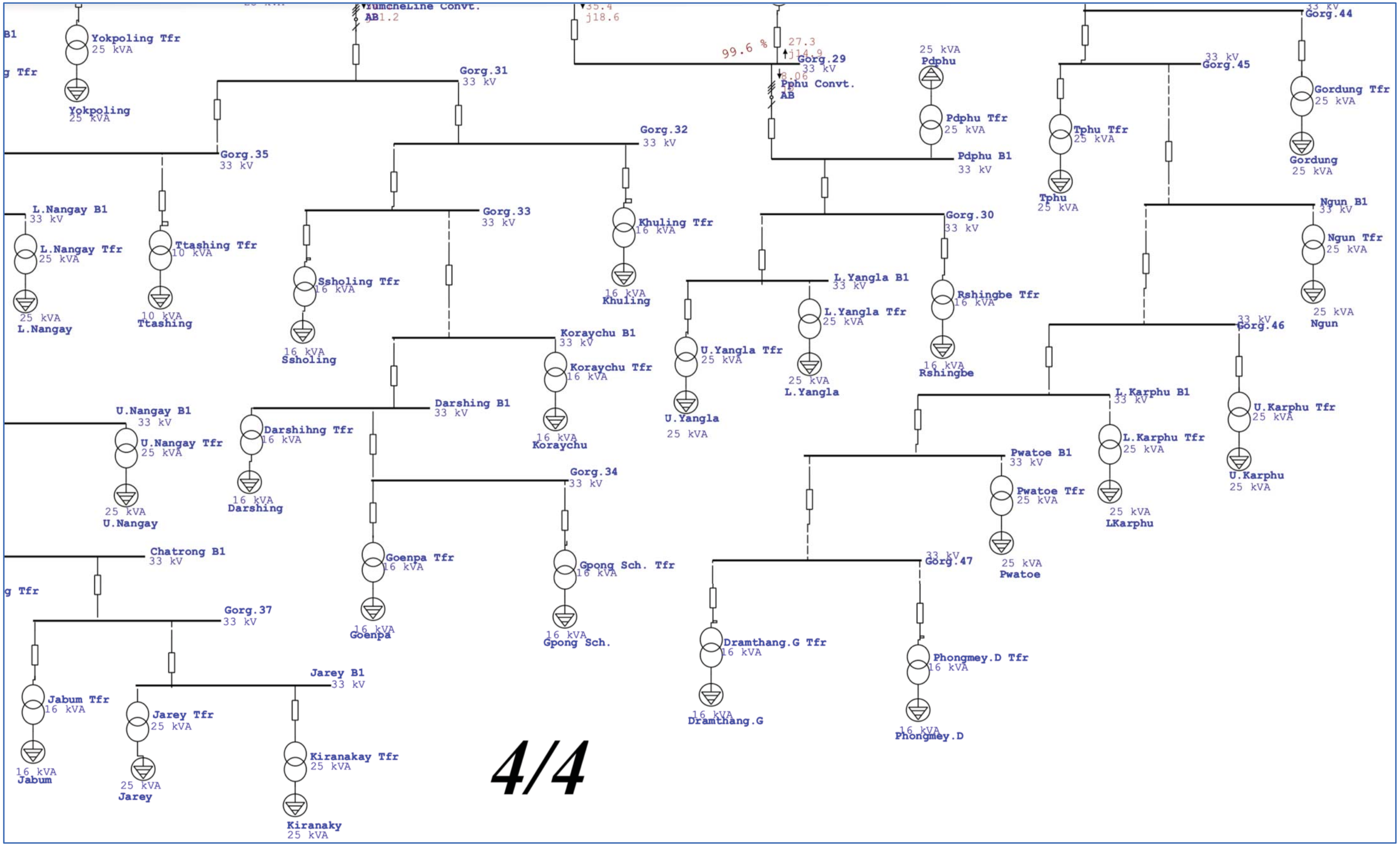




1/4
TangmachuSS B1
Kupensa B1
33 kV
Kupensa Tfr
63 kVA
Kupensa
63 kVA
Gorg.1
33 kV
Budhur Tfr
63 kVA
Budhur
63 kVA
L.Wambur B1
L.Wambur Tfr
63 kVA
L.Wambur
63 kVA
U.Wambur B1
U.Wambur Tfr
63 kVA
U.Wambur
63 kVA
Gorg.2
Dagathang B1
Dagathang Tfr
30 kVA
Dagathang
30 kVA
Gorg.3
Dorshong Tfr
125 kVA
Dorshong
125 kVA
Gorgan B1
gorgan Tfr
63 kVA
Gorgan
63 kVA
Gorg.4
Serzam Tfr
30 kVA
Serzam
30 kVA
Gorg.5
Tshochan Tfr
30 kVA
Tshochan
30 kVA
Gorg.6
Zangkhar Tfr
30 kVA
Zangkhar
30 kVA
Nabar Convt.
AB
Nabar Tfr
16 kVA
Nabar
16 kVA
Yabee B1
Yabee Tfr
30 kVA
Yabee
30 kVA
Changkhala Tfr
30 kVA
Changkhala
30 kVA
Gorg.7
Bamdr Convt.
AB
Bamdir Tfr
25 kVA
Bamdir
25 kVA
Gorg.8
Yur Convt.
AB
Gorg.9
Obee Convt.
AB
Obee Tfr
25 kVA
Gorg.10
Yurung Tfr
25 kVA
Gorg.11
L.Shongmey B1
L.Shongmey Tfr
25 kVA
U.Shongmey B1
Umling Convt.
AB
Gorg.18
Umling Tfr
25 kVA
Umling
25 kVA
Bangtsho Tfr
25 kVA
Bangtsho
25 kVA
Kiphu
30 kVA
99.85 %
99.78 %
99.77 %
99.76 %
99.75 %
99.74 %
99.73 %
99.72 %

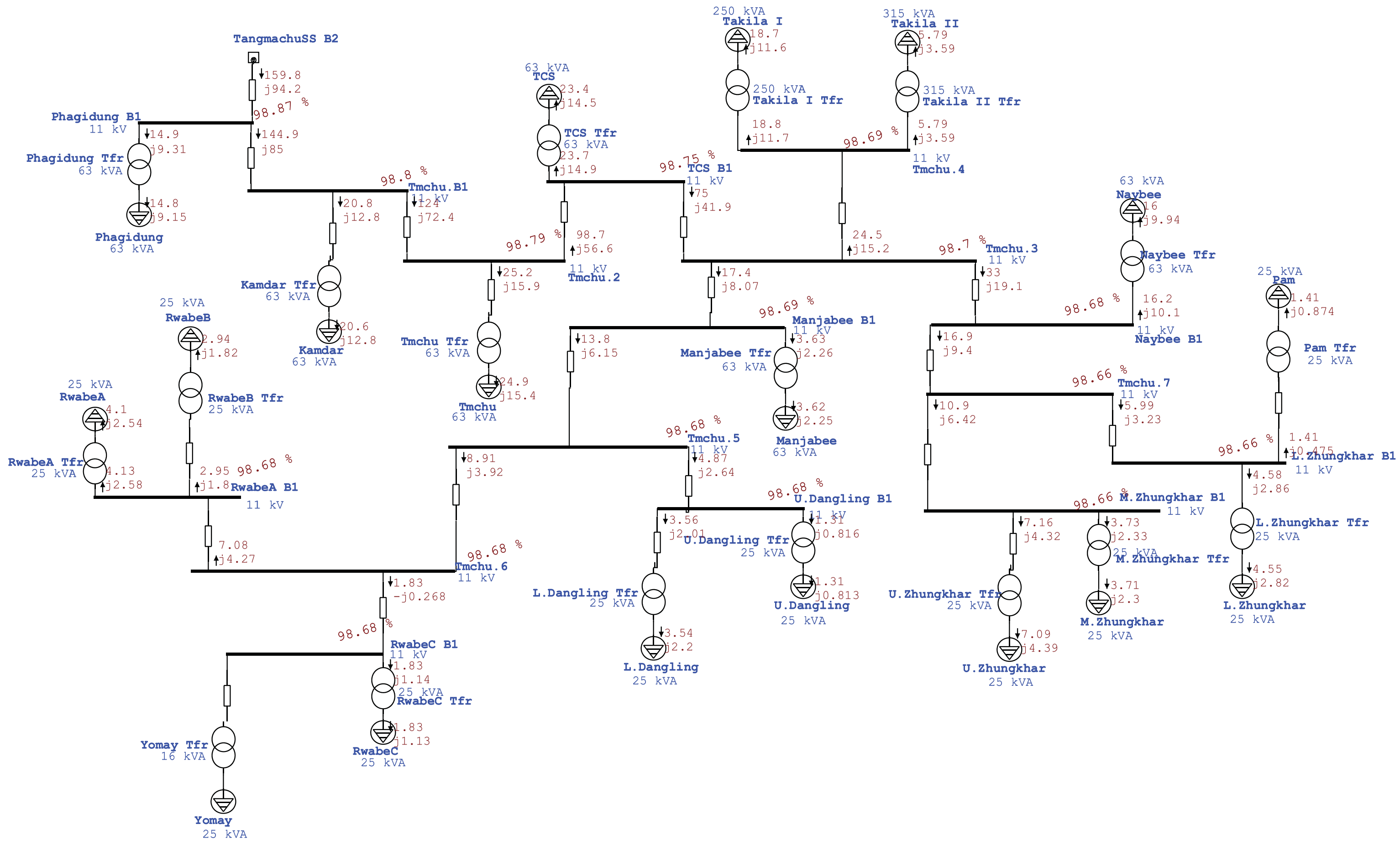

2/4
Lagyel
30 kVA
Lagyel Tfr
Kiphu B1
33 kV
Gorg.16
Gorg.17
Changchang
16 kVA
Changchang Tfr
Kawachen
Kawachen Tfr
Gorg.28
Chabee
25 kVA
Chabee Tfr
Gorg.27
Toktling
Toktling Tfr
Chulung
Chulung Tfr
Gorg.26
U.Tgang
10 kVA
U.Tgang Tfr
U.Tgang B1
Gorg.25
Takchu
Takchu Tfr
Gorg.41
Gamanang
Gamanang Tfr
Gorg.42
U.Domkhar
63 kVA
U.Domkhar Tfr
U.Domkhar B1
L.Domkhar
L.Domkhar Tfr
L.Domkhar B1
L.Tgang
L.Tgang Tfr
L.Tgang B1
Gorg.19
Dongphu Tfr
Dongphu
Fawan B1
Fawan Tfr
Fawan
L.Tgang Convt.
AB
Gorg.20
Pshorong B1
Pshorong Tfr
Pshorong
B.Factory B1
B.Factory Tfr
B.Factory
Autso.Baz
250 kVA
Autso.Baz Tfr
Autso.Sch
125 kVA
Autso.Sch Tfr
Gorg.23
Gorg.43
Tshochen
Tshochen Tfr
Tshochen B1
Pshingmey
Pshingmey Tfr
Pshingmey B1
Gorg.21
Jachung Tfr
Gorg.22
Namdruling
Chowa Tfr
Gorg.12


Gorsum.V
25 kVA
Gorsum.V Tfr
25 kVA
Pelphu Tfr
16 kVA
Pelphu
16 kVA
U.Shongmey
16 kVA
Gongdar
16 kVA
Gongdar Tfr
16 kVA
Gondar B1
33 kV
Gorg.14
33 kV
GO B1
33 kV
GO Tfr
25 kVA
GO
25 kVA
Tongthrong
25 kVA
Gorg.13
33 kV
Singyebe Tfr
25 kVA
Singyebe
25 kVA
Gorsum.S B1
33 kV
Gorsum.S Tfr
25 kVA
Gorsum.S
25 kVA
Karma.D B1
33 kV
Karma.D Tfr
25 kVA
Karma.D
25 kVA
Mugpakhar Tfr
25 kVA
Mugpakhar
25 kVA
Golipang B1
33 kV
Golipang Tfr
25 kVA
Golipang
25 kVA
Jamachen B1
33 kV
Janachen Tfr
25 kVA
Janachen
25 kVA
Drukla B1
33 kV
Drukla Tfr
16 kVA
Drukla
16 kVA
Gorg.15
33 kV
Ladrong Sch. B1
33 kV
Ladrong Sch. Tfr
25 kVA
Ladrong Sch.
25 kVA
Gorg.38
33 kV
Ongar.S B1
33 kV
Ongar.S Tfr
25 kVA
Ongar.S
25 kVA
Zowabee Tfr
16 kVA
Zowabee
16 kVA
Ongar.Lkhang B1
33 kV
Ongar.Lkhang Tfr
25 kVA
Ongar.Lkhang
25 kVA
Ongar Ttshang Tfr
25 kVA
Ongar Ttshang
25 kVA
Ntshang B1
33 kV
Ntshang Tfr
25 kVA
Ntshang
25 kVA
Gorg.39
33 kV
Chatrong
16 kVA
Dhowamg Tfr
25 kVA
Dhowamg
25 kVA
Khesibung Tfr
25 kVA
Khesibung
25 kVA
Gorg.40
33 kV
L.Pam B1
33 kV
L.Pam Tfr
16 kVA
L.Pam
16 kVA
U.Yumche B1
33 kV
U.Yumche Tfr
25 kVA
U.Yumche
25 kVA
L.Yumche Tfr
25 kVA
L.Yumche
25 kVA
U.Pam B1
33 kV
U.Pam Tfr
25 kVA
Yedang Tfr
16 kVA
3/4

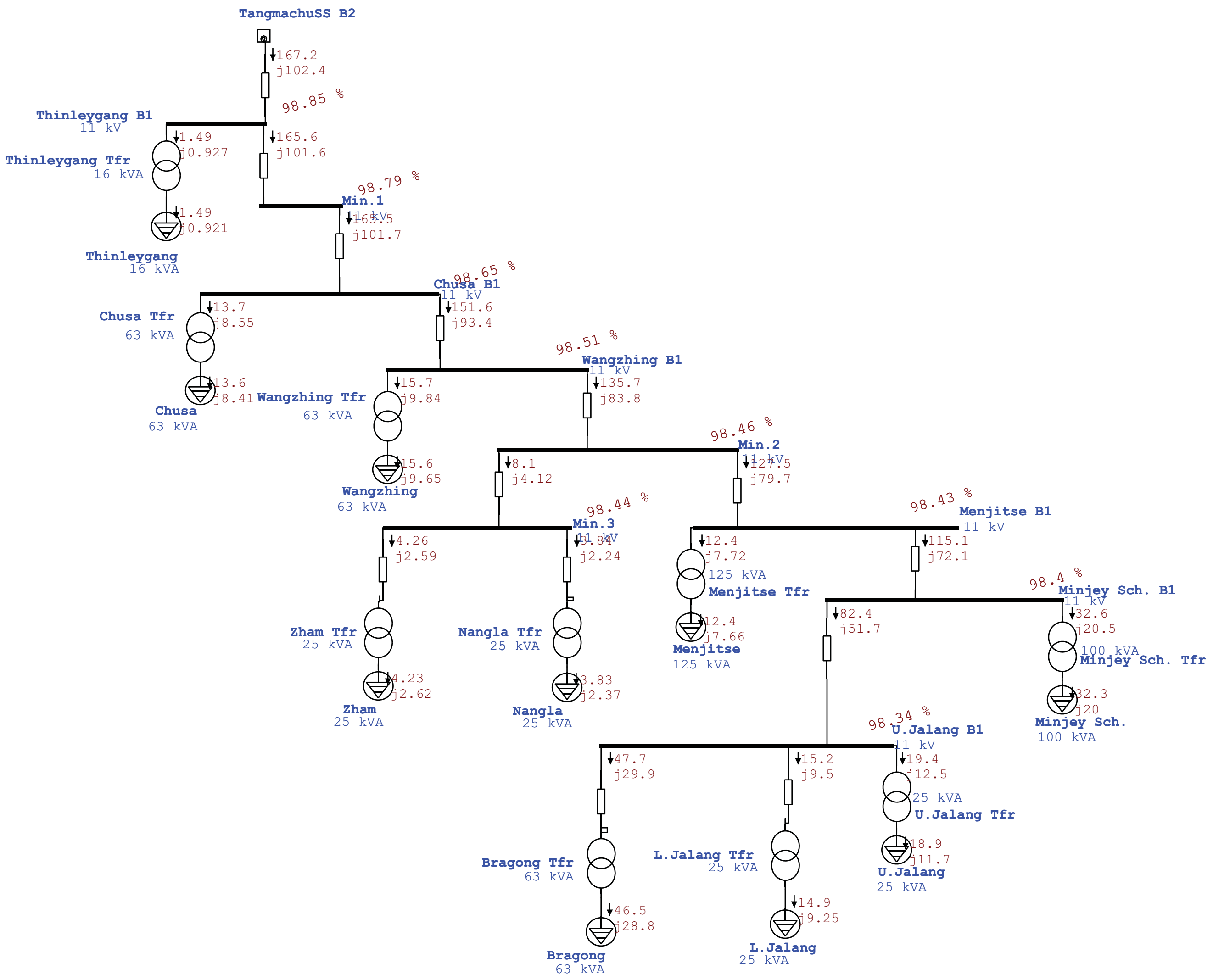

Gorg.44
33 kV
Gordung Tfr
25 kVA
Gordung
25 kVA
Gorg.45
33 kV
Tphu Tfr
25 kVA
Tphu
25 kVA
Ngun B1
33 kV
Ngun Tfr
25 kVA
25 kVA
Ngun
Gorg.46
33 kV
U.Karphu Tfr
25 kVA
U.Karphu
25 kVA
L.Karphu B1
33 kV
L.Karphu Tfr
25 kVA
25 kVA
LKarphu
Pwatoe B1
33 kV
Pwatoe Tfr
25 kVA
25 kVA
Pwatoe
Gorg.47
33 kV
Phongmey.D Tfr
16 kVA
16 kVA
Phongmey.D
Dramthang.G Tfr
16 kVA
16 kVA
Dramthang.G
Gorg.29
33 kV
27.3
j14.9
8.06
Pphu Convt.
AB
99.6 %
25 kVA
Pdphu
Pdphu Tfr
25 kVA
Pdphu B1
33 kV
Gorg.30
33 kV
Rshingbe Tfr
16 kVA
16 kVA
Rshingbe
L.Yangla B1
33 kV
L.Yangla Tfr
25 kVA
25 kVA
L.Yangla
U.Yangla Tfr
25 kVA
U.Yangla
25 kVA
35.4
j18.6
Gorg.32
33 kV
Khuling Tfr
16 kVA
16 kVA
Khuling
Koraychu B1
33 kV
Koraychu Tfr
16 kVA
16 kVA
Koraychu
Gorg.34
33 kV
Gpong Sch. Tfr
16 kVA
16 kVA
Gpong Sch.
Gorg.31
33 kV
YumcheLine Convt.
AB
1.2
Gorg.33
33 kV
Darshing B1
33 kV
Goenpa Tfr
16 kVA
16 kVA
Goenpa
Ssholing Tfr
16 kVA
16 kVA
Ssholing
Darshihng Tfr
16 kVA
16 kVA
Darshing
Jarey B1
33 kV
Kiranakay Tfr
25 kVA
Kiranaky
25 kVA
Gorg.35
33 kV
Ttashing Tfr
10 kVA
10 kVA
Ttashing
Gorg.37
33 kV
Jarey Tfr
25 kVA
25 kVA
Jarey
Yokpoling Tfr
25 kVA
Yokpoling
25 kVA
U.Nangay B1
33 kV
U.Nangay Tfr
25 kVA
25 kVA
U.Nangay
Chatrong B1
33 kV
L.Nangay B1
33 kV
L.Nangay Tfr
25 kVA
25 kVA
L.Nangay
Jabum Tfr
16 kVA
16 kVA
Jabum
B1
g Tfr
g Tfr

4/4

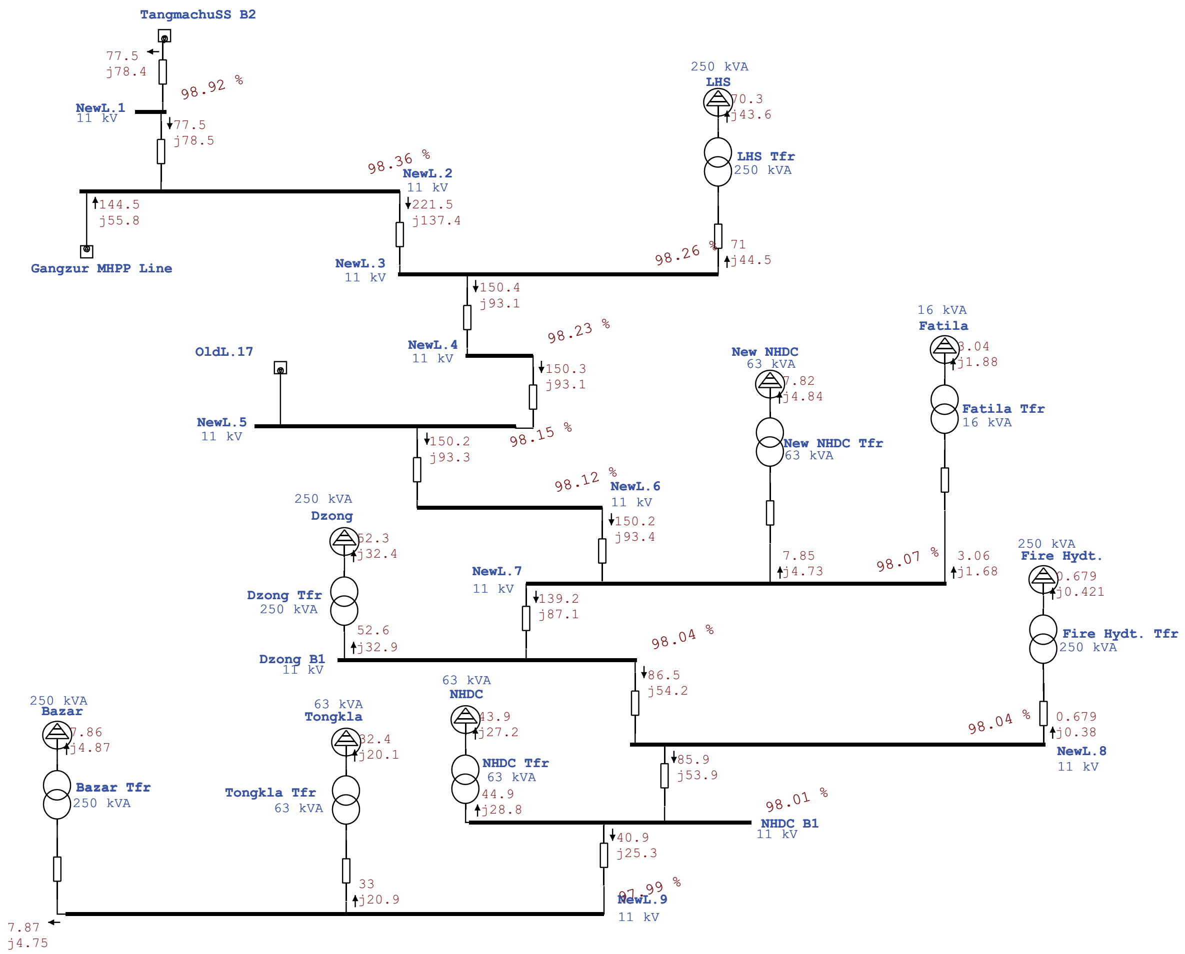
One-Line Diagram - OLV1=>Tangmachu Feeder (Load Flow Analysis)



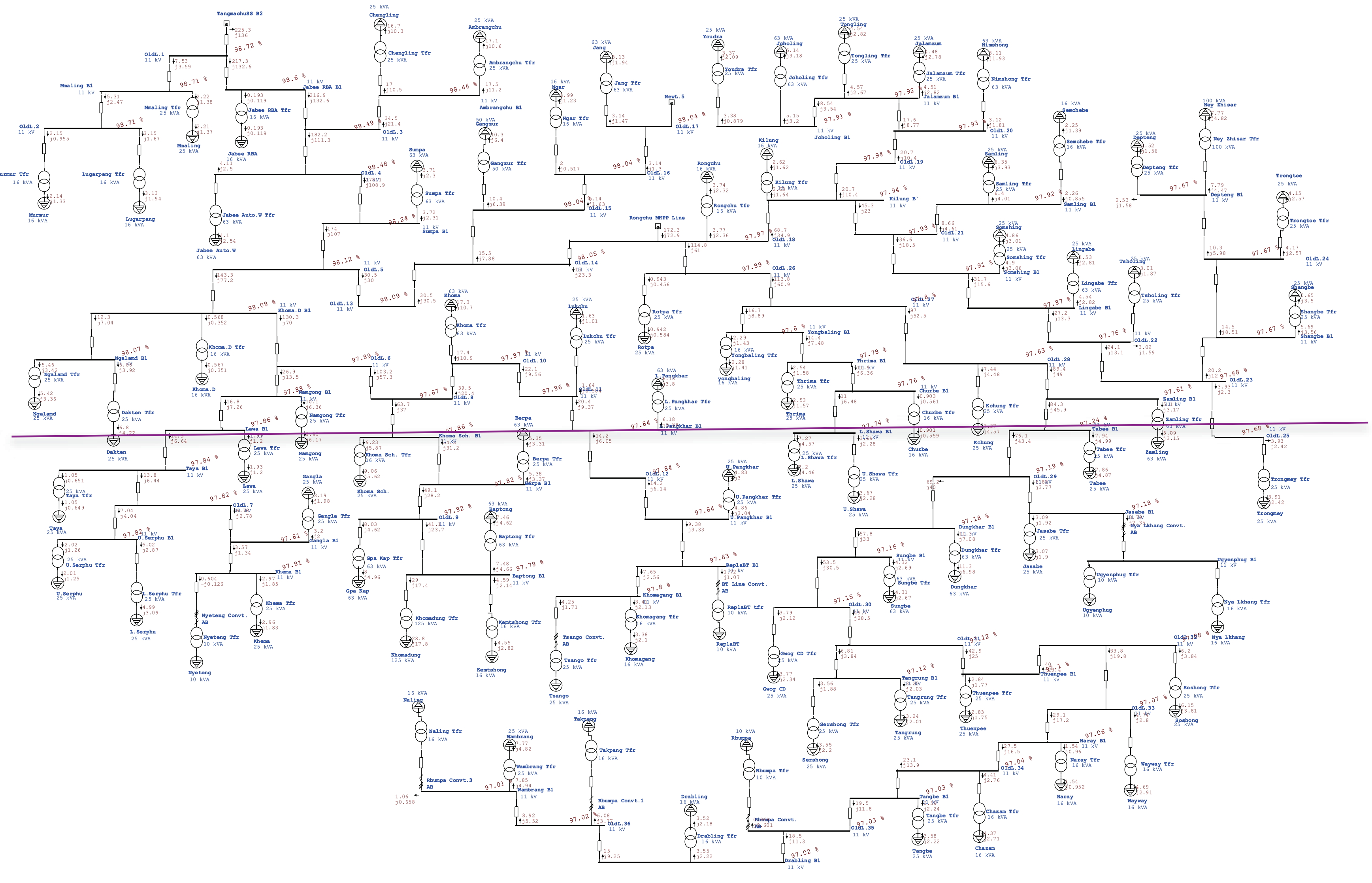
One-Line Diagram - OLV1=>Minjey Feeder (Load Flow Analysis)

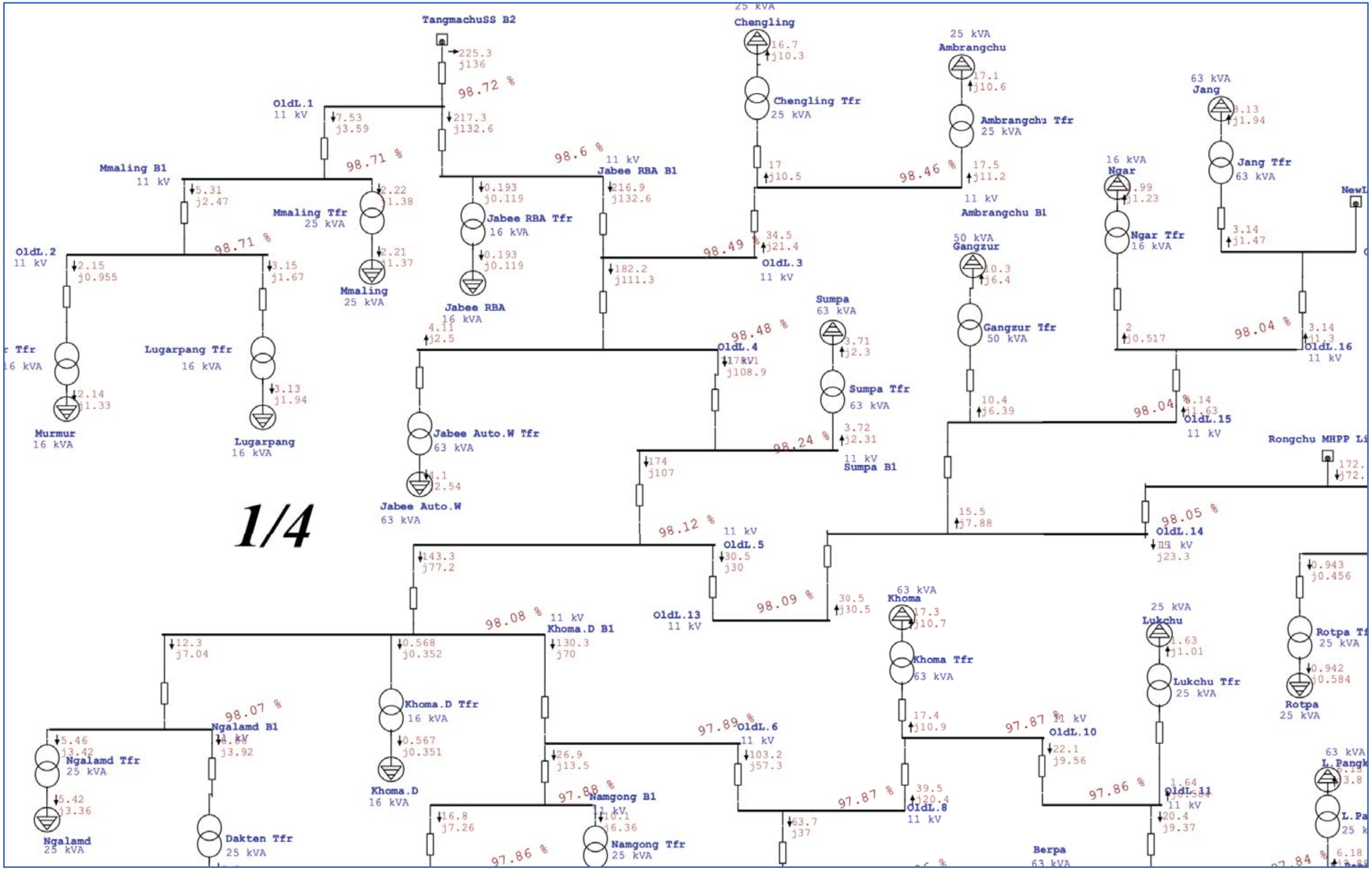


One-Line Diagram - OLV1=>New Lhuentse Feeder (Load Flow Analysis)

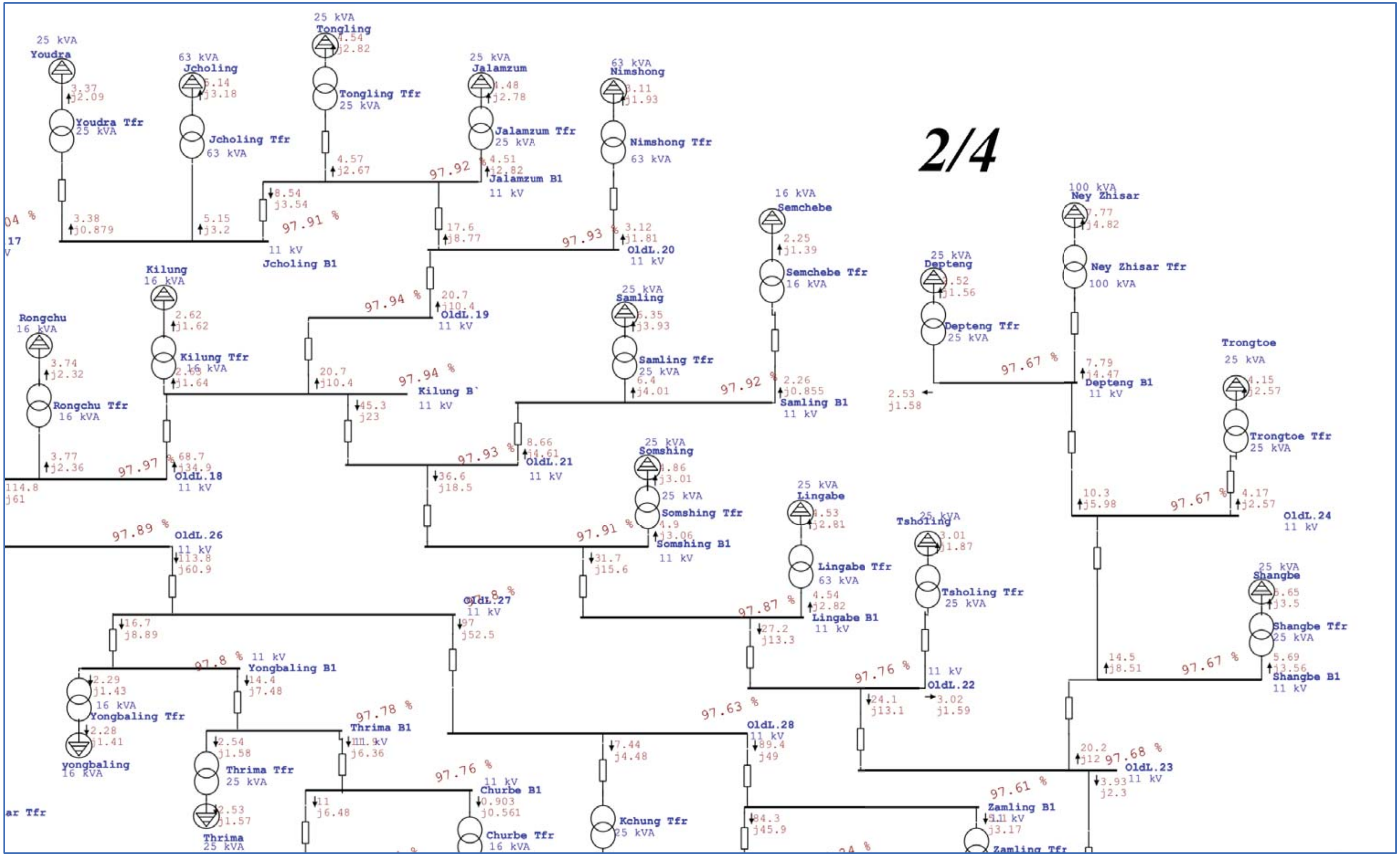


One-Line Diagram - OLV1=>Old Lhuentse Feeder (Load Flow Analysis)

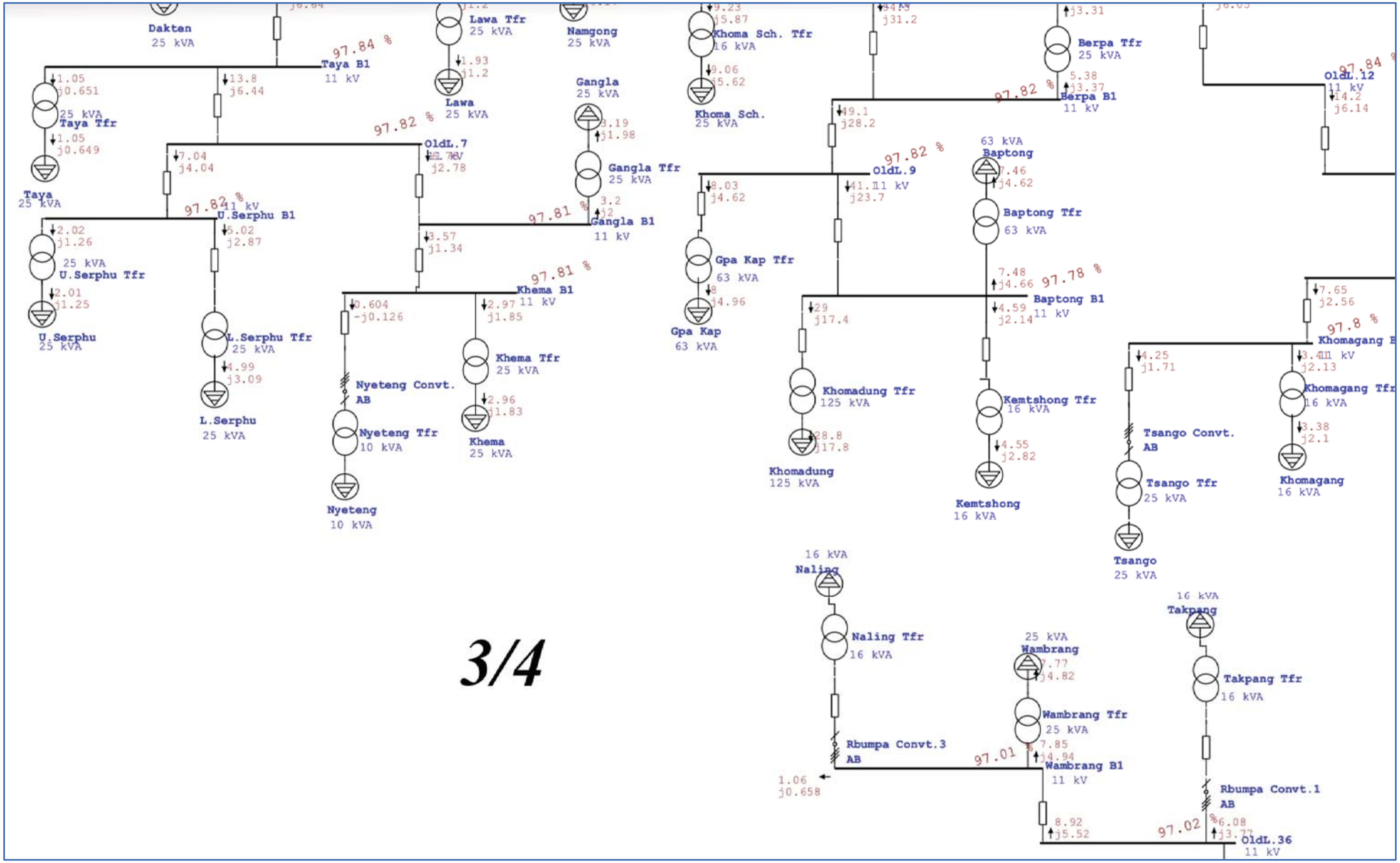


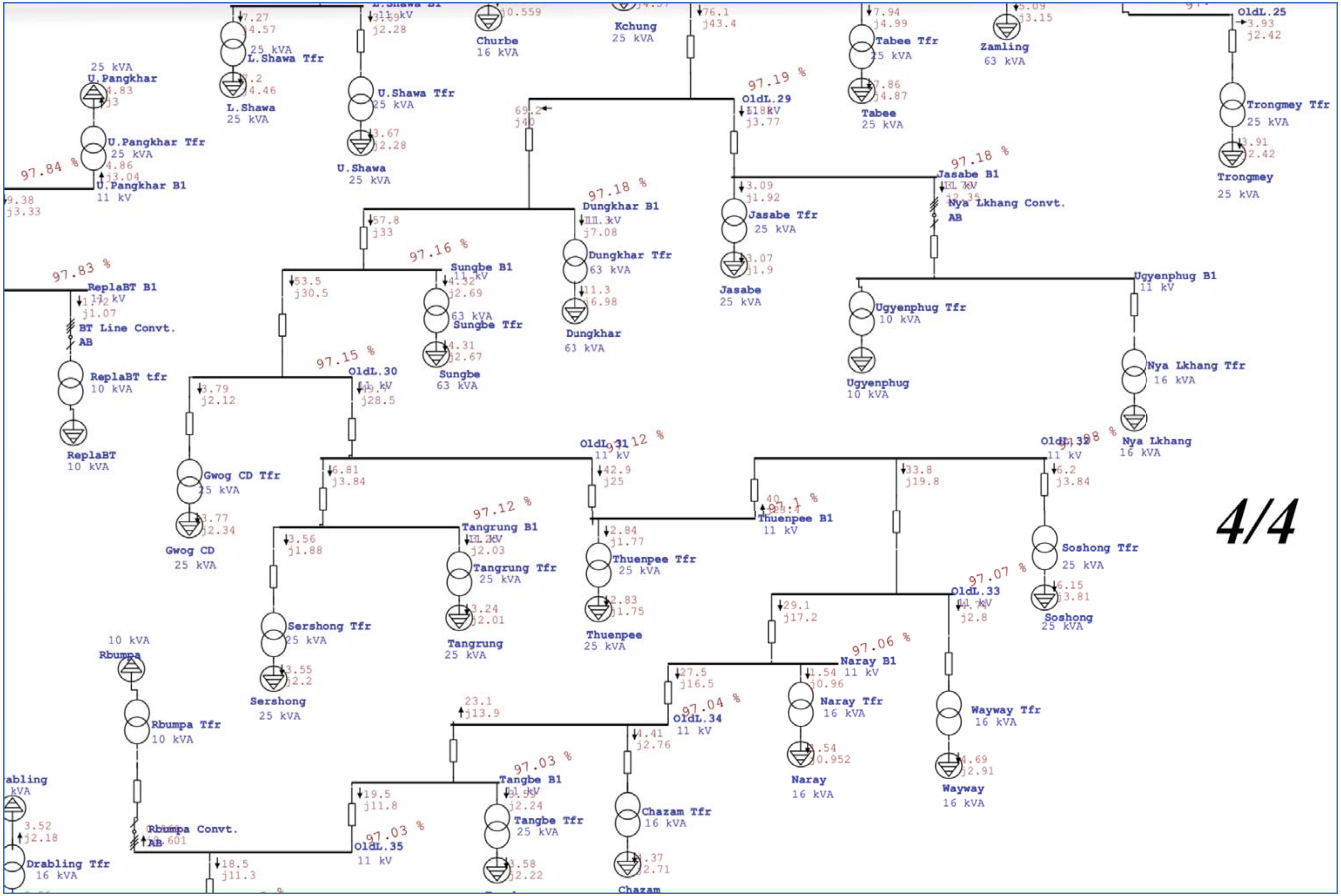


TangmachuSS B2
OldL.1
11 kV
Mmaling B1
11 kV
Mmaling Tfr
25 kVA
Mmaling
25 kVA
OldL.2
11 kV
Lugarpang Tfr
16 kVA
Lugarpang
16 kVA
Murmur
16 kVA
Jabee RBA Tfr
16 kVA
Jabee RBA
16 kVA
11 kV
Jabee RBA B1
Chengling
Chengling Tfr
25 kVA
25 kVA
Ambrangchu
Ambrangchu Tfr
25 kVA
11 kV
Ambrangchu B1
OldL.3
11 kV
63 kVA
Jang
Jang Tfr
63 kVA
16 kVA
Ngar
Ngar Tfr
16 kVA
50 kVA
Gangzur
Gangzur Tfr
50 kVA
Sumpa
63 kVA
Sumpa Tfr
63 kVA
11 kV
Sumpa B1
OldL.4
Jabee Auto.W Tfr
63 kVA
Jabee Auto.W
63 kVA
OldL.16
11 kV
OldL.15
11 kV
Rongchu MHPP Li
OldL.14
11 kV
OldL.5
11 kV
OldL.13
11 kV
1/4
11 kV
Khoma.D B1
Khoma.D Tfr
16 kVA
Khoma.D
16 kVA
Ngalamd B1
Ngalamd Tfr
25 kVA
Ngalamd
25 kVA
Dakten Tfr
25 kVA
OldL.6
11 kV
Namgong B1
Namgong Tfr
25 kVA
63 kVA
Khoma
Khoma Tfr
63 kVA
OldL.8
11 kV
OldL.10
11 kV
25 kVA
Lukchu
Lukchu Tfr
25 kVA
OldL.11
11 kV
Berpa
63 kVA
Rotpa
25 kVA
63 kVA



2/4
Youdra
25 kVA
Youdra Tfr
25 kVA
Jcholing
63 kVA
Jcholing Tfr
63 kVA
Jcholing B1
11 kV
Tongling
25 kVA
Tongling Tfr
25 kVA
Jalamzum
25 kVA
Jalamzum Tfr
25 kVA
Jalamzum B1
11 kV
Nimshong
63 kVA
Nimshong Tfr
63 kVA
OldL.20
11 kV
Semchebe
16 kVA
Semchebe Tfr
16 kVA
Samling
25 kVA
Samling Tfr
25 kVA
Samling B1
11 kV
Depteng
25 kVA
Depteng Tfr
25 kVA
Depteng B1
11 kV
Ney Zhisar
100 kVA
Ney Zhisar Tfr
100 kVA
Trongtoe
25 kVA
Trongtoe Tfr
25 kVA
OldL.24
11 kV
Kilung
16 kVA
Kilung Tfr
16 kVA
Kilung B`
11 kV
OldL.19
11 kV
Rongchu
16 kVA
Rongchu Tfr
16 kVA
OldL.18
11 kV
OldL.21
11 kV
Somshing
25 kVA
Somshing Tfr
25 kVA
Somshing B1
11 kV
Lingabe
25 kVA
Lingabe Tfr
63 kVA
Lingabe B1
11 kV
Tsholing
25 kVA
Tsholing Tfr
25 kVA
OldL.22
11 kV
Shangbe
25 kVA
Shangbe Tfr
25 kVA
Shangbe B1
11 kV
OldL.26
11 kV
OldL.27
11 kV
Yongbaling B1
11 kV
Yongbaling Tfr
16 kVA
yongbaling
16 kVA
Thrima B1
11 kV
Thrima Tfr
25 kVA
Thrima
25 kVA
Churbe B1
11 kV
Churbe Tfr
16 kVA
Kchung Tfr
25 kVA
OldL.28
11 kV
Zamling B1
11 kV
Zamling Tfr
OldL.23
11 kV
97.91 %
97.92 %
97.93 %
97.94 %
97.94 %
97.97 %
97.93 %
97.92 %
97.91 %
97.89 %
97.8 %
97.78 %
97.76 %
97.87 %
97.76 %
97.63 %
97.67 %
97.67 %
97.67 %
97.68 %
97.61 %


Dakten 25 kVA
Taya B1 11 kV 97.84 %
Taya Tfr 25 kVA
Taya 25 kVA
Lawa Tfr 25 kVA
Lawa 25 kVA
Namgong 25 kVA
OldL.7 11 kV 97.82 %
U.Serphu B1 11 kV 97.82 %
U.Serphu Tfr 25 kVA
U.Serphu 25 kVA
L.Serphu Tfr 25 kVA
L.Serphu 25 kVA
Gangla 25 kVA
Gangla Tfr 25 kVA
Gangla B1 11 kV 97.81 %
Khema B1 11 kV 97.81 %
Khema Tfr 25 kVA
Khema 25 kVA
Nyeteng Convt. AB
Nyeteng Tfr 10 kVA
Nyeteng 10 kVA
Khoma Sch. Tfr 16 kVA
Khoma Sch. 25 kVA
OldL.9 11 kV 97.82 %
Gpa Kap Tfr 63 kVA
Gpa Kap 63 kVA
Berpa Tfr 25 kVA
Berpa B1 11 kV 97.82 %
Baptong 63 kVA
Baptong Tfr 63 kVA
Baptong B1 11 kV 97.78 %
Khomadung Tfr 125 kVA
Khomadung 125 kVA
Kemtshong Tfr 16 kVA
Kemtshong 16 kVA
OldL.12 11 kV 97.84 %
Khomagang B 11 kV 97.8 %
Khomagang Tfr 16 kVA
Khomagang 16 kVA
Tsango Convt. AB
Tsango Tfr 25 kVA
Tsango 25 kVA
Naling 16 kVA
Naling Tfr 16 kVA
Rbumpa Convt.3 AB
Wambrang 25 kVA
Wambrang Tfr 25 kVA
Wambrang B1 11 kV 97.01 %
Takpang 16 kVA
Takpang Tfr 16 kVA
Rbumpa Convt.1 AB
OldL.36 11 kV 97.02 %
3/4



4/4
OldL.25
Trongmey Tfr
25 kVA
Trongmey
25 kVA
Zamling
63 kVA
Tabee Tfr
25 kVA
Tabee
25 kVA
Kchung
25 kVA
Churbe
16 kVA
U.Shawa Tfr
25 kVA
U.Shawa
25 kVA
L.Shawa Tfr
25 kVA
L.Shawa
25 kVA
U.Pangkhar
25 kVA
U.Pangkhar Tfr
25 kVA
U.Pangkhar B1
11 kV
97.84 %
OldL.29
97.19 %
Jasabe B1
97.18 %
Nya Lkhang Convt.
AB
Jasabe Tfr
25 kVA
Jasabe
25 kVA
Ugyenphug B1
11 kV
Ugyenphug Tfr
10 kVA
Ugyenphug
10 kVA
Nya Lkhang Tfr
16 kVA
Nya Lkhang
16 kVA
Dungkhar B1
97.18 %
Dungkhar Tfr
63 kVA
Dungkhar
63 kVA
Sungbe B1
97.16 %
Sungbe Tfr
63 kVA
Sungbe
63 kVA
ReplaBT B1
97.83 %
BT Line Convt.
AB
ReplaBT tfr
10 kVA
ReplaBT
10 kVA
OldL.30
97.15 %
Gwog CD Tfr
25 kVA
Gwog CD
25 kVA
OldL.31
11 kV
Tangrung B1
97.12 %
Tangrung Tfr
25 kVA
Tangrung
25 kVA
Sershong Tfr
25 kVA
Sershong
25 kVA
Thuenpee B1
11 kV
Thuenpee Tfr
25 kVA
Thuenpee
25 kVA
OldL.32
11 kV
Soshong Tfr
25 kVA
Soshong
25 kVA
OldL.33
97.07 %
Wayway Tfr
16 kVA
Wayway
16 kVA
Naray B1
11 kV
97.06 %
Naray Tfr
16 kVA
Naray
16 kVA
OldL.34
11 kV
97.04 %
Chazam Tfr
16 kVA
Chazam
Tangbe B1
97.03 %
Tangbe Tfr
25 kVA
OldL.35
11 kV
97.03 %
Rbumpa Convt.
AB
Rbumpa Tfr
10 kVA
Rbumpa
10 kVA
Drabling Tfr
16 kVA

MV line details of Lhuentse Dzongkhag

Annexure-II: Verified data of Lhuentse Distribution Network of Dzongkhag

Sl. No.	Source	Feeder details: Name	Feeder details: ID	Voltage (kV)	Section	CONDUCTOR	Conductor type & Line Length: 300 UG	WOLF	DOG	RABBIT	AAAC	Length (km): Section Length (km)	Cumulative Length (km)	Phase
	33 kV Gorgan Feeder (Lhuentse)													
1	**Tangmachu Substation (33/11 kV), 1.5x2 MVA**	**33kV Gorgan Feeder(Lhuentse)**	**LHE90**	33	LHE90H01 to LHE90H159	DG			11.93			11.93	11.93	3
					LHE90H18 to LHE90H22	DG			0.41			0.41	12.34	3
					LHE90H74 to LHE90H86	RAB				1.46		1.46	13.8	3
					LHE90H22 to LHE90H29	RAB				0.6		0.6	14.4	3
					LHE90H29 to LHE90H43, LHE90H37 to LHE90H55,	RAB				4.1		4.1	18.5	3
					LHE90H001 to LHE90H654	DG			4.3			4.3	22.8	3
					LHE90H643 to LHE90H677	RAB				2.78		2.78	25.58	1
					LHE90H156 to LHE90H602	RAB				1.43		1.43	27.01	1
					LHE90H126 to LHE90H506	RAB				15		15	42.01	1
					LHE90H128 to LHE90H199, LHE90H276	RAB				20		20	62.01	1
					LHE90H649 to LHE90H797	RAB				20.2		20.2	82.21	1
					LHE90H520 to LHE90H55	DG			7.84			7.84	90.05	3
					LHE90H486 to LHE90H599, LHE90H590 to LHE90H591	RAB				4.47		4.47	94.52	1
					LHE90H238 to G80H29	RAB				5.33		5.33	99.85	1
	Total								**24.48**	**75.37**		**99.85**	**99.85**	
2	**33/11kV Substation Tangmachu**	Lhuentse Feeder New	**LHE10**	**33**	LHE10H132 to LHE10H146	DG			1.64			1.64	1.64	3
		Lhuentse Feeder		**11**	LHE10H6 to LHE10H132	DG			9.36			9.36	11	3
	Total								**11**	**0**	**0**	**11**	**11**	
3	**33/11kV Substation Tangmachu**	**Tangmachu Feeder**	**LHE20**	**11kV**	LHE20H00 to LHE20H52	DG			4.2			4.2	4.2	3
					LHE20H39 to LHE20H194	DG			4.31			4.31	8.51	3
					LHE20H76 to LHE20H120, LHE20H83 to LHE20H192	RAB				10.81		10.81	19.32	3
	Total								**8.51**	**10.81**		**19.32**	**19.32**	
4	**33/11kV Substation Tangmachu**	**Minjey Feeder**	**LHE40**	**11kV**	LHE40H16 to LHE40H60	DG			5.38			5.38	5.38	3
					LHE40H48 to LHE40H126,LHE40H57 to LHE40H83,	RAB				5.01		5.01	10.39	3
	Total								**5.38**	**5.01**		**10.39**	**10.39**	
	33/11kV Substation Tangmachu	Dungkar Feeder	**LHE30**		LHE30H451 to LHE30H458	RAB				3.11		3.11	3.11	3
	33/11kV Substation Tangmachu & Rongchu PH	Dungkar Feeder			LHE30H20 to LHE30H258	DG			16.27			16.27	19.38	3
	33/11kV Substation Tangmachu & Rongchu PH	Dungkar Feeder			LHE30H48 to LHE30H67	RAB				1.99		1.99	21.37	3
	PH Rongchu	Dungkar Feeder			LHE30H00 to LHE30H26	DG			1.69			1.69	23.06	3

5	33/11kV Substation Tangmachu & Rongchu PH	Dungkar Feeder		11kV	LHE30H67 to LHE30H441, LHE30H336 to LHE30H394,LHE30H354 to LHE377,LHE30H277 to LHE30H412	RAB				14.14		14.14	37.2	1
	33/11kV Substation Tangmachu &	Dungkar Feeder			LHE30H258 to LHE30H342,LHE30H277	RAB				6.88		6.88	44.08	1
	33/11kV Substation Tangmachu	Lhuentse Feeder	LHE50		F50H41,F50H00 to LHE60H293, LHE50H41	DG			2.31			2.31	46.39	3
	Gangzur PH	Ngar Jang Feeder	LHE50		LHE50H02 to LHE50H30	RAB				2.35		2.35	48.74	3
	Gangzur PH	Gangzur Feeder			H50H01 to LHE50H41	DG			1			1	49.74	3
	Gangzur PH	Gangzur Feeder			LHE50H41 to LHE50H58	DG			1.25			1.25	50.99	3
	33/11kV Substation Tangmachu	Lhuentse Feeder	LHE60		LHE60H148 to LHE60H223	RAB				4.34		4.34	55.33	3
	33/11kV Substation Tangmachu	Lhuentse Feeder			LHE60H135 to LHE60H142	RAB				1.63		1.63	56.96	3
	33/11kV Substation Tangmachu	Lhuentse Feeder			LHE60H242 to LHE60H293	DG			0.71			0.71	57.67	3
	33/11kV Substation Tangmachu	Lhuentse Feeder			LHE60H173 to LHE60H299	RAB				0.605		0.605	58.275	3
	33/11kV Substation Tangmachu	Lhuentse Feeder			LHE60H669 to LHE60H688	RAB				1.41		1.41	59.685	3
	33/11kV Substation Tangmachu	Lhuentse Feeder			LHE60H211 to LHE60H634	RAB				2.5		2.5	62.185	3
	33/11kV Substation Tangmachu	Lhuentse Feeder			LHE60H00 to LHE60Grty1, LHE60H275	DG			17.46			17.46	79.645	3
	Rongchu & Gang	Rongchu Feeder			LHE60H271 to LHE80H00	DG			6.41			6.41	86.055	3
	33/11kV Substation Tangmachu	Lhuentse feeder			LHE60H300 to LHE60H587	RAB				8.41		8.41	94.465	3
	33/11kV Substation Tangmachu	Lhuentse feeder			LHE60H178 to LHE60H449	RAB				4.46		4.46	98.925	3
	33/11kV Substation Tangmachu	Lhuentse feeder			LHE60H408 to LHE60H470	RAB				1.59		1.59	100.515	3
	33/11kV Substation Tangmachu	Lhuentse Feeder			LHE60H210 to LHE60H662	DG			2.5			2.5	103.015	3
	33/11kV Substation Tangmachu	Lhuentse Feeder			LHE60H382 to LHE601, LHE60H449 to LHE585	RAB				12.85		12.85	115.865	3
	33/11kV Substation Tangmachu	Lhuentse Feeder			LHE60H35 to LHE511, LHE60H59 to LHE492	RAB				5.11		5.11	120.975	3
	Rongchu PH	Thimyul Feeder	LHE70		LHE70H07 to LHE70H119	RAB				8.02		8.02	128.995	3
	Rongchu PH	Thimyul Feeder			LHE70H01 to LHE70H61	RAB				4.861		4.861	133.856	3
	PH Rongchu	Thimyul Feeder			LHE70H30 to LHE70H270	RAB				1.85		1.85	135.706	3
	PH Rongchu	Thimyul Feeder			LHE70H238 to LHE70H255 to LHE70H255	RAB				1.5		1.5	137.206	3
	PH Rongchu	Thimyul Feeder			LHE70H61 to LHE70H239	RAB				11.64		11.64	148.846	3
	PH Rongchu	Gangzur Rongchu	LHE80		LHE80H00 to LHE60H271	DG			6.41			6.41	155.256	3
	Total								**56.01**	**99.246**	**0**	**155.256**	**155.256**	

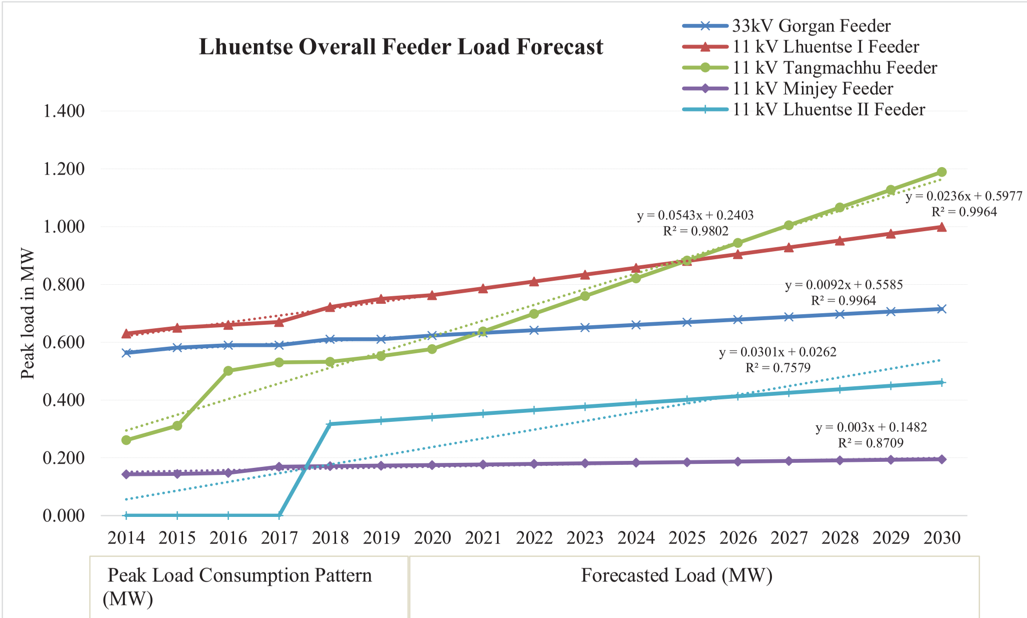
Annexure-2: IS 2026, IEC 60076 (Technical parameters for Distribution Lines and Transformers)

Sl. No.	Parameter	Requirement
1	Applicable standard	IS 2026, IEC 60076
2	Type	Oil filled[1] / two winding
3	Winding material	Copper
4	Core Material	CRGO silicon steel/Amorphous Metal
5	Cooling	Oil natural air natural (ONAN)
6	Terminations	
	· Primary	Outdoor Bushing or cable box[2]
	· Secondary	Outdoor Bushing or Cable box
7	Rated no load voltage	
	· Primary	33 kV or 11 kV
	· Secondary	415/240 V
8	% Impedance	
	10 kVA-24 kVA (1phase/3phase)	3%
	25 kVA-630 kVA	4%
	631 kVA-1250 kVA	5%
9	Vector group	Dyn11
10	Tap changer	
	· Type	Off load
	· Range	+5% to -5%
	· Step value	2.50%
11	Insulation Class (IEC-76)	A
12	Permissible Temperature rise	
	· Maximum winding temperature	55ºC
	· Max. Top oil temperature	50°C
13	Insulation levels	
	· Primary	170 kVp-70 kV/75 kVp-28 kV
	· Secondary	7500 Vp-3000 V

Annexure-3: Load Forecast adopting LRM & TSA

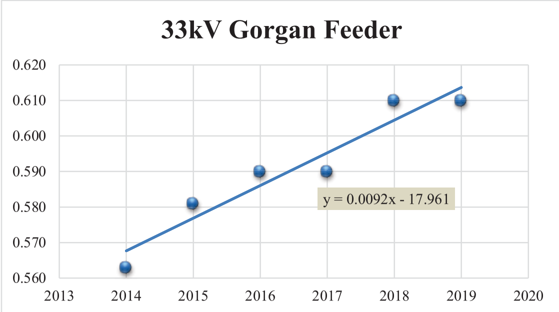
Load forecast of Lhuentse Dzongkhag

Sl.No.	Power Source	Feeder Name	Peak Load (MW)						Load Forecast (2020-2030) (MW)										
			2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1	33/11 kV, 2x1.5MVA Tangmachhu Substation	33kV Gorgan Feeder	0.563	0.581	0.590	0.590	0.610	0.610	0.623	0.632	0.641	0.651	0.660	0.669	0.678	0.687	0.697	0.706	0.715
2		11 kV Lhuentse I Feeder	0.63	0.65	0.66	0.67	0.722	0.75	0.763	0.787	0.810	0.834	0.857	0.881	0.905	0.928	0.952	0.975	0.999
3		11 kV Tangmachhu Feeder	0.261	0.311	0.501	0.530	0.532	0.552	0.576	0.637	0.699	0.760	0.821	0.883	0.944	1.005	1.066	1.128	1.189
4		11 kV Minjey Feeder	0.143	0.144	0.148	0.169	0.171	0.173	0.175	0.177	0.179	0.181	0.183	0.185	0.187	0.189	0.191	0.193	0.195
5		11 kV Lhuentse II Feeder	-	-	-	-	0.317	0.329	0.341	0.353	0.365	0.377	0.389	0.401	0.413	0.425	0.437	0.449	0.461

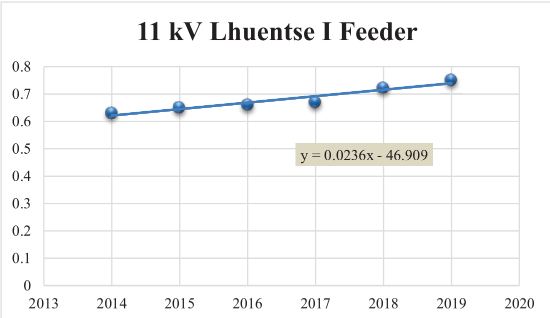


Lhuentse Feederwise Load Forecast

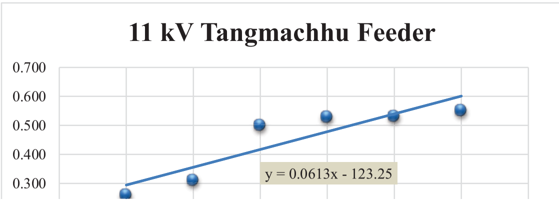
Sl.No.	Feeder Name	2014	2015	2016	2017	2018	2019	Load Forecast (2020-2030) (MW)										
								2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1	33kV Gorgan Feeder	0.563	0.581	0.590	0.590	0.610	0.610	0.623	0.632	0.641	0.651	0.660	0.669	0.678	0.687	0.697	0.706	0.715

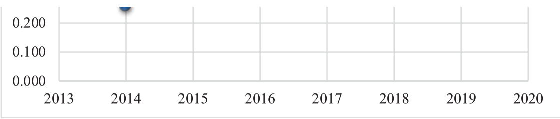


Sl.No.	Feeder Name	2014	2015	2016	2017	2018	2019	Load Forecast (2020-2030) (MW)										
								2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
2	11 kV Lhuentse I Feeder	0.63	0.65	0.66	0.67	0.722	0.75	0.763	0.787	0.810	0.834	0.857	0.881	0.905	0.928	0.952	0.975	0.999

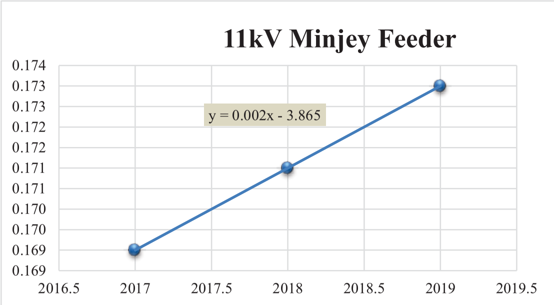


Sl.No.	Feeder Name	2014	2015	2016	2017	2018	2019	Load Forecast (2020-2030) (MW)										
								2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
3	11 kV Tangmachhu Feeder	0.261	0.311	0.501	0.530	0.532	0.552	0.576	0.637	0.699	0.760	0.821	0.883	0.944	1.005	1.066	1.128	1.189

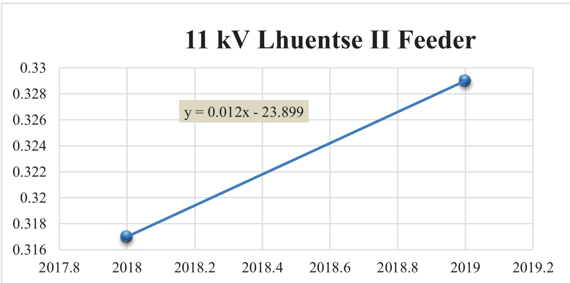




Sl.No.	Feeder Name	2014	2015	2016	2017	2018	2019	Load Forecast (2020-2030) (MW) 2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
4	11 kV Minjey Feeder	0.143	0.144	0.148	0.169	0.171	0.173	0.175	0.177	0.179	0.181	0.183	0.185	0.187	0.189	0.191	0.193	0.195



Feeder Name	2014	2015	2016	2017	2018	2019	Load Forecast (2020-2030) (MW) 2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
11 kV Lhuentse II Feeder	-	-	-	-	0.317	0.329	0.341	0.353	0.365	0.377	0.389	0.401	0.413	0.425	0.437	0.449	0.461



Load forecast methodolgy

1. Load Forecast

1.1 Type of Load Forecast and Power System Planning

One of the power system planning element is the load forecast. Although, there are no documented standards specifying the type of planning however, the power system planning can be short-term planning (STP) (less than one year), medium-term planning (MTP) (1-3 years) and long-term planning (LTP) (3-10 years and even higher). It is necessary to predict the power requirement for a specified time-horizon which is referred to as load (power) forecasting based on the historical consumption pattern for better planning and optimizing the available resources. Analogy to power system planning, the load forecast can be also short-term load forecasting (STLF), medium-term load forecasting (MTLF) and long-term load forecasting (LTLF) and accordingly the distribution network expansion programs are proposed[1] for distributing the electricity.

There are number of driving factors which are listed below affecting the forecasted load.

a) Time
   - Hours of the day (day or night)
   - Day of the week (weekdays or weekend)
   - Time of the year (winter or summer season)

b) Weather conditions (temperature and humidity)
c) Type of customers (residential, commercial, industries etc.)
d) Population
e) Economic indicators (per capita income, Gross Domestic Product (GDP) etc.)
f) Prices of the electricity

As the DSMP is being developed for 10-year period, the load forecast has to be done for same time horizon. Therefore, some of the driving factors as listed above which affects the LTLF may not impact the accuracy as daily, weekly and monthly time factors and weather conditions will have minimum contribution to the load variance.

1.2 Methods of Load (LTLF) Forecast

The LTLF methods are generally the trend analysis or time series analysis, economic modelling, end-use analysis and hybrid analysis. As the DSMP is for 10-year period, the methods of LTFL is being outlined for forecasting the load[1].

1.2.1 Trend Analysis

In the trend analysis, the historical data (power) is used to forecast the load. The details on load forecast adopting power consumption trend is reflected in **Section 1.3.** Typical load forecast is as shown in **Figure 1.**

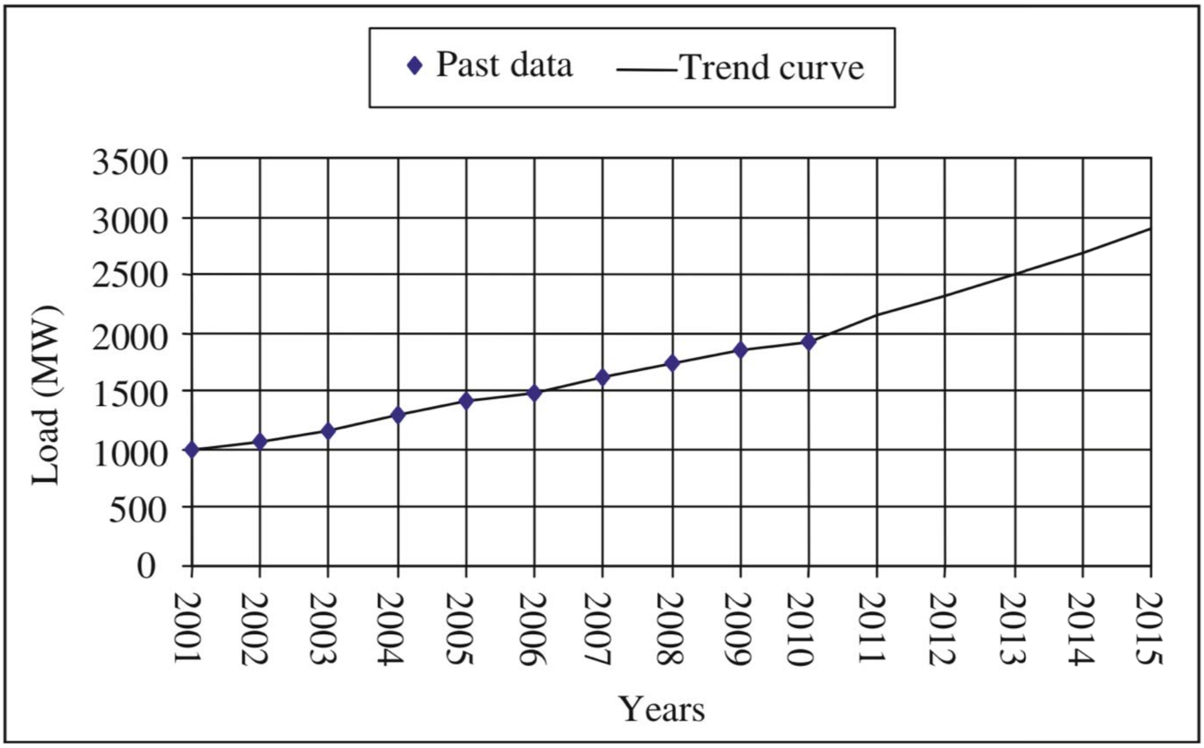


Figure 1: Typical trend curve[1]

1.2.2 Economic Modelling

In this method, the relationship between the load and the driving parameters are established and accordingly the future values of the driving factors are projected. Although, this approach is widely being used, as most of the data for driving factors are not available and for simplicity the trend analysis is adopted to forecast the load.

1.2.3 End-use Analysis

This approach is exclusively used for residential loads which is forecasted in terms of energy and therefore, it requires some methods to convert the predicted energy consumption to load (power demand). There is uncertainty in the accuracy of the predicted load and is also confined to residential customers. Therefore, end-use analysis approach is not adopted to predict the load.

1.2.4 Hybrid Analysis

Although, the end-use and econometric methods may be simultaneously used to forecast the load, it is not widely used as it has advantages and disadvantages of both the approaches.

1.3 Trend Line Analysis

The LTLF is carried out using the trend analysis approach and accordingly for planning the distribution system network. In order to forecast the load, the peak power demand prior to 2020 was considered and the power requirement trend is obtained. Load requirement is then predicted for next ten-year period (2020-2030) by extrapolating the trend line considering the load of 2019 as a base data. The case study of Punakha Dzongkhag is chosen to get insight of actual load forecast.

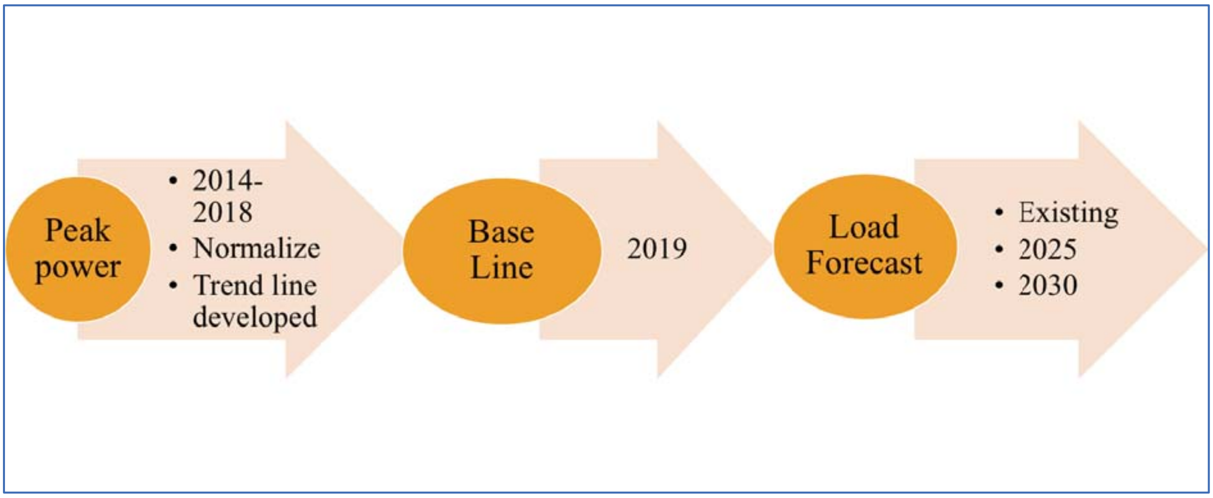


Figure 2: Flow diagram for load forecast

1.3.1 Normalizing the Data

Some of the distribution network do have ring feeders and multiple sources for better reliability and contingency. This in turn has resulted in abnormality in the power consumption data (recordings). Further, in the absence of meters or malfunctioning of the reading equipment or recorded data, some of the feeders have unreliable data for some of the years. Therefore, data is normalized by omitting the outliers or by taking the average of the past data (or average of preceding and future load if a year's data is missing). Such exercise is carried out for all the feeders and substation loads.

Table 1: Actual power data of Punakha Dzongkhag

Sl.No.	Name of Feeder	Consumption Pattern (MW)						
		2013	2014	2015	2016	2017	2018	2019
1	Feeder A	1.85	2.01	0.90	0.22	2.45	2.64	2.63
2	Feeder B	0.48	0.51	4.86	0.50	0.49	0.74	0.72
3	Feeder C	1.35	1.60	1.60	1.80	2.10	1.76	2.40
4	Feeder D	0.96	1.02	1.47	1.48	1.80	2.24	1.89
	Total	**4.64**	**5.14**	**8.83**	**4.00**	**6.84**	**7.37**	**7.64**

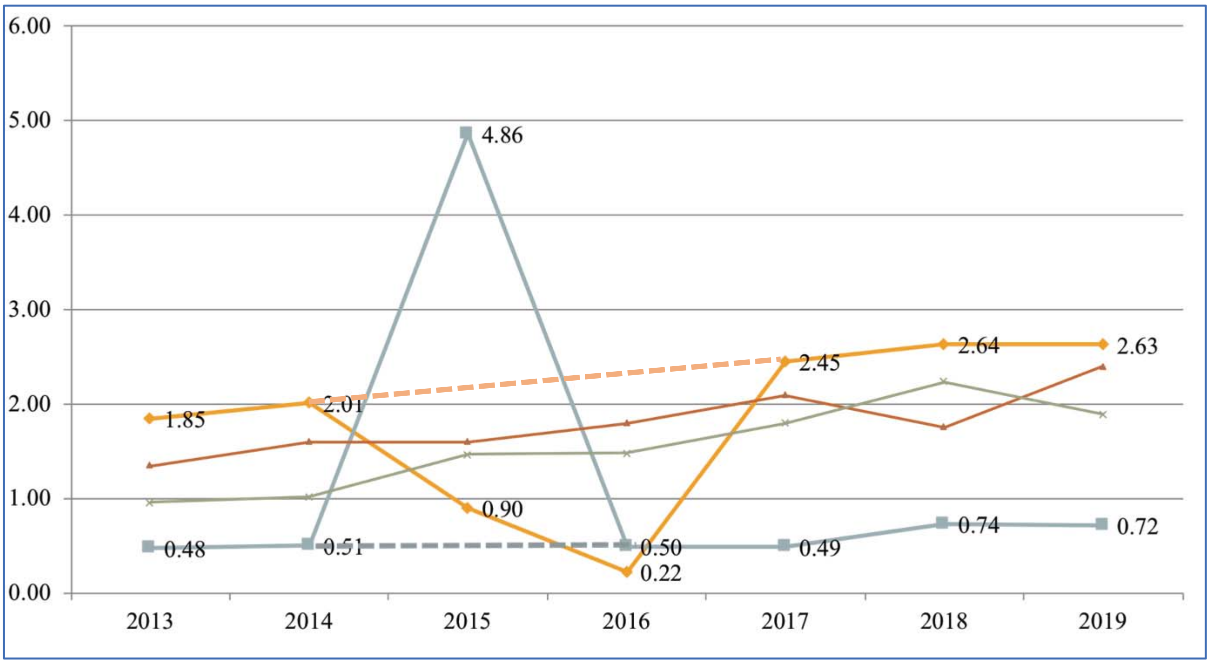


Figure 3: Actual data of Punakha Dzongkhag

$$x = \left(\frac{x_1 + x_2}{2}\right)$$

$Where:$
$x \text{ is the normalized data}$

x_1 and x_2 is the data for two years

Table 2: Normalized power data of Punakha Dzongkhag

Sl.No.	Name of Feeder	Consumption Pattern (MW)						
		2013	2014	2015	2016	2017	2018	2019
1	Feeder A	1.85	2.01	1.93	1.97	2.45	2.64	2.63
2	Feeder B	0.48	0.51	0.49	0.50	0.49	0.74	0.72
3	Feeder C	1.35	1.60	1.60	1.80	2.10	1.76	2.40
4	Feeder D	0.96	1.02	1.47	1.48	1.80	2.24	1.89
	Total	**4.64**	**5.14**	**8.83**	**4.00**	**6.84**	**7.37**	**7.64**

1.3.2 Trend Line and Load Forecast

Based on the power data, the trend line is added to portray the power consumption pattern which gets generated as per the linear regression equation[1]. The trend line added is then extrapolated to forecast the load for next ten years which is as shown in **Figure 4.**

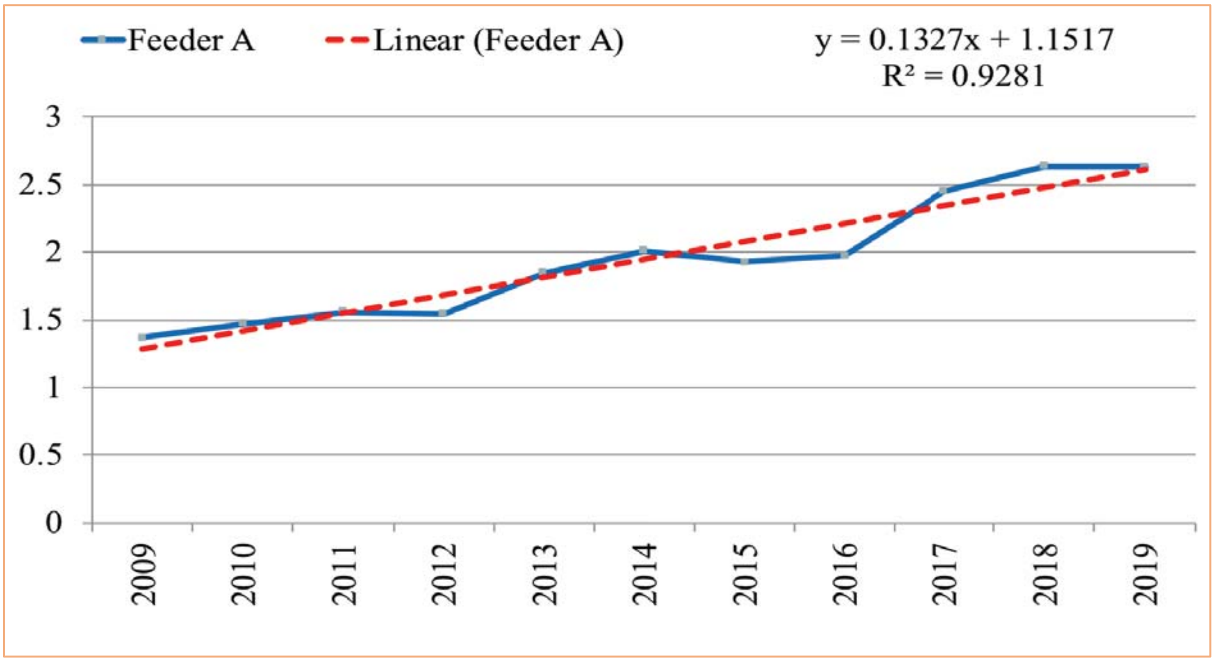


Figure 4: Trend line and load forecast for Punakha Dzongkhag

The trend line equation is given by[2]:

$$y = ax + b$$

Where:

y is the dependent variable or forecasted load
a is the slope which is the average change in y for every increment of x (increase in year).
It also gives x is the independent variable or time in year
b is the intercept which is the predicted value of y when x is zero (time is zero)

The Pearson correlation coefficient *'r'*, which can take values between -1 & 1 corresponds to the linear relationship between variables *x & y*. If the *r* value is either -1 or 1, dependent variable can be perfectly explained by a linear function of the other.

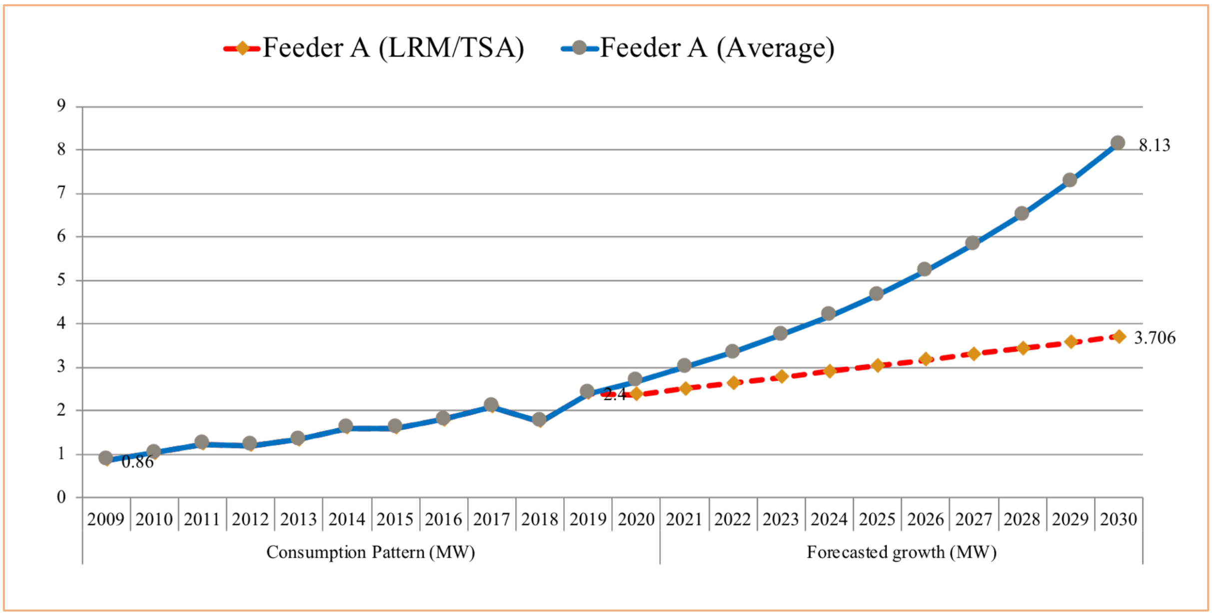


Figure 5: Forecasted load (trend line with red shows the linear regression and one with blue shows the forecast with average method)

2. Electrical Transient Analyser Program (ETAP) –Modelling and Load Flow Analysis

2.1 ETAP Software

"**ETAP** is an analytical engineering solution tool specializing in the simulation, design, monitoring, control, operator training, optimizing, and automating power systems[3]. ETAP's integrated digital platform offers the best comprehensive suite of enterprise solutions."
ETAP software is used in DSMP for modelling/designing, network simulation and to carry out the technical evaluation for distribution power system. The modelled network is fed with the essential data (such as specifications, constraints and parameters for network components) and the simulation results are assessed and analysed. Conclusively, different measures are considered and performed in ETAP for improving the efficiency of a system.

2.2 Load Flow Analysis (ETAP)

Load Flow Analysis (LFA) is a major tool to study and analyse the operation of a power system and determines voltage drops and power flow throughout the electrical system. Using network parameters (Input) for power sources, lines, transformers and connected loads, LFA provides voltages magnitude, real/reactive power, currents, and power losses as a result from the load flow simulation. The study also allows for swing, voltage regulated, and unregulated power sources with multiple power grids and generator connections and the analysis can be performed on both radial and loop systems.

Numerical analysis method such as Adaptive Newton-Raphson, Newton-Raphson, Fast Decoupled, & Accelerated Gauss Seidel methods are accessible in ETAP and can be used for solving the load flow analysis problems.

In this analysis, Adaptive Newton-Raphson method is used for load flow study of distribution networks and the study is carried out under 3-time horizon: present (2019), 2025 and 2030 (forecast load). The results (total generation, loading, system losses, and critical report of load flow) obtained under the scenarios are analysed and corresponding corrective measures are proposed.

2.2.1 Creating the Library

Although, the electrical parameters and specifications are inbuilt, to suit the requirements of the study, the missing electrical parameters are customized by creating a library. The units are set to metric system and accordingly the network is modelled and the relative data for network components such as transformers, line types, power sources and load details are fed in which are detailed as follows:

a) Transmission Cable

- Library-Transmission Line-Phase Conductor-Add-Transmission line library
- In transmission line library: change unit system into Metric, conductor type into ACSR and frequency into 50HZ, and Source name as BPC.
- Click BPC and click edit properties.
- In edit properties add the required conductor parameter by referring the Excel sheet (technical parameters.)
- For AAAC use the source name "Pirelli" and select the required size.

b) UG cable (Since 33kV Al UG Cable is not available):

- Library- Cable- Add-change the source name to BPC and make the necessary changes especially type of conductor to Aluminium and installation into non-magnetic.
- Change insulation type to XLPE.
- Select BPC from the Cable library table and click edit properties
- In edit properties add the required UG cable parameters referring the Excel sheet as shown in Pictures below.

c) Set Loading and Generation Categories.

- Go to Project- Settings- Loading and generation categories
- In Generation Category, set 3 categories as Maximum, Normal and Minimum.
- In AC Load, set 3 categories as 2019, 2025 and 2030.
- Keep the DC Load Empty.

2.2.2 Network Modelling and Load Flow Analysis

a) Draw Distribution Network (SLD).
b) Enter the height=8 and spacing =1.25 in the Transmission line table.
c) Enter the electrical parameters (kW, kVA, kV, etc.) ratings for power sources, transformers, line type, bus kV and loading details.

d) Under the Lump Load, in "Nameplate" edit and enter DT % loading and forecasted % loading details for 2019,2025,2030. Set the load type (80% as constant impedance and 20% as constant KVA) as most of the loads are impedance load.

e) Make sure to run the load flow for each composite network before you continue with other network. This is to avoid numerous errors at the end.

f) After completing the SLD, study case for different load scenarios needs to be created.

g) Switch to "Load Flow Analysis" mode in Mode Toolbar. Go to "Study Case," select present Case 1 as 2019 and select "Prompt" in "Output Report"

h) Edit the "Load Flow Study Case [Brief Case Symbol]." Go to "Loading" and set to "2019" under Loading Category and set "Normal" under Generation Category. Check the Margins set under Alerts and set "Marginal (±5% for Over and Under Voltage Category)" and set "Critical (±10% for Over and Under Voltage Category)"

i) Close "Load Flow Study Case" and run "Run Load Flow" and save the result as 2019.

j) Similarly, follow step b), c) and d) for 2025 and 2030.

k) To generate the report (SLD drawings) in PDF, go to print preview- set up- change the printer name "Microsoft print to PDF".

2.3 Consideration/Assumptions made while simulating in ETAP software

a) All Network is considered as balanced system as there is limitation of unbalanced system in ETAP Key.

b) The voltage level of ±10% is given as critical value which is indicated by red colour while simulating and voltage level of ±5% is given as marginal value which is indicated by pink colour while simulating.

c) The typical value of X/R ratio from ETAP inbuilt system is taken for all the power transformers for the simulation.

d) Some of the types of transmission cables /underground cables used in BPC are not available in ETAP library therefore, a new source is created in ETAP library by inserting all the parameters of those unavailable cables/transmission lines.

e) There are three cases created in ETAP simulation depending on the load forecast namely the 2019, 2025 and 2030 where the forecasted loads are given respectively and simulated/analysed accordingly.

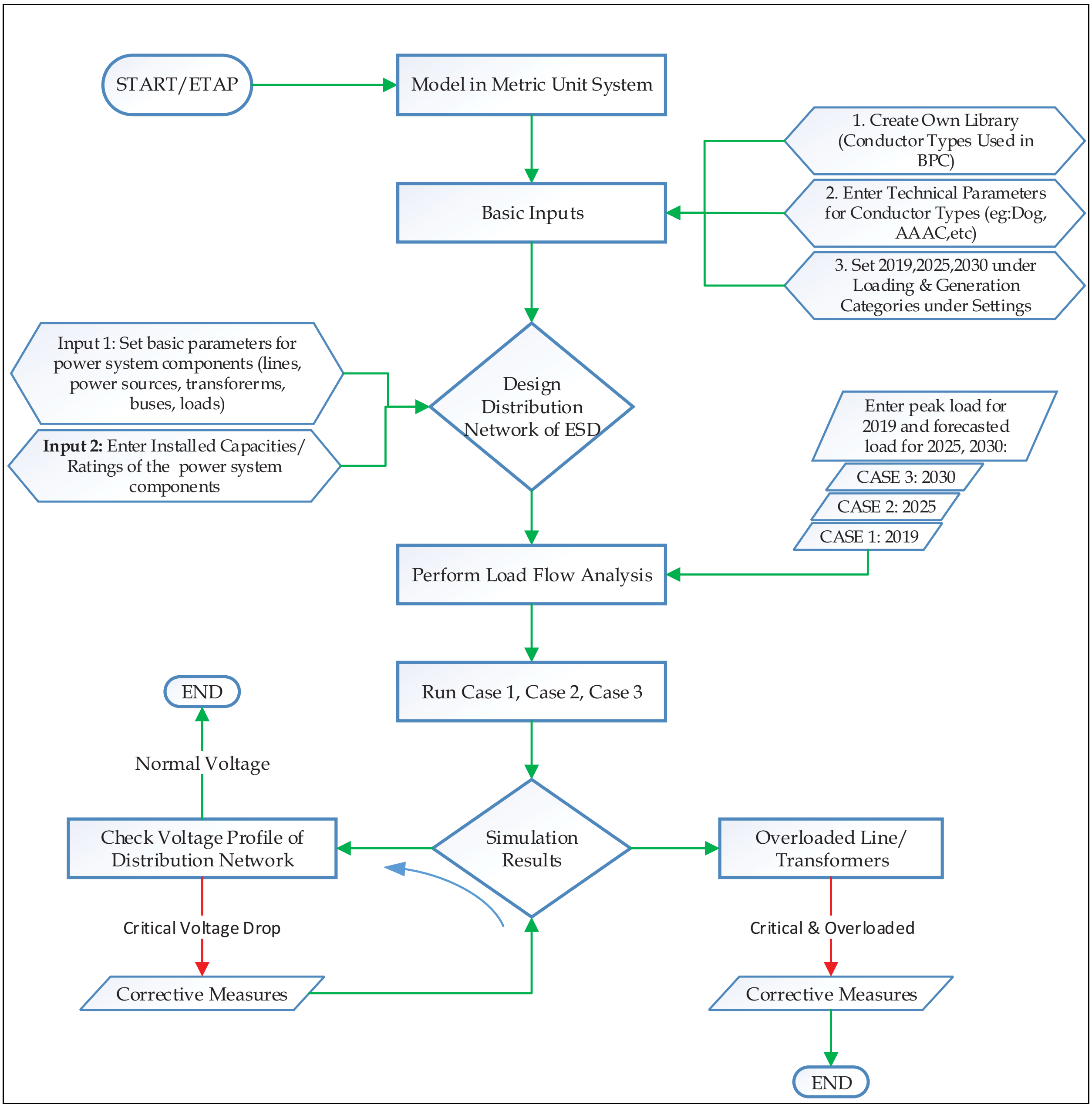


Figure 6: Flow Chart for Network Modelling & Load Flow Analysis (ETAP)

[1]Electric Power System Planning Issues, Algorithms and Solutions by Hossein Seifi Mohammad Sadegh Sepasian

[2]http://sites.utexas.edu/sos/guided/inferential/numeric/bivariate/cor/: dated September 29, 2020

[3]http://www.powerqualityworld.com/2011/05/etap-tutorials-load-flow-analysis.html dated September 30, 2020

Annexure 4: The Simulation Results

Bus Loading Summary Report

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					Percent
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Loading
Ambrangchu B1	11.000										0.102	83.2	5.6	
Ambrangchu B2	0.415		0.010	0.006	0.031	0.019					0.048	85.0	74.7	
Autso.Baz B1	33.000										0.134	84.5	2.4	
Autso.Baz B2	0.415		0.023	0.014	0.088	0.055					0.131	85.0	187.3	
Autso.Sch B1	33.000										0.094	84.3	1.7	
Autso.Sch B2	0.415		0.016	0.010	0.061	0.038					0.091	85.0	131.6	
B.Factory B1	33.000										0.370	86.5	6.5	
B.Factory B2	0.415		0.002	0.002	0.010	0.006					0.014	85.0	20.1	
Baptong B1	11.000										0.100	85.1	5.5	
Baptong B2	0.415		0.004	0.003	0.014	0.009					0.022	85.0	32.1	
Bazar B1	11.000										0.018	84.9	1.0	
Bazar B2	0.415		0.003	0.002	0.012	0.007					0.018	85.0	26.0	
Berpa B1	11.000										0.138	85.2	7.7	
Berpa B2	0.415		0.003	0.002	0.010	0.006					0.015	85.0	23.0	
Bragong B1	0.415		0.011	0.007	0.039	0.024					0.060	85.0	89.2	
Bragong B2	11.000										0.062	84.1	3.4	
Budhur B1	33.000										0.025	84.7	0.4	
Budhur B2	0.415		0.004	0.003	0.016	0.010					0.024	85.0	34.5	
Changkhala B1	33.000										0.021	84.4	0.4	
Changkhala B2	0.415		0.004	0.002	0.014	0.008					0.020	85.0	29.2	
Chazam B1	11.000										0.013	84.2	0.7	
Chazam B2	0.415		0.002	0.002	0.008	0.005					0.012	85.0	18.8	
Chengling B1	11.000										0.051	83.0	2.8	
Chengling B2	0.415		0.010	0.006	0.030	0.019					0.047	85.0	73.0	
Churbe B1	11.000										0.034	84.8	1.9	
Churbe B2	0.415		0.000	0.000	0.002	0.001					0.003	85.0	3.9	
Chusa B1	11.000										0.220	85.0	11.8	
Chusa B2	0.415		0.003	0.002	0.012	0.008					0.018	85.0	26.6	
Dagathang B1	33.000										0.504	88.3	8.9	
Dagathang B2	0.415		0.002	0.001	0.008	0.005					0.011	85.0	16.1	
Dakten B1	11.000										0.020	84.2	1.1	
Dakten B2	0.415		0.004	0.002	0.013	0.008					0.020	85.0	29.7	
Depteng B1	11.000										0.030	85.3	1.7	
Depteng B2	0.415		0.001	0.001	0.005	0.003					0.007	85.0	10.9	
Dorshong B1	33.000												-	
Dorshong B2	0.415													
Drabling B1	11.000										0.053	84.6	3.0	
Drabling B2	0.415		0.002	0.001	0.006	0.004					0.010	85.0	15.2	
Dungkhar B1	11.000										0.197	85.1	11.1	

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					Percent
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Loading
Dungkhar B2	0.415		0.006	0.004	0.021	0.013					0.032	85.0	48.5	
Dzong B1	11.000										0.315	84.2	17.2	
Dzong B2	0.415		0.022	0.014	0.078	0.048					0.117	85.0	173.5	
Fatila B1	11.000										0.007	84.6	0.4	
Fatila B2	0.415		0.001	0.001	0.005	0.003					0.007	85.0	10.1	
Fawan B1	33.000										0.460	86.5	8.1	
Fawan B2	0.415		0.004	0.002	0.014	0.008					0.020	85.0	28.4	
Fire Hydt. B1	11.000										0.002	85.0	0.1	
Fire Hydt. B2	0.415		0.000	0.000	0.001	0.001					0.002	85.0	2.2	
Gangla B1	11.000										0.020	86.5	1.1	
Gangla B2	0.415		0.002	0.001	0.006	0.004					0.009	85.0	13.9	
Gangzur B1	11.000										0.031	84.4	1.7	
Gangzur B2	0.415		0.006	0.004	0.020	0.012					0.030	85.0	45.1	
Gangzur MHPP B1	0.415										0.317	91.8	440.5	
Gangzur MHPP B2	11.000										0.306	92.7	16.6	
Gorg.1	33.000										0.694	89.5	12.2	
Gorg.2	33.000										0.635	89.6	11.2	
Gorg.3	33.000										0.134	92.9	2.3	
Gorg.4	33.000										0.129	91.1	2.3	
Gorg.5	33.000										0.122	90.6	2.2	
Gorg.6	33.000		0.000	0.000	0.001	0.001					0.045	88.8	0.8	
Gorg.7	33.000										0.080	89.3	1.4	
Gorg.8	33.000		0.001	0.000	0.002	0.001					0.077	85.8	1.4	
Gorg.9	33.000		0.013	0.008	0.051	0.032					0.075	85.0	1.3	
Gorg.16	33.000										0.494	88.1	8.7	
Gorg.17	33.000										0.481	87.5	8.5	
Gorg.20	33.000		0.012	0.008	0.048	0.030					0.440	86.6	7.8	
Gorg.21	33.000										0.358	86.0	6.3	
Gorg.22	33.000										0.359	85.5	6.3	
Gorg.23	33.000										0.227	84.6	4.0	
Gorg.24	33.000		0.011	0.007	0.045	0.028					0.134	85.9	2.4	
Gorg.29	33.000		0.003	0.002	0.011	0.007					0.068	85.9	1.2	
Gorgan B1	33.000										0.134	92.5	2.4	
Gorgan B2	0.415		0.001	0.001	0.005	0.003					0.007	85.0	10.3	
Gpa Kap B1	11.000										0.023	84.6	1.3	
Gpa Kap B2	0.415		0.004	0.003	0.015	0.009					0.023	85.0	34.5	
Gwog CD B1	11.000										0.011	84.6	0.6	
Gwog CD B2	0.415		0.002	0.001	0.007	0.004					0.010	85.0	16.0	
Jabee Auto.W B1	11.000										0.012	84.8	0.7	
Jabee Auto.W B2	0.415		0.002	0.001	0.008	0.005					0.012	85.0	17.9	
Jabee RBA B1	11.000										0.690	83.4	37.4	
Jabee RBA B2	0.415		0.000	0.000	0.000	-					0.001	85.0	0.8	

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					Percent
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Loading
Jachung B1	33.000										0.001	85.0	-	
Jachung B2	0.415		0.000	0.000	0.001	0.001					0.001	85.0	1.7	
Jalamzum B1	11.000										0.050	86.2	2.8	
Jalamzum B2	0.415		0.002	0.002	0.008	0.005					0.013	85.0	19.3	
Jang B1	11.000										0.009	84.9	0.5	
Jang B2	0.415		0.002	0.001	0.006	0.004					0.009	85.0	13.7	
Jasabe B1	11.000		0.002	0.001	0.006	0.004					0.018	84.8	1.0	
Jasabe B2	0.415		0.002	0.001	0.006	0.004					0.009	85.0	13.2	
Jcholing B1	11.000										0.024	86.8	1.3	
Jcholing B2	0.415		0.003	0.002	0.010	0.006					0.015	85.0	22.1	
Kamdar B1	0.415		0.009	0.005	0.031	0.019					0.047	85.0	68.8	
Kamdar B2	11.000										0.048	84.3	2.6	
Kchung B1	11.000										0.021	84.1	1.2	
Kchung B2	0.415		0.004	0.003	0.013	0.008					0.021	85.0	31.7	
Kemtshong B1	11.000										0.013	84.2	0.7	
Kemtshong B2	0.415		0.003	0.002	0.008	0.005					0.013	85.0	19.6	
Khema B1	11.000										0.010	86.7	0.6	
Khema B2	0.415		0.002	0.001	0.006	0.004					0.009	85.0	12.9	
Khoma B1	11.000										0.051	84.2	2.8	
Khoma B2	0.415		0.010	0.006	0.033	0.020					0.050	85.0	75.4	
Khoma Sch. B1	11.000										0.165	85.0	9.2	
Khoma Sch. B2	0.415		0.005	0.003	0.016	0.010					0.025	85.0	39.7	
Khoma.D B1	11.000										0.404	85.6	22.2	
Khoma.D B2	0.415		0.000	0.000	0.001	0.001					0.002	85.0	2.5	
Khomadung B1	11.000										0.065	84.5	3.6	
Khomadung B2	0.415		0.012	0.008	0.042	0.026					0.064	85.0	95.8	
Khomagang B1	11.000										0.022	86.5	1.2	
Khomagang B2	0.415		0.002	0.001	0.006	0.004					0.010	85.0	14.6	
Kilung B2	0.415		0.001	0.001	0.005	0.003					0.008	85.0	11.3	
Kilung B`	11.000										0.202	86.2	11.2	
Kiphu B1	33.000										0.015	92.8	0.3	
Kiphu B2	0.415		0.001	0.001	0.005	0.003					0.007	85.0	9.6	
Kupensa B1	33.000										0.713	89.7	12.5	
Kupensa B2	0.415		0.003	0.002	0.014	0.008					0.020	85.0	28.2	
L.Dangling B1	0.415		0.001	0.001	0.005	0.003					0.008	85.0	11.8	
L.Dangling B2	11.000										0.008	84.7	0.4	
L.Domkhar B1	33.000										0.471	86.8	8.3	
L.Domkhar B2	0.415		0.002	0.001	0.008	0.005					0.012	85.0	17.6	
L.Jalang B1	0.415		0.004	0.002	0.013	0.008					0.020	85.0	29.2	
L.Jalang B2	11.000										0.020	84.2	1.1	
L.Pangkhar B1	11.000										0.058	86.5	3.2	
L.Pangkhar B2	0.415		0.003	0.002	0.011	0.007					0.017	85.0	26.5	

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					Percent
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Loading
L.Serphu B1	11.000										0.015	84.4	0.8	
L.Serphu B2	0.415		0.003	0.002	0.010	0.006					0.014	85.0	21.8	
L.Shawa B1	11.000										0.032	84.3	1.8	
L.Shawa B2	0.415		0.004	0.002	0.013	0.008					0.020	85.0	31.0	
L.Wambur B1	33.000										0.671	89.6	11.8	
L.Wambur B2	0.415		0.003	0.002	0.011	0.007					0.016	85.0	23.0	
L.Zhungkhar B1	11.000										0.014	85.9	0.7	
L.Zhungkhar B2	0.415		0.002	0.001	0.007	0.004					0.010	85.0	15.2	
Lagyel B1	33.000										0.010	84.7	0.2	
Lagyel B2	0.415		0.002	0.001	0.007	0.004					0.010	85.0	13.7	
Lawa B1	11.000										0.048	86.9	2.7	
Lawa B2	0.415		0.001	0.001	0.004	0.002					0.006	85.0	8.4	
LHS B1	11.000										0.162	84.4	8.8	
LHS B2	0.415		0.030	0.018	0.105	0.065					0.158	85.0	233.6	
Lingabe B1	11.000										0.091	86.3	5.0	
Lingabe B2	0.415		0.002	0.002	0.009	0.005					0.013	85.0	19.5	
Lugarpang B1	11.000										0.010	84.4	0.5	
Lugarpang B2	0.415		0.002	0.001	0.006	0.004					0.009	85.0	13.7	
Lukchu B1	11.000										0.013	84.5	0.7	
Lukchu b2	0.415		0.002	0.002	0.008	0.005					0.013	85.0	19.2	
M.Zhungkhar B1	11.000										0.025	84.8	1.4	
M.Zhungkhar B2	0.415		0.002	0.001	0.006	0.004					0.009	85.0	12.3	
Manjabee B1	11.000										0.039	87.4	2.1	
Manjabee B2	0.415		0.001	0.001	0.006	0.003					0.008	85.0	12.0	
Menjitse B1	11.000										0.166	84.6	8.9	
Menjitse B2	0.415		0.003	0.002	0.011	0.007					0.017	85.0	23.9	
Min.1	11.000										0.220	85.0	11.8	
Min.2	11.000										0.180	84.9	9.7	
Min.3	11.000										0.015	85.4	0.8	
Minjey Sch. B1	11.000										0.149	84.6	8.0	
Minjey Sch. B2	0.415		0.007	0.005	0.027	0.017					0.041	85.0	59.6	
Mmaling B1	11.000										0.022	86.2	1.2	
Mmaling B2	0.415		0.001	0.001	0.004	0.003					0.007	85.0	9.7	
Murmur B1	11.000										0.007	84.6	0.4	
Murmur B2	0.415		0.001	0.001	0.004	0.003					0.006	85.0	9.4	
Namdruling B1	33.000										0.053	84.2	0.9	
Namdruling B2	0.415		0.009	0.006	0.035	0.021					0.052	85.0	74.7	
Namgong B1	11.000										0.077	86.1	4.3	
Namgong B2	0.415		0.005	0.003	0.018	0.011					0.028	85.0	42.3	
Nangla B1	0.415		0.001	0.001	0.005	0.003					0.007	85.0	10.2	
Nangla B2	11.000										0.007	84.7	0.4	
Naray B1	11.000										0.082	84.9	4.7	

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					Percent
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Loading
Naray B2	0.415		0.001	0.001	0.003	0.002					0.004	85.0	6.6	
Naybee B1	11.000										0.076	85.2	4.1	
Naybee B2	0.415		0.007	0.004	0.024	0.015					0.037	85.0	53.5	
New NHDC B1	11.000										0.018	84.7	1.0	
New NHDC B2	0.415		0.003	0.002	0.012	0.007					0.018	85.0	25.9	
NewL.1	11.000										0.210	68.0	11.3	
NewL.2	11.000										0.504	84.3	27.4	
NewL.3	11.000										0.503	84.3	27.4	
NewL.4	11.000										0.341	84.3	18.6	
NewL.5	11.000										0.340	84.3	18.6	
NewL.6	11.000										0.340	84.3	18.6	
NewL.7	11.000										0.340	84.3	18.6	
NewL.8	11.000										0.196	83.9	10.7	
NewL.9	11.000										0.092	84.2	5.1	
Ney Zhisar B1	11.000										0.023	84.8	1.3	
Ney Zhisar B2	0.415		0.004	0.003	0.015	0.009					0.022	85.0	33.4	
Ngalamd B1	11.000										0.036	84.7	2.0	
Ngalamd B2	0.415		0.003	0.002	0.010	0.006					0.016	85.0	23.7	
Ngar B1	11.000										0.006	84.6	0.3	
Ngar B2	0.415		0.001	0.001	0.004	0.002					0.006	85.0	8.7	
NHDC B1	11.000										0.194	83.8	10.6	
NHDC B2	0.415		0.019	0.012	0.062	0.038					0.095	85.0	147.4	
Nimshong B1	11.000										0.015	84.8	0.8	
Nimshong B2	0.415		0.003	0.002	0.010	0.006					0.014	85.0	21.5	
Nyeteng B1	11.000		0.000	0.000	0.001	0.001					0.002	85.0	0.1	
OldL.1	11.000										0.715	83.5	38.6	
OldL.2	11.000										0.016	86.4	0.9	
OldL.3	11.000										0.688	83.4	37.4	
OldL.4	11.000										0.585	83.4	31.8	
OldL.5	11.000										0.557	83.4	30.6	
OldL.6	11.000										0.364	85.6	20.2	
OldL.7	11.000										0.040	86.4	2.2	
OldL.8	11.000										0.287	85.4	15.9	
OldL.9	11.000										0.123	85.3	6.8	
OldL.10	11.000										0.122	85.8	6.8	
OldL.11	11.000										0.071	86.8	3.9	
OldL.12	11.000										0.040	87.4	2.2	
OldL.13	11.000										0.154	76.9	8.5	
OldL.14	11.000										0.154	76.7	8.5	
OldL.15	11.000										0.045	86.1	2.5	
OldL.16	11.000										0.015	88.5	0.8	
OldL.17	11.000										0.009	87.0	0.5	

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Percent Loading
OldL.18	11.000										0.540	85.8	29.9	
OldL.19	11.000										0.065	86.2	3.6	
OldL.20	11.000										0.065	86.1	3.6	
OldL.21	11.000										0.129	86.2	7.2	
OldL.22	11.000										0.078	85.8	4.3	
OldL.23	11.000										0.070	85.0	3.9	
OldL.24	11.000										0.042	85.2	2.3	
OldL.25	11.000										0.011	84.7	0.6	
OldL.26	11.000										0.326	85.6	18.1	
OldL.27	11.000										0.323	85.5	18.0	
OldL.28	11.000										0.275	85.4	15.3	
OldL.29	11.000										0.215	85.2	12.1	
OldL.30	11.000										0.152	85.2	8.6	
OldL.31	11.000										0.142	85.1	8.0	
OldL.32	11.000										0.114	84.9	6.5	
OldL.33	11.000										0.097	84.9	5.5	
OldL.34	11.000										0.078	84.8	4.4	
OldL.35	11.000		0.001	0.000	0.002	0.001					0.055	84.7	3.1	
OldL.36	11.000		0.003	0.002	0.011	0.007					0.043	84.6	2.4	
Pam B1	11.000										0.003	84.9	0.2	
Pam B2	0.415		0.001	0.000	0.002	0.001					0.003	85.0	4.7	
Phagidung B1	11.000										0.367	85.1	19.7	
Phagidunng B2	0.415		0.006	0.004	0.023	0.014					0.034	85.0	49.2	
ReplaBT B1	11.000		0.001	0.001	0.003	0.002					0.026	88.1	1.5	
Rongchu B2	0.415		0.002	0.001	0.007	0.004					0.011	85.0	16.1	
Rongchu MHPP B1	0.415										0.457	87.4	635.2	
Rongchu MHPP B2	11.000										0.433	88.8	24.0	
Rotpa B1	11.000										0.003	84.9	0.2	
Rotpa B2	0.415		0.001	0.000	0.002	0.001					0.003	85.0	4.1	
RwabeA B1	11.000										0.016	84.8	0.9	
RwabeA B2	0.415		0.002	0.001	0.006	0.004					0.009	85.0	13.7	
RwabeB B1	0.415		0.001	0.001	0.005	0.003					0.007	85.0	9.8	
RwabeB B2	11.000										0.007	84.7	0.4	
RwabeC B1	11.000										0.004	84.8	0.2	
RwabeC B2	0.415		0.001	0.000	0.003	0.002					0.004	85.0	6.1	
Samling B1	11.000										0.025	85.3	1.4	
Samling B2	0.415		0.004	0.002	0.012	0.007					0.018	85.0	27.3	
Semchebe B1	11.000										0.007	84.6	0.4	
Semchebe B2	0.415		0.001	0.001	0.004	0.003					0.006	85.0	9.7	
Sershong B1	11.000										0.010	84.6	0.6	
Sershong B2	0.415		0.002	0.001	0.007	0.004					0.010	85.0	15.3	
Serzam B1	33.000										0.008	84.8	0.1	

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Percent Loading
Serzam B2	0.415		0.001	0.001	0.005	0.003					0.008	85.0	11.5	
Shangbe B1	11.000										0.058	85.0	3.2	
Shangbe B2	0.415		0.003	0.002	0.010	0.007					0.016	85.0	24.3	
Somshing B1	11.000										0.105	86.3	5.8	
Somshing B2	0.415		0.003	0.002	0.009	0.006					0.014	85.0	20.9	
Soshong B1	11.000										0.018	84.3	1.0	
Soshong B2	0.415		0.003	0.002	0.011	0.007					0.017	85.0	26.5	
Sumpa B1	11.000										0.569	83.4	31.2	
Sumpa B2	0.415		0.002	0.001	0.007	0.005					0.011	85.0	16.2	
Sungbe B1	11.000										0.164	85.2	9.3	
Sungbe B2	0.415		0.002	0.001	0.008	0.005					0.012	85.0	18.6	
Tabee B1	11.000										0.237	85.2	13.4	
Tabee B2	0.415		0.004	0.003	0.014	0.009					0.021	85.0	33.4	
Takila I B1	0.415		0.008	0.005	0.029	0.018					0.043	85.0	62.2	
Takila II B2	0.415		0.002	0.001	0.009	0.006					0.013	85.0	19.2	
Tangbe B1	11.000										0.066	84.8	3.7	
Tangbe B2	0.415		0.002	0.001	0.007	0.004					0.010	85.0	15.4	
TangmachuSS B1	33.000										2.244	84.5	39.3	
TangmachuSS B2	11.000										1.514	82.3	81.3	
Tangrung B1	11.000										0.019	85.3	1.1	
Tangrung B2	0.415		0.002	0.001	0.006	0.004					0.009	85.0	13.9	
Taya B1	11.000										0.043	86.7	2.4	
Taya B2	0.415		0.001	0.000	0.002	0.001					0.003	85.0	4.6	
TCS B1	11.000										0.226	85.5	12.2	
TCS B2	0.415		0.010	0.006	0.035	0.022					0.053	85.0	78.1	
Thinleygang B1	11.000										0.224	85.1	12.1	
Thinleygang B2	0.415		0.001	0.000	0.003	0.002					0.004	85.0	6.3	
Thrima B1	11.000										0.041	85.5	2.3	
Thrima B2	0.415		0.001	0.001	0.005	0.003					0.007	85.0	10.9	
Thuenpee B1	11.000										0.122	84.9	6.9	
Thuenpee B2	0.415		0.002	0.001	0.005	0.003					0.008	85.0	12.2	
Tmchu B1	0.415		0.011	0.007	0.037	0.023					0.056	85.0	83.3	
Tmchu B2	11.000										0.058	84.1	3.1	
Tmchu.2	11.000										0.284	85.3	15.3	
Tmchu.3	11.000										0.171	85.8	9.3	
Tmchu.4	11.000										0.057	84.9	3.1	
Tmchu.5	11.000										0.031	87.5	1.7	
Tmchu.6	11.000										0.020	88.0	1.1	
Tmchu.7	11.000										0.039	85.6	2.1	
Tmchu.B1	11.000										0.332	85.2	17.9	
Tongkla B1	11.000										0.075	83.9	4.1	
Tongkla B2	0.415		0.014	0.009	0.047	0.029					0.071	85.0	108.3	

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Percent Loading
Tongling B1	11.000										0.013	84.5	0.7	
Tongling B2	0.415		0.002	0.002	0.009	0.005					0.013	85.0	19.6	
Trongmey B1	11.000										0.011	84.5	0.6	
Trongmey B2	0.415		0.002	0.001	0.007	0.005					0.011	85.0	16.8	
Trongtoe B1	11.000										0.012	84.5	0.7	
Trongtoe B2	0.415		0.002	0.001	0.008	0.005					0.012	85.0	17.9	
Tsango B1	11.000		0.002	0.001	0.008	0.005					0.012	85.0	0.7	
Tshochan B1	33.000										0.006	84.8	0.1	
Tshochan B2	0.415		0.001	0.001	0.004	0.002					0.006	85.0	7.9	
Tsholing B1	11.000										0.009	84.7	0.5	
Tsholing B2	0.415		0.002	0.001	0.006	0.004					0.009	85.0	13.0	
U.Dangling B1	11.000										0.011	85.5	0.6	
U.Dangling B2	0.415		0.001	0.000	0.002	0.001					0.003	85.0	4.4	
U.Domkhar B1	33.000										0.484	86.9	8.5	
U.Domkhar B2	0.415		0.002	0.001	0.009	0.006					0.014	85.0	19.2	
U.Jalang B1	11.000										0.107	84.5	5.8	
U.Jalang B2	0.415		0.005	0.003	0.016	0.010					0.024	85.0	36.1	
U.Pangkhar B1	11.000										0.040	87.2	2.2	
U.Pangkhar B2	0.415		0.003	0.002	0.009	0.006					0.014	85.0	20.8	
U.Serphu B1	11.000										0.021	85.1	1.1	
U.Serphu B2	0.415		0.001	0.001	0.004	0.002					0.006	85.0	8.8	
U.Shawa B1	11.000										0.011	84.6	0.6	
U.Shawa B2	0.415		0.002	0.001	0.007	0.004					0.011	85.0	15.8	
U.Wambur B1	33.000										0.655	89.6	11.5	
U.Wambur B2	0.415		0.004	0.002	0.014	0.008					0.020	85.0	28.5	
U.Zhungkhar B1	0.415		0.003	0.002	0.011	0.007					0.016	85.0	23.7	
U.Zhungkhar B2	11.000										0.017	84.4	0.9	
Wambrang B1	11.000		0.001	0.000	0.002	0.001					0.025	84.2	1.4	
Wambrang B2	0.415		0.004	0.003	0.014	0.009					0.021	85.0	33.5	
Wangzhing B1	11.000										0.201	84.9	10.8	
Wangzhing B2	0.415		0.004	0.002	0.014	0.009					0.021	85.0	30.0	
Wayway B1	11.000										0.014	84.1	0.8	
Wayway B2	0.415		0.003	0.002	0.009	0.006					0.014	85.0	21.7	
Yabee B1	33.000										0.039	87.4	0.7	
Yabee B2	0.415		0.003	0.002	0.012	0.008					0.019	85.0	26.6	
Yongbaling B1	11.000										0.048	85.8	2.7	
Yongbaling B2	0.415		0.001	0.001	0.004	0.003					0.007	85.0	9.8	
Youdra B1	11.000										0.010	84.6	0.5	
Youdra B2	0.415		0.002	0.001	0.006	0.004					0.010	85.0	14.5	
Zamling B1	11.000										0.253	85.5	14.1	
Zamling B2	0.415		0.003	0.002	0.010	0.006					0.015	85.0	21.9	
Zangkhar B1	0.415		0.001	0.001	0.004	0.002					0.005	85.0	7.5	

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					Percent
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Loading
Zham B1	0.415		0.001	0.001	0.005	0.003					0.008	85.0	10.9	
Zham B2	11.000										0.008	84.7	0.4	

* Indicates operating load of a bus exceeds the bus critical limit (100.0% of the Continuous Ampere rating).
# Indicates operating load of a bus exceeds the bus marginal limit (95.0% of the Continuous Ampere rating).

Branch Loading Summary Report

CKT / Branch		Cable & Reactor			Transformer				
						Loading (input)		Loading (output)	
ID	Type	Ampacity (Amp)	Loading Amp	%	Capability (MVA)	MVA	%	MVA	%
Gangzur MHPP Line	Cable	229.86	16.62	7.23					
Rongchu MHPP Line	Cable	229.86	23.96	10.42					
* Ambrangchu Tfr	Transformer				0.025	0.052	207.1	0.048	190.2
Autso.Baz Tfr	Transformer				0.250	0.134	53.5	0.131	52.4
Autso.Sch Tfr	Transformer				0.125	0.094	75.1	0.091	73.1
B.Factory Tfr	Transformer				0.063	0.014	22.8	0.014	22.6
Baptong Tfr	Transformer				0.063	0.022	34.7	0.022	34.2
Bazar Tfr	Transformer				0.250	0.018	7.2	0.018	7.1
Berpa Tfr	Transformer				0.025	0.016	62.8	0.015	61.2
Bragong Tfr	Transformer				0.063	0.062	98.7	0.060	94.9
Budhur Tfr	Transformer				0.063	0.025	39.2	0.024	38.6
Changkhala Tfr	Transformer				0.030	0.021	69.6	0.020	67.8
Chazam Tfr	Transformer				0.016	0.013	78.2	0.012	75.6
* Chengling Tfr	Transformer				0.025	0.051	202.2	0.047	186.1
Churbe Tfr	Transformer				0.016	0.003	16.4	0.003	16.3
Chusa Tfr	Transformer				0.063	0.019	29.5	0.018	29.2
Dagathang Tfr	Transformer				0.030	0.011	38.3	0.011	37.7
Dakten Tfr	Transformer				0.025	0.020	81.4	0.020	78.8
Depteng Tfr	Transformer				0.025	0.007	29.4	0.007	29.0
Dorshong Tfr	Transformer				0.125				
Drabling Tfr	Transformer				0.016	0.010	63.0	0.010	61.3
Dungkhar Tfr	Transformer				0.063	0.032	51.4	0.032	50.3
Dzong Tfr	Transformer				0.250	0.120	47.9	0.117	47.0
Fatila Tfr	Transformer				0.016	0.007	43.5	0.007	42.7
Fawan Tfr	Transformer				0.063	0.020	32.2	0.020	31.8
Fire Hydt. Tfr	Transformer				0.250	0.002	0.6	0.002	0.6
Gangla Tfr	Transformer				0.025	0.009	37.9	0.009	37.3
* Gangzur MHPP Tfr	Transformer				0.315	0.317	100.5	0.306	97.2
Gangzur Tfr	Transformer				0.050	0.031	61.7	0.030	60.1
gorgan Tfr	Transformer				0.063	0.007	11.8	0.007	11.7
Gpa Kap Tfr	Transformer				0.063	0.023	37.2	0.023	36.7
Gwog CD Tfr	Transformer				0.025	0.011	42.7	0.010	41.9
Jabee Auto.W Tfr	Transformer				0.063	0.012	19.7	0.012	19.6

CKT / Branch		Cable & Reactor			Transformer				
						Loading (input)		Loading (output)	
ID	Type	Ampacity (Amp)	Loading Amp	%	Capability (MVA)	MVA	%	MVA	%
Jabee RBA Tfr	Transformer				0.016	0.001	3.6	0.001	3.6
Jachung Tfr	Transformer				0.025	0.001	4.8	0.001	4.8
Jalamzum Tfr	Transformer				0.025	0.013	52.6	0.013	51.4
Jang Tfr	Transformer				0.063	0.009	14.8	0.009	14.8
Jasabe Tfr	Transformer				0.025	0.009	35.3	0.009	34.8
Jcholing Tfr	Transformer				0.063	0.015	23.9	0.015	23.7
Kamdar Tfr	Transformer				0.063	0.048	76.5	0.047	74.3
Kchung Tfr	Transformer				0.025	0.021	85.8	0.021	82.7
Kemtshong Tfr	Transformer				0.016	0.013	83.4	0.013	80.6
Khema Tfr	Transformer				0.025	0.009	35.1	0.009	34.6
* Khoma Sch. Tfr	Transformer				0.016	0.027	168.9	0.025	157.3
Khoma Tfr	Transformer				0.063	0.051	81.5	0.050	78.8
Khoma.D Tfr	Transformer				0.016	0.002	10.6	0.002	10.6
Khomadung Tfr	Transformer				0.125	0.065	52.1	0.064	51.0
Khomagang Tfr	Transformer				0.016	0.010	62.0	0.010	60.4
Kilung Tfr	Transformer				0.016	0.008	48.0	0.008	47.1
Kiphu Tfr	Transformer				0.030	0.007	23.0	0.007	22.8
Kupensa Tfr	Transformer				0.063	0.020	32.1	0.020	31.7
L.Dangling Tfr	Transformer				0.025	0.008	33.0	0.008	32.5
L.Domkhar Tfr	Transformer				0.063	0.013	19.9	0.012	19.8
L.Jalang Tfr	Transformer				0.025	0.020	81.5	0.020	78.9
L.Pangkhar Tfr	Transformer				0.025	0.018	72.1	0.017	70.0
L.Serphu Tfr	Transformer				0.025	0.015	59.3	0.014	57.9
L.Shawa Tfr	Transformer				0.025	0.021	84.1	0.020	81.2
L.Wambur Tfr	Transformer				0.063	0.016	26.1	0.016	25.9
L.Zhungkhar Tfr	Transformer				0.025	0.011	42.4	0.010	41.7
Lagyel Tfr	Transformer				0.030	0.010	32.8	0.010	32.4
Lawa Tfr	Transformer				0.025	0.006	22.9	0.006	22.7
LHS Tfr	Transformer				0.250	0.162	64.8	0.158	63.1
Lingabe Tfr	Transformer				0.063	0.013	21.0	0.013	20.9
Lugarpang Tfr	Transformer				0.016	0.010	59.7	0.009	58.3
Lukchu Tfr	Transformer				0.025	0.013	52.3	0.013	51.2
M.Zhungkhar Tfr	Transformer				0.025	0.009	34.5	0.009	34.1
Manjabee Tfr	Transformer				0.063	0.008	13.4	0.008	13.3
Menjitse Tfr	Transformer				0.125	0.017	13.3	0.017	13.3

CKT / Branch		Cable & Reactor			Transformer				
					Capability	Loading (input)		Loading (output)	
ID	Type	Ampacity (Amp)	Loading Amp	%	(MVA)	MVA	%	MVA	%
Minjey Sch. Tfr	Transformer				0.100	0.042	41.6	0.041	41.0
Mmaling Tfr	Transformer				0.025	0.007	27.0	0.007	26.7
Murmur Tfr	Transformer				0.016	0.007	40.8	0.006	40.2
Namdruling Tfr	Transformer				0.063	0.053	84.6	0.052	81.9
* Namgong Tfr	Transformer				0.025	0.029	115.4	0.028	110.0
Nangla Tfr	Transformer				0.025	0.007	28.5	0.007	28.2
Naray Tfr	Transformer				0.016	0.004	27.5	0.004	27.2
Naybee Tfr	Transformer				0.063	0.037	59.3	0.037	58.0
New NHDC Tfr	Transformer				0.063	0.018	28.4	0.018	28.1
Ney Zhisar Tfr	Transformer				0.100	0.023	22.6	0.022	22.4
Ngalamd Tfr	Transformer				0.025	0.016	64.9	0.016	63.2
Ngar Tfr	Transformer				0.016	0.006	37.1	0.006	36.6
* NHDC Tfr	Transformer				0.063	0.102	161.3	0.095	151.0
Nimshong Tfr	Transformer				0.063	0.015	23.2	0.014	23.0
Pam Tfr	Transformer				0.025	0.003	13.1	0.003	13.0
Phagidung Tfr	Transformer				0.063	0.034	54.8	0.034	53.6
* Rongchu MHPP Tfr	Transformer				0.315	0.457	144.9	0.433	137.5
Rongchu Tfr	Transformer				0.016	0.011	68.6	0.011	66.7
Rotpa Tfr	Transformer				0.025	0.003	11.0	0.003	11.0
RwabeA Tfr	Transformer				0.025	0.010	38.2	0.009	37.6
RwabeB Tfr	Transformer				0.025	0.007	27.4	0.007	27.1
RwabeC Tfr	Transformer				0.025	0.004	17.0	0.004	16.9
Samling Tfr	Transformer				0.025	0.019	74.5	0.018	72.3
Semchebe Tfr	Transformer				0.016	0.007	41.2	0.006	40.5
Sershong Tfr	Transformer				0.025	0.010	40.7	0.010	40.0
Serzam Tfr	Transformer				0.030	0.008	27.4	0.008	27.1
Shangbe Tfr	Transformer				0.025	0.016	65.9	0.016	64.1
Somshing Tfr	Transformer				0.025	0.014	57.1	0.014	55.7
Soshong Tfr	Transformer				0.025	0.018	70.6	0.017	68.5
Sumpa Tfr	Transformer				0.063	0.011	17.7	0.011	17.6
Sungbe Tfr	Transformer				0.063	0.012	19.6	0.012	19.5
Tabee Tfr	Transformer				0.025	0.022	89.3	0.021	85.9
Takila I Tfr	Transformer				0.250	0.043	17.4	0.043	17.3
Takila II Tfr	Transformer				0.315	0.013	4.3	0.013	4.3
Tangbe Tfr	Transformer				0.025	0.010	41.0	0.010	40.3

CKT / Branch		Cable & Reactor			Transformer				
						Loading (input)		Loading (output)	
ID	Type	Ampacity (Amp)	Loading Amp	%	Capability (MVA)	MVA	%	MVA	%
TangmachuSS Tfr1	Transformer				1.500	0.775	51.7	0.757	50.5
TangmachuSS Tfr2	Transformer				1.500	0.775	51.7	0.757	50.5
Tangrung Tfr	Transformer				0.025	0.009	37.1	0.009	36.5
Taya Tfr	Transformer				0.025	0.003	12.5	0.003	12.4
TCS Tfr	Transformer				0.063	0.055	86.8	0.053	83.9
Thinleygang Tfr	Transformer				0.016	0.004	27.7	0.004	27.5
Thrima Tfr	Transformer				0.025	0.007	29.5	0.007	29.2
Thuenpee Tfr	Transformer				0.025	0.008	32.5	0.008	32.0
Tmchu Tfr	Transformer				0.063	0.058	92.6	0.056	89.3
* Tongkla Tfr	Transformer				0.063	0.075	118.5	0.071	112.9
Tongling Tfr	Transformer				0.025	0.013	53.3	0.013	52.1
Trongmey Tfr	Transformer				0.025	0.011	45.6	0.011	44.7
Trongtoe Tfr	Transformer				0.025	0.012	48.4	0.012	47.4
Tshochan Tfr	Transformer				0.030	0.006	18.9	0.006	18.8
Tsholing Tfr	Transformer				0.025	0.009	35.1	0.009	34.6
U.Dangling Tfr	Transformer				0.025	0.003	12.2	0.003	12.1
U.Domkhar Tfr	Transformer				0.063	0.014	21.8	0.014	21.6
* U.Jalang Tfr	Transformer				0.025	0.025	100.7	0.024	96.8
U.Pangkhar Tfr	Transformer				0.025	0.014	56.8	0.014	55.5
U.Serphu Tfr	Transformer				0.025	0.006	23.9	0.006	23.7
U.Shawa Tfr	Transformer				0.025	0.011	42.9	0.011	42.1
U.Wambur Tfr	Transformer				0.063	0.020	32.4	0.020	32.0
U.Zhungkhar Tfr	Transformer				0.025	0.017	66.1	0.016	64.4
Wambrang Tfr	Transformer				0.025	0.022	89.1	0.021	85.7
Wangzhing Tfr	Transformer				0.063	0.021	33.2	0.021	32.8
Wayway Tfr	Transformer				0.016	0.014	90.2	0.014	86.7
Yabee Tfr	Transformer				0.030	0.019	63.3	0.019	61.9
Yongbaling Tfr	Transformer				0.016	0.007	41.6	0.007	40.9
Youdra Tfr	Transformer				0.025	0.010	39.5	0.010	38.9
Zamling Tfr	Transformer				0.063	0.015	23.5	0.015	23.2
Zangkhar Tfr	Transformer				0.030	0.005	17.9	0.005	17.8
Zham Tfr	Transformer				0.025	0.008	30.4	0.008	30.0

* Indicates a branch with operating load exceeding the branch capability.

Branch Losses Summary Report

Branch ID	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop in Vmag
	MW	Mvar	MW	Mvar	kW	kvar	From	To	
Ambrangchu-Chengling	0.042	0.028	-0.042	-0.028	0.0	-0.4	96.5	96.4	0.05
OldL.3-Ambrangchu	-0.085	-0.057	0.085	0.056	0.1	-0.2	96.5	96.5	0.06
Ambrangchu Tfr	0.043	0.029	-0.040	-0.025	2.6	3.8	96.5	88.6	7.88
Gorg.23-Autso.Baz	-0.113	-0.071	0.113	0.071	0.0	-0.5	99.3	99.3	0.00
Autso.Baz Tfr	0.113	0.071	-0.111	-0.069	1.6	2.4	99.3	97.3	1.96
Gorg.23-Autso.Sch	-0.079	-0.050	0.079	0.050	0.0	-0.4	99.3	99.3	0.00
Autso.Sch Tfr	0.079	0.050	-0.078	-0.048	1.6	2.4	99.3	96.5	2.76
B.Factory-Gorg.21	0.308	0.178	-0.308	-0.182	0.1	-4.6	99.4	99.3	0.03
Gorg.20-B.Factory	-0.320	-0.185	0.320	0.183	0.0	-2.5	99.4	99.4	0.02
B.Factory Tfr	0.012	0.008	-0.012	-0.008	0.1	0.1	99.4	98.5	0.84
Baptong-Kemtshong	0.011	0.007	-0.011	-0.007	0.0	-0.7	94.6	94.6	0.02
Baptong-Khomadung	0.055	0.034	-0.055	-0.035	0.0	-0.7	94.6	94.6	0.07
Old.9-Baptong	-0.085	-0.052	0.085	0.052	0.1	-0.4	94.6	94.7	0.07
Baptong Tfr	0.019	0.012	-0.018	-0.011	0.2	0.3	94.6	93.3	1.34
NewL.9-Bazar	-0.015	-0.009	0.015	0.009	0.0	-0.1	95.9	95.9	0.00
Bazar Tfr	0.015	0.009	-0.015	-0.009	0.0	0.0	95.9	95.6	0.27
Berpa-OldL.9	0.105	0.064	-0.105	-0.064	0.0	-0.1	94.7	94.7	0.02
Khoma Sch.-Berpa	-0.118	-0.072	0.118	0.072	0.1	-0.3	94.7	94.8	0.09
Berpa Tfr	0.013	0.008	-0.013	-0.008	0.2	0.4	94.7	92.3	2.42
Bragong Tfr	-0.051	-0.032	0.052	0.034	1.4	2.2	93.2	97.0	3.72
U.Jalang-Bragong	-0.052	-0.034	0.052	0.033	0.1	-0.6	97.0	97.1	0.10
Gorg.1-Budhur	-0.021	-0.013	0.021	0.011	0.0	-1.7	99.6	99.6	0.00
Budhur Tfr	0.021	0.013	-0.021	-0.013	0.2	0.3	99.6	98.2	1.43
Yabee-Changkhala	-0.018	-0.011	0.018	0.009	0.0	-2.7	99.5	99.5	0.00
Changkhala Tfr	0.018	0.011	-0.017	-0.011	0.3	0.5	99.5	97.0	2.55
OldL.34-Chazam	-0.011	-0.007	0.011	0.007	0.0	0.0	92.5	92.5	0.00
Chazam Tfr	0.011	0.007	-0.010	-0.006	0.3	0.4	92.5	89.4	3.09
Chengling Tfr	0.042	0.028	-0.040	-0.025	2.4	3.7	96.4	88.7	7.70
Churbe-L.Shawa	0.027	0.017	-0.027	-0.017	0.0	-0.3	94.3	94.3	0.03
Thrima-Churbe	-0.029	-0.018	0.029	0.017	0.0	-0.6	94.3	94.4	0.06
Churbe Tfr	0.002	0.001	-0.002	-0.001	0.0	0.0	94.3	93.7	0.63
Chusa-Wangzhing	0.171	0.106	-0.170	-0.106	0.3	-0.2	97.4	97.3	0.16
Min.1-Chusa	-0.187	-0.116	0.187	0.116	0.3	-0.1	97.4	97.6	0.16
Chusa Tfr	0.016	0.010	-0.016	-0.010	0.1	0.2	97.4	96.3	1.10

Branch ID	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
Dagathang-Gorg.16	0.435	0.231	-0.435	-0.234	0.1	-3.0	99.5	99.5	0.02
Gorg.2-Dagathang	-0.445	-0.237	0.445	0.235	0.1	-1.6	99.5	99.6	0.02
Dagathang Tfr	0.010	0.006	-0.010	-0.006	0.1	0.1	99.5	98.1	1.40
Ngalamd-Dakten	-0.017	-0.011	0.017	0.011	0.0	-0.4	95.4	95.4	0.01
Dakten Tfr	0.017	0.011	-0.017	-0.010	0.4	0.6	95.4	92.2	3.12
Depteng-Ney Zhisar	0.019	0.012	-0.019	-0.012	0.0	-0.3	94.1	94.1	0.02
OldL.24-Depteng	-0.025	-0.016	0.025	0.015	0.0	-0.1	94.1	94.1	0.01
Depteng Tfr	0.006	0.004	-0.006	-0.004	0.1	0.1	94.1	93.0	1.14
Gorg.3-Dorshong	0.000	0.000	0.000	0.000	0.0	-0.2	99.5	99.5	0.00
Dorshong Tfr	0.000	0.000	0.000	0.000			99.5	99.5	
Drabling-OldL.36	0.036	0.023	-0.036	-0.023	0.0	0.0	92.4	92.4	0.00
Old.35-Drabling	-0.045	-0.028	0.045	0.028	0.0	-0.1	92.4	92.4	0.02
Drabling Tfr	0.009	0.005	-0.008	-0.005	0.2	0.2	92.4	89.9	2.49
Dungkhar-Sungbe	0.140	0.086	-0.140	-0.086	0.1	-0.1	92.8	92.8	0.05
OldL.29-Dungkhar	-0.168	-0.103	0.168	0.103	0.0	0.0	92.8	92.9	0.02
Dungkhar Tfr	0.027	0.017	-0.027	-0.017	0.4	0.6	92.8	90.8	2.02
Dzong-NewL.8	0.164	0.106	-0.164	-0.106	0.0	0.0	96.0	96.0	0.02
NewL.7-Dzong	-0.265	-0.170	0.265	0.170	0.1	0.0	96.0	96.1	0.04
Dzong Tfr	0.101	0.064	-0.100	-0.062	1.4	2.1	96.0	94.2	1.82
NewL.7-Fatila	-0.006	-0.004	0.006	0.003	0.0	-0.2	96.1	96.1	0.00
Fatila Tfr	0.006	0.004	-0.006	-0.004	0.1	0.1	96.1	94.4	1.65
Fawan-Gorg.20	0.381	0.220	-0.381	-0.221	0.0	-0.4	99.4	99.4	0.00
L.Domkhar-Fawan	-0.398	-0.231	0.398	0.227	0.1	-3.9	99.4	99.4	0.03
Fawan Tfr	0.017	0.011	-0.017	-0.011	0.1	0.2	99.4	98.2	1.18
NewL.7-Fire.Hydt	-0.001	-0.001	0.001	0.001	0.0	0.0	96.0	96.0	0.00
Fire Hydt. Tfr	0.001	0.001	-0.001	-0.001	0.0	0.0	96.0	96.0	0.02
Gangla-Khema	0.009	0.005	-0.009	-0.005	0.0	-0.4	94.7	94.7	0.01
OldL.7-Gangla	-0.017	-0.010	0.017	0.009	0.0	-0.5	94.7	94.7	0.03
Gangla Tfr	0.008	0.005	-0.008	-0.005	0.1	0.1	94.7	93.2	1.46
OldL.15-Gangzur	-0.026	-0.017	0.026	0.016	0.0	-0.1	95.2	95.2	0.01
Gangzur Tfr	0.026	0.017	-0.026	-0.016	0.5	0.7	95.2	92.8	2.36
Gangzur MHPP Tfr	0.291	0.125	-0.284	-0.115	7.1	10.6	100.0	96.7	3.35
Gangzur MHPP Line	0.284	0.115	-0.284	-0.115	0.0	0.0	96.7	96.7	0.00
Gorg.1-L.Wambur	0.601	0.298	-0.601	-0.298	0.0	-0.3	99.6	99.6	0.01
Kupensa-Gorg.1	-0.622	-0.309	0.622	0.304	0.7	-5.8	99.6	99.7	0.12
Gorg(2-3)	0.124	0.046	-0.124	-0.049	0.0	-3.0	99.6	99.5	0.01
U.Wambur-Gorg.2	-0.569	-0.281	0.569	0.280	0.1	-1.2	99.6	99.6	0.01

	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd
Branch ID	MW	Mvar	MW	Mvar	kW	kvar	From	To	% Drop in Vmag
Gorg.3-Gorgan	0.124	0.050	-0.124	-0.051	0.0	-1.6	99.5	99.5	0.00
Gorg(4-5)	0.111	0.051	-0.111	-0.052	0.0	-1.2	99.5	99.5	0.00
Gorg.4-Serzam	0.007	0.003	-0.007	-0.004	0.0	-1.6	99.5	99.5	0.00
Gorgan-Gorg.4	-0.118	-0.054	0.118	0.047	0.0	-6.3	99.5	99.5	0.01
Gorg(5-6)	0.040	0.018	-0.040	-0.021	0.0	-2.1	99.5	99.5	0.00
Gorg(5-7)	0.071	0.033	-0.071	-0.036	0.0	-2.5	99.5	99.5	0.00
Gorg.6-Yabee	0.034	0.017	-0.034	-0.019	0.0	-1.9	99.5	99.5	0.00
Zangkhar Tfr	0.005	0.003	-0.005	-0.003	0.0	0.0	99.5	98.9	0.66
Gorg(7-8)	0.066	0.034	-0.066	-0.040	0.0	-5.3	99.5	99.5	0.01
Gorg.7-Tshochan	0.005	0.002	-0.005	-0.003	0.0	-1.5	99.5	99.5	0.00
Gorg(8-9)	0.064	0.038	-0.064	-0.040	0.0	-1.4	99.5	99.5	0.00
Gorg(16-17)	0.421	0.229	-0.421	-0.233	0.1	-4.0	99.5	99.5	0.03
Gorg.16-Kiphu	0.014	0.005	-0.014	-0.006	0.0	-1.2	99.5	99.5	0.00
Gorg.17-U.Domkhar	0.421	0.233	-0.421	-0.239	0.2	-6.3	99.5	99.4	0.05
Gorg(21-22)	0.307	0.182	-0.307	-0.186	0.1	-4.1	99.3	99.3	0.02
Gorg.21-Jachung	0.001	0.000	-0.001	-0.001	0.0	-0.2	99.3	99.3	0.00
Gorg(22-23)	0.192	0.120	-0.192	-0.121	0.0	-0.8	99.3	99.3	0.00
Gorg(22-24)	0.115	0.066	-0.115	-0.068	0.0	-2.5	99.3	99.3	0.01
Gorg(24-29)	0.058	0.033	-0.058	-0.035	0.0	-1.3	99.3	99.3	0.00
Gorg.29-Namdruling	0.045	0.026	-0.045	-0.029	0.0	-2.4	99.3	99.3	0.00
gorgan Tfr	0.006	0.004	-0.006	-0.004	0.0	0.0	99.5	99.1	0.43
Old.9- Gpa Kap	-0.020	-0.012	0.020	0.012	0.0	-0.4	94.7	94.7	0.01
Gpa Kap Tfr	0.020	0.012	-0.020	-0.012	0.2	0.3	94.7	93.3	1.43
OldL.30-Gwog CD	-0.009	-0.006	0.009	0.005	0.0	-0.2	92.7	92.7	0.00
Gwog CD Tfr	0.009	0.006	-0.009	-0.006	0.1	0.2	92.7	91.1	1.68
Old.4-Jabee Auto.W	-0.011	-0.007	0.011	0.007	0.0	-0.1	96.5	96.5	0.00
Jabee Auto.W Tfr	0.011	0.007	-0.010	-0.006	0.1	0.1	96.5	95.8	0.74
Jabee-OldL.3	0.575	0.380	-0.574	-0.379	1.5	1.2	96.8	96.5	0.30
OldL.1-Jabee RBA	-0.576	-0.381	0.577	0.382	1.7	1.4	96.8	97.2	0.33
Jabee RBA Tfr	0.000	0.000	0.000	0.000	0.0	0.0	96.8	96.7	0.14
Jachung Tfr	0.001	0.001	-0.001	-0.001	0.0	0.0	99.3	99.2	0.18
Jalamzum-Jcholing	0.021	0.012	-0.021	-0.012	0.0	-0.5	94.8	94.7	0.03
Jalamzum-Tongling	0.011	0.007	-0.011	-0.007	0.0	-0.2	94.8	94.8	0.01
OldL.20-Jalamzum	-0.043	-0.026	0.043	0.025	0.0	-0.2	94.8	94.8	0.03
Jalamzum Tfr	0.011	0.007	-0.011	-0.007	0.2	0.3	94.8	92.7	2.02
OldL.17-Jang	-0.008	-0.005	0.008	0.005	0.0	-0.4	95.2	95.2	0.01
Jang Tfr	0.008	0.005	-0.008	-0.005	0.0	0.1	95.2	94.6	0.57

Branch ID	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
Old.29-Jasabe	-0.015	-0.010	0.015	0.009	0.0	-0.5	92.8	92.9	0.02
Jasabe Tfr	0.007	0.005	-0.007	-0.005	0.1	0.1	92.8	91.4	1.39
Jcholing-Youdra	0.008	0.004	-0.008	-0.005	0.0	-1.2	94.7	94.7	0.03
Jcholing Tfr	0.013	0.008	-0.013	-0.008	0.1	0.1	94.7	93.8	0.92
Kamdar Tfr	-0.040	-0.025	0.041	0.026	0.9	1.3	94.6	97.5	2.87
Tmchu.1-Kamdar	-0.041	-0.026	0.041	0.026	0.0	-0.3	97.5	97.5	0.02
OldL.28-Kchung	-0.018	-0.012	0.018	0.011	0.0	-0.2	94.0	94.0	0.01
Kchung Tfr	0.018	0.012	-0.018	-0.011	0.5	0.7	94.0	90.6	3.33
Kemtshong Tfr	0.011	0.007	-0.011	-0.007	0.3	0.4	94.6	91.4	3.22
Khema-Nyeteng	0.002	0.000	-0.002	-0.001	0.0	-0.5	94.7	94.7	0.00
Khema Tfr	0.007	0.005	-0.007	-0.005	0.1	0.1	94.7	93.3	1.35
Old.10-Khoma	-0.043	-0.028	0.043	0.028	0.0	0.0	94.8	94.8	0.00
Khoma Tfr	0.043	0.028	-0.042	-0.026	1.0	1.5	94.8	91.7	3.14
OldL.8-Khoma Sch.	-0.141	-0.087	0.141	0.087	0.0	-0.1	94.8	94.8	0.03
Khoma Sch. Tfr	0.023	0.015	-0.021	-0.013	1.1	1.7	94.8	88.3	6.53
Khoma.D-Ngalamd	0.031	0.019	-0.031	-0.019	0.0	-0.3	95.4	95.4	0.02
Khoma.D-OldL.6	0.313	0.189	-0.312	-0.189	1.4	0.5	95.4	94.9	0.49
OldL.5-Khoma.D	-0.346	-0.209	0.346	0.209	0.3	0.1	95.4	95.5	0.10
Khoma.D Tfr	0.001	0.001	-0.001	-0.001	0.0	0.0	95.4	95.0	0.40
Khomadung Tfr	0.055	0.035	-0.054	-0.034	0.8	1.3	94.6	92.6	2.01
Khomagang-Tsango	0.011	0.006	-0.011	-0.007	0.0	-0.9	94.7	94.6	0.03
ReplaBT-Khomagang	-0.019	-0.011	0.019	0.010	0.0	-1.2	94.7	94.7	0.07
Khomagang Tfr	0.008	0.005	-0.008	-0.005	0.2	0.2	94.7	92.3	2.39
Kilung Tfr	-0.006	-0.004	0.006	0.004	0.1	0.1	93.0	94.8	1.85
Kilung-OldL.19	0.056	0.033	-0.056	-0.033	0.0	0.0	94.8	94.8	0.00
Kilung-OldL.21	0.112	0.066	-0.112	-0.066	0.0	-0.1	94.8	94.8	0.04
OldL.18-Kilung	-0.174	-0.102	0.174	0.102	0.1	-0.1	94.8	94.9	0.06
Kiphu-Lagyel	0.008	0.002	-0.008	-0.005	0.0	-3.2	99.5	99.5	0.00
Kiphu Tfr	0.006	0.004	-0.006	-0.004	0.0	0.1	99.5	98.7	0.84
L1-Kupensa	-0.640	-0.314	0.641	0.291	1.5	-23.2	99.7	100.0	0.27
Kupensa Tfr	0.017	0.011	-0.017	-0.011	0.1	0.2	99.7	98.6	1.17
L.Dangling Tfr	-0.007	-0.004	0.007	0.004	0.1	0.1	96.0	97.2	1.24
Dangling(U-L)	-0.007	-0.004	0.007	0.004	0.0	-0.2	97.2	97.2	0.00
Domkhar(U-L)	-0.409	-0.234	0.409	0.232	0.0	-1.5	99.4	99.4	0.01
L.Domkhar Tfr	0.011	0.007	-0.011	-0.007	0.1	0.1	99.4	98.7	0.73
L.Jalang Tfr	-0.017	-0.010	0.017	0.011	0.4	0.6	94.0	97.1	3.06
Jalang(U-L)	-0.017	-0.011	0.017	0.011	0.0	-0.2	97.1	97.1	0.01

Branch ID	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
L.Pangkhar0OldL.12	0.035	0.020	-0.035	-0.020	0.0	-0.1	94.8	94.8	0.01
OldL.11-L.Pangkhar	-0.050	-0.029	0.050	0.029	0.0	-0.5	94.8	94.8	0.05
L.Pangkhar Tfr	0.015	0.010	-0.015	-0.009	0.3	0.5	94.8	92.0	2.78
Serphu(U-L)	-0.013	-0.008	0.013	0.008	0.0	-0.2	94.7	94.7	0.01
L.Serphu Tfr	0.013	0.008	-0.012	-0.008	0.2	0.3	94.7	92.4	2.28
Shawa(L-U)	0.009	0.006	-0.009	-0.006	0.0	0.0	94.3	94.3	0.00
L.Shawa Tfr	0.018	0.011	-0.017	-0.011	0.4	0.7	94.3	91.0	3.26
Wambur(L-U)	0.587	0.289	-0.587	-0.291	0.2	-1.6	99.6	99.6	0.03
L.Wambur Tfr	0.014	0.009	-0.014	-0.009	0.1	0.1	99.6	98.6	0.95
L.Zhingkhar-Pam	0.003	0.001	-0.003	-0.002	0.0	-0.4	97.2	97.2	0.00
Tmchu.7-L.Zhungkhar	-0.012	-0.007	0.012	0.007	0.0	-0.1	97.2	97.2	0.00
L.Zhungkhar Tfr	0.009	0.006	-0.009	-0.005	0.1	0.2	97.2	95.6	1.59
Lagyel Tfr	0.008	0.005	-0.008	-0.005	0.1	0.1	99.5	98.3	1.20
Lawa-Taya	0.037	0.021	-0.037	-0.021	0.0	-0.4	94.8	94.8	0.05
Namgong-Lawa	-0.042	-0.024	0.042	0.023	0.0	-0.5	94.8	94.9	0.07
Lawa Tfr	0.005	0.003	-0.005	-0.003	0.0	0.0	94.8	93.9	0.88
NewL.3-LHS	-0.137	-0.087	0.137	0.087	0.0	-0.1	96.4	96.4	0.03
LHS Tfr	0.137	0.087	-0.134	-0.083	2.5	3.8	96.4	94.0	2.45
Lingabe-OldL.22	0.067	0.039	-0.067	-0.040	0.2	-1.2	94.6	94.3	0.27
Somshing-Lingabe	-0.078	-0.046	0.078	0.045	0.1	-0.4	94.6	94.7	0.11
Lingabe Tfr	0.011	0.007	-0.011	-0.007	0.1	0.1	94.6	93.8	0.81
Old.2-Lugarpang	-0.008	-0.005	0.008	0.005	0.0	-0.3	97.1	97.1	0.01
Lugarpang Tfr	0.008	0.005	-0.008	-0.005	0.1	0.2	97.1	94.9	2.24
OldL.11-Lukchu	-0.011	-0.007	0.011	0.007	0.0	-0.5	94.8	94.8	0.02
Lukchu Tfr	0.011	0.007	-0.011	-0.007	0.2	0.3	94.8	92.8	2.01
Tmchu.7-M.Zhungkhar	-0.021	-0.013	0.021	0.013	0.0	-0.2	97.2	97.2	0.01
Zhungkhar(M-U)	0.014	0.009	-0.014	-0.009	0.0	-0.2	97.2	97.2	0.01
M.Zhungkhar Tfr	0.007	0.005	-0.007	-0.004	0.1	0.1	97.2	95.9	1.29
Manjabee-Tmchu.5	0.027	0.015	-0.027	-0.015	0.0	-0.4	97.3	97.2	0.02
Tmchu.3-Manjabee	-0.034	-0.019	0.034	0.019	0.0	-0.3	97.3	97.3	0.02
Manjabee Tfr	0.007	0.004	-0.007	-0.004	0.0	0.0	97.3	96.8	0.50
Menjitse-Minjey Sch.	0.126	0.079	-0.126	-0.079	0.0	-0.1	97.2	97.1	0.04
Min.2-Menjitse	-0.140	-0.088	0.140	0.088	0.0	0.0	97.2	97.2	0.03
Menjitse Tfr	0.014	0.009	-0.014	-0.009	0.1	0.1	97.2	96.7	0.50
Thinleygang-Min.1	-0.187	-0.116	0.187	0.116	0.1	-0.1	97.6	97.6	0.07
Min(2-3)	0.012	0.007	-0.012	-0.008	0.0	-0.7	97.2	97.2	0.02
Wangzhing-Min.2	-0.153	-0.095	0.153	0.095	0.1	-0.1	97.2	97.3	0.06

Branch ID	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
Min.3-Nangla	0.006	0.004	-0.006	-0.004	0.0	-0.2	97.2	97.2	0.00
Min.3-Zham	0.006	0.004	-0.006	-0.004	0.0	-0.1	97.2	97.2	0.00
Minjey Sch.-U.Jalang	0.091	0.057	-0.091	-0.057	0.1	-0.2	97.1	97.1	0.07
Minjey Sch. Tfr	0.035	0.022	-0.035	-0.022	0.4	0.6	97.1	95.6	1.56
Mmaling-OldL.2	0.014	0.008	-0.014	-0.008	0.0	-0.2	97.1	97.1	0.01
OldL.1-Mmaling	-0.019	-0.011	0.019	0.011	0.0	-0.2	97.1	97.2	0.01
Mmaling Tfr	0.006	0.004	-0.006	-0.004	0.0	0.1	97.1	96.1	1.01
Old.2-Murmur	-0.006	-0.003	0.006	0.003	0.0	-0.4	97.1	97.1	0.01
Murmur Tfr	0.006	0.003	-0.005	-0.003	0.1	0.1	97.1	95.6	1.53
Namdruling Tfr	0.045	0.029	-0.044	-0.027	1.0	1.5	99.3	96.2	3.11
OldL.6-Namgong	-0.066	-0.039	0.066	0.039	0.0	-0.2	94.9	94.9	0.02
Namgong Tfr	0.024	0.016	-0.023	-0.014	0.8	1.2	94.9	90.4	4.45
Nangla Tfr	-0.006	-0.004	0.006	0.004	0.0	0.1	96.1	97.2	1.07
Naray-OldL.34	0.066	0.041	-0.066	-0.041	0.0	-0.2	92.5	92.5	0.04
OldL.33-Naray	-0.070	-0.044	0.070	0.043	0.0	-0.2	92.5	92.5	0.02
Naray Tfr	0.004	0.002	-0.004	-0.002	0.0	0.0	92.5	91.4	1.08
Naybee-Tmchu.7	0.033	0.020	-0.033	-0.020	0.0	-0.2	97.2	97.2	0.02
Tmchu.3-Naybee	-0.065	-0.040	0.065	0.039	0.0	-0.4	97.2	97.3	0.05
Naybee Tfr	0.032	0.020	-0.031	-0.019	0.5	0.8	97.2	95.0	2.23
NewL.7-New NHDC	-0.015	-0.009	0.015	0.009	0.0	-0.2	96.1	96.1	0.01
New NHDC Tfr	0.015	0.009	-0.015	-0.009	0.1	0.2	96.1	95.0	1.08
L1-NewL.1	-0.143	-0.154	0.143	0.154	0.0	0.0	97.7	97.7	0.01
NewL(1-2)	0.143	0.154	-0.141	-0.156	1.6	-1.9	97.7	96.7	1.07
NewL(2-3)	0.425	0.271	-0.424	-0.270	0.8	0.5	96.7	96.4	0.20
NewL(3-4)	0.287	0.183	-0.287	-0.183	0.1	0.0	96.4	96.4	0.05
NewL(4-5)	0.287	0.183	-0.287	-0.183	0.4	0.1	96.4	96.2	0.16
NewL(5-6)	0.287	0.183	-0.287	-0.183	0.2	0.0	96.2	96.2	0.07
NewL(6-7)	0.287	0.183	-0.286	-0.183	0.3	0.0	96.2	96.1	0.10
NewL.8- NHDC	0.163	0.106	-0.163	-0.106	0.1	-0.1	96.0	96.0	0.05
NewL.9-Tongkla	0.063	0.041	-0.063	-0.041	0.0	-0.1	95.9	95.9	0.01
NHDC-NewL.9	-0.078	-0.050	0.078	0.050	0.0	-0.3	95.9	96.0	0.04
Ney Zhisar Tfr	0.019	0.012	-0.019	-0.012	0.1	0.2	94.1	93.2	0.88
Ngalamd Tfr	0.014	0.009	-0.013	-0.008	0.3	0.4	95.4	92.9	2.48
OldL.16-Ngar	-0.005	-0.003	0.005	0.002	0.0	-0.7	95.2	95.2	0.01
Ngar Tfr	0.005	0.003	-0.005	-0.003	0.1	0.1	95.2	93.8	1.42
NHDC Tfr	0.085	0.056	-0.081	-0.050	4.0	5.9	96.0	89.8	6.16
OldL.20-Nimshong	-0.012	-0.008	0.012	0.008	0.0	-0.1	94.8	94.8	0.00

Branch ID	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
Nimshong Tfr	0.012	0.008	-0.012	-0.008	0.1	0.1	94.8	93.9	0.89
L1-OldL.1	-0.597	-0.393	0.600	0.396	3.1	2.5	97.2	97.7	0.57
OldL(3-4)	0.489	0.323	-0.489	-0.323	0.1	0.1	96.5	96.5	0.02
OldL.4-Sumpa	0.478	0.316	-0.475	-0.314	3.0	2.1	96.5	95.8	0.69
OldL(5-13)	0.118	0.098	-0.118	-0.098	0.1	-0.3	95.5	95.4	0.10
Sumpa-OldL.5	-0.464	-0.307	0.466	0.308	1.4	1.0	95.5	95.8	0.33
OldL(6-8)	0.246	0.150	-0.245	-0.150	0.1	0.0	94.9	94.8	0.04
OldL.7-U.Serphu	0.018	0.011	-0.018	-0.011	0.0	-0.1	94.7	94.7	0.00
Taya-OldL.7	-0.035	-0.020	0.035	0.020	0.0	-0.3	94.7	94.8	0.04
OldL(8-10)	0.105	0.063	-0.105	-0.063	0.0	0.0	94.8	94.8	0.01
OldL(10-11)	0.062	0.035	-0.062	-0.035	0.0	-0.3	94.8	94.8	0.03
OldL.12-U.Pangkhar	0.035	0.020	-0.035	-0.020	0.0	-0.2	94.8	94.7	0.01
OldL(13-14)	0.118	0.098	-0.118	-0.099	0.2	-0.5	95.4	95.2	0.16
OldL(14-15)	0.039	0.023	-0.039	-0.023	0.0	-0.1	95.2	95.2	0.01
OldL(14-18)	0.079	0.076	-0.079	-0.078	0.3	-1.7	95.2	94.9	0.34
OldL(15-16)	0.013	0.007	-0.013	-0.007	0.0	-0.2	95.2	95.2	0.00
OldL(16-17)	0.008	0.004	-0.008	-0.005	0.0	-0.2	95.2	95.2	0.00
Rongchu MHPP Line	-0.384	-0.200	0.384	0.200	0.0	0.0	94.9	94.9	0.00
OldL(18-26)	0.280	0.169	-0.279	-0.169	0.5	0.1	94.9	94.7	0.19
Rongchu Tfr	0.009	0.006	-0.009	-0.006	0.2	0.3	94.9	92.2	2.64
OldL(19-20)	0.056	0.033	-0.056	-0.033	0.0	-0.2	94.8	94.8	0.03
OldL.21-Samling	0.021	0.013	-0.021	-0.013	0.0	-0.2	94.8	94.8	0.02
OldL.21-Somshing	0.090	0.053	-0.090	-0.053	0.0	-0.2	94.8	94.7	0.05
OldL(22-23)	0.059	0.036	-0.059	-0.037	0.1	-1.1	94.3	94.1	0.22
OldL.22-Tsholing	0.007	0.004	-0.007	-0.005	0.0	-0.3	94.3	94.3	0.01
OldL(22-25)	0.010	0.006	-0.010	-0.006	0.0	-0.1	94.1	94.1	0.00
OldL.23-Shangbe	0.050	0.031	-0.050	-0.031	0.0	0.0	94.1	94.1	0.01
OldL.24-Trongtoe	0.010	0.006	-0.010	-0.006	0.0	0.0	94.1	94.1	0.00
Shangbe-OldL.24	-0.036	-0.022	0.036	0.022	0.0	0.0	94.1	94.1	0.00
OldL.12-Trongmey	0.010	0.006	-0.010	-0.006	0.0	0.0	94.1	94.1	0.00
OldL(26-27)	0.277	0.167	-0.276	-0.167	0.6	0.1	94.7	94.4	0.25
OldL.26-Rotpa	0.002	0.001	-0.002	-0.001	0.0	-0.1	94.7	94.7	0.00
OldL(27-28)	0.235	0.143	-0.234	-0.143	1.0	-0.1	94.4	94.0	0.45
OldL.27-Yongbaling	0.041	0.025	-0.041	-0.025	0.0	0.0	94.4	94.4	0.00
OldL.28-Zamling	0.216	0.131	-0.216	-0.131	0.1	0.0	94.0	94.0	0.03
Tabee-OldL.29	-0.183	-0.112	0.183	0.112	0.2	-0.2	92.9	93.0	0.14
OldL(30-31)	0.121	0.074	-0.120	-0.074	0.1	-0.2	92.7	92.7	0.07

Branch ID	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
Sungbe-OldL.30	-0.130	-0.080	0.130	0.080	0.0	-0.1	92.7	92.8	0.04
Old.31-Tangrung	0.016	0.010	-0.016	-0.010	0.0	-0.1	92.7	92.7	0.00
Old.31-Thuenpee	0.104	0.064	-0.104	-0.065	0.1	-0.1	92.7	92.6	0.06
OldL(32-33)	0.082	0.051	-0.082	-0.051	0.0	-0.2	92.6	92.5	0.04
OldL.32-Soshong	0.015	0.009	-0.015	-0.010	0.0	0.0	92.6	92.6	0.00
Thuenpee-OldL.32	-0.097	-0.060	0.097	0.060	0.0	-0.1	92.6	92.6	0.03
OldL.32-Wayway	0.012	0.008	-0.012	-0.008	0.0	-0.2	92.5	92.5	0.00
Old.34-Tangbe	0.056	0.035	-0.056	-0.035	0.0	-0.1	92.5	92.5	0.03
Tangbe-OldL.35	-0.047	-0.029	0.047	0.029	0.0	-0.1	92.4	92.5	0.01
OldL.36-Warmbrang	0.021	0.014	-0.021	-0.014	0.0	-0.1	92.4	92.4	0.01
Pam Tfr	0.003	0.002	-0.003	-0.002	0.0	0.0	97.2	96.7	0.49
L1-Phagidung	-0.313	-0.193	0.313	0.193	0.3	0.1	97.6	97.7	0.11
Phagidung-Tmchu	0.284	0.174	-0.283	-0.174	0.4	0.0	97.6	97.5	0.15
Phagidung Tfr	0.029	0.018	-0.029	-0.018	0.4	0.7	97.6	95.6	2.05
U.Pangkhar-ReplaB	-0.023	-0.013	0.023	0.012	0.0	-0.3	94.7	94.7	0.02
Rongchu MHPP Tfr	0.399	0.222	-0.384	-0.200	14.7	22.0	100.0	94.9	5.12
Rotpa Tfr	0.002	0.001	-0.002	-0.001	0.0	0.0	94.7	94.3	0.42
Rwabe(A-B)	0.006	0.004	-0.006	-0.004	0.0	0.0	97.2	97.2	0.00
Tmchu.6-RwabeA	-0.014	-0.009	0.014	0.009	0.0	-0.1	97.2	97.2	0.00
RwabeA Tfr	0.008	0.005	-0.008	-0.005	0.1	0.1	97.2	95.8	1.43
RwabeB Tfr	-0.006	-0.004	0.006	0.004	0.0	0.1	96.2	97.2	1.02
Tmchu.6-RwabeC	-0.004	-0.001	0.004	0.001	0.0	-0.1	97.2	97.2	0.00
RwabeC-Yomay	0.000	-0.001	0.000	0.000	0.0	-1.3	97.2	97.2	0.00
RwabeC Tfr	0.004	0.002	-0.004	-0.002	0.0	0.0	97.2	96.6	0.64
Samling-Semchebe	0.006	0.003	-0.006	-0.004	0.0	-0.5	94.8	94.8	0.01
Samling Tfr	0.016	0.010	-0.015	-0.010	0.3	0.5	94.8	91.9	2.87
Semchebe Tfr	0.006	0.004	-0.006	-0.003	0.1	0.1	94.8	93.2	1.58
Tangrung-Sershong	-0.009	-0.005	0.009	0.005	0.0	-0.3	92.7	92.7	0.01
Sershong Tfr	0.009	0.005	-0.009	-0.005	0.1	0.2	92.7	91.1	1.60
Serzam Tfr	0.007	0.004	-0.007	-0.004	0.1	0.1	99.5	98.5	1.00
Shangbe Tfr	0.014	0.009	-0.014	-0.008	0.3	0.4	94.1	91.6	2.55
Somshing Tfr	0.012	0.008	-0.012	-0.007	0.2	0.3	94.7	92.5	2.20
Soshong Tfr	0.015	0.010	-0.015	-0.009	0.3	0.5	92.6	89.8	2.79
Sumpa Tfr	0.009	0.006	-0.009	-0.006	0.0	0.1	95.8	95.1	0.67
Sungbe Tfr	0.010	0.007	-0.010	-0.006	0.1	0.1	92.8	92.0	0.77
Zamling-Tabee	-0.202	-0.124	0.204	0.124	1.8	-0.8	93.0	94.0	0.96
Tabee Tfr	0.019	0.012	-0.018	-0.011	0.5	0.8	93.0	89.5	3.51

Branch ID	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
Takila I Tfr	-0.037	-0.023	0.037	0.023	0.2	0.3	96.6	97.3	0.65
Takila II Tfr	-0.011	-0.007	0.011	0.007	0.0	0.0	97.1	97.3	0.16
Tangbe Tfr	0.009	0.005	-0.009	-0.005	0.1	0.2	92.5	90.8	1.62
TangmachuSS Tfr1	0.627	0.455	-0.623	-0.430	4.1	24.7	100.0	97.7	2.27
TangmachuSS Tfr2	0.627	0.455	-0.623	-0.430	4.1	24.7	100.0	97.7	2.27
L1-Thinleygang	0.191	0.118	-0.191	-0.118	0.1	-0.1	97.7	97.6	0.08
Tangrung Tfr	0.008	0.005	-0.008	-0.005	0.1	0.1	92.7	91.2	1.46
Taya Tfr	0.003	0.002	-0.003	-0.002	0.0	0.0	94.8	94.3	0.48
TCS-Tmchu.3	0.147	0.088	-0.147	-0.088	0.1	-0.3	97.4	97.3	0.11
Tmchu.2-TCS	-0.193	-0.117	0.193	0.117	0.1	-0.1	97.4	97.5	0.07
TCS Tfr	0.046	0.030	-0.045	-0.028	1.1	1.7	97.4	94.1	3.26
Thinleygang Tfr	0.004	0.002	-0.004	-0.002	0.0	0.0	97.6	96.6	1.04
Yongbaling-Thrima	-0.035	-0.021	0.035	0.021	0.0	-0.4	94.4	94.4	0.05
Thrima Tfr	0.006	0.004	-0.006	-0.004	0.1	0.1	94.4	93.3	1.14
Thuenpee Tfr	0.007	0.004	-0.007	-0.004	0.1	0.1	92.6	91.3	1.28
Tmchu Tfr	-0.048	-0.030	0.049	0.032	1.3	1.9	94.0	97.4	3.47
Tmchu.2-Tmchu	-0.049	-0.032	0.049	0.031	0.0	-0.1	97.4	97.5	0.01
Tmchu(1-2)	-0.242	-0.149	0.243	0.149	0.0	0.0	97.5	97.5	0.02
Tmchu(3-4)	0.048	0.030	-0.048	-0.030	0.0	-0.1	97.3	97.3	0.01
Tmchu(5-6)	0.017	0.009	-0.017	-0.009	0.0	-0.1	97.2	97.2	0.00
Tmchu.5-U.Dangling	0.010	0.006	-0.010	-0.006	0.0	-0.2	97.2	97.2	0.00
Tongkla Tfr	0.063	0.041	-0.060	-0.037	2.1	3.2	95.9	91.4	4.52
Tongling Tfr	0.011	0.007	-0.011	-0.007	0.2	0.3	94.8	92.7	2.05
Trongmey Tfr	0.010	0.006	-0.010	-0.006	0.1	0.2	94.1	92.4	1.77
Trongtoe Tfr	0.010	0.006	-0.010	-0.006	0.1	0.2	94.1	92.2	1.87
Tshochan Tfr	0.005	0.003	-0.005	-0.003	0.0	0.0	99.5	98.8	0.69
Tsholing Tfr	0.007	0.005	-0.007	-0.005	0.1	0.1	94.3	93.0	1.36
U.Dangling Tfr	0.003	0.002	-0.003	-0.002	0.0	0.0	97.2	96.8	0.46
U.Domkhar Tfr	0.012	0.007	-0.012	-0.007	0.1	0.1	99.4	98.6	0.80
U.Jalang Tfr	0.021	0.014	-0.021	-0.013	0.6	0.9	97.1	93.3	3.79
U.Pangkhar Tfr	0.012	0.008	-0.012	-0.007	0.2	0.3	94.7	92.6	2.19
U.Serphu Tfr	0.005	0.003	-0.005	-0.003	0.0	0.1	94.7	93.8	0.92
U.Shawa Tfr	0.009	0.006	-0.009	-0.006	0.1	0.2	94.3	92.6	1.66
U.Wambur Tfr	0.017	0.011	-0.017	-0.011	0.1	0.2	99.6	98.4	1.19
U.Zhungkhar Tfr	-0.014	-0.008	0.014	0.009	0.3	0.4	94.7	97.2	2.48
Wambrang Tfr	0.019	0.012	-0.018	-0.011	0.5	0.8	92.4	88.9	3.52
Wangzhing Tfr	0.018	0.011	-0.018	-0.011	0.2	0.2	97.3	96.0	1.25

Branch ID	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
Wayway Tfr	0.012	0.008	-0.012	-0.007	0.3	0.5	92.5	89.0	3.56
Yabee Tfr	0.016	0.010	-0.016	-0.010	0.3	0.4	99.5	97.2	2.32
Yongbaling Tfr	0.006	0.004	-0.006	-0.003	0.1	0.1	94.4	92.8	1.61
Youdra Tfr	0.008	0.005	-0.008	-0.005	0.1	0.1	94.7	93.2	1.52
Zamling Tfr	0.013	0.008	-0.012	-0.008	0.1	0.1	94.0	93.0	0.91
Zham Tfr	-0.006	-0.004	0.006	0.004	0.1	0.1	96.0	97.2	1.14
					102.4	8.6			

Alert Summary Report

	% Alert Settings	
	Critical	**Marginal**
Loading		
Bus	100.0	95.0
Cable	100.0	95.0
Reactor	100.0	95.0
Line	100.0	95.0
Transformer	100.0	95.0
Panel	100.0	95.0
Protective Device	100.0	95.0
Generator	100.0	95.0
Inverter/Charger	100.0	95.0
Bus Voltage		
OverVoltage	110.0	105.0
UnderVoltage	90.0	95.0
Generator Excitation		
OverExcited (Q Max.)	100.0	95.0
UnderExcited (Q Min.)		

Critical Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
Ambrangchu B2	Bus	Under Voltage	0.415	kV	0.368	88.6	3-Phase
Ambrangchu Tfr	Transformer	Overload	0.025	MVA	0.05	207.1	3-Phase
Chazam B2	Bus	Under Voltage	0.415	kV	0.37	89.4	3-Phase
Chengling B2	Bus	Under Voltage	0.415	kV	0.37	88.7	3-Phase
Chengling Tfr	Transformer	Overload	0.025	MVA	0.05	202.2	3-Phase
Drabling B2	Bus	Under Voltage	0.415	kV	0.37	89.9	3-Phase
Gangzur MHPP	Generator	Overload	0.120	MW	0.29	242.3	3-Phase
Gangzur MHPP Tfr	Transformer	Overload	0.315	MVA	0.32	100.5	3-Phase
Khoma Sch. B2	Bus	Under Voltage	0.415	kV	0.37	88.3	3-Phase
Khoma Sch. Tfr	Transformer	Overload	0.016	MVA	0.03	168.9	3-Phase
Namgong Tfr	Transformer	Overload	0.025	MVA	0.03	115.4	3-Phase
NHDC B2	Bus	Under Voltage	0.415	kV	0.37	89.8	3-Phase
NHDC Tfr	Transformer	Overload	0.063	MVA	0.10	161.3	3-Phase
Rongchu MHPP	Generator	Overload	0.200	MW	0.40	199.6	3-Phase
Rongchu MHPP Tfr	Transformer	Overload	0.315	MVA	0.46	144.9	3-Phase

Critical Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
Soshong B2	Bus	Under Voltage	0.415	kV	0.373	89.8	3-Phase
Tabee B2	Bus	Under Voltage	0.415	kV	0.37	89.5	3-Phase
Tongkla Tfr	Transformer	Overload	0.063	MVA	0.07	118.5	3-Phase
U.Jalang Tfr	Transformer	Overload	0.025	MVA	0.03	100.7	3-Phase
Wambrang B2	Bus	Under Voltage	0.415	kV	0.37	88.9	3-Phase
Wayway B2	Bus	Under Voltage	0.415	kV	0.37	89.0	3-Phase

Marginal Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
Baptong B1	Bus	Under Voltage	11.000	kV	10.411	94.6	3-Phase
Baptong B2	Bus	Under Voltage	0.415	kV	0.39	93.3	3-Phase
Berpa B1	Bus	Under Voltage	11.000	kV	10.42	94.7	3-Phase
Berpa B2	Bus	Under Voltage	0.415	kV	0.38	92.3	3-Phase
Bragong B1	Bus	Under Voltage	0.415	kV	0.39	93.2	3-Phase
Bragong Tfr	Transformer	Overload	0.063	MVA	0.06	98.7	3-Phase
Chazam B1	Bus	Under Voltage	11.000	kV	10.17	92.5	3-Phase
Churbe B1	Bus	Under Voltage	11.000	kV	10.38	94.3	3-Phase
Churbe B2	Bus	Under Voltage	0.415	kV	0.39	93.7	3-Phase
Dakten B2	Bus	Under Voltage	0.415	kV	0.38	92.2	3-Phase
Depteng B1	Bus	Under Voltage	11.000	kV	10.35	94.1	3-Phase
Depteng B2	Bus	Under Voltage	0.415	kV	0.39	93.0	3-Phase
Drabling B1	Bus	Under Voltage	11.000	kV	10.17	92.4	3-Phase
Dungkhar B1	Bus	Under Voltage	11.000	kV	10.21	92.8	3-Phase
Dungkhar B2	Bus	Under Voltage	0.415	kV	0.38	90.8	3-Phase
Dzong B2	Bus	Under Voltage	0.415	kV	0.39	94.2	3-Phase
Fatila B2	Bus	Under Voltage	0.415	kV	0.39	94.4	3-Phase
Gangla B1	Bus	Under Voltage	11.000	kV	10.42	94.7	3-Phase
Gangla B2	Bus	Under Voltage	0.415	kV	0.39	93.2	3-Phase
Gangzur B2	Bus	Under Voltage	0.415	kV	0.39	92.8	3-Phase
Gpa Kap B1	Bus	Under Voltage	11.000	kV	10.42	94.7	3-Phase
Gpa Kap B2	Bus	Under Voltage	0.415	kV	0.39	93.3	3-Phase
Gwog CD B1	Bus	Under Voltage	11.000	kV	10.20	92.7	3-Phase
Gwog CD B2	Bus	Under Voltage	0.415	kV	0.38	91.1	3-Phase
Jalamzum B1	Bus	Under Voltage	11.000	kV	10.42	94.8	3-Phase
Jalamzum B2	Bus	Under Voltage	0.415	kV	0.38	92.7	3-Phase
Jang B2	Bus	Under Voltage	0.415	kV	0.39	94.6	3-Phase

Marginal Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
Jasabe B1	Bus	Under Voltage	11.000	kV	10.211	92.8	3-Phase
Jasabe B2	Bus	Under Voltage	0.415	kV	0.38	91.4	3-Phase
Jcholing B1	Bus	Under Voltage	11.000	kV	10.42	94.7	3-Phase
Jcholing B2	Bus	Under Voltage	0.415	kV	0.39	93.8	3-Phase
Kamdar B1	Bus	Under Voltage	0.415	kV	0.39	94.6	3-Phase
Kchung B1	Bus	Under Voltage	11.000	kV	10.34	94.0	3-Phase
Kchung B2	Bus	Under Voltage	0.415	kV	0.38	90.6	3-Phase
Kemtshong B1	Bus	Under Voltage	11.000	kV	10.41	94.6	3-Phase
Kemtshong B2	Bus	Under Voltage	0.415	kV	0.38	91.4	3-Phase
Khema B1	Bus	Under Voltage	11.000	kV	10.41	94.7	3-Phase
Khema B2	Bus	Under Voltage	0.415	kV	0.39	93.3	3-Phase
Khoma B1	Bus	Under Voltage	11.000	kV	10.43	94.8	3-Phase
Khoma B2	Bus	Under Voltage	0.415	kV	0.38	91.7	3-Phase
Khoma Sch. B1	Bus	Under Voltage	11.000	kV	10.43	94.8	3-Phase
Khoma.D B2	Bus	Under Voltage	0.415	kV	0.39	95.0	3-Phase
Khomadung B1	Bus	Under Voltage	11.000	kV	10.40	94.6	3-Phase
Khomadung B2	Bus	Under Voltage	0.415	kV	0.38	92.6	3-Phase
Khomagang B1	Bus	Under Voltage	11.000	kV	10.41	94.7	3-Phase
Khomagang B2	Bus	Under Voltage	0.415	kV	0.38	92.3	3-Phase
Kilung B`	Bus	Under Voltage	11.000	kV	10.43	94.8	3-Phase
Kilung B2	Bus	Under Voltage	0.415	kV	0.39	93.0	3-Phase
L.Jalang B1	Bus	Under Voltage	0.415	kV	0.39	94.0	3-Phase
L.Pangkhar B1	Bus	Under Voltage	11.000	kV	10.42	94.8	3-Phase
L.Pangkhar B2	Bus	Under Voltage	0.415	kV	0.38	92.0	3-Phase
L.Serphu B1	Bus	Under Voltage	11.000	kV	10.42	94.7	3-Phase
L.Serphu B2	Bus	Under Voltage	0.415	kV	0.38	92.4	3-Phase
L.Shawa B1	Bus	Under Voltage	11.000	kV	10.37	94.3	3-Phase
L.Shawa B2	Bus	Under Voltage	0.415	kV	0.38	91.0	3-Phase
Lawa B1	Bus	Under Voltage	11.000	kV	10.43	94.8	3-Phase
Lawa B2	Bus	Under Voltage	0.415	kV	0.39	93.9	3-Phase
LHS B2	Bus	Under Voltage	0.415	kV	0.39	94.0	3-Phase
Lingabe B1	Bus	Under Voltage	11.000	kV	10.41	94.6	3-Phase
Lingabe B2	Bus	Under Voltage	0.415	kV	0.39	93.8	3-Phase
Lugarpang B2	Bus	Under Voltage	0.415	kV	0.39	94.9	3-Phase
Lukchu B1	Bus	Under Voltage	11.000	kV	10.43	94.8	3-Phase
Lukchu b2	Bus	Under Voltage	0.415	kV	0.39	92.8	3-Phase

Marginal Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
Namgong B1	Bus	Under Voltage	11.000	kV	10.436	94.9	3-Phase
Namgong B2	Bus	Under Voltage	0.415	kV	0.38	90.4	3-Phase
Naray B1	Bus	Under Voltage	11.000	kV	10.18	92.5	3-Phase
Naray B2	Bus	Under Voltage	0.415	kV	0.38	91.4	3-Phase
New NHDC B2	Bus	Under Voltage	0.415	kV	0.39	95.0	3-Phase
Ney Zhisar B1	Bus	Under Voltage	11.000	kV	10.35	94.1	3-Phase
Ney Zhisar B2	Bus	Under Voltage	0.415	kV	0.39	93.2	3-Phase
Ngalamd B2	Bus	Under Voltage	0.415	kV	0.39	92.9	3-Phase
Ngar B2	Bus	Under Voltage	0.415	kV	0.39	93.8	3-Phase
Nimshong B1	Bus	Under Voltage	11.000	kV	10.43	94.8	3-Phase
Nimshong B2	Bus	Under Voltage	0.415	kV	0.39	93.9	3-Phase
Nyeteng B1	Bus	Under Voltage	11.000	kV	10.41	94.7	3-Phase
OldL.10	Bus	Under Voltage	11.000	kV	10.43	94.8	3-Phase
OldL.11	Bus	Under Voltage	11.000	kV	10.43	94.8	3-Phase
OldL.12	Bus	Under Voltage	11.000	kV	10.42	94.8	3-Phase
OldL.18	Bus	Under Voltage	11.000	kV	10.44	94.9	3-Phase
OldL.19	Bus	Under Voltage	11.000	kV	10.43	94.8	3-Phase
OldL.20	Bus	Under Voltage	11.000	kV	10.43	94.8	3-Phase
OldL.21	Bus	Under Voltage	11.000	kV	10.43	94.8	3-Phase
OldL.22	Bus	Under Voltage	11.000	kV	10.38	94.3	3-Phase
OldL.23	Bus	Under Voltage	11.000	kV	10.35	94.1	3-Phase
OldL.24	Bus	Under Voltage	11.000	kV	10.35	94.1	3-Phase
OldL.25	Bus	Under Voltage	11.000	kV	10.35	94.1	3-Phase
OldL.26	Bus	Under Voltage	11.000	kV	10.42	94.7	3-Phase
OldL.27	Bus	Under Voltage	11.000	kV	10.39	94.4	3-Phase
OldL.28	Bus	Under Voltage	11.000	kV	10.34	94.0	3-Phase
OldL.29	Bus	Under Voltage	11.000	kV	10.21	92.9	3-Phase
OldL.30	Bus	Under Voltage	11.000	kV	10.20	92.7	3-Phase
OldL.31	Bus	Under Voltage	11.000	kV	10.19	92.7	3-Phase
OldL.32	Bus	Under Voltage	11.000	kV	10.18	92.6	3-Phase
OldL.33	Bus	Under Voltage	11.000	kV	10.18	92.5	3-Phase
OldL.34	Bus	Under Voltage	11.000	kV	10.17	92.5	3-Phase
OldL.35	Bus	Under Voltage	11.000	kV	10.17	92.4	3-Phase
OldL.36	Bus	Under Voltage	11.000	kV	10.17	92.4	3-Phase
OldL.6	Bus	Under Voltage	11.000	kV	10.44	94.9	3-Phase
OldL.7	Bus	Under Voltage	11.000	kV	10.42	94.7	3-Phase

Marginal Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
OldL.8	Bus	Under Voltage	11.000	kV	10.433	94.8	3-Phase
OldL.9	Bus	Under Voltage	11.000	kV	10.42	94.7	3-Phase
ReplaBT B1	Bus	Under Voltage	11.000	kV	10.42	94.7	3-Phase
Rongchu B2	Bus	Under Voltage	0.415	kV	0.38	92.2	3-Phase
Rongchu MHPP B2	Bus	Under Voltage	11.000	kV	10.44	94.9	3-Phase
Rotpa B1	Bus	Under Voltage	11.000	kV	10.42	94.7	3-Phase
Rotpa B2	Bus	Under Voltage	0.415	kV	0.39	94.3	3-Phase
Samling B1	Bus	Under Voltage	11.000	kV	10.42	94.8	3-Phase
Samling B2	Bus	Under Voltage	0.415	kV	0.38	91.9	3-Phase
Semchebe B1	Bus	Under Voltage	11.000	kV	10.42	94.8	3-Phase
Semchebe B2	Bus	Under Voltage	0.415	kV	0.39	93.2	3-Phase
Sershong B1	Bus	Under Voltage	11.000	kV	10.19	92.7	3-Phase
Sershong B2	Bus	Under Voltage	0.415	kV	0.38	91.1	3-Phase
Shangbe B1	Bus	Under Voltage	11.000	kV	10.35	94.1	3-Phase
Shangbe B2	Bus	Under Voltage	0.415	kV	0.38	91.6	3-Phase
Somshing B1	Bus	Under Voltage	11.000	kV	10.42	94.7	3-Phase
Somshing B2	Bus	Under Voltage	0.415	kV	0.38	92.5	3-Phase
Soshong B1	Bus	Under Voltage	11.000	kV	10.18	92.6	3-Phase
Sungbe B1	Bus	Under Voltage	11.000	kV	10.21	92.8	3-Phase
Sungbe B2	Bus	Under Voltage	0.415	kV	0.38	92.0	3-Phase
Tabee B1	Bus	Under Voltage	11.000	kV	10.23	93.0	3-Phase
Tangbe B1	Bus	Under Voltage	11.000	kV	10.17	92.5	3-Phase
Tangbe B2	Bus	Under Voltage	0.415	kV	0.38	90.8	3-Phase
Tangrung B1	Bus	Under Voltage	11.000	kV	10.19	92.7	3-Phase
Tangrung B2	Bus	Under Voltage	0.415	kV	0.38	91.2	3-Phase
Taya B1	Bus	Under Voltage	11.000	kV	10.42	94.8	3-Phase
Taya B2	Bus	Under Voltage	0.415	kV	0.39	94.3	3-Phase
TCS B2	Bus	Under Voltage	0.415	kV	0.39	94.1	3-Phase
Thrima B1	Bus	Under Voltage	11.000	kV	10.38	94.4	3-Phase
Thrima B2	Bus	Under Voltage	0.415	kV	0.39	93.3	3-Phase
Thuenpee B1	Bus	Under Voltage	11.000	kV	10.19	92.6	3-Phase
Thuenpee B2	Bus	Under Voltage	0.415	kV	0.38	91.3	3-Phase
Tmchu B1	Bus	Under Voltage	0.415	kV	0.39	94.0	3-Phase
Tongkla B2	Bus	Under Voltage	0.415	kV	0.38	91.4	3-Phase
Tongling B1	Bus	Under Voltage	11.000	kV	10.42	94.8	3-Phase
Tongling B2	Bus	Under Voltage	0.415	kV	0.38	92.7	3-Phase

Marginal Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
Trongmey B1	Bus	Under Voltage	11.000	kV	10.353	94.1	3-Phase
Trongmey B2	Bus	Under Voltage	0.415	kV	0.38	92.4	3-Phase
Trongtoe B1	Bus	Under Voltage	11.000	kV	10.35	94.1	3-Phase
Trongtoe B2	Bus	Under Voltage	0.415	kV	0.38	92.2	3-Phase
Tsango B1	Bus	Under Voltage	11.000	kV	10.41	94.6	3-Phase
Tsholing B1	Bus	Under Voltage	11.000	kV	10.38	94.3	3-Phase
Tsholing B2	Bus	Under Voltage	0.415	kV	0.39	93.0	3-Phase
U.Jalang B2	Bus	Under Voltage	0.415	kV	0.39	93.3	3-Phase
U.Pangkhar B1	Bus	Under Voltage	11.000	kV	10.42	94.7	3-Phase
U.Pangkhar B2	Bus	Under Voltage	0.415	kV	0.38	92.6	3-Phase
U.Serphu B1	Bus	Under Voltage	11.000	kV	10.42	94.7	3-Phase
U.Serphu B2	Bus	Under Voltage	0.415	kV	0.39	93.8	3-Phase
U.Shawa B1	Bus	Under Voltage	11.000	kV	10.37	94.3	3-Phase
U.Shawa B2	Bus	Under Voltage	0.415	kV	0.38	92.6	3-Phase
U.Zhungkhar B1	Bus	Under Voltage	0.415	kV	0.39	94.7	3-Phase
Wambrang B1	Bus	Under Voltage	11.000	kV	10.17	92.4	3-Phase
Wayway B1	Bus	Under Voltage	11.000	kV	10.18	92.5	3-Phase
Yongbaling B1	Bus	Under Voltage	11.000	kV	10.39	94.4	3-Phase
Yongbaling B2	Bus	Under Voltage	0.415	kV	0.39	92.8	3-Phase
Youdra B1	Bus	Under Voltage	11.000	kV	10.42	94.7	3-Phase
Youdra B2	Bus	Under Voltage	0.415	kV	0.39	93.2	3-Phase
Zamling B1	Bus	Under Voltage	11.000	kV	10.34	94.0	3-Phase
Zamling B2	Bus	Under Voltage	0.415	kV	0.39	93.0	3-Phase

SUMMARY OF TOTAL GENERATION , LOADING & DEMAND

	MW	Mvar	MVA	% PF
Source (Swing Buses):	2.586	1.548	3.014	85.80 Lagging
Source (Non-Swing Buses):	0.000	0.000	0.000	
Total Demand:	2.586	1.548	3.014	85.80 Lagging
Total Motor Load:	0.546	0.339	0.643	85.00 Lagging
Total Static Load:	1.937	1.201	2.279	85.00 Lagging
Total Constant I Load:	0.000	0.000	0.000	
Total Generic Load:	0.000	0.000	0.000	
Apparent Losses:	0.102	0.009		
System Mismatch:	0.000	0.000		

Number of Iterations: 3

Bus Loading Summary Report

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					Percent
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Loading
Ambrangchu B1	11.000										0.091	83.5	4.9	
Ambrangchu B2	0.415		0.009	0.005	0.028	0.017					0.043	85.0	66.5	
Autso.Baz B1	33.000										0.125	84.6	2.2	
Autso.Baz B2	0.415		0.022	0.014	0.083	0.051					0.123	85.0	175.7	
Autso.Sch B1	33.000										0.088	84.4	1.6	
Autso.Sch B2	0.415		0.015	0.010	0.058	0.036					0.086	85.0	123.5	
B.Factory B1	33.000										0.347	86.7	6.1	
B.Factory B2	0.415		0.002	0.001	0.009	0.006					0.013	85.0	18.9	
Baptong B1	11.000										0.080	85.4	4.4	
Baptong B2	0.415		0.004	0.002	0.013	0.008					0.019	85.0	28.5	
Bazar B1	11.000										0.016	84.9	0.9	
Bazar B2	0.415		0.003	0.002	0.011	0.007					0.016	85.0	22.7	
Berpa B1	11.000										0.115	85.5	6.3	
Berpa B2	0.415		0.003	0.002	0.009	0.006					0.014	85.0	20.5	
Bragong B1	0.415		0.011	0.007	0.038	0.023					0.057	85.0	84.3	
Bragong B2	11.000										0.059	84.1	3.2	
Budhur B1	33.000										0.023	84.7	0.4	
Budhur B2	0.415		0.004	0.002	0.015	0.010					0.023	85.0	32.3	
Changkhala B1	33.000										0.020	84.4	0.3	
Changkhala B2	0.415		0.003	0.002	0.013	0.008					0.019	85.0	27.4	
Chazam B1	11.000										0.011	84.3	0.6	
Chazam B2	0.415		0.002	0.001	0.007	0.004					0.011	85.0	16.8	
Chengling B1	11.000										0.045	83.3	2.5	
Chengling B2	0.415		0.008	0.005	0.027	0.017					0.042	85.0	65.0	
Churbe B1	11.000										0.031	85.0	1.7	
Churbe B2	0.415		0.000	0.000	0.002	0.001					0.002	85.0	3.4	
Chusa B1	11.000										0.205	85.0	11.0	
Chusa B2	0.415		0.003	0.002	0.011	0.007					0.017	85.0	24.4	
Dagathang B1	33.000										0.472	88.5	8.3	
Dagathang B2	0.415		0.002	0.001	0.007	0.004					0.011	85.0	15.0	
Dakten B1	11.000										0.018	84.3	1.0	
Dakten B2	0.415		0.003	0.002	0.012	0.007					0.018	85.0	26.4	
Depteng B1	11.000										0.027	85.4	1.5	
Depteng B2	0.415		0.001	0.001	0.004	0.003					0.007	85.0	9.6	
Dorshong B1	33.000												-	
Dorshong B2	0.415													
Drabling B1	11.000										0.047	84.7	2.7	
Drabling B2	0.415		0.002	0.001	0.006	0.004					0.009	85.0	13.5	
Dungkhar B1	11.000										0.177	85.3	9.9	

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					Percent
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Loading
Dungkhar B2	0.415		0.006	0.003	0.019	0.012					0.029	85.0	43.2	
Dzong B1	11.000										0.277	84.3	15.1	
Dzong B2	0.415		0.019	0.012	0.069	0.043					0.104	85.0	151.6	
Fatila B1	11.000										0.006	84.6	0.3	
Fatila B2	0.415		0.001	0.001	0.004	0.002					0.006	85.0	8.8	
Fawan B1	33.000										0.431	86.7	7.6	
Fawan B2	0.415		0.003	0.002	0.013	0.008					0.019	85.0	26.6	
Fire Hydt. B1	11.000										0.001	85.0	0.1	
Fire Hydt. B2	0.415		0.000	0.000	0.001	0.001					0.001	85.0	2.0	
Gangla B1	11.000										0.018	86.8	1.0	
Gangla B2	0.415		0.002	0.001	0.006	0.003					0.008	85.0	12.4	
Gangzur B1	11.000										0.028	84.5	1.5	
Gangzur B2	0.415		0.005	0.003	0.018	0.011					0.027	85.0	40.0	
Gangzur MHPP B1	0.415										0.273	92.0	379.5	
Gangzur MHPP B2	11.000										0.265	92.7	14.3	
Gorg.1	33.000										0.649	89.9	11.4	
Gorg.2	33.000										0.594	90.0	10.4	
Gorg.3	33.000										0.125	93.4	2.2	
Gorg.4	33.000										0.121	91.5	2.1	
Gorg.5	33.000										0.114	91.0	2.0	
Gorg.6	33.000		0.000	0.000	0.001	0.001					0.042	89.1	0.7	
Gorg.7	33.000										0.075	89.6	1.3	
Gorg.8	33.000		0.001	0.000	0.002	0.001					0.073	85.9	1.3	
Gorg.9	33.000		0.012	0.007	0.048	0.030					0.070	85.0	1.2	
Gorg.16	33.000										0.462	88.3	8.1	
Gorg.17	33.000										0.450	87.7	7.9	
Gorg.20	33.000		0.011	0.007	0.045	0.028					0.412	86.7	7.3	
Gorg.21	33.000										0.336	86.2	5.9	
Gorg.22	33.000										0.337	85.6	5.9	
Gorg.23	33.000										0.213	84.7	3.8	
Gorg.24	33.000		0.011	0.007	0.042	0.026					0.125	86.0	2.2	
Gorg.29	33.000		0.003	0.002	0.010	0.006					0.064	86.1	1.1	
Gorgan B1	33.000										0.125	92.9	2.2	
Gorgan B2	0.415		0.001	0.001	0.005	0.003					0.007	85.0	9.7	
Gpa Kap B1	11.000										0.021	84.7	1.2	
Gpa Kap B2	0.415		0.004	0.002	0.014	0.009					0.021	85.0	30.6	
Gwog CD B1	11.000										0.010	84.6	0.5	
Gwog CD B2	0.415		0.002	0.001	0.006	0.004					0.009	85.0	14.2	
Jabee Auto.W B1	11.000										0.011	84.8	0.6	
Jabee Auto.W B2	0.415		0.002	0.001	0.007	0.005					0.011	85.0	15.9	
Jabee RBA B1	11.000										0.605	83.9	32.6	
Jabee RBA B2	0.415		0.000	0.000	0.000	-					0.001	85.0	0.7	

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Percent Loading
Jachung B1	33.000										0.001	85.0	-	
Jachung B2	0.415		0.000	0.000	0.001	-					0.001	85.0	1.6	
Jalamzum B1	11.000										0.045	86.5	2.5	
Jalamzum B2	0.415		0.002	0.001	0.008	0.005					0.012	85.0	17.1	
Jang B1	11.000										0.008	84.9	0.5	
Jang B2	0.415		0.002	0.001	0.006	0.003					0.008	85.0	12.1	
Jasabe B1	11.000		0.001	0.001	0.005	0.003					0.016	84.8	0.9	
Jasabe B2	0.415		0.002	0.001	0.005	0.003					0.008	85.0	11.8	
Jcholing B1	11.000										0.022	87.1	1.2	
Jcholing B2	0.415		0.002	0.002	0.009	0.005					0.013	85.0	19.6	
Kamdar B1	0.415		0.006	0.004	0.024	0.015					0.035	85.0	51.4	
Kamdar B2	11.000										0.036	84.5	1.9	
Kchung B1	11.000										0.019	84.2	1.1	
Kchung B2	0.415		0.004	0.002	0.012	0.008					0.019	85.0	28.2	
Kemtshong B1	11.000										0.012	84.3	0.7	
Kemtshong B2	0.415		0.002	0.001	0.008	0.005					0.012	85.0	17.4	
Khema B1	11.000										0.009	87.0	0.5	
Khema B2	0.415		0.001	0.001	0.005	0.003					0.008	85.0	11.5	
Khoma B1	11.000										0.046	84.3	2.5	
Khoma B2	0.415		0.009	0.005	0.029	0.018					0.045	85.0	67.0	
Khoma Sch. B1	11.000										0.139	85.3	7.6	
Khoma Sch. B2	0.415		0.005	0.003	0.015	0.009					0.023	85.0	35.3	
Khoma.D B1	11.000										0.344	85.9	18.8	
Khoma.D B2	0.415		0.000	0.000	0.001	0.001					0.002	85.0	2.2	
Khomadung B1	11.000										0.049	84.6	2.7	
Khomadung B2	0.415		0.009	0.006	0.032	0.020					0.048	85.0	71.7	
Khomagang B1	11.000										0.020	86.7	1.1	
Khomagang B2	0.415		0.002	0.001	0.006	0.004					0.009	85.0	13.0	
Kilung B2	0.415		0.001	0.001	0.004	0.003					0.007	85.0	10.0	
Kilung B`	11.000										0.180	86.5	9.9	
Kiphu B1	33.000										0.014	93.2	0.3	
Kiphu B2	0.415		0.001	0.001	0.004	0.003					0.006	85.0	9.0	
Kupensa B1	33.000										0.666	90.1	11.7	
Kupensa B2	0.415		0.003	0.002	0.013	0.008					0.019	85.0	26.5	
L.Dangling B1	0.415		0.001	0.001	0.004	0.003					0.006	85.0	8.8	
L.Dangling B2	11.000										0.006	84.8	0.3	
L.Domkhar B1	33.000										0.441	87.0	7.8	
L.Domkhar B2	0.415		0.002	0.001	0.008	0.005					0.012	85.0	16.5	
L.Jalang B1	0.415		0.003	0.002	0.012	0.008					0.018	85.0	27.2	
L.Jalang B2	11.000										0.019	84.3	1.0	
L.Pangkhar B1	11.000										0.052	86.9	2.9	
L.Pangkhar B2	0.415		0.003	0.002	0.010	0.006					0.016	85.0	23.5	

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Percent Loading
L.Serphu B1	11.000										0.013	84.5	0.7	
L.Serphu B2	0.415		0.002	0.002	0.009	0.005					0.013	85.0	19.4	
L.Shawa B1	11.000										0.028	84.4	1.6	
L.Shawa B2	0.415		0.004	0.002	0.012	0.007					0.018	85.0	27.6	
L.Wambur B1	33.000										0.627	89.9	11.0	
L.Wambur B2	0.415		0.003	0.002	0.010	0.006					0.015	85.0	21.5	
L.Zhungkhar B1	11.000										0.010	86.5	0.5	
L.Zhungkhar B2	0.415		0.001	0.001	0.005	0.003					0.008	85.0	11.3	
Lagyel B1	33.000										0.009	84.7	0.2	
Lagyel B2	0.415		0.002	0.001	0.006	0.004					0.009	85.0	13.2	
Lawa B1	11.000										0.043	87.2	2.4	
Lawa B2	0.415		0.001	0.001	0.003	0.002					0.005	85.0	7.5	
LHS B1	11.000										0.142	84.5	7.7	
LHS B2	0.415		0.026	0.016	0.092	0.057					0.139	85.0	204.2	
Lingabe B1	11.000										0.081	86.6	4.5	
Lingabe B2	0.415		0.002	0.001	0.008	0.005					0.012	85.0	17.3	
Lugarpang B1	11.000										0.009	84.5	0.5	
Lugarpang B2	0.415		0.002	0.001	0.006	0.003					0.008	85.0	12.1	
Lukchu B1	11.000										0.004	84.8	0.2	
Lukchu b2	0.415		0.001	0.000	0.003	0.002					0.004	85.0	6.3	
M.Zhungkhar B1	11.000										0.019	85.0	1.0	
M.Zhungkhar B2	0.415		0.001	0.001	0.004	0.003					0.006	85.0	9.2	
Manjabee B1	11.000										0.029	88.3	1.6	
Manjabee B2	0.415		0.001	0.001	0.004	0.003					0.006	85.0	9.0	
Menjitse B1	11.000										0.157	84.7	8.5	
Menjitse B2	0.415		0.003	0.002	0.010	0.007					0.016	85.0	22.4	
Min.1	11.000										0.206	85.1	11.0	
Min.2	11.000										0.169	85.0	9.1	
Min.3	11.000										0.012	85.6	0.6	
Minjey Sch. B1	11.000										0.141	84.7	7.6	
Minjey Sch. B2	0.415		0.007	0.004	0.026	0.016					0.039	85.0	57.0	
Mmaling B1	11.000										0.020	86.5	1.1	
Mmaling B2	0.415		0.001	0.001	0.004	0.002					0.006	85.0	8.6	
Murmur B1	11.000										0.006	84.7	0.3	
Murmur B2	0.415		0.001	0.001	0.004	0.002					0.006	85.0	8.3	
Namdruling B1	33.000										0.050	84.3	0.9	
Namdruling B2	0.415		0.009	0.005	0.033	0.020					0.049	85.0	70.1	
Namgong B1	11.000										0.069	86.4	3.8	
Namgong B2	0.415		0.005	0.003	0.016	0.010					0.025	85.0	37.6	
Nangla B1	0.415		0.001	0.001	0.004	0.002					0.006	85.0	8.2	
Nangla B2	11.000										0.006	84.8	0.3	
Naray B1	11.000										0.074	85.0	4.2	

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Percent Loading
Naray B2	0.415		0.001	0.000	0.003	0.002					0.004	85.0	5.9	
Naybee B1	11.000										0.057	85.5	3.0	
Naybee B2	0.415		0.005	0.003	0.018	0.011					0.028	85.0	39.9	
New NHDC B1	11.000										0.016	84.8	0.9	
New NHDC B2	0.415		0.003	0.002	0.010	0.006					0.016	85.0	22.6	
NewL.1	11.000										0.187	69.1	10.0	
NewL.2	11.000										0.443	84.5	23.9	
NewL.3	11.000										0.442	84.5	23.9	
NewL.4	11.000										0.300	84.5	16.2	
NewL.5	11.000										0.299	84.4	16.2	
NewL.6	11.000										0.299	84.4	16.2	
NewL.7	11.000										0.299	84.4	16.3	
NewL.8	11.000										0.172	84.1	9.4	
NewL.9	11.000										0.081	84.3	4.4	
Ney Zhisar B1	11.000										0.020	84.8	1.1	
Ney Zhisar B2	0.415		0.004	0.002	0.013	0.008					0.020	85.0	29.7	
Ngalamd B1	11.000										0.033	84.9	1.8	
Ngalamd B2	0.415		0.003	0.002	0.009	0.006					0.014	85.0	21.0	
Ngar B1	11.000										0.005	84.7	0.3	
Ngar B2	0.415		0.001	0.001	0.003	0.002					0.005	85.0	7.7	
NHDC B1	11.000										0.171	84.0	9.3	
NHDC B2	0.415		0.017	0.010	0.055	0.034					0.085	85.0	129.2	
Nimshong B1	11.000										0.013	84.8	0.7	
Nimshong B2	0.415		0.002	0.001	0.009	0.005					0.013	85.0	19.1	
Nyeteng B1	11.000		0.000	0.000	0.001	0.001					0.002	85.0	0.1	
OldL.1	11.000										0.627	84.0	33.7	
OldL.2	11.000										0.014	86.7	0.8	
OldL.3	11.000										0.603	83.9	32.6	
OldL.4	11.000										0.512	84.0	27.7	
OldL.5	11.000										0.487	83.9	26.6	
OldL.6	11.000										0.309	85.9	17.0	
OldL.7	11.000										0.036	86.7	2.0	
OldL.8	11.000										0.240	85.7	13.2	
OldL.9	11.000										0.101	85.6	5.5	
OldL.10	11.000										0.102	86.2	5.6	
OldL.11	11.000										0.056	87.5	3.1	
OldL.12	11.000										0.036	87.8	2.0	
OldL.13	11.000										0.144	78.5	7.9	
OldL.14	11.000										0.144	78.2	7.9	
OldL.15	11.000										0.040	86.3	2.2	
OldL.16	11.000										0.013	89.0	0.7	
OldL.17	11.000										0.008	87.3	0.4	

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Percent Loading
OldL.18	11.000										0.481	86.1	26.4	
OldL.19	11.000										0.058	86.5	3.2	
OldL.20	11.000										0.058	86.4	3.2	
OldL.21	11.000										0.116	86.5	6.4	
OldL.22	11.000										0.069	86.0	3.8	
OldL.23	11.000										0.062	85.1	3.4	
OldL.24	11.000										0.037	85.3	2.1	
OldL.25	11.000										0.010	84.7	0.6	
OldL.26	11.000										0.291	85.9	16.0	
OldL.27	11.000										0.288	85.8	15.9	
OldL.28	11.000										0.245	85.6	13.6	
OldL.29	11.000										0.192	85.4	10.7	
OldL.30	11.000										0.136	85.4	7.6	
OldL.31	11.000										0.127	85.2	7.1	
OldL.32	11.000										0.103	85.0	5.8	
OldL.33	11.000										0.087	85.0	4.9	
OldL.34	11.000										0.070	84.9	3.9	
OldL.35	11.000		0.000	0.000	0.002	0.001					0.050	84.8	2.8	
OldL.36	11.000		0.003	0.002	0.010	0.006					0.038	84.7	2.2	
Pam B1	11.000										0.002	84.9	0.1	
Pam B2	0.415		0.000	0.000	0.002	0.001					0.002	85.0	3.5	
Phagidung B1	11.000										0.275	85.5	14.7	
Phagidunng B2	0.415		0.005	0.003	0.017	0.011					0.025	85.0	36.7	
ReplaBT B1	11.000		0.001	0.001	0.003	0.002					0.024	88.6	1.3	
Rongchu B2	0.415		0.002	0.001	0.006	0.004					0.010	85.0	14.3	
Rongchu MHPP B1	0.415										0.397	87.7	551.7	
Rongchu MHPP B2	11.000										0.379	88.9	20.8	
Rotpa B1	11.000										0.002	84.9	0.1	
Rotpa B2	0.415		0.000	0.000	0.002	0.001					0.002	85.0	3.6	
RwabeA B1	11.000										0.012	84.9	0.7	
RwabeA B2	0.415		0.001	0.001	0.005	0.003					0.007	85.0	10.2	
RwabeB B1	0.415		0.001	0.001	0.003	0.002					0.005	85.0	7.3	
RwabeB B2	11.000										0.005	84.8	0.3	
RwabeC B1	11.000										0.003	84.9	0.2	
RwabeC B2	0.415		0.001	0.000	0.002	0.001					0.003	85.0	4.5	
Samling B1	11.000										0.022	85.5	1.2	
Samling B2	0.415		0.003	0.002	0.011	0.007					0.016	85.0	24.3	
Semchebe B1	11.000										0.006	84.6	0.3	
Semchebe B2	0.415		0.001	0.001	0.004	0.002					0.006	85.0	8.6	
Sershong B1	11.000										0.009	84.6	0.5	
Sershong B2	0.415		0.002	0.001	0.006	0.004					0.009	85.0	13.6	
Serzam B1	33.000										0.008	84.8	0.1	

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					Percent
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Loading
Serzam B2	0.415		0.001	0.001	0.005	0.003					0.008	85.0	10.8	
Shangbe B1	11.000										0.052	85.1	2.9	
Shangbe B2	0.415		0.003	0.002	0.009	0.006					0.014	85.0	21.6	
Somshing B1	11.000										0.093	86.5	5.1	
Somshing B2	0.415		0.002	0.001	0.008	0.005					0.013	85.0	18.6	
Soshong B1	11.000										0.016	84.4	0.9	
Soshong B2	0.415		0.003	0.002	0.010	0.006					0.015	85.0	23.6	
Sumpa B1	11.000										0.498	83.9	27.1	
Sumpa B2	0.415		0.002	0.001	0.007	0.004					0.010	85.0	14.4	
Sungbe B1	11.000										0.148	85.4	8.3	
Sungbe B2	0.415		0.002	0.001	0.007	0.005					0.011	85.0	16.5	
Tabee B1	11.000										0.212	85.3	11.9	
Tabee B2	0.415		0.004	0.002	0.013	0.008					0.019	85.0	29.7	
Takila I B1	0.415		0.006	0.004	0.022	0.013					0.032	85.0	46.3	
Takila II B2	0.415		0.002	0.001	0.007	0.004					0.010	85.0	14.3	
Tangbe B1	11.000										0.059	84.8	3.3	
Tangbe B2	0.415		0.002	0.001	0.006	0.004					0.009	85.0	13.7	
TangmachuSS B1	33.000										1.969	85.2	34.5	
TangmachuSS B2	11.000										1.295	82.7	69.3	
Tangrung B1	11.000										0.017	85.5	1.0	
Tangrung B2	0.415		0.002	0.001	0.005	0.003					0.008	85.0	12.4	
Taya B1	11.000										0.038	87.0	2.1	
Taya B2	0.415		0.001	0.000	0.002	0.001					0.003	85.0	4.1	
TCS B1	11.000										0.169	85.9	9.1	
TCS B2	0.415		0.007	0.005	0.027	0.017					0.040	85.0	58.4	
Thinleygang B1	11.000										0.209	85.1	11.2	
Thinleygang B2	0.415		0.001	0.000	0.002	0.001					0.003	85.0	4.3	
Thrima B1	11.000										0.037	85.7	2.0	
Thrima B2	0.415		0.001	0.001	0.004	0.003					0.007	85.0	9.7	
Thuenpee B1	11.000										0.110	85.1	6.2	
Thuenpee B2	0.415		0.001	0.001	0.005	0.003					0.007	85.0	10.8	
Tmchu B1	0.415		0.008	0.005	0.028	0.018					0.043	85.0	62.3	
Tmchu B2	11.000										0.044	84.4	2.3	
Tmchu.2	11.000										0.213	85.7	11.4	
Tmchu.3	11.000										0.128	86.3	6.9	
Tmchu.4	11.000										0.043	84.9	2.3	
Tmchu.5	11.000										0.023	88.5	1.2	
Tmchu.6	11.000										0.015	89.1	0.8	
Tmchu.7	11.000										0.029	86.0	1.5	
Tmchu.B1	11.000										0.249	85.6	13.3	
Tongkla B1	11.000										0.066	84.0	3.6	
Tongkla B2	0.415		0.012	0.008	0.041	0.026					0.063	85.0	94.8	

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Percent Loading
Tongling B1	11.000										0.012	84.5	0.7	
Tongling B2	0.415		0.002	0.001	0.008	0.005					0.012	85.0	17.4	
Trongmey B1	11.000										0.010	84.6	0.6	
Trongmey B2	0.415		0.002	0.001	0.007	0.004					0.010	85.0	15.0	
Trongtoe B1	11.000										0.011	84.6	0.6	
Trongtoe B2	0.415		0.002	0.001	0.007	0.004					0.011	85.0	15.9	
Tsango B1	11.000		0.002	0.001	0.007	0.005					0.011	85.0	0.6	
Tshochan B1	33.000										0.005	84.8	0.1	
Tshochan B2	0.415		0.001	0.001	0.004	0.002					0.005	85.0	7.4	
Tsholing B1	11.000										0.008	84.7	0.4	
Tsholing B2	0.415		0.001	0.001	0.005	0.003					0.008	85.0	11.5	
U.Dangling B1	11.000										0.008	85.9	0.4	
U.Dangling B2	0.415		0.000	0.000	0.002	0.001					0.002	85.0	3.2	
U.Domkhar B1	33.000										0.453	87.1	8.0	
U.Domkhar B2	0.415		0.002	0.001	0.009	0.005					0.013	85.0	18.0	
U.Jalang B1	11.000										0.102	84.5	5.5	
U.Jalang B2	0.415		0.004	0.003	0.015	0.009					0.023	85.0	34.2	
U.Pangkhar B1	11.000										0.036	87.5	2.0	
U.Pangkhar B2	0.415		0.002	0.001	0.008	0.005					0.012	85.0	18.5	
U.Serphu B1	11.000										0.018	85.2	1.0	
U.Serphu B2	0.415		0.001	0.001	0.004	0.002					0.005	85.0	7.8	
U.Shawa B1	11.000										0.010	84.6	0.5	
U.Shawa B2	0.415		0.002	0.001	0.006	0.004					0.009	85.0	14.1	
U.Wambur B1	33.000										0.612	89.9	10.8	
U.Wambur B2	0.415		0.003	0.002	0.013	0.008					0.019	85.0	26.7	
U.Zhungkhar B1	0.415		0.002	0.001	0.008	0.005					0.012	85.0	17.7	
U.Zhungkhar B2	11.000										0.012	84.5	0.7	
Wambrang B1	11.000		0.001	0.000	0.002	0.001					0.023	84.3	1.3	
Wambrang B2	0.415		0.004	0.002	0.013	0.008					0.019	85.0	29.9	
Wangzhing B1	11.000										0.188	85.0	10.1	
Wangzhing B2	0.415		0.003	0.002	0.013	0.008					0.019	85.0	27.8	
Wayway B1	11.000										0.013	84.2	0.7	
Wayway B2	0.415		0.002	0.002	0.008	0.005					0.013	85.0	19.3	
Yabee B1	33.000										0.036	87.6	0.6	
Yabee B2	0.415		0.003	0.002	0.012	0.007					0.017	85.0	24.9	
Yongbaling B1	11.000										0.043	86.0	2.4	
Yongbaling B2	0.415		0.001	0.001	0.004	0.002					0.006	85.0	8.7	
Youdra B1	11.000										0.009	84.7	0.5	
Youdra B2	0.415		0.002	0.001	0.006	0.004					0.009	85.0	12.9	
Zamling B1	11.000										0.226	85.7	12.5	
Zamling B2	0.415		0.002	0.002	0.009	0.005					0.013	85.0	19.4	
Zangkhar B1	0.415		0.001	0.001	0.003	0.002					0.005	85.0	7.0	

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					Percent
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Loading
Zham B1	0.415		0.001	0.001	0.004	0.003					0.006	85.0	8.9	
Zham B2	11.000										0.006	84.8	0.3	

* Indicates operating load of a bus exceeds the bus critical limit (100.0% of the Continuous Ampere rating).
# Indicates operating load of a bus exceeds the bus marginal limit (95.0% of the Continuous Ampere rating).

Branch Loading Summary Report

CKT / Branch		Cable & Reactor			Transformer				
					Capability (MVA)	Loading (input)		Loading (output)	
ID	Type	Ampacity (Amp)	Loading Amp	%		MVA	%	MVA	%
Gangzur MHPP Line	Cable	229.86	14.32	6.23					
Rongchu MHPP Line	Cable	229.86	20.82	9.06					
* Ambrangchu Tfr	Transformer				0.025	0.046	185.4	0.043	172.0
Autso.Baz Tfr	Transformer				0.250	0.125	50.2	0.123	49.3
Autso.Sch Tfr	Transformer				0.125	0.088	70.5	0.086	68.7
B.Factory Tfr	Transformer				0.063	0.013	21.4	0.013	21.2
Baptong Tfr	Transformer				0.063	0.020	31.1	0.019	30.7
Bazar Tfr	Transformer				0.250	0.016	6.3	0.016	6.3
Berpa Tfr	Transformer				0.025	0.014	56.2	0.014	55.0
Bragong Tfr	Transformer				0.063	0.059	93.6	0.057	90.2
Budhur Tfr	Transformer				0.063	0.023	36.8	0.023	36.3
Changkhala Tfr	Transformer				0.030	0.020	65.3	0.019	63.7
Chazam Tfr	Transformer				0.016	0.011	70.3	0.011	68.3
* Chengling Tfr	Transformer				0.025	0.045	181.0	0.042	168.2
Churbe Tfr	Transformer				0.016	0.002	14.7	0.002	14.6
Chusa Tfr	Transformer				0.063	0.017	27.3	0.017	27.0
Dagathang Tfr	Transformer				0.030	0.011	35.9	0.011	35.4
Dakten Tfr	Transformer				0.025	0.018	72.9	0.018	70.8
Depteng Tfr	Transformer				0.025	0.007	26.3	0.007	26.0
Dorshong Tfr	Transformer				0.125				
Drabling Tfr	Transformer				0.016	0.009	56.6	0.009	55.3
Dungkhar Tfr	Transformer				0.063	0.029	46.2	0.029	45.3
Dzong Tfr	Transformer				0.250	0.105	42.1	0.104	41.4
Fatila Tfr	Transformer				0.016	0.006	38.2	0.006	37.6
Fawan Tfr	Transformer				0.063	0.019	30.2	0.019	29.9
Fire Hydt. Tfr	Transformer				0.250	0.001	0.5	0.001	0.5
Gangla Tfr	Transformer				0.025	0.008	33.9	0.008	33.5
Gangzur MHPP Tfr	Transformer				0.315	0.273	86.6	0.265	84.1
Gangzur Tfr	Transformer				0.050	0.028	55.2	0.027	54.0
gorgan Tfr	Transformer				0.063	0.007	11.0	0.007	11.0
Gpa Kap Tfr	Transformer				0.063	0.021	33.3	0.021	32.9
Gwog CD Tfr	Transformer				0.025	0.010	38.3	0.009	37.7
Jabee Auto.W Tfr	Transformer				0.063	0.011	17.6	0.011	17.5

CKT / Branch		Cable & Reactor			Transformer				
						Loading (input)		Loading (output)	
ID	Type	Ampacity (Amp)	Loading Amp	%	Capability (MVA)	MVA	%	MVA	%
Jabee RBA Tfr	Transformer				0.016	0.001	3.2	0.001	3.2
Jachung Tfr	Transformer				0.025	0.001	4.5	0.001	4.5
Jalamzum Tfr	Transformer				0.025	0.012	47.0	0.012	46.1
Jang Tfr	Transformer				0.063	0.008	13.3	0.008	13.2
Jasabe Tfr	Transformer				0.025	0.008	31.7	0.008	31.3
Jcholing Tfr	Transformer				0.063	0.013	21.4	0.013	21.2
Kamdar Tfr	Transformer				0.063	0.036	57.4	0.035	56.2
Kchung Tfr	Transformer				0.025	0.019	76.9	0.019	74.5
Kemtshong Tfr	Transformer				0.016	0.012	74.8	0.012	72.5
Khema Tfr	Transformer				0.025	0.008	31.5	0.008	31.1
* Khoma Sch. Tfr	Transformer				0.016	0.024	151.7	0.023	142.4
Khoma Tfr	Transformer				0.063	0.046	73.1	0.045	70.9
Khoma.D Tfr	Transformer				0.016	0.002	9.5	0.002	9.4
Khomadung Tfr	Transformer				0.125	0.049	39.3	0.048	38.7
Khomagang Tfr	Transformer				0.016	0.009	55.6	0.009	54.3
Kilung Tfr	Transformer				0.016	0.007	42.9	0.007	42.2
Kiphu Tfr	Transformer				0.030	0.006	21.5	0.006	21.3
Kupensa Tfr	Transformer				0.063	0.019	30.1	0.019	29.8
L.Dangling Tfr	Transformer				0.025	0.006	24.7	0.006	24.5
L.Domkhar Tfr	Transformer				0.063	0.012	18.7	0.012	18.6
L.Jalang Tfr	Transformer				0.025	0.019	76.2	0.018	74.0
L.Pangkhar Tfr	Transformer				0.025	0.016	64.6	0.016	62.9
L.Serphu Tfr	Transformer				0.025	0.013	53.1	0.013	52.0
L.Shawa Tfr	Transformer				0.025	0.019	75.4	0.018	73.1
L.Wambur Tfr	Transformer				0.063	0.015	24.5	0.015	24.3
L.Zhungkhar Tfr	Transformer				0.025	0.008	31.8	0.008	31.4
Lagyel Tfr	Transformer				0.030	0.009	31.5	0.009	31.2
Lawa Tfr	Transformer				0.025	0.005	20.5	0.005	20.4
LHS Tfr	Transformer				0.250	0.142	56.9	0.139	55.6
Lingabe Tfr	Transformer				0.063	0.012	18.8	0.012	18.7
Lugarpang Tfr	Transformer				0.016	0.009	53.2	0.008	52.1
Lukchu Tfr	Transformer				0.025	0.004	17.2	0.004	17.1
M.Zhungkhar Tfr	Transformer				0.025	0.006	25.9	0.006	25.6
Manjabee Tfr	Transformer				0.063	0.006	10.0	0.006	10.0
Menjitse Tfr	Transformer				0.125	0.016	12.5	0.016	12.5

CKT / Branch		Cable & Reactor			Transformer				
						Loading (input)		Loading (output)	
ID	Type	Ampacity (Amp)	Loading Amp	%	Capability (MVA)	MVA	%	MVA	%
Minjey Sch. Tfr	Transformer				0.100	0.040	40.0	0.039	39.3
Mmaling Tfr	Transformer				0.025	0.006	24.0	0.006	23.8
Murmur Tfr	Transformer				0.016	0.006	36.3	0.006	35.8
Namdruling Tfr	Transformer				0.063	0.050	79.4	0.049	77.1
* Namgong Tfr	Transformer				0.025	0.026	103.5	0.025	99.2
Nangla Tfr	Transformer				0.025	0.006	23.0	0.006	22.8
Naray Tfr	Transformer				0.016	0.004	24.7	0.004	24.5
Naybee Tfr	Transformer				0.063	0.028	44.5	0.028	43.8
New NHDC Tfr	Transformer				0.063	0.016	24.9	0.016	24.7
Ney Zhisar Tfr	Transformer				0.100	0.020	20.2	0.020	20.1
Ngalamd Tfr	Transformer				0.025	0.015	58.1	0.014	56.7
Ngar Tfr	Transformer				0.016	0.005	33.2	0.005	32.7
* NHDC Tfr	Transformer				0.063	0.090	142.3	0.085	134.3
Nimshong Tfr	Transformer				0.063	0.013	20.8	0.013	20.6
Pam Tfr	Transformer				0.025	0.002	9.8	0.002	9.8
Phagidung Tfr	Transformer				0.063	0.026	41.0	0.025	40.4
* Rongchu MHPP Tfr	Transformer				0.315	0.397	125.9	0.379	120.3
Rongchu Tfr	Transformer				0.016	0.010	61.4	0.010	59.9
Rotpa Tfr	Transformer				0.025	0.002	9.9	0.002	9.8
RwabeA Tfr	Transformer				0.025	0.007	28.6	0.007	28.3
RwabeB Tfr	Transformer				0.025	0.005	20.5	0.005	20.3
RwabeC Tfr	Transformer				0.025	0.003	12.7	0.003	12.7
Samling Tfr	Transformer				0.025	0.017	66.7	0.016	64.9
Semchebe Tfr	Transformer				0.016	0.006	36.8	0.006	36.3
Sershong Tfr	Transformer				0.025	0.009	36.6	0.009	36.0
Serzam Tfr	Transformer				0.030	0.008	25.7	0.008	25.4
Shangbe Tfr	Transformer				0.025	0.015	59.0	0.014	57.6
Somshing Tfr	Transformer				0.025	0.013	51.1	0.013	50.0
Soshong Tfr	Transformer				0.025	0.016	63.5	0.015	61.8
Sumpa Tfr	Transformer				0.063	0.010	15.8	0.010	15.7
Sungbe Tfr	Transformer				0.063	0.011	17.6	0.011	17.5
Tabee Tfr	Transformer				0.025	0.020	80.2	0.019	77.6
Takila I Tfr	Transformer				0.250	0.033	13.0	0.032	13.0
Takila II Tfr	Transformer				0.315	0.010	3.2	0.010	3.2
Tangbe Tfr	Transformer				0.025	0.009	36.8	0.009	36.2

CKT / Branch		Cable & Reactor			Transformer				
						Loading (input)		Loading (output)	
ID	Type	Ampacity (Amp)	Loading Amp	%	Capability (MVA)	MVA	%	MVA	%
TangmachuSS Tfr1	Transformer				1.500	0.660	44.0	0.648	43.2
TangmachuSS Tfr2	Transformer				1.500	0.660	44.0	0.648	43.2
Tangrung Tfr	Transformer				0.025	0.008	33.3	0.008	32.9
Taya Tfr	Transformer				0.025	0.003	11.1	0.003	11.1
TCS Tfr	Transformer				0.063	0.041	65.2	0.040	63.6
Thinleygang Tfr	Transformer				0.016	0.003	18.9	0.003	18.7
Thrima Tfr	Transformer				0.025	0.007	26.4	0.007	26.1
Thuenpee Tfr	Transformer				0.025	0.007	29.2	0.007	28.8
Tmchu Tfr	Transformer				0.063	0.044	69.5	0.043	67.7
* Tongkla Tfr	Transformer				0.063	0.066	104.4	0.063	100.1
Tongling Tfr	Transformer				0.025	0.012	47.7	0.012	46.8
Trongmey Tfr	Transformer				0.025	0.010	40.8	0.010	40.1
Trongtoe Tfr	Transformer				0.025	0.011	43.3	0.011	42.5
Tshochan Tfr	Transformer				0.030	0.005	17.7	0.005	17.6
Tsholing Tfr	Transformer				0.025	0.008	31.5	0.008	31.1
U.Dangling Tfr	Transformer				0.025	0.002	9.1	0.002	9.1
U.Domkhar Tfr	Transformer				0.063	0.013	20.4	0.013	20.3
U.Jalang Tfr	Transformer				0.025	0.024	95.9	0.023	92.4
U.Pangkhar Tfr	Transformer				0.025	0.013	50.8	0.012	49.8
U.Serphu Tfr	Transformer				0.025	0.005	21.4	0.005	21.2
U.Shawa Tfr	Transformer				0.025	0.010	38.4	0.009	37.8
U.Wambur Tfr	Transformer				0.063	0.019	30.4	0.019	30.0
U.Zhungkhar Tfr	Transformer				0.025	0.012	49.6	0.012	48.7
Wambrang Tfr	Transformer				0.025	0.020	80.2	0.019	77.5
Wangzhing Tfr	Transformer				0.063	0.020	31.0	0.019	30.6
Wayway Tfr	Transformer				0.016	0.013	81.1	0.013	78.4
Yabee Tfr	Transformer				0.030	0.018	59.4	0.017	58.1
Yongbaling Tfr	Transformer				0.016	0.006	37.2	0.006	36.7
Youdra Tfr	Transformer				0.025	0.009	35.3	0.009	34.8
Zamling Tfr	Transformer				0.063	0.013	21.0	0.013	20.8
Zangkhar Tfr	Transformer				0.030	0.005	16.8	0.005	16.7
Zham Tfr	Transformer				0.025	0.006	24.9	0.006	24.7

* Indicates a branch with operating load exceeding the branch capability.

Branch Losses Summary Report

	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
Branch ID	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
Ambrangchu-Chengling	0.038	0.025	-0.038	-0.025	0.0	-0.4	97.0	96.9	0.05
OldL.3-Ambrangchu	-0.076	-0.050	0.076	0.050	0.0	-0.2	97.0	97.0	0.06
Ambrangchu Tfr	0.039	0.026	-0.037	-0.023	2.0	3.0	97.0	90.0	7.01
Gorg.23-Autso.Baz	-0.106	-0.067	0.106	0.067	0.0	-0.5	99.4	99.4	0.00
Autso.Baz Tfr	0.106	0.067	-0.105	-0.065	1.4	2.1	99.4	97.5	1.84
Gorg.23-Autso.Sch	-0.074	-0.047	0.074	0.047	0.0	-0.4	99.4	99.4	0.00
Autso.Sch Tfr	0.074	0.047	-0.073	-0.045	1.4	2.1	99.4	96.8	2.59
B.Factory-Gorg.21	0.289	0.166	-0.289	-0.170	0.1	-4.6	99.4	99.4	0.03
Gorg.20-B.Factory	-0.301	-0.173	0.301	0.170	0.0	-2.5	99.4	99.4	0.01
B.Factory Tfr	0.011	0.007	-0.011	-0.007	0.1	0.1	99.4	98.6	0.78
Baptong-Kemtshong	0.010	0.006	-0.010	-0.006	0.0	-0.7	95.4	95.4	0.02
Baptong-Khomadung	0.042	0.025	-0.042	-0.026	0.0	-0.7	95.4	95.4	0.05
Old.9-Baptong	-0.068	-0.042	0.068	0.041	0.0	-0.4	95.4	95.5	0.05
Baptong Tfr	0.017	0.010	-0.016	-0.010	0.1	0.2	95.4	94.2	1.19
NewL.9-Bazar	-0.013	-0.008	0.013	0.008	0.0	-0.1	96.5	96.5	0.00
Bazar Tfr	0.013	0.008	-0.013	-0.008	0.0	0.0	96.5	96.2	0.24
Berpa-OldL.9	0.086	0.052	-0.086	-0.052	0.0	-0.1	95.5	95.5	0.01
Khoma Sch.-Berpa	-0.098	-0.059	0.098	0.059	0.1	-0.3	95.5	95.6	0.07
Berpa Tfr	0.012	0.008	-0.012	-0.007	0.2	0.3	95.5	93.4	2.15
Bragong Tfr	-0.048	-0.030	0.050	0.032	1.3	1.9	93.9	97.4	3.51
U.Jalang-Bragong	-0.050	-0.032	0.050	0.031	0.1	-0.6	97.4	97.5	0.09
Gorg.1-Budhur	-0.020	-0.012	0.020	0.011	0.0	-1.7	99.6	99.6	0.00
Budhur Tfr	0.020	0.012	-0.019	-0.012	0.2	0.3	99.6	98.3	1.35
Yabee-Changkhala	-0.017	-0.011	0.017	0.008	0.0	-2.7	99.6	99.6	0.00
Changkhala Tfr	0.017	0.011	-0.016	-0.010	0.3	0.4	99.6	97.2	2.39
OldL.34-Chazam	-0.009	-0.006	0.009	0.006	0.0	0.0	93.4	93.4	0.00
Chazam Tfr	0.009	0.006	-0.009	-0.006	0.2	0.3	93.4	90.7	2.75
Chengling Tfr	0.038	0.025	-0.036	-0.022	1.9	2.9	96.9	90.1	6.85
Churbe-L.Shawa	0.024	0.015	-0.024	-0.015	0.0	-0.3	95.1	95.1	0.03
Thrima-Churbe	-0.026	-0.016	0.026	0.016	0.0	-0.6	95.1	95.1	0.05
Churbe Tfr	0.002	0.001	-0.002	-0.001	0.0	0.0	95.1	94.5	0.56
Chusa-Wangzhing	0.160	0.099	-0.160	-0.099	0.3	-0.2	97.8	97.6	0.15
Min.1-Chusa	-0.175	-0.108	0.175	0.108	0.3	-0.2	97.8	97.9	0.15
Chusa Tfr	0.015	0.009	-0.014	-0.009	0.1	0.2	97.8	96.8	1.02

Branch ID	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
Dagathang-Gorg.16	0.409	0.214	-0.408	-0.217	0.1	-3.0	99.6	99.5	0.02
Gorg.2-Dagathang	-0.418	-0.219	0.418	0.218	0.1	-1.6	99.6	99.6	0.02
Dagathang Tfr	0.009	0.006	-0.009	-0.006	0.1	0.1	99.6	98.2	1.31
Ngalamd-Dakten	-0.015	-0.010	0.015	0.009	0.0	-0.4	96.0	96.0	0.01
Dakten Tfr	0.015	0.010	-0.015	-0.009	0.3	0.5	96.0	93.2	2.77
Depteng-Ney Zhisar	0.017	0.010	-0.017	-0.011	0.0	-0.3	94.9	94.9	0.02
OldL.24-Depteng	-0.023	-0.014	0.023	0.014	0.0	-0.1	94.9	94.9	0.01
Depteng Tfr	0.006	0.003	-0.006	-0.003	0.0	0.1	94.9	93.9	1.01
Gorg.3-Dorshong	0.000	0.000	0.000	0.000	0.0	-0.2	99.6	99.6	0.00
Dorshong Tfr	0.000	0.000	0.000	0.000			99.6	99.6	
Drabling-OldL.36	0.032	0.020	-0.032	-0.020	0.0	0.0	93.4	93.4	0.00
Old.35-Drabling	-0.040	-0.025	0.040	0.025	0.0	-0.2	93.4	93.4	0.02
Drabling Tfr	0.008	0.005	-0.008	-0.005	0.1	0.2	93.4	91.2	2.21
Dungkhar-Sungbe	0.126	0.077	-0.126	-0.077	0.0	-0.1	93.7	93.7	0.04
OldL.29-Dungkhar	-0.151	-0.092	0.151	0.092	0.0	0.0	93.7	93.8	0.02
Dungkhar Tfr	0.025	0.016	-0.024	-0.015	0.3	0.5	93.7	92.0	1.80
Dzong-NewL.8	0.145	0.093	-0.145	-0.093	0.0	0.0	96.6	96.6	0.01
NewL.7-Dzong	-0.234	-0.149	0.234	0.149	0.1	0.0	96.6	96.6	0.04
Dzong Tfr	0.089	0.056	-0.088	-0.055	1.1	1.6	96.6	95.0	1.59
NewL.7-Fatila	-0.005	-0.003	0.005	0.003	0.0	-0.2	96.6	96.6	0.00
Fatila Tfr	0.005	0.003	-0.005	-0.003	0.1	0.1	96.6	95.2	1.44
Fawan-Gorg.20	0.358	0.205	-0.358	-0.205	0.0	-0.4	99.4	99.4	0.00
L.Domkhar-Fawan	-0.374	-0.215	0.374	0.211	0.1	-3.9	99.4	99.5	0.03
Fawan Tfr	0.016	0.010	-0.016	-0.010	0.1	0.2	99.4	98.3	1.11
NewL.7-Fire.Hydt	-0.001	-0.001	0.001	0.001	0.0	0.0	96.6	96.6	0.00
Fire Hydt. Tfr	0.001	0.001	-0.001	-0.001	0.0	0.0	96.6	96.5	0.02
Gangla-Khema	0.008	0.004	-0.008	-0.005	0.0	-0.4	95.4	95.4	0.01
OldL.7-Gangla	-0.015	-0.009	0.015	0.008	0.0	-0.5	95.4	95.5	0.02
Gangla Tfr	0.007	0.005	-0.007	-0.004	0.1	0.1	95.4	94.2	1.30
OldL.15-Gangzur	-0.023	-0.015	0.023	0.015	0.0	-0.1	95.9	95.9	0.01
Gangzur Tfr	0.023	0.015	-0.023	-0.014	0.4	0.6	95.9	93.8	2.10
Gangzur MHPP Tfr	0.251	0.107	-0.246	-0.099	5.2	7.9	100.0	97.1	2.88
Gangzur MHPP Line	0.246	0.099	-0.246	-0.099	0.0	0.0	97.1	97.1	0.00
Gorg.1-L.Wambur	0.564	0.274	-0.564	-0.275	0.0	-0.3	99.6	99.6	0.00
Kupensa-Gorg.1	-0.583	-0.285	0.584	0.279	0.7	-5.9	99.6	99.7	0.11
Gorg(2-3)	0.116	0.041	-0.116	-0.044	0.0	-3.0	99.6	99.6	0.01
U.Wambur-Gorg.2	-0.534	-0.259	0.534	0.258	0.1	-1.2	99.6	99.6	0.01

Branch ID	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
Gorg.3-Gorgan	0.116	0.045	-0.116	-0.046	0.0	-1.6	99.6	99.6	0.00
Gorg(4-5)	0.104	0.046	-0.104	-0.048	0.0	-1.2	99.6	99.6	0.00
Gorg.4-Serzam	0.007	0.003	-0.007	-0.004	0.0	-1.6	99.6	99.6	0.00
Gorgan-Gorg.4	-0.111	-0.049	0.111	0.043	0.0	-6.3	99.6	99.6	0.01
Gorg(5-6)	0.037	0.017	-0.037	-0.019	0.0	-2.1	99.6	99.6	0.00
Gorg(5-7)	0.067	0.031	-0.067	-0.033	0.0	-2.5	99.6	99.6	0.00
Gorg.6-Yabee	0.032	0.015	-0.032	-0.017	0.0	-1.9	99.6	99.6	0.00
Zangkhar Tfr	0.004	0.003	-0.004	-0.003	0.0	0.0	99.6	98.9	0.61
Gorg(7-8)	0.062	0.032	-0.062	-0.037	0.0	-5.3	99.6	99.5	0.01
Gorg.7-Tshochan	0.005	0.001	-0.005	-0.003	0.0	-1.5	99.6	99.6	0.00
Gorg(8-9)	0.060	0.036	-0.060	-0.037	0.0	-1.4	99.5	99.5	0.00
Gorg(16-17)	0.395	0.212	-0.395	-0.216	0.1	-4.0	99.5	99.5	0.03
Gorg.16-Kiphu	0.013	0.004	-0.013	-0.005	0.0	-1.2	99.5	99.5	0.00
Gorg.17-U.Domkhar	0.395	0.216	-0.395	-0.223	0.2	-6.3	99.5	99.5	0.05
Gorg(21-22)	0.288	0.170	-0.288	-0.174	0.1	-4.1	99.4	99.4	0.02
Gorg.21-Jachung	0.001	0.000	-0.001	-0.001	0.0	-0.2	99.4	99.4	0.00
Gorg(22-23)	0.180	0.113	-0.180	-0.113	0.0	-0.8	99.4	99.4	0.00
Gorg(22-24)	0.108	0.061	-0.108	-0.064	0.0	-2.5	99.4	99.3	0.01
Gorg(24-29)	0.055	0.031	-0.055	-0.032	0.0	-1.3	99.3	99.3	0.00
Gorg.29-Namdruling	0.042	0.025	-0.042	-0.027	0.0	-2.4	99.3	99.3	0.00
gorgan Tfr	0.006	0.004	-0.006	-0.004	0.0	0.0	99.6	99.2	0.40
Old.9- Gpa Kap	-0.018	-0.011	0.018	0.011	0.0	-0.4	95.5	95.5	0.01
Gpa Kap Tfr	0.018	0.011	-0.018	-0.011	0.2	0.3	95.5	94.2	1.27
OldL.30-Gwog CD	-0.008	-0.005	0.008	0.005	0.0	-0.2	93.7	93.7	0.00
Gwog CD Tfr	0.008	0.005	-0.008	-0.005	0.1	0.1	93.7	92.2	1.49
Old.4-Jabee Auto.W	-0.009	-0.006	0.009	0.006	0.0	-0.1	97.0	97.0	0.00
Jabee Auto.W Tfr	0.009	0.006	-0.009	-0.006	0.0	0.1	97.0	96.4	0.66
Jabee-OldL.3	0.507	0.329	-0.506	-0.328	1.2	0.9	97.3	97.0	0.26
OldL.1-Jabee RBA	-0.508	-0.329	0.509	0.330	1.3	1.0	97.3	97.6	0.29
Jabee RBA Tfr	0.000	0.000	0.000	0.000	0.0	0.0	97.3	97.2	0.12
Jachung Tfr	0.001	0.001	-0.001	-0.001	0.0	0.0	99.4	99.2	0.17
Jalamzum-Jcholing	0.019	0.010	-0.019	-0.011	0.0	-0.5	95.5	95.4	0.03
Jalamzum-Tongling	0.010	0.006	-0.010	-0.006	0.0	-0.2	95.5	95.5	0.01
OldL.20-Jalamzum	-0.039	-0.023	0.039	0.022	0.0	-0.2	95.5	95.5	0.03
Jalamzum Tfr	0.010	0.006	-0.010	-0.006	0.1	0.2	95.5	93.7	1.80
OldL.17-Jang	-0.007	-0.004	0.007	0.004	0.0	-0.5	95.9	95.9	0.01
Jang Tfr	0.007	0.004	-0.007	-0.004	0.0	0.0	95.9	95.4	0.50

Branch ID	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
Old.29-Jasabe	-0.013	-0.008	0.013	0.008	0.0	-0.5	93.7	93.8	0.02
Jasabe Tfr	0.007	0.004	-0.007	-0.004	0.1	0.1	93.7	92.5	1.23
Jcholing-Youdra	0.007	0.004	-0.007	-0.005	0.0	-1.2	95.4	95.4	0.03
Jcholing Tfr	0.011	0.007	-0.011	-0.007	0.1	0.1	95.4	94.6	0.82
Kamdar Tfr	-0.030	-0.019	0.031	0.019	0.5	0.7	95.7	97.9	2.14
Tmchu.1-Kamdar	-0.031	-0.019	0.031	0.019	0.0	-0.3	97.9	97.9	0.02
OldL.28-Kchung	-0.016	-0.010	0.016	0.010	0.0	-0.2	94.8	94.8	0.01
Kchung Tfr	0.016	0.010	-0.016	-0.010	0.4	0.5	94.8	91.8	2.96
Kemtshong Tfr	0.010	0.006	-0.010	-0.006	0.2	0.3	95.4	92.5	2.86
Khema-Nyeteng	0.001	0.000	-0.001	-0.001	0.0	-0.5	95.4	95.4	0.00
Khema Tfr	0.007	0.004	-0.007	-0.004	0.1	0.1	95.4	94.2	1.20
Old.10-Khoma	-0.039	-0.025	0.039	0.025	0.0	0.0	95.6	95.6	0.00
Khoma Tfr	0.039	0.025	-0.038	-0.024	0.8	1.2	95.6	92.8	2.79
OldL.8-Khoma Sch.	-0.118	-0.072	0.118	0.072	0.0	-0.1	95.6	95.6	0.02
Khoma Sch. Tfr	0.020	0.013	-0.019	-0.012	0.9	1.3	95.6	89.8	5.81
Khoma.D-Ngalamd	0.028	0.017	-0.028	-0.017	0.0	-0.3	96.0	96.0	0.01
Khoma.D-OldL.6	0.267	0.158	-0.266	-0.158	1.0	0.1	96.0	95.6	0.41
OldL.5-Khoma.D	-0.295	-0.176	0.296	0.176	0.2	0.1	96.0	96.1	0.08
Khoma.D Tfr	0.001	0.001	-0.001	-0.001	0.0	0.0	96.0	95.7	0.36
Khomadung Tfr	0.042	0.026	-0.041	-0.025	0.5	0.7	95.4	93.9	1.50
Khomagang-Tsango	0.009	0.005	-0.009	-0.006	0.0	-0.9	95.4	95.4	0.02
ReplaBT-Khomagang	-0.017	-0.010	0.017	0.009	0.0	-1.2	95.4	95.5	0.06
Khomagang Tfr	0.008	0.005	-0.007	-0.005	0.1	0.2	95.4	93.3	2.12
Kilung Tfr	-0.006	-0.004	0.006	0.004	0.1	0.1	93.9	95.5	1.64
Kilung-OldL.19	0.050	0.029	-0.050	-0.029	0.0	0.0	95.5	95.5	0.00
Kilung-OldL.21	0.100	0.058	-0.100	-0.058	0.0	-0.1	95.5	95.5	0.03
OldL.18-Kilung	-0.156	-0.091	0.156	0.091	0.1	-0.1	95.5	95.6	0.05
Kiphu-Lagyel	0.008	0.002	-0.008	-0.005	0.0	-3.2	99.5	99.5	0.00
Kiphu Tfr	0.005	0.003	-0.005	-0.003	0.0	0.0	99.5	98.8	0.79
L1-Kupensa	-0.600	-0.289	0.601	0.266	1.3	-23.3	99.7	100.0	0.25
Kupensa Tfr	0.016	0.010	-0.016	-0.010	0.1	0.2	99.7	98.6	1.10
L.Dangling Tfr	-0.005	-0.003	0.005	0.003	0.0	0.1	96.8	97.7	0.92
Dangling(U-L)	-0.005	-0.003	0.005	0.003	0.0	-0.2	97.7	97.7	0.00
Domkhar(U-L)	-0.384	-0.218	0.384	0.216	0.0	-1.5	99.5	99.5	0.01
L.Domkhar Tfr	0.010	0.006	-0.010	-0.006	0.0	0.1	99.5	98.8	0.68
L.Jalang Tfr	-0.016	-0.010	0.016	0.010	0.3	0.5	94.6	97.4	2.85
Jalang(U-L)	-0.016	-0.010	0.016	0.010	0.0	-0.2	97.4	97.5	0.01

Branch ID	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
L.Pangkhar0OldL.12	0.032	0.017	-0.032	-0.017	0.0	-0.1	95.5	95.5	0.00
OldL.11-L.Pangkhar	-0.045	-0.026	0.045	0.025	0.0	-0.5	95.5	95.6	0.04
L.Pangkhar Tfr	0.014	0.009	-0.013	-0.008	0.3	0.4	95.5	93.1	2.47
Serphu(U-L)	-0.011	-0.007	0.011	0.007	0.0	-0.3	95.5	95.5	0.01
L.Serphu Tfr	0.011	0.007	-0.011	-0.007	0.2	0.3	95.5	93.4	2.03
Shawa(L-U)	0.008	0.005	-0.008	-0.005	0.0	0.0	95.1	95.1	0.00
L.Shawa Tfr	0.016	0.010	-0.016	-0.010	0.3	0.5	95.1	92.2	2.90
Wambur(L-U)	0.551	0.266	-0.550	-0.268	0.2	-1.7	99.6	99.6	0.03
L.Wambur Tfr	0.013	0.008	-0.013	-0.008	0.1	0.1	99.6	98.7	0.89
L.Zhingkhar-Pam	0.002	0.001	-0.002	-0.001	0.0	-0.4	97.7	97.7	0.00
Tmchu.7-L.Zhungkhar	-0.009	-0.005	0.009	0.005	0.0	-0.1	97.7	97.7	0.00
L.Zhungkhar Tfr	0.007	0.004	-0.007	-0.004	0.1	0.1	97.7	96.5	1.19
Lagyel Tfr	0.008	0.005	-0.008	-0.005	0.1	0.1	99.5	98.4	1.15
Lawa-Taya	0.033	0.018	-0.033	-0.019	0.0	-0.4	95.5	95.5	0.04
Namgong-Lawa	-0.038	-0.021	0.038	0.021	0.0	-0.5	95.5	95.6	0.06
Lawa Tfr	0.004	0.003	-0.004	-0.003	0.0	0.0	95.5	94.8	0.78
NewL.3-LHS	-0.120	-0.076	0.120	0.076	0.0	-0.1	96.9	96.9	0.02
LHS Tfr	0.120	0.076	-0.118	-0.073	1.9	2.9	96.9	94.8	2.14
Lingabe-OldL.22	0.060	0.034	-0.060	-0.035	0.2	-1.3	95.3	95.1	0.24
Somshing-Lingabe	-0.070	-0.040	0.070	0.040	0.1	-0.4	95.3	95.4	0.10
Lingabe Tfr	0.010	0.006	-0.010	-0.006	0.1	0.1	95.3	94.6	0.72
Old.2-Lugarpang	-0.007	-0.005	0.007	0.004	0.0	-0.3	97.6	97.6	0.01
Lugarpang Tfr	0.007	0.005	-0.007	-0.004	0.1	0.2	97.6	95.6	1.99
OldL.11-Lukchu	-0.004	-0.002	0.004	0.002	0.0	-0.5	95.6	95.6	0.01
Lukchu Tfr	0.004	0.002	-0.004	-0.002	0.0	0.0	95.6	94.9	0.65
Tmchu.7-M.Zhungkhar	-0.016	-0.010	0.016	0.010	0.0	-0.2	97.7	97.7	0.01
Zhungkhar(M-U)	0.010	0.006	-0.010	-0.007	0.0	-0.2	97.7	97.7	0.00
M.Zhungkhar Tfr	0.005	0.003	-0.005	-0.003	0.0	0.1	97.7	96.7	0.96
Manjabee-Tmchu.5	0.020	0.010	-0.020	-0.011	0.0	-0.4	97.7	97.7	0.01
Tmchu.3-Manjabee	-0.026	-0.014	0.026	0.013	0.0	-0.3	97.7	97.7	0.01
Manjabee Tfr	0.005	0.003	-0.005	-0.003	0.0	0.0	97.7	97.4	0.37
Menjitse-Minjey Sch.	0.120	0.075	-0.120	-0.075	0.0	-0.1	97.6	97.5	0.03
Min.2-Menjitse	-0.133	-0.084	0.133	0.083	0.0	0.0	97.6	97.6	0.03
Menjitse Tfr	0.013	0.008	-0.013	-0.008	0.0	0.1	97.6	97.1	0.47
Thinleygang-Min.1	-0.175	-0.108	0.175	0.108	0.1	-0.1	97.9	98.0	0.06
Min(2-3)	0.010	0.005	-0.010	-0.006	0.0	-0.7	97.6	97.6	0.02
Wangzhing-Min.2	-0.143	-0.089	0.143	0.089	0.1	-0.1	97.6	97.6	0.06

Branch ID	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
Min.3-Nangla	0.005	0.003	-0.005	-0.003	0.0	-0.2	97.6	97.6	0.00
Min.3-Zham	0.005	0.003	-0.005	-0.003	0.0	-0.1	97.6	97.6	0.00
Minjey Sch.-U.Jalang	0.086	0.054	-0.086	-0.054	0.1	-0.2	97.5	97.5	0.07
Minjey Sch. Tfr	0.034	0.021	-0.033	-0.021	0.4	0.6	97.5	96.0	1.49
Mmaling-OldL.2	0.012	0.007	-0.012	-0.007	0.0	-0.2	97.6	97.6	0.01
OldL.1-Mmaling	-0.017	-0.010	0.017	0.010	0.0	-0.2	97.6	97.6	0.01
Mmaling Tfr	0.005	0.003	-0.005	-0.003	0.0	0.1	97.6	96.7	0.90
Old.2-Murmur	-0.005	-0.003	0.005	0.003	0.0	-0.4	97.6	97.6	0.01
Murmur Tfr	0.005	0.003	-0.005	-0.003	0.0	0.1	97.6	96.2	1.36
Namdruling Tfr	0.042	0.027	-0.041	-0.026	0.9	1.3	99.3	96.4	2.92
OldL.6-Namgong	-0.059	-0.035	0.059	0.035	0.0	-0.2	95.6	95.6	0.02
Namgong Tfr	0.022	0.014	-0.021	-0.013	0.6	1.0	95.6	91.7	3.96
Nangla Tfr	-0.005	-0.003	0.005	0.003	0.0	0.0	96.7	97.6	0.86
Naray-OldL.34	0.060	0.037	-0.060	-0.037	0.0	-0.2	93.5	93.4	0.03
OldL.33-Naray	-0.063	-0.039	0.063	0.039	0.0	-0.2	93.5	93.5	0.02
Naray Tfr	0.003	0.002	-0.003	-0.002	0.0	0.0	93.5	92.5	0.96
Naybee-Tmchu.7	0.025	0.014	-0.025	-0.015	0.0	-0.2	97.7	97.7	0.02
Tmchu.3-Naybee	-0.049	-0.029	0.049	0.029	0.0	-0.4	97.7	97.7	0.03
Naybee Tfr	0.024	0.015	-0.023	-0.015	0.3	0.4	97.7	96.1	1.66
NewL.7-New NHDC	-0.013	-0.008	0.013	0.008	0.0	-0.2	96.6	96.6	0.01
New NHDC Tfr	0.013	0.008	-0.013	-0.008	0.1	0.1	96.6	95.7	0.94
L1-NewL.1	-0.130	-0.135	0.130	0.135	0.0	0.0	98.1	98.1	0.01
NewL(1-2)	0.130	0.135	-0.128	-0.138	1.3	-2.2	98.1	97.1	0.95
NewL(2-3)	0.374	0.237	-0.373	-0.236	0.6	0.3	97.1	96.9	0.18
NewL(3-4)	0.253	0.160	-0.253	-0.160	0.1	0.0	96.9	96.9	0.04
NewL(4-5)	0.253	0.160	-0.253	-0.160	0.3	0.0	96.9	96.8	0.14
NewL(5-6)	0.253	0.160	-0.253	-0.160	0.1	0.0	96.8	96.7	0.06
NewL(6-7)	0.253	0.160	-0.252	-0.160	0.2	0.0	96.7	96.6	0.09
NewL.8- NHDC	0.144	0.093	-0.144	-0.093	0.1	-0.1	96.6	96.5	0.05
NewL.9-Tongkla	0.055	0.036	-0.055	-0.036	0.0	-0.1	96.5	96.5	0.01
NHDC-NewL.9	-0.069	-0.044	0.069	0.044	0.0	-0.3	96.5	96.5	0.04
Ney Zhisar Tfr	0.017	0.011	-0.017	-0.011	0.1	0.2	94.9	94.1	0.78
Ngalamd Tfr	0.012	0.008	-0.012	-0.007	0.2	0.3	96.0	93.8	2.21
OldL.16-Ngar	-0.004	-0.003	0.004	0.002	0.0	-0.7	95.9	95.9	0.01
Ngar Tfr	0.004	0.003	-0.004	-0.003	0.0	0.1	95.9	94.6	1.26
NHDC Tfr	0.075	0.049	-0.072	-0.045	3.0	4.6	96.5	91.1	5.39
OldL.20-Nimshong	-0.011	-0.007	0.011	0.007	0.0	-0.1	95.5	95.5	0.00

Branch ID	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
Nimshong Tfr	0.011	0.007	-0.011	-0.007	0.1	0.1	95.5	94.7	0.79
L1-OldL.1	-0.526	-0.340	0.529	0.342	2.3	1.7	97.6	98.1	0.50
OldL(3-4)	0.430	0.278	-0.430	-0.278	0.1	0.0	97.0	97.0	0.01
OldL.4-Sumpa	0.420	0.272	-0.418	-0.271	2.3	1.4	97.0	96.4	0.60
OldL(5-13)	0.113	0.089	-0.113	-0.089	0.1	-0.3	96.1	96.0	0.09
Sumpa-OldL.5	-0.409	-0.265	0.410	0.266	1.1	0.6	96.1	96.4	0.29
OldL(6-8)	0.206	0.124	-0.206	-0.124	0.1	0.0	95.6	95.6	0.03
OldL.7-U.Serphu	0.016	0.010	-0.016	-0.010	0.0	-0.1	95.5	95.5	0.00
Taya-OldL.7	-0.031	-0.018	0.031	0.017	0.0	-0.4	95.5	95.5	0.03
OldL(8-10)	0.088	0.051	-0.088	-0.051	0.0	-0.1	95.6	95.6	0.01
OldL(10-11)	0.049	0.027	-0.049	-0.027	0.0	-0.3	95.6	95.6	0.02
OldL.12-U.Pangkhar	0.032	0.017	-0.032	-0.017	0.0	-0.2	95.5	95.5	0.01
OldL(13-14)	0.113	0.089	-0.113	-0.090	0.2	-0.5	96.0	95.9	0.15
OldL(14-15)	0.035	0.020	-0.035	-0.020	0.0	-0.1	95.9	95.9	0.01
OldL(14-18)	0.078	0.069	-0.078	-0.071	0.2	-1.7	95.9	95.6	0.32
OldL(15-16)	0.012	0.006	-0.012	-0.006	0.0	-0.2	95.9	95.9	0.00
OldL(16-17)	0.007	0.004	-0.007	-0.004	0.0	-0.2	95.9	95.9	0.00
Rongchu MHPP Line	-0.337	-0.174	0.337	0.174	0.0	0.0	95.6	95.6	0.00
OldL(18-26)	0.250	0.149	-0.250	-0.149	0.4	0.0	95.6	95.4	0.17
Rongchu Tfr	0.008	0.005	-0.008	-0.005	0.1	0.2	95.6	93.2	2.35
OldL(19-20)	0.050	0.029	-0.050	-0.029	0.0	-0.2	95.5	95.5	0.03
OldL.21-Samling	0.019	0.011	-0.019	-0.012	0.0	-0.2	95.5	95.5	0.01
OldL.21-Somshing	0.081	0.047	-0.081	-0.047	0.0	-0.2	95.5	95.4	0.04
OldL(22-23)	0.053	0.032	-0.053	-0.033	0.1	-1.1	95.1	94.9	0.19
OldL.22-Tsholing	0.007	0.004	-0.007	-0.004	0.0	-0.3	95.1	95.1	0.01
OldL(22-25)	0.009	0.005	-0.009	-0.005	0.0	-0.1	94.9	94.9	0.00
OldL.23-Shangbe	0.044	0.027	-0.044	-0.027	0.0	0.0	94.9	94.9	0.01
OldL.24-Trongtoe	0.009	0.006	-0.009	-0.006	0.0	0.0	94.9	94.9	0.00
Shangbe-OldL.24	-0.032	-0.020	0.032	0.020	0.0	0.0	94.9	94.9	0.00
OldL.12-Trongmey	0.009	0.005	-0.009	-0.005	0.0	0.0	94.9	94.9	0.00
OldL(26-27)	0.248	0.148	-0.247	-0.148	0.5	0.0	95.4	95.2	0.22
OldL.26-Rotpa	0.002	0.001	-0.002	-0.001	0.0	-0.1	95.4	95.4	0.00
OldL(27-28)	0.211	0.126	-0.210	-0.127	0.8	-0.3	95.2	94.8	0.40
OldL.27-Yongbaling	0.037	0.022	-0.037	-0.022	0.0	0.0	95.2	95.2	0.00
OldL.28-Zamling	0.194	0.116	-0.194	-0.116	0.1	0.0	94.8	94.7	0.03
Tabee-OldL.29	-0.164	-0.100	0.164	0.100	0.2	-0.2	93.8	93.9	0.13
OldL(30-31)	0.108	0.066	-0.108	-0.066	0.1	-0.2	93.7	93.6	0.06

Branch ID	From-To Bus Flow MW	From-To Bus Flow Mvar	To-From Bus Flow MW	To-From Bus Flow Mvar	Losses kW	Losses kvar	% Bus Voltage From	% Bus Voltage To	Vd % Drop in Vmag
Sungbe-OldL.30	-0.116	-0.071	0.116	0.071	0.0	-0.1	93.7	93.7	0.03
Old.31-Tangrung	0.015	0.009	-0.015	-0.009	0.0	-0.1	93.6	93.6	0.00
Old.31-Thuenpee	0.093	0.058	-0.093	-0.058	0.1	-0.1	93.6	93.6	0.05
OldL(32-33)	0.074	0.045	-0.074	-0.046	0.0	-0.2	93.5	93.5	0.04
OldL.32-Soshong	0.013	0.008	-0.013	-0.009	0.0	0.0	93.5	93.5	0.00
Thuenpee-OldL.32	-0.087	-0.054	0.087	0.054	0.0	-0.2	93.5	93.6	0.03
OldL.32-Wayway	0.011	0.007	-0.011	-0.007	0.0	-0.2	93.5	93.5	0.00
Old.34-Tangbe	0.050	0.031	-0.050	-0.031	0.0	-0.1	93.4	93.4	0.02
Tangbe-OldL.35	-0.042	-0.026	0.042	0.026	0.0	-0.1	93.4	93.4	0.01
OldL.36-Warmbrang	0.019	0.012	-0.019	-0.012	0.0	-0.1	93.4	93.4	0.00
Pam Tfr	0.002	0.001	-0.002	-0.001	0.0	0.0	97.7	97.3	0.37
L1-Phagidung	-0.235	-0.142	0.235	0.142	0.2	0.0	98.0	98.1	0.08
Phagidung-Tmchu	0.213	0.129	-0.213	-0.129	0.2	-0.1	98.0	97.9	0.11
Phagidung Tfr	0.022	0.014	-0.022	-0.013	0.2	0.4	98.0	96.5	1.53
U.Pangkhar-ReplaB	-0.021	-0.011	0.021	0.011	0.0	-0.3	95.5	95.5	0.02
Rongchu MHPP Tfr	0.348	0.190	-0.337	-0.174	11.1	16.6	100.0	95.6	4.43
Rotpa Tfr	0.002	0.001	-0.002	-0.001	0.0	0.0	95.4	95.0	0.38
Rwabe(A-B)	0.004	0.003	-0.004	-0.003	0.0	0.0	97.7	97.7	0.00
Tmchu.6-RwabeA	-0.010	-0.006	0.010	0.006	0.0	-0.1	97.7	97.7	0.00
RwabeA Tfr	0.006	0.004	-0.006	-0.004	0.0	0.1	97.7	96.6	1.07
RwabeB Tfr	-0.004	-0.003	0.004	0.003	0.0	0.0	97.0	97.7	0.76
Tmchu.6-RwabeC	-0.003	0.000	0.003	0.000	0.0	-0.1	97.7	97.7	0.00
RwabeC-Yomay	0.000	-0.001	0.000	0.000	0.0	-1.3	97.7	97.7	0.00
RwabeC Tfr	0.003	0.002	-0.003	-0.002	0.0	0.0	97.7	97.2	0.47
Samling-Semchebe	0.005	0.003	-0.005	-0.003	0.0	-0.5	95.5	95.5	0.01
Samling Tfr	0.014	0.009	-0.014	-0.009	0.3	0.4	95.5	92.9	2.55
Semchebe Tfr	0.005	0.003	-0.005	-0.003	0.1	0.1	95.5	94.1	1.41
Tangrung-Sershong	-0.008	-0.005	0.008	0.005	0.0	-0.3	93.6	93.6	0.00
Sershong Tfr	0.008	0.005	-0.008	-0.005	0.1	0.1	93.6	92.2	1.42
Serzam Tfr	0.007	0.004	-0.006	-0.004	0.0	0.1	99.6	98.6	0.94
Shangbe Tfr	0.012	0.008	-0.012	-0.008	0.2	0.3	94.9	92.6	2.27
Somshing Tfr	0.011	0.007	-0.011	-0.007	0.2	0.2	95.4	93.5	1.95
Soshong Tfr	0.013	0.009	-0.013	-0.008	0.3	0.4	93.5	91.1	2.48
Sumpa Tfr	0.008	0.005	-0.008	-0.005	0.0	0.1	96.4	95.8	0.60
Sungbe Tfr	0.009	0.006	-0.009	-0.006	0.0	0.1	93.7	93.0	0.69
Zamling-Tabee	-0.181	-0.111	0.182	0.109	1.4	-1.2	93.9	94.7	0.85
Tabee Tfr	0.017	0.011	-0.016	-0.010	0.4	0.6	93.9	90.8	3.12

Branch ID	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
Takila I Tfr	-0.028	-0.017	0.028	0.017	0.1	0.1	97.3	97.7	0.48
Takila II Tfr	-0.009	-0.005	0.009	0.005	0.0	0.0	97.6	97.7	0.12
Tangbe Tfr	0.008	0.005	-0.008	-0.005	0.1	0.1	93.4	92.0	1.44
TangmachuSS Tfr1	0.538	0.382	-0.535	-0.364	3.0	17.9	100.0	98.1	1.92
TangmachuSS Tfr2	0.538	0.382	-0.535	-0.364	3.0	17.9	100.0	98.1	1.92
L1-Thinleygang	0.178	0.109	-0.178	-0.109	0.1	-0.1	98.1	98.0	0.08
Tangrung Tfr	0.007	0.004	-0.007	-0.004	0.1	0.1	93.6	92.3	1.30
Taya Tfr	0.002	0.001	-0.002	-0.001	0.0	0.0	95.5	95.1	0.42
TCS-Tmchu.3	0.110	0.064	-0.110	-0.065	0.1	-0.4	97.8	97.7	0.08
Tmchu.2-TCS	-0.145	-0.086	0.145	0.086	0.1	-0.2	97.8	97.9	0.05
TCS Tfr	0.035	0.022	-0.034	-0.021	0.6	0.9	97.8	95.4	2.43
Thinleygang Tfr	0.003	0.002	-0.003	-0.002	0.0	0.0	98.0	97.3	0.70
Yongbaling-Thrima	-0.032	-0.019	0.032	0.019	0.0	-0.4	95.1	95.2	0.04
Thrima Tfr	0.006	0.004	-0.006	-0.003	0.0	0.1	95.1	94.1	1.01
Thuenpee Tfr	0.006	0.004	-0.006	-0.004	0.1	0.1	93.6	92.4	1.14
Tmchu Tfr	-0.036	-0.022	0.037	0.024	0.7	1.1	95.3	97.9	2.59
Tmchu.2-Tmchu	-0.037	-0.024	0.037	0.023	0.0	-0.1	97.9	97.9	0.00
Tmchu(1-2)	-0.182	-0.110	0.182	0.110	0.0	0.0	97.9	97.9	0.01
Tmchu(3-4)	0.036	0.022	-0.036	-0.023	0.0	-0.1	97.7	97.7	0.01
Tmchu(5-6)	0.013	0.007	-0.013	-0.007	0.0	-0.1	97.7	97.7	0.00
Tmchu.5-U.Dangling	0.007	0.004	-0.007	-0.004	0.0	-0.2	97.7	97.7	0.00
Tongkla Tfr	0.055	0.036	-0.054	-0.033	1.6	2.5	96.5	92.5	3.96
Tongling Tfr	0.010	0.006	-0.010	-0.006	0.1	0.2	95.5	93.6	1.82
Trongmey Tfr	0.009	0.005	-0.009	-0.005	0.1	0.2	94.9	93.3	1.57
Trongtoe Tfr	0.009	0.006	-0.009	-0.006	0.1	0.2	94.9	93.2	1.66
Tshochan Tfr	0.005	0.003	-0.004	-0.003	0.0	0.0	99.6	98.9	0.65
Tsholing Tfr	0.007	0.004	-0.007	-0.004	0.1	0.1	95.1	93.9	1.21
U.Dangling Tfr	0.002	0.001	-0.002	-0.001	0.0	0.0	97.7	97.4	0.34
U.Domkhar Tfr	0.011	0.007	-0.011	-0.007	0.1	0.1	99.5	98.7	0.75
U.Jalang Tfr	0.020	0.013	-0.020	-0.012	0.5	0.8	97.5	93.9	3.60
U.Pangkhar Tfr	0.011	0.007	-0.011	-0.007	0.2	0.2	95.5	93.6	1.94
U.Serphu Tfr	0.005	0.003	-0.005	-0.003	0.0	0.0	95.5	94.7	0.82
U.Shawa Tfr	0.008	0.005	-0.008	-0.005	0.1	0.1	95.1	93.6	1.47
U.Wambur Tfr	0.016	0.010	-0.016	-0.010	0.1	0.2	99.6	98.5	1.11
U.Zhungkhar Tfr	-0.010	-0.006	0.010	0.007	0.1	0.2	95.8	97.7	1.85
Wambrang Tfr	0.017	0.011	-0.016	-0.010	0.4	0.6	93.4	90.2	3.14
Wangzhing Tfr	0.017	0.010	-0.016	-0.010	0.1	0.2	97.6	96.5	1.16

Branch ID	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
Wayway Tfr	0.011	0.007	-0.011	-0.007	0.3	0.4	93.5	90.3	3.17
Yabee Tfr	0.015	0.010	-0.015	-0.009	0.2	0.4	99.6	97.4	2.18
Yongbaling Tfr	0.005	0.003	-0.005	-0.003	0.1	0.1	95.2	93.7	1.43
Youdra Tfr	0.007	0.005	-0.007	-0.005	0.1	0.1	95.4	94.1	1.35
Zamling Tfr	0.011	0.007	-0.011	-0.007	0.1	0.1	94.7	93.9	0.81
Zham Tfr	-0.005	-0.003	0.005	0.003	0.0	0.1	96.6	97.6	0.93
					78.3	-35.0			

Alert Summary Report

	% Alert Settings	
	Critical	**Marginal**
Loading		
Bus	100.0	95.0
Cable	100.0	95.0
Reactor	100.0	95.0
Line	100.0	95.0
Transformer	100.0	95.0
Panel	100.0	95.0
Protective Device	100.0	95.0
Generator	100.0	95.0
Inverter/Charger	100.0	95.0
Bus Voltage		
OverVoltage	110.0	105.0
UnderVoltage	90.0	95.0
Generator Excitation		
OverExcited (Q Max.)	100.0	95.0
UnderExcited (Q Min.)		

Critical Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
Ambrangchu B2	Bus	Under Voltage	0.415	kV	0.373	90.0	3-Phase
Ambrangchu Tfr	Transformer	Overload	0.025	MVA	0.05	185.4	3-Phase
Chengling Tfr	Transformer	Overload	0.025	MVA	0.05	181.0	3-Phase
Gangzur MHPP	Generator	Overload	0.120	MW	0.25	209.1	3-Phase
Khoma Sch. B2	Bus	Under Voltage	0.415	kV	0.37	89.8	3-Phase
Khoma Sch. Tfr	Transformer	Overload	0.016	MVA	0.02	151.7	3-Phase
Namgong Tfr	Transformer	Overload	0.025	MVA	0.03	103.5	3-Phase
NHDC Tfr	Transformer	Overload	0.063	MVA	0.09	142.3	3-Phase
Rongchu MHPP	Generator	Overload	0.200	MW	0.35	174.0	3-Phase
Rongchu MHPP Tfr	Transformer	Overload	0.315	MVA	0.40	125.9	3-Phase
Tongkla Tfr	Transformer	Overload	0.063	MVA	0.07	104.4	3-Phase

Marginal Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
Baptong B2	Bus	Under Voltage	0.415	kV	0.391	94.2	3-Phase

Marginal Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
Berpa B2	Bus	Under Voltage	0.415	kV	0.387	93.4	3-Phase
Bragong B1	Bus	Under Voltage	0.415	kV	0.39	93.9	3-Phase
Chazam B1	Bus	Under Voltage	11.000	kV	10.28	93.4	3-Phase
Chazam B2	Bus	Under Voltage	0.415	kV	0.38	90.7	3-Phase
Chengling B2	Bus	Under Voltage	0.415	kV	0.37	90.1	3-Phase
Churbe B2	Bus	Under Voltage	0.415	kV	0.39	94.5	3-Phase
Dakten B2	Bus	Under Voltage	0.415	kV	0.39	93.2	3-Phase
Depteng B1	Bus	Under Voltage	11.000	kV	10.44	94.9	3-Phase
Depteng B2	Bus	Under Voltage	0.415	kV	0.39	93.9	3-Phase
Drabling B1	Bus	Under Voltage	11.000	kV	10.27	93.4	3-Phase
Drabling B2	Bus	Under Voltage	0.415	kV	0.38	91.2	3-Phase
Dungkhar B1	Bus	Under Voltage	11.000	kV	10.31	93.7	3-Phase
Dungkhar B2	Bus	Under Voltage	0.415	kV	0.38	92.0	3-Phase
Dzong B2	Bus	Under Voltage	0.415	kV	0.39	95.0	3-Phase
Gangla B2	Bus	Under Voltage	0.415	kV	0.39	94.2	3-Phase
Gangzur B2	Bus	Under Voltage	0.415	kV	0.39	93.8	3-Phase
Gpa Kap B2	Bus	Under Voltage	0.415	kV	0.39	94.2	3-Phase
Gwog CD B1	Bus	Under Voltage	11.000	kV	10.30	93.7	3-Phase
Gwog CD B2	Bus	Under Voltage	0.415	kV	0.38	92.2	3-Phase
Jalamzum B2	Bus	Under Voltage	0.415	kV	0.39	93.7	3-Phase
Jasabe B1	Bus	Under Voltage	11.000	kV	10.31	93.7	3-Phase
Jasabe B2	Bus	Under Voltage	0.415	kV	0.38	92.5	3-Phase
Jcholing B2	Bus	Under Voltage	0.415	kV	0.39	94.6	3-Phase
Kchung B1	Bus	Under Voltage	11.000	kV	10.42	94.8	3-Phase
Kchung B2	Bus	Under Voltage	0.415	kV	0.38	91.8	3-Phase
Kemtshong B2	Bus	Under Voltage	0.415	kV	0.38	92.5	3-Phase
Khema B2	Bus	Under Voltage	0.415	kV	0.39	94.2	3-Phase
Khoma B2	Bus	Under Voltage	0.415	kV	0.39	92.8	3-Phase
Khomadung B2	Bus	Under Voltage	0.415	kV	0.39	93.9	3-Phase
Khomagang B2	Bus	Under Voltage	0.415	kV	0.39	93.3	3-Phase
Kilung B2	Bus	Under Voltage	0.415	kV	0.39	93.9	3-Phase
L.Jalang B1	Bus	Under Voltage	0.415	kV	0.39	94.6	3-Phase
L.Pangkhar B2	Bus	Under Voltage	0.415	kV	0.39	93.1	3-Phase
L.Serphu B2	Bus	Under Voltage	0.415	kV	0.39	93.4	3-Phase
L.Shawa B2	Bus	Under Voltage	0.415	kV	0.38	92.2	3-Phase
Lawa B2	Bus	Under Voltage	0.415	kV	0.39	94.8	3-Phase

Marginal Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
LHS B2	Bus	Under Voltage	0.415	kV	0.393	94.8	3-Phase
Lingabe B2	Bus	Under Voltage	0.415	kV	0.39	94.6	3-Phase
Lukchu b2	Bus	Under Voltage	0.415	kV	0.39	94.9	3-Phase
Namgong B2	Bus	Under Voltage	0.415	kV	0.38	91.7	3-Phase
Naray B1	Bus	Under Voltage	11.000	kV	10.28	93.5	3-Phase
Naray B2	Bus	Under Voltage	0.415	kV	0.38	92.5	3-Phase
Ney Zhisar B1	Bus	Under Voltage	11.000	kV	10.43	94.9	3-Phase
Ney Zhisar B2	Bus	Under Voltage	0.415	kV	0.39	94.1	3-Phase
Ngalamd B2	Bus	Under Voltage	0.415	kV	0.39	93.8	3-Phase
Ngar B2	Bus	Under Voltage	0.415	kV	0.39	94.6	3-Phase
NHDC B2	Bus	Under Voltage	0.415	kV	0.38	91.1	3-Phase
Nimshong B2	Bus	Under Voltage	0.415	kV	0.39	94.7	3-Phase
OldL.23	Bus	Under Voltage	11.000	kV	10.44	94.9	3-Phase
OldL.24	Bus	Under Voltage	11.000	kV	10.44	94.9	3-Phase
OldL.25	Bus	Under Voltage	11.000	kV	10.44	94.9	3-Phase
OldL.28	Bus	Under Voltage	11.000	kV	10.43	94.8	3-Phase
OldL.29	Bus	Under Voltage	11.000	kV	10.31	93.8	3-Phase
OldL.30	Bus	Under Voltage	11.000	kV	10.30	93.7	3-Phase
OldL.31	Bus	Under Voltage	11.000	kV	10.30	93.6	3-Phase
OldL.32	Bus	Under Voltage	11.000	kV	10.29	93.5	3-Phase
OldL.33	Bus	Under Voltage	11.000	kV	10.28	93.5	3-Phase
OldL.34	Bus	Under Voltage	11.000	kV	10.28	93.4	3-Phase
OldL.35	Bus	Under Voltage	11.000	kV	10.27	93.4	3-Phase
OldL.36	Bus	Under Voltage	11.000	kV	10.27	93.4	3-Phase
Rongchu B2	Bus	Under Voltage	0.415	kV	0.39	93.2	3-Phase
Samling B2	Bus	Under Voltage	0.415	kV	0.39	92.9	3-Phase
Semchebe B2	Bus	Under Voltage	0.415	kV	0.39	94.1	3-Phase
Sershong B1	Bus	Under Voltage	11.000	kV	10.30	93.6	3-Phase
Sershong B2	Bus	Under Voltage	0.415	kV	0.38	92.2	3-Phase
Shangbe B1	Bus	Under Voltage	11.000	kV	10.44	94.9	3-Phase
Shangbe B2	Bus	Under Voltage	0.415	kV	0.38	92.6	3-Phase
Somshing B2	Bus	Under Voltage	0.415	kV	0.39	93.5	3-Phase
Soshong B1	Bus	Under Voltage	11.000	kV	10.29	93.5	3-Phase
Soshong B2	Bus	Under Voltage	0.415	kV	0.38	91.1	3-Phase
Sungbe B1	Bus	Under Voltage	11.000	kV	10.31	93.7	3-Phase
Sungbe B2	Bus	Under Voltage	0.415	kV	0.39	93.0	3-Phase

Marginal Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
Tabee B1	Bus	Under Voltage	11.000	kV	10.329	93.9	3-Phase
Tabee B2	Bus	Under Voltage	0.415	kV	0.38	90.8	3-Phase
Tangbe B1	Bus	Under Voltage	11.000	kV	10.28	93.4	3-Phase
Tangbe B2	Bus	Under Voltage	0.415	kV	0.38	92.0	3-Phase
Tangrung B1	Bus	Under Voltage	11.000	kV	10.30	93.6	3-Phase
Tangrung B2	Bus	Under Voltage	0.415	kV	0.38	92.3	3-Phase
Thrima B2	Bus	Under Voltage	0.415	kV	0.39	94.1	3-Phase
Thuenpee B1	Bus	Under Voltage	11.000	kV	10.29	93.6	3-Phase
Thuenpee B2	Bus	Under Voltage	0.415	kV	0.38	92.4	3-Phase
Tongkla B2	Bus	Under Voltage	0.415	kV	0.38	92.5	3-Phase
Tongling B2	Bus	Under Voltage	0.415	kV	0.39	93.6	3-Phase
Trongmey B1	Bus	Under Voltage	11.000	kV	10.44	94.9	3-Phase
Trongmey B2	Bus	Under Voltage	0.415	kV	0.39	93.3	3-Phase
Trongtoe B1	Bus	Under Voltage	11.000	kV	10.44	94.9	3-Phase
Trongtoe B2	Bus	Under Voltage	0.415	kV	0.39	93.2	3-Phase
Tsholing B2	Bus	Under Voltage	0.415	kV	0.39	93.9	3-Phase
U.Jalang B2	Bus	Under Voltage	0.415	kV	0.39	93.9	3-Phase
U.Jalang Tfr	Transformer	Overload	0.025	MVA	0.02	95.9	3-Phase
U.Pangkhar B2	Bus	Under Voltage	0.415	kV	0.39	93.6	3-Phase
U.Serphu B2	Bus	Under Voltage	0.415	kV	0.39	94.7	3-Phase
U.Shawa B2	Bus	Under Voltage	0.415	kV	0.39	93.6	3-Phase
Wambrang B1	Bus	Under Voltage	11.000	kV	10.27	93.4	3-Phase
Wambrang B2	Bus	Under Voltage	0.415	kV	0.37	90.2	3-Phase
Wayway B1	Bus	Under Voltage	11.000	kV	10.28	93.5	3-Phase
Wayway B2	Bus	Under Voltage	0.415	kV	0.37	90.3	3-Phase
Yongbaling B2	Bus	Under Voltage	0.415	kV	0.39	93.7	3-Phase
Youdra B2	Bus	Under Voltage	0.415	kV	0.39	94.1	3-Phase
Zamling B1	Bus	Under Voltage	11.000	kV	10.42	94.7	3-Phase
Zamling B2	Bus	Under Voltage	0.415	kV	0.39	93.9	3-Phase

SUMMARY OF TOTAL GENERATION , LOADING & DEMAND

	MW	Mvar	MVA	% PF
Source (Swing Buses):	2.277	1.328	2.636	86.39 Lagging
Source (Non-Swing Buses):	0.000	0.000	0.000	
Total Demand:	2.277	1.328	2.636	86.39 Lagging
Total Motor Load:	0.477	0.296	0.562	85.00 Lagging
Total Static Load:	1.722	1.067	2.025	85.00 Lagging
Total Constant I Load:	0.000	0.000	0.000	
Total Generic Load:	0.000	0.000	0.000	
Apparent Losses:	0.078	-0.035		
System Mismatch:	0.000	0.000		

Number of Iterations: 3

Annexure 5: Feeder Wise Reliability Indices

Feeder Wise Reliability Indices

Sl.No.	Year	Reliability Indices	33kV Gorgan Feeder	11 kV Lhuentse I Feeder	11 kV Tangmachhu Feeder	11 kV Minjey Feeder	11 kV Lhuentse II Feeder
1	2017	SAIFI	0.62	1.4	0.14	0	0
		SAIDI	0.490	3.576	0.27	0	0
2	2018	SAIFI	0.3	0.11	0.970	0.27	0
		SAIDI	0.16	0.01	0	0.43	0
3	2019	SAIFI	0.330	3.22	0	0.09	0.04
		SAIDI	0.170	12.27	0.135	0.014	6.85
	Total *	**SAIFI**	**1.250**	**4.730**	**1.110**	**0.360**	**0.040**
		SAIDI	**0.820**	**15.856**	**0.405**	**0.444**	**6.850**
Average Reliability Indices			**SAIFI**	**1.498**		**SAIDI**	**4.875**

Annexure 6: Material Cost for Upgrading single phase (11 kV and 33 kV) Lines to three-phase

Sl. No	Name of ESDs	Total Cost in Nu. For upgradation of Line to 3Φ from 1Φ		Total cost in Nu.
		11 kV Line in Km	33 kV Line in Km	
		Cost in Nu.	Cost in Nu.	
1	Bumthang	604,083.80	626,364.17	1,230,447.97
2	Chukhha	1,372,746.06	6,450,371.80	7,823,117.86
3	Dagana	–	2,495,645.61	2,495,645.61
4	Haa	–	341,755.04	341,755.04
5	Lhuntse	1,648,680.77	6,292,698.01	7,941,378.78
6	Mongar	–	–	–
7	Paro	1,576,599.08	1,663,407.47	3,240,006.55
8	Pemagatshel	–	2,467,625.51	2,467,625.51
9	Punakha	612,259.13	8,183,731.48	8,795,990.60
10	S/Jongkhar	–	7,593,301.40	7,593,301.40
11	Samtse	2,031,083.74	536,799.03	2,567,882.76
12	Sarpang	756,490.07	1,112,902.61	1,869,392.68
13	Trashi Gang	251,649.96	626,304.45	877,954.41
14	Trashiyangtse		2,207,281.49	2,207,281.49
15	Thimphu	5,228,316.74	-	5,228,316.74
16	Trongsa	–	651,860.25	651,860.25
17	Tsirang	–	1,693,286.88	1,693,286.88
18	Wangdue	98,146.90	3,133,078.14	3,231,225.04
19	Zhemgang	–	5,303,863.16	5,303,863.16
	TOTAL	**14,180,056.24**	**51,380,276.50**	**65,560,332.75**

The cost of extending one phase in case of ACSR conductor and AAAC covered conductor were considered and incase of HV ABC, the cost of constructing three core cable has been considered in estimation. Above estimation indicates the total material cost involved in upgrading the existing single phase line to three phase under each ESD.

The total cost including material cost (Nu. 65 million), transportation cost (Nu. 3.47 million) and labor cost (Nu. 28 million) will amount to Nu. 97 million.

11 kV and 33 kV Single Phase Line Length in km under each ESD

Sl. No	Name of ESDs	11kV 1Φ Line (km)	33kV 1Φ Line (km)	Total 1Φ Line (km)
1	Bumthang	6.96276	5.6246	12.58736
2	Chukhha	21.569	78.274	99.843
3	Dagana	0	30.527	30.527
4	Haa	0	4.391	4.391
5	Lhuntse	18.7075	80.851	99.5585
6	Mongar	0	0	0
7	Paro	24.772	14.937	39.709
8	Pemagatshel	0	31.705	31.705
9	Punakha	9.62	58.4	68.02
10	S/Jongkhar	0	93.672	93.672
11	Samtse	31.913	6.897	38.81
12	Sarpang	11.8862	14.299	26.1852
13	Trashigang	3.954	8.047	12.001
14	Trashiyangtse	0	28.36	28.36
15	Thimphu	5.93	0	5.93
16	Trongsa	0	5.383	5.383
17	Tsirang	0	21.756	21.756
18	Wangdue	1.01	29.7	30.71
19	Zhemgang	0	66.785	66.785
TOTAL		**136.32446**	**579.6086**	**715.93306**

Annexure 7: Distribution Transformer Loading

Lhuentse Transformer Loading Details

Sl.No.	Name of Feeder	DT Location Name	Transformer Ratio	Transformer Details				Peak Load (kVA)**		2025		2030	
				kVA	Installed Yr/MFD*	Serial Number	Trans ID	2019-2020	% loading	KVA	% loading	KVA	% loading
										785.88		**838.82**	
										0.39		**0.48**	
										1.39		**1.48**	
1	33kV Gorgan Feeder	Brick Factory	33/0.415kV	63	2013	2772-4	LHE90T57	8.74	13.87%	12.15	19.28%	12.96	20.58%
2	33kV Gorgan Feeder	Jachung SS	33/0.230kV	16	2007	13427	LHE90T11	0.47	2.92%	0.65	4.06%	0.69	4.33%
3	33kV Gorgan Feeder	Fawan SS	33/0.415kV	63	2006	29244	LHE90T10	12.36	19.61%	17.17	27.25%	18.33	29.09%
4	33kV Gorgan Feeder	Upper Domkhar SS	33/0.415kV	63	2005	29232	LHE90T8	8.34	13.23%	11.58	18.39%	12.36	19.63%
5	33kV Gorgan Feeder	Lower Domkhar SS	33/0.415kV	63	2006	29238	LHE90T9	7.63	12.11%	10.60	16.82%	11.31	17.96%
6	33kV Gorgan Feeder	Lower Wambur vill. SS	33/0.415kV	63	2006	29241	LHE90T2	9.97	15.83%	13.86	22.00%	14.79	23.48%
7	33kV Gorgan Feeder	Upper Wambur SS	33/0.415kV	63	2006	29240	LHE90T1	12.40	19.69%	17.24	27.36%	18.40	29.20%
8	33kV Gorgan Feeder	Dagathang SS	33/0.415kV	30	2006	29184	LHE90T5	6.99	23.30%	9.71	32.38%	10.37	34.56%
9	33kV Gorgan Feeder	Laghel vill. SS	33/0.415kV	30	2006	29228	LHE90T7	5.98	19.94%	8.31	27.71%	8.87	29.58%
10	33kV Gorgan Feeder	Kiphu vill.SS	33/0.415kV	30	2006	29210	LHE90T6	4.18	13.93%	5.81	19.36%	6.20	20.66%
11	33kV Gorgan Feeder	Namdroling Gonpa SS	33/0.415kV	63	2010	12306	LHE90T55	32.90	52.22%	45.72	72.57%	48.80	77.45%
12	33kV Gorgan Feeder	Autsho School SS	33/0.415kV	125	2009	10630	LHE90T56	57.85	46.28%	80.39	64.32%	85.81	68.65%
13	33kV Gorgan Feeder	Gorgan SS	33/0.415kV	63	2006	29236	LHE80T1	4.48	7.11%	6.23	9.89%	6.65	10.55%
14	33kV Gorgan Feeder	Autsho Bazzar	33/0.415kV	250	2009	10467	LHE90T12	81.98	32.79%	113.92	45.57%	121.59	48.64%
15	33kV Gorgan Feeder	Dorshong Goenpa	33/0.415kV	125	2005	29163	LHE90t59	63.00	50.40%	87.54	70.04%	93.44	74.75%
16	33kV Gorgan Feeder	Zangkhar SS	33/0.415kV	30	2006	29187	LHE90T62	3.26	10.86%	4.53	15.09%	4.83	16.10%
17	33kV Gorgan Feeder	Yabee village SS	33/0.415kV	30	2006	29208	LHE90T63	11.63	38.77%	16.16	53.87%	17.25	57.50%
18	33kV Gorgan Feeder	Changkhala vill. SS	33/0.415kV	30	2006	29198	LHE90T64	12.80	42.66%	17.79	59.28%	18.98	63.28%
19	33kV Gorgan Feeder	Yumchen-I	33/0.240kV	25	2009	9112727	LHE90T23	4.78	19.14%	6.65	26.59%	7.10	28.38%
20	33kV Gorgan Feeder	Yumchen-II	33/0.240kV	25	2009	9112734	LHE90T22	3.11	12.42%	4.31	17.26%	4.61	18.42%
21	33kV Gorgan Feeder	Lower Ladrong/Nakstang pang	33/0.240kV	25	2009	9112686	LHE90T19	3.24	12.97%	4.51	18.03%	4.81	19.24%
22	33kV Gorgan Feeder	Ladrong school	33/0.240kV	25	2009	9112710	LHE90T18	0.74	2.94%	1.02	4.09%	1.09	4.37%
23	33kV Gorgan Feeder	Ngangay-Lower	33/0.240kV	25	2009	9112717	LHE90T17	0.60	2.39%	0.83	3.32%	0.89	3.55%
24	33kV Gorgan Feeder	Ngangay-Upper	33/0.240kV	25	2009	9112673	LHE90T27	3.45	13.80%	4.79	19.18%	5.12	20.47%
25	33kV Gorgan Feeder	Jabum	33/0.240kV	16	2009	9112215	LHE90T29	1.77	11.07%	2.46	15.38%	2.63	16.42%
26	33kV Gorgan Feeder	Jarey	33/0.240kV	25	2009	9112713	LHE90T30	1.82	7.27%	2.52	10.10%	2.69	10.78%
27	33kV Gorgan Feeder	Chatrong	33/0.240kV	16	2009	9112209	LHE90T28	0.25	1.58%	0.35	2.20%	0.38	2.35%
28	33kV Gorgan Feeder	Trashiling/Kiranaki	33/0.240kV	25	2009	9112800	LHE90T31	2.42	9.66%	3.36	13.42%	3.58	14.33%
29	33kV Gorgan Feeder	Upper Ladrong/Dowarimung	33/0.240kV	25	2009	9112756	LHE90T20	1.24	4.97%	1.73	6.90%	1.84	7.37%
30	33kV Gorgan Feeder	Middle Ladrong/ Jaibrangto	33/0.240kV	25	2009	9112785	LHE90T21	1.45	5.80%	2.01	8.05%	2.15	8.60%
31	33kV Gorgan Feeder	Pam-Lower	33/0.240kV	16	2009	9112213	LHE90T24	0.55	3.45%	0.77	4.79%	0.82	5.12%
32	33kV Gorgan Feeder	Pam-Upper	33/0.240kV	25	2009	9112752	LHE90T25	0.78	3.13%	1.09	4.35%	1.16	4.64%
33	33kV Gorgan Feeder	Yeedang	33/0.240kV	16	2009	9112196	LHE90T26	0.60	3.74%	0.83	5.19%	0.89	5.54%
34	33kV Gorgan Feeder	Trintashing	33/0.230kV	10	2009	9112206	LHE90T58	0.53	5.29%	0.74	7.35%	0.78	7.85%
35	33kV Gorgan Feeder	Nabar	33/0.230kV	16	2011	NA	LHE90T89	0.99	6.18%	1.37	8.59%	1.47	9.17%
36	33kV Gorgan Feeder	Khuling	33/0.230kV	16				2.07	12.94%	2.88	17.98%	3.07	19.19%
37	33kV Gorgan Feeder	Ganglapong School	33/0.230kV	16				2.88	17.97%	4.00	24.97%	4.26	26.65%

38	33kV Gorgan Feeder	Goenpa Ganglapong	33/0.230kV	16				1.36	8.48%	1.89	11.79%	2.01	12.58%
39	33kV Gorgan Feeder	Darshaling	33/0.230kV	16				2.35	14.66%	3.26	20.37%	3.48	21.75%
40	33kV Gorgan Feeder	Koraychu	33/0.230kV	16				2.94	18.40%	4.09	25.57%	4.37	27.29%
41	33kV Gorgan Feeder	Shokshaling	33/0.230kV	16				2.69	16.82%	3.74	23.37%	3.99	24.95%
42	33kV Gorgan Feeder	Tongthrong	33/0.240kV	25	2009	9112287	LHE90T73	1.43	5.73%	1.99	7.96%	2.13	8.50%
43	33kV Gorgan Feeder	Gortshum village	33/0.240kV	25	2009	9112763	LHE90T79	5.93	23.72%	8.24	32.96%	8.79	35.18%
44	33kV Gorgan Feeder	Gortshum school	33/0.240kV	25	2009	9112690	LHE90T78	5.75	22.98%	7.98	31.94%	8.52	34.09%
45	33kV Gorgan Feeder	Janachen/Tshathomay/W aney	33/0.240kV	25	2009	9112777	LHE90T80	3.04	12.14%	4.22	16.88%	4.50	18.01%
46	33kV Gorgan Feeder	Gongdhar	33/0.240kV	16	2009	9112192	LHE90T81	1.45	9.06%	2.01	12.58%	2.15	13.43%
47	33kV Gorgan Feeder	Gulipang/Tongzibi	33/0.240kV	25	2009	9112308	LHE90T82	4.21	16.84%	5.85	23.40%	6.24	24.97%
48	33kV Gorgan Feeder	Drukla	33/0.240kV	16	2009	9112243	LHE90T83	1.40	8.77%	1.95	12.19%	2.08	13.01%
49	33kV Gorgan Feeder	Ongar/Zowabi	33/0.240kV	16	2009	9112272	LHE90T84	1.29	8.05%	1.79	11.19%	1.91	11.94%
50	33kV Gorgan Feeder	Tsendenshing/ Ongar school	33/0.240kV	25	2009	9112770	LHE90T85	3.02	12.06%	4.19	16.76%	4.47	17.89%
51	33kV Gorgan Feeder	Ongar Lhakhang	33/0.240kV	25	2009	9112784	LHE90T86	2.11	8.44%	2.93	11.72%	3.13	12.51%
52	33kV Gorgan Feeder	Ongar/ Thaptshang	33/0.240kV	25	2009	9112295	LHE90T87	1.40	5.61%	1.95	7.80%	2.08	8.32%
53	33kV Gorgan Feeder	Obee	33/0.240kV	25	2009	9112286	LHE90T70	1.90	7.62%	2.65	10.59%	2.82	11.30%
54	33kV Gorgan Feeder	Pangshingmay	33/0.240kV	16	2009	9112257	LHE90T71	1.04	6.48%	1.44	9.01%	1.54	9.62%
55	33kV Gorgan Feeder	Khanapang/New gup office/Dulabee	33/0.240kV	25	2009	9112712	LHE90T74	2.53	10.10%	3.51	14.04%	3.75	14.98%
56	33kV Gorgan Feeder	Pelphu Goenpa	33/0.240kV	16	2009	9112273	LHE90T69	0.97	6.04%	1.34	8.39%	1.43	8.95%
57	33kV Gorgan Feeder	Shongmay Lower	33/0.240kV	25	2009	9112280	LHE90T67	2.30	9.18%	3.19	12.76%	3.40	13.62%
58	33kV Gorgan Feeder	Shongmay upper	33/0.240kV	16	2009	9112263	LHE90T68	1.87	11.67%	2.60	16.22%	2.77	17.31%
59	33kV Gorgan Feeder	Yurung	33/0.240kV	25	2009	9112719	LHE90T66	1.89	7.55%	2.62	10.50%	2.80	11.20%
60	33kV Gorgan Feeder	Bamdhir	33/0.240kV	25	2009	9112759	LHE90T65	1.89	7.57%	2.63	10.52%	2.81	11.23%
61	33kV Gorgan Feeder	Changshingpokpa/Mangd hir	33/0.240kV	25	2009	9112780	LHE90T77	4.00	16.00%	5.56	22.23%	5.93	23.73%
62	33kV Gorgan Feeder	Karma Demo/Mukpakhar	33/0.240kV	25	2009	9112729	LHE90T76	1.43	5.73%	1.99	7.96%	2.13	8.50%
63	33kV Gorgan Feeder	Yokpaling/Balam	33/0.240kV	25	2009	9112679	LHE90T72	1.51	6.04%	2.10	8.39%	2.24	8.95%
64	33kV Gorgan Feeder	Singaybee	33/0.240kV	25	2009	9112683	LHE90T75	1.89	7.57%	2.63	10.52%	2.81	11.23%
65	33kV Gorgan Feeder	Tshochen vill. SS	33/0.415kV	30	2006	29229	LHE90T61	3.43	11.45%	4.77	15.91%	5.09	16.98%
66	33kV Gorgan Feeder	Pelphu Tsamkhang	33/0.240kV	25	2009	9112735		4.78	19.13%	6.64	26.58%	7.09	28.37%
67	33kV Gorgan Feeder	Sethsham Diary Farm	33/0.415kV	30	2009	72335	LHE90T88	4.98	16.61%	6.93	23.09%	7.39	24.64%
68	33kV Gorgan Feeder	Bangtsho	33/0.240kV	25	2009	9112796	LHE90T51	5.58	22.34%	7.76	31.04%	8.28	33.13%
69	33kV Gorgan Feeder	Umling	33/0.240kV	25	2009	9112721	LHE90T49	4.35	17.39%	6.04	24.16%	6.45	25.79%
70	33kV Gorgan Feeder	Dongphu	33/0.240kV	16	2009	9112204	LHE90T50	0.76	4.74%	1.05	6.59%	1.13	7.04%
71	33kV Gorgan Feeder	Tongphugang-Lower	33/0.240kV	16	2009	9112199	LHE90T32	1.17	7.30%	1.62	10.15%	1.73	10.83%
72	33kV Gorgan Feeder	Tongphugang-Upper	33/0.240kV	10	2009	9112140	LHE90T33	0.93	9.34%	1.30	12.98%	1.39	13.85%
73	33kV Gorgan Feeder	Takchu	33/0.240kV	25	2009	9112788	LHE90T38	2.96	11.84%	4.11	16.45%	4.39	17.56%
74	33kV Gorgan Feeder	Gamanang	33/0.240kV	25	2009	9112285	LHE90T39	2.38	9.52%	3.31	13.23%	3.53	14.12%
75	33kV Gorgan Feeder	Phurtshogang	33/0.240kV	25	2009	9112791	LHE90T40	3.01	12.04%	4.18	16.73%	4.47	17.86%
76	33kV Gorgan Feeder	Chowa	33/0.240kV	25	2009	9112714	LHE90T41	1.63	6.52%	2.27	9.06%	2.42	9.67%
77	33kV Gorgan Feeder	Tshochen School Area	33/0.240kV	25	2009	9112749	LHE90T42	3.01	12.02%	4.18	16.71%	4.46	17.83%
78	33kV Gorgan Feeder	Ngathun	33/0.240kV	25	2009	9112703	LHE90T45	1.85	7.41%	2.57	10.29%	2.75	10.98%
79	33kV Gorgan Feeder	Kharphu-Lower	33/0.240kV	25	2009	9112726	LHE90T46	2.78	11.11%	3.86	15.44%	4.12	16.48%
80	33kV Gorgan Feeder	Kharphu-Upper	33/0.240kV	25	2009	9112758	LHE90T47	3.24	12.94%	4.50	17.99%	4.80	19.20%
81	33kV Gorgan Feeder	Gordung/Barchu	33/0.240kV	25	2009	9112745	LHE90T43	1.63	6.51%	2.26	9.05%	2.42	9.66%

82	33kV Gorgan Feeder	Tsangphu	33/0.240kV	25	2009	9112760	LHE90T44	2.77	11.10%	3.85	15.42%	4.11	16.46%
83	33kV Gorgan Feeder	Chabee/Tshokeygang	33/0.240kV	25	2009	9112751	LHE90T35	2.54	10.18%	3.53	14.14%	3.77	15.09%
84	33kV Gorgan Feeder	Chulung/Garstang	33/0.240kV	16	2009	10866	LHE90T37	1.23	7.68%	1.71	10.67%	1.82	11.39%
85	33kV Gorgan Feeder	Toktselung	33/0.240kV	16	2009	9112188	LHE90T34	0.93	5.81%	1.29	8.07%	1.38	8.61%
86	33kV Gorgan Feeder	Kilam/Kawachen	33/0.240kV	16	2009	9112203	LHE90T36	0.98	6.14%	1.36	8.53%	1.46	9.10%
87	33kV Gorgan Feeder	Kawachen/Ngadenshong/ Changchang	33/0.240kV	16	2009	9112193	LHE90T48	0.92	5.78%	1.28	8.03%	1.37	8.57%
88	33kV Gorgan Feeder	Yangla-Lower	33/0.240kV	16	2009	9112190	LHE90T14	2.09	13.04%	2.90	18.12%	3.09	19.34%
89	33kV Gorgan Feeder	Yangla-Upper	33/0.240kV	25	2009	9112728	LHE90T15	1.86	7.44%	2.59	10.34%	2.76	11.04%
90	33kV Gorgan Feeder	Peldraphu	33/0.240kV	25	2009	9112783	LHE90T13	3.72	14.89%	5.17	20.68%	5.52	22.08%
91	33kV Gorgan Feeder	Rashingbee	33/0.240kV	16	2009	9112712	LHE90T16	0.71	4.41%	0.98	6.13%	1.05	6.55%
92	33kV Gorgan Feeder	Phawantoe/Dekaling/Tad ogang	33/0.230kV	25	2009	9112909	LHE90T52	1.17	4.68%	1.63	6.51%	1.74	6.95%
93	33kV Gorgan Feeder	Phomeydung/Toekhar	33/0.230kV	16	2011	9112218	LHE90T53	1.16	7.23%	1.61	10.05%	1.72	10.72%
94	33kV Gorgan Feeder	Dramthang Goenpa	33/0.230kV	16	2011	201116331 3401	LHE90T54	2.84	17.75%	3.95	24.67%	4.21	26.33%
95	33kV Gorgan Feeder	Dragmar Water Processing Unit	33/0.415kV	63	2006	30490	LHE90T90	25.08	39.81%	34.85	55.32%	37.20	59.05%
96	33kV Gorgan Feeder	Budhur	33/.415kVA	63	NA	NA	LHE90T3	15.02	23.85%	20.88	33.14%	22.28	35.37%
97	33kV Gorgan Feeder	Kupenasa	33/.415kVA	63	2006	29234	LHE90T4	12.26	19.46%	17.04	27.04%	18.18	28.86%
								565.55					
										1038.20		**1398.8**	
										0.37		**0.85**	
										1.37		**1.85**	
1	11kV Tangmachu Feeder	Shungkhar Upper	11/0.415kV	16	2009	9132402	LHE20T12	5.57	34.79%	7.64	47.77%	10.30	64.36%
2	11kV Tangmachu Feeder	Shungkhar Lower	11/0.415kV	25	2009	9132481	LHE20T9	5.54	22.17%	7.61	30.45%	10.26	41.02%
3	11kV Tangmachu Feeder	Shungkhar Middle	11/0.415kV	25	2009	9132454	LHE20T11	4.51	18.03%	6.19	24.76%	8.34	33.36%
4	11kV Tangmachu Feeder	Pam	11/0.415kV	25	2009	9132470	LHE20T10	1.70	6.81%	2.34	9.35%	3.15	12.60%
5	11kV Tangmachu Feeder	Dangling Upper	11/0.415kV	16	2009	BC/16/07	LHE20T13	1.01	6.33%	1.39	8.69%	1.87	11.70%
6	11kV Tangmachu Feeder	Dangling Lower	11/0.415kV	25	2009	9132487	LHE20T14	4.30	17.20%	5.91	23.62%	7.96	31.83%
7	11kV Tangmachu Feeder	Yomay/Narwangbi/Tsetse bu Goenpa	11/0.415kV	16	2009	9112391	LHE20T18	0.71	4.46%	0.98	6.12%	1.32	8.24%
8	11kV Tangmachu Feeder	Rawabi A	11/0.415kV	25	2009	9132444	LHE20T16	4.99	19.96%	6.85	27.41%	9.23	36.94%
9	11kV Tangmachu Feeder	Rawabi B	11/0.415kV	25	2009	9132489	LHE20T15	3.57	14.26%	4.90	19.58%	6.60	26.38%
10	11kV Tangmachu Feeder	Rawabi C	11/0.415kV	25	2009	9132550	LHE20T17	2.21	8.83%	3.03	12.13%	4.09	16.34%
11	11kV Tangmachu Feeder	Naybee SS	11/0.415 kV	63	2006	29024	LHE20T5	19.62	31.14%	26.94	42.76%	36.30	57.61%
12	11kV Tangmachu Feeder	Manjabee SS	11/0.415 kV	63	2006	29065	LHE20T6	4.37	6.94%	6.00	9.52%	8.08	12.83%
13	11kV Tangmachu Feeder	Takila SS	11/0.415 kV	250	2013	11/1335	LHE20T7	22.60	9.04%	31.04	12.41%	41.82	16.73%
14	11kV Tangmachu Feeder	Takila SS	11/0.415 kV	315	2010	12291	LHE20T8	6.97	2.21%	9.57	3.04%	12.89	4.09%
15	11kV Tangmachu Feeder	Kamdhar	11/0.415 kV	63	2003	TCB03-27/500	LHE20T4	25.31	40.18%	34.76	55.17%	46.83	74.34%
16	11kV Tangmachu Feeder	Tangmachu School SS	11/0.415 kV	63	2011	6065	LHE20T3	28.82	45.75%	39.58	62.82%	53.32	84.64%
17	11kV Tangmachu Feeder	Tangmachu Vill.SS	11/0.415 kV	63	2001	10663-02	LHE20T2	30.74	48.79%	42.21	67.00%	56.87	90.27%
18	11kV Tangmachu Feeder	Phagidung SS	11/0.415 kV	63	2001	0-010863-2	LHE20T1	17.98	28.54%	24.69	39.19%	33.26	52.80%
								756.06					

										471.76		**542.3529412**	
										0.74		**1.00**	
										1.74		**2.00**	
1	11kV New Lhuentse Feeder	Phyum School	11/0.415 kV	250	2003	78270	LHE10T11	86.85	34.74%	151.40	60.56%	174.05	69.62%
2	11kV New Lhuentse Feeder	Phaling Town / Bazaar ss	11/0.415 kV	250	2018	78270	LHE60T11	9.57	3.83%	16.68	6.67%	19.18	7.67%
3	11kV New Lhuentse Feeder	New NHDCL Coloney	11/0.415 kV	63	2009	9132556	LHE60T12	9.57	15.19%	16.68	26.48%	19.18	30.44%
4	11kV New Lhuentse Feeder	Fatala	11/0.415 kV	10	2010	12238	LHE60T37	2.33	23.35%	4.07	40.70%	4.68	46.79%
5	11kV New Lhuentse Feeder	Dzong	11/0.415 kV	250	2009	10431	LHE10T13	64.42	25.77%	112.30	44.92%	129.10	51.64%
6	11kV New Lhuentse Feeder	Dzong Hydrant	11/0.415 kV	250	2017	1042	LHE10T39	0.83	0.33%	1.44	0.58%	1.66	0.66%
7	11kV New Lhuentse Feeder	Old NHDCL Colony	11/0.415 kV	63	2007	8789	LHE10T12	56.16	89.15%	97.90	155.40%	112.55	178.65%
8	11kV New Lhuentse Feeder	Tongkulung	11/0.415 kV	63	2007	94AD-140	LHE10T10	40.89	64.91%	71.29	113.16%	81.95	130.09%
								270.62					
										1031.80		**1168.24**	
										1.32		**1.62**	
										2.32		**2.62**	
1	11kV Old Lhuentse Feeder	Jabee Army Camp SS	11/0.415 kV	100	1995	NA	LHE60T31	1.45	1.45%	3.35	3.35%	3.79	3.79%
2	11kV Old Lhuentse Feeder	Jabee Workshop SS	11/0.415 kV	63	2011	6027	LHE60T30	4.97	7.89%	11.51	18.27%	13.04	20.69%
3	11kV Old Lhuentse Feeder	Murmur	11/0.415kV	16	2009	9132401	LHE60T27	2.60	16.24%	6.02	37.63%	6.82	42.60%
4	11kV Old Lhuentse Feeder	Zarthang Goenpa/Lugarpang	11/0.415kV	16	2009	9132404	LHE60T28	3.82	23.86%	8.84	55.27%	10.01	62.58%
5	11kV Old Lhuentse Feeder	Mudmaling SS	11/0.415 kV	25	2003	39-232	LHE60T1	2.67	10.70%	6.20	24.78%	7.02	28.06%
6	11kV Old Lhuentse Feeder	Gangzur	11/.415kV	50	2018	384	LHE60T1	12.73	25.46%	29.48	58.97%	33.38	66.76%
7	11kV Old Lhuentse Feeder	Sumpa Saw mail	11/.415kV	63	2003		LHE60T2	4.51	7.16%	10.44	16.57%	11.82	18.77%
8	11kV Old Lhuentse Feeder	Khoma Druthoe	11/.415kV	16	2018	16585	LHE60T29	0.69	4.31%	1.60	9.99%	1.81	11.31%
9	11kV Old Lhuentse Feeder	Ngar	11/.415kV	16	2003	10863-2	LHE50T1	2.44	15.24%	5.65	35.29%	6.39	39.96%
10	11kV Old Lhuentse Feeder	Jung	11/.415kV	63	2011	8022	LHE50T2	3.82	6.06%	8.84	14.04%	10.01	15.89%
11	11kV Old Lhuentse Feeder	Upper Shawa	11/.415kV	25	2014	9132475	LHE30T26	4.53	18.12%	10.50	41.98%	11.88	47.53%
12	11kV Old Lhuentse Feeder	Lower Shawa	11/.415kV	25	2014	9132458	LHE30T27	8.97	35.88%	20.78	83.11%	23.52	94.10%
13	11kV Old Lhuentse Feeder	Thrima	11/.415kV	25	2006	29133	LHE30T3	3.11	12.42%	7.19	28.77%	8.14	32.57%
14	11kV Old Lhuentse Feeder	Rotpa	11/.415kV	25	2010	HT25/92A 2	LHE30T1	1.15	4.60%	2.66	10.66%	3.02	12.06%
15	11kV Old Lhuentse Feeder	Zhamling	11/.415kV	63	2002	2443	LHE30T5	6.26	9.93%	14.49	23.00%	16.41	26.04%
16	11kV Old Lhuentse Feeder	Khawchung	11/.415kV	25	2002	9241	LHE30T4	9.20	36.80%	21.31	85.24%	24.13	96.51%
17	11kV Old Lhuentse Feeder	Ney Zhisar	11/.415kV	100	2013	6017	LHE70T17	9.55	9.55%	22.11	22.11%	25.03	25.03%
18	11kV Old Lhuentse Feeder	Ney I Sangbee	11/.415kV	25	2011	9132438	LHE70T12	7.02	28.06%	16.25	65.00%	18.40	73.59%
19	11kV Old Lhuentse Feeder	Ney II Depteng	11/.415kV	25	2011	9132436	LHE70T13	3.11	12.42%	7.19	28.77%	8.14	32.57%
20	11kV Old Lhuentse Feeder	Ney III Trongtoe	11/.415kV	25	2011	9132408	LHE70T14	5.13	20.52%	11.88	47.52%	13.45	53.81%
21	11kV Old Lhuentse Feeder	Ney IV Trongmay	11/.415kV	25	2011	9132478	LHE70T16	4.83	19.32%	11.19	44.75%	12.67	50.67%
22	11kV Old Lhuentse Feeder	Yodra	11/.415kV	25	2003	NA	LHE70T10	4.14	16.56%	9.59	38.36%	10.86	43.43%
23	11kV Old Lhuentse Feeder	Nimshong	11/.415kV	63	2003	0T0108632 2	LHE70T6	6.03	9.57%	13.96	22.16%	15.81	25.10%
24	11kV Old Lhuentse Feeder	Jangchubling	11/.415kV	63	2009	72265	LHE70T9	6.29	9.98%	14.56	23.11%	16.49	26.17%
25	11kV Old Lhuentse Feeder	Semcheebi	11/.415kV	16	2010	12239	LHE70T18	2.76	17.25%	6.39	39.96%	7.24	45.24%
26	11kV Old Lhuentse Feeder	Maggar Somling	11/.415kV	25	2003	NA	LHE70T2	7.87	31.46%	18.22	72.88%	20.63	82.52%
27	11kV Old Lhuentse Feeder	Somshing	11/.415kV	25	2003	10863	LHE70T4	6.00	24.01%	13.90	55.62%	15.74	62.97%
28	11kV Old Lhuentse Feeder	Jalamzur	11/.415kV	25	2003	0T01230	LHE70T7	5.52	22.09%	12.79	51.17%	14.48	57.93%
29	11kV Old Lhuentse Feeder	Lingabee	11/.415kV	25	2003	CT010863	LHE70T5	5.54	22.17%	12.84	51.36%	14.54	58.15%
30	11kV Old Lhuentse Feeder	Kilung	11/.415kV	16	2003	0T01230	LHE70T1	3.22	20.13%	7.46	46.62%	8.44	52.78%

31	11kV Old Lhuentse Feeder	Tsholing	11/.415kV	25	2011	9132442	LHE70T11	3.70	14.81%	8.58	34.31%	9.71	38.85%
32	11kV Old Lhuentse Feeder	Yongbaling	11/.415kV	16	2007	29167	LHE30T2	2.81	17.54%	6.50	40.62%	7.36	45.99%
33	11kV Old Lhuentse Feeder	Rongchu PH	11/.415kV	16	2007	10863	LHE30T31	4.62	28.89%	10.71	66.93%	12.12	75.78%
34	11kV Old Lhuentse Feeder	Lawa	11/.415kV	25	2010	9132513	LHE60T15	2.36	9.45%	5.47	21.89%	6.19	24.78%
35	11kV Old Lhuentse Feeder	Taya	11/.415kV	25	2010	9132396	LHE60T16	1.28	5.12%	2.97	11.87%	3.36	13.44%
36	11kV Old Lhuentse Feeder	Upper Serphu	11/.415kV	25	2010	9132504	LHE60T17	2.47	9.87%	5.72	22.87%	6.47	25.89%
37	11kV Old Lhuentse Feeder	Lower Serphu	11/.415kV	16	2010	9132524	LHE60T18	3.95	24.67%	9.14	57.14%	10.35	64.69%
38	11kV Old Lhuentse Feeder	Gangla	11/.415kV	25	2010	9132510	LHE60T19	3.92	15.69%	9.08	36.33%	10.28	41.14%
39	11kV Old Lhuentse Feeder	Khema	11/.415kV	25	2010	9132532	LHE60T20	3.64	14.55%	8.42	33.69%	9.54	38.15%
40	11kV Old Lhuentse Feeder	Lukchu	11/.415kV	25	2010	9132544	LHE60T24	2.00	8.00%	4.63	18.54%	5.25	20.99%
41	11kV Old Lhuentse Feeder	Khoma Village	11/.415kV	63	2003	12246	LHE60T5	21.43	34.01%	49.64	78.79%	56.20	89.21%
42	11kV Old Lhuentse Feeder	Khoma School	11/.415kV	16	2003	11273	LHE60T6	7.36	46.01%	17.05	106.58%	19.31	120.68%
43	11kV Old Lhuentse Feeder	Namgong	11/.415kV	25	2008	8782	LHE60T14	3.12	12.47%	7.22	28.88%	8.17	32.69%
44	11kV Old Lhuentse Feeder	Khomadung	11/.415kV	125	2015		LHE60T36	8.49	6.79%	19.66	15.73%	22.26	17.81%
45	11kV Old Lhuentse Feeder	Berpa	11/.415kV	63	2006	29064	LHE60T7	6.61	10.50%	15.32	24.31%	17.34	27.53%
46	11kV Old Lhuentse Feeder	Gonpa karp	11/.415kV	63	2006	29066	LHE60T9	9.83	15.61%	22.78	36.15%	25.79	40.93%
47	11kV Old Lhuentse Feeder	Kemtshong	11/.415kV	16	2010	11246	LHE60T35	5.66	35.38%	13.11	81.94%	14.84	92.78%
48	11kV Old Lhuentse Feeder	Dakten	11/.415kV	25	2006	29136	LHE60T4	5.39	21.56%	12.48	49.93%	14.13	56.53%
49	11kV Old Lhuentse Feeder	Ngalamdung	11/.415kV	25	2003	NA	LHE60T3	6.69	26.74%	15.49	61.95%	17.54	70.14%
50	11kV Old Lhuentse Feeder	Babtong	11/.415kV	63	2006	29018	LHE60T8	9.17	14.55%	21.23	33.70%	24.04	38.15%
51	11kV Old Lhuentse Feeder	Namgong	11/.415kV	25	2007	8782	LHE60T14	12.47	49.86%	28.88	115.50%	32.69	130.77%
52	11kV Old Lhuentse Feeder	Pangkhar Upper	11/.415kV	25	2009	9132521	LHE60T21	5.97	23.88%	13.83	55.32%	15.66	62.64%
53	11kV Old Lhuentse Feeder	Pangkhar Lower	11/.415kV	63	2009	9132508	LHE60T23	7.60	12.07%	17.61	27.96%	19.94	31.66%
54	11kV Old Lhuentse Feeder	Lower Tsango	11/.415kV	16	2013	9321398	LHE60T32	4.19	26.16%	9.70	60.60%	10.98	68.61%
55	11kV Old Lhuentse Feeder	Upper Tsango	11/.230kV	16	2013	10119904	LHE60T33	3.31	20.70%	7.67	47.95%	8.69	54.29%
56	11kV Old Lhuentse Feeder via Dungkar Feeder	Neyteng SS	11/.230kV	10	2013	10119903	LHE60T34	0.74	7.36%	1.70	17.05%	1.93	19.30%
57	11kV Old Lhuentse Feeder via Dungkar Feeder	Tabee SS	11/.415kV	63	2003	9132477	LHE30T6	9.89	15.70%	22.91	36.36%	25.94	41.17%
58	11kV Old Lhuentse Feeder via Dungkar Feeder	Dungkar Village	11/.415kV	63	2003	2439	LHE30T7	14.05	22.31%	32.55	51.67%	36.86	58.50%
59	11kV Old Lhuentse Feeder via Dungkar Feeder	Sugbee	11/.415kV	63	2003	2440	LHE30T8	5.34	8.47%	12.36	19.62%	13.99	22.21%
60	11kV Old Lhuentse Feeder via Dungkar Feeder	Jasabee	11/.415kV	25	2011	9132477	LHE30T9	3.82	15.27%	8.84	35.37%	10.01	40.05%
61	11kV Old Lhuentse Feeder via Dungkar Feeder	Tangrung	11/.415kV	25	2011	9132494	LHE30T10	4.03	16.10%	9.32	37.29%	10.56	42.22%
62	11kV Old Lhuentse Feeder via Dungkar Feeder	Sershong	11/.415kV	25	2011	9132456	LHE30T11	4.42	17.66%	10.23	40.92%	11.58	46.33%
63	11kV Old Lhuentse Feeder via Dungkar Feeder	Thuenpee	11/.415kV	25	2011	9132476	LHE30T12	3.52	14.08%	8.15	32.60%	9.23	36.92%
64	11kV Old Lhuentse Feeder via Dungkar Feeder	Shonshong	11/.415kV	25	2011	9132441	LHE30T13	7.73	30.91%	17.90	71.60%	20.27	81.07%
65	11kV Old Lhuentse Feeder via Dungkar Feeder	Narey	11/.415kV	16	2011	9112395	LHE30T14	1.91	11.93%	4.42	27.64%	5.01	31.29%
66	11kV Old Lhuentse Feeder via Dungkar Feeder	Wayway	11/.415kV	16	2011	9132403	LHE30T15	6.35	39.68%	14.70	91.90%	16.65	104.05%
67	11kV Old Lhuentse Feeder via Dungkar Feeder	Chazam	11/.415kV	16	2013	10139908	LHE30T16	5.50	34.36%	12.73	79.58%	14.42	90.10%

68	11kV Old Lhuentse Feeder via Dungkar Feeder	Thangbi	11/.415kV	25	2013	90656	LHE30T17	4.46	17.85%	10.34	41.34%	11.70	46.81%
69	11kV Old Lhuentse Feeder via Dungkar Feeder	Drabling	11/.415kV	16	2013	101399909	LHE30T18	4.42	27.60%	10.23	63.93%	11.58	72.38%
70	11kV Old Lhuentse Feeder via Dungkar Feeder	Tabkang	11/.230kV	16	2014	10119906	LHE30T19	7.50	46.88%	17.37	108.58%	19.67	122.93%
71	11kV Old Lhuentse Feeder via Dungkar Feeder	Chusa /Wamdrang	11/.415kV	25	2014	9132488	LHE30T20	9.82	39.28%	22.75	90.99%	25.76	103.03%
72	11kV Old Lhuentse Feeder via Dungkar Feeder	Naling	11/.230kV	16	2014	9112393	LHE30T21	1.31	8.19%	3.04	18.98%	3.44	21.49%
73	11kV Old Lhuentse Feeder via Dungkar Feeder	Rinchenbumpa	11/.230kV	10	2014	9112390	LHE30T22	1.20	11.96%	2.77	27.70%	3.14	31.37%
74	11kV Old Lhuentse Feeder via Dungkar Feeder	Ugyenphu SS	11/.230kV	10	2014	14467	LHE30T23	0.28	2.76%	0.64	6.39%	0.72	7.24%
75	11kV Old Lhuentse Feeder via Dungkar Feeder	Nay Lhakang	11/.230kV	16	2014	10119905	LHE30T24	1.82	11.36%	4.21	26.30%	4.77	29.78%
76	11kV Old Lhuentse Feeder via Dungkar Feeder	Churbee	11/.415kV	16	2014	9132411	LHE30T25	1.10	6.90%	2.56	15.98%	2.90	18.10%
77	11kV Old Lhuentse Feeder	Ambrangchu	11/.415kV	25	2011	9132406	LHE60T25	21.63	86.52%	50.10	200.40%	56.72	226.90%
78	11kV Old Lhuentse Feeder	Chengling	11/.415kV	25	2011	9132443	LHE60T26	21.11	84.46%	48.91	195.63%	55.37	221.49%
79	11kV Old Lhuentse Feeder	Rongchu PH (step up)	0.415/11 kV	315	2001	KM-190/D			0.00%	0.00	0.00%	0.00	0.00%
80	11kV Old Lhuentse Feeder	Gangzur PH (step up)	0.415/11 kV	200					0.00%	0.00	0.00%	0.00	0.00%
81	11kV Old Lhuentse Feeder	Tongling	0.415/11 kV	25				5.60	22.40%	12.97	51.89%	14.69	58.75%
								445.45					
								205.88		**217.65**		**229.41**	
								0.34		**0.41**		**0.49**	
										1.41		**1.49**	
1	11kV Minjey Feeder	Chusa	11/.415kV	63	2006	29014	LHE40T2	16.56	26.29%	17.98	28.53%	19.47	31%
2	11kV Minjey Feeder	Wangshing	11/.415kV	63	2006	29029	LHE40T3	19.10	30.31%	20.51	32.56%	22.00	35%
3	11kV Minjey Feeder	Menjey	11/.415kV	125	2006	28985	LHE40T4	15.02	12.02%	16.43	13.15%	17.92	14%
4	11kV Minjey Feeder	Upper Jalang	11/.415kV	25	2010	29137	LHE40T5	24.19	96.75%	25.60	102.40%	27.09	108%
5	11kV Minjey Feeder	Lower Jalang	11/.415kV	25	2009	NA	LHE40T6	18.85	75.40%	20.26	81.05%	21.75	87%
6	11kV Minjey Feeder	Bragong	11/.415kV	63	2013	9132555	LHE40T7	23.60	37.46%	25.01	39.70%	26.50	42%
7	11kV Minjey Feeder	Zham	11/.415kV	25	2013	9132462	LHE40T8	5.17	20.68%	6.58	26.33%	8.07	32%
8	11kV Minjey Feeder	Ngangla	11/.415kV	25	2013	9132490	LHE40T9	4.66	18.66%	6.08	24.31%	7.57	30%
9	11kV Minjey Feeder	Minjey School	11/.415kV	100	2012		LHE40T10	25.10	25.10%	26.51	26.51%	28.00	28%
10	11kV Minjey Feeder	Thinleypang SS	11/0.415 kV	16	1993	DT01230	LHE40T1	1.79	11.20%	3.20	20.03%	4.69	29%
								154.04					

Annexure-8: Material Cost of three phase (3Φ) Transformers

Sl. No	Name of ESDs	Cost for replacement of single phase transformers and distribution boards with three phase		Total cost in Nu.
		11 kV transformers	33 kV transformers	
		Cost in Nu.	Cost in Nu.	
1	Bumthang	421,565.09	132,535.04	554,100.14
2	Chukhha	956,241.73	9,144,917.99	10,101,159.72
3	Dagana	–	6,361,682.08	6,361,682.08
4	Haa	–	3,048,306.00	3,048,306.00
5	Lhuntse	731,506.19	8,747,312.86	9,478,819.05
6	Mongar	182,876.55	4,108,586.34	4,291,462.89
7	Paro	836,897.46	1,060,280.35	1,897,177.81
8	Pemagatshel	91,438.27	6,759,287.21	6,850,725.48
9	Punakha	274,314.82	4,771,261.56	5,045,576.38
10	S/Jongkhar	–	15,506,600.07	15,506,600.07
11	Samtse	6,674,993.95	4,241,121.39	10,916,115.34
12	Sarpang	2,053,501.01	3,445,911.13	5,499,412.14
13	Trashi Gang	906,662.46	4,903,796.60	5,810,459.06
14	Trashiyangtse	–	4,638,726.52	4,638,726.52
15	Thimphu	723,785.91	–	723,785.91
16	Trongsa	91,438.27	3,445,911.13	3,537,349.40
17	Tsirang	–	5,168,866.69	5,168,866.69
18	Wangdue	182,876.55	1,457,885.48	1,640,762.02
19	Zhemgang	105,391.27	11,928,153.90	12,033,545.17
	TOTAL	**14,233,489.55**	**98,871,142.33**	**113,104,631.87**

Here the existing single phase transformers and distribution boards were replaced by three phase system, therefore the estimation includes the cost of three phase transformers and distribution boards.In line with Distribution Design and Construction Standard (DDCS) 2015, the transformer capacities according to voltage level are standardized as shown below:

33 kV System		11 kV System	
3 Φ	1Φ	3 Φ	1Φ
25 kVA	25 kVA, 16 kVA	25 kVA, 16 kVA	25 kVA,16 kVA, 10 kVA

Therefore, during the estimation, on 33 kV system, the cost of 25 kVA transformers was taken for 10 kVA and 16 kVA transformers and for 11 kV system, the cost of 16 kVA transformers was taken for 10 kVA ratings. The total cost for replacing the 1-phase transformers under whole ESD including transportation cost (Nu. 2.6 million) and labor cost (Nu. 70 million) is Nu. 186 million. Therefore, the total cost under this option will amount to Nu. 283 million.

11 kV & 33 kV Single Phase Transformers used under each ESD

Sl. No	Name of ESDs	TRANSFORMERS (Nos.)					
		11/0.240 kV			33/0.240 kV		
		10 kVA	16kVA	25kVA	10 kVA	16kVA	25kVA
1	Bumthang	–	–	4	–	1	–
2	Chukhha	2	5	3	19	31	19
3	Dagana	–	–	–	4	43	1
4	Haa	–	–	–	8	13	2
5	Lhuntse	3	5	–	3	19	44
6	Mongar		2	–	12	17	2
7	Paro	5	3	1	6	2	–
8	Pemagatshel	–	1	–	4	8	39
9	Punakha	1	2	–	2	5	29
10	S/Jongkhar	–	–	–	18	24	75
11	Samtse	15	58	–	–	32	–
12	Sarpang	10	9	3	9	8	9
13	Trashi Gang	3	–	6	–	–	37
14	Trashiyangtse	–	–	–	16	19	–
15	Thimphu*	–	1	6	–	–	–
16	Trongsa	1	–	–	9	17	–
17	Tsirang	–	–	–	7	32	–
18	Wangdue	1	1	–	–	2	9
19	Zhemgang	–	–	1	27	36	27
	TOTAL	**41**	**87**	**24**	**144**	**309**	**293**