BHUTAN POWER CORPORATION LIMITED

(An ISO 9001:2015, ISO 14001:2015 & OHSAS 18001:2007 Certified Company)

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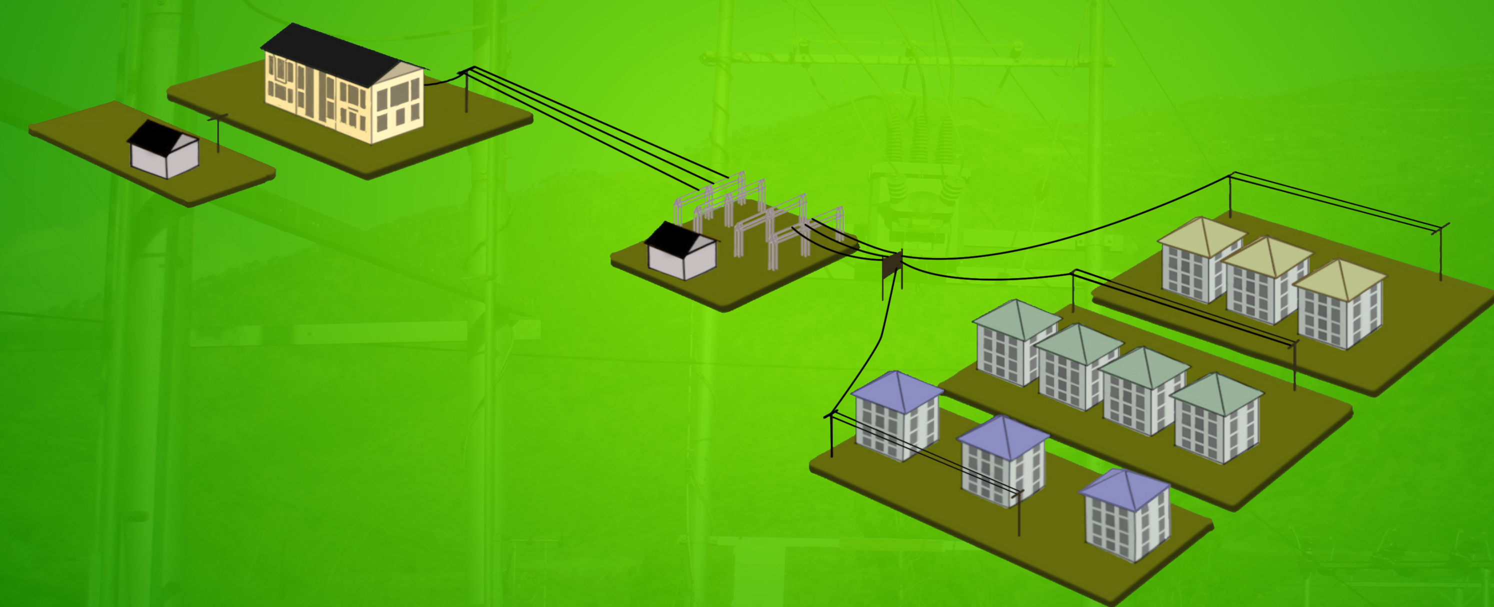
DISTRIBUTION SYSTEM MASTER PLAN (2020-2030)

PEMAGATSHEL DZONGKHAG



Distribution and Customer Services Department
Distribution Services
Bhutan Power Corporation Limited

2019

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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

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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**

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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
DCD: Distribution Construction Department
ICT: Interconnecting Transformer
DGPL: Druk Gyp Product Limited (PoP production)
DCCL: Dungsum Cement Corporation Limited

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 (2020-2030), 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 are 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 (2020-20230). 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.

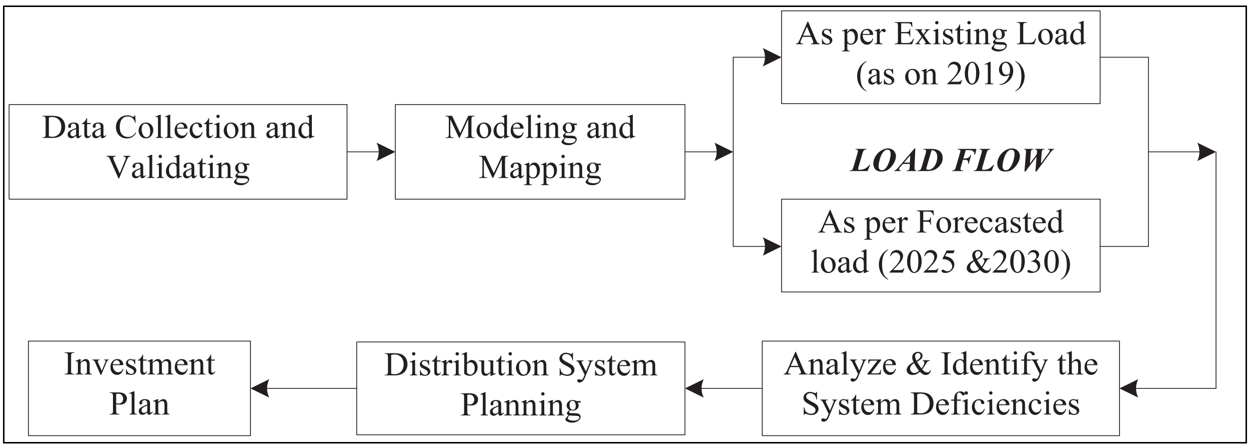


Figure 1: Block diagram for distribution system planning for thematic studies

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 (Details 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 2023) 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 eleven (11) Gewogs (Zobel, Shumar, Khar, Yurung, Chongshing, Dungmin, Chimmung, Decheeling, Cheokhorling, Nanong and Norbugang) of Pemagatshel Dzongkhag is from 132/33kV Nangkor (2x5 MVA-132/33kV and 2x2.5MVA-33/11kV) and Nganglam (2x3.5 MVA-132/33kV and 2x1.5MVA-33/11kV) substations. The 132kV line (34km long) which is transformed through 132/33/11kV substations at Nangkor and Nganglam are sourced from KHP.

a) Nangkor Substation

The 33/11kV Nangkor substation has three (3) number of 11kV outgoing feeders (*i.e. 11kV, 11kV Nangkor, 11kV Pemagatshel and 11kV PoP*) and 132/33kV has four (4) number of 33kV outgoing feeder (*i.e.33kV Nanong feeder, 33kV Yurung, 33kV Tshebar & 33kV Wamrong*). The substation has a transformer capacity of 10 MVA (2x5) at 33 kV voltage level and 5 MVA (2x2.5) at 11 kV voltage level.

b) Nganglam Substation

The 33/11kV Nganglam substation has three (3) number of 11kV outgoing feeders (i.e. 11kV Nganglam, 11kV Satshalo & 11kV Gashari) and 132/33kV has four (4) number of 33kV outgoing feeders (i.e. 33kV Decheeling, 33kV Panbang, 33kV DCCL& 33kV DGCL). The substation has a transformer capacity of 7 MVA (2x3.5) at 33 kV voltage level and 3 MVA (2x1.5) 11 kV voltage level.

The Dzongkhag has also access to the western transmission grid through Gelephu ICT. The basic electricity distribution network model is exhibited in **Figure 2.**

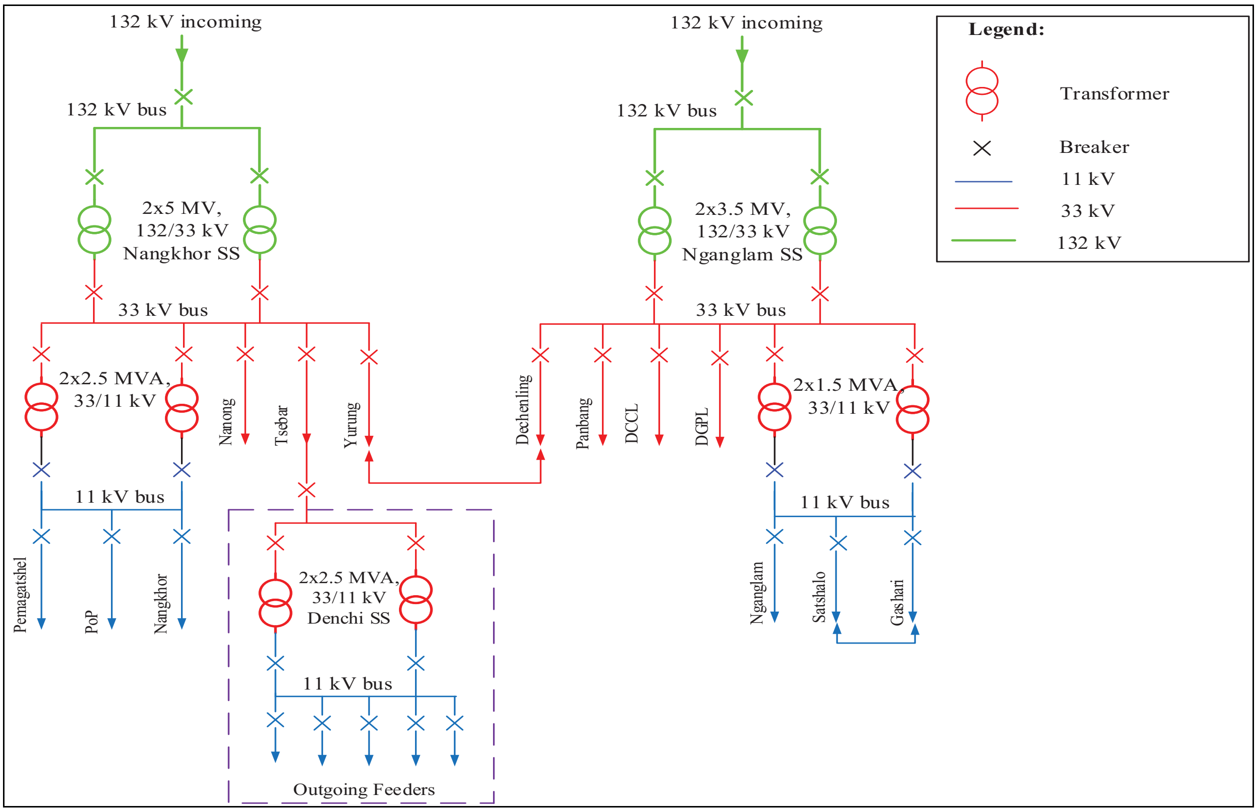


Figure 2: Electricity distribution schematic diagram

6.2 Electricity Distribution Lines

The quantity of MV and LV lines infrastructure operated and maintained by the Division is summarized in **Table1**.

Table1: 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	OH	UG	
1	266.29	-	46.84	0.13	313.26	0.13	389.45	1.60	391.05

The total MV line length is 313.39 km and the total LV line length is 391.05km. The ratio of LV to MV line length is 1.25:1, which reflects a high proportion of power distribution through LV networks. 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.)
132/33/ 11kV Nangkor	2x5MVA (132/33kV) & 2x2.5MVA (33/11kV)	11kVPemagatshel	6.45	8	964.00	532
		11kV Nangkor	9.56	13	767.00	522
		11kV PoP	3.1	5	1,876.00	98
		33kV Nanong	76.92	61	3,365.00	1704
		33kV Yurung	45.3	31	1,094.00	794
		33kV Tshebar	52.88	45	2,104.00	1349
132/33/ 11kV Nganglam	2x3.5MVA (132/33kV) & 2x1.5MVA (33/11kV)	11kV Nganglam	20.22	19	1,411.00	974
		11kV Gashari	2.54	2	150.00	66
		11kV Satshalo	5.1		0.00	5
		33kV Decheeling	65.39	63	1,735.00	1312
		33kV Panbang	22.58	30	1,336.00	308
		33kV DGPL	3.22	5	4,314.00	176
		33kV DCCL	0.00	1	2000	1
Total			**313.26**	**283**	**21,116.00**	**7841**

As of July 2020, there were 283 distribution transformers with a total capacity of 21,116kVA. As can be inferred from **Table 2**, the installed capacity of the transformer per customer is 2.69kVA.

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 (132/33/11 kV)

Nganglam and Nangkhor substations are the primary power sources for the Dzongkhag.To assess the adequacy of the substations; the peak power consumed has been compiled based on the historical data. The daily and monthly peak demand has been consolidated to annual peak demand as shown in **Table 3.**

Table 3: Peak load of Nganglam and Nangkhor substations

Sl. No.	Name of Source	Voltage Level (kV)	Installed Capacity		Peak Load (MW)	Forecasted Load (MW)	
			MVA	MW*	2019	2025	2030
1	Nangkor Substation**	132/33	2x5	8.5	2.44	5.03	7.05
		33/11	2x2.5	4.25	1.04	2.47	3.57
2	Nganglam	132/33	2x3.5	5.95	3.68	4.71	5.27

Sl. No.	Name of Source	Voltage Level (kV)	Installed Capacity		Peak Load (MW)	Forecasted Load (MW)	
			MVA	MW*	2019	2025	2030
	Substation	33/11	2x1.5	2.55	0.66	0.98	1.15

**pf of 0.85 is considered for study purpose. ** Forecasted load of Denchi town has been included.*

a) 132/33/11kV Nangkhor Substation

As evident from **Table 3,** the substation recorded a peak load of 2.44MW at 33 kV voltage level and 1.04 MW at 11 kV voltage level. It is forecasted that the peak power requirement would reach 7.05 MW (including 2.57MW of Denchi town) against the installed capacity of 8.50 MW by 2030 at 33kV voltage level. Similarly, at 11kV voltage level, the peak power requirement would reach 3.57 MW (including 2.57MW of Denchi town) against the installed capacity of 4.25MW by 2030. Therefore, the installed substation capacities would be adequate to meet the power requirement till 2030. However, the load at 33/11kV will be shared between Denchi and Nangkor substations as the two substations are interlinked through 11kV PoP feeder.

b) 132/33/11kV Nganglam Substation

Similarly, the Nganglam substation would be adequate to meet the power requirement as the forecasted peak power requirement will not surpass the installed capacity by 2030.

7.1.2 MV Substation (33/11 kV)

Currently, the Electrification Division, DCD is constructing 2x2.5 MVA, 33/11 kV substation at Denchi which is scheduled to be commissioned by the end of July 2020. The new substation would cater the load of new Dzong and Denchi LAPs which is anticipated to improve the reliability and quality of power. As the total forecasted load is 3.57MW for 33/11kV substations, the MV substations would be adequate to meet the power requirement. Further the 3.57MW load would be shared between the Nangkor and Denchi 33/11kV substations as the substations are interlinked through 11kV PoP feeder.

7.2 Assessment of MV Feeder

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.

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 4** and the corresponding feeder-wise annual load curve is presented in **Figures 3 & 4.**

Table 4: Historical feeder wise peak power demand of ESD Pemagatshel & ESSD Nganglam

Sl.No.	Power Source	Feeder Name	Peak Load (MW)					
			2014	2015	2016	2017	2018	2019
1	132/33/11kV Nangkor SS	33kV Nanong Feeder	0.46	0.48	0.43	0.62	0.71	0.49
2		33kV Tsebar Feeder	0.38	0.42	0.44	0.45	0.47	0.51
3		33kV Yurung Feeder	0.19	0.19	0.20	0.23	0.22	0.33
4		33kV Wamrong	0.76	0.69	1.21	1.14	1.04	1.21
5		11kV Feeder	0.30	0.36	0.27	0.30	0.32	0.34
6		11kV PoP Feeder	0.41	0.47	0.38	0.50	0.46	0.47
7		11kV Nangkor Feeder	0.18	0.19	0.18	0.20	0.22	0.23

Sl.No.	Power Source	Feeder Name	Peak Load (MW)					
			2014	2015	2016	2017	2018	2019
8	132/33/11kV Nganglam SS	33kV DCCL Feeder	0.21	0.22	0.23	0.26	0.26	0.26
9		33kV Decheeling Feeder	0.796	0.84	0.33	0.36	0.41	0.44
10		33kV Panbang Feeder	1.04	1.20	0.61	0.62	1.76	0.69
11		33kV DGCL Feeder		0.07	0.08	2.54	2.53	2.37
12		11kV Nganglam Feeder	0.49	0.52	0.56	0.60	0.62	0.65
13		11kV Gashari Feeder	0.02	0.02	0.03	0.03	0.03	0.03
14		11kV Alibari Feeder	Spare feeder					

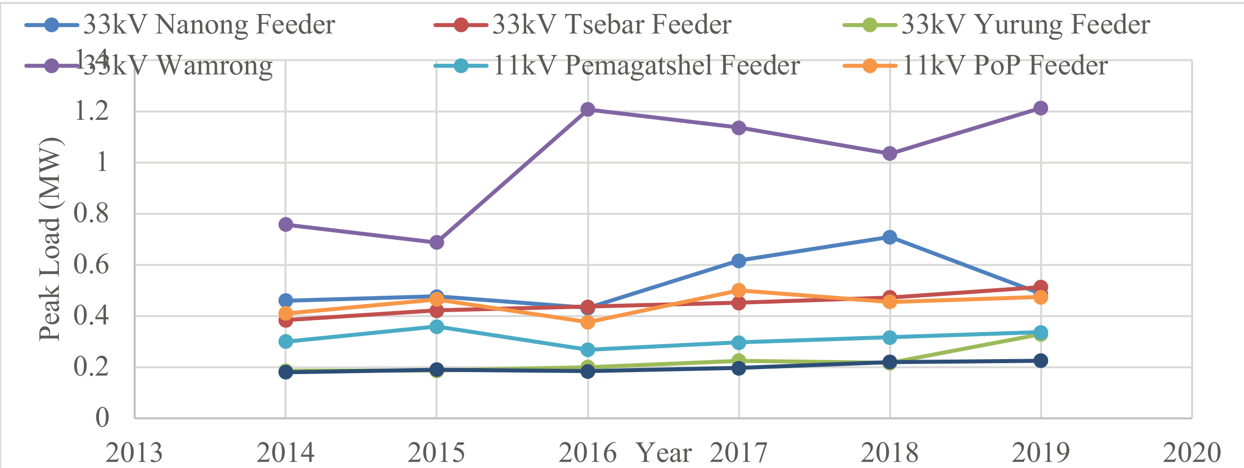


Figure 3: Peak load (MW) of 132/33/11kV Nangkor substation outgoing feeders

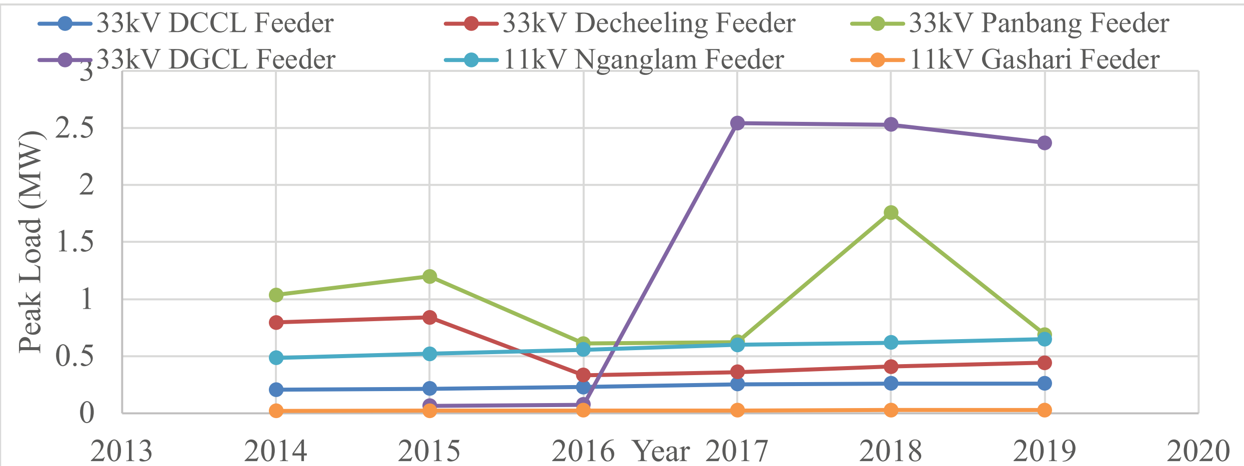


Figure 4: Peak load (MW) of 132/33/11kV Nganglam substation outgoing feeders

As evident from **Figure 3**, the recorded peak load for 33 kV Wamrong feeder is fluctuating which is the primary source for 2x2.5 MVA, 33/11 kV Wamrong substation. The sudden peak and crest of the peak load could be due to change in power sources (Power is being catered from Kanglung when there is no supply from Nangkor). During the normal condition, the power supply to the customers of Khaling is being fed from Kanglung substation. Therefore, the peak load of normal operation is considered to forecast the power demand for the next ten years.

Similarly, there is an anomaly in the recorded peak load as can be seen from **Figure 4** for those feeders emanating from Nganglam substation. Besides the anomaly, the graph also shows a rapid increase in power demand. The rapid increase in peak load of 33 kV DGPL feeder from the year 2016-17 is because of the PoP industrial load which was under the administration of Samdrup Jongkhar Dzongkhag.

The 33 kV Panbang feeder is interconnected with the 33 kV Gomphu feeder emanating from the Tingtibi substation. The said feeder acts as a contingency source and caters to the entire load of the customer connected to the Gomphu feeder when the Gomphu feeder is down from the source. Hence, there is an inconsistency in the recorded peak load. However, the peak load data has been normalized to forecast energy demand for the next 10 years.

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 based on when the source is from Kanglung substation

d) System study based on when the Denchi substation is commissioned

e) System study when the Denchi substation is fed from Nganglam substation.

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 capability of the feeders will be within the range with the existing as well as with the forecasted load. The thermal capacity of the different conductor sizes is as shown in **Table 5.**

Table 5: 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.

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 6** and **Figure 5** adopting the commonly practiced methodology of LRM and TSA with the help of ETAP. The detailed load simulation result is attached as **Annexure-4.**

Table 6: Feeder wise Load forecast of Nangkhor Substation

Name of Feeder	Forecasted Load (MW)										
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Nangkor Substation											

Name of Feeder	Forecasted Load (MW)										
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
33kV Nanong Feeder	0.72	0.75	0.78	0.81	0.83	0.86	0.89	0.92	0.95	0.98	1.01
33kV Tsebar Feeder	0.79	1.05	1.30	1.56	1.82	2.07	2.34	2.59	2.84	3.11	3.36
33kV Yurung Feeder	0.25	0.27	0.30	0.32	0.34	1.44	1.47	1.49	1.51	1.54	2.02
33kV Wamrong Feeder	1.30	1.39	1.47	1.56	1.65	1.73	1.82	1.91	2.00	2.08	2.17
11kV Feeder	0.23	0.24	0.24	0.24	0.24	0.25	0.25	0.25	0.25	0.26	0.26
11kV PoP Feeder	0.43	0.44	0.45	0.47	0.48	0.49	0.50	0.51	0.52	0.54	0.55
11kV Nangkor Feeder	0.29	0.30	0.31	0.32	0.33	0.34	0.34	0.35	0.36	0.37	0.38
Nganglam Substation											
33kV DCCL Feeder	0.34	0.35	0.36	0.38	0.39	0.40	0.41	0.42	0.44	0.45	0.46
33kV Decheeling Feeder	0.48	0.52	0.56	0.60	0.63	0.67	0.71	0.75	0.79	0.82	0.86
33kV Panbang Feeder	0.76	0.80	0.84	0.89	0.93	0.97	1.01	1.05	1.09	1.13	1.17
11kV DGCL Feeder	2.57	2.59	2.61	2.63	2.65	2.67	2.69	2.71	2.73	2.76	2.78
11kV Nganglam Feeder	0.75	0.78	0.81	0.85	0.88	0.91	0.95	0.98	1.01	1.05	1.08
11kV Gashari Feeder	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.07

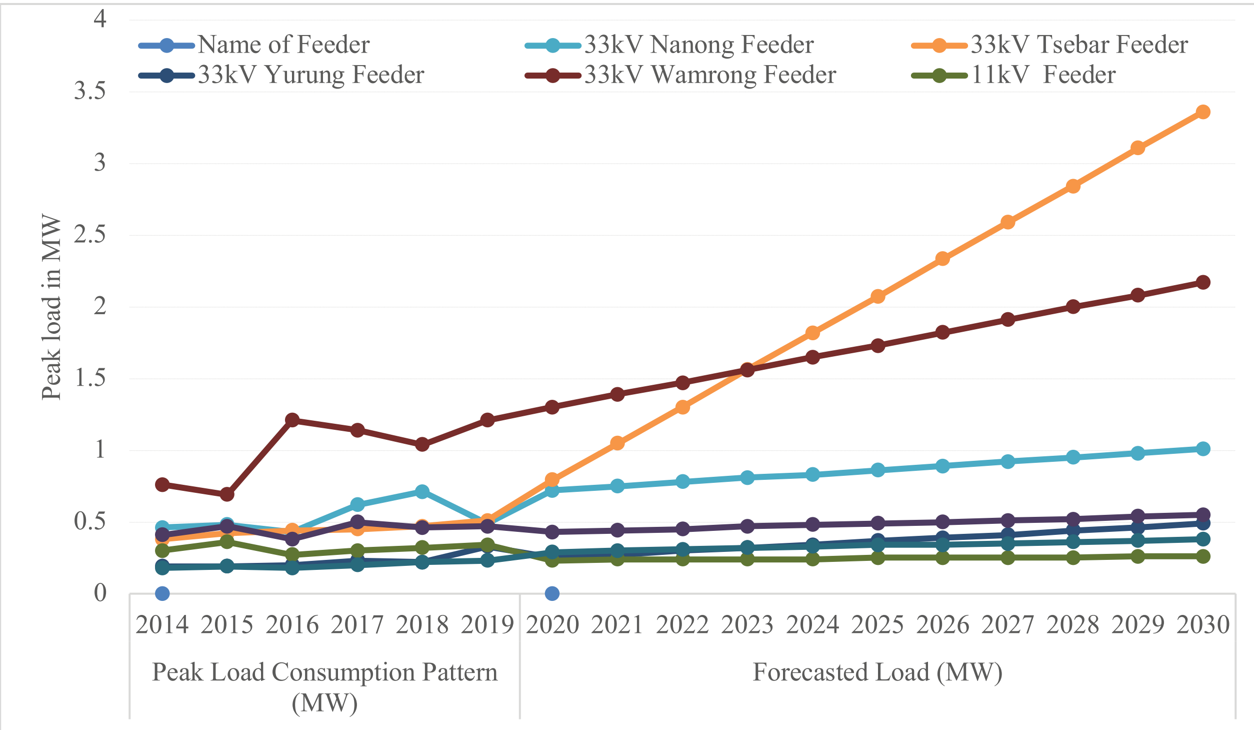


Figure 5:Plot of feeder wise peak power demand forecast for Nangkor substation

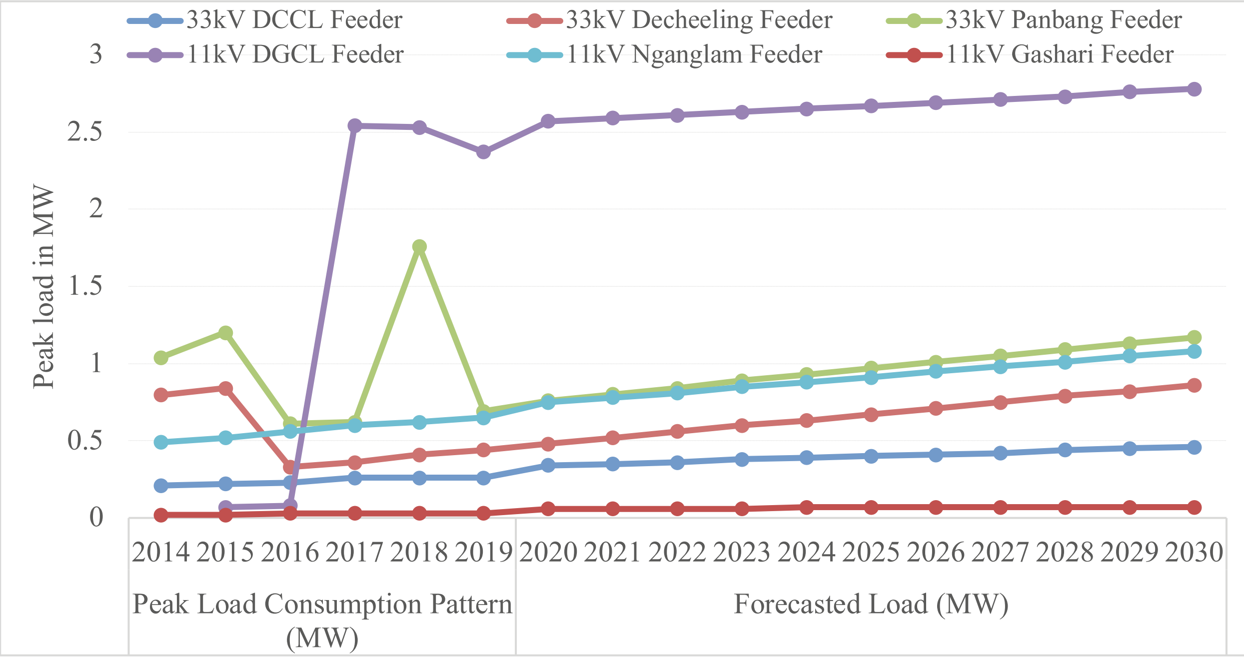


Figure 6:Plot of feeder wise peak power demand forecast for Nganglam substation

The simulation results for the feeders indicating the voltage profile is tabulated in **Table 7** which is based on 2025 & 2030 forecasted load. From the simulation result, no abnormality was found, and the voltage profile will be within the range.

Table 7: Voltage profile of the feeders

Name of Feeder	**2025 Load (MW) and Voltage (%)**			**2030 Load (MW) and Voltage**		
	Load	**Bus**	**End**	**Load**	**Bus**	**End**
11kV Nangkor Bus	**1.07**			**1.186**		
11kV Feeder	0.25	97.45%	97.04%	0.26	97.03%	96.60%
11kV Nangkor Feeder	0.34	94.97%	94.65%	0.38	94.18%	93.89%
11kV PoP Feeder	0.49		93.35%	0.55		92.34%
33kV Nangkor bus	**1.90**			**2.282**		
33kV Nanong Feeder	0.86	97.95%	96.62%	1.01	97.56%	95.99%
33kV Yurung Feeder	0.37		97.83%	0.49		97.38%
33kV Tshebar Feeder	0.67		97.67%	0.79		97.23%
11k Nganglam Bus	**0.98**			**1.15**		

Name of Feeder	2025 Load (MW) and Voltage (%)			2030 Load (MW) and Voltage		
	Load	Bus	End	Load	Bus	End
11kV Nganglam	0.91		92.94%	1.08		91.72%
11kV Gashari Feeder	0.07	95.65%	95.58%	0.07	94.89%	94.81%
11kV Satshalo						
33kV Nganglam Bus	**4.71**			**5.27**		
33kV Decheeling Feeder	0.67		86,83%	0.86		96.12%
33kV Panbang Feeder	0.97	97.27%	96.67%	1.17	96.81%	96.04%
33kV DGPL Feeder	2.67		96.64%	2.78		96.15%
33kV DCCL Feeder	0.400		97.27%	0.46		96.81%

As evident from **Table 7,** the 11kV PoP and 11kV Nganglam feeders would experience marginal voltage drops (92.34 % and 91.72 % respectively). The voltage profile of PoP feeder can be improved either by changing the transformer tap position or by connecting the PoP feeder to 2x2.5 MVA, 33/11 kV Denchi substation which is scheduled to be commissioned by 2020. Similarly, the voltage profile of 11 kV Nganglam feeder can be improved by off-loading some of its load to the 11kV Satshalo feeder which is currently idle.

c) Commissioning of Denchi Substation

The system study was also carried out by including the 2x2.5, 33/11 kV Denchi substation which will be put into operation by 2020. Individual load of Denchi LAPs, new Dzong, and the PoP feeder is transferred to the substation to check the behavior of the system. No abnormality was observed in the system from the power flow analysis.

d) Denchi Substation fed from Nganglam Substation

33kV Tshebar feeder originating from the Nangkhor substation is the primary source of the Denchi substation. A system analysis was carried out to check the end voltage profile at the Denchi substation when it is fed from the Nganglam substation. The power from the Nganglam substation can be channeled through a 33 kV Decheeling feeder via Yurung feeder. However, additional investment for extending the 33 kV line from Yurungzampa to the substation is required.

Table 8: Voltage profile at Denchi 33 kV bus when fed from Nganglam substation

Source	**Voltage profile at 33 kV bus at Denchi SS**		
	2020	**2025**	**2030**
Nganglam SS	98.4 %	96.53 %	95.93 %
Name of the feeder	End voltage		
Denchi Town	98.03	95.08%	93.65%

As evident from **Table 8**, the voltage drop is within the permissible range (±10 %). Hence it is recommended to extend a secondary source to Denchi substation for better reliability.

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 shown in **Table 9** and **Figure 7.**

Table 9: Energy sales, purchase and loss trend

Sl. No.	**Particulars**	**2015**	**2016**	**2017**	**2018**	**2019**	**Average**
1	**Energy Requirement in kWh**						
i)	Purchase from GenCos as per TD bill	7.84	7.92	8.45	109.64	110.90	
ii)	Mini/Micro Hydel Generation						

Sl. No.	Particulars	2015	2016	2017	2018	2019	Average
iii)	Diesel Generation	0.00		0.00	0.00	0.00	
iv)	Export to Trashigang and Zhemgang	-1.82	-1.89	-2.29	-1.88	-2.82	
v)	HV Purchase				93.58	95.17	
	Total	**6.02**	**6.03**	**6.16**	**107.76**	**108.08**	
	% growth over previous year	-	0.14%	2.17%	1649.19%	0.29%	412.95%
2	**Energy Sales in kWh (Category Wise)**						
i)	LV Total	3.84	4.21	4.22	8.43	8.45	
ii)	Medium Voltage	1.33	1.11	1.11	3.25	2.87	
iii)	High Voltage				93.58	95.17	
	Total Energy Sales	**5.17**	**5.32**	**5.33**	**105.26**	**106.49**	
	% growth over previous year	-	2.81%	0.22%	1874.84%	1.17%	469.76%
	Energy Loss (1-2)	**0.85**	**0.71**	**0.83**	**2.50**	**1.59**	
	Total Loss (%)	**10.83%**	**8.99%**	**9.83%**	**2.28%**	**1.43%**	**6.67%**
	Loss excluding HV (%)	**10.83%**	**8.99%**	**9.83%**	**15.60%**	**10.10%**	**11.07%**
3	**Number of Customers (Category wise)**						
i)	**LV Total**	**4,495**	**4,635**	**4,752**	**7,584**	**7,752**	
ii)	Medium Voltage	3	3	3	4	4	
iii)	High Voltage				1	1	
	Total Customers	**4,498**	**4,638**	**4,755**	**7,589**	**7,757**	
	% growth over previous year	-	3.11%	2.52%	59.60%	2.21%	16.86%

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.

The energy consumption and energy requirement growth between the years 2017-18 indicates a drastic increase which is due to addition of Dungsam Cement Corporation Limited (DCCL) under the Dzongkhag (Nganglam Dungkhag). The DCCL factory was earlier under the jurisdiction of ESD Samdrup Jongkhar.

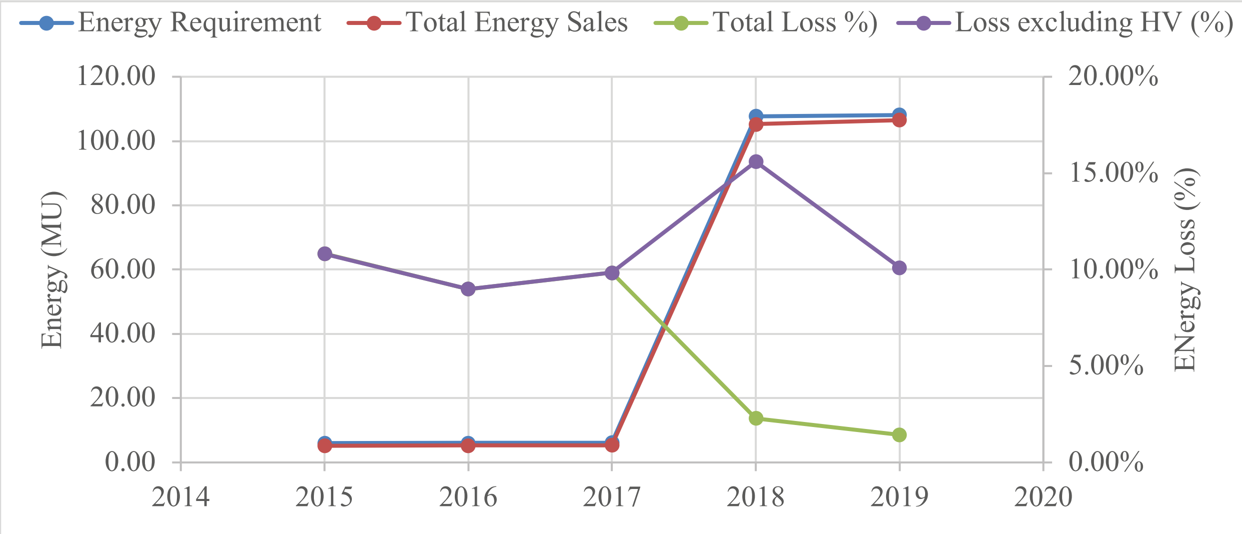


Figure 7: Energy sales, purchase and loss trend

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 the Dzongkhag (2015-2019) is 11.07% (1.69 million units on average). The loss in 2018 is 15.60% which is exceptionally high, and this has resulted in high energy loss for the Dzongkhag. Otherwise the loss is 10% which is within the acceptable range of 8.9%. The feeder wise MV and DT technical loss is as shown in **Table 10.**

Table 10: Feeder wise power Loss (Technical)

Feeder Name	Total Load (MW)	Loss (MW)	Loss (%)
Nangkhor Substation			
11 kV Nangkhor	0.196	0.002	1.02%
11 kV	0.26	0.004	1.54%
11 kV PoP	0.542	0.008	1.48%
33 kV Nanong	0.788	0.012	1.52%

Feeder Name	Total Load (MW)	Loss (MW)	Loss (%)
33 kV Tsebar	0.424	0.003	0.71%
33 kV Yurung	0.135	0.001	0.74%
Overall System loss	**2.29**	**0.034**	**1.48%**
Nganglam Substation			
11kV Nganglam	0.416	0.012	2.88%
11kV Gashari	0.012	0	0.00%
33kV Decheeling	0.319	0.002	0.63%
33kV Panbang	0.207	0.001	0.48%
33kV DCCL	0.267	0.001	0.37%
33kV DGPL	1.315	0.019	1.44%
Overall System loss	**2.501**	**0.041**	**1.64%**

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 1.56 % loss out of 11.07% as technical loss due to MV lines, DT and rest (9.51%) is due to LV and commercial loss.

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 13.89 & 28.05 respectively which indicates that the power supply to the customers of the Dzongkhag is acceptable.

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

Name of Feeder	**Reliability Indices**							
	2017		**2018**		**2019**		**Average**	
	SAIFI	**SAIDI**	**SAIFI**	**SAIDI**	**SAIFI**	**SAIDI**	**SAIFI**	**SAIDI**
33kV Nanong Feeder	4.08	9.16	2.14	1.81	2.25	2.44	2.82	4.47
33kV Tsebar feeder	3.19	3.35	1.78	2.26	1.04	2.49	2.00	2.70
33kV Yurung Feeder	1.11	1.56	0.31	1.25	0.27	0.64	0.56	1.15
11kV Nangkor Feeder	0.39	0.93	0.21	0.24	0.25	0.12	0.28	0.43
11kV PoP Feeder	0.09	0.01	-	-	-	-	0.03	0.01
11kV PG Feeder	0.39	0.17	0.10	0.09	0.08	0.13	0.19	0.13
33kV DCCL Feeder	0.01	0.01	-	-	-	-	-	-
33kV Decheeling Feeder	5.91	11.68	4.20	13.24	4.86	14.95	4.99	13.29
33kV Panbang Feeder	0.93	2.98	0.59	2.68	0.64	2.34	0.72	2.66
33kV DGCL Feeder	0.28	0.96	0.05	0.07	0.13	0.57	0.15	0.53
11kV Nganglam Feeder	2.50	2.66	1.61	2.28	2.06	2.89	2.06	2.61
11kV Gashari Feeder	0.18	0.06	0.04	0.05	0.02	0.09	0.08	0.07
Total SAIFI/SAIDI	**19.05**	**33.53**	**11.04**	**23.98**	**11.59**	**26.65**	**13.89**	**28.05**

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.

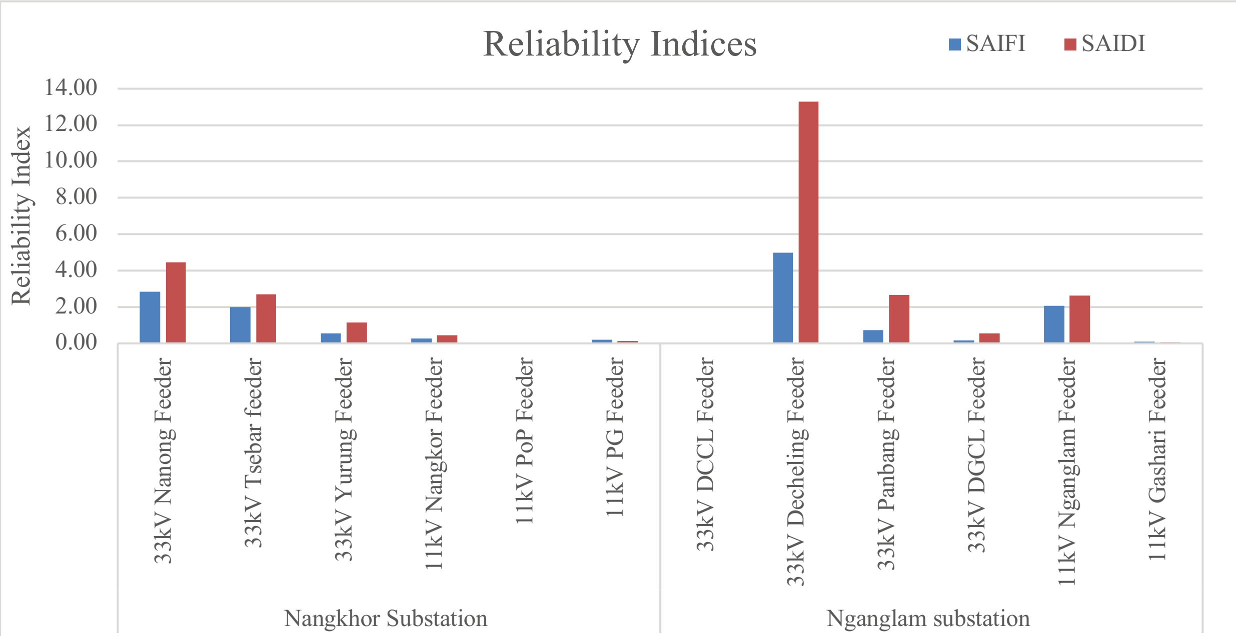


Figure 8: Graphical representation of reliability indices

As seen in **Table 11,** the average interruption per customer is 13.89 times in a year (SAIFI) and the duration of the average outages per customer is 28.05 hours (SAIDI). The table also indicates that the 33 kV Nanong and 33 kV Decheeling feeders have the highest reliability indices indicating the feeders have sustained more interruptions and took longer time to restore the power supply compared to other feeders. Feeder wise reliability improvement mechanism for two feeders are presented as follows:

a) 33kV Decheeling and Nganglam Feeders

The 33kV Decheeling feeder recorded 4.99 and 13.29 (on average from 2017-2019) as SAIFI and SAIDI respectively indicating the customers connected to this feeder has received erratic power supply compared to other customers in the Dzongkhag. In order to improve the reliability of the feeder, following corrective measures are proposed:

- It is proposed to construct an interconnection MV line of 2.5 km (approximately) from lower Khenadrang to Panthang as shown in **Figure 9** which will have alternate route. The construction of a new line will not only improve the reliability of the feeder but will also reduce the circuit line length and accordingly the system losses to some extent.

- It is proposed to construct 5.5 km (approximately) of MV line and install 33/11 kV Inter-Connection Transformer (ICT) at Nganglam for interconnecting 33 kV Decheeling and 11 kV Nganglam which is aimed at further improving reliability of 33 kV Decheeling feeder and 11kV Nganglam as well. **(OR)**

- The reliability of the 33kV Decheeling feeder can be also improved by installing 33kV Ring Main Unit (RMU) at Cheokhorling T-off to interconnect 33kV Yurung feeder (source from Nangkhor substation) and 33kV Decheeling feeder (source from Nganglam substation) as shown in **Figure 10.**

Figure 9: Proposed interconnection

b) 33kV Tshebar Feeder

The 33 kV Tshebar feeder emanating from Nangkhor substation is further transformed through 2x2.5 MVA, 33/11 kV Denchi substation. There are five DTs connected in this feeder before it terminates to the Denchi substation. Any fault emanating from DTs or in between would result in total power interruption to all the 11kV outgoing feeders (Gashari, Satshalu and Nganglam) from

Denchi substation. Therefore, it recommended to have dedicated 33kV feeder for Denchi substation. However, the proposal would require all the existing 33 kV DTs to be replaced with 11 kV DTs.

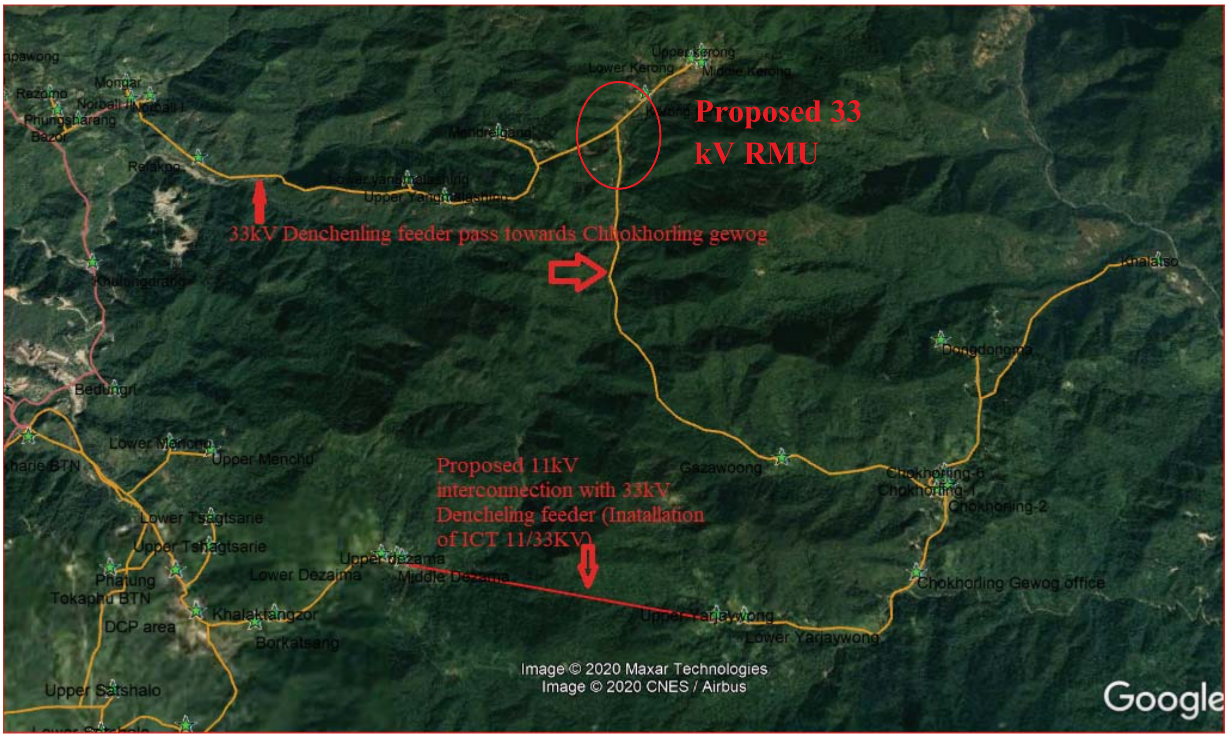


Figure 10: Interconnection of 11kV Nganglam feeder to 33kV Decheeling feeder

To get a better understanding of the reliability index, the detailed root cause outages of the individual feeder had been computed in **Table 12**.

Table 12: The Root cause analysis data

Nangkor Substation			Nganglam Substation		
Cause of Outages	**Frequency**	**Interruption %**	**Root Causes**	**Frequency**	**Interruption %**
HT fuse Replace	75	29.24%	Tree/branch fall on line	82	30.87%
Tree/branch fall on line	42	16.18%	HT fuse Replace	73	27.46%
Momentary/Transient fault	40	15.59%	RoW Clearing	47	17.80%
RoW Clearing	31	12.09%	Line Jumpering/Snap	40	14.96%

Preventive Maintenance	21	7.99%	Puncture of insulator/LA	12	4.36%
Lightning & Storm/Rain	14	5.26%	Lightning& Strom/Rain	7	2.65%
Breakdown Maintenance	13	4.87%	Momentary/Transient fault	3	1.14%
Line Jumpering/Snap	10	3.90%	Breakdown Maintenance	2	0.57%
Puncture of insulator/LA	8	2.92%	Others	1	0.19%
Others	5	1.95%	**Total**	**264.00**	**100.00%**
Total	**257**	**100.00%**			

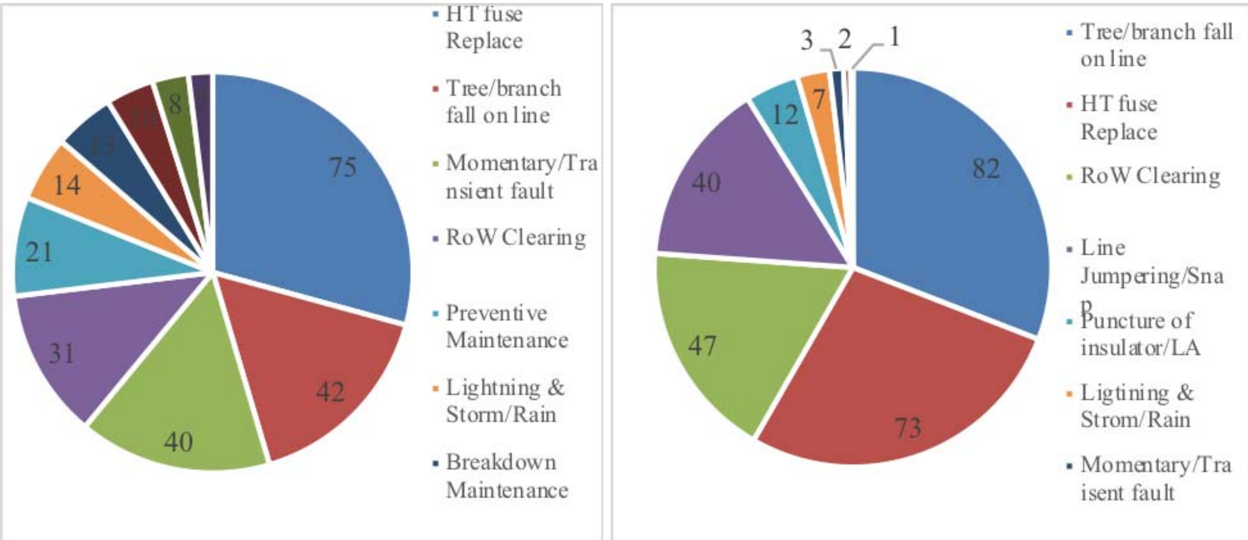


Figure 11: Graphical representation for root causes of power interruptions

Source: Adapted from monthly tripping report of DCSD, BPC

**The data is compiled for previous two years (2018&2019)*

As evident from the table, the power outages are mainly due to HT fuse replacements, trees and branches falling on the line, transient faults followed by RoW clearing are the top four root causes for power interruption for the outgoing feeders of Nangkor substations. Similarly, the power interruptions for outgoing feeders of Nganglam substation are primarily due to Tree/branches falling on the line, HT fuse replacements, RoW and line jumpering.

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.**

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:

i. 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.

ii. 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.

iii. 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. 97.00 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 31.71km and the estimate for such conversion would require Nu. 3.84 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 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 capability of the transformers for the future. 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.	DT Location Name	kVA	Existing Loading 2020		Forecasted Loading %		Remarks
			(kVA)	%	2025	2030	
1	Nangkor HS	125	65.00	52%	101%	115%	Up-grade to 315kVA post 2025. Replace with Phatawoong 315 kVA DT.
2	Lower Nangkor SS	63	29.20	46%	90%	103%	
3	Khonmari substation-I	63	36.55	58%	92%	108%	
4	Khonmari substation-II	63	43.28	69%	109%	127%	
5	Lower Khar substation	63	23.67	38%	101%	118%	Up-grade to 250kVA post 2025
6	Upper Khar substation	63	26.55	42%	113%	133%	Up-grade to 125kVA by 2025.
7	Thongsa substation	63	24.75	39%	106%	124%	Up-grade to 125kVA post 2025
8	Thungkhar substation	10	4.36	44%	118%	156%	Up-grade to 63kVA post 2025. Replace with lower Khar 63kVA DT
9	BHU, Yurung	63	28.34	45%	122%	161%	Up-grade to 125kVA by 2025.
10	Phatawoong, Nganglam	315	225.38	72%	149%	176%	Up-grade to 750kVA by 2025.
11	Nganglam Bazar (old DCCL colony)	315	196.73	62%	130%	154%	Up-grade to 500kVA by 2025
12	Kilikher, Thsenkeri	25	10.05	40%	84%	99%	
13	Bapta	63	23.23	37%	81%	103%	
14	Bazor	16	7.60	47%	104%	133%	Up-grade to 25kVA post 2025. Replace with Telung 25kVA DT
15	Rezomo	16	6.09	38%	83%	107%	
16	Relakpo	30	23.94	80%	174%	224%	Up-grade to 63kVA by 2025. Replace with upper Khar 63kVA DT.
17	Mandralgang	25	9.79	39%	86%	110%	

Sl. No.	DT Location Name	kVA	Existing Loading 2020		Forecasted Loading %		Remarks
			(kVA)	%	2025	2030	
18	Telung village	25	14.14	57%	124%	159%	Up-grade to 125kVA by 2025.
19	Ballee	25	10.81	43%	95%	121%	
20	Daksa School Area	16	10.39	65%	142%	182%	Up-grade to 30kVA by 2025. Replace with Relakpo 30kVA by 2025.
21	Pemathang	25	8.18	33%	105%	127%	
22	Lashingri	25	8.05	32%	103%	125%	
23	Rinchenzor	16	4.11	26%	82%	100%	
24	Ningshingborang (school area)	25	6.68	27%	86%	104%	
25	Gewog office	25	11.46	46%	147%	178%	
26	Middle Tsheshingzor	16	5.17	32%	104%	125%	
27	Daksa School	25					

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 twenty seven (27) transformers as tabulated in **Table 13**. However, cross-swapping the existing transformers prior to procurement of new transformers would mean that, only seven (7) 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 transmit 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

Sl. No.	DT Location Name	Transformer Ratio	kVA	MFD	2020	2025	2030
1	Upper Nangkor substation	11/0.415kV	125	1997	23	28	33
2	Telecom substation	11/0.415kV	25	1996	24	29	34
3	Dzong substation	11/0.415kV	250	1995	25	30	35
4	Rinchenthang (old Check Post Area)	11/0.415kV	100	1987	33	38	43
5	Lower Menchu	11/0.415kV	63	1976	44	49	54

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. Sum 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 52 single phase transformers in the Dzongkhag and the estimate for up-grading all the single to three-phase transformers would require Nu. 11.05 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

The Dzongkhag comprises of eleven (11) Gewogs (Zobel, Shumar, Khar, Yurung, Chongshing, Dungmin, Chimmung, Decheeling, Cheokhorling, Nanong and Norbugang). **Figure 12** shows the structural plan of Denchi LAP and 181 plots have been allotted for the construction as detailed in **Table 15.**

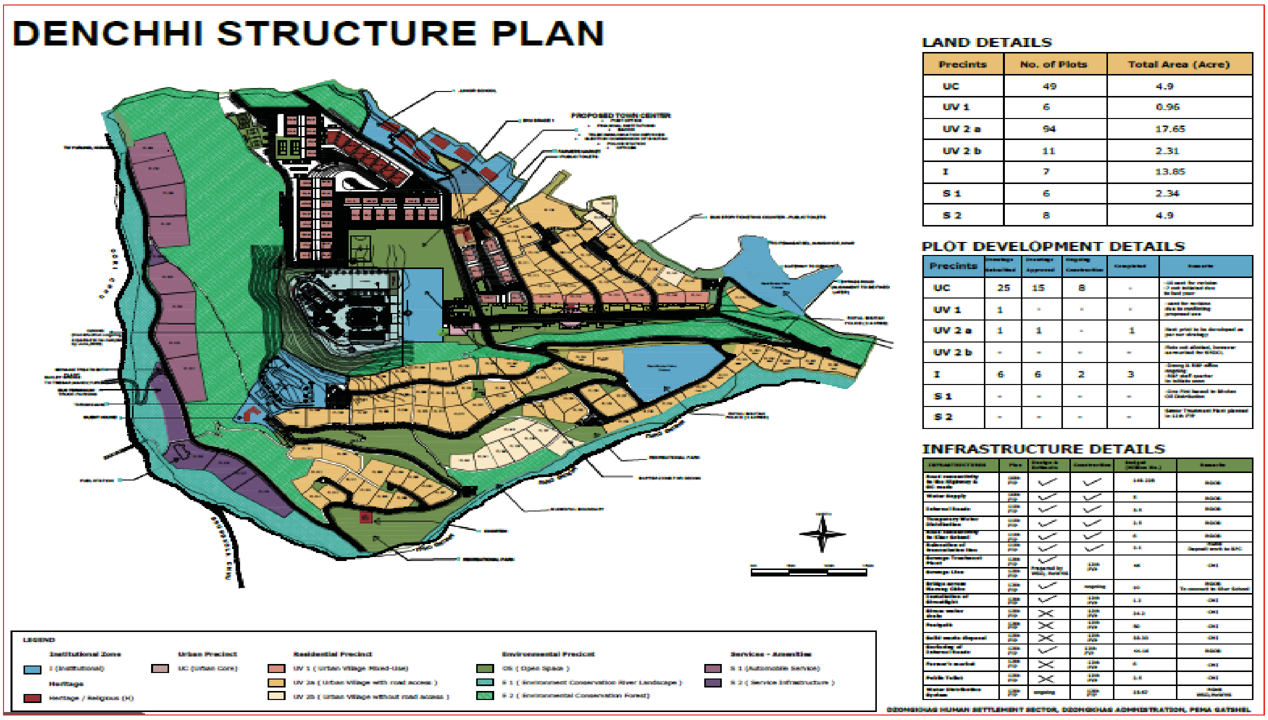


Figure 12: Structure plan for Denchhi town.

Table 15: Infrastructure detail of Denchi town

Sl.No.	Particulars	No. of Buildings	Average Demand Load (W)	Total Demand Load (W)
1	Urban Core (Commercial)	49	138,565.00	6,789,685.00
2	Mixed (GF commercial residential	6	112,368.00	674,208.00
3	Urban Village (residential with road access)	94	79,716.00	7,493,304.00
4	Urban Village 2b (residential without road access)	11	79,716.00	876,876.00
5	Institutional (Dzong, RBP, Thrimkhang etc.)	7	180,720.00	1,265,040.00
6	Service 1 (light industry and automobile)	8	125,466.00	1,003,728.00

Sl.No.	Particulars	No. of Buildings	Average Demand Load (W)	Total Demand Load (W)
7	Service 2 (common service)	6	50,000.00	300,000.00
	Total	**181**	**766,551.00**	**18,402,841.00**

As shown in **Table 15,** power requirement of 18.40 MW is estimated which is unrealistic judging from the power demand of other more developed Dzongkhags. To be more realistic, the power demand has been estimated assuming a coincident peak power demand of 2 kW per customer. While for the institutions, the power demand has been estimated considering the power consumption of other similar institutes. Accordingly, the power demand of Denchi town works out to be 2.57 MW as shown in **Table 16** when all the 181 units are operational which is considered in two time horizons (2025-1.40MW & 2030-2.57MW) for analysis purpose. **Figure 13** depicts the proposed location of DTs and 11 kV overhead line extensions to the new town. Installation of two additional DT (11/0.415 kV, 500 and 750 kVA) is essential to cater to a load of Denchi town.

Table 16: Power demand projection of Denchi town

Sl.No.	Particulars	No. of Buildings	Average Demand (kW)	Total Demand Load (kW)	Remarks
1	Urban Core (Commercial)	49	2.00	588.00	6 units considered for each building
2	Mixed (GF commercial+residential)	6	2.00	72.00	
3	Urban Village 2a (residential with road access)	94	2.00	1,128.00	
4	Urban Village 2b (residential without road access)	11	2.00	132.00	
5	Institutional (Dzong, RBP, Thrimkhang etc.)	7	70.00	490.00	
6	Service 1 (light industry and automobile)	8	2.00	96.00	

Sl.No.	Particulars	No. of Buildings	Average Demand (kW)	Total Demand Load (kW)	Remarks
7	Service 2 (common service)	6	2.00	72.00	
	Total	**181**		**2,578.00**	

Figure 13: Distribution Network for Denchi town

Nganglam being another commercial hub and satellite town of the Dzongkhag, without concrete information of the approved structured plan, it is proposed to install additional 750kVA DT.

As a transitional phase, in urban areas of Dzongkhag, it would be prudent to opt for HV ABC/UG lines for MV lines considering that ACSR conductors pose serious RoW and safety constraints.

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

As per power source assessment made in **Section 7.1.1,** the 132/33kV, 2x5 MVA, Nangkor and 132/33kV, 2x3.5MVA, Nganglam substations would be adequate to cater the existing and forecasted power demand.

8.1.2 MV Substations

Similarly, as detailed in **Section 7.1.2,** MV substation would be adequate to cater the existing and forecasted power requirement.

8.2 MV Lines

As detailed in **Section 7.2,** the MV distribution lines of would be adequate to cater the power requirement till 2030 nevertheless, for a reliable power supply, it is proposed to:

a) Construct 2.8km of 33 kV line from Yurungzampa to Denchi substation for the arrangement of the alternative source from the Nganglam substation;

b) Extend 2.5km of 33 kV Nanong feeder from lower Khandrang to Pangthang to improve the reliability of the Nanong and Decheeling feeders; and

c) Improve the reliability of 33 kV Decheeling feeder it is proposed to:

- Extend5.5 km of 33 kV line and installation of 33/11 kV Inter-Connection Transformer (ICT) to interconnect 33 kV Decheeling and 11 kV Nganglam feeder **(OR)**
- Install 33kV Ring Main Unit (RMU) at Cheokhorling T-off to interconnect the Yurung and Decheeling feeder.

8.3 Distribution Transformers

As detailed in **Section 7.3.1,** the DTs of urban areas might get overloaded as forecasted and considering the plans of the LAPs, following are the list of DTs which would require either up-gradation or installation of new substations.

a) Up-grade 125kVA, 11/0.415kV transformer at Nangkor School to 250 kVA.

b) Up-grade 63kVA, 33/0.415kV transformer at Lower Khar to 250 kVA.

c) Up-grade 63kVA, 33/0.415kV transformer at Upper Khar to 125 kVA.

d) Up-grade 63kVA, 33/0.415kV transformer at Thongsa to 125 kVA.

e) Up-grade 10kVA, 33/0.230kV transformer at Thungkhar to 63kVA.

f) Up-grade 63 kVA, 33/0.415kV transformer at Yurung BHU to 125 kVA.

g) Up-grade 315kVA, 11/0.415kV transformer at Phatawoong to 750 kVA

h) Up-grade 315 kVA, 11/0.415kV transformer at Old DCCL colony to 500 kVA

i) Up-grade 16 kVA, 33/0.230kV transformer at Bazor to 25kVA.

j) Up-grade 30 kVA, 33/0.415kV transformer at Relakpo to 63 kVA

k) Up-grade 25 kVA, 33/0.415kV transformer at Telung to 125 kVA.

l) Up-grade 16 kVA, 33/0.230kV transformer at Daksa School to 30 kVA.

m) Up-grade 25 kVA, 33/0.230kV transformer at Daksa School to 63 kVA.

n) Construction of 750 kVA, 11/0.415 transformer at Denchi Town (commercial areas)

o) Construction of 500 kVA, 11/0.415 transformer at Denchi town (Residential areas)

p) Construction of ICT 11/33kV at Nganglam for interconnection of 33kV Decheeling and 11kV Nganglam feeder.

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. Similarly, 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 33 kV (Nanong, Yurung, Tshebar, Decheeling & Panbang) feeder & 11kV (Nankor & Nganglam) feeders seem to be more susceptible. In order to improve reliability and power quality of the above mentioned feeders which are more susceptible to power outages (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 14 & Table 17** shows the list of proposed switching devices for easing operation and maintenance and for improving the reliability of the power supply for the Dzongkhag Dzongkhag.

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

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.

Table 17: List of switching equipment

Sl. No.	Name of Feeder	ARCBs		FPIs		Sectionalizer
		Existing	Proposed	Existing	Proposed	Proposed
1	33kV Nanong feeder	2	0	0	7	2
2	33kV Tshebar feeder	1	0	0	7	
3	33kV Yurung feeder	1	0	0	7	
4	11kV Nganglam	0	0	0	2	
5	11kV Satshalo	0	0	0	1	
6	33kV Decheeling feeder	1	1	0	6	2
3	33 kV Pangbang feeder	1	0	0	3	
	Total	**6**	**1**	**0**	**33**	**4**

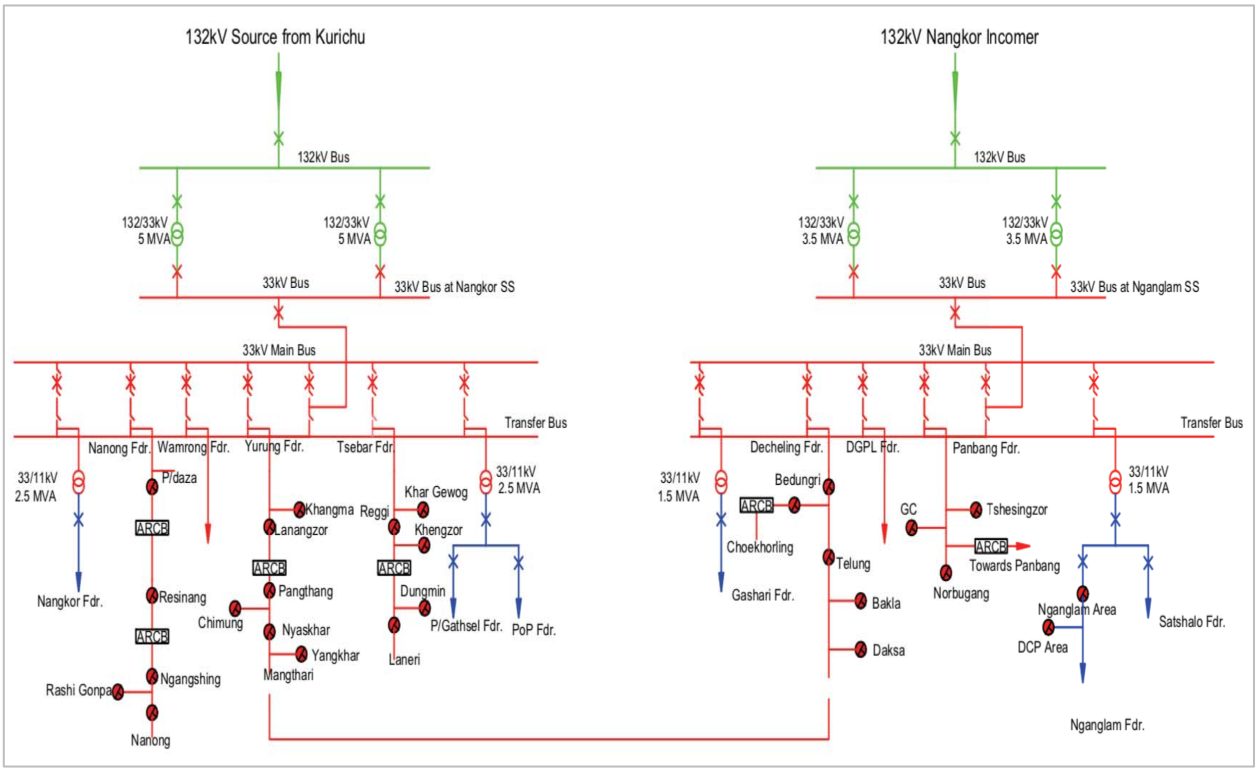


Figure 14: Switching equipment for distribution network

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, SCADA 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 15.**

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.

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 15: Priority Matrix

According to the investment prioritization matrix framework, the yearly investment plan along with the cost estimation is derived and is consolidated in **Table 18** 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 adequately deliver the power to the customers of Pemagatshel Dzongkhag is Nu. 86.19 million (Nu. 8.62 million per year).

Table18: Investment Plan till 2030

Sl.No.	Activities	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
1	**MV Lines**												
1.1	Construction 1km 11kV line with AAAC to Denchi town with 500kVA USS		-	-	-	-	2.80	-	-	-	-	-	**2.80**
1.2	Construction of 2.8km 33kV Yurung from Yurungzamp to 33/11kV Denchi SS		4.20	-	-	-	-	-	-	-	-	-	**4.20**
1.3	Construction of 3.2km 33kV Nanong feeder from Lower Khandrang SS to Pangthang SS		-	-	-	-	-	-	-	-	-	-	**0.00**
1.4	Construction of 5.5km 33kV line and 0.5km 11kV line with 11/33kV ICT at Nganglam		-	4.80	-	-	-	-	-	-	-	-	**4.80**
1.5	Conversion of OH line to UG 11kV around Nganglam Bazar 4kM		-	-	-	-	5.00	-	-	-	-	-	**5.00**
1.6	Conversion of 11kV Nganglam feeder from ACSR Rabbit to ACSR Dog from SMD Phatowoong 3km		-	-	2.00	-	-	-	-	-	-	-	**2.00**
1.7	Construction of 33kV Line & 30kVA at Lashingre Village of 3km for upcoming household (application received from customer/Gewog)		3.40	-	-	-	-	-	-	-	-	-	**3.40**
1.8	Construction of 33kV Line & 25kVA at Domling Village of 2km for upcoming household (Application received from customer)		-	4.20	-	-	-	-	-	-	-	-	**4.20**
1.9	Single Phase to Three-phase Line conversion		0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	**3.80**
2	**LV Lines**												**0.00**

Sl.No.	Activities	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
2.1	Construction of 4km 95 sq.mm LV ABC line for new upcoming Denchi town.		1.32	1.32	-	-	-	-	-	-	-	-	**2.64**
2.2	Construction of 4Cx150sq.mm UG LV at Denchi Town 5KM		-	-	2.20	3.30	-	-	-	-	-	-	**5.50**
2.3	Up-grade 5km of LV ABC to UG of 4core 95sqmm LV line for upcoming town plan for Nganglam						3.50	5.00		2.00			**10.50**
3	**Distribution Transformers**												**0.00**
3.1	Construction 500kVA for industrial area, BOD & Bus terminal		-	-	-	-	-	-	1.00	-	-	-	**1.00**
3.2	Construction of 33kV, 750kVA for upcoming town at Nganglam								1.00				**1.00**
3.3	Construction of 750kVA at Denchi with 150m 150sq.mm UG cable		1.00										**1.00**
3.4	Conversation of 33kV distribution transformer to 11kV distribution transformer Borangchilo		0.50	-	-	-	-	-	-	-	-	-	**0.50**
3.5	Nangkor Higher Secondary School s/s (11/0.415kV, 125KVA) upgrade to 250kVA						1.00						**1.00**
3.6	Lower Nangkor substation (11/0.415kV, 63kVA to 125kVA)											0.70	**0.70**
3.7	Lower Khar substation (33/0.415kV, 63kVA to 250kVA)			1.00									**1.00**
3.8	Upper Khar substation (33/0.415kV, 63kVA to 125kVA)									0.90			**0.90**
3.9	Thongsa substation (33/0.415kV, 63kVA to 125kVA)								1.00				**1.00**

Sl.No.	Activities	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
3.11	Thungkhar substation (33.0.240kV, 10KVA to 30kVA-33/0.240KV)					0.30							**0.30**
3.12	BHU, Yurung (33/0.415kV, 63kVA to 125kVA)				0.25								**0.25**
3.13	Phatawoong, Nganglam (11/0.415kV, 315kVA to 750kVA)			1.00									**1.00**
3.14	Nganglam Bazar (old DCCL colony) (11/0.415kV, 315kVA to 750kVA)		1.50										**1.50**
3.15	Bapta (33/0.415kV, 63kVA to 125kVA)											0.30	**0.30**
3.16	Bazor (33/0.240kV, 16kVA to 30kVA)							0.18					**0.18**
3.17	Rezomo (33/0.240kV, 16kVA to 30kVA)											0.18	**0.18**
3.18	Relakpo (33/0.415kV, 30kVA to 63kVA)			0.30									**0.30**
3.19	Mandralgang (33/0.240kV, 25kVA to 30kVA)										0.18		**0.18**
3.20	Telung village (33/0.240kV, 25kVA to 63kVA-33/0.415kV)			0.30									**0.30**
3.21	Ballee (33/0.240kV, 25kVA to 30kVA)											0.18	**0.18**
3.22	Daksa School Area (33/0.240kV, 16kVA to 30kVA)											0.18	**0.18**
3.23	Pemathang (33/0.415kV, 25kVA to 63kVA)									0.30			**0.30**
3.24	Lashingri (33/0.415kV, 25kVA to 63kVA)											0.30	**0.30**
3.25	Ningshingborang (school area) (33/0.415kV, 25kVA to 63kVA)					0.30							**0.30**
3.26	Gewog office (33/0.240kV, 25kVA to 63kVA-33/0.415kV)					0.30							**0.30**
3.27	Middle Tsheshingzor (33/0.240kV, 16kVA to 30kVA)											0.30	**0.30**

Sl.No.	Activities	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
3.28	Replacement of single by three-phase transformer		1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	**11.10**
4	**Switching and Control**		-	-	-	-	-	-	-	-	-	-	**0.00**
4.1	Installation of RMU 33kV at 33kV Decheeling feeder						5.00						**5.00**
4.2	Installation of 33kV and 11kV LBS		2.40	1.00	1.00	0.40	0.60	0.40	0.40	0.20	0.20	0.20	**6.80**
	Total	**0.00**	**15.81**	**15.41**	**6.94**	**6.09**	**19.39**	**7.07**	**4.89**	**4.89**	**1.87**	**3.83**	**86.19**

10. Conclusion

Based on the inputs from 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 and 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 to 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	132/33/11kV Nangkor and 132/33/11kV Nganglam substations would be adequate to cater the load requirement.
2	MV Substations	The 33/11kV Denchi substation would be adequate to cater the load requirement.
B. MV Lines		
1	33kV Decheeling & Tshebar Feeders	In order to improve reliability to these feeders and reduce loss, as detailed in **Section 7.2.3,** it recommended implementing the proposed interconnecting MV lines and RMU.
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.

Sl. No.	Parameters	Recommendations
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 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 or the number of customers affected. In this regard, the following initiatives are recommended:

Sl. No.	Parameters	Recommendations
		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. Annexures

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: Overloaded DTs

Annexure-8: Material Cost for 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. Pemagatshel 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

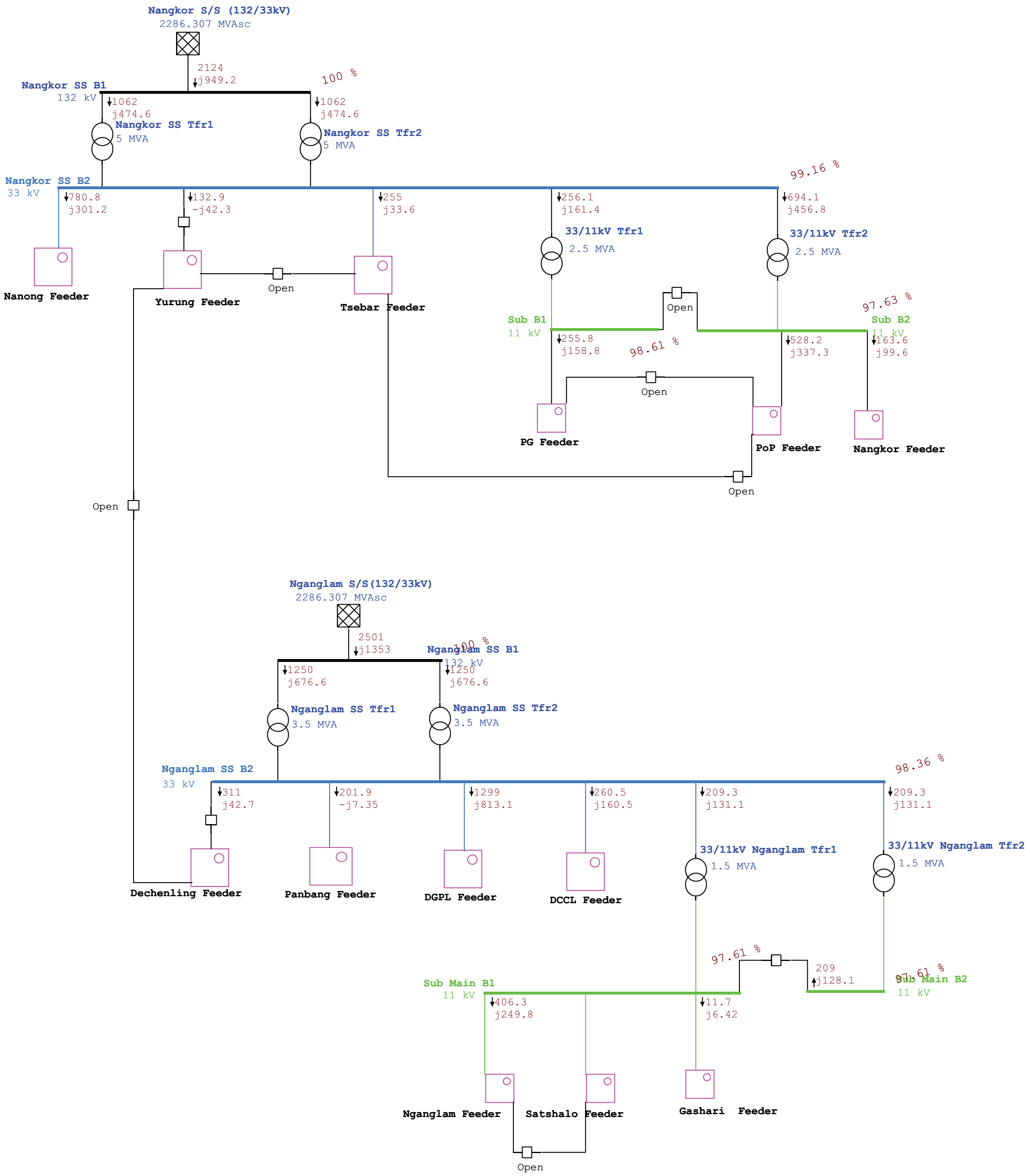
Sl. No.	Parameters	Challenges	Opportunities/Proposals
1	Software Tool (ETAP)	a) Only one key & off-line Key b) Balanced Load Flow c) Limitations of No. of buses (1000)	a) Can opt for on line key with fewer more modules especially to carry out the technical evaluation of un-balanced load flow system. This would be more applicable and accrue good result for LV networks.

Sl. No.	Parameters	Challenges	Opportunities/Proposals
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.

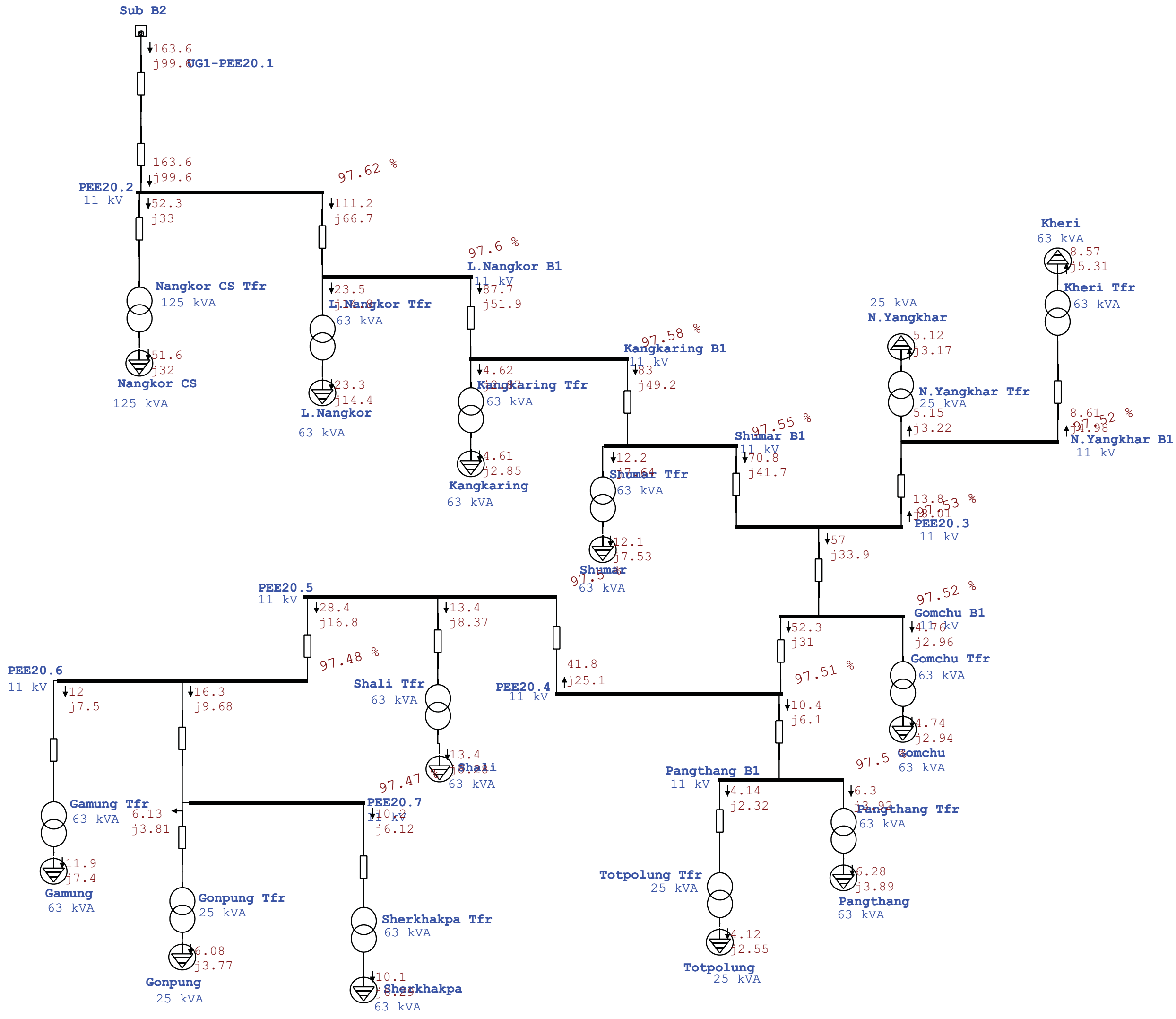
12. Annexures

Annexure-1: MV Line Details and Single Line Diagram

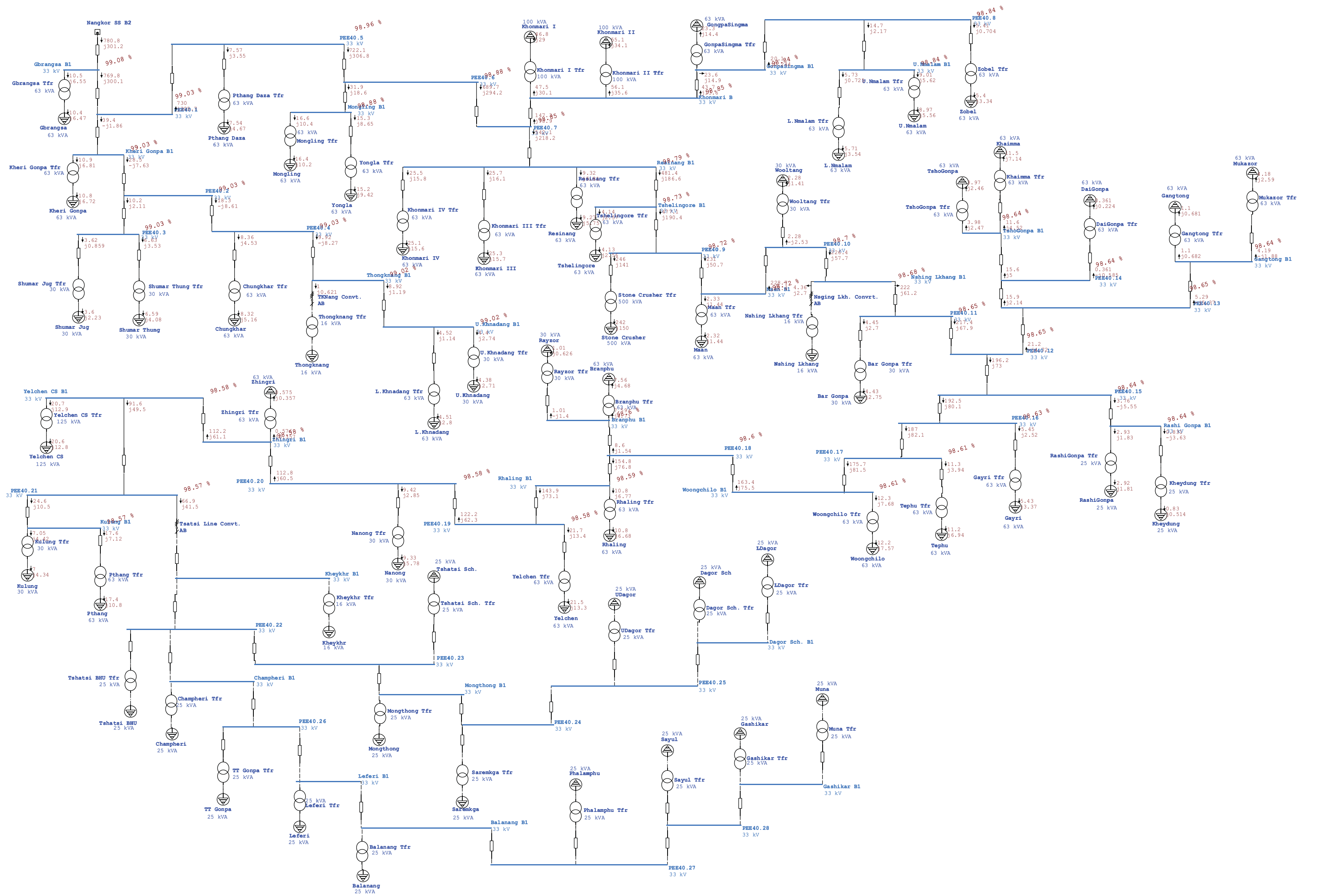
One-Line Diagram - PG (Load Flow Analysis)

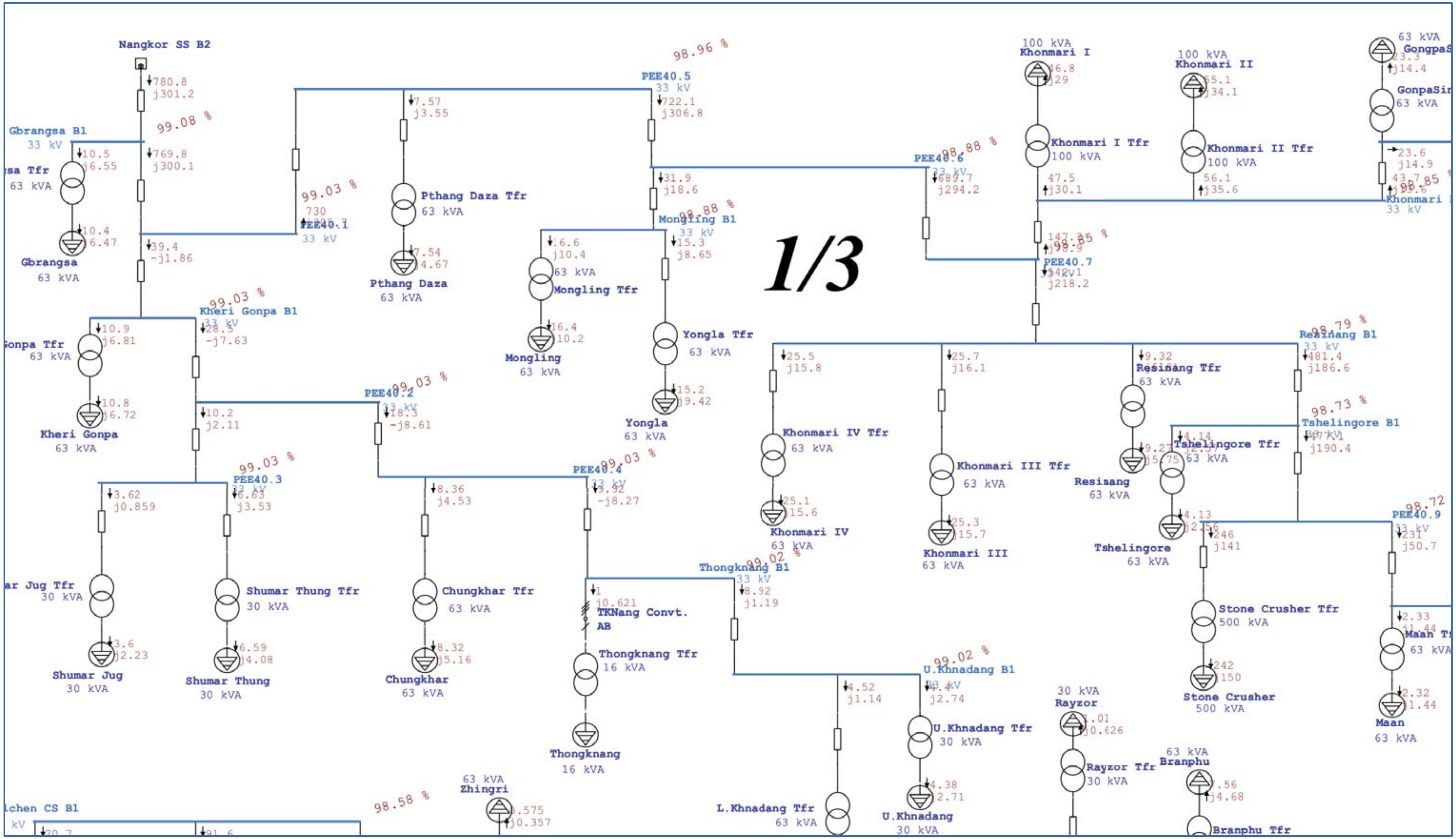


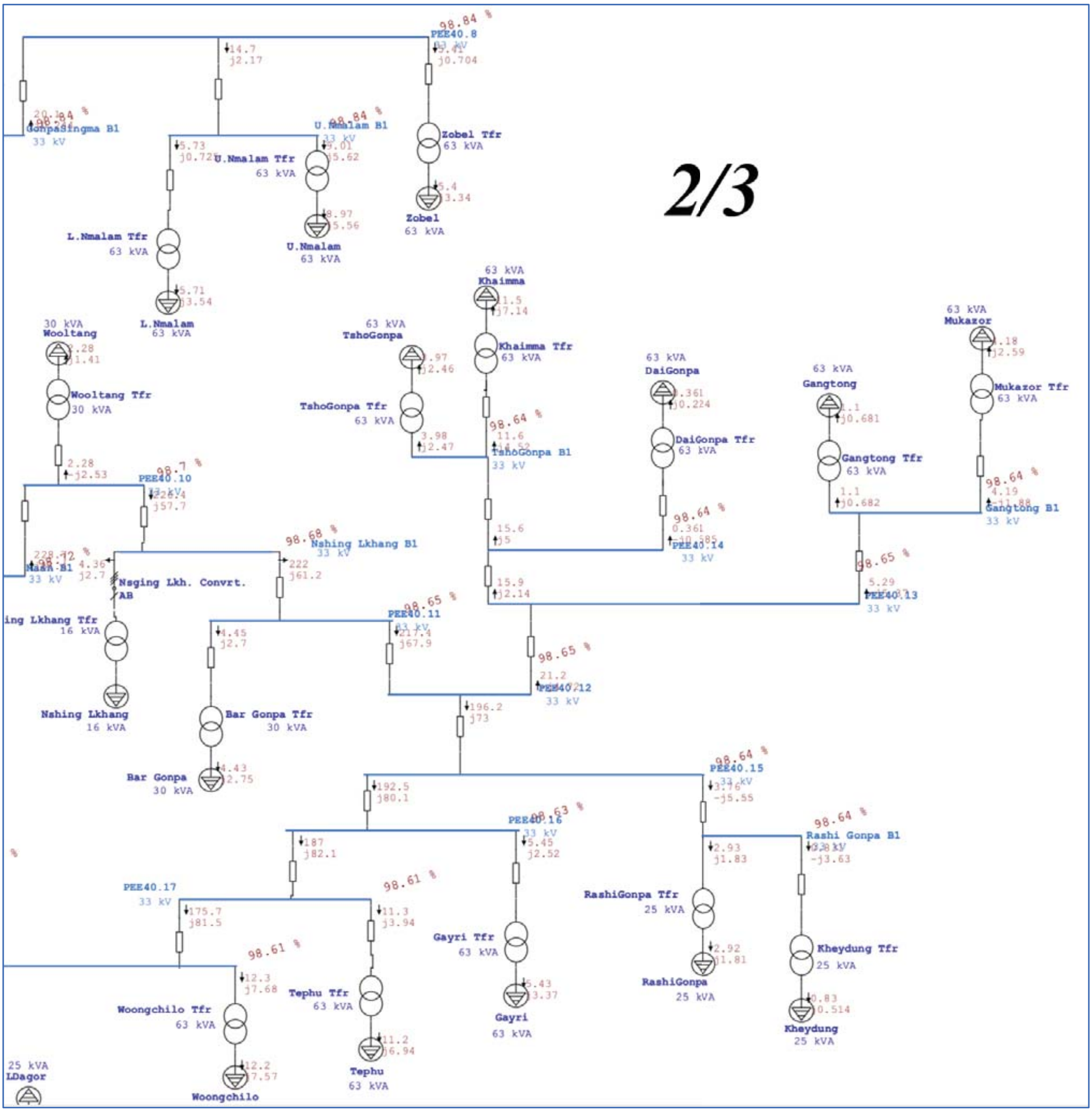
One-Line Diagram - PG=>Nangkor Feeder (Load Flow Analysis)



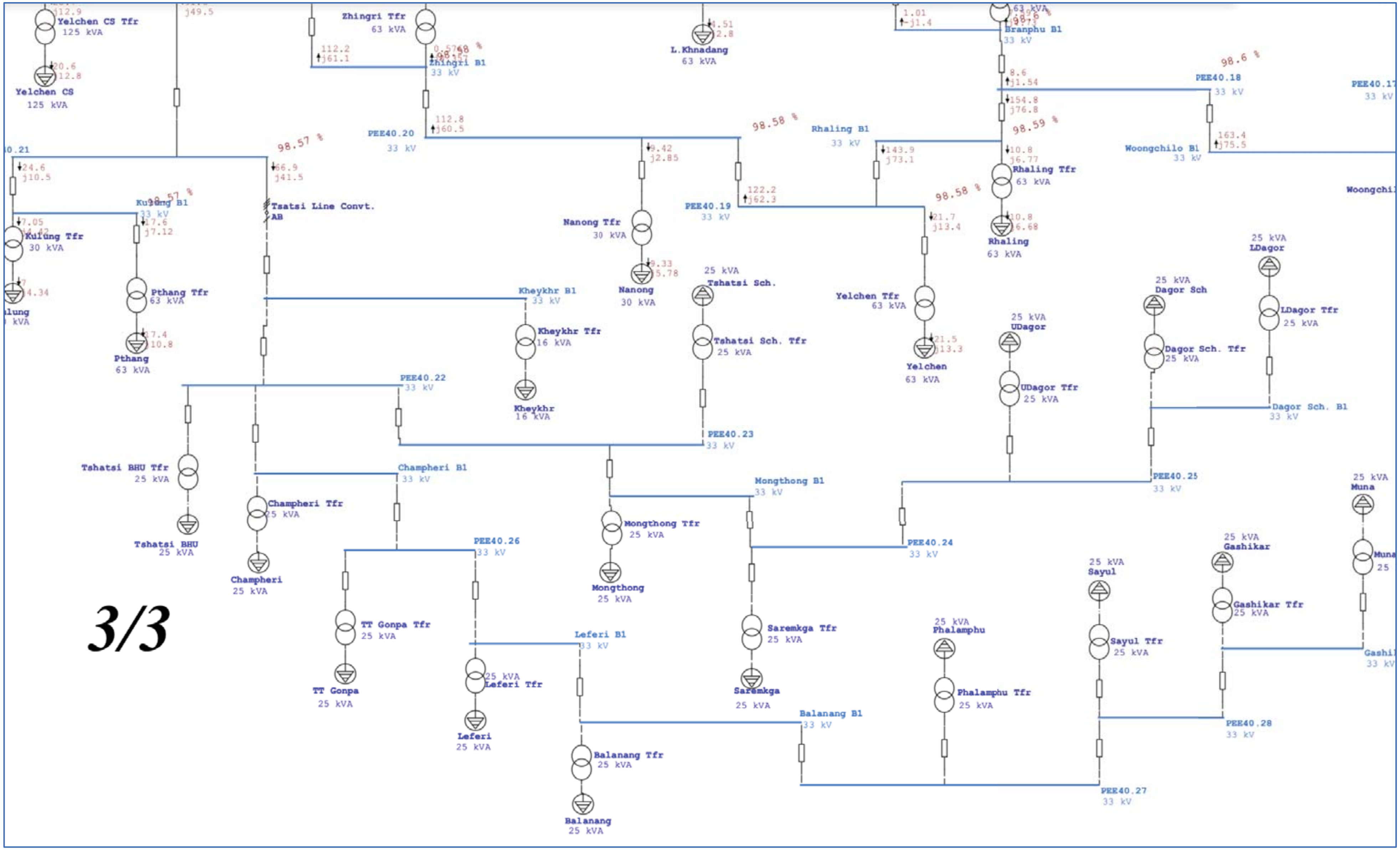
One-Line Diagram - PG=>Nanong Feeder (Load Flow Analysis)




1/3
Nangkor SS B2
780.8
j301.2
99.08 %
769.8
j300.1
Gbrangsa B1
33 kV
Gbrangsa
63 kVA
PEE40.1
33 kV
99.03 %
PEE40.5
33 kV
98.96 %
722.1
j306.8
Pthang Daza Tfr
63 kVA
Pthang Daza
63 kVA
Kheri Gonpa B1
99.03 %
Kheri Gonpa
63 kVA
PEE40.2
PEE40.3
PEE40.4
Shumar Jug
30 kVA
Shumar Thung Tfr
30 kVA
Shumar Thung
30 kVA
Chungkhar Tfr
63 kVA
Chungkhar
63 kVA
TKNang Convt.
AB
Thongknang Tfr
16 kVA
Thongknang
16 kVA
Thongknang B1
99.02 %
Mongling B1
98.88 %
Mongling Tfr
63 kVA
Mongling
63 kVA
Yongla Tfr
63 kVA
Yongla
63 kVA
PEE40.6
98.88 %
689.7
j294.2
PEE40.7
j218.2
Khonmari I
100 kVA
Khonmari I Tfr
100 kVA
Khonmari II
100 kVA
Khonmari II Tfr
100 kVA
GonpaSir
63 kVA
Khonmari IV Tfr
63 kVA
Khonmari IV
63 kVA
Khonmari III Tfr
63 kVA
Khonmari III
63 kVA
Resinang B1
98.79 %
33 kV
481.4
j186.6
Resinang Tfr
63 kVA
Resinang
63 kVA
Tshelingore B1
98.73 %
j190.4
Tshelingore Tfr
63 kVA
Tshelingore
63 kVA
PEE40.9
98.72
231
j50.7
Stone Crusher Tfr
500 kVA
Stone Crusher
500 kVA
Maan
63 kVA
U.Khnadang B1
99.02 %
U.Khnadang Tfr
30 kVA
U.Khnadang
30 kVA
L.Khnadang Tfr
63 kVA
Rayzor
30 kVA
Rayzor Tfr
30 kVA
Branphu
63 kVA
Branphu Tfr
Zhingri
63 kVA
98.58 %



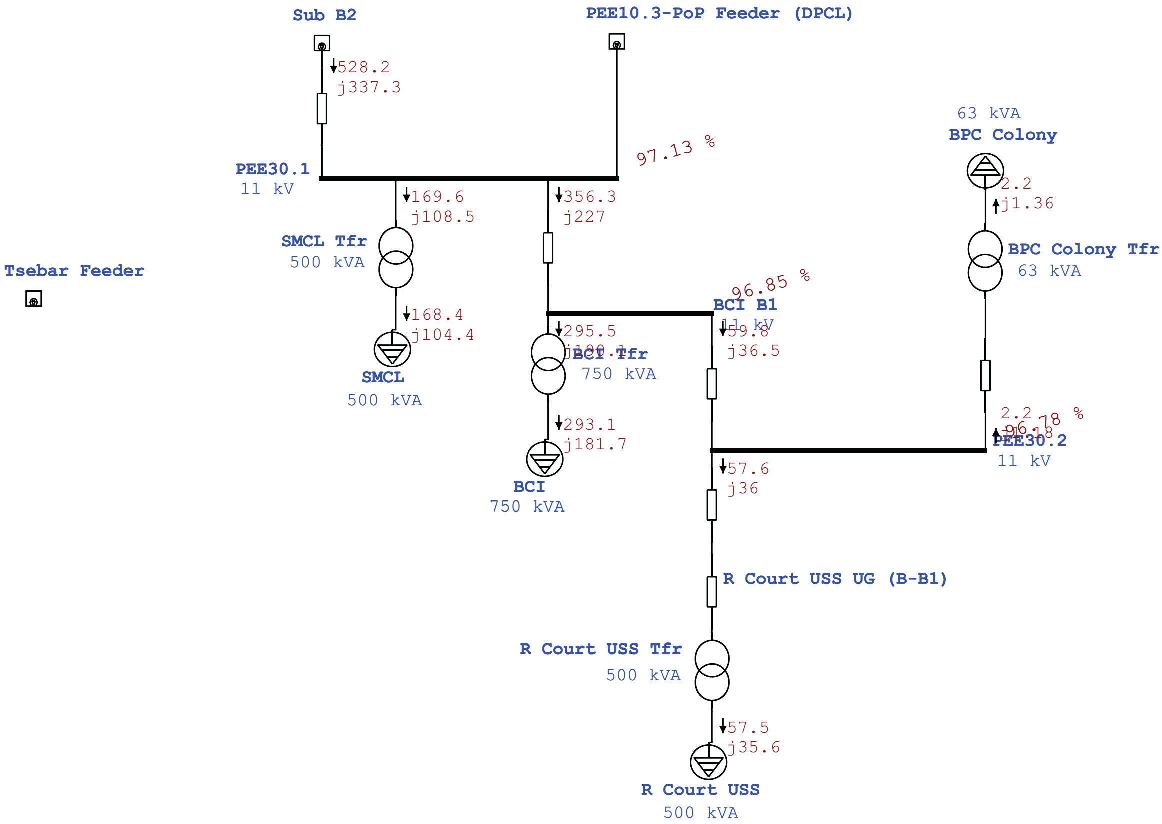
2/3
PEE40.8
Gonpasingma B1
33 kV
U.Nmalam B1
U.Nmalam Tfr
63 kVA
Zobel Tfr
63 kVA
Zobel
63 kVA
L.Nmalam Tfr
63 kVA
U.Nmalam
63 kVA
L.Nmalam
63 kVA
Khaimma
63 kVA
Khaimma Tfr
63 kVA
TshoGonpa
63 kVA
TshoGonpa Tfr
63 kVA
TshoGonpa B1
33 kV
Wooltang
30 kVA
Wooltang Tfr
30 kVA
DaiGonpa
63 kVA
DaiGonpa Tfr
63 kVA
Gangtong
63 kVA
Gangtong Tfr
63 kVA
Mukazor
63 kVA
Mukazor Tfr
63 kVA
Gangtong B1
33 kV
PEE40.10
PEE40.14
33 kV
PEE40.13
33 kV
Nshing Lkhang B1
33 kV
Nsging Lkh. Convrt.
AB
Nshing Lkhang
16 kVA
PEE40.11
PEE40.12
33 kV
Bar Gonpa Tfr
30 kVA
Bar Gonpa
30 kVA
PEE40.15
PEE40.16
Rashi Gonpa B1
RashiGonpa Tfr
25 kVA
RashiGonpa
25 kVA
Kheydung Tfr
25 kVA
Kheydung
25 kVA
Gayri Tfr
63 kVA
Gayri
63 kVA
PEE40.17
33 kV
Tephu Tfr
63 kVA
Tephu
63 kVA
Woongchilo Tfr
63 kVA
Woongchilo
LDagor
25 kVA



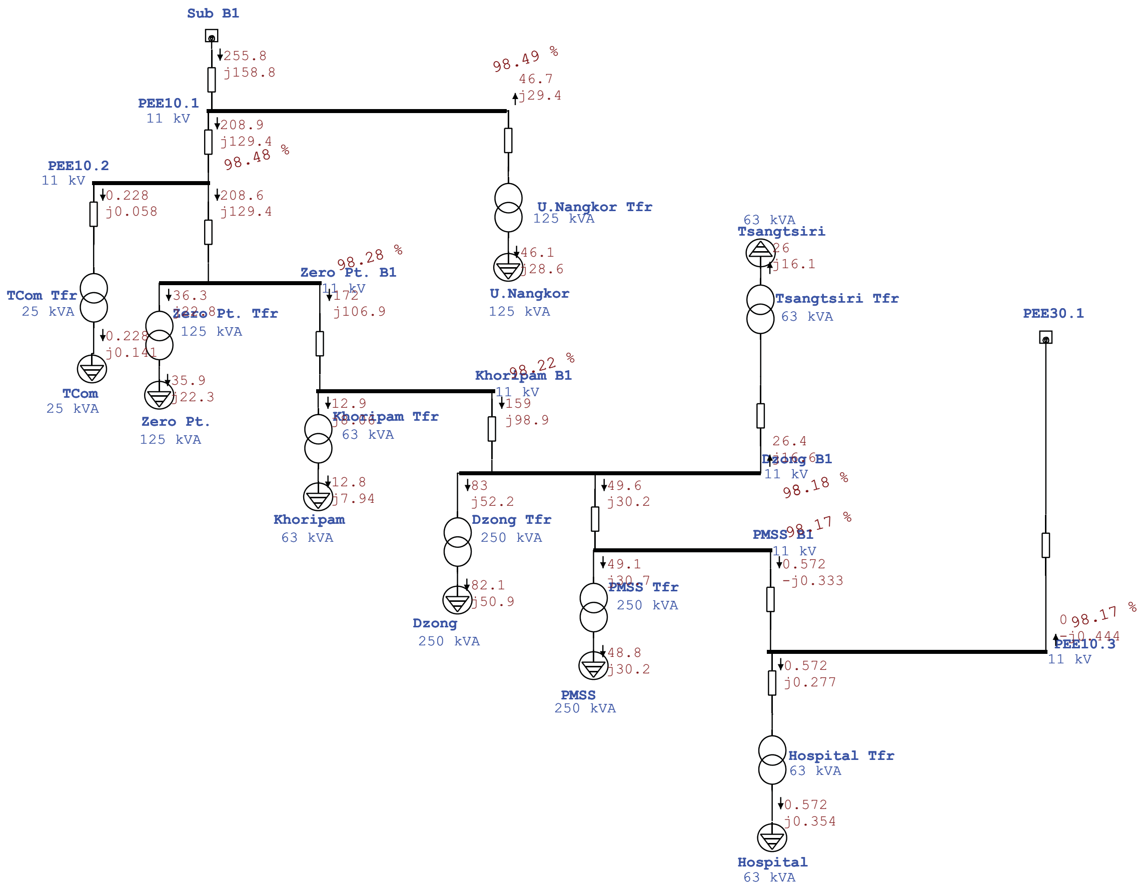
Yelchen CS Tfr
125 kVA
Yelchen CS
125 kVA
j49.5
Zhingri Tfr
63 kVA
112.2
j61.1
Zhingri B1
33 kV
112.8
j60.5
PEE40.20
33 kV
L.Khnadang
63 kVA
1.01
j1.4
Branphu B1
33 kV
8.6
j1.54
154.8
j76.8
98.59 %
98.6 %
PEE40.18
33 kV
PEE40.17
33 kV
163.4
j75.5
Woongchilo B1
33 kV
Woongchi
98.57 %
24.6
j10.5
66.9
j41.5
Tsatsi Line Convt.
AB
Kulung B1
33 kV
17.6
j7.12
Kulung Tfr
30 kVA
4.34
Pthang Tfr
63 kVA
17.4
10.8
Pthang
63 kVA
9.42
j2.85
Nanong Tfr
30 kVA
Nanong
30 kVA
98.58 %
Rhaling B1
33 kV
143.9
j73.1
122.2
j62.3
PEE40.19
33 kV
10.8
j6.77
Rhaling Tfr
63 kVA
10.8
6.68
Rhaling
63 kVA
98.58 %
21.7
j13.4
Yelchen Tfr
63 kVA
21.5
j13.3
Yelchen
63 kVA
25 kVA
Tshatsi Sch.
Tshatsi Sch. Tfr
25 kVA
Kheykhr B1
33 kV
Kheykhr Tfr
16 kVA
Kheykhr
16 kVA
PEE40.22
33 kV
PEE40.23
33 kV
Tshatsi BHU Tfr
25 kVA
Tshatsi BHU
25 kVA
Champheri B1
33 kV
Champheri Tfr
25 kVA
Champheri
25 kVA
PEE40.26
33 kV
TT Gonpa Tfr
25 kVA
TT Gonpa
25 kVA
25 kVA
Leferi Tfr
Leferi
25 kVA
Leferi B1
33 kV
Balanang Tfr
25 kVA
Balanang
25 kVA
Balanang B1
33 kV
Mongthong B1
33 kV
Mongthong Tfr
25 kVA
Mongthong
25 kVA
Saremkga Tfr
25 kVA
Saremkga
25 kVA
PEE40.24
33 kV
25 kVA
UDagor
UDagor Tfr
25 kVA
25 kVA
Dagor Sch
Dagor Sch. Tfr
25 kVA
25 kVA
LDagor
LDagor Tfr
25 kVA
Dagor Sch. B1
33 kV
PEE40.25
33 kV
25 kVA
Phalamphu
Phalamphu Tfr
25 kVA
PEE40.27
33 kV
25 kVA
Sayul
Sayul Tfr
25 kVA
25 kVA
Gashikar
Gashikar Tfr
25 kVA
PEE40.28
33 kV
25 kVA
Muna
Muna
25
Gashi
33 kV

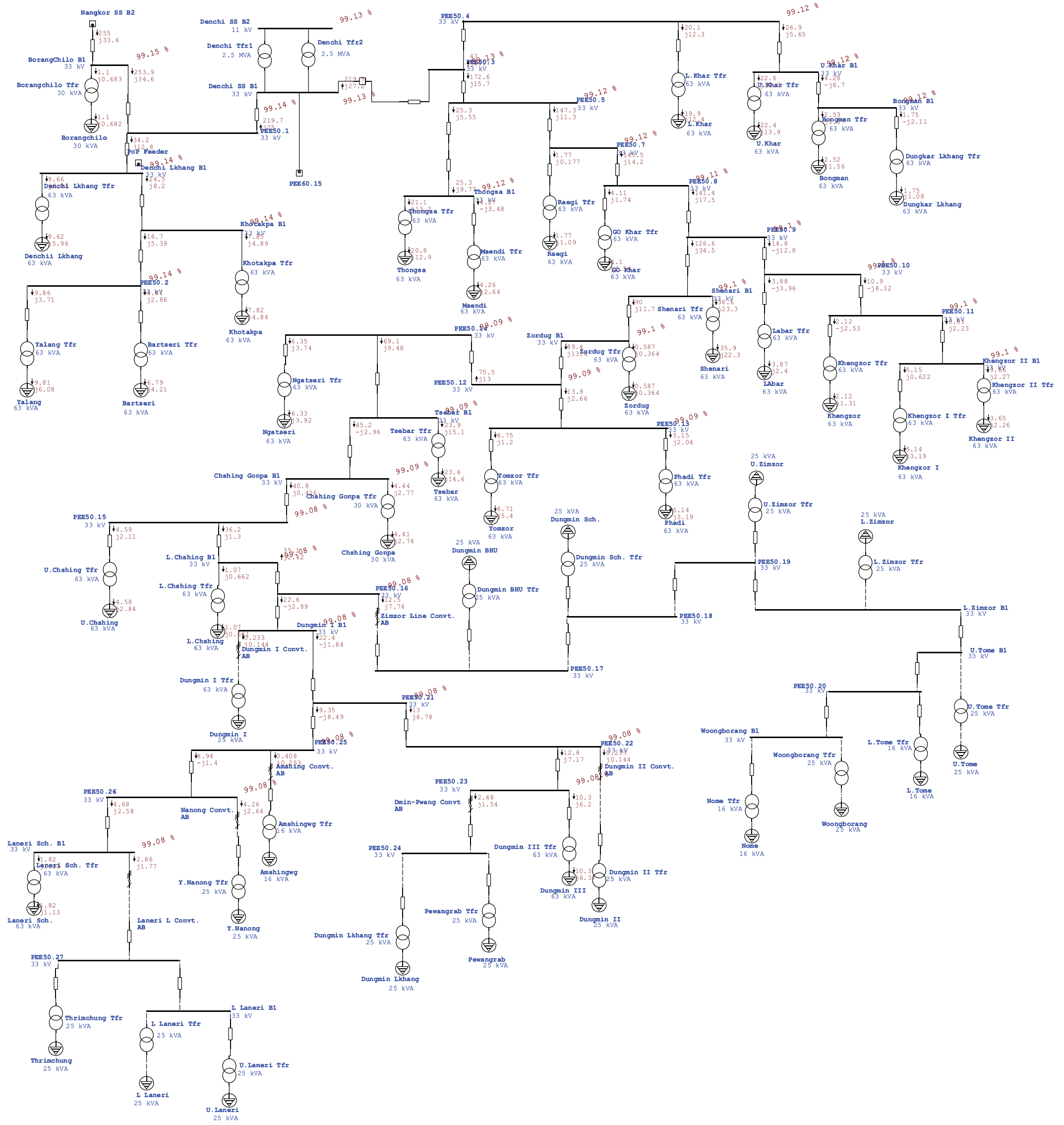
3/3

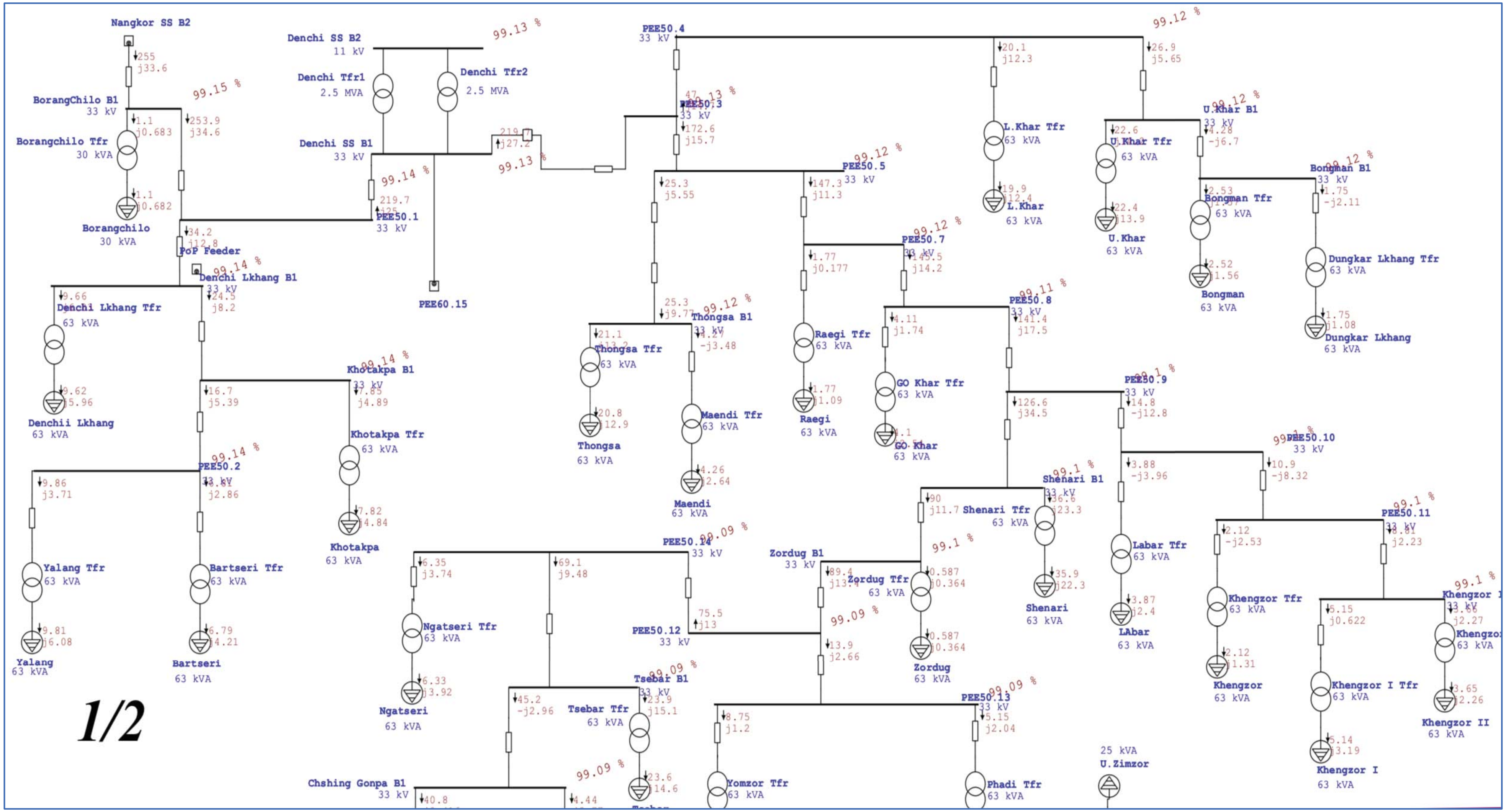
One-Line Diagram - PG=>PoP Feeder (Load Flow Analysis)

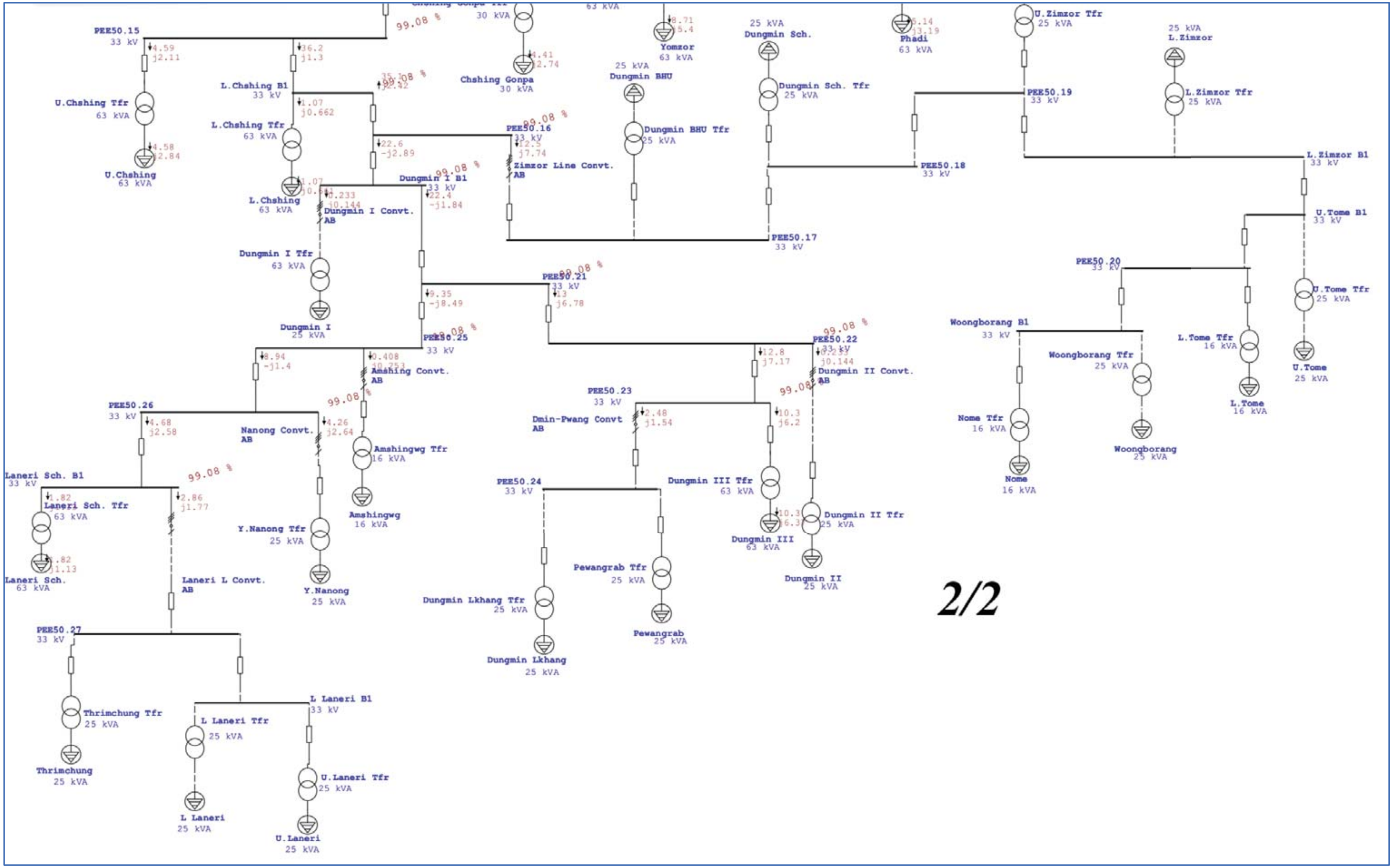


One-Line Diagram - PG=>PG Feeder (Load Flow Analysis)

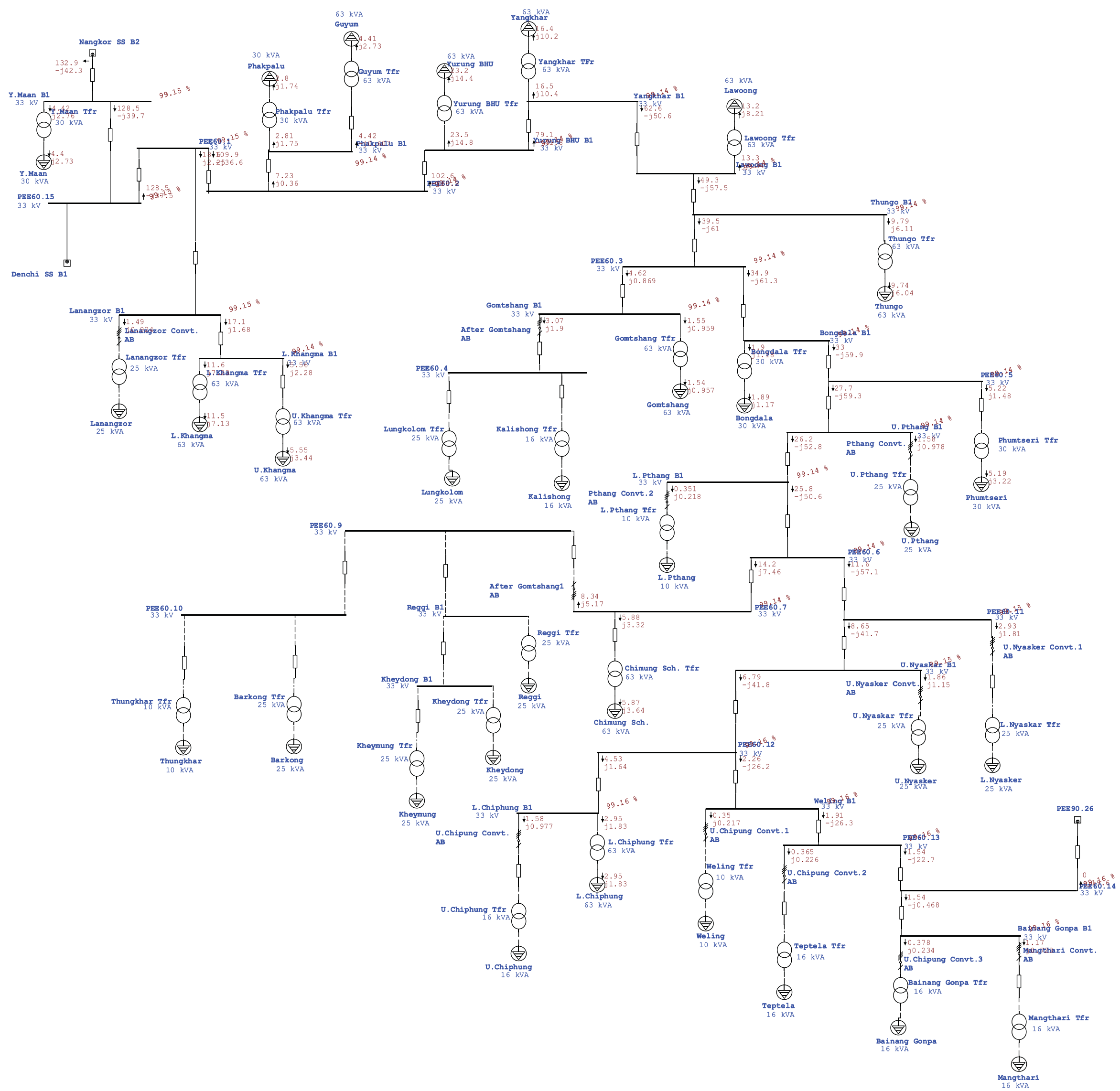


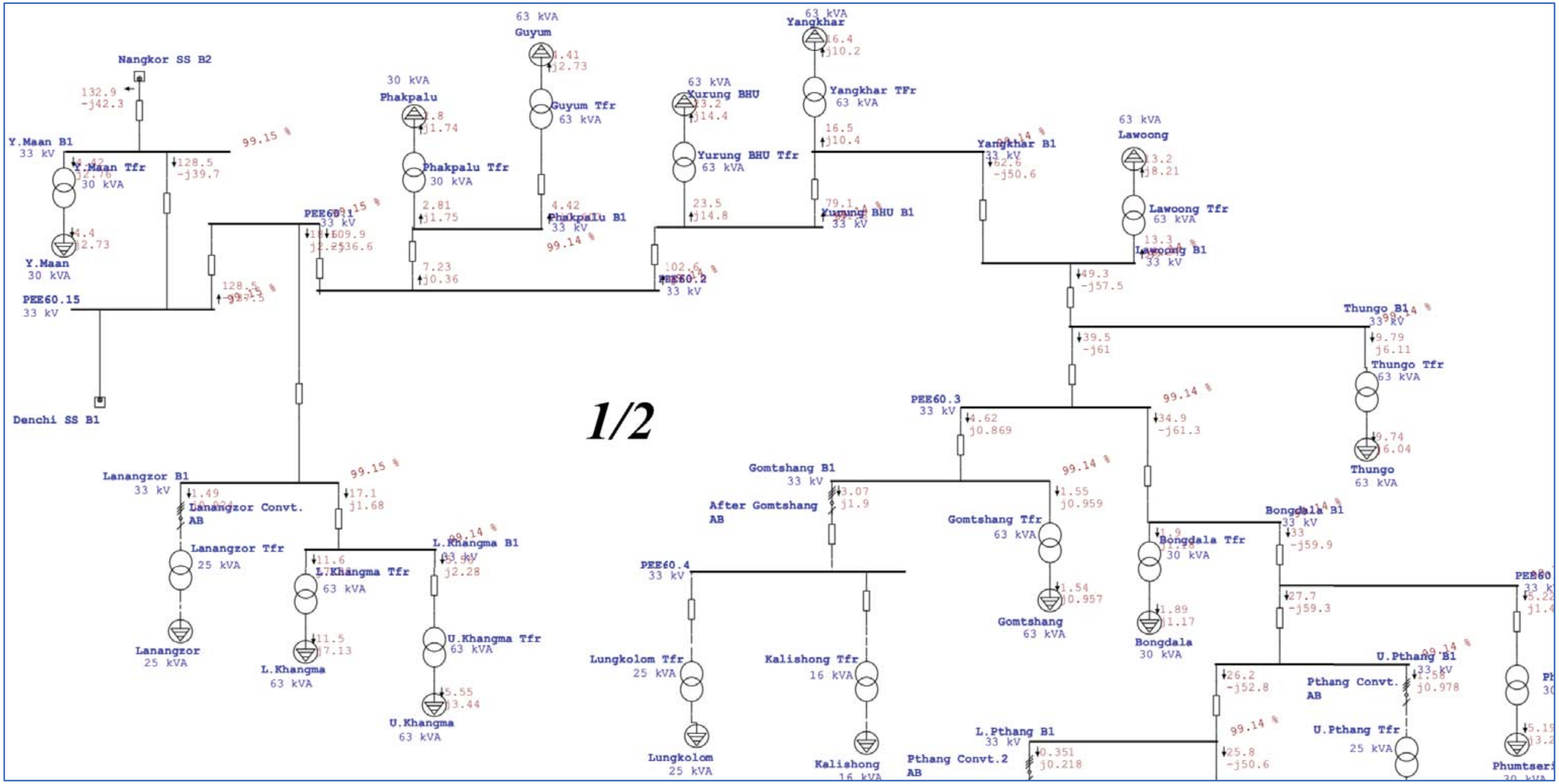



Nangkor SS B2
BorangChilo B1
33 kV
Borangchilo Tfr
30 kVA
Borangchilo
30 kVA
99.15 %
PoP Feeder
Denchi SS B2
11 kV
Denchi Tfr1
2.5 MVA
Denchi Tfr2
2.5 MVA
Denchi SS B1
33 kV
99.13 %
PEE50.1
33 kV
99.14 %
PEE60.15
Denchi Lkhang B1
33 kV
Denchi Lkhang Tfr
63 kVA
Denchii Lkhang
63 kVA
Khotakpa B1
33 kV
Khotakpa Tfr
63 kVA
Khotakpa
63 kVA
PEE50.2
Yalang Tfr
63 kVA
Yalang
63 kVA
Bartseri Tfr
63 kVA
Bartseri
63 kVA
PEE50.4
33 kV
PEE50.3
33 kV
PEE50.5
33 kV
Thongsa B1
Thongsa Tfr
63 kVA
Thongsa
63 kVA
Maendi Tfr
63 kVA
Maendi
63 kVA
PEE50.7
Raegi Tfr
63 kVA
Raegi
63 kVA
GO Khar Tfr
63 kVA
GO Khar
63 kVA
PEE50.8
L.Khar Tfr
63 kVA
L.Khar
63 kVA
U.Khar B1
33 kV
U.Khar Tfr
63 kVA
U.Khar
63 kVA
Bongman B1
33 kV
Bongman Tfr
63 kVA
Bongman
63 kVA
Dungkar Lkhang Tfr
63 kVA
Dungkar Lkhang
63 kVA
PEE50.9
Shenari B1
Shenari Tfr
63 kVA
Shenari
63 kVA
PEE50.10
33 kV
Labar Tfr
63 kVA
LAbar
63 kVA
PEE50.11
Khengzor Tfr
63 kVA
Khengzor
63 kVA
Khengzor I Tfr
63 kVA
Khengzor I
63 kVA
Khengzor II
63 kVA
Zordug B1
33 kV
Zordug Tfr
63 kVA
Zordug
63 kVA
PEE50.12
33 kV
PEE50.13
Yomzor Tfr
63 kVA
Phadi Tfr
63 kVA
25 kVA
U.Zimzor
Ngatseri Tfr
63 kVA
Ngatseri
63 kVA
Tsebar B1
Tsebar Tfr
63 kVA
Chshing Gonpa B1
33 kV
1/2

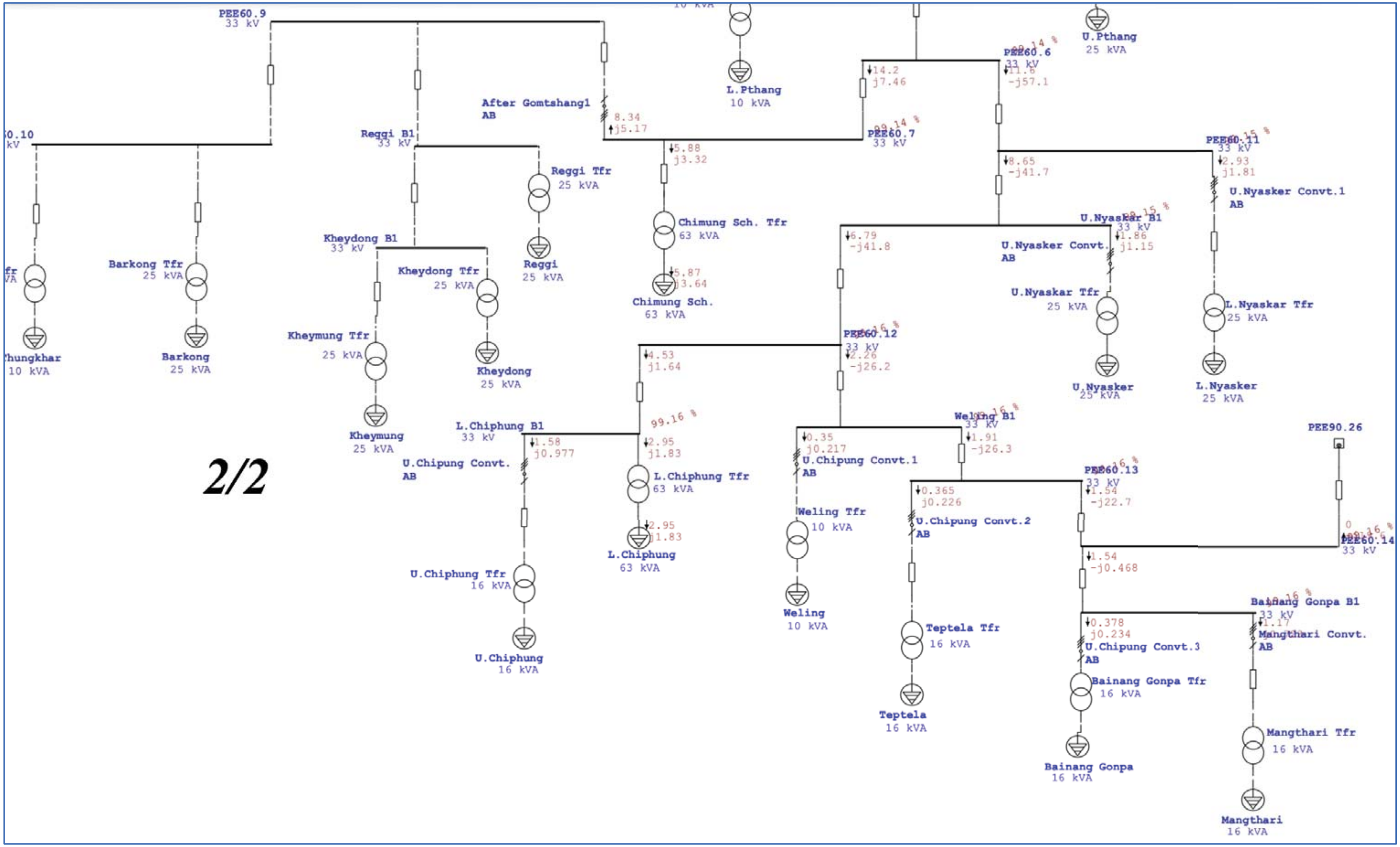


PEE50.15
33 kV
U.Chshing Tfr
63 kVA
U.Chshing
63 kVA
L.Chshing B1
33 kV
L.Chshing Tfr
63 kVA
L.Chshing
63 kVA
Chshing Gonpa
30 kVA
Yomzor
63 kVA
Dungmin BHU
25 kVA
Dungmin BHU Tfr
25 kVA
Dungmin Sch.
25 kVA
Dungmin Sch. Tfr
25 kVA
Phadi
63 kVA
U.Zimzor Tfr
25 kVA
L.Zimzor
25 kVA
L.Zimzor Tfr
25 kVA
PEE50.19
33 kV
PEE50.18
33 kV
L.Zimzor B1
33 kV
PEE50.16
33 kV
Zimzor Line Convt.
AB
Dungmin I B1
33 kV
Dungmin I Convt.
AB
PEE50.17
33 kV
U.Tome B1
33 kV
Dungmin I Tfr
63 kVA
Dungmin I
25 kVA
PEE50.21
33 kV
PEE50.20
33 kV
U.Tome Tfr
25 kVA
Woongborang B1
33 kV
L.Tome Tfr
16 kVA
U.Tome
25 kVA
PEE50.25
33 kV
Amshing Convt.
AB
PEE50.22
33 kV
Dungmin II Convt.
AB
Woongborang Tfr
25 kVA
L.Tome
16 kVA
PEE50.23
33 kV
Nome Tfr
16 kVA
PEE50.26
33 kV
Nanong Convt.
AB
Amshingwg Tfr
16 kVA
Dmin-Pwang Convt
AB
Woongborang
25 kVA
Laneri Sch. B1
33 kV
Laneri Sch. Tfr
63 kVA
PEE50.24
33 kV
Dungmin III Tfr
63 kVA
Nome
16 kVA
Amshingwg
16 kVA
Dungmin II Tfr
25 kVA
Y.Nanong Tfr
25 kVA
Dungmin III
63 kVA
Laneri Sch.
63 kVA
Laneri L Convt.
AB
Pewangrab Tfr
25 kVA
Dungmin II
25 kVA
Y.Nanong
25 kVA
Dungmin Lkhang Tfr
25 kVA
2/2
PEE50.27
33 kV
Pewangrab
25 kVA
Dungmin Lkhang
25 kVA
L Laneri B1
33 kV
Thrimchung Tfr
25 kVA
L Laneri Tfr
25 kVA
U.Laneri Tfr
25 kVA
Thrimchung
25 kVA
L Laneri
25 kVA
U.Laneri
25 kVA


Nangkor SS B2
Y.Maan B1
Y.Maan Tfr 30 kVA
Y.Maan 30 kVA
PEE60.15 33 kV
Denchi SS B1
PEE60.1 33 kV
Phakpalu 30 kVA
Phakpalu Tfr 30 kVA
Phakpalu B1 33 kV
Guyum 63 kVA
Guyum Tfr 63 kVA
Yurung BHU 63 kVA
Yurung BHU Tfr 63 kVA
Yurung BHU B1 33 kV
PEE60.2 33 kV
Yangkhar 63 kVA
Yangkhar TFr 63 kVA
Yangkhar B1 33 kV
Lawoong 63 kVA
Lawoong Tfr 63 kVA
Lawoong B1 33 kV
Thungo B1 33 kV
Thungo Tfr 63 kVA
Thungo 63 kVA
PEE60.3 33 kV
Lanangzor B1 33 kV
Lanangzor Convt. AB
Lanangzor Tfr 25 kVA
Lanangzor 25 kVA
L.Khangma Tfr 63 kVA
L.Khangma 63 kVA
L.Khangma B1 33 kV
U.Khangma Tfr 63 kVA
U.Khangma 63 kVA
Gomtshang B1 33 kV
After Gomtshang AB
PEE60.4 33 kV
Lungkolom Tfr 25 kVA
Lungkolom 25 kVA
Kalishong Tfr 16 kVA
Kalishong 16 kVA
Gomtshang Tfr 63 kVA
Gomtshang 63 kVA
Bongdala Tfr 30 kVA
Bongdala 30 kVA
Bongdala B1 33 kV
PEE60.5 33 kV
Phumtseri Tfr 30 kVA
Phumtseri 30 kVA
U.Pthang B1 33 kV
Pthang Convt. AB
U.Pthang Tfr 25 kVA
U.Pthang 25 kVA
L.Pthang B1 33 kV
Pthang Convt.2 AB
L.Pthang Tfr 10 kVA
L.Pthang 10 kVA
PEE60.6 33 kV
PEE60.9 33 kV
After Gomtshang1 AB
PEE60.7 33 kV
PEE60.10 33 kV
Thungkhar Tfr 10 kVA
Thungkhar 10 kVA
Barkong Tfr 25 kVA
Barkong 25 kVA
Reggi B1 33 kV
Reggi Tfr 25 kVA
Reggi 25 kVA
Kheydong B1 33 kV
Kheydong Tfr 25 kVA
Kheydong 25 kVA
Kheymung Tfr 25 kVA
Kheymung 25 kVA
Chimung Sch. Tfr 63 kVA
Chimung Sch. 63 kVA
PEE60.11 33 kV
U.Nyasker Convt.1 AB
L.Nyaskar Tfr 25 kVA
L.Nyasker 25 kVA
U.Nyasker B1 33 kV
U.Nyasker Convt. AB
U.Nyaskar Tfr 25 kVA
U.Nyasker 25 kVA
PEE60.12 33 kV
L.Chiphung B1 33 kV
U.Chipung Convt. AB
U.Chiphung Tfr 16 kVA
U.Chiphung 16 kVA
L.Chiphung Tfr 63 kVA
L.Chiphung 63 kVA
Weling B1 33 kV
U.Chipung Convt.1 AB
Weling Tfr 10 kVA
Weling 10 kVA
PEE60.13 33 kV
U.Chipung Convt.2 AB
Teptela Tfr 16 kVA
Teptela 16 kVA
PEE90.26
PEE60.14 33 kV
U.Chipung Convt.3 AB
Bainang Gonpa Tfr 16 kVA
Bainang Gonpa 16 kVA
Bainang Gonpa B1 33 kV
Mangthari Convt. AB
Mangthari Tfr 16 kVA
Mangthari 16 kVA

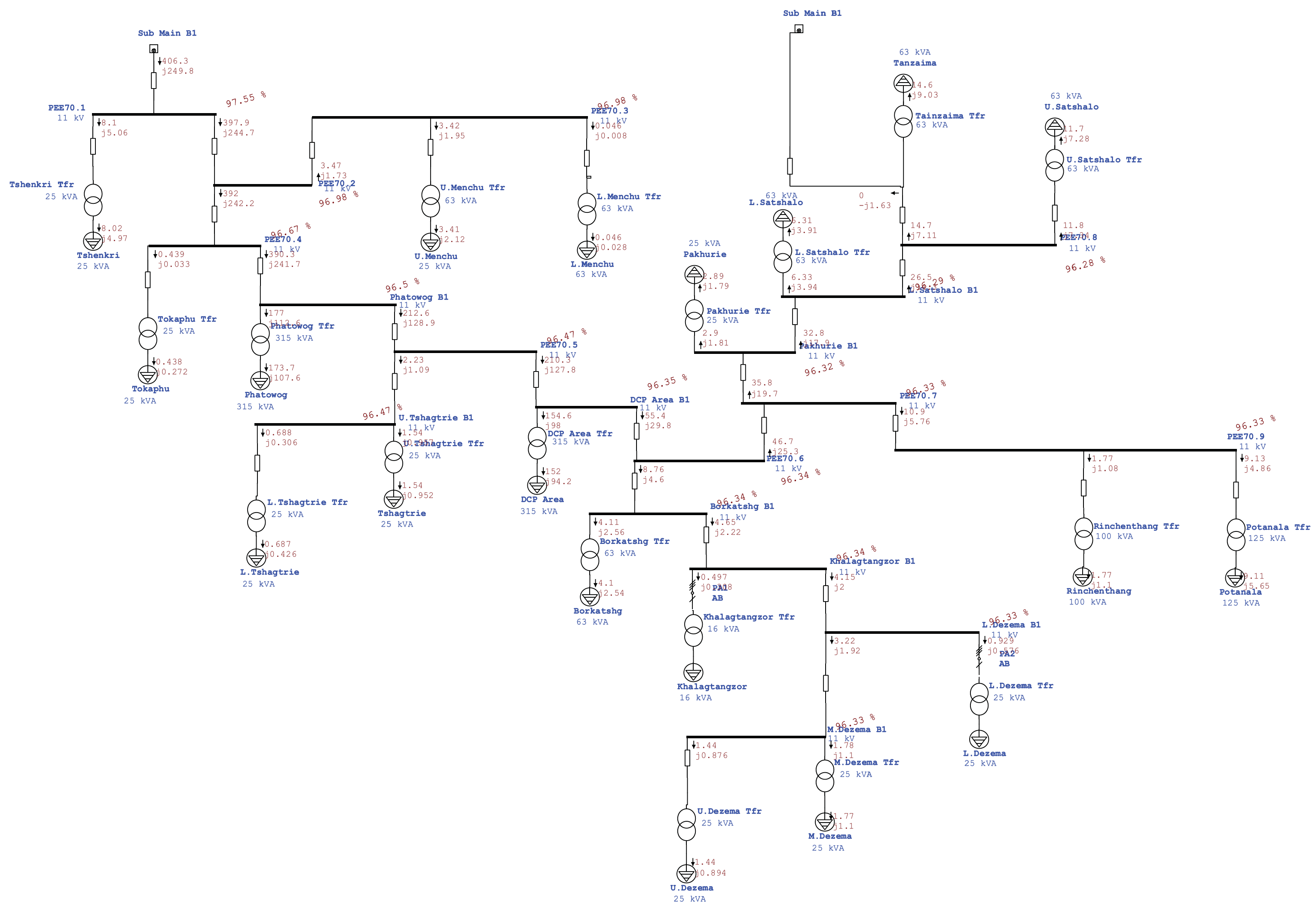


Nangkor SS B2
132.9
-j42.3
Y.Maan B1
33 kV
Y.Maan Tfr
30 kVA
Y.Maan
30 kVA
99.15 %
128.5
-j39.7
PEE60.15
33 kV
Denchi SS B1
PEE60.1
33 kV
Phakpalu
30 kVA
Phakpalu Tfr
30 kVA
2.81
j1.75
7.23
j0.36
Guyum
63 kVA
4.41
j2.73
Guyum Tfr
63 kVA
4.42
Phakpalu B1
33 kV
99.14 %
Yurung BHU
63 kVA
Yurung BHU Tfr
63 kVA
23.5
j14.8
PEE60.2
33 kV
Yangkhar
63 kVA
16.4
j10.2
Yangkhar TFr
63 kVA
16.5
j10.4
Yurung BHU B1
33 kV
Yangkhar B1
33 kV
-j50.6
Lawoong
63 kVA
13.2
j8.21
Lawoong Tfr
63 kVA
Lawoong B1
33 kV
49.3
-j57.5
Thungo B1
33 kV
9.79
j6.11
Thungo Tfr
63 kVA
9.74
j6.04
Thungo
63 kVA
39.5
-j61
PEE60.3
33 kV
4.62
j0.869
34.9
-j61.3
1/2
Lanangzor B1
33 kV
1.49
Lanangzor Convt.
AB
Lanangzor Tfr
25 kVA
Lanangzor
25 kVA
17.1
j1.68
11.6
L.Khangma Tfr
63 kVA
11.5
j7.13
L.Khangma
63 kVA
L.Khangma B1
33 kV
j2.28
U.Khangma Tfr
63 kVA
5.55
j3.44
U.Khangma
63 kVA
Gomtshang B1
33 kV
3.07
j1.9
After Gomtshang
AB
PEE60.4
33 kV
Lungkolom Tfr
25 kVA
Lungkolom
25 kVA
Kalishong Tfr
16 kVA
Kalishong
1.55
j0.959
Gomtshang Tfr
63 kVA
1.54
j0.957
Gomtshang
63 kVA
Bongdala B1
33 kV
-j59.9
1.9
Bongdala Tfr
30 kVA
1.89
j1.17
Bongdala
30 kVA
27.7
-j59.3
26.2
-j52.8
25.8
-j50.6
L.Pthang B1
33 kV
0.351
j0.218
Pthang Convt.2
AB
U.Pthang B1
33 kV
j0.978
Pthang Convt.
AB
U.Pthang Tfr
25 kVA

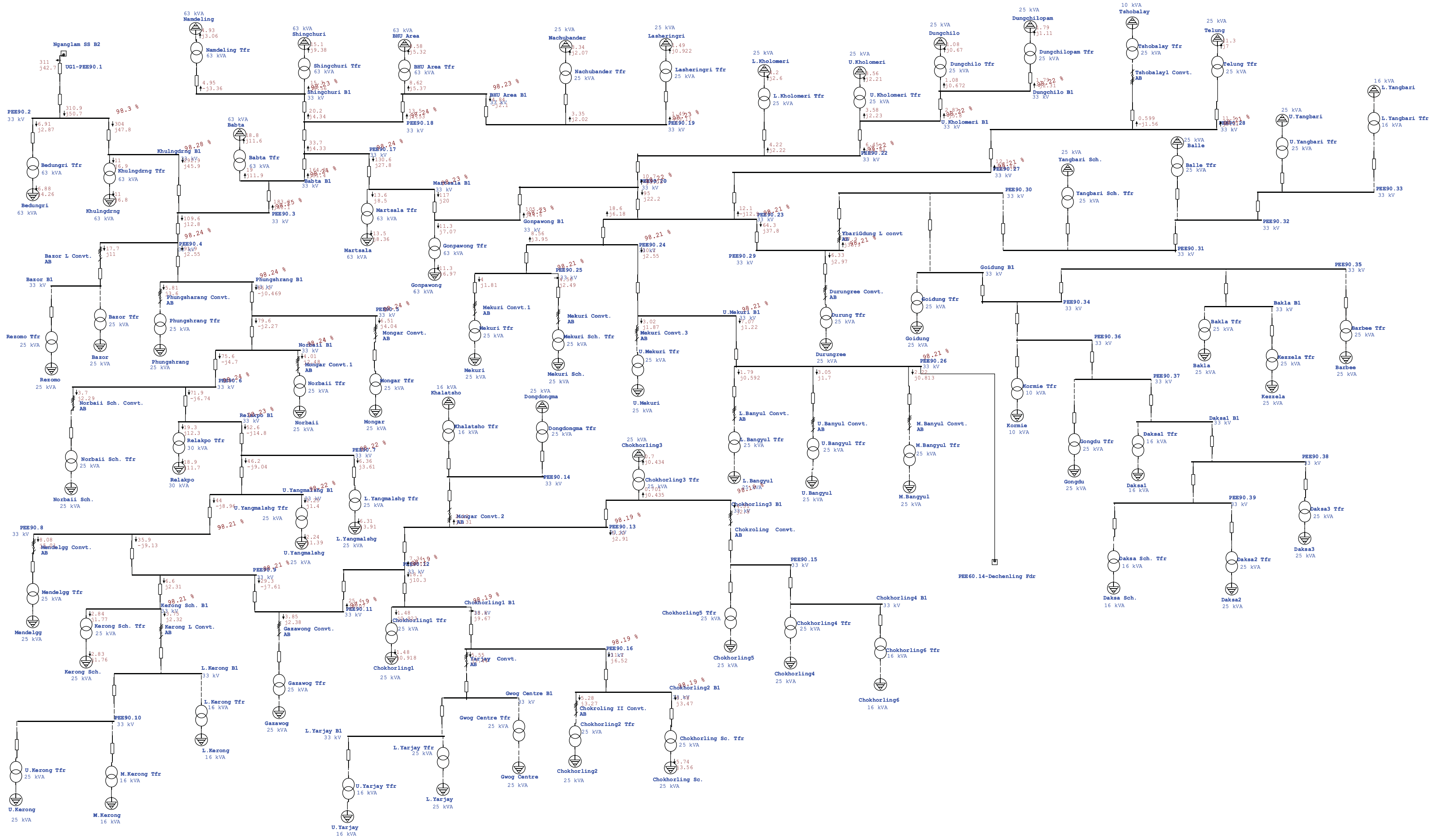


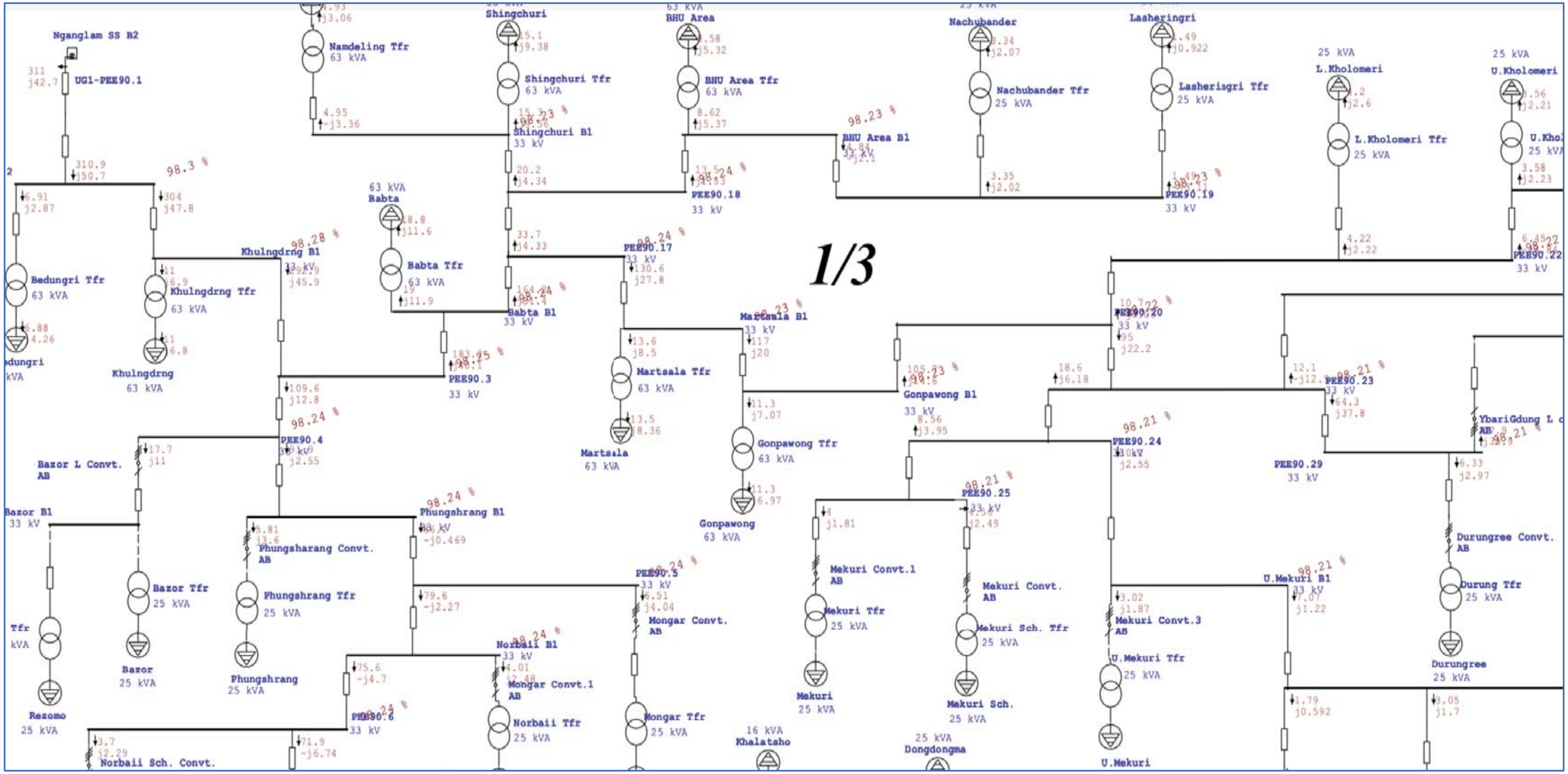
PEE60.9
33 kV
After Gomtshang1
AB
8.34
j5.17
L.Pthang
10 kVA
U.Pthang
25 kVA
PEE60.6
33 kV
14.2
j7.46
11.6
-j57.1
PEE60.7
33 kV
Reggi B1
33 kV
Reggi Tfr
25 kVA
Reggi
25 kVA
5.88
j3.32
Chimung Sch. Tfr
63 kVA
5.87
j3.64
Chimung Sch.
63 kVA
8.65
-j41.7
PEE60.11
33 kV
2.93
j1.81
U.Nyasker Convt.1
AB
L.Nyaskar Tfr
25 kVA
L.Nyasker
25 kVA
U.Nyaskar B1
33 kV
1.86
j1.15
U.Nyasker Convt.
AB
U.Nyaskar Tfr
25 kVA
U.Nyasker
25 kVA
6.79
-j41.8
Barkong Tfr
25 kVA
Barkong
25 kVA
10 kVA
Kheydong B1
33 kV
Kheydong Tfr
25 kVA
Kheydong
25 kVA
Kheymung Tfr
25 kVA
Kheymung
25 kVA
PEE60.12
33 kV
2.26
-j26.2
4.53
j1.64
99.16 %
L.Chiphung B1
33 kV
1.58
j0.977
U.Chipung Convt.
AB
2.95
j1.83
L.Chiphung Tfr
63 kVA
2.95
j1.83
L.Chiphung
63 kVA
U.Chiphung Tfr
16 kVA
U.Chiphung
16 kVA
Weling B1
33 kV
1.91
-j26.3
0.35
j0.217
U.Chipung Convt.1
AB
Weling Tfr
10 kVA
Weling
10 kVA
PEE60.13
33 kV
1.54
-j22.7
0.365
j0.226
U.Chipung Convt.2
AB
Teptela Tfr
16 kVA
Teptela
16 kVA
PEE90.26
PEE60.14
33 kV
1.54
-j0.468
0.378
j0.234
U.Chipung Convt.3
AB
Bainang Gonpa Tfr
16 kVA
Bainang Gonpa
16 kVA
Bainang Gonpa B1
33 kV
1.17
Mangthari Convt.
AB
Mangthari Tfr
16 kVA
Mangthari
16 kVA
2/2

One-Line Diagram - PG=>Nganglam Feeder (Load Flow Analysis)

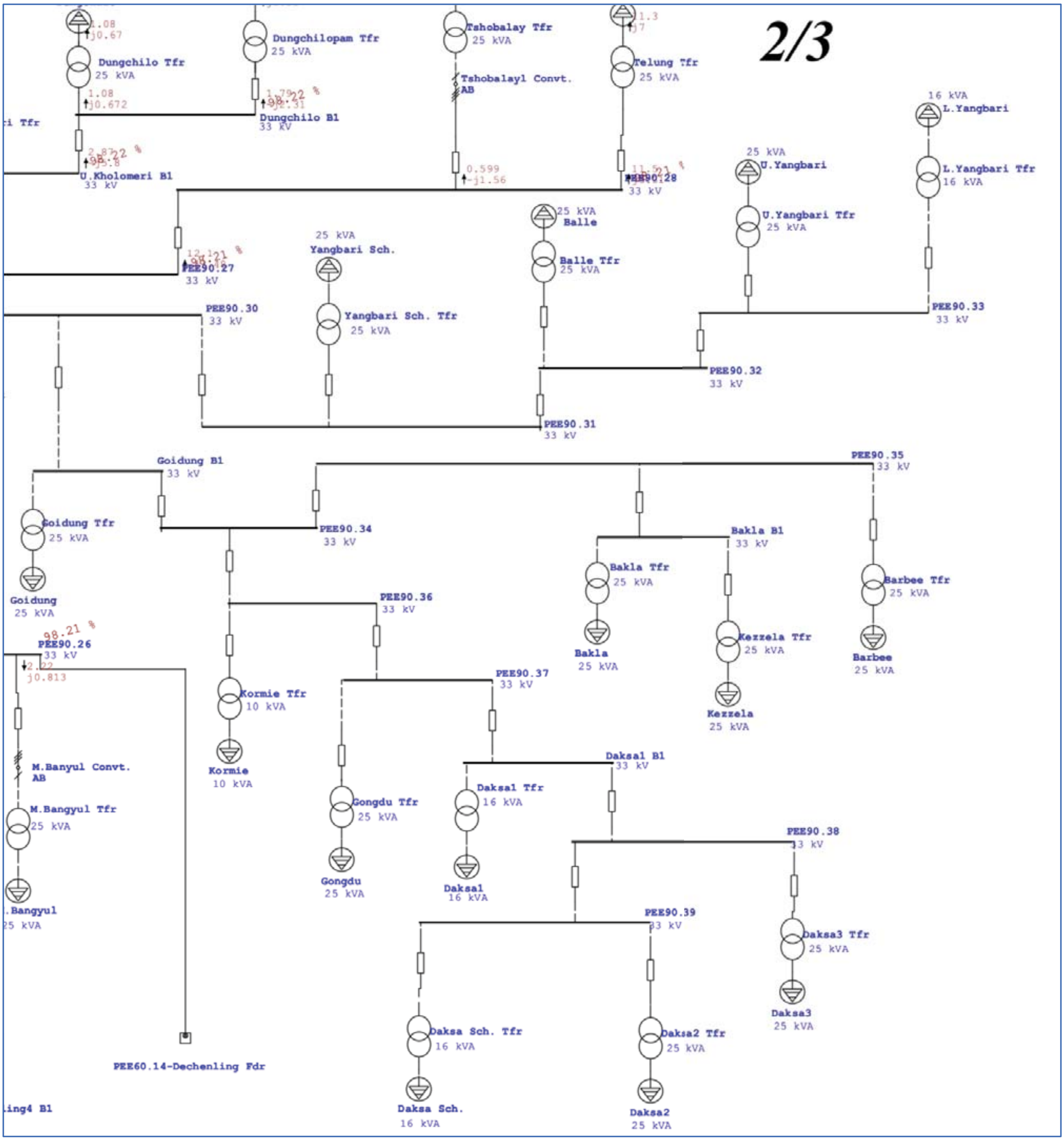


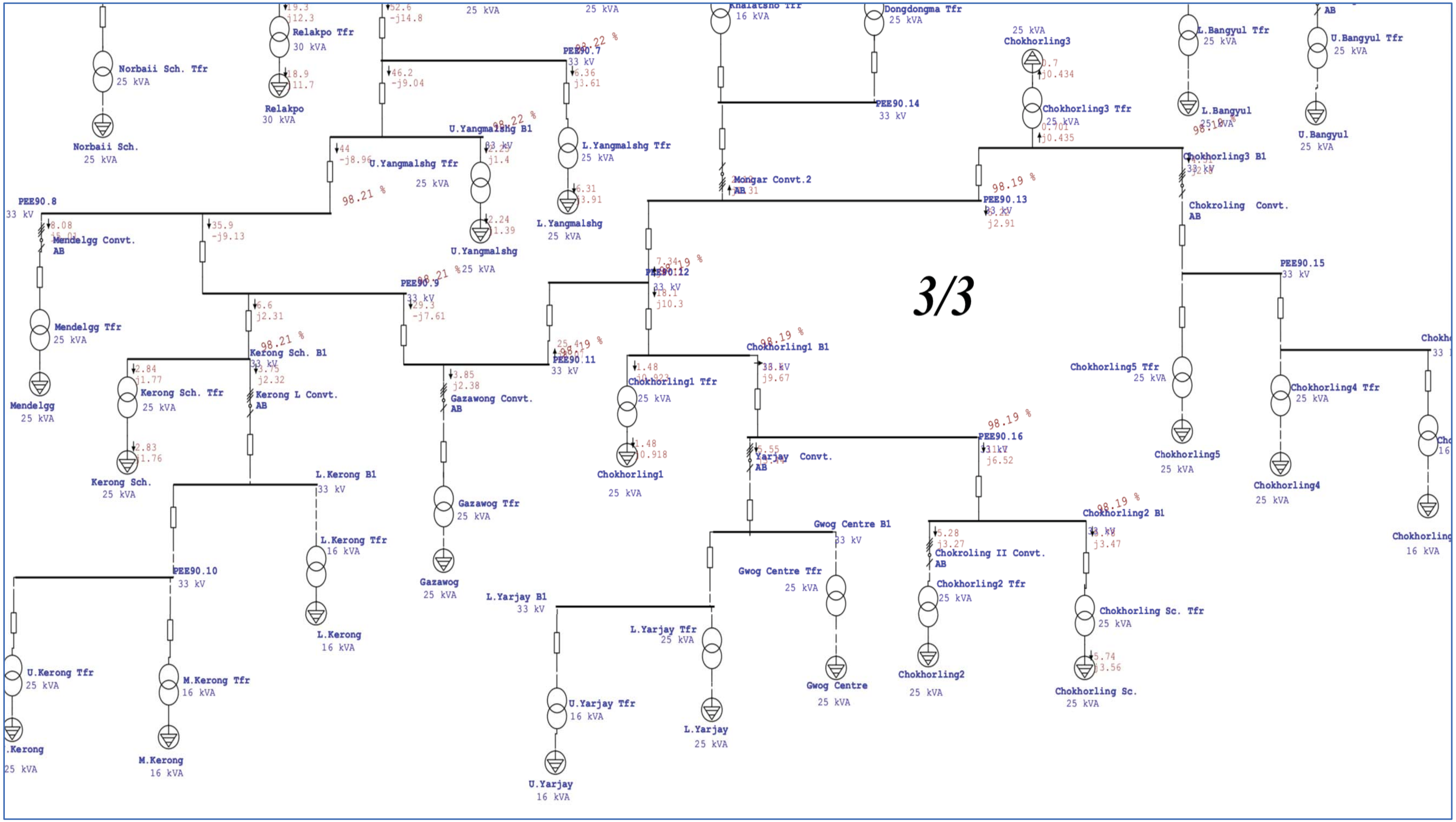
One-Line Diagram - PG=>Dechenling Feeder (Load Flow Analysis)



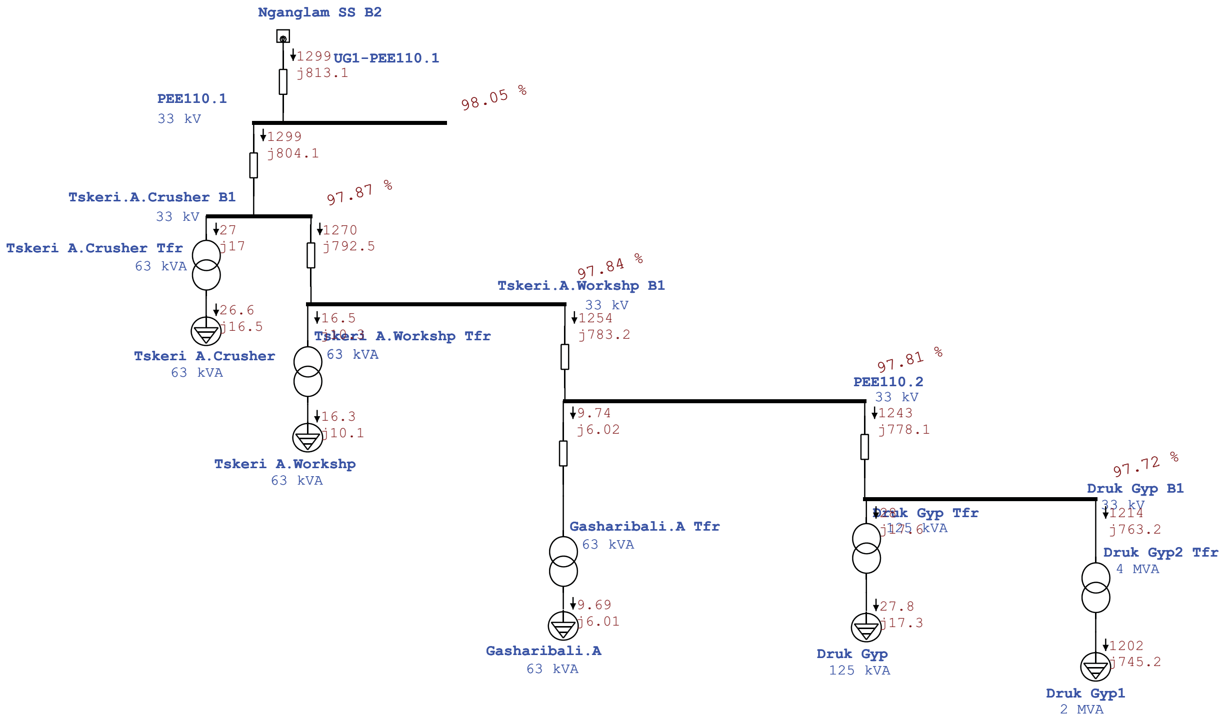


1/3
Nganglam SS B2
UG1-PEE90.1
98.3 %
Namdeling Tfr
63 kVA
Shingchuri
Shingchuri Tfr
63 kVA
Shingchuri B1
33 kV
BHU Area
BHU Area Tfr
63 kVA
BHU Area B1
Nachubander
Nachubander Tfr
25 kVA
Lasheringri
Lasheringri Tfr
25 kVA
L.Kholomeri
L.Kholomeri Tfr
25 kVA
U.Kholomeri
Bedungri Tfr
63 kVA
Khulngdrng B1
Khulngdrng Tfr
63 kVA
Khulngdrng
Babta
Babta Tfr
63 kVA
Babta B1
PEE90.17
PEE90.18
PEE90.19
PEE90.22
PEE90.3
PEE90.4
Martsala B1
Martsala Tfr
Martsala
63 kVA
Gonpawong B1
Gonpawong Tfr
Gonpawong
PEE90.20
PEE90.23
PEE90.24
PEE90.25
PEE90.29
YbariGdung L
Bazor L Convt.
AB
Bazor B1
Bazor Tfr
Bazor
Rezomo
Phungshrang B1
Phungsharang Convt.
Phungshrang Tfr
Phungshrang
PEE90.5
PEE90.6
Mongar Convt.
Mongar Convt.1
Mongar Tfr
Norbaii B1
Norbaii Tfr
Norbaii Sch. Convt.
Khalatsho
16 kVA
Dongdongma
Mekuri Convt.1
Mekuri Tfr
Mekuri
Mekuri Convt.
Mekuri Sch. Tfr
Mekuri Sch.
Mekuri Convt.3
U.Mekuri Tfr
U.Mekuri
U.Mekuri B1
Durungree Convt.
Durung Tfr
Durungree
25 kVA
33 kV

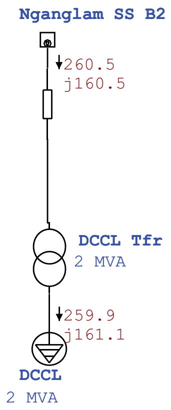

2/3
Dungchilo Tfr
25 kVA
Dungchilopam Tfr
25 kVA
Dungchilo B1
33 kV
Tshobalay Tfr
25 kVA
Tshobalay1 Convt. AB
Telung Tfr
25 kVA
U.Kholomeri B1
33 kV
PEE90.28
33 kV
16 kVA
L.Yangbari
L.Yangbari Tfr
16 kVA
25 kVA
U.Yangbari
U.Yangbari Tfr
25 kVA
25 kVA
Balle
Balle Tfr
25 kVA
25 kVA
Yangbari Sch.
Yangbari Sch. Tfr
25 kVA
PEE90.27
33 kV
PEE90.30
33 kV
PEE90.33
33 kV
PEE90.32
33 kV
PEE90.31
33 kV
Goidung B1
33 kV
PEE90.35
33 kV
Goidung Tfr
25 kVA
Goidung
25 kVA
PEE90.34
33 kV
Bakla B1
33 kV
Bakla Tfr
25 kVA
Bakla
25 kVA
Barbee Tfr
25 kVA
Barbee
25 kVA
Kezzela Tfr
25 kVA
Kezzela
25 kVA
PEE90.36
33 kV
PEE90.26
33 kV
PEE90.37
33 kV
Kormie Tfr
10 kVA
Kormie
10 kVA
M.Banyul Convt. AB
M.Bangyul Tfr
25 kVA
Daksa1 B1
33 kV
Gongdu Tfr
25 kVA
Gongdu
25 kVA
Daksa1 Tfr
16 kVA
Daksa1
16 kVA
PEE90.38
33 kV
PEE90.39
33 kV
Daksa3 Tfr
25 kVA
Daksa3
25 kVA
Daksa Sch. Tfr
16 kVA
Daksa Sch.
16 kVA
Daksa2 Tfr
25 kVA
Daksa2
25 kVA
PEE60.14-Dechenling Fdr


3/3
Norbaii Sch. Tfr
25 kVA
Norbaii Sch.
25 kVA
Relakpo Tfr
30 kVA
Relakpo
30 kVA
PEE90.7
33 kV
98.22 %
U.Yangmalshg B1
U.Yangmalshg Tfr
25 kVA
U.Yangmalshg
25 kVA
L.Yangmalshg Tfr
25 kVA
L.Yangmalshg
25 kVA
PEE90.8
33 kV
98.21 %
Mendelgg Convt.
AB
Mendelgg Tfr
25 kVA
Mendelgg
25 kVA
PEE90.9
33 kV
Kerong Sch. B1
Kerong Sch. Tfr
25 kVA
Kerong Sch.
25 kVA
Kerong L Convt.
AB
L.Kerong B1
33 kV
L.Kerong Tfr
16 kVA
L.Kerong
16 kVA
PEE90.10
33 kV
U.Kerong Tfr
25 kVA
M.Kerong Tfr
16 kVA
M.Kerong
16 kVA
Gazawong Convt.
AB
Gazawog Tfr
25 kVA
Gazawog
25 kVA
PEE90.11
33 kV
PEE90.12
33 kV
98.19 %
Mongar Convt.2
AB
Dongdongma Tfr
25 kVA
PEE90.14
33 kV
PEE90.13
33 kV
Chokhorling1 B1
Chokhorling1 Tfr
25 kVA
Chokhorling1
25 kVA
Yarjay Convt.
AB
PEE90.16
Gwog Centre B1
33 kV
Gwog Centre Tfr
25 kVA
Gwog Centre
25 kVA
L.Yarjay B1
33 kV
L.Yarjay Tfr
25 kVA
L.Yarjay
25 kVA
U.Yarjay Tfr
16 kVA
U.Yarjay
16 kVA
Chokhorling2 B1
Chokroling II Convt.
AB
Chokhorling2 Tfr
25 kVA
Chokhorling2
25 kVA
Chokhorling Sc. Tfr
25 kVA
Chokhorling Sc.
25 kVA
Chokhorling3
25 kVA
Chokhorling3 Tfr
25 kVA
Chokhorling3 B1
Chokroling Convt.
AB
L.Bangyul Tfr
25 kVA
L.Bangyul
U.Bangyul Tfr
25 kVA
U.Bangyul
25 kVA
PEE90.15
33 kV
Chokhorling5 Tfr
25 kVA
Chokhorling5
25 kVA
Chokhorling4 Tfr
25 kVA
Chokhorling4
25 kVA
16 kVA

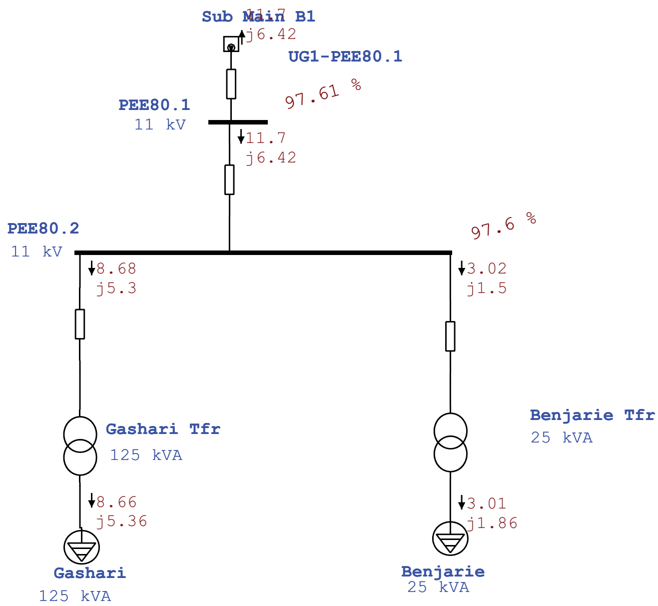
One-Line Diagram - PG=>DGPL Feeder (Load Flow Analysis)

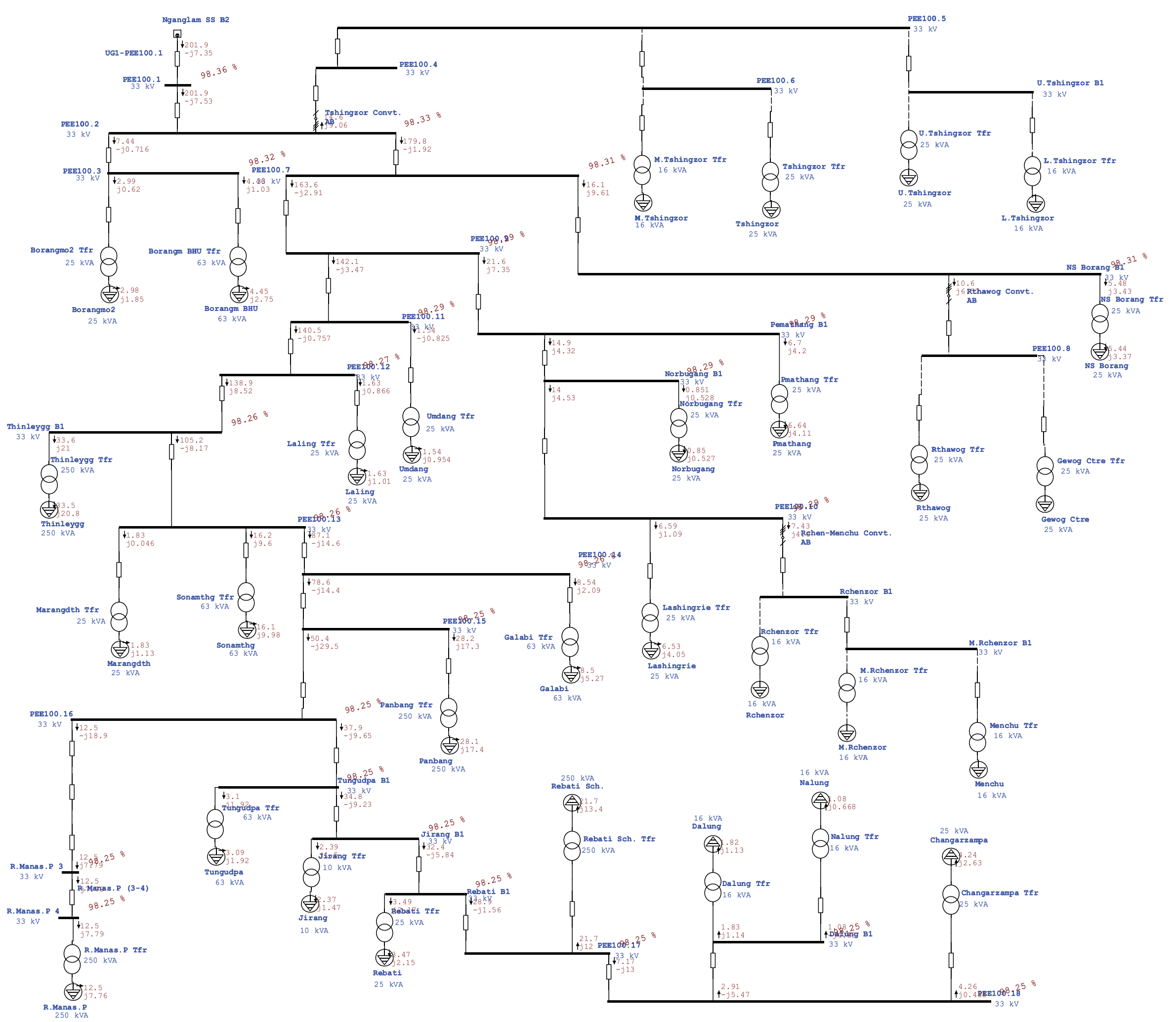


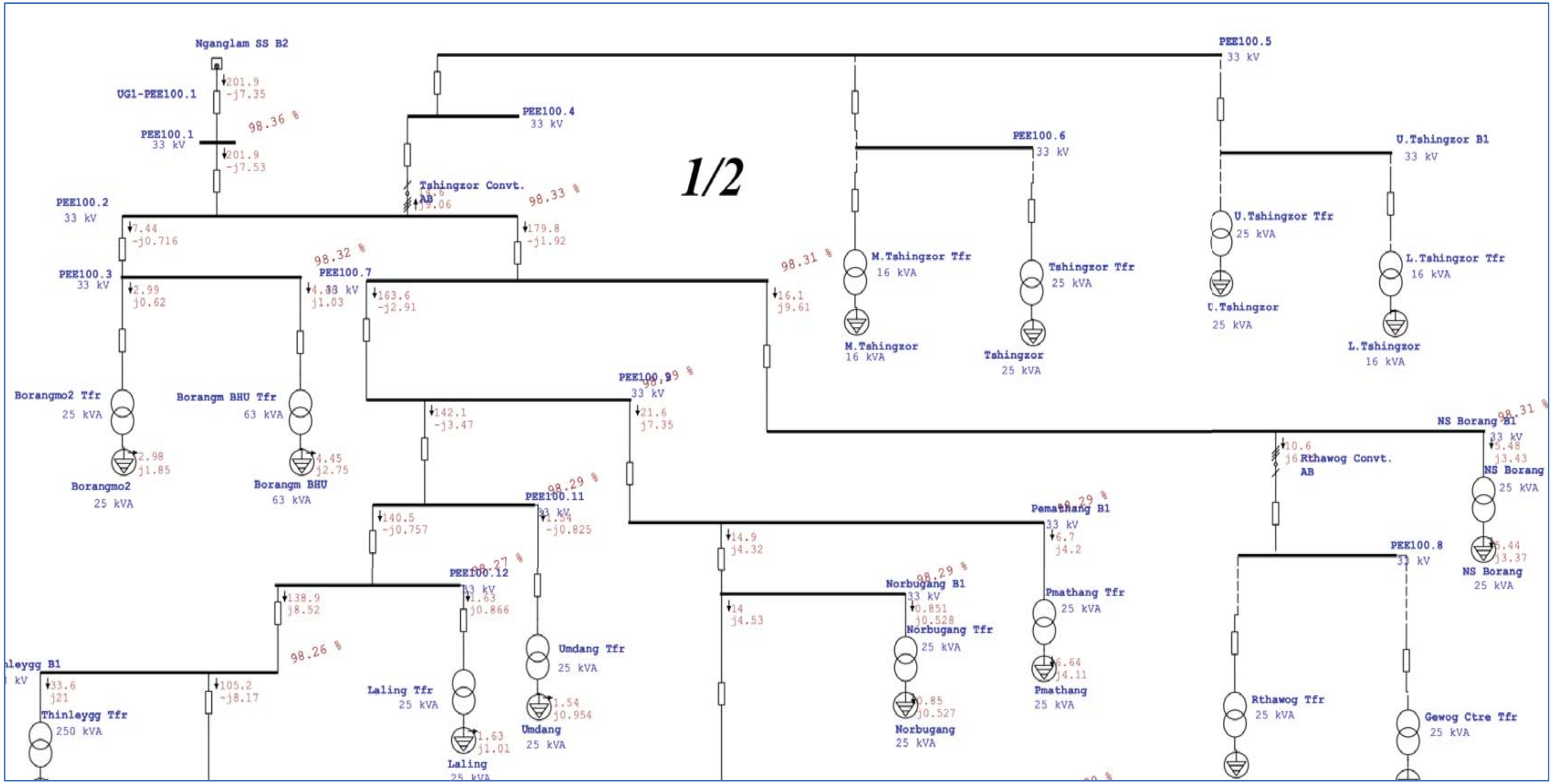
One-Line Diagram - PG=>DCCL Feeder (Load Flow Analysis)



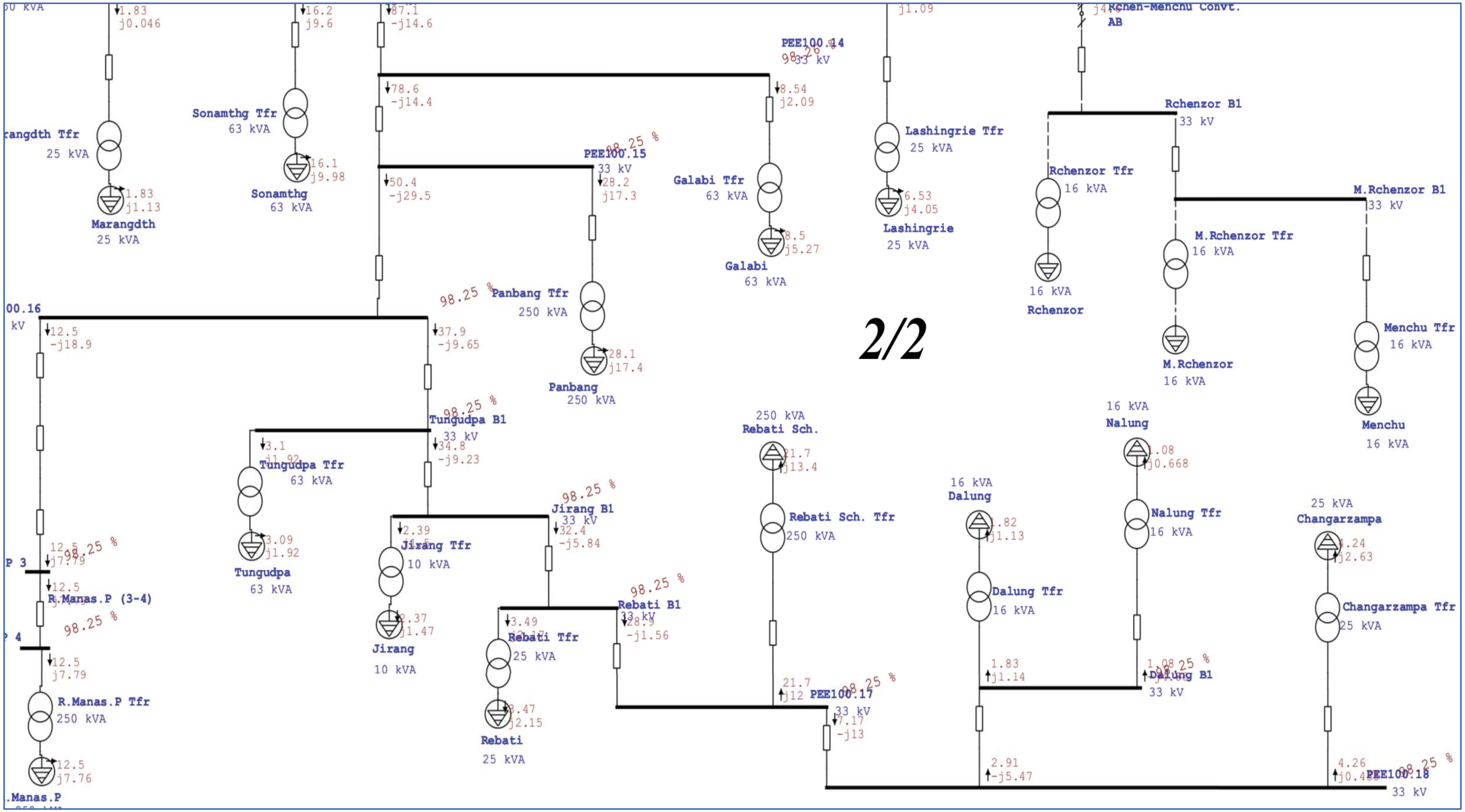
One-Line Diagram - PG=>Gashari Feeder (Load Flow Analysis)




Nganglam SS B2
UG1-PEE100.1
PEE100.1
33 kV
PEE100.2
33 kV
PEE100.3
33 kV
PEE100.4
33 kV
PEE100.5
33 kV
PEE100.6
33 kV
PEE100.7
PEE100.8
PEE100.11
PEE100.12
PEE100.13
PEE100.14
PEE100.15
PEE100.16
PEE100.17
PEE100.18
Tshingzor Convt.
Rthawog Convt.
Rchen-Menchu Convt.
U.Tshingzor B1
U.Tshingzor Tfr
L.Tshingzor Tfr
M.Tshingzor Tfr
Tshingzor Tfr
NS Borang B1
NS Borang Tfr
Borangmo2 Tfr
Borangm BHU Tfr
Pemathang B1
Pmathang Tfr
Norbugang B1
Norbugang Tfr
Umdang Tfr
Laling Tfr
Thinleygg B1
Thinleygg Tfr
Rthawog Tfr
Gewog Ctre Tfr
Lashingrie Tfr
Rchenzor B1
Rchenzor Tfr
M.Rchenzor B1
M.Rchenzor Tfr
Menchu Tfr
Marangdth Tfr
Sonamthg Tfr
Galabi Tfr
Panbang Tfr
Tungudpa B1
Tungudpa Tfr
Jirang B1
Jirang Tfr
Rebati B1
Rebati Tfr
Rebati Sch. Tfr
Dalung B1
Dalung Tfr
Nalung Tfr
Changarzampa Tfr
R.Manas.P 3
R.Manas.P 4
R.Manas.P (3-4)
R.Manas.P Tfr



1/2
Nganglam SS B2
UG1-PEE100.1
201.9
-j7.35
PEE100.1
33 kV
98.36 %
201.9
-j7.53
PEE100.2
33 kV
7.44
-j0.716
PEE100.3
33 kV
2.99
j0.62
PEE100.4
33 kV
Tshingzor Convt.
AB
98.33 %
179.8
-j1.92
PEE100.7
98.32 %
163.6
-j2.91
j1.03
Borangmo2 Tfr
25 kVA
2.98
j1.85
Borangmo2
25 kVA
Borangm BHU Tfr
63 kVA
4.45
j2.75
Borangm BHU
63 kVA
PEE100.5
33 kV
PEE100.6
33 kV
U.Tshingzor B1
33 kV
M.Tshingzor Tfr
16 kVA
M.Tshingzor
16 kVA
Tshingzor Tfr
25 kVA
Tshingzor
25 kVA
U.Tshingzor Tfr
25 kVA
U.Tshingzor
25 kVA
L.Tshingzor Tfr
16 kVA
L.Tshingzor
16 kVA
98.31 %
16.1
j9.61
33 kV
21.6
j7.35
142.1
-j3.47
NS Borang B1
33 kV
5.48
j3.43
NS Borang
25 kVA
6.44
j3.37
NS Borang
25 kVA
10.6
Rthawog Convt.
AB
PEE100.8
33 kV
Rthawog Tfr
25 kVA
Gewog Ctre Tfr
25 kVA
PEE100.11
140.5
-j0.757
-j0.825
Pemathang B1
33 kV
6.7
j4.2
Pmathang Tfr
25 kVA
6.64
j4.11
Pmathang
25 kVA
14.9
j4.32
14
j4.53
Norbugang B1
33 kV
0.851
j0.528
Norbugang Tfr
25 kVA
0.85
j0.527
Norbugang
25 kVA
PEE100.12
33 kV
1.63
j0.866
138.9
j8.52
98.26 %
105.2
-j8.17
Laling Tfr
25 kVA
1.63
j1.01
Laling
Umdang Tfr
25 kVA
1.54
j0.954
Umdang
25 kVA
33.6
j21
Thinleygg Tfr
250 kVA


2/2
Rchen-Menchu Convt.
AB
Rchenzor B1
33 kV
M.Rchenzor B1
33 kV
Rchenzor Tfr
16 kVA
Rchenzor
16 kVA
M.Rchenzor Tfr
16 kVA
M.Rchenzor
16 kVA
Menchu Tfr
16 kVA
Menchu
16 kVA
Lashingrie Tfr
25 kVA
Lashingrie
25 kVA
6.53
j4.05
j1.09
PEE100.14
98.26 %
33 kV
8.54
j2.09
Galabi Tfr
63 kVA
Galabi
63 kVA
8.5
j5.27
PEE100.15
98.25 %
33 kV
28.2
j17.3
Panbang Tfr
250 kVA
Panbang
250 kVA
28.1
j17.4
87.1
-j14.6
78.6
-j14.4
50.4
-j29.5
Sonamthg Tfr
63 kVA
Sonamthg
63 kVA
16.2
j9.6
16.1
j9.98
Marangdth Tfr
25 kVA
Marangdth
25 kVA
1.83
j0.046
1.83
j1.13
PEE100.16
kV
98.25 %
12.5
-j18.9
37.9
-j9.65
Tungudpa B1
98.25 %
33 kV
34.8
-j9.23
3.1
j1.92
Tungudpa Tfr
63 kVA
Tungudpa
63 kVA
3.09
j1.92
Jirang B1
98.25 %
33 kV
32.4
-j5.84
2.39
Jirang Tfr
10 kVA
Jirang
10 kVA
2.37
j1.47
Rebati B1
98.25 %
33 kV
28.9
-j1.56
3.49
Rebati Tfr
25 kVA
Rebati
25 kVA
3.47
j2.15
R.Manas.P 3
12.5
j7.79
98.25 %
12.5
R.Manas.P (3-4)
R.Manas.P 4
98.25 %
12.5
j7.79
R.Manas.P Tfr
250 kVA
R.Manas.P
12.5
j7.76
Rebati Sch.
250 kVA
21.7
j13.4
Rebati Sch. Tfr
250 kVA
21.7
j12
PEE100.17
98.25 %
33 kV
7.17
-j13
Dalung
16 kVA
1.82
j1.13
Dalung Tfr
16 kVA
1.83
j1.14
2.91
-j5.47
Nalung
16 kVA
1.08
j0.668
Nalung Tfr
16 kVA
Dalung B1
98.25 %
33 kV
Changarzampa
25 kVA
4.24
j2.63
Changarzampa Tfr
25 kVA
4.26
PEE100.18
98.25 %
33 kV

MV line details of Pemagatshel Dzongkhag

Annexure-I: Verified data of Distribution Network of Pemagatshel Dzongkhag

Sl.No.	Source	Feeder details		Voltage (kV)	Section	CONDUCTOR	Conductor type & Line Length					Length (km)	
		Name	ID				150 UG	WOLF	DOG	RABBIT	AAAC	Section Length (km)	Cumulative Length (km)
1	132/33/11kV Nangkor Substation	11 KV Pemagatshel Feeder	PEE10	11	PEE10M000 to PEE10M061(PMSS)	DG			4.171			4.17	4.17
					PEE10M014 to PEE10M063	DG			0.085			0.09	0.09
					PEE10M015 to PEE10M018	DG			0.254			0.25	0.25
					PEE10M056 to PEE10M087	DG			0.14			0.14	0.14
					PEE10M061 to PEE10M085	DG			1.316			1.32	1.32
					PEE10M072 to PEE10M091	RAB						0.23	0.23
					PEE10M055 to PEE10M056	UG	0.100					0.10	0.10
					PEE10M060 to PEE10M060	UG	0.15					0.15	0.15
					TOTAL		**0.250**		**5.966**			**6.45**	**6.45**
2	132/33/11kV Nangkor Substation	11 KV Nangkhor Feeder	PEE20	11	PEE20M000 to PEE20M085	DG			4.410			4.41	4.41
					PEE20M002 to PEE20M006	DG			0.315			0.32	0.32
					PEE20M036 to PEE20M120	RB				1.85		1.85	1.85
					PEE20M044 to PEE20M064	RB				1.30		1.30	1.30
					PEE20M084 to PEE20M103	RB				1.58		1.58	1.58
					PEE20M094 to PEE20M096	RB				0.11		0.11	0.11
					TOTAL				**4.725**	**4.83**		**9.56**	**9.56**
3	132/33/11kV Nangkor Substation	11 KV Denchi Feeder	PEE30	11	PEE30M036 to PEE30M057	DG			2.67			2.67	2.67
					PEE30M051 to PEE30M059	RB				0.30		0.30	0.30
					PEE30M059 to PEE30M060	UG	0.13					0.13	0.13
					TOTAL		**0.13**		**2.67**	**0.30**		**3.10**	**3.10**
4	132/33/11kV Nangkor Substation	33 KV Nanong Feeder	PEE40	33	PEE40M000 to PEE40M042	DG			3.191			3.19	3.19
					PEE40M042 to PEE40M411	DG			19.008			19.01	19.01
					PEE40M411 to PEE40M515	DG			5.555			5.55	5.55
					PEE40M042 to PEE40M051	DG			0.735			0.74	0.74
					PEE40M051 to PEE40M335	RB				1.26		1.26	1.26
					PEE40M322 to PEE40M326	RB				0.21		0.21	0.21
					PEE40M051 to PEE40M843	RB				5.31		5.31	5.31
					PEE40M070 to PEE40M073	RB				0.23		0.23	0.23
					PEE40M096 toPEE40M102	RB				0.52		0.52	0.52
					PEE40M129 to PEE40M310	RB				2.40		2.40	2.40
					PEE40M150 to PEE40M218	DG			3.131			3.13	3.13
					PEE40M172 to PEE40M184	DG			0.865			0.87	0.87
					PEE40M260 to PEE40M933	RB				2.09		2.09	2.09
					PEE40M351 to PEE40M362	RB				1.44		1.44	1.44
					PEE40M382 to PEE40M908	RB				3.36		3.36	3.36
					PEE40M380 to PEE40M874	RB				2.42		2.42	2.42
					PEE40M853 to PEE40M856	RB				0.28		0.28	0.28
					PEE40M390 to PEE40M804	RB				2.65		2.65	2.65
					PEE40M406 to PEE40M410	RB				0.30		0.30	0.30
					PEE40M418 to PEE40M425	RB				1.07		1.07	1.07
					PEE40M438 to PEE40M466	RB				1.50		1.50	1.50
					PEE40M445 to PEE40M456	RB				0.70		0.70	0.70
					PEE40M493 to PEE40M506	RB				1.06		1.06	1.06
					PEE40M514 to PEE40M848	DG			0.845			0.85	0.85

					PEE40M514 to PEE40M515	RB				0.07		0.07	0.07
					PEE40M848 to PEE40M539	DG			1.612			1.61	1.61
					PEE40M848 to PEE40M601	DG			1.145			1.15	1.15
					PEE40M601 to PEE40M617	RB				1.15		1.15	1.15
					PEE40M617 to PEE40M619	RB				0.12		0.12	0.12
					PEE40M617 to PEE40M658	RB				3.36		3.36	3.36
					PEE40M624 to PEE40M628	RB				0.22		0.22	0.22
					PEE40M644 to PEE40M647	RB				0.13		0.13	0.13
					PEE40M650 to PEE40M651	RB				0.54		0.54	0.54
					PEE40M617 to PEE40M766	RB				7.08		7.08	7.08
					PEE40M667 to PEE40M676	RB				0.85		0.85	0.85
					PEE40M694 to PEE40M699	RB				0.46		0.46	0.46
					PEE40M714 to PEE40M715	RB				0.07		0.07	0.07
					TOTAL				**36.088**	**40.83**		**76.92**	**76.92**
5	132/33/11kV Nangkor Substation	33kV Tsebar Feeder	PEE50	33	PEE50M000 to PEE50M057	DG			1.866			1.87	1.87
					PEE50M058 to PEE50M080	DG			1.713			1.71	1.71
					PEE50M081 to PEE50M069	RB				0.41		0.41	0.41
					PEE50M667 to PEE50M384	DG			10.345			10.34	10.34
					PEE50M026 to PEE50M055	DG			1.847			1.85	1.85
					PEE50M049 to PEE50M196	RB				0.93		0.93	0.93
					PEE50M384 to PEE50M602	RB				7.33		7.33	7.33
					PEE50M069 to PEE50M475	RB				4.55		4.55	4.55
					PEE50M078 to PEE50M081	RB				0.12		0.12	0.12
					PEE50M101 to PEE50M433	RB				3.20		3.20	3.20
					PEE50M114 to PEE50M119	RB				0.31		0.31	0.31
					PEE50M136 to PEE50M461	DG			0.266			0.27	0.27
					PEE50M150 to PEE50M457	RB				4.36		4.36	4.36
					PEE50M232 to PEE50M261	RB				1.99		1.99	1.99
					PEE50M297 to PEE50M309	RB				0.88		0.88	0.88
					PEE50M167 to PEE50M334	RB				1.70		1.70	1.70
					PEE50M169 to PEE50M173	RB				0.45		0.45	0.45
					PEE50M179 to PEE50M182	DG			0.180			0.18	0.18
					PEE50M374 to PEE50M390	RB				0.25		0.25	0.25
					PEE50M487 to PEE50M519	RB				0.13		0.13	0.13
					PEE50M519 to PEE50M521	RB				0.09		0.09	0.09
					PEE50M519 to PEE50M655	RB				6.50		6.50	6.50
					PEE50M524 to PEE50M525	RB				0.08		0.08	0.08
					PEE50M538 to PEE50M542	RB				0.28		0.28	0.28
					PEE50M618 to PEE50M624	RB				0.57		0.57	0.57
					PEE50M494 to PEE50M504	RB				0.50		0.50	0.50
					PEE50M497 to PEE50M499	RB				0.09		0.09	0.09
					PEE50M502 to PEE50M516	RB				0.88		0.88	0.88
					PEE50M507 to PEE50M510	RB				0.17		0.17	0.17
					PEE50M562 to PEE50M564	RB				0.12		0.12	0.12
					PEE50M583 to PEE50M587	RB				0.42		0.42	0.42
					PEE50M591 to PEE50M594	RB				0.33		0.33	0.33
					TOTAL				**16.217**	**36.67**		**52.88**	**52.88**
					PEE60M000 to PEE60M106	DG			8.458			8.46	8.46
					PEE60M106 to PEE60M404	DG			16.247			16.25	16.25
					PEE60M404 to PEE60M482	DG			6.734			6.73	6.73

6	132/33/11kV Nangkor Substation	33kV Yurung Feeder	PEE60	33	PEE60M052 to PEE60M151	RB				3.19		3.19	3.19
					PEE60M064 to PEE60M174	RB				1.41		1.41	1.41
					PEE60M176 to PEE60M211	RB				0.68		0.68	0.68
					PEE60M211 to PEE60M231	RB				1.89		1.89	1.89
					PEE60M227 to PEE60M239	RB				1.16		1.16	1.16
					PEE60M196 to PEE60M202	DG			1.305			1.31	1.31
					PEE60M281 to PEE60M285	RB				0.47		0.47	0.47
					PEE60M284 to PEE60M305	RB				0.83		0.83	0.83
					PEE60M288 to PEE60M298	RB				0.75		0.75	0.75
					PEE60M301 to PEE60M303	RB				0.32		0.32	0.32
					PEE60M352 to PEE60M354	RB				0.31		0.31	0.31
					PEE60M377 to PEE60M381	RB				0.46		0.46	0.46
					PEE60M381 to PEE60M383	RB				0.17		0.17	0.17
					PEE60M392 to PEE60M395	RB				0.38		0.38	0.38
					PEE60M404 to PEE60M421	RB				0.53		0.53	0.53
					TOTAL				**32.744**	**12.56**		**45.30**	**45.30**
7	132/33/11kV Nganglam Substation	11kV Nganglam Feeder	PEE70	11	PEE70M000 to PEE70M067	RB				4.58		4.58	4.58
					PEE70M067 to PEE70M073	DG			0.45			0.45	0.45
					PEE70M073 to PEE70M100	RB				2.28		2.28	2.28
					PEE70M100 to PEE70M104	DG			0.21			0.21	0.21
					PEE70M104 to PEE70M217	RB				2.02		2.02	2.02
					PEE70M003 to PEE70M142	RB				0.13		0.13	0.13
					PEE70M025 to PEE70M039	RB				0.82		0.82	0.82
					PEE70M038 to PEE70M048	RB				0.55		0.55	0.55
					PEE70M064 to PEE70M150	RB				0.77		0.77	0.77
					PEE70M073 to PEE70M160	RB				0.94		0.94	0.94
					PEE70M084 to PEE70M189	RB				2.75		2.75	2.75
					PEE70M0166 to PEE70M168	RB				0.11		0.11	0.11
					PEE70M104 to PEE70M113	DG			0.61			0.61	0.61
					PEE70M112 to PEE70M213	DG			2.67			2.67	2.67
					PEE70M138 to PEE70M140	RB				0.15		0.15	0.15
					PEE70M217 to PEE70M228	RB				1.18		1.18	1.18
					TOTAL				**3.93913**	**16.28**		**20.22**	**20.22**
8	132/33/11kV Nganglam Substation	11kV Gashari Feeder	PEE80	11	PEE80M000 to PEE80M034	RB				2.24		2.24	2.24
					PEE80M020 to PEE80M025	RB				0.30		0.30	0.30
					TOTAL					**2.54**		**2.54**	**2.54**
					PEE90M000 to PEE90M078	DG			7.605			7.61	7.61
					PEE90M078 to PEE90M244	DG			9.375			9.38	9.38
					PEE90M006 to PEE90M010	DG			0.298			0.30	0.30
					PEE90M020 to PEE90M033	RB				0.48		0.48	0.48
					PEE90M069 to PEE90M381	RB				6.62		6.62	6.62
					PEE90M381 to PEE90M502	RB				11.79		11.79	11.79
					PEE90M317 to PEE90M322	RB				0.65		0.65	0.65
					PEE90M330 to PEE90M332	RB				0.30		0.30	0.30
					PEE90M334 to PEE90M335	RB				0.19		0.19	0.19
					PEE90M375 to PEE90M376	RB				0.13		0.13	0.13
					PEE90M391 to PEE90M396	RB				0.78		0.78	0.78
					PEE90M406 to PEE90M414	RB				0.62		0.62	0.62
					PEE90M414 to PEE90M424	RB				1.13		1.13	1.13

9	132/33/11kV Nganglam Substation	33 kV Denchenling Feeder	PEE90	33	PEE90M420 to PEE90M422	RB				0.14		0.14	0.14
					PEE90M475 to PEE90M476	RB				0.13		0.13	0.13
					PEE90M495 to PEE90M519	RB				2.79		2.79	2.79
					PEE90M512 to PEE90M544	RB				3.73		3.73	3.73
					PEE90M494 to PEE90M496	RB				0.15		0.15	0.15
					PEE90M496 to PEE90M500	RB				0.15		0.15	0.15
					PEE90M502 to PEE90M504	RB				0.23		0.23	0.23
					PEE90M502 to PEE90M576	RB				4.25		4.25	4.25
					PEE90M080 to PEE90M095	DG			0.508			0.51	0.51
					PEE90M095 to PEE90M107	RB				0.97		0.97	0.97
					PEE90M107 to PEE90M291	RB				1.45		1.45	1.45
					PEE90M107 to PEE90M108	RB				0.37		0.37	0.37
					PEE90M095 to PEE90M277	RB				2.88		2.88	2.88
					PEE90M130 to PEE90M313	RB				2.03		2.03	2.03
					PEE90M294 to PEE90M295	RB				0.14		0.14	0.14
					PEE90M150 to PEE90M166	RB				1.16		1.16	1.16
					PEE90M151 to PEE90M153	RB				0.35		0.35	0.35
					PEE90M152 to PEE90M156	RB				0.12		0.12	0.12
					PEE90M161 to PEE90M162	RB				0.18		0.18	0.18
					PEE90M161 to PEE90M164	RB				0.07		0.07	0.07
					PEE90M199 to PEE90M219	RB				1.82		1.82	1.82
					PEE90M218 to PEE90M255	RB				1.38		1.38	1.38
					PEE90M218 to PEE90M219	RB				0.07		0.07	0.07
					PEE90M224 to PEE90M228	RB				0.33		0.33	0.33
					TOTAL				**17.786**	**47.60**		**65.38**	**65.38**
10	132/33/11 Nganglam Substation	33kV Panbang Feeder	PEE100	33	PEE100M000 to PEE100M215	DG			14.94			14.94	14.94
					PEE100M072 to PEE100M086	RB				1.35		1.35	1.35
					PEE100M081 to PEE100M091	RB				0.41		0.41	0.41
					PEE100M152 to PEE100M155	RB				0.35		0.35	0.35
					PEE100M155 to PEE100M161	RB				0.42		0.42	0.42
					PEE100M155 to PEE100M157	RB				0.20		0.20	0.20
					PEE100M156 to PEE100M158	RB				0.12		0.12	0.12
					PEE100M185 to PEE100M186	RB				0.13		0.13	0.13
					PEE100M186 to PEE100M197	RB				0.83		0.83	0.83
					PEE100M190 to PEE100M192	RB				0.22		0.22	0.22
					PEE100M215 to PEE100M222	RB				1.15		1.15	1.15
					PEE100M220 to PEE100M248	RB				1.00		1.00	1.00
					PEE100M222 to PEE100M232	RB				1.47		1.47	1.47
					TOTAL				**14.94**	**7.64**		**22.58**	**22.58**
11	132/33/11kV Nganglam Substation	33 kV DGPL Feeder	PEE110	33	PEE110M000 to PEE110M037	AAAC					3.20	3.20	3.20
					PEE110M037 to PEE110M038	AAAC					0.02	0.02	0.02
					TOTAL						**3.22**	**3.22**	**3.22**
12	132/33/11kV Nganglam Substation	11kV Satsalo Feeder	PEE120	11	PEE120M000 to PEE70M051	RB				5.10		5.10	5.10
					TOTAL					**5.10**		**5.10**	**5.10**
13	132/33/11kV Pemagatshel Substation	33kV Wamrong Feeder	PEE150	33	PEE150M000 to PEE150M181	DG			17.91053			17.91	17.91
					TOTAL				**17.91053**			**17.91**	**17.91**

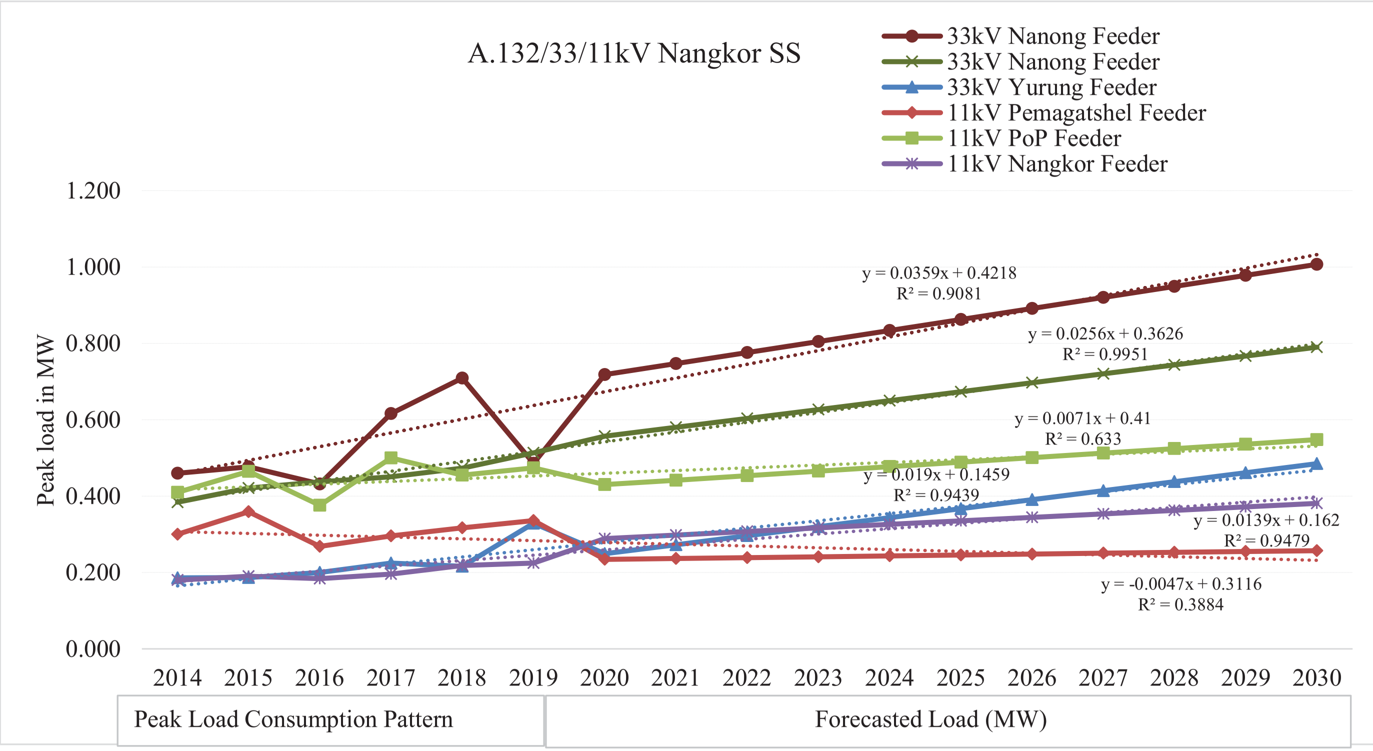
Annexure-2: IS 2026, IEC 60076 (Technical parameters for Distribution Lines and Transformers)

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

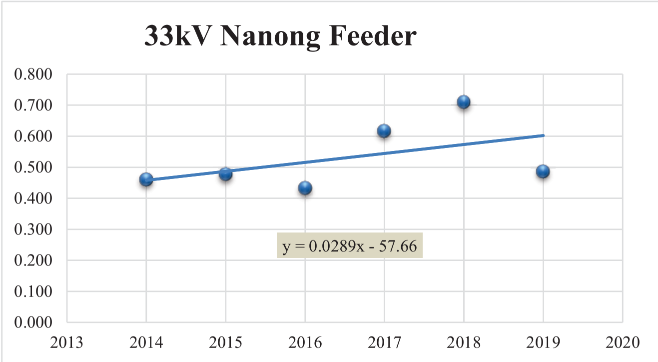
Load forecast for Pemagatshel Dzongkhag

A.132/33/11kV Nangkor SS																	
Feeder Name	**2014-2019 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**
33kV Nanong Feeder	0.460	0.477	0.432	0.616	0.709	0.486	0.718	0.747	0.776	0.805	0.834	0.862	0.891	0.920	0.949	0.978	1.007
33kV Tsebar Feeder	0.384	0.421	0.437	0.451	0.473	0.513	0.557	0.580	0.604	0.627	0.650	0.674	0.697	0.720	0.743	0.767	0.790
33kV Yurung Feeder	0.186	0.187	0.200	0.225	0.216	0.329	0.249	0.273	0.296	0.320	0.343	0.367	0.391	0.414	0.438	0.461	0.485
11kV Pemagatshel Feeder	0.300	0.359	0.268	0.296	0.317	0.336	0.234	0.237	0.239	0.241	0.244	0.246	0.248	0.250	0.253	0.255	0.257
11kV PoP Feeder	0.410	0.465	0.376	0.500	0.455	0.474	0.430	0.442	0.454	0.465	0.477	0.489	0.501	0.513	0.524	0.536	0.548
11kV Nangkor Feeder	0.180	0.190	0.184	0.196	0.218	0.225	0.289	0.298	0.307	0.317	0.326	0.335	0.344	0.353	0.363	0.372	0.381

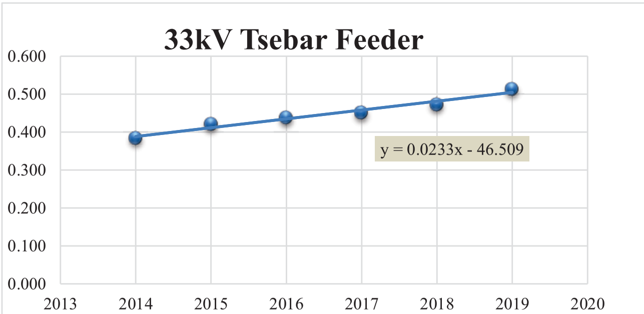


A. 132/33/11kV Nangkor SS - Feeder Wise Load Forecast

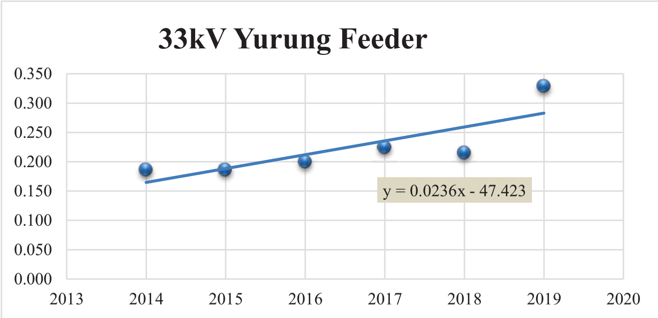
										Load Forecast 2020-2030										
1	Feeder Name	33kV Nanong Feeder	Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
			Peak Load (MW)	0.460	0.477	0.432	0.616	0.709	0.486	**0.718**	**0.747**	**0.776**	**0.805**	**0.834**	**0.862**	**0.891**	**0.920**	**0.949**	**0.978**	**1.007**



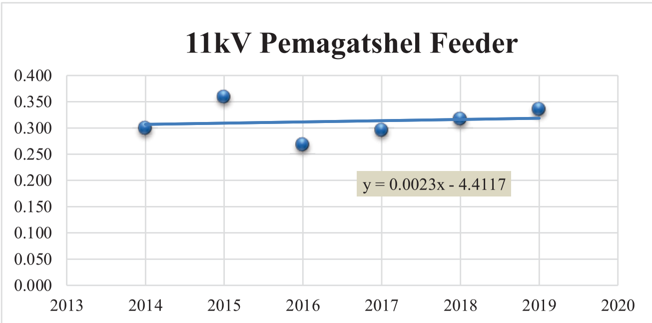
										Load Forecast 2020-2030										
2	Feeder Name	33kV Tsebar Feeder	Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
			Peak Load (MW)	0.384	0.421	0.437	0.451	0.473	0.513	**0.557**	**0.580**	**0.604**	**0.627**	**0.650**	**0.674**	**0.697**	**0.720**	**0.743**	**0.767**	**0.790**



										Load Forecast 2020-2030										
3	Feeder Name	33kV Yurung Feeder	Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
			Peak Load (MW)	0.186	0.187	0.200	0.225	0.216	0.329	**0.249**	**0.273**	**0.296**	**0.320**	**0.343**	**0.367**	**0.391**	**0.414**	**0.438**	**0.461**	**0.485**

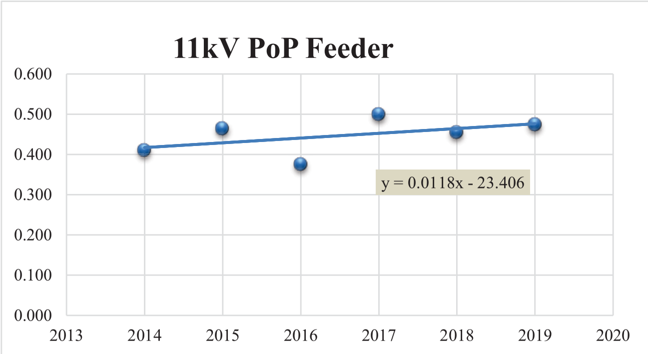


										Load Forecast 2020-2030										
4	Feeder Name	11kV Pemagatshel Feeder	Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
			Peak Load (MW)	0.300	0.359	0.268	0.296	0.317	0.336	**0.234**	**0.237**	**0.239**	**0.241**	**0.244**	**0.246**	**0.248**	**0.250**	**0.253**	**0.255**	**0.257**

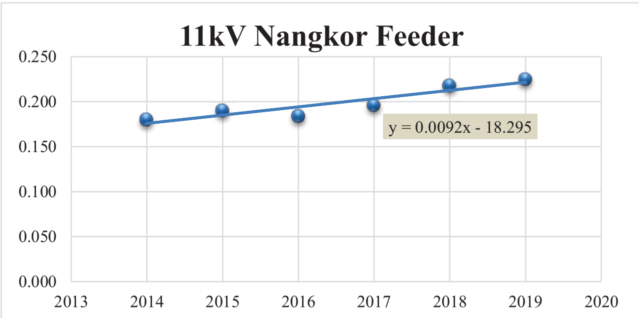


PG Feeder customers will be shifted to Dechi Town and the load will be connected to Tsebar Feeder

										Load Forecast 2020-2030										
5	Feeder Name	11kV PoP Feeder	Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
			Peak Load (MW)	0.410	0.465	0.376	0.500	0.455	0.474	0.430	0.442	0.454	0.465	0.477	0.489	0.501	0.513	0.524	0.536	0.548

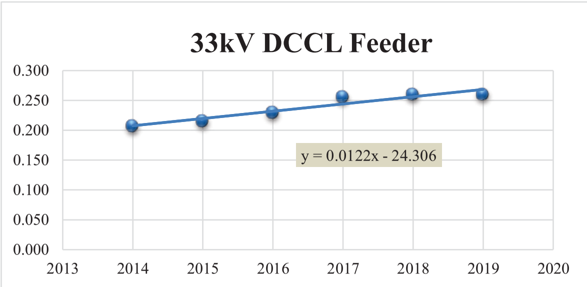


										Load Forecast 2020-2030										
6	Feeder Name	11kV Nangkor Feeder	Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
			Peak Load (MW)	0.180	0.190	0.184	0.196	0.218	0.225	0.289	0.298	0.307	0.317	0.326	0.335	0.344	0.353	0.363	0.372	0.381

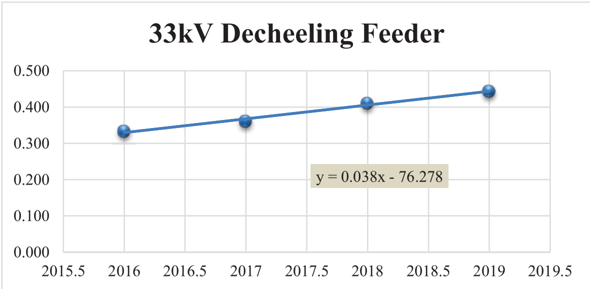


B. 132/33/11kV Nganglam SS - Feeder Wise Load Forecast

										Load Forecast 2020-2030										
1	Feeder Name	33kV DCCL Feeder	Year	2014	2015	2016	2017	2018	2019	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
			Peak Load (MW)	0.207	0.215	0.230	0.256	0.260	0.260	**0.338**	**0.350**	**0.362**	**0.375**	**0.387**	**0.399**	**0.411**	**0.423**	**0.436**	**0.448**	**0.460**



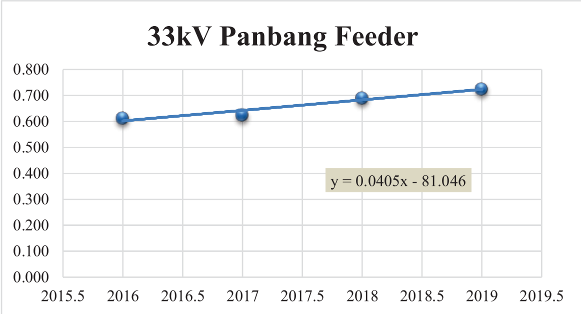
										Load Forecast 2020-2030										
2	Feeder Name	33kV Decheeling Feeder	Year	2014	2015	2016	2017	2018	2019	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
			Peak Load (MW)	0.796	0.841	0.333	0.36	0.41	0.443	**0.482**	**0.520**	**0.558**	**0.596**	**0.634**	**0.672**	**0.710**	**0.748**	**0.786**	**0.824**	**0.862**



REASON for drop in MW:

2014-2015 LV Bulk Customers were catered by Dechling Fdr. from 2016 the LV customer were connected to DCCL Feeder

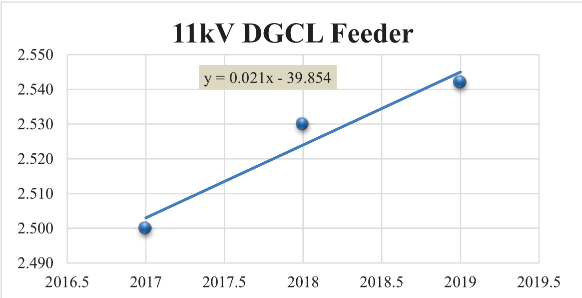
										Load Forecast 2020-2030										
3	Feeder Name	33kV Panbang Feeder	Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
			Peak Load (MW)	1.036	1.200	0.612	0.624	0.690	0.725	**0.764**	**0.804**	**0.845**	**0.885**	**0.926**	**0.966**	**1.007**	**1.048**	**1.088**	**1.129**	**1.169**



Panbang Feeder

is interconnected with the Gomphu Feeder (Zhemgang). 2014-2015 the panbang feeder recorded highest PL as it fed to the Gomphu Feeder

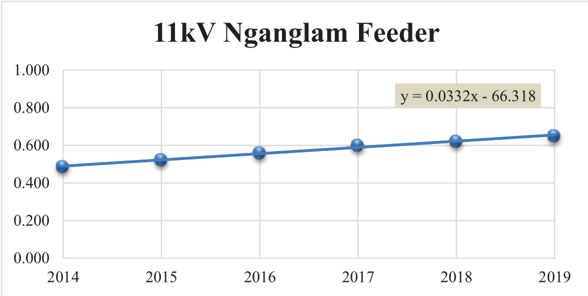
										Load Forecast 2020-2030										
4	Feeder Name	11kV DGCL Feeder	Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
			Peak Load (MW)		0.065	0.075	2.500	2.530	2.542	**2.566**	**2.587**	**2.608**	**2.629**	**2.650**	**2.671**	**2.692**	**2.713**	**2.734**	**2.755**	**2.776**



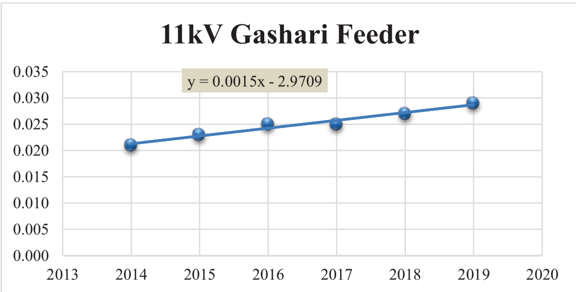
DGCL Feeder:

PoP Factory load connected to this Feeder

										Load Forecast 2020-2030										
5	Feeder Name	11kV Nganglam Feeder	Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
			Peak Load (MW)	0.485	0.522	0.558	0.600	0.620	0.650	**0.746**	**0.779**	**0.812**	**0.846**	**0.879**	**0.912**	**0.945**	**0.978**	**1.012**	**1.045**	**1.078**



										Load Forecast 2020-2030										
6	Feeder Name	11kV Gashari Feeder	Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
			Peak Load (MW)	0.021	0.023	0.025	0.025	0.027	0.029	**0.059**	**0.061**	**0.062**	**0.064**	**0.065**	**0.067**	**0.068**	**0.070**	**0.071**	**0.073**	**0.074**



Load forecast methdology

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.**

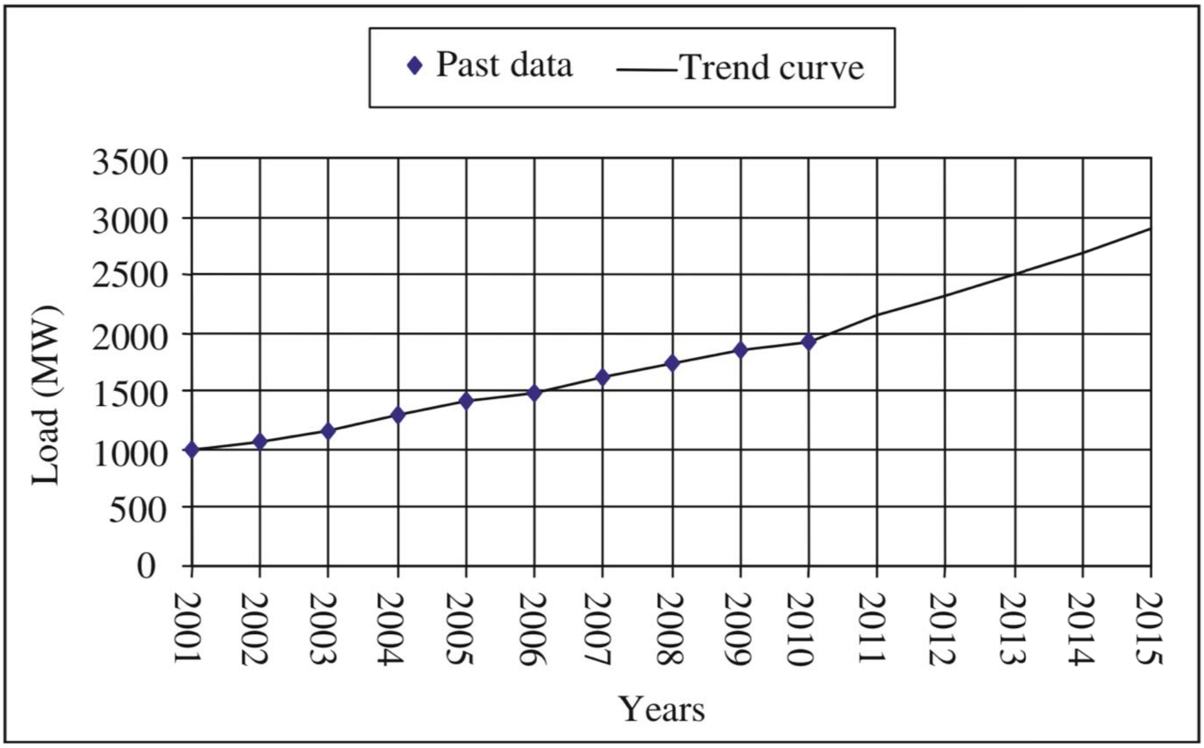


Figure 1: Typical trend curve[1]

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.

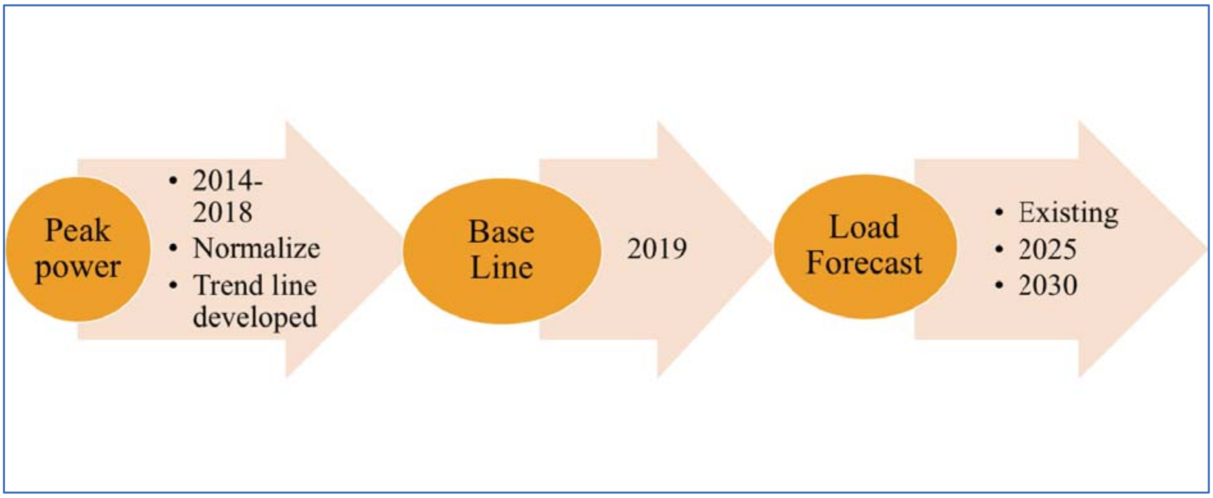


Figure 2: Flow diagram for load forecast

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**

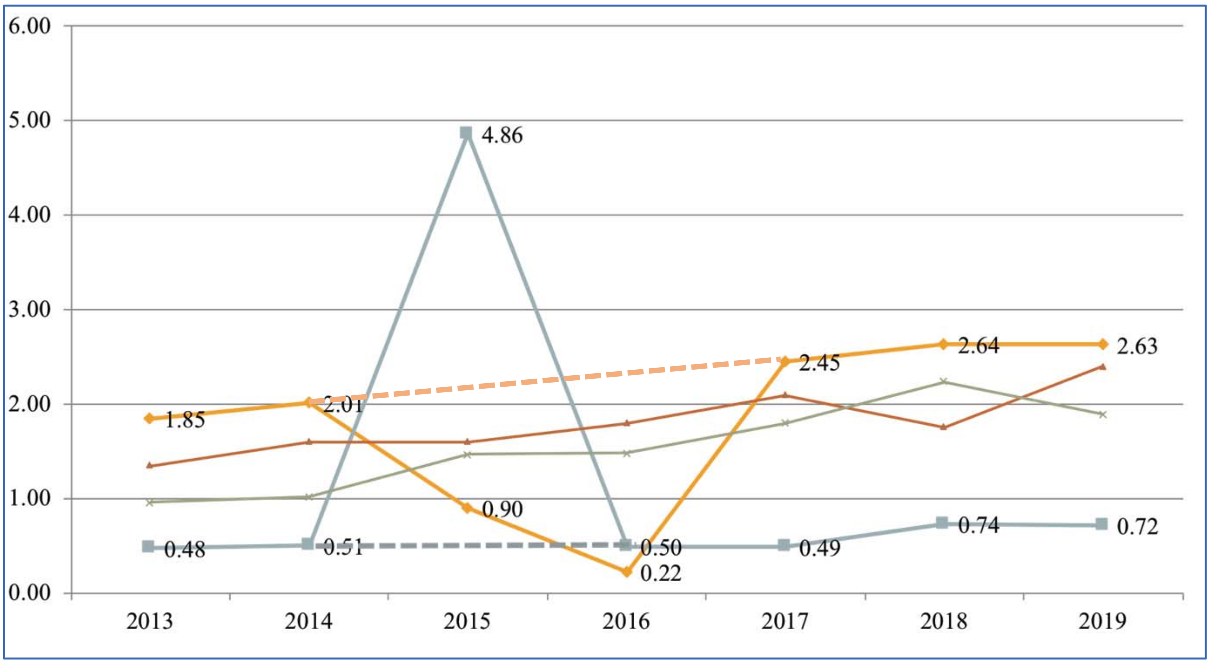


Figure 3: Actual data of Punakha Dzongkhag

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

$Where:$
$x\ is\ the\ normalized\ data$

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.**

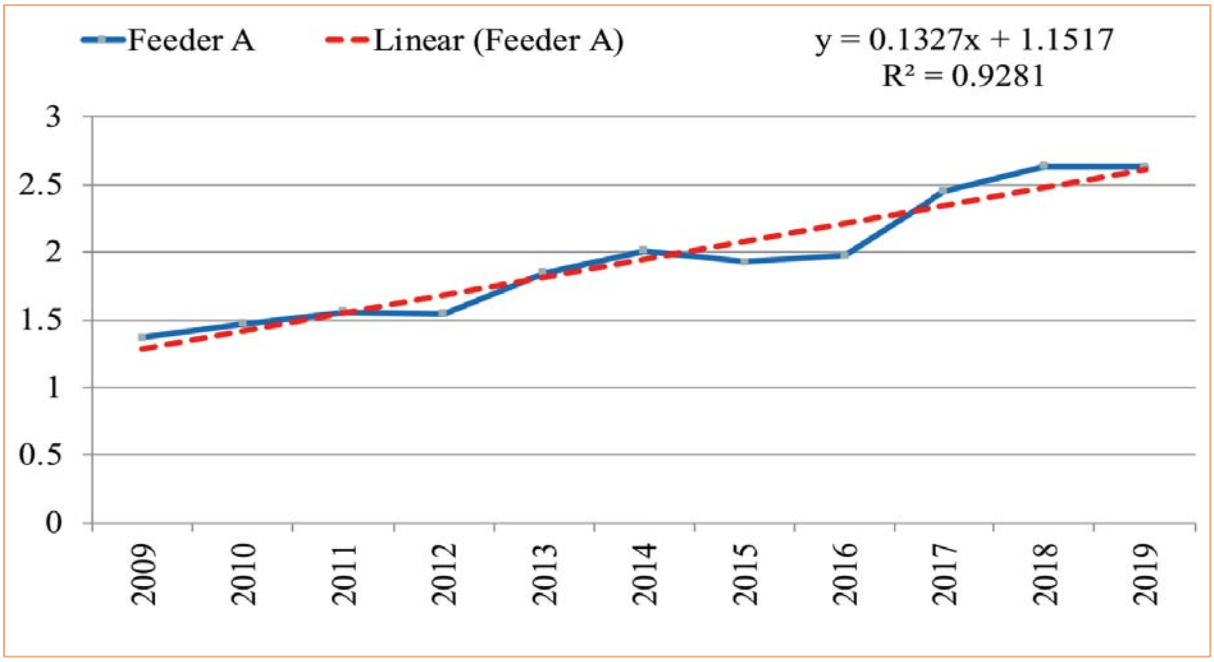


Figure 4: Trend line and load forecast for Punakha Dzongkhag

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.

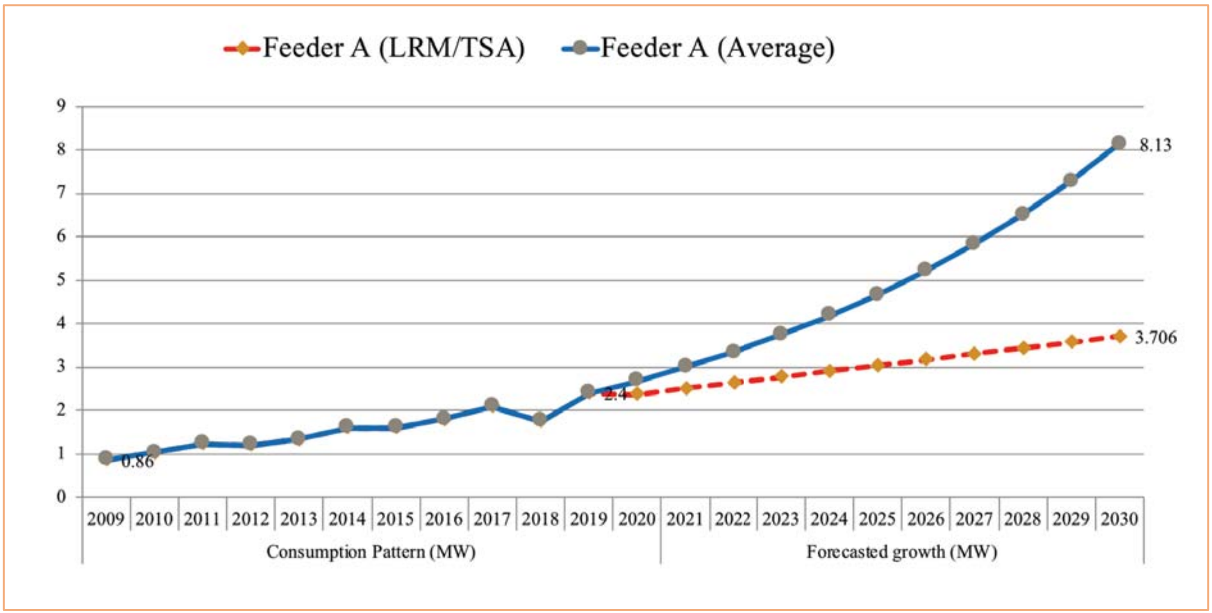


Figure 5: Forecasted load (trend line with red shows the linear regression and one with blue shows the forecast with average method)

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.

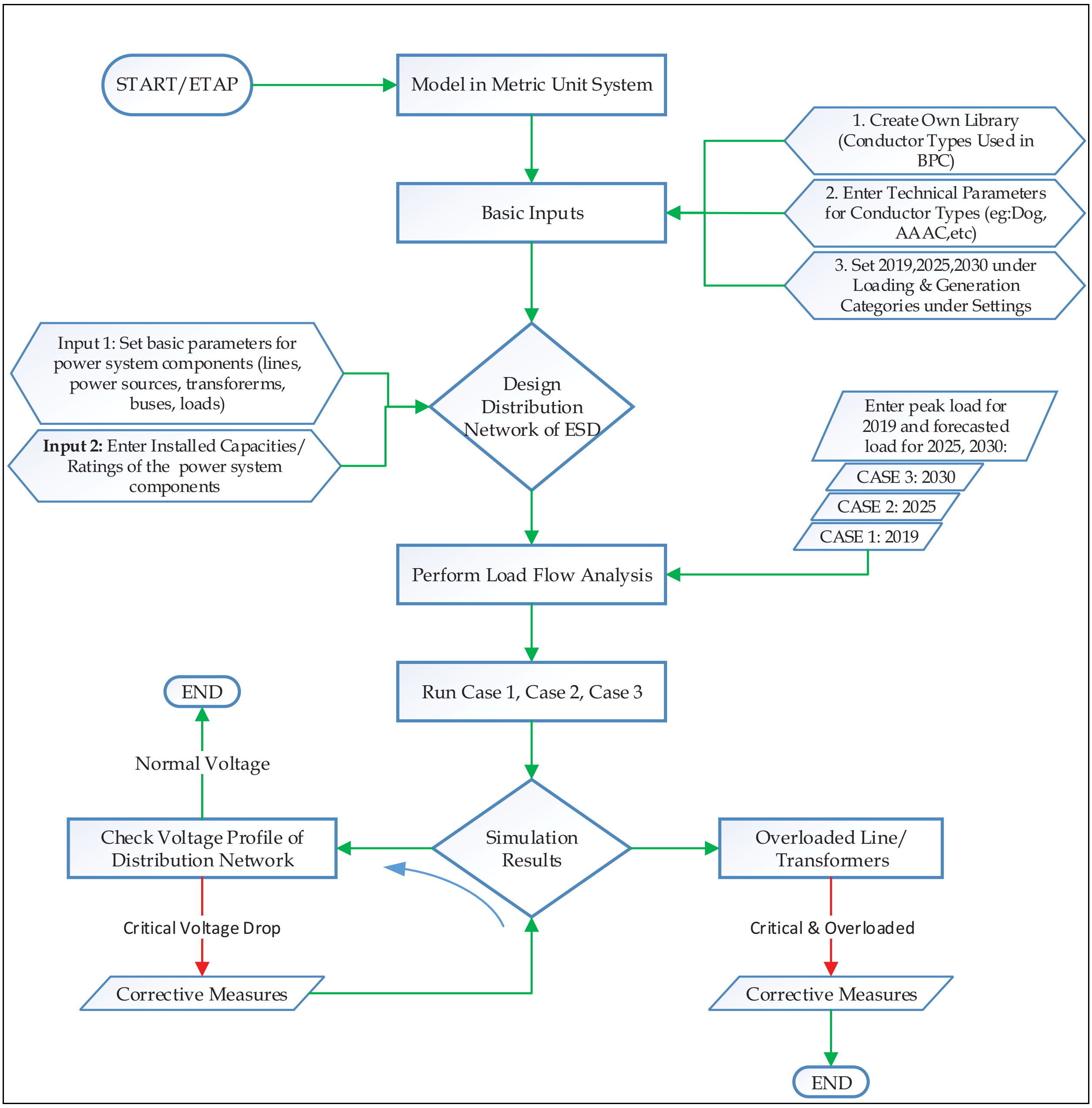


Figure 6: Flow Chart for Network Modelling & Load Flow Analysis (ETAP)

[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					
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Percent Loading
Babta B1	33.000										0.550	89.7	10.0	
Babta B2	0.415		0.011	0.007	0.038	0.023					0.058	85.0	86.4	
Bainang Gonpa B1	33.000		0.001	0.001	0.004	0.003					0.006	85.0	0.1	
Banjarie B1	11.000										0.020	84.2	1.1	
Bar Gonpa B1	33.000										0.013	84.6	0.2	
Bar Gonpa B2	0.415		0.002	0.001	0.008	0.005					0.013	85.0	18.6	
Bartseri B1	33.000										0.025	84.6	0.5	
Bartseri B2	0.415		0.017	0.011	0.004	0.002					0.025	85.0	36.0	
BCI B1	11.000										0.859	83.3	48.7	
BCI B2	0.415		0.140	0.087	0.441	0.273					0.683	85.0	1072.8	
Bedungri B1	33.000										0.022	84.7	0.4	
Bedungri B2	0.415		0.004	0.002	0.014	0.009					0.022	85.0	31.5	
Benjarie B2	0.415		0.004	0.002	0.013	0.008					0.020	85.0	29.8	
BHU Area B1	33.000										0.041	89.6	0.7	
BHU Area B2	0.415		0.005	0.003	0.018	0.011					0.027	85.0	39.9	
Bongdala B1	33.000										0.121	99.9	2.2	
Bongdala B2	0.415		0.001	0.001	0.005	0.003					0.008	85.0	11.0	
Bongman B1	33.000										0.014	93.2	0.3	
Bongman B2	0.415		0.006	0.004	0.002	0.001					0.009	85.0	13.4	
BorangChilo B1	33.000										0.894	89.7	16.0	
Borangchilo B2	0.415		0.003	0.002	0.001	-					0.004	85.0	6.0	
Borangm BHU B1	33.000										0.019	84.7	0.4	
Borangm BHU B2	0.415		0.004	0.002	0.013	0.008					0.019	85.0	28.1	
Borangmo2 B1	33.000										0.013	84.5	0.2	
Borangmo2 B2	0.415		0.002	0.001	0.009	0.005					0.013	85.0	18.8	
Borkatshg B1	11.000										0.023	86.0	1.3	
Borkatshg B2	0.415		0.002	0.001	0.007	0.004					0.011	85.0	16.6	
BPC Colony B1	11.000										0.006	84.8	0.3	
BPC Colony B2	0.415		0.001	0.001	0.004	0.002					0.006	85.0	8.4	
Branphu B1	33.000										0.024	87.3	0.4	
Branphu B2	0.415		0.004	0.003	0.015	0.009					0.022	85.0	32.3	
Changarzampa B1	33.000										0.019	84.3	0.3	
Changarzampa B2	0.415		0.003	0.002	0.012	0.007					0.018	85.0	27.1	
Chimung Sch. B1	33.000										0.024	84.6	0.4	
Chimung Sch. B2	0.415		0.004	0.003	0.016	0.010					0.024	85.0	34.2	
Chokhorling Sc. B1	33.000										0.018	84.3	0.3	
Chokhorling Sc. B2	0.415		0.003	0.002	0.012	0.007					0.018	85.0	26.4	
Chokhorling1 B1	33.000										0.057	85.3	1.0	
Chokhorling1 B2	0.415		0.001	0.001	0.003	0.002					0.005	85.0	6.8	

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
Chokhorling2 B1	33.000		0.003	0.002	0.011	0.007					0.035	84.8	0.6	
Chokhorling3 B1	33.000		0.003	0.002	0.010	0.006					0.017	85.0	0.3	
Chokhorling3 B2	0.415		0.000	0.000	0.002	0.001					0.002	85.0	3.4	
Chshing Gonpa B1	33.000										0.151	91.2	2.7	
Chshing Gonpa B2	0.415		0.011	0.007	0.003	0.002					0.016	85.0	23.7	
Chungkhar B1	33.000										0.024	84.6	0.4	
Chungkhar B2	0.415		0.004	0.003	0.016	0.010					0.024	85.0	35.0	
DaiGonpa B1	33.000										0.001	85.0	-	
DaiGonpa B2	0.415		0.000	0.000	0.001	-					0.001	85.0	1.7	
Dalung B1	33.000										0.012	93.0	0.2	
Dalung B2	0.415		0.001	0.001	0.005	0.003					0.008	85.0	11.6	
DCCL B1	33.000										0.378	84.5	6.8	
DCCL B2	0.415		0.068	0.042	0.251	0.155					0.375	85.0	543.3	
DCP Area B1	11.000										0.559	84.2	31.9	
DCP Area B2	0.415		0.082	0.051	0.248	0.154					0.389	85.0	623.7	
Denchi Lkhang B1	33.000										0.123	86.9	2.2	
Denchi Lkhang B2	0.415		0.024	0.015	0.006	0.003					0.035	85.0	51.4	
Denchi SS B1	33.000										0.769	89.8	13.8	
Denchi SS B2	11.000													
Druk Gy B2	0.415		0.006	0.004	0.022	0.014					0.033	85.0	49.0	
Druk Gyp B1	33.000										1.506	84.7	27.4	
Druk Gyp2 B1	0.415		0.269	0.166	0.965	0.598					1.451	85.0	2130.1	
Dungchilo B1	33.000										0.008	97.2	0.1	
Dungchilo B2	0.415		0.001	0.000	0.002	0.001					0.003	85.0	5.1	
Dungchilopam B1	33.000										0.006	84.8	0.1	
Dungchilopam B2	0.415		0.001	0.001	0.004	0.002					0.006	85.0	8.1	
Dungkar Lkhang B1	33.000										0.006	84.9	0.1	
Dungkar Lkhang B2	0.415		0.004	0.003	0.001	0.001					0.006	85.0	8.9	
Dungmin I B1	33.000		0.001	0.000	0.000	-					0.077	92.4	1.4	
Dungmin III B1	33.000										0.039	84.4	0.7	
Dungmin III B2	0.415		0.026	0.016	0.006	0.004					0.038	85.0	55.2	
Durungree B1	33.000		0.004	0.002	0.014	0.008					0.020	85.0	0.4	
Dzong B1	11.000										0.179	84.9	9.7	
Dzong B2	0.415		0.017	0.011	0.062	0.038					0.092	85.0	135.2	
Galabi B1	33.000										0.037	84.4	0.7	
Galabi B2	0.415		0.007	0.004	0.024	0.015					0.036	85.0	54.1	
Gamung B1	11.000										0.029	84.5	1.6	
Gamung B2	0.415		0.006	0.003	0.019	0.012					0.029	85.0	43.5	
Gangtong B1	33.000										0.014	95.9	0.2	
Gangtong B2	0.415		0.001	0.000	0.002	0.001					0.003	85.0	4.3	
Gashari B1	11.000										0.059	84.5	3.3	
Gashari B2	0.415		0.011	0.007	0.038	0.024					0.058	85.0	86.7	

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
Gasharibali.A B1	33.000										0.012	84.8	0.2	
Gasharibali.A B2	0.415		0.002	0.001	0.008	0.005					0.012	85.0	17.1	
Gayri B1	33.000										0.016	84.8	0.3	
Gayri B2	0.415		0.003	0.002	0.010	0.006					0.016	85.0	23.0	
Gbrangsa B1	33.000										2.069	87.7	37.2	
Gbrangsa B2	0.415		0.006	0.003	0.020	0.013					0.030	85.0	44.4	
GO Khar B1	33.000										0.015	84.8	0.3	
GO Khar B2	0.415		0.010	0.006	0.002	0.001					0.015	85.0	21.5	
Gomchu B1	11.000										0.138	85.1	7.7	
Gomchu B2	0.415		0.002	0.001	0.008	0.005					0.012	85.0	17.7	
Gomtshang B1	33.000		0.002	0.001	0.008	0.005					0.019	85.0	0.3	
Gomtshang B2	0.415		0.001	0.001	0.004	0.003					0.006	85.0	8.6	
GonpaSingma B1	33.000										0.121	88.4	2.2	
GonpaSingma B2	0.415		0.013	0.008	0.043	0.027					0.065	85.0	98.1	
Gonpawong B1	33.000										0.349	90.5	6.3	
Gonpawong B2	0.415		0.007	0.004	0.023	0.014					0.035	85.0	51.6	
Gonpung B1	11.000										0.015	84.4	0.8	
Gonpung B2	0.415		0.003	0.002	0.010	0.006					0.015	85.0	22.2	
Guyum B1	33.000										0.018	84.7	0.3	
Guyum B2	0.415		0.003	0.002	0.012	0.007					0.018	85.0	25.7	
Hospital B1	11.000										0.002	85.0	0.1	
Hospital B2	0.415		0.000	0.000	0.001	0.001					0.002	85.0	2.6	
Jirang B1	33.000										0.142	91.5	2.6	
Jirang B2	0.415		0.002	0.001	0.007	0.005					0.011	85.0	17.2	
Kangkaring B1	11.000										0.213	85.1	11.9	
Kangkaring B2	0.415		0.002	0.001	0.007	0.005					0.011	85.0	16.8	
Kerong Sch. B1	33.000		0.002	0.001	0.008	0.005					0.021	84.9	0.4	
Kerong Sch. B2	0.415		0.002	0.001	0.006	0.004					0.009	85.0	13.1	
Khaimma B1	33.000										0.033	84.5	0.6	
Khaimma B2	0.415		0.006	0.004	0.022	0.013					0.033	85.0	48.2	
Khalagtangzor B1	11.000		0.000	0.000	0.001	0.001					0.012	86.7	0.7	
Khengzor B1	33.000										0.008	84.9	0.1	
Khengzor B2	0.415		0.006	0.003	0.001	0.001					0.008	85.0	11.6	
Khengzor I B1	33.000										0.019	84.7	0.3	
Khengzor I B2	0.415		0.013	0.008	0.003	0.002					0.019	85.0	26.9	
Khengzor II B1	33.000										0.031	88.1	0.6	
Khengzor II B2	0.415		0.009	0.006	0.002	0.001					0.014	85.0	19.7	
Kheri B1	11.000										0.021	84.7	1.2	
Kheri B2	0.415		0.004	0.002	0.014	0.008					0.021	85.0	31.0	
Kheri Gonpa B1	33.000										0.116	92.7	2.1	
Kheri Gonpa B2	0.415		0.008	0.005	0.028	0.018					0.043	85.0	62.8	
Kheydung B1	33.000										0.002	84.9	-	

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
Kheydung B2	0.415		0.000	0.000	0.002	0.001					0.002	85.0	3.4	
Khonmari B	33.000										0.338	85.8	6.1	
Khonmari I B2	0.415		0.018	0.011	0.063	0.039					0.096	85.0	144.1	
Khonmari II B1	0.415		0.022	0.013	0.074	0.046					0.112	85.0	168.8	
Khonmari III B1	33.000										0.054	84.2	1.0	
Khonmari III B2	0.415		0.010	0.006	0.034	0.021					0.052	85.0	77.5	
Khonmari IV B1	33.000										0.053	84.2	1.0	
Khonmari IV B2	0.415		0.010	0.006	0.034	0.021					0.051	85.0	76.7	
Khoripam B1	11.000										0.193	84.9	10.5	
Khoripam B2	0.415		0.003	0.002	0.009	0.006					0.014	85.0	20.5	
Khotakpa B1	33.000										0.088	86.9	1.6	
Khotakpa B2	0.415		0.020	0.012	0.005	0.003					0.028	85.0	41.4	
Khulngdrng B1	33.000										0.910	90.5	16.5	
Khulngdrng B2	0.415		0.006	0.004	0.023	0.014					0.034	85.0	50.8	
Kulung B1	33.000										0.069	86.6	1.3	
Kulung B2	0.415		0.004	0.002	0.013	0.008					0.020	85.0	29.7	
L.Bangyul B1	33.000		0.001	0.001	0.004	0.002					0.006	85.0	0.1	
L.Chiphung B1	33.000		0.001	0.001	0.004	0.003					0.018	84.9	0.3	
L.Chiphung B2	0.415		0.002	0.001	0.008	0.005					0.012	85.0	17.2	
L.Chshing B1	33.000										0.120	91.1	2.2	
L.Chshing B2	0.415		0.003	0.002	0.001	-					0.004	85.0	5.4	
L.Dezema B1	11.000		0.000	0.000	0.002	0.001					0.011	85.2	0.6	
L.Khangma B1	33.000										0.069	85.2	1.2	
L.Khangma B2	0.415		0.008	0.005	0.030	0.019					0.046	85.0	67.1	
L.Khar B1	33.000										0.076	83.9	1.4	
L.Khar B2	0.415		0.051	0.031	0.011	0.007					0.072	85.0	108.3	
L.Khnadang B1	33.000										0.013	84.8	0.2	
L.Khnadang B2	0.415		0.002	0.001	0.009	0.005					0.013	85.0	18.9	
L.Kholomeri B1	33.000										0.013	84.5	0.2	
L.Kholomeri B2	0.415		0.002	0.002	0.009	0.005					0.013	85.0	19.5	
L.Menchu B1	11.000										0.011	84.8	0.6	
L.Menchu B2	0.415		0.002	0.001	0.007	0.005					0.011	85.0	16.8	
L.Nangkor B1	11.000										0.271	84.9	15.1	
L.Nangkor B2	0.415		0.011	0.007	0.036	0.022					0.056	85.0	85.3	
L.Nmalam B1	33.000										0.017	84.8	0.3	
L.Nmalam B2	0.415		0.003	0.002	0.011	0.007					0.016	85.0	23.9	
L.Pthang B1	33.000		0.000	0.000	0.001	0.001					0.091	99.6	1.6	
L.Satshalo B1	11.000										0.087	85.5	5.0	
L.Satshalo B2	0.415		0.003	0.002	0.011	0.007					0.017	85.0	25.7	
L.Tshagtrie B1	11.000										0.002	84.9	0.1	
L.Tshagtrie B2	0.415		0.000	0.000	0.001	0.001					0.002	85.0	2.7	
L.Yangmalshg B1	33.000										0.020	84.2	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
L.Yangmalshg B2	0.415		0.004	0.002	0.013	0.008					0.019	85.0	29.0	
Labar B1	33.000										0.014	84.8	0.3	
Labar B2	0.415		0.010	0.006	0.002	0.001					0.014	85.0	20.6	
Laling B1	33.000										0.007	84.7	0.1	
Laling B2	0.415		0.001	0.001	0.005	0.003					0.007	85.0	10.5	
Lanangzor B1	33.000		0.001	0.001	0.004	0.003					0.072	89.5	1.3	
Laneri Sch. B1	33.000		0.008	0.005	0.002	0.001					0.018	85.0	0.3	
Laneri Sch. B2	0.415		0.005	0.003	0.001	0.001					0.007	85.0	9.8	
Lasheringri B1	33.000										0.005	84.8	0.1	
Lasheringri B2	0.415		0.001	0.001	0.003	0.002					0.005	85.0	6.8	
Lashingrie B1	33.000										0.029	83.9	0.5	
Lashingrie B2	0.415		0.005	0.003	0.018	0.011					0.027	85.0	41.4	
Lawoong B1	33.000										0.221	97.4	4.0	
Lawoong B2	0.415		0.010	0.006	0.035	0.021					0.052	85.0	77.0	
M.Banyul B1	33.000		0.001	0.001	0.005	0.003					0.007	85.0	0.1	
M.Dezema B1	11.000										0.009	84.9	0.5	
M.Dezema B2	0.415		0.001	0.001	0.003	0.002					0.005	85.0	7.3	
Maan B1	33.000										0.628	90.2	11.4	
Maan B2	0.415		0.001	0.001	0.004	0.003					0.006	85.0	9.4	
Maendi B1	33.000										0.016	84.8	0.3	
Maendi B2	0.415		0.011	0.007	0.002	0.002					0.016	85.0	22.4	
Marangdth B1	33.000										0.008	84.7	0.1	
Marangdth B2	0.415		0.001	0.001	0.005	0.003					0.008	85.0	11.5	
Martsala B1	33.000										0.391	90.0	7.1	
Martsala B2	0.415		0.008	0.005	0.028	0.017					0.042	85.0	62.5	
Mekuri B1	33.000		0.002	0.001	0.008	0.005					0.013	85.0	0.2	
Mekuri Sch. B1	33.000		0.003	0.002	0.010	0.006					0.015	85.0	0.3	
Mongling B1	33.000										0.093	84.7	1.7	
Mongling B2	0.415		0.009	0.005	0.031	0.019					0.047	85.0	69.3	
Mukazor B1	33.000										0.012	84.8	0.2	
Mukazor B2	0.415		0.002	0.001	0.008	0.005					0.012	85.0	17.9	
N.Yangkhar B1	11.000										0.033	85.1	1.9	
N.Yangkhar B2	0.415		0.002	0.001	0.008	0.005					0.012	85.0	18.6	
Nachubander B1	33.000										0.011	84.6	0.2	
Nachubander B2	0.415		0.002	0.001	0.007	0.004					0.011	85.0	15.5	
Nalung B1	33.000										0.005	84.7	0.1	
Nalung B2	0.415		0.001	0.001	0.003	0.002					0.005	85.0	6.9	
Namdeling B1	33.000										0.016	84.8	0.3	
Namdeling B2	0.415		0.003	0.002	0.011	0.007					0.016	85.0	23.0	
Nangkor CS B1	11.000										0.128	84.0	7.1	
Nangkor CS B2	0.415		0.024	0.015	0.079	0.049					0.122	85.0	188.6	
Nangkor SS B1	132.000										5.605	85.0	24.5	

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
Nangkor SS B2	33.000										5.468	86.7	98.1	
Nanong B1	33.000										0.027	84.1	0.5	
Nanong B2	0.415		0.005	0.003	0.017	0.011					0.026	85.0	39.5	
Nganglam SS B1	132.000										5.074	84.4	22.2	
Nganglam SS B2	33.000										4.912	86.6	88.8	
Ngatseri B1	33.000										0.023	84.7	0.4	
Ngatseri B2	0.415		0.016	0.010	0.004	0.002					0.023	85.0	33.3	
Norbaii B1	33.000		0.002	0.001	0.009	0.005					0.235	92.6	4.3	
Norbugang B1	33.000										0.063	87.3	1.1	
Norbugang B2	0.415		0.001	0.000	0.002	0.002					0.004	85.0	5.4	
NS Borang B1	33.000		0.008	0.005	0.031	0.019					0.071	84.7	1.3	
NS Borang B2	0.415		0.004	0.003	0.015	0.009					0.023	85.0	34.6	
Nshing Lkhang B1	33.000		0.002	0.001	0.008	0.005					0.620	89.5	11.3	
Pakhurie B1	11.000										0.095	85.6	5.4	
Pakhurie B2	0.415		0.002	0.001	0.005	0.003					0.008	85.0	11.8	
Panbang B2	0.415		0.023	0.014	0.080	0.050					0.121	85.0	178.1	
Pangbang B1	33.000										0.123	84.5	2.2	
Pangthang B1	11.000										0.025	85.1	1.4	
Pangthang B2	0.415		0.003	0.002	0.010	0.006					0.015	85.0	22.7	
PEE10.1	11.000										0.287	84.9	15.5	
PEE10.2	11.000										0.235	85.0	12.7	
PEE10.3	11.000										0.002	86.8	0.1	
PEE20.1	11.000										0.398	84.6	22.2	
PEE20.2	11.000										0.398	84.6	22.2	
PEE20.3	11.000										0.172	85.1	9.6	
PEE20.4	11.000										0.127	85.0	7.1	
PEE20.5	11.000										0.101	84.9	5.7	
PEE20.6	11.000										0.069	84.9	3.8	
PEE20.7	11.000										0.040	84.8	2.2	
PEE30.1	11.000										1.276	83.2	71.9	
PEE30.2	11.000										0.146	84.5	8.3	
PEE40.1	33.000										2.037	87.7	36.7	
PEE40.2	33.000										0.074	95.8	1.3	
PEE40.3	33.000										0.029	87.4	0.5	
PEE40.4	33.000										0.047	95.6	0.9	
PEE40.5	33.000										1.921	87.3	34.6	
PEE40.6	33.000										1.899	87.2	34.3	
PEE40.7	33.000										1.806	87.2	32.7	
PEE40.8	33.000										0.054	91.5	1.0	
PEE40.9	33.000										1.325	87.4	24.0	
PEE40.10	33.000										0.623	90.0	11.3	
PEE40.11	33.000										0.611	89.0	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
PEE40.12	33.000										0.598	89.1	10.9	
PEE40.13	33.000										0.055	94.9	1.0	
PEE40.14	33.000										0.044	89.4	0.8	
PEE40.15	33.000										0.546	88.0	9.9	
PEE40.16	33.000										0.540	87.3	9.8	
PEE40.17	33.000										0.526	87.0	9.6	
PEE40.18	33.000										0.461	86.7	8.4	
PEE40.19	33.000										0.409	86.0	7.5	
PEE40.20	33.000										0.348	86.2	6.3	
PEE40.21	33.000		0.035	0.022	0.130	0.081					0.263	85.6	4.8	
PEE50.1	33.000										0.891	89.5	16.0	
PEE50.2	33.000										0.060	87.2	1.1	
PEE50.3	33.000										0.770	89.6	13.8	
PEE50.4	33.000										0.171	86.7	3.1	
PEE50.5	33.000										0.600	90.1	10.8	
PEE50.6	33.000										0.091	88.2	1.6	
PEE50.7	33.000										0.511	90.1	9.2	
PEE50.8	33.000										0.507	89.7	9.1	
PEE50.9	33.000										0.494	89.5	8.9	
PEE50.10	33.000										0.048	98.4	0.9	
PEE50.11	33.000										0.038	91.9	0.7	
PEE50.12	33.000										0.309	89.6	5.6	
PEE50.13	33.000										0.049	89.0	0.9	
PEE50.14	33.000										0.260	89.6	4.7	
PEE50.15	33.000										0.136	91.1	2.4	
PEE50.16	33.000		0.028	0.017	0.007	0.004					0.117	90.5	2.1	
PEE50.21	33.000										0.077	92.4	1.4	
PEE50.22	33.000		0.001	0.000	0.000	-					0.048	85.3	0.9	
PEE50.23	33.000		0.006	0.004	0.001	0.001					0.048	84.8	0.9	
PEE50.25	33.000		0.001	0.001	0.000	-					0.032	93.0	0.6	
PEE50.26	33.000		0.011	0.007	0.003	0.002					0.033	85.4	0.6	
PEE60.1	33.000										0.471	93.3	8.4	
PEE60.2	33.000										0.401	93.6	7.2	
PEE60.3	33.000										0.136	99.8	2.5	
PEE60.5	33.000										0.115	99.3	2.1	
PEE60.6	33.000										0.097	92.4	1.7	
PEE60.7	33.000		0.006	0.004	0.023	0.014					0.058	85.1	1.0	
PEE60.11	33.000		0.002	0.001	0.008	0.005					0.048	83.3	0.9	
PEE60.12	33.000										0.032	73.5	0.6	
PEE60.13	33.000		0.000	0.000	0.001	0.001					0.021	32.2	0.4	
PEE60.14	33.000										0.020	27.2	0.4	
PEE60.15	33.000										0.470	93.5	8.4	

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
PEE70.1	11.000										1.110	84.1	61.5	
PEE70.2	11.000										1.072	84.0	60.2	
PEE70.3	11.000										0.021	85.2	1.2	
PEE70.4	11.000										1.043	83.9	59.1	
PEE70.5	11.000										0.566	84.3	32.2	
PEE70.6	11.000										0.147	85.9	8.4	
PEE70.7	11.000										0.124	85.8	7.1	
PEE70.8	11.000										0.070	85.6	4.0	
PEE70.9	11.000										0.029	86.0	1.7	
PEE80.1	11.000										0.079	84.9	4.4	
PEE80.2	11.000										0.079	84.7	4.4	
PEE90.1	33.000										0.928	90.9	16.8	
PEE90.2	33.000										0.930	90.6	16.9	
PEE90.3	33.000										0.877	90.4	15.9	
PEE90.4	33.000		0.010	0.006	0.038	0.023					0.329	91.0	6.0	
PEE90.5	33.000		0.004	0.002	0.014	0.009					0.256	92.1	4.6	
PEE90.6	33.000		0.002	0.001	0.008	0.005					0.223	93.0	4.1	
PEE90.7	33.000										0.157	93.6	2.9	
PEE90.8	33.000		0.005	0.003	0.017	0.011					0.127	93.8	2.3	
PEE90.9	33.000										0.103	94.4	1.9	
PEE90.11	33.000		0.002	0.001	0.008	0.005					0.090	88.4	1.6	
PEE90.12	33.000										0.080	85.6	1.5	
PEE90.13	33.000		0.001	0.001	0.005	0.003					0.024	85.6	0.4	
PEE90.16	33.000		0.003	0.002	0.012	0.007					0.053	85.1	1.0	
PEE90.17	33.000										0.490	90.3	8.9	
PEE90.18	33.000										0.100	90.4	1.8	
PEE90.19	33.000										0.014	91.8	0.3	
PEE90.20	33.000										0.315	90.6	5.7	
PEE90.22	33.000										0.030	95.2	0.5	
PEE90.23	33.000										0.289	88.7	5.3	
PEE90.24	33.000										0.057	88.6	1.0	
PEE90.25	33.000										0.027	86.6	0.5	
PEE90.26	33.000										0.022	87.4	0.4	
PEE90.27	33.000										0.033	95.3	0.6	
PEE90.28	33.000										0.036	89.3	0.6	
PEE90.29	33.000		0.033	0.021	0.124	0.077					0.205	85.2	3.7	
PEE100.1	33.000										0.828	90.7	15.0	
PEE100.2	33.000		0.012	0.007	0.043	0.027					0.832	90.1	15.1	
PEE100.3	33.000										0.031	88.5	0.6	
PEE100.7	33.000										0.740	90.0	13.4	
PEE100.9	33.000										0.672	90.2	12.2	
PEE100.10	33.000		0.006	0.004	0.022	0.014					0.060	86.6	1.1	

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
PEE100.11	33.000										0.582	90.5	10.6	
PEE100.12	33.000										0.579	89.8	10.5	
PEE100.13	33.000										0.430	90.8	7.8	
PEE100.14	33.000										0.354	91.7	6.4	
PEE100.15	33.000										0.319	91.8	5.8	
PEE100.16	33.000										0.199	95.0	3.6	
PEE100.17	33.000										0.118	90.8	2.2	
PEE100.18	33.000										0.028	95.8	0.5	
PEE110.1	33.000										1.569	85.0	28.4	
PEE110.2	33.000										1.517	84.7	27.6	
Pemathang B1	33.000										0.092	86.6	1.7	
Phadi B1	33.000										0.019	84.7	0.3	
Phadi B2	0.415		0.013	0.008	0.003	0.002					0.019	85.0	26.9	
Phakpalu B1	33.000										0.028	89.5	0.5	
Phakpalu B2	0.415		0.002	0.001	0.008	0.005					0.011	85.0	16.3	
Phatowog B1	11.000										1.038	83.9	59.1	
Phatowog B2	0.415		0.094	0.058	0.281	0.174					0.441	85.0	711.3	
Phumtseri B1	33.000										0.021	84.3	0.4	
Phumtseri B2	0.415		0.004	0.002	0.014	0.009					0.021	85.0	30.3	
Phungshrang B1	33.000		0.003	0.002	0.012	0.008					0.273	92.0	5.0	
Pmathang B2	0.415		0.005	0.003	0.018	0.011					0.028	85.0	42.1	
PMSS B1	11.000										0.056	85.3	3.0	
PMSS B2	0.415		0.010	0.006	0.036	0.022					0.054	85.0	78.0	
Potanal B1	11.000										0.025	84.8	1.4	
Potanala B2	0.415		0.005	0.003	0.016	0.010					0.025	85.0	37.9	
Pthang B1	33.000										0.050	84.2	0.9	
Pthang B2	0.415		0.009	0.006	0.032	0.020					0.049	85.0	73.1	
Pthang Daza B1	33.000										0.022	84.7	0.4	
Pthang Daza B2	0.415		0.004	0.002	0.015	0.009					0.022	85.0	31.6	
R Court USS B2	0.415		0.027	0.017	0.090	0.056					0.138	85.0	211.2	
R.Court USS B	11.000										0.140	84.4	8.0	
R.Court USS B1	11.000										0.140	84.4	8.0	
R.Manas.P 1	33.000										0.048	99.3	0.9	
R.Manas.P 2	33.000										0.054	88.6	1.0	
R.Manas.P 3	33.000										0.056	84.8	1.0	
R.Manas.P 4	33.000										0.056	84.8	1.0	
R.Manas.P 5	0.415		0.010	0.006	0.037	0.023					0.055	85.0	81.1	
Raegi B1	33.000										0.006	84.9	0.1	
Raegi B2	0.415		0.004	0.003	0.001	0.001					0.006	85.0	8.9	
Rashi Gonpa B1	33.000										0.010	89.8	0.2	
RashiGonpa B2	0.415		0.002	0.001	0.006	0.003					0.008	85.0	12.1	
Rayzor B1	33.000										0.003	84.9	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
Rayzor B2	0.415		0.001	0.000	0.002	0.001					0.003	85.0	4.1	
Rebati B1	33.000										0.133	90.3	2.4	
Rebati B2	0.415		0.003	0.002	0.010	0.006					0.015	85.0	22.1	
Rebati Sch. B1	33.000										0.095	84.6	1.7	
Rebati Sch. B2	0.415		0.017	0.011	0.062	0.039					0.094	85.0	138.1	
Relakpo B1	33.000										0.213	92.7	3.9	
Relakpo B2	0.415		0.011	0.007	0.036	0.022					0.056	85.0	87.4	
Resinang B1	33.000										1.469	87.4	26.6	
Resinang B2	0.415		0.005	0.003	0.018	0.011					0.027	85.0	39.1	
Rhaling B1	33.000										0.439	86.2	8.0	
Rhaling B2	0.415		0.006	0.004	0.021	0.013					0.031	85.0	45.7	
Rinchenthang B1	11.000										0.004	85.0	0.2	
Rinchenthang B2	0.415		0.001	0.001	0.003	0.002					0.004	85.0	6.6	
Shali B1	11.000										0.033	84.5	1.8	
Shali B2	0.415		0.006	0.004	0.021	0.013					0.032	85.0	48.4	
Shenari B1	33.000										0.449	88.0	8.1	
Shenari B2	0.415		0.092	0.057	0.018	0.011					0.129	85.0	202.2	
Sherkhakpa B1	11.000										0.025	84.6	1.4	
Sherkhakpa B2	0.415		0.005	0.003	0.016	0.010					0.024	85.0	36.8	
Shingchuri B1	33.000										0.061	88.7	1.1	
Shingchuri B2	0.415		0.009	0.006	0.031	0.019					0.047	85.0	69.9	
Shumar B1	11.000										0.202	85.1	11.3	
Shumar B2	0.415		0.006	0.004	0.019	0.012					0.029	85.0	44.3	
Shumar Jug B1	33.000										0.011	84.7	0.2	
Shumar Jug B2	0.415		0.002	0.001	0.007	0.004					0.010	85.0	15.1	
Shumar Thung B1	33.000										0.020	84.4	0.4	
Shumar Thung B2	0.415		0.004	0.002	0.013	0.008					0.019	85.0	27.9	
SMCL B1	0.415		0.080	0.050	0.258	0.160					0.397	85.0	615.3	
Sonamthg B1	33.000										0.070	83.9	1.3	
Sonamthg B2	0.415		0.013	0.008	0.044	0.027					0.067	85.0	101.9	
Stone Crusher B1	33.000										0.706	83.6	12.8	
Stone Crusher B2	0.415		0.132	0.082	0.435	0.270					0.667	85.0	1021.0	
Sub B1	11.000										0.287	85.0	15.5	
Sub B2	11.000										1.689	83.5	94.1	
Sub Main B1	11.000										1.190	84.2	65.8	
Sub Main B2	11.000										0.595	84.2	32.9	
Tanzaima B1	11.000										0.040	84.3	2.3	
Tanzaima B2	0.415		0.008	0.005	0.025	0.015					0.038	85.0	60.0	
TCom B1	11.000										0.001	85.0	-	
TCom B2	0.415		0.000	0.000	0.000	-					0.001	85.0	1.0	
Telung B1	33.000										0.036	83.6	0.7	
Telung B2	0.415		0.007	0.004	0.022	0.014					0.034	85.0	52.3	

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
Tephu B1	33.000										0.033	84.5	0.6	
Tephu B2	0.415		0.006	0.004	0.021	0.013					0.032	85.0	47.4	
Thinleygg B1	33.000										0.574	89.6	10.4	
Thinleygg B2	0.415		0.027	0.017	0.094	0.059					0.143	85.0	211.3	
Thongknang B1	33.000		0.001	0.000	0.002	0.001					0.027	91.0	0.5	
Thongsa B1	33.000										0.092	86.8	1.7	
Thongsa B2	0.415		0.053	0.033	0.011	0.007					0.076	85.0	114.0	
Thungo B1	33.000										0.172	99.0	3.1	
Thungo B2	0.415		0.007	0.004	0.026	0.016					0.039	85.0	57.0	
Tokaphu B1	11.000										0.001	85.0	0.1	
Tokaphu B2	0.415		0.000	0.000	0.001	-					0.001	85.0	1.7	
Totpolung B1	11.000										0.010	84.6	0.6	
Totpolung B2	0.415		0.002	0.001	0.007	0.004					0.010	85.0	14.9	
Tsangtsiri B1	11.000										0.030	84.6	1.6	
Tsangtsiri B2	0.415		0.005	0.003	0.019	0.012					0.029	85.0	42.5	
Tsebar B1	33.000										0.238	89.6	4.3	
Tsebar B2	0.415		0.060	0.037	0.013	0.008					0.085	85.0	129.4	
Tshagtrie B2	0.415		0.001	0.001	0.003	0.002					0.004	85.0	6.3	
Tshelingore B1	33.000										1.337	87.5	24.2	
Tshelingore B2	0.415		0.002	0.001	0.008	0.005					0.012	85.0	17.1	
Tshenkri B1	11.000										0.022	84.1	1.2	
Tshenkri B2	0.415		0.004	0.003	0.014	0.009					0.021	85.0	32.7	
Tshobalay B1	33.000		0.000	0.000	0.001	0.001					0.002	85.0	-	
TshoGonpa B1	33.000										0.044	87.1	0.8	
TshoGonpa B2	0.415		0.002	0.001	0.008	0.005					0.012	85.0	17.1	
Tskeri A.Crusher B2	0.415		0.006	0.004	0.021	0.013					0.032	85.0	47.4	
Tskeri A.Workshp B2	0.415		0.004	0.002	0.013	0.008					0.020	85.0	28.9	
Tskeri.A.Crusher B1	33.000										1.570	84.8	28.5	
Tskeri.A.Workshp B1	33.000										1.537	84.8	27.9	
Tungudpa B1	33.000										0.154	92.1	2.8	
Tungudpa B2	0.415		0.002	0.002	0.009	0.006					0.013	85.0	19.6	
U.Banyul B1	33.000		0.002	0.001	0.006	0.004					0.010	85.0	0.2	
U.Chshing B1	33.000										0.017	84.8	0.3	
U.Chshing B2	0.415		0.012	0.007	0.003	0.002					0.017	85.0	24.2	
U.Dezema B1	11.000										0.004	84.8	0.2	
U.Dezema B2	0.415		0.001	0.000	0.003	0.002					0.004	85.0	5.9	
U.Khangma B1	33.000										0.023	84.7	0.4	
U.Khangma B2	0.415		0.004	0.003	0.015	0.009					0.022	85.0	32.5	
U.Khar B1	33.000										0.097	87.6	1.7	
U.Khar B2	0.415		0.057	0.035	0.012	0.008					0.081	85.0	122.6	
U.Khnadang B1	33.000										0.025	87.5	0.5	
U.Khnadang B2	0.415		0.002	0.001	0.008	0.005					0.013	85.0	18.3	

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
U.Kholomeri B1	33.000										0.018	94.4	0.3	
U.Kholomeri B2	0.415		0.002	0.001	0.007	0.005					0.011	85.0	16.5	
U.Mekuri B1	33.000		0.002	0.001	0.006	0.004					0.030	89.1	0.6	
U.Menchu B1	11.000										0.009	84.9	0.5	
U.Menchu B2	0.415		0.002	0.001	0.006	0.004					0.009	85.0	14.0	
U.Nangkor B2	0.415		0.009	0.006	0.034	0.021					0.051	85.0	74.4	
U.Nangkor B1	11.000										0.052	84.6	2.8	
U.Nmalam B1	33.000										0.041	87.5	0.7	
U.Nmalam B2	0.415		0.005	0.003	0.017	0.011					0.026	85.0	37.5	
U.Nyaskar B1	33.000		0.001	0.001	0.005	0.003					0.042	71.1	0.8	
U.Pthang B1	33.000		0.001	0.001	0.004	0.003					0.097	99.4	1.7	
U.Satshalo B1	11.000										0.032	84.5	1.8	
U.Satshalo B2	0.415		0.006	0.004	0.020	0.012					0.031	85.0	47.8	
U.Tshagtrie B1	11.000										0.006	85.7	0.3	
U.Yangmalshg B1	33.000										0.138	94.2	2.5	
U.Yangmalshg B2	0.415		0.002	0.001	0.008	0.005					0.013	85.0	18.8	
Umdang B1	33.000										0.007	84.7	0.1	
Umdang B2	0.415		0.001	0.001	0.004	0.003					0.007	85.0	9.8	
Weling B1	33.000		0.000	0.000	0.001	0.001					0.024	33.1	0.4	
Wololtang B1	33.000										0.007	84.8	0.1	
Wooltang B2	0.415		0.001	0.001	0.004	0.003					0.007	85.0	9.8	
Woongchilo B1	33.000										0.496	86.8	9.0	
Woongchilo B2	0.415		0.007	0.004	0.023	0.014					0.035	85.0	51.6	
Y.Maan B1	33.000										0.487	93.4	8.7	
Y.Maan B2	0.415		0.003	0.002	0.012	0.007					0.018	85.0	25.6	
Yalang B1	33.000										0.037	84.5	0.7	
Yalang B2	0.415		0.025	0.015	0.006	0.003					0.036	85.0	52.4	
Yangkhar B1	33.000										0.284	95.4	5.1	
Yangkhar B2	0.415		0.012	0.008	0.042	0.026					0.064	85.0	95.2	
Yelchen B1	33.000										0.061	84.1	1.1	
Yelchen B2	0.415		0.011	0.007	0.039	0.024					0.059	85.0	88.7	
Yelchen CS B1	33.000										0.322	85.7	5.9	
Yelchen CS B2	0.415		0.011	0.007	0.039	0.024					0.059	85.0	87.3	
Yomzor B1	33.000										0.033	84.5	0.6	
Yomzor B2	0.415		0.022	0.014	0.005	0.003					0.032	85.0	46.9	
Yongla B1	33.000										0.045	84.3	0.8	
Yongla B2	0.415		0.008	0.005	0.029	0.018					0.044	85.0	64.3	
Yurung BHU B1	33.000										0.375	93.3	6.7	
Yurung BHU B2	0.415		0.017	0.011	0.058	0.036					0.089	85.0	134.4	
Zero Pt. B1	11.000										0.234	84.9	12.7	
Zero Pt. B2	0.415		0.007	0.005	0.027	0.017					0.041	85.0	59.2	
Zhingri B1	33.000										0.323	85.9	5.9	

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
Zhingri B2	0.415		0.000	0.000	0.001	0.001					0.002	85.0	2.6	
Zobel B1	33.000										0.016	84.8	0.3	
Zobel B2	0.415		0.003	0.002	0.011	0.007					0.016	85.0	23.1	
Zordug B1	33.000										0.310	89.9	5.6	
Zordug B2	0.415		0.001	0.001	0.000	-					0.002	85.0	2.7	

* 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	%
R Court USS UG (B-B1)	Cable	270.43	7.97	2.95					
R.Manas.P (3-4)	Cable	190.58	1.02	0.54					
UG1-PEE20.1	Cable	270.43	22.21	8.21					
UG1-PEE80.1	Cable	270.43	4.37	1.62					
UG1-PEE90.1	Cable	190.58	16.80	8.81					
UG1-PEE100.1	Cable	190.58	14.98	7.86					
UG1-PEE110.1	Cable	190.58	28.45	14.93					
33/11kV Nganglam Tfr1	Transformer				1.500	0.607	40.5	0.595	39.7
33/11kV Nganglam Tfr2	Transformer				1.500	0.607	40.5	0.595	39.7
33/11kV Tfr1	Transformer				2.500	0.289	11.5	0.287	11.5
33/11kV Tfr2	Transformer				2.500	1.749	70.0	1.689	67.5
Babta Tfr	Transformer				0.063	0.060	94.9	0.058	91.4
Bar Gonpa Tfr	Transformer				0.030	0.013	42.8	0.013	42.1
Bartseri Tfr	Transformer				0.063	0.025	40.0	0.025	39.4
BCI Tfr	Transformer				0.750	0.713	95.1	0.683	91.1
Bedungri Tfr	Transformer				0.063	0.022	34.7	0.022	34.2
Benjarie Tfr	Transformer				0.025	0.020	81.2	0.020	78.5
BHU Area Tfr	Transformer				0.063	0.028	43.8	0.027	43.1
Bongdala Tfr	Transformer				0.030	0.008	25.7	0.008	25.5
Bongman Tfr	Transformer				0.063	0.009	14.9	0.009	14.8
Borangchilo Tfr	Transformer				0.030	0.004	13.9	0.004	13.8
Borangm BHU Tfr	Transformer				0.063	0.019	31.0	0.019	30.6
Borangmo2 Tfr	Transformer				0.025	0.013	52.3	0.013	51.2
Borkatshg Tfr	Transformer				0.063	0.011	17.4	0.011	17.3
BPC Colony Tfr	Transformer				0.063	0.006	8.8	0.006	8.8
Branphu Tfr	Transformer				0.063	0.022	35.4	0.022	34.9
Changarzampa Tfr	Transformer				0.025	0.019	74.7	0.018	72.5
Chimung Sch. Tfr	Transformer				0.063	0.024	38.0	0.024	37.5
Chokhorling Sc. Tfr	Transformer				0.025	0.018	73.0	0.018	70.9
Chokhorling1 Tfr	Transformer				0.025	0.005	18.7	0.005	18.6
Chokhorling3 Tfr	Transformer				0.025	0.002	9.4	0.002	9.3
Chshing Gonpa Tfr	Transformer				0.030	0.017	55.1	0.016	54.0
Chungkhar Tfr	Transformer				0.063	0.024	38.9	0.024	38.3

CKT / Branch		Cable & Reactor			Transformer				
						Loading (input)		Loading (output)	
ID	Type	Ampacity (Amp)	Loading Amp	%	Capability (MVA)	MVA	%	MVA	%
DaiGonpa Tfr	Transformer				0.063	0.001	1.9	0.001	1.9
Dalung Tfr	Transformer				0.016	0.008	50.1	0.008	49.1
DCCL Tfr	Transformer				2.000	0.378	18.9	0.375	18.7
* DCP Area Tfr	Transformer				0.315	0.412	130.8	0.389	123.4
Denchi Lkhang Tfr	Transformer				0.063	0.036	57.2	0.035	56.0
Denchi Tfr1	Transformer				2.500				
Denchi Tfr2	Transformer				2.500				
Druk Gyp Tfr	Transformer				0.125	0.034	27.1	0.033	26.8
Druk Gyp2 Tfr	Transformer				4.000	1.472	36.8	1.451	36.3
Dungchilo Tfr	Transformer				0.025	0.004	14.1	0.003	14.0
Dungchilopam Tfr	Transformer				0.025	0.006	22.5	0.006	22.3
Dungkar Lkhang Tfr	Transformer				0.063	0.006	9.9	0.006	9.9
Dungmin III Tfr	Transformer				0.063	0.039	61.2	0.038	59.8
Dzong Tfr	Transformer				0.250	0.094	37.5	0.092	37.0
Galabi Tfr	Transformer				0.063	0.037	59.3	0.036	57.9
Gamung Tfr	Transformer				0.063	0.029	46.5	0.029	45.6
Gangtong Tfr	Transformer				0.063	0.003	4.7	0.003	4.7
Gashari Tfr	Transformer				0.125	0.059	47.3	0.058	46.4
Gasharibali.A Tfr	Transformer				0.063	0.012	18.7	0.012	18.6
Gayri Tfr	Transformer				0.063	0.016	25.2	0.016	25.0
Gbrangsa Tfr	Transformer				0.063	0.031	49.3	0.030	48.3
GO Khar Tfr	Transformer				0.063	0.015	23.9	0.015	23.7
Gomchu Tfr	Transformer				0.063	0.012	18.9	0.012	18.8
Gomtshang Tfr	Transformer				0.063	0.006	9.6	0.006	9.5
* GonpaSingma Tfr	Transformer				0.063	0.068	108.3	0.065	103.7
Gonpawong Tfr	Transformer				0.063	0.036	56.7	0.035	55.4
Gonpung Tfr	Transformer				0.025	0.015	59.7	0.015	58.3
Guyum Tfr	Transformer				0.063	0.018	28.6	0.018	28.3
Hospital Tfr	Transformer				0.063	0.002	2.8	0.002	2.8
* Jirang Tfr	Transformer				0.010	0.012	118.7	0.011	113.1
Kangkaring Tfr	Transformer				0.063	0.011	18.1	0.011	17.9
Kerong Sch. Tfr	Transformer				0.025	0.009	36.4	0.009	35.8
Khaimma Tfr	Transformer				0.063	0.033	52.9	0.033	51.8
Khengzor I Tfr	Transformer				0.063	0.019	29.9	0.019	29.5
Khengzor II Tfr	Transformer				0.063	0.014	21.9	0.014	21.7

CKT / Branch		Cable & Reactor			Transformer				
						Loading (input)		Loading (output)	
ID	Type	Ampacity (Amp)	Loading Amp	%	Capability (MVA)	MVA	%	MVA	%
Khengzor Tfr	Transformer				0.063	0.008	12.9	0.008	12.8
Kheri Gonpa Tfr	Transformer				0.063	0.044	69.6	0.043	67.8
Kheri Tfr	Transformer				0.063	0.021	33.2	0.021	32.8
Kheydung Tfr	Transformer				0.025	0.002	9.4	0.002	9.3
* Khonmari I Tfr	Transformer				0.100	0.100	100.2	0.096	96.3
* Khonmari II Tfr	Transformer				0.100	0.117	117.4	0.112	112.0
Khonmari III Tfr	Transformer				0.063	0.054	85.4	0.052	82.6
Khonmari IV Tfr	Transformer				0.063	0.053	84.5	0.051	81.7
Khoripam Tfr	Transformer				0.063	0.014	22.6	0.014	22.4
Khotakpa Tfr	Transformer				0.063	0.029	46.0	0.028	45.2
Khulngdrng Tfr	Transformer				0.063	0.035	55.9	0.034	54.7
Kulung Tfr	Transformer				0.030	0.020	68.3	0.020	66.4
L.Chiphung Tfr	Transformer				0.063	0.012	19.1	0.012	18.9
L.Chshing Tfr	Transformer				0.063	0.004	5.9	0.004	5.9
L.Khangma Tfr	Transformer				0.063	0.047	74.6	0.046	72.4
* L.Khar Tfr	Transformer				0.063	0.076	120.3	0.072	114.8
L.Khnadang Tfr	Transformer				0.063	0.013	20.9	0.013	20.8
L.Kholomeri Tfr	Transformer				0.025	0.013	53.9	0.013	52.8
L.Menchu Tfr	Transformer				0.063	0.011	17.9	0.011	17.7
L.Nangkor Tfr	Transformer				0.063	0.058	91.6	0.056	88.2
L.Nmalam Tfr	Transformer				0.063	0.017	26.4	0.016	26.1
L.Satshalo Tfr	Transformer				0.063	0.017	26.9	0.017	26.6
L.Tshagtrie Tfr	Transformer				0.025	0.002	7.0	0.002	7.0
L.Yangmalshg Tfr	Transformer				0.025	0.020	80.4	0.019	77.8
Labar Tfr	Transformer				0.063	0.014	22.9	0.014	22.7
Laling Tfr	Transformer				0.025	0.007	28.9	0.007	28.6
Laneri Sch. Tfr	Transformer				0.063	0.007	10.9	0.007	10.9
Lasheringri Tfr	Transformer				0.025	0.005	18.8	0.005	18.6
* Lashingrie Tfr	Transformer				0.025	0.029	114.7	0.027	109.5
Lawoong Tfr	Transformer				0.063	0.054	85.6	0.052	82.8
M.Dezema Tfr	Transformer				0.025	0.005	19.2	0.005	19.0
Maan Tfr	Transformer				0.063	0.007	10.4	0.006	10.3
Maendi Tfr	Transformer				0.063	0.016	24.9	0.016	24.7
Marangdth Tfr	Transformer				0.025	0.008	31.7	0.008	31.3
Martsala Tfr	Transformer				0.063	0.043	68.6	0.042	66.7

CKT / Branch		Cable & Reactor			Transformer				
					Capability	Loading (input)		Loading (output)	
ID	Type	Ampacity (Amp)	Loading Amp	%	(MVA)	MVA	%	MVA	%
Mongling Tfr	Transformer				0.063	0.048	76.6	0.047	74.3
Mukazor Tfr	Transformer				0.063	0.012	19.7	0.012	19.5
N.Yangkhar Tfr	Transformer				0.025	0.013	50.1	0.012	49.1
Nachubander Tfr	Transformer				0.025	0.011	42.9	0.011	42.2
Nalung Tfr	Transformer				0.016	0.005	29.8	0.005	29.5
Namdeling Tfr	Transformer				0.063	0.016	25.3	0.016	25.0
* Nangkor CS Tfr	Transformer				0.125	0.128	102.1	0.122	97.8
Nangkor SS Tfr1	Transformer				5.000	2.802	56.0	2.734	54.7
Nangkor SS Tfr2	Transformer				5.000	2.802	56.0	2.734	54.7
Nanong Tfr	Transformer				0.030	0.027	90.9	0.026	87.6
Nganglam SS Tfr1	Transformer				3.500	2.537	72.5	2.456	70.2
Nganglam SS Tfr2	Transformer				3.500	2.537	72.5	2.456	70.2
Ngatseri Tfr	Transformer				0.063	0.023	36.9	0.023	36.4
Norbugang Tfr	Transformer				0.025	0.004	15.0	0.004	14.9
NS Borang Tfr	Transformer				0.025	0.024	96.0	0.023	92.3
Pakhurie Tfr	Transformer				0.025	0.008	31.3	0.008	30.8
Panbang Tfr	Transformer				0.250	0.123	49.2	0.121	48.2
Pangthang Tfr	Transformer				0.063	0.015	24.3	0.015	24.1
Phadi Tfr	Transformer				0.063	0.019	29.9	0.019	29.5
Phakpalu Tfr	Transformer				0.030	0.011	38.1	0.011	37.5
* Phatowog Tfr	Transformer				0.315	0.472	149.7	0.441	140.1
Phumtseri Tfr	Transformer				0.030	0.021	70.8	0.021	68.9
* Pmathang Tfr	Transformer				0.025	0.029	116.5	0.028	111.1
PMSS Tfr	Transformer				0.250	0.054	21.7	0.054	21.5
Potanala Tfr	Transformer				0.125	0.025	20.0	0.025	19.8
Pthang Daza Tfr	Transformer				0.063	0.022	35.0	0.022	34.5
Pthang Tfr	Transformer				0.063	0.050	80.1	0.049	77.5
R Court USS Tfr	Transformer				0.500	0.140	28.0	0.138	27.7
R.Manas.P Tfr	Transformer				0.250	0.056	22.4	0.055	22.2
Raegi Tfr	Transformer				0.063	0.006	9.9	0.006	9.9
RashiGonpa Tfr	Transformer				0.025	0.008	33.6	0.008	33.1
Rayzor Tfr	Transformer				0.030	0.003	9.4	0.003	9.3
Rebati Sch. Tfr	Transformer				0.250	0.095	38.1	0.094	37.5
Rebati Tfr	Transformer				0.025	0.015	61.1	0.015	59.6
* Relakpo Tfr	Transformer				0.030	0.060	201.5	0.056	185.4

CKT / Branch		Cable & Reactor			Transformer				
					Capability	Loading (input)		Loading (output)	
ID	Type	Ampacity (Amp)	Loading Amp	%	(MVA)	MVA	%	MVA	%
Resinang Tfr	Transformer				0.063	0.027	43.1	0.027	42.4
Rhaling Tfr	Transformer				0.063	0.032	50.1	0.031	49.1
Rinchenthang Tfr	Transformer				0.100	0.004	4.4	0.004	4.4
Shali Tfr	Transformer				0.063	0.033	51.9	0.032	50.8
* Shenari Tfr	Transformer				0.063	0.141	224.5	0.129	205.0
Sherkhakpa Tfr	Transformer				0.063	0.025	39.4	0.024	38.8
Shingchuri Tfr	Transformer				0.063	0.048	76.8	0.047	74.5
Shumar Jug Tfr	Transformer				0.030	0.011	35.1	0.010	34.6
Shumar Tfr	Transformer				0.063	0.030	47.5	0.029	46.6
Shumar Thung Tfr	Transformer				0.030	0.020	65.0	0.019	63.4
SMCL Tfr	Transformer				0.500	0.412	82.4	0.397	79.4
* Sonamthg Tfr	Transformer				0.063	0.070	111.7	0.067	106.7
* Stone Crusher Tfr	Transformer				0.500	0.706	141.3	0.667	133.4
Tainzaima Tfr	Transformer				0.063	0.040	62.7	0.038	61.0
TCom Tfr	Transformer				0.025	0.001	2.9	0.001	2.8
* Telung Tfr	Transformer				0.025	0.036	144.7	0.034	136.4
Tephu Tfr	Transformer				0.063	0.033	52.0	0.032	50.9
Thinleygg Tfr	Transformer				0.250	0.146	58.4	0.143	57.0
* Thongsa Tfr	Transformer				0.063	0.080	126.7	0.076	120.5
Thungo Tfr	Transformer				0.063	0.040	63.3	0.039	61.8
Tokaphu Tfr	Transformer				0.025	0.001	4.4	0.001	4.4
Totpolung Tfr	Transformer				0.025	0.010	40.4	0.010	39.7
Tsangtsiri Tfr	Transformer				0.063	0.030	46.8	0.029	46.0
* Tsebar Tfr	Transformer				0.063	0.090	143.6	0.085	135.6
Tshelingore Tfr	Transformer				0.063	0.012	18.8	0.012	18.7
Tshenkri Tfr	Transformer				0.025	0.022	89.1	0.021	85.8
TshoGonpa Tfr	Transformer				0.063	0.012	18.7	0.012	18.6
Tskeri A.Crusher Tfr	Transformer				0.063	0.033	52.1	0.032	51.1
Tskeri A.Workshp Tfr	Transformer				0.063	0.020	31.8	0.020	31.4
Tungudpa Tfr	Transformer				0.063	0.014	21.5	0.013	21.3
U.Chshing Tfr	Transformer				0.063	0.017	26.9	0.017	26.6
U.Dezema Tfr	Transformer				0.025	0.004	15.7	0.004	15.6
U.Khangma Tfr	Transformer				0.063	0.023	36.2	0.022	35.7
* U.Khar Tfr	Transformer				0.063	0.086	136.2	0.081	129.1
U.Khnadang Tfr	Transformer				0.030	0.013	42.6	0.013	41.9

CKT / Branch		Cable & Reactor			Transformer				
						Loading (input)		Loading (output)	
ID	Type	Ampacity (Amp)	Loading Amp	%	Capability (MVA)	MVA	%	MVA	%
U.Kholomeri Tfr	Transformer				0.025	0.011	45.6	0.011	44.8
U.Menchu Tfr	Transformer				0.063	0.009	14.9	0.009	14.8
U.Nangkor Tfr	Transformer				0.125	0.052	41.5	0.051	40.8
U.Nmalam Tfr	Transformer				0.063	0.026	41.4	0.026	40.7
U.Satshalo Tfr	Transformer				0.063	0.032	50.0	0.031	49.0
U.Tshagtrie Tfr	Transformer				0.025	0.004	16.6	0.004	16.5
U.Yangmalshg Tfr	Transformer				0.025	0.013	52.1	0.013	51.0
Umdang Tfr	Transformer				0.025	0.007	27.1	0.007	26.8
Wooltang Tfr	Transformer				0.030	0.007	22.5	0.007	22.3
Woongchilo Tfr	Transformer				0.063	0.036	56.5	0.035	55.3
Y.Maan Tfr	Transformer				0.030	0.018	59.7	0.018	58.4
Yalang Tfr	Transformer				0.063	0.037	58.2	0.036	56.9
* Yangkhar TFr	Transformer				0.063	0.067	105.8	0.064	101.5
Yelchen CS Tfr	Transformer				0.125	0.060	48.2	0.059	47.3
Yelchen Tfr	Transformer				0.063	0.061	97.2	0.059	93.5
Yomzor Tfr	Transformer				0.063	0.033	52.1	0.032	51.0
Yongla Tfr	Transformer				0.063	0.045	71.1	0.044	69.1
* Yurung BHU Tfr	Transformer				0.063	0.094	149.4	0.089	140.7
Zero Pt. Tfr	Transformer				0.125	0.041	32.9	0.041	32.5
Zhingri Tfr	Transformer				0.063	0.002	2.8	0.002	2.8
Zobel Tfr	Transformer				0.063	0.016	25.5	0.016	25.2
Zordug Tfr	Transformer				0.063	0.002	3.0	0.002	3.0

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

Branch Losses Summary Report

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
Babta-PEE90.17	0.443	0.210	-0.443	-0.211	0.0	-0.6	96.3	96.3	0.01
PEE90.3-Babta	-0.493	-0.243	0.493	0.240	0.1	-3.0	96.3	96.3	0.03
Babta Tfr	0.050	0.032	-0.049	-0.030	1.4	2.0	96.3	92.7	3.60
PEE60.14-Bainang Gonpa	-0.005	-0.003	0.005	0.002	0.0	-1.4	97.4	97.4	0.00
PEE80.2-Benjarie	-0.017	-0.011	0.017	0.011	0.0	-0.4	94.8	94.8	0.02
Benjarie Tfr	0.017	0.011	-0.017	-0.010	0.4	0.6	94.8	91.7	3.13
PEE40.11-Bar Gonpa	-0.011	-0.007	0.011	0.007	0.0	-0.1	96.2	96.2	0.00
Bar Gonpa Tfr	0.011	0.007	-0.011	-0.007	0.1	0.2	96.2	94.6	1.62
PEE50.2-Bartseri	-0.021	-0.013	0.021	0.012	0.0	-1.3	97.5	97.5	0.00
Bartseri Tfr	0.021	0.013	-0.021	-0.013	0.2	0.4	97.5	96.0	1.50
BCI-PEE30.2	0.123	0.077	-0.123	-0.078	0.2	-0.5	92.5	92.3	0.15
PEE30.1-BCI	-0.715	-0.475	0.719	0.479	4.1	3.6	92.5	93.1	0.61
BCI Tfr	0.592	0.398	-0.581	-0.360	10.9	38.1	92.5	88.6	3.87
PEE90.2-Bedungri	-0.019	-0.012	0.019	0.010	0.0	-1.4	96.5	96.5	0.00
Bedungri Tfr	0.019	0.012	-0.018	-0.011	0.2	0.3	96.5	95.2	1.31
BHU Area-PEE90.19	0.013	0.003	-0.013	-0.004	0.0	-1.0	96.3	96.3	0.00
PEE90.18-BHU Area	-0.036	-0.018	0.036	0.016	0.0	-1.7	96.3	96.3	0.00
BHU Area Tfr	0.023	0.015	-0.023	-0.014	0.3	0.4	96.3	94.6	1.66
Bongdala-PEE60.5	0.114	-0.006	-0.114	0.004	0.0	-2.1	97.4	97.4	0.00
PEE60.3-Bongdala	-0.121	0.002	0.121	-0.005	0.0	-2.4	97.4	97.4	0.00
Bongdala Tfr	0.007	0.004	-0.006	-0.004	0.0	0.1	97.4	96.4	0.96
Bongman-Dunkar Lkhang	0.005	0.000	-0.005	-0.003	0.0	-3.1	97.4	97.4	0.00
U.Khar-Bongman	-0.013	-0.005	0.013	-0.001	0.0	-5.9	97.4	97.4	0.00
Bongman Tfr	0.008	0.005	-0.008	-0.005	0.0	0.0	97.4	96.8	0.56
Borangchilo-PEE50.1	0.798	0.394	-0.797	-0.396	0.3	-2.7	97.5	97.5	0.05
L1-Borangchilo	-0.801	-0.396	0.801	0.394	0.2	-1.5	97.5	97.6	0.03
Borangchilo Tfr	0.004	0.002	-0.004	-0.002	0.0	0.0	97.5	97.0	0.52
PEE100.3-Borangm BHU	-0.017	-0.010	0.017	0.009	0.0	-1.7	96.5	96.5	0.00
Borangm BHU Tfr	0.017	0.010	-0.016	-0.010	0.1	0.2	96.5	95.3	1.17
PEE100.3-Borangmo2	-0.011	-0.007	0.011	0.006	0.0	-1.2	96.5	96.5	0.00
Borangmo2 Tfr	0.011	0.007	-0.011	-0.007	0.2	0.2	96.5	94.5	1.98
Borkatshg-Khalagtangzor	0.011	0.006	-0.011	-0.006	0.0	-0.1	91.9	91.9	0.00
PEE70.6-Borkatshg	-0.020	-0.012	0.020	0.012	0.0	-0.2	91.9	91.9	0.01
Borkatshg Tfr	0.009	0.006	-0.009	-0.006	0.1	0.1	91.9	91.2	0.69

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
PEE30.2-BPC Colony	-0.005	-0.003	0.005	0.003	0.0	-0.2	92.3	92.3	0.00
BPC Colony Tfr	0.005	0.003	-0.005	-0.003	0.0	0.0	92.3	92.0	0.35
Branphu-Rayzor	0.002	0.000	-0.002	-0.001	0.0	-1.9	96.1	96.1	0.00
PEE40.18-Branphu	-0.021	-0.011	0.021	0.010	0.0	-1.7	96.1	96.1	0.00
Branphu Tfr	0.019	0.012	-0.019	-0.012	0.2	0.3	96.1	94.7	1.34
PEE100.18-Changarzampa	-0.016	-0.010	0.016	0.008	0.0	-2.1	96.0	96.0	0.00
Changarzampa Tfr	0.016	0.010	-0.015	-0.010	0.3	0.5	96.0	93.2	2.84
PEE60.7-Chimung Sch.	-0.020	-0.013	0.020	0.012	0.0	-0.3	97.4	97.4	0.00
Chimung Sch. Tfr	0.020	0.013	-0.020	-0.012	0.2	0.3	97.4	96.0	1.42
Chokhorling(2-Sc.)	-0.015	-0.010	0.015	0.010	0.0	-0.1	96.1	96.1	0.00
Chokhorling Sc. Tfr	0.015	0.010	-0.015	-0.009	0.3	0.5	96.1	93.3	2.77
Chokhorling1-PEE90.16	0.045	0.027	-0.045	-0.028	0.0	-0.3	96.1	96.1	0.00
PEE90.12-Chokhorling1	-0.049	-0.030	0.049	0.029	0.0	-0.3	96.1	96.1	0.00
Chokhorling1 Tfr	0.004	0.002	-0.004	-0.002	0.0	0.0	96.1	95.4	0.71
PEE90.16-Chokhorling2	-0.030	-0.019	0.030	0.018	0.0	-0.2	96.1	96.1	0.00
PEE90.13-Chokhorling3	-0.014	-0.009	0.014	0.009	0.0	-0.3	96.1	96.1	0.00
Chokhorling3 Tfr	0.002	0.001	-0.002	-0.001	0.0	0.0	96.1	95.8	0.35
Chshing Gonpa-PEE50.15	0.124	0.053	-0.124	-0.056	0.0	-2.9	97.3	97.2	0.01
Tsebar-Cshing Gonpa	-0.138	-0.062	0.138	0.056	0.0	-5.9	97.3	97.3	0.01
Chshing Gonpa Tfr	0.014	0.009	-0.014	-0.009	0.2	0.3	97.3	95.2	2.07
PEE40.3-Chungkhar	-0.021	-0.013	0.021	0.012	0.0	-0.7	97.2	97.2	0.00
Chungkhar Tfr	0.021	0.013	-0.020	-0.013	0.2	0.3	97.2	95.7	1.46
PEE40.14-DaiGonpa	-0.001	-0.001	0.001	0.000	0.0	-0.8	96.2	96.2	0.00
DaiGonpa Tfr	0.001	0.001	-0.001	-0.001	0.0	0.0	96.2	96.1	0.07
Dalung-Nalung	0.004	-0.003	-0.004	-0.003	0.0	-5.3	96.0	96.0	0.00
PEE100.18-Dalung	-0.011	-0.002	0.011	0.000	0.0	-1.7	96.0	96.0	0.00
Dalung Tfr	0.007	0.004	-0.007	-0.004	0.1	0.1	96.0	94.1	1.90
L1-DCCL	-0.319	-0.202	0.319	0.199	0.1	-3.5	96.8	96.8	0.02
DCCL Tfr	0.319	0.202	-0.319	-0.197	0.8	4.7	96.8	96.0	0.81
DCP Area-PEE70.6	0.126	0.075	-0.126	-0.075	0.0	0.0	91.9	91.9	0.02
PEE70.5-DCP Area	-0.470	-0.301	0.472	0.302	1.5	0.6	91.9	92.2	0.27
DCP Area Tfr	0.344	0.226	-0.330	-0.205	14.2	21.2	91.9	86.7	5.21
Denchi Lkhang-Khotakpa	0.077	0.042	-0.077	-0.044	0.0	-2.0	97.5	97.5	0.01
PEE50.1-Denchi Lkhang	-0.107	-0.061	0.107	0.060	0.0	-1.4	97.5	97.5	0.01
Denchi Lkhang Tfr	0.030	0.019	-0.030	-0.019	0.5	0.7	97.5	95.3	2.14
Denchi SS B1-PEE50.3	0.690	0.339	-0.690	-0.342	0.2	-2.8	97.5	97.4	0.04
PEE50.1-Denchi SS	-0.690	-0.339	0.690	0.337	0.2	-2.1	97.5	97.5	0.03

	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
Denchi Tfr1	0.000	0.000	0.000	0.000			97.5	97.5	
Denchi Tfr2	0.000	0.000	0.000	0.000			97.5	97.5	
Druk Gyp Tfr	-0.028	-0.018	0.029	0.018	0.2	0.3	95.1	96.1	1.03
PEE110.2-Druk Gyp	-1.275	-0.802	1.276	0.799	1.1	-2.4	96.1	96.2	0.10
Druk Gyp2 Tfr	1.246	0.784	-1.233	-0.764	13.0	19.5	96.1	94.8	1.40
Dungchilo-Dungchilopam	0.005	0.000	-0.005	-0.003	0.0	-3.3	96.2	96.2	0.00
U.Kholomeri-Dungchupam	-0.008	-0.002	0.008	-0.002	0.0	-4.0	96.2	96.2	0.00
Dungchilo Tfr	0.003	0.002	-0.003	-0.002	0.0	0.0	96.2	95.7	0.53
Dungchilopam Tfr	0.005	0.003	-0.005	-0.003	0.0	0.0	96.2	95.4	0.85
Dungkar Lkhang Tfr	0.005	0.003	-0.005	-0.003	0.0	0.0	97.4	97.0	0.37
Dungmin I-PEE50.21	0.071	0.029	-0.071	-0.029	0.0	-0.1	97.2	97.2	0.00
PEE50.16-Dungmin I	-0.071	-0.030	0.071	0.028	0.0	-1.1	97.2	97.2	0.00
PEE50.23-Dungmin III	-0.033	-0.021	0.033	0.020	0.0	-0.2	97.2	97.2	0.00
Dungmin III Tfr	0.033	0.021	-0.032	-0.020	0.6	0.8	97.2	94.9	2.30
PEE90.29-Durungree	-0.017	-0.011	0.017	0.010	0.0	-0.9	96.2	96.2	0.00
Dzong-PMSS	0.047	0.029	-0.047	-0.029	0.0	-0.1	96.6	96.6	0.01
Dzong-Tsangtsiri	0.025	0.016	-0.025	-0.016	0.0	-0.1	96.6	96.6	0.00
Khoripam Tfr-Dzong	-0.152	-0.095	0.152	0.094	0.0	-0.1	96.6	96.6	0.03
Dzong Tfr	0.079	0.050	-0.079	-0.049	0.8	1.3	96.6	95.2	1.42
PEE100.14-Galabi	-0.032	-0.020	0.032	0.017	0.0	-3.1	96.1	96.1	0.00
Galabi Tfr	0.032	0.020	-0.031	-0.019	0.5	0.8	96.1	93.8	2.25
PEE20.6-Gamung	-0.025	-0.016	0.025	0.016	0.0	0.0	93.8	93.8	0.00
Gamung Tfr	0.025	0.016	-0.024	-0.015	0.3	0.5	93.8	92.0	1.81
Gangtong-Mukazor	0.011	0.002	-0.011	-0.007	0.0	-4.3	96.2	96.2	0.00
PEE40.13-Gangtong	-0.013	-0.004	0.013	0.000	0.0	-4.0	96.2	96.2	0.00
Gangtong Tfr	0.003	0.002	-0.003	-0.002	0.0	0.0	96.2	96.0	0.18
PEE80.2-Gashari	-0.050	-0.032	0.050	0.031	0.0	-0.1	94.8	94.8	0.01
Gashari Tfr	0.050	0.032	-0.049	-0.031	0.7	1.0	94.8	93.0	1.82
PEE110.2-Gasharibali.A	-0.010	-0.006	0.010	0.006	0.0	-0.1	96.2	96.2	0.00
Gasharibali.A Tfr	0.010	0.006	-0.010	-0.006	0.1	0.1	96.2	95.5	0.71
PEE40.16-Gayri	-0.013	-0.008	0.013	0.008	0.0	-0.8	96.1	96.1	0.00
Gayri Tfr	0.013	0.008	-0.013	-0.008	0.1	0.1	96.1	95.2	0.96
Gbrangsa-PEE40.1	1.789	0.976	-1.786	-0.978	2.1	-1.8	97.4	97.2	0.14
L1-Gbrangsa	-1.815	-0.993	1.818	0.990	3.2	-2.6	97.4	97.6	0.21
Gbrangsa Tfr	0.026	0.017	-0.026	-0.016	0.4	0.5	97.4	95.5	1.85
PEE50.8-GO Khar	-0.013	-0.008	0.013	0.007	0.0	-0.8	97.3	97.3	0.00
GO Khar Tfr	0.013	0.008	-0.013	-0.008	0.1	0.1	97.3	96.4	0.89

	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
Gomchu-PEE20.4	0.108	0.066	-0.108	-0.067	0.0	-0.2	93.9	93.9	0.04
PEE20.3-Gomchu	-0.118	-0.073	0.118	0.073	0.0	0.0	93.9	93.9	0.00
Gomchu Tfr	0.010	0.006	-0.010	-0.006	0.1	0.1	93.9	93.2	0.73
PEE60.3-Gomtshang	-0.016	-0.010	0.016	0.008	0.0	-1.9	97.4	97.4	0.00
Gomtshang Tfr	0.005	0.003	-0.005	-0.003	0.0	0.0	97.4	97.0	0.36
GonpaSingma-PEE40.8	0.050	0.019	-0.050	-0.022	0.0	-2.5	96.7	96.7	0.00
Khonmari-Gonpasingma	-0.107	-0.057	0.107	0.055	0.0	-1.4	96.7	96.7	0.00
GonpaSingma Tfr	0.057	0.037	-0.056	-0.034	1.8	2.6	96.7	92.7	4.09
Gonpawong-PEE90.20	0.285	0.129	-0.285	-0.134	0.1	-4.4	96.3	96.2	0.02
Martsala-Gonpawong	-0.316	-0.148	0.316	0.147	0.0	-1.6	96.3	96.3	0.01
Gonpawong Tfr	0.030	0.019	-0.030	-0.018	0.5	0.7	96.3	94.1	2.15
PEE20.7-Gonpung	-0.013	-0.008	0.013	0.008	0.0	0.0	93.8	93.8	0.00
Gonpung Tfr	0.013	0.008	-0.012	-0.008	0.2	0.3	93.8	91.5	2.32
Phakpalu-Guyum	-0.015	-0.010	0.015	0.006	0.0	-3.2	97.5	97.5	0.00
Guyum Tfr	0.015	0.010	-0.015	-0.009	0.1	0.2	97.5	96.4	1.07
PEE10.3-Hospital	-0.002	-0.001	0.002	0.001	0.0	-0.1	96.6	96.6	0.00
Hospital Tfr	0.002	0.001	-0.002	-0.001	0.0	0.0	96.6	96.5	0.11
Jirang-Rebati	0.120	0.051	-0.120	-0.057	0.0	-6.2	96.1	96.0	0.01
Tungudpa-Jirang	-0.130	-0.057	0.130	0.053	0.0	-4.7	96.1	96.1	0.01
Jirang Tfr	0.010	0.006	-0.010	-0.006	0.3	0.5	96.1	91.5	4.52
Kangkaring-Shumar	0.172	0.106	-0.171	-0.106	0.1	-0.1	94.1	94.0	0.06
L.Nangkor-Kangkaring	-0.181	-0.112	0.181	0.112	0.1	-0.1	94.1	94.1	0.05
Kangkaring Tfr	0.010	0.006	-0.010	-0.006	0.1	0.1	94.1	93.4	0.70
PEE90.9-Kerong Sch.	-0.018	-0.011	0.018	0.009	0.0	-1.7	96.2	96.2	0.00
Kerong Sch. Tfr	0.008	0.005	-0.008	-0.005	0.1	0.1	96.2	94.8	1.38
TshoGonpa-Khaimma	-0.028	-0.018	0.028	0.015	0.0	-2.6	96.2	96.2	0.00
Khaimma Tfr	0.028	0.018	-0.028	-0.017	0.4	0.6	96.2	94.2	2.01
Khalagtangzor-L.Dezema	0.009	0.005	-0.009	-0.006	0.0	-0.4	91.9	91.8	0.01
PEE50.11-Khengzor CPS	-0.007	-0.004	0.007	0.001	0.0	-3.7	97.3	97.3	0.00
Khengzor Tfr	0.007	0.004	-0.007	-0.004	0.0	0.0	97.3	96.8	0.48
Khengzor (II-I)	-0.016	-0.010	0.016	0.008	0.0	-2.5	97.3	97.3	0.00
Khengzor I Tfr	0.016	0.010	-0.016	-0.010	0.1	0.2	97.3	96.2	1.12
PEE50.11-Khengzor II	-0.028	-0.015	0.028	0.014	0.0	-0.6	97.3	97.3	0.00
Khengzor II Tfr	0.012	0.007	-0.012	-0.007	0.1	0.1	97.3	96.5	0.82
N.Yangkhar-Kheri	-0.018	-0.011	0.018	0.011	0.0	-0.4	93.9	93.9	0.02
Kheri Tfr	0.018	0.011	-0.018	-0.011	0.2	0.3	93.9	92.6	1.29
Kheri Gonapa-PEE40.2	0.071	0.020	-0.071	-0.021	0.0	-1.1	97.2	97.2	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
PEE40.1-Kheri Gonpa	-0.108	-0.044	0.108	0.043	0.0	-1.0	97.2	97.2	0.00
Kheri Gonpa Tfr	0.037	0.024	-0.036	-0.022	0.7	1.1	97.2	94.6	2.61
RashiGonpa-Kheydung	-0.002	-0.001	0.002	-0.003	0.0	-3.9	96.2	96.2	0.00
Kheydung Tfr	0.002	0.001	-0.002	-0.001	0.0	0.0	96.2	95.8	0.36
PEE40.7-Khonmari	-0.290	-0.173	0.290	0.173	0.0	-0.4	96.7	96.7	0.00
Khonmari I Tfr	0.084	0.054	-0.082	-0.051	2.4	3.6	96.7	93.0	3.78
Khonmari II Tfr	0.098	0.064	-0.095	-0.059	3.3	4.9	96.7	92.3	4.44
Resinang-Khonmari III	-0.045	-0.029	0.045	0.029	0.0	-0.1	96.6	96.6	0.00
Khonmari III Tfr	0.045	0.029	-0.044	-0.027	1.1	1.6	96.6	93.4	3.23
Resinang-Khonmari IV	-0.045	-0.029	0.045	0.028	0.0	-0.3	96.6	96.6	0.00
Khonmari IV Tfr	0.045	0.029	-0.044	-0.027	1.1	1.6	96.6	93.4	3.19
Zero Pt.-Khoripam	-0.164	-0.102	0.164	0.102	0.1	-0.1	96.6	96.7	0.06
Khoripam Tfr	0.012	0.008	-0.012	-0.007	0.1	0.1	96.6	95.8	0.85
Khotakpa-PEE60.2	0.052	0.028	-0.052	-0.029	0.0	-1.1	97.5	97.5	0.00
Khotakpa Tfr	0.025	0.015	-0.024	-0.015	0.3	0.5	97.5	95.8	1.72
Khulungdrang-PEE90.3	0.794	0.369	-0.793	-0.375	0.7	-6.1	96.4	96.3	0.10
PEE90.2-Khulngdrng	-0.823	-0.388	0.824	0.384	0.5	-4.3	96.4	96.5	0.08
Khulngdrng Tfr	0.030	0.019	-0.029	-0.018	0.5	0.7	96.4	94.3	2.12
Kulung-Pthang	0.042	0.023	-0.042	-0.027	0.0	-3.7	96.0	96.0	0.00
PEE40.21-Kulung	-0.060	-0.034	0.060	0.034	0.0	-0.9	96.0	96.0	0.00
Kulung Tfr	0.017	0.011	-0.017	-0.010	0.3	0.5	96.0	93.4	2.60
PEE90.26-L.Bangyul	-0.005	-0.003	0.005	0.002	0.0	-0.5	96.2	96.2	0.00
PEE60.12-L.Chiphung	-0.016	-0.010	0.016	0.009	0.0	-1.1	97.4	97.4	0.00
L.Chiphung Tfr	0.010	0.006	-0.010	-0.006	0.1	0.1	97.4	96.7	0.71
L.Chshing-PEE50.16	0.106	0.048	-0.106	-0.050	0.0	-2.3	97.2	97.2	0.01
PEE50.15-L.Chshing	-0.109	-0.050	0.109	0.048	0.0	-1.7	97.2	97.2	0.00
L.Chshing Tfr	0.003	0.002	-0.003	-0.002	0.0	0.0	97.2	97.0	0.22
Dezema (L-M)	0.007	0.005	-0.007	-0.005	0.0	-0.1	91.8	91.8	0.00
Khangma(L-U)	0.019	0.011	-0.019	-0.012	0.0	-1.1	97.5	97.5	0.00
Lanangzor-L.Khangma	-0.059	-0.036	0.059	0.029	0.0	-7.6	97.5	97.5	0.02
L.Khangma Tfr	0.040	0.025	-0.039	-0.024	0.8	1.2	97.5	94.7	2.79
PEE50.4-L.Khar	-0.064	-0.041	0.064	0.041	0.0	-0.3	97.4	97.4	0.00
L.Khar Tfr	0.064	0.041	-0.061	-0.038	2.1	3.2	97.4	92.9	4.52
Khnadang(U-L)	-0.011	-0.007	0.011	0.005	0.0	-1.6	97.2	97.2	0.00
L.Khnadang Tfr	0.011	0.007	-0.011	-0.007	0.1	0.1	97.2	96.4	0.78
PEE90.22-L.Kholomeri	-0.011	-0.007	0.011	0.007	0.0	-0.4	96.2	96.2	0.00
L.Kholomeri Tfr	0.011	0.007	-0.011	-0.007	0.2	0.3	96.2	94.2	2.04

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	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
PEE70.3-L.Menchu	-0.010	-0.006	0.010	0.006	0.0	0.0	93.4	93.4	0.00
L.Menchu Tfr	0.010	0.006	-0.010	-0.006	0.1	0.1	93.4	92.7	0.70
PEE20.2-L.Nangkor	-0.230	-0.143	0.230	0.143	0.1	0.0	94.1	94.1	0.04
L.Nangkor Tfr	0.049	0.031	-0.047	-0.029	1.3	2.0	94.1	90.6	3.56
Nmalam(U-L)	-0.014	-0.009	0.014	0.006	0.0	-2.7	96.7	96.7	0.00
L.Nmalam Tfr	0.014	0.009	-0.014	-0.009	0.1	0.2	96.7	95.7	0.99
L.Pthang-PEE60.6	0.089	-0.009	-0.089	0.008	0.0	-0.9	97.4	97.4	0.00
Pthang (U-L)	-0.091	0.008	0.091	-0.010	0.0	-2.4	97.4	97.4	0.00
L.Satshalo-PEE70.8	0.060	0.036	-0.060	-0.036	0.0	-0.1	91.7	91.7	0.02
Pakhurie-L.Satshalo	-0.074	-0.045	0.074	0.045	0.1	-0.3	91.7	91.8	0.08
L.Satshalo Tfr	0.014	0.009	-0.014	-0.009	0.1	0.2	91.7	90.7	1.07
Tshagtrie(U-L)	-0.001	-0.001	0.001	0.001	0.0	-0.1	92.2	92.2	0.00
L.Tshagtrie Tfr	0.001	0.001	-0.001	-0.001	0.0	0.0	92.2	91.9	0.28
PEE90.7-L.Yangmalshg	-0.017	-0.011	0.017	0.010	0.0	-0.4	96.2	96.2	0.00
L.Yangmalshg Tfr	0.017	0.011	-0.017	-0.010	0.4	0.6	96.2	93.2	3.05
PEE50.10-Labar	-0.012	-0.008	0.012	0.002	0.0	-6.1	97.3	97.3	0.00
Labar Tfr	0.012	0.008	-0.012	-0.008	0.1	0.1	97.3	96.4	0.86
PEE100.12-Laling	-0.006	-0.004	0.006	0.004	0.0	-0.1	96.2	96.2	0.00
Laling Tfr	0.006	0.004	-0.006	-0.004	0.1	0.1	96.2	95.1	1.10
PEE60.1-Lanangzor	-0.064	-0.032	0.064	0.032	0.0	-0.3	97.5	97.5	0.00
PEE50.26-Laneri Sch.	-0.015	-0.009	0.015	0.009	0.0	-0.3	97.2	97.2	0.00
Laneri Sch. Tfr	0.006	0.004	-0.006	-0.004	0.0	0.0	97.2	96.8	0.41
PEE90.19-Lasheringri	-0.004	-0.002	0.004	-0.001	0.0	-3.9	96.3	96.3	0.00
Lasheringri Tfr	0.004	0.002	-0.004	-0.002	0.0	0.0	96.3	95.6	0.71
PEE100.10-Lashingrie	-0.024	-0.016	0.024	0.013	0.0	-2.9	96.3	96.3	0.00
Lashingrie Tfr	0.024	0.016	-0.023	-0.014	0.8	1.2	96.3	91.9	4.36
Lawoong-Thungo	0.170	0.021	-0.170	-0.024	0.0	-2.5	97.4	97.4	0.01
Yangkhar-Lawoong	-0.215	-0.051	0.215	0.049	0.0	-1.4	97.4	97.4	0.00
Lawoong Tfr	0.045	0.029	-0.044	-0.027	1.1	1.6	97.4	94.2	3.21
PEE90.26-M.Bangyul	-0.006	-0.004	0.006	0.003	0.0	-0.5	96.2	96.2	0.00
Dezema(M-U)	0.003	0.002	-0.003	-0.002	0.0	0.0	91.8	91.8	0.00
M.Dezema Tfr	0.004	0.003	-0.004	-0.003	0.0	0.0	91.8	91.1	0.76
Maan-PEE40.10	0.561	0.267	-0.561	-0.271	0.2	-3.4	96.4	96.4	0.04
PEE40.9-Maan	-0.567	-0.271	0.567	0.269	0.1	-2.0	96.4	96.4	0.02
Maan Tfr	0.006	0.003	-0.006	-0.003	0.0	0.0	96.4	96.0	0.39
Thongsa-Maendi	-0.013	-0.008	0.013	0.002	0.0	-5.9	97.4	97.4	0.00
Maendi Tfr	0.013	0.008	-0.013	-0.008	0.1	0.1	97.4	96.5	0.93

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	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
PEE100.13-Marangdth	-0.007	-0.004	0.007	0.003	0.0	-1.0	96.1	96.1	0.00
Marangdth Tfr	0.007	0.004	-0.007	-0.004	0.1	0.1	96.1	94.9	1.20
PEE90.17-Martsala	-0.352	-0.170	0.352	0.169	0.0	-0.6	96.3	96.3	0.00
Martsala Tfr	0.036	0.023	-0.036	-0.022	0.7	1.1	96.3	93.7	2.60
PEE90.25-Mekuri	-0.011	-0.007	0.011	0.006	0.0	-0.6	96.2	96.2	0.00
PEE90.25-Mekuri Sch.	-0.012	-0.008	0.012	0.007	0.0	-0.3	96.2	96.2	0.00
Mongling-Yongla	0.038	0.023	-0.038	-0.024	0.0	-0.9	96.8	96.8	0.00
PEE40.6-Mongling	-0.078	-0.049	0.078	0.049	0.0	-0.5	96.8	96.8	0.00
Mongling Tfr	0.041	0.026	-0.040	-0.025	0.9	1.3	96.8	94.0	2.89
Mukazor Tfr	0.011	0.007	-0.010	-0.006	0.1	0.1	96.2	95.4	0.74
PEE20.3-N.Yangkhar	-0.028	-0.017	0.028	0.017	0.0	-0.2	93.9	93.9	0.02
N.Yangkhar Tfr	0.011	0.007	-0.010	-0.006	0.2	0.2	93.9	92.0	1.95
PEE90.19-Nachubander	-0.009	-0.006	0.009	0.006	0.0	-0.1	96.3	96.3	0.00
Nachubander Tfr	0.009	0.006	-0.009	-0.006	0.1	0.2	96.3	94.6	1.62
Nalung Tfr	0.004	0.003	-0.004	-0.002	0.0	0.1	96.0	94.9	1.13
Shingchuri-Namdeling	-0.013	-0.008	0.013	0.002	0.0	-6.2	96.3	96.3	0.00
Namdeling Tfr	0.013	0.008	-0.013	-0.008	0.1	0.1	96.3	95.3	0.96
PEE20.2-Nangkor CS	-0.107	-0.069	0.107	0.069	0.0	-0.1	94.1	94.1	0.02
Nangkor CS Tfr	0.107	0.069	-0.104	-0.064	3.3	4.9	94.1	90.2	3.96
Nangkor SS Tfr1	2.383	1.475	-2.370	-1.364	13.1	111.5	100.0	97.6	2.44
Nangkor SS Tfr2	2.383	1.475	-2.370	-1.364	13.1	111.5	100.0	97.6	2.44
L1-Y.Maan	0.455	0.169	-0.454	-0.174	0.2	-5.1	97.6	97.5	0.04
33/11kV Tfr1	0.244	0.154	-0.244	-0.151	0.3	2.5	97.6	97.0	0.53
33/11kV Tfr2	1.421	1.021	-1.410	-0.929	10.7	91.3	97.6	94.2	3.38
PEE40.20-Nanong	-0.023	-0.015	0.023	0.012	0.0	-2.9	96.0	96.0	0.00
Nanong Tfr	0.023	0.015	-0.022	-0.014	0.6	0.9	96.0	92.6	3.46
Nganglam SS Tfr1	2.142	1.359	-2.127	-1.229	15.4	130.6	100.0	96.8	3.19
Nganglam SS Tfr2	2.142	1.359	-2.127	-1.229	15.4	130.6	100.0	96.8	3.19
UG1-PEE90.1	0.843	0.391	-0.843	-0.387	0.0	4.2	96.8	96.6	0.19
UG1-PEE100.1	0.751	0.351	-0.751	-0.348	0.0	3.0	96.8	96.7	0.15
UG1-PEE110.1	1.333	0.837	-1.333	-0.827	0.1	9.7	96.8	96.5	0.32
33/11kV Nganglam Tfr1	0.503	0.340	-0.501	-0.321	2.2	18.6	96.8	94.9	1.92
33/11kV Nganglam Tfr2	0.503	0.340	-0.501	-0.321	2.2	18.6	96.8	94.9	1.92
PEE50.14-Ngatseri	-0.020	-0.012	0.020	0.012	0.0	-0.2	97.3	97.3	0.00
Ngatseri Tfr	0.020	0.012	-0.019	-0.012	0.2	0.3	97.3	95.9	1.38
Norbaii-PEE90.6	0.207	0.082	-0.207	-0.082	0.0	-0.2	96.3	96.3	0.00
PEE90.5-Norbaii	-0.218	-0.089	0.218	0.089	0.0	-0.1	96.3	96.3	0.00

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Norbugang-PEE100.10	0.052	0.029	-0.052	-0.030	0.0	-1.1	96.3	96.3	0.00
Pmathang-Nobugang	-0.055	-0.031	0.055	0.030	0.0	-0.7	96.3	96.3	0.00
Norbugang Tfr	0.003	0.002	-0.003	-0.002	0.0	0.0	96.3	95.7	0.57
PEE100.7-NS Borang	-0.060	-0.038	0.060	0.037	0.0	-0.4	96.4	96.4	0.00
NS Borang Tfr	0.020	0.013	-0.020	-0.012	0.6	0.8	96.4	92.7	3.64
Nshing Lkhang-PEE40.11	0.544	0.270	-0.544	-0.278	0.5	-8.5	96.3	96.2	0.10
PEE40.10-Nshing Lkhang	-0.555	-0.277	0.555	0.271	0.3	-5.6	96.3	96.4	0.06
PEE70.7-Pakhurie	-0.081	-0.049	0.081	0.049	0.0	0.0	91.8	91.8	0.02
Pakhurie Tfr	0.007	0.004	-0.007	-0.004	0.1	0.1	91.8	90.6	1.24
Panbang Tfr	-0.102	-0.064	0.104	0.066	1.5	2.2	94.2	96.1	1.87
PEE100.15-Panbang	-0.104	-0.066	0.104	0.065	0.0	-0.3	96.1	96.1	0.00
Pangthang-Totpolung	0.009	0.005	-0.009	-0.005	0.0	-0.2	93.9	93.9	0.01
PEE20.4-Pangthang	-0.022	-0.013	0.022	0.013	0.0	-0.1	93.9	93.9	0.01
Pangthang Tfr	0.013	0.008	-0.013	-0.008	0.1	0.1	93.9	92.9	0.94
L1-PEE10.1	-0.244	-0.151	0.244	0.151	0.3	0.0	96.9	97.0	0.12
PEE10(1-2)	0.200	0.124	-0.200	-0.124	0.0	0.0	96.9	96.9	0.00
PEE10.1-U.Nangkor	0.044	0.028	-0.044	-0.028	0.0	0.0	96.9	96.9	0.00
PEE10.2-TCom	0.001	0.000	-0.001	0.000	0.0	-0.1	96.9	96.9	0.00
PEE10.2-Zero Pt.	0.199	0.124	-0.199	-0.124	0.3	-0.2	96.9	96.7	0.20
PMSS-PEE10.1	-0.002	0.000	0.002	0.000	0.0	-0.2	96.6	96.6	0.00
PEE10.3-PoP Feeder (DPCL)	0.000	0.000	0.000	0.000	0.0	-0.4	96.6	96.6	0.00
UG1-PEE20.1	-0.337	-0.212	0.337	0.212	0.0	0.0	94.2	94.2	0.01
PEE20(1-2)	0.337	0.212	-0.337	-0.212	0.1	0.0	94.2	94.1	0.02
Shumar-PEE20.3	-0.146	-0.090	0.146	0.090	0.1	-0.1	93.9	94.0	0.06
PEE20(4-5)	0.086	0.053	-0.086	-0.054	0.0	-0.1	93.9	93.9	0.02
PEE20(5-6)	0.058	0.036	-0.058	-0.036	0.0	-0.3	93.9	93.8	0.03
PEE20.5-Shali	0.028	0.017	-0.028	-0.017	0.0	0.0	93.9	93.9	0.00
PEE20(6-7)	0.034	0.021	-0.034	-0.021	0.0	-0.2	93.8	93.8	0.02
PEE20.6-Sherkhakpa	0.021	0.013	-0.021	-0.013	0.0	-0.2	93.8	93.8	0.02
L1-PEE30.1	-1.062	-0.707	1.073	0.717	10.6	10.0	93.1	94.2	1.07
SMCL Tfr	0.343	0.228	-0.338	-0.209	5.4	18.8	93.1	89.8	3.32
PEE30.2-R.Court USS	0.118	0.075	-0.118	-0.075	0.0	-0.1	92.3	92.3	0.02
PEE40(1-5)	1.679	0.935	-1.677	-0.938	2.4	-2.5	97.2	97.1	0.16
PEE40(2-3)	0.025	0.012	-0.025	-0.014	0.0	-2.2	97.2	97.2	0.00
PEE40(2-4)	0.045	0.009	-0.045	-0.014	0.0	-4.7	97.2	97.2	0.01
PEE40.3-Shumar Jug	0.009	0.004	-0.009	-0.006	0.0	-1.3	97.2	97.2	0.00
PEE40.3-Shumar Thung	0.016	0.010	-0.016	-0.010	0.0	-0.6	97.2	97.2	0.00

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PEE40.4-Thongknang	0.024	0.001	-0.024	-0.011	0.0	-9.7	97.2	97.2	0.01
PEE40(5-6)	1.658	0.927	-1.655	-0.931	3.0	-3.2	97.1	96.8	0.20
PEE40.5-Pthang Daza	0.019	0.011	-0.019	-0.012	0.0	-1.1	97.1	97.0	0.00
PEE40(6-7)	1.576	0.882	-1.575	-0.884	1.3	-1.7	96.8	96.7	0.10
PEE40.7-Resinang	1.285	0.711	-1.284	-0.715	1.7	-4.3	96.7	96.6	0.16
PEE40.8-U.Nmalam	0.036	0.016	-0.036	-0.020	0.0	-4.0	96.7	96.7	0.00
PEE40.8-Zobel	0.014	0.006	-0.014	-0.009	0.0	-2.6	96.7	96.7	0.00
PEE40.9-Stone Crusher	0.592	0.374	-0.591	-0.387	1.0	-13.3	96.4	96.2	0.18
Tshelingore-PEE40.9	-1.159	-0.643	1.159	0.642	0.3	-1.0	96.4	96.4	0.03
PEE40.10-Wooltang	0.006	0.000	-0.006	-0.004	0.0	-3.8	96.4	96.4	0.00
PEE40(11-12)	0.533	0.272	-0.533	-0.272	0.0	-0.4	96.2	96.2	0.00
PEE40(12-13)	0.052	0.016	-0.052	-0.017	0.0	-1.4	96.2	96.2	0.00
PEE40(12-15)	0.481	0.256	-0.481	-0.258	0.1	-1.4	96.2	96.2	0.01
PEE40(13-14)	0.039	0.017	-0.039	-0.019	0.0	-2.2	96.2	96.2	0.00
DaiGonpa-TshoGonpa	0.038	0.020	-0.038	-0.022	0.0	-1.9	96.2	96.2	0.00
PEE40(15-16)	0.472	0.259	-0.471	-0.264	0.2	-4.1	96.2	96.1	0.04
PEE40.15-Rashi Gonpa	0.009	-0.002	-0.009	-0.002	0.0	-3.6	96.2	96.2	0.00
PEE40(16-17)	0.458	0.256	-0.458	-0.259	0.1	-3.1	96.1	96.1	0.03
PEE40.17-Tephu	0.028	0.015	-0.028	-0.018	0.0	-2.9	96.1	96.1	0.00
PEE40.17-Woongchilo	0.430	0.245	-0.430	-0.246	0.1	-1.6	96.1	96.1	0.01
PEE40.18-Rhaling	0.379	0.220	-0.379	-0.223	0.1	-2.9	96.1	96.0	0.02
Woongchilo-PEE40.18	-0.400	-0.230	0.400	0.227	0.1	-2.6	96.1	96.1	0.02
PEE40(19-20)	0.300	0.175	-0.300	-0.176	0.0	-0.9	96.0	96.0	0.01
PEE40.19-Yelchen	0.051	0.033	-0.051	-0.033	0.0	-0.2	96.0	96.0	0.00
Rhaling-PEE40.19	-0.352	-0.208	0.352	0.206	0.1	-2.4	96.0	96.0	0.02
PEE40.20-Zhingri	0.277	0.165	-0.277	-0.165	0.0	-0.9	96.0	96.0	0.01
Yelchen CS-PEE40.21	-0.225	-0.136	0.225	0.134	0.0	-2.4	96.0	96.0	0.01
PEE50.2-Yalang	0.031	0.017	-0.031	-0.020	0.0	-2.4	97.5	97.5	0.00
PEE50(3-4)	0.149	0.082	-0.149	-0.085	0.0	-3.2	97.4	97.4	0.02
PEE50(3-5)	0.541	0.259	-0.541	-0.261	0.1	-1.1	97.4	97.4	0.01
PEE50.4-U.Khar	0.085	0.044	-0.085	-0.046	0.0	-1.8	97.4	97.4	0.01
PEE50(5-6)	0.080	0.042	-0.080	-0.043	0.0	-0.9	97.4	97.4	0.00
PEE50(5-7)	0.461	0.219	-0.461	-0.222	0.1	-2.9	97.4	97.4	0.03
PEE50.6-Thongsa	0.080	0.043	-0.080	-0.046	0.0	-3.1	97.4	97.4	0.01
PEE50(7-8)	0.455	0.219	-0.455	-0.224	0.2	-4.7	97.4	97.3	0.04
PEE50.7-Raegi	0.005	0.002	-0.005	-0.003	0.0	-0.9	97.4	97.4	0.00
PEE50(8-9)	0.442	0.217	-0.442	-0.221	0.1	-3.9	97.3	97.3	0.03

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PEE50(9-10)	0.047	0.008	-0.047	-0.009	0.0	-0.5	97.3	97.3	0.00
PEE50.9-Shenari	0.396	0.213	-0.396	-0.213	0.0	-0.5	97.3	97.3	0.00
PEE50(10-11)	0.035	0.007	-0.035	-0.015	0.0	-7.7	97.3	97.3	0.01
PEE50(12-13)	0.044	0.022	-0.044	-0.022	0.0	-0.6	97.3	97.3	0.00
PEE50(12-14)	0.233	0.115	-0.233	-0.115	0.0	-0.3	97.3	97.3	0.00
Zordug-PEE50.12	-0.277	-0.137	0.277	0.135	0.0	-2.1	97.3	97.3	0.01
PEE50.13-Phadi	0.016	0.009	-0.016	-0.010	0.0	-1.1	97.3	97.3	0.00
PEE50.13-Yomzor	0.028	0.013	-0.028	-0.018	0.0	-4.1	97.3	97.3	0.00
PEE50.14-Tsebar	0.213	0.103	-0.213	-0.106	0.0	-2.5	97.3	97.3	0.01
PEE50.15-U.Chshing	0.014	0.008	-0.014	-0.009	0.0	-0.7	97.2	97.2	0.00
PEE50(21-22)	0.041	0.025	-0.041	-0.025	0.0	-0.5	97.2	97.2	0.00
PEE50(21-25)	0.030	0.005	-0.030	-0.012	0.0	-7.1	97.2	97.2	0.01
PEE50(22-23)	0.040	0.025	-0.040	-0.025	0.0	-0.5	97.2	97.2	0.00
PEE50(25-26)	0.029	0.011	-0.029	-0.017	0.0	-6.4	97.2	97.2	0.01
PEE60(1-2)	0.375	0.138	-0.375	-0.141	0.1	-2.9	97.5	97.5	0.02
PEE60(15-1)	-0.439	-0.169	0.439	0.166	0.1	-2.9	97.5	97.5	0.02
PEE60.2-Phakpalu	0.025	0.012	-0.025	-0.012	0.0	-0.8	97.5	97.5	0.00
PEE60.2-Yurung BHU	0.350	0.129	-0.350	-0.135	0.1	-6.6	97.5	97.4	0.04
Thungo-PEE60.3	-0.136	-0.003	0.136	0.003	0.0	-0.5	97.4	97.4	0.00
PEE60.5-Phumtseri	0.018	0.010	-0.018	-0.011	0.0	-1.7	97.4	97.4	0.00
PEE60.5-U.Pthang	0.096	-0.014	-0.096	0.007	0.0	-7.2	97.4	97.4	0.01
PEE60(6-7)	0.049	0.029	-0.049	-0.030	0.0	-1.0	97.4	97.4	0.00
PEE60(6-11)	0.040	-0.037	-0.040	0.020	0.0	-16.6	97.4	97.4	0.00
PEE60.11-U.Nyaskar	0.030	-0.027	-0.030	0.026	0.0	-1.0	97.4	97.4	0.00
PEE60.12-Weling	0.008	-0.022	-0.008	0.022	0.0	-0.1	97.4	97.4	0.00
U.Nyaskar-PEE60.12	-0.024	0.013	0.024	-0.030	0.0	-16.6	97.4	97.4	0.00
PEE60(13-14)	0.005	-0.020	-0.005	0.017	0.0	-2.5	97.4	97.4	0.00
Weling-PEE60.13	-0.007	0.019	0.007	-0.022	0.0	-3.7	97.4	97.4	0.00
PEE60.14-Dechenling Fdr	0.000	-0.019	0.000	0.000	0.0	-18.9	97.4	97.4	0.00
Y.Maan-PEE60.15	-0.439	-0.166	0.439	0.164	0.1	-2.0	97.5	97.5	0.02
L1-PEE70.1	-0.933	-0.600	0.935	0.601	1.6	0.8	94.7	94.9	0.15
PEE70(1-2)	0.915	0.588	-0.901	-0.581	13.9	6.8	94.7	93.4	1.36
PEE70.1-Tshenkri	0.019	0.012	-0.019	-0.012	0.0	0.0	94.7	94.7	0.00
PEE70(2-3)	0.018	0.011	-0.018	-0.011	0.0	-0.2	93.4	93.4	0.01
PEE70(2-4)	0.883	0.571	-0.876	-0.567	7.4	3.6	93.4	92.6	0.74
PEE70.3-U.Menchu	0.008	0.005	-0.008	-0.005	0.0	-0.2	93.4	93.4	0.00
PEE70.4-Phatowog	0.875	0.567	-0.871	-0.565	3.9	1.9	92.6	92.3	0.39

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
PEE70.4-Tokaphu	0.001	0.000	-0.001	-0.001	0.0	-0.2	92.6	92.6	0.00
PEE70.5-U.Tshagtrie	0.005	0.003	-0.005	-0.003	0.0	-0.2	92.2	92.2	0.00
Phatowog-PEE70.5	-0.477	-0.304	0.477	0.305	0.5	0.2	92.2	92.3	0.08
PEE70(6-7)	0.106	0.063	-0.106	-0.064	0.0	-0.1	91.9	91.8	0.04
PEE70(7-9)	0.025	0.015	-0.025	-0.015	0.0	-0.2	91.8	91.8	0.01
PEE70.8-Tanzaima	0.033	0.019	-0.033	-0.020	0.0	-0.4	91.7	91.7	0.05
PEE70.8-U.Satshalo	0.027	0.017	-0.027	-0.017	0.0	0.0	91.7	91.7	0.00
PEE70.9-Potanala	0.021	0.013	-0.021	-0.013	0.0	-0.7	91.8	91.8	0.05
PEE70.9-Rinchenhang	0.004	0.002	-0.004	-0.002	0.0	0.0	91.8	91.8	0.00
UG1-PEE80.1	-0.067	-0.042	0.067	0.042	0.0	0.0	94.9	94.9	0.00
PEE80(1-2)	0.067	0.042	-0.067	-0.042	0.1	-0.3	94.9	94.8	0.08
PEE90(1-2)	0.843	0.387	-0.842	-0.394	1.0	-7.3	96.6	96.5	0.13
PEE90(3-4)	0.300	0.136	-0.300	-0.136	0.0	-0.7	96.3	96.3	0.01
PEE90.4-Phungshrang	0.252	0.107	-0.252	-0.107	0.0	-0.6	96.3	96.3	0.00
Phungshrang-PEE90.5	-0.236	-0.100	0.236	0.097	0.0	-2.1	96.3	96.3	0.02
PEE90.6-Relakpo	0.197	0.076	-0.197	-0.080	0.1	-4.1	96.3	96.3	0.03
PEE90.7-U.Yangmalshg	0.130	0.045	-0.130	-0.046	0.0	-1.4	96.2	96.2	0.01
Relakpo-PEE90.7	-0.147	-0.055	0.147	0.046	0.1	-9.0	96.2	96.3	0.04
PEE90(8-9)	0.097	0.030	-0.097	-0.034	0.0	-3.7	96.2	96.2	0.01
U.Yangmalshg-PEE90.8	-0.119	-0.044	0.119	0.039	0.0	-4.6	96.2	96.2	0.02
PEE90(9-11)	0.079	0.025	-0.079	-0.042	0.0	-17.3	96.2	96.1	0.05
PEE90(11-12)	0.069	0.036	-0.069	-0.042	0.0	-6.1	96.1	96.1	0.01
PEE90(12-13)	0.020	0.012	-0.020	-0.012	0.0	-0.1	96.1	96.1	0.00
PEE90(17-18)	0.091	0.041	-0.091	-0.043	0.0	-1.5	96.3	96.3	0.00
PEE90.18-Shingchuri	0.054	0.027	-0.054	-0.028	0.0	-1.8	96.3	96.3	0.00
PEE90(20-21)	0.029	0.009	-0.029	-0.009	0.0	-0.4	96.2	96.2	0.00
PEE90(20-23)	0.257	0.125	-0.257	-0.133	0.1	-8.3	96.2	96.2	0.04
PEE90.22-U.Kholomeri	0.017	0.002	-0.017	-0.004	0.0	-1.2	96.2	96.2	0.00
PEE90(23-24)	0.050	0.026	-0.050	-0.026	0.0	-0.3	96.2	96.2	0.00
PEE90(23-27)	0.032	0.001	-0.032	-0.010	0.0	-9.0	96.2	96.2	0.00
PEE90(23-29)	0.174	0.106	-0.174	-0.107	0.0	-1.1	96.2	96.2	0.00
PEE90(24-25)	0.023	0.013	-0.023	-0.013	0.0	-0.3	96.2	96.2	0.00
PEE90.24-U.Mekuri	0.027	0.013	-0.027	-0.014	0.0	-0.5	96.2	96.2	0.00
PEE90.26-U.Bangyul	0.008	0.005	-0.008	-0.005	0.0	-0.2	96.2	96.2	0.00
U.Mekuri-PEE90.26	-0.019	-0.011	0.019	0.009	0.0	-1.8	96.2	96.2	0.00
PEE90(27-28)	0.032	0.010	-0.032	-0.015	0.0	-5.0	96.2	96.2	0.01
PEE90.28-Telung	0.030	0.016	-0.030	-0.020	0.0	-3.8	96.2	96.2	0.00

	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
PEE90.28-Tshobalay	0.002	-0.001	-0.002	-0.001	0.0	-1.8	96.2	96.2	0.00
PEE100(1-2)	0.751	0.348	-0.749	-0.360	1.3	-12.3	96.7	96.5	0.19
PEE100(2-3)	0.028	0.012	-0.028	-0.014	0.0	-2.3	96.5	96.5	0.00
PEE100(2-7)	0.667	0.314	-0.666	-0.322	0.6	-7.7	96.5	96.4	0.11
PEE100(7-9)	0.606	0.285	-0.606	-0.291	0.4	-6.2	96.4	96.3	0.08
PEE100(9-11)	0.526	0.246	-0.526	-0.248	0.1	-1.7	96.3	96.3	0.02
PEE100.9-Pmathang	0.080	0.045	-0.080	-0.046	0.0	-1.1	96.3	96.3	0.00
PEE100(11-12)	0.520	0.246	-0.520	-0.255	0.4	-9.3	96.3	96.2	0.10
PEE100.11-Umdang	0.006	0.002	-0.006	-0.004	0.0	-1.7	96.3	96.3	0.00
PEE100.12-Thinleygg	0.514	0.251	-0.514	-0.255	0.2	-3.9	96.2	96.1	0.04
PEE100(13-14)	0.325	0.139	-0.325	-0.141	0.0	-2.1	96.1	96.1	0.01
PEE100.13-Sonamthg	0.059	0.038	-0.059	-0.038	0.0	-0.6	96.1	96.1	0.00
Thinleygg-PEE100.13	-0.390	-0.180	0.390	0.177	0.1	-3.0	96.1	96.1	0.02
PEE100(14-15)	0.293	0.124	-0.293	-0.126	0.0	-2.1	96.1	96.1	0.01
PEE100(15-16)	0.189	0.061	-0.189	-0.062	0.0	-0.9	96.1	96.1	0.00
PEE100.16-R.Manas.P 1	0.047	0.004	-0.047	-0.006	0.0	-1.5	96.1	96.1	0.00
PEE100.16-Tungudpa	0.142	0.058	-0.142	-0.060	0.0	-2.2	96.1	96.1	0.01
PEE100(17-18)	0.027	0.000	-0.027	-0.008	0.0	-7.6	96.0	96.0	0.00
PEE100.17-Rebati Sch.	0.081	0.049	-0.081	-0.051	0.0	-1.5	96.0	96.0	0.00
Rebati-PEE100.17	-0.107	-0.049	0.107	0.049	0.0	-0.5	96.0	96.0	0.00
PEE110.1-Tskeri.A.Crusher	1.333	0.827	-1.331	-0.832	2.1	-5.0	96.5	96.3	0.19
Tskeri A.Workshp-PEE110.2	-1.286	-0.805	1.286	0.805	0.3	-0.8	96.2	96.3	0.03
Pmathang Tfr	0.024	0.016	-0.024	-0.015	0.8	1.2	96.3	91.9	4.42
Phadi Tfr	0.016	0.010	-0.016	-0.010	0.1	0.2	97.3	96.2	1.12
Phakpalu Tfr	0.010	0.006	-0.010	-0.006	0.1	0.2	97.5	96.0	1.42
Phatowog Tfr	0.393	0.260	-0.375	-0.232	18.4	27.6	92.3	86.3	5.95
Phumtseri Tfr	0.018	0.011	-0.018	-0.011	0.4	0.5	97.4	94.7	2.65
PMSS Tfr	0.046	0.029	-0.046	-0.028	0.3	0.4	96.6	95.8	0.82
Potanala Tfr	0.021	0.013	-0.021	-0.013	0.1	0.2	91.8	91.0	0.79
Pthang Tfr	0.042	0.027	-0.042	-0.026	1.0	1.5	96.0	92.9	3.05
Pthang Daza Tfr	0.019	0.012	-0.018	-0.011	0.2	0.3	97.0	95.7	1.31
R Court USS Tfr	-0.118	-0.073	0.118	0.075	0.6	2.2	91.2	92.3	1.13
R Court USS UG (B-B1)	0.118	0.075	-0.118	-0.075	0.1	0.0	92.3	92.3	0.04
R.Manas.P (1-2)	0.047	0.006	-0.047	-0.025	0.0	-19.2	96.1	96.1	0.01
R.Manas.P 2(2-3)	0.047	0.025	-0.047	-0.030	0.0	-4.8	96.1	96.1	0.01
R.Manas.P (3-4)	0.047	0.030	-0.047	-0.030	0.0	0.0	96.1	96.0	0.02
R.Manas.P Tfr	0.047	0.030	-0.047	-0.029	0.3	0.5	96.0	95.2	0.85

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
Raegi Tfr	0.005	0.003	-0.005	-0.003	0.0	0.0	97.4	97.0	0.37
RashiGonpa Tfr	0.007	0.004	-0.007	-0.004	0.1	0.1	96.2	94.9	1.27
Rayzor Tfr	0.002	0.001	-0.002	-0.001	0.0	0.0	96.1	95.7	0.35
Rebati Tfr	0.013	0.008	-0.013	-0.008	0.2	0.3	96.0	93.7	2.32
Rebati Sch. Tfr	0.081	0.051	-0.080	-0.049	0.9	1.3	96.0	94.6	1.45
Relakpo Tfr	0.050	0.034	-0.047	-0.029	2.9	4.4	96.3	88.6	7.68
Resinang-Tshelingore	1.171	0.643	-1.169	-0.648	1.5	-4.8	96.6	96.4	0.15
Resinang Tfr	0.023	0.014	-0.023	-0.014	0.3	0.4	96.6	95.0	1.63
Rhaling Tfr	0.027	0.017	-0.026	-0.016	0.4	0.6	96.0	94.1	1.90
Rinchenthang Tfr	0.004	0.002	-0.004	-0.002	0.0	0.0	91.8	91.7	0.17
Shali Tfr	0.028	0.017	-0.027	-0.017	0.4	0.6	93.9	91.9	2.02
Shenari-Zordug	0.278	0.134	-0.278	-0.136	0.0	-1.9	97.3	97.3	0.01
Shenari Tfr	0.117	0.079	-0.110	-0.068	7.4	11.2	97.3	88.8	8.47
Sherkhakpa Tfr	0.021	0.013	-0.021	-0.013	0.2	0.4	93.8	92.3	1.53
Shingchuri Tfr	0.041	0.026	-0.040	-0.025	0.9	1.3	96.3	93.4	2.91
Shumar Tfr	0.025	0.016	-0.025	-0.015	0.4	0.5	94.0	92.2	1.84
Shumar Jug Tfr	0.009	0.006	-0.009	-0.005	0.1	0.1	97.2	95.9	1.32
Shumar Thung Tfr	0.016	0.010	-0.016	-0.010	0.3	0.4	97.2	94.8	2.44
Sonamthg Tfr	0.059	0.038	-0.057	-0.035	1.9	2.8	96.1	91.9	4.25
Stone Crusher Tfr	0.591	0.387	-0.567	-0.351	23.9	35.9	96.2	90.9	5.37
Tanzaima-Satshalo Feeder	0.000	-0.001	0.000	0.000	0.0	-1.5	91.7	91.7	0.00
Tainzaima Tfr	0.033	0.021	-0.033	-0.020	0.7	1.0	91.7	89.2	2.50
TCom Tfr	0.001	0.000	-0.001	0.000	0.0	0.0	96.9	96.8	0.11
Telung Tfr	0.030	0.020	-0.029	-0.018	1.3	1.9	96.2	90.7	5.51
Tephu Tfr	0.028	0.018	-0.027	-0.017	0.4	0.6	96.1	94.1	1.97
Thinleygg Tfr	0.123	0.078	-0.121	-0.075	2.0	3.1	96.1	93.9	2.22
Thongknang-U.Khnadang	0.022	0.010	-0.022	-0.012	0.0	-2.6	97.2	97.2	0.00
Thongsa Tfr	0.067	0.044	-0.065	-0.040	2.4	3.5	97.4	92.6	4.76
Thungo Tfr	0.034	0.021	-0.033	-0.021	0.6	0.9	97.4	95.0	2.37
Tokaphu Tfr	0.001	0.001	-0.001	-0.001	0.0	0.0	92.6	92.5	0.17
Totpolung Tfr	0.009	0.005	-0.008	-0.005	0.1	0.2	93.9	92.3	1.57
Tsangtsiri Tfr	0.025	0.016	-0.025	-0.015	0.3	0.5	96.6	94.8	1.77
Tsebar Tfr	0.076	0.050	-0.073	-0.045	3.0	4.6	97.3	91.9	5.40
U.Tshagtrie Tfr	-0.004	-0.002	0.004	0.002	0.0	0.0	91.5	92.2	0.66
Tshelingore Tfr	0.010	0.006	-0.010	-0.006	0.1	0.1	96.4	95.7	0.71
Tshenkri Tfr	0.019	0.012	-0.018	-0.011	0.5	0.7	94.7	91.3	3.43
TshoGonpa Tfr	0.010	0.006	-0.010	-0.006	0.1	0.1	96.2	95.5	0.71

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
Tskeri A.Crusher Tfr	-0.027	-0.017	0.028	0.018	0.4	0.6	94.3	96.3	1.97
Tskeri A.Workshp Tfr	-0.017	-0.010	0.017	0.011	0.2	0.2	95.1	96.3	1.20
Tskeri A(Crusher-Workshp)	1.304	0.814	-1.303	-0.815	0.4	-0.9	96.3	96.3	0.03
Tungudpa Tfr	0.011	0.007	-0.011	-0.007	0.1	0.1	96.1	95.3	0.81
U.Chshing Tfr	0.014	0.009	-0.014	-0.009	0.1	0.2	97.2	96.2	1.01
U.Dezema Tfr	0.003	0.002	-0.003	-0.002	0.0	0.0	91.8	91.2	0.62
U.Khangma Tfr	0.019	0.012	-0.019	-0.012	0.2	0.3	97.5	96.1	1.35
U.Khar Tfr	0.072	0.047	-0.069	-0.043	2.7	4.1	97.4	92.3	5.12
U.Khnadang Tfr	0.011	0.007	-0.011	-0.007	0.1	0.2	97.2	95.6	1.60
U.Kholomeri Tfr	0.010	0.006	-0.010	-0.006	0.1	0.2	96.2	94.5	1.73
U.Menchu Tfr	0.008	0.005	-0.008	-0.005	0.0	0.1	93.4	92.8	0.58
U.Nangkor Tfr	-0.043	-0.027	0.044	0.028	0.5	0.8	95.3	96.9	1.56
U.Nmalam Tfr	0.022	0.014	-0.022	-0.014	0.3	0.4	96.7	95.2	1.56
U.Satshalo Tfr	0.027	0.017	-0.026	-0.016	0.4	0.6	91.7	89.7	1.99
U.Yangmalshg Tfr	0.011	0.007	-0.011	-0.007	0.2	0.2	96.2	94.2	1.97
Umdang Tfr	0.006	0.004	-0.006	-0.004	0.0	0.1	96.3	95.2	1.03
Wooltang Tfr	0.006	0.004	-0.006	-0.004	0.0	0.1	96.4	95.5	0.85
Woongchilo Tfr	0.030	0.019	-0.030	-0.018	0.5	0.7	96.1	93.9	2.15
Y.Maan Tfr	0.015	0.010	-0.015	-0.009	0.2	0.4	97.5	95.3	2.23
Yalang Tfr	0.031	0.020	-0.030	-0.019	0.5	0.7	97.5	95.3	2.18
Yurung BHU-Yangkhar	-0.271	-0.085	0.271	0.084	0.0	-1.5	97.4	97.4	0.01
Yangkhar TFr	0.056	0.036	-0.054	-0.034	1.7	2.5	97.4	93.4	3.97
Yelchen Tfr	0.051	0.033	-0.050	-0.031	1.4	2.1	96.0	92.3	3.70
Zhingri-Yelchen CS	-0.276	-0.166	0.276	0.165	0.0	-1.2	96.0	96.0	0.01
Yelchen CS Tfr	0.051	0.032	-0.050	-0.031	0.7	1.0	96.0	94.2	1.83
Yomzor Tfr	0.028	0.018	-0.027	-0.017	0.4	0.6	97.3	95.3	1.95
Yongla Tfr	0.038	0.024	-0.037	-0.023	0.8	1.1	96.8	94.2	2.68
Yurung BHU Tfr	0.079	0.052	-0.075	-0.047	3.3	4.9	97.4	91.8	5.61
Zero Pt. Tfr	0.035	0.022	-0.035	-0.021	0.3	0.5	96.7	95.5	1.24
Zhingri Tfr	0.002	0.001	-0.002	-0.001	0.0	0.0	96.0	95.9	0.11
Zobel Tfr	0.014	0.009	-0.014	-0.008	0.1	0.1	96.7	95.8	0.96
Zordug Tfr	0.002	0.001	-0.002	-0.001	0.0	0.0	97.3	97.2	0.11
					320.2	259.2			

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	105.0	102.0
UnderVoltage	95.0	98.0
Generator Excitation		
OverExcited (Q Max.)	100.0	95.0
UnderExcited (Q Min.)	100.0	

Critical Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
Babta B2	Bus	Under Voltage	0.415	kV	0.385	92.7	3-Phase
Banjarie B1	Bus	Under Voltage	11.000	kV	10.43	94.8	3-Phase
Bar Gonpa B2	Bus	Under Voltage	0.415	kV	0.39	94.6	3-Phase
BCI B1	Bus	Under Voltage	11.000	kV	10.17	92.5	3-Phase
BCI B2	Bus	Under Voltage	0.415	kV	0.37	88.6	3-Phase
Benjarie B2	Bus	Under Voltage	0.415	kV	0.38	91.7	3-Phase
BHU Area B2	Bus	Under Voltage	0.415	kV	0.39	94.6	3-Phase
Borangmo2 B2	Bus	Under Voltage	0.415	kV	0.39	94.5	3-Phase
Borkatshg B1	Bus	Under Voltage	11.000	kV	10.10	91.9	3-Phase
Borkatshg B2	Bus	Under Voltage	0.415	kV	0.38	91.2	3-Phase
BPC Colony B1	Bus	Under Voltage	11.000	kV	10.16	92.3	3-Phase
BPC Colony B2	Bus	Under Voltage	0.415	kV	0.38	92.0	3-Phase
Branphu B2	Bus	Under Voltage	0.415	kV	0.39	94.7	3-Phase
Changarzampa B2	Bus	Under Voltage	0.415	kV	0.39	93.2	3-Phase
Chokhorling Sc. B2	Bus	Under Voltage	0.415	kV	0.39	93.3	3-Phase

Critical Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
Dalung B2	Bus	Under Voltage	0.415	kV	0.391	94.1	3-Phase
DCP Area B1	Bus	Under Voltage	11.000	kV	10.11	91.9	3-Phase
DCP Area B2	Bus	Under Voltage	0.415	kV	0.36	86.7	3-Phase
DCP Area Tfr	Transformer	Overload	0.315	MVA	0.41	130.8	3-Phase
Druk Gyp2 B1	Bus	Under Voltage	0.415	kV	0.39	94.8	3-Phase
Dungmin III B2	Bus	Under Voltage	0.415	kV	0.39	94.9	3-Phase
Galabi B2	Bus	Under Voltage	0.415	kV	0.39	93.8	3-Phase
Gamung B1	Bus	Under Voltage	11.000	kV	10.32	93.8	3-Phase
Gamung B2	Bus	Under Voltage	0.415	kV	0.38	92.0	3-Phase
Gashari B1	Bus	Under Voltage	11.000	kV	10.43	94.8	3-Phase
Gashari B2	Bus	Under Voltage	0.415	kV	0.39	93.0	3-Phase
Gomchu B1	Bus	Under Voltage	11.000	kV	10.33	93.9	3-Phase
Gomchu B2	Bus	Under Voltage	0.415	kV	0.39	93.2	3-Phase
GonpaSingma B2	Bus	Under Voltage	0.415	kV	0.38	92.7	3-Phase
GonpaSingma Tfr	Transformer	Overload	0.063	MVA	0.07	108.3	3-Phase
Gonpawong B2	Bus	Under Voltage	0.415	kV	0.39	94.1	3-Phase
Gonpung B1	Bus	Under Voltage	11.000	kV	10.32	93.8	3-Phase
Gonpung B2	Bus	Under Voltage	0.415	kV	0.38	91.5	3-Phase
Jirang B2	Bus	Under Voltage	0.415	kV	0.38	91.5	3-Phase
Jirang Tfr	Transformer	Overload	0.010	MVA	0.01	118.7	3-Phase
Kangkaring B1	Bus	Under Voltage	11.000	kV	10.35	94.1	3-Phase
Kangkaring B2	Bus	Under Voltage	0.415	kV	0.39	93.4	3-Phase
Kerong Sch. B2	Bus	Under Voltage	0.415	kV	0.39	94.8	3-Phase
Khaimma B2	Bus	Under Voltage	0.415	kV	0.39	94.2	3-Phase
Khalagtangzor B1	Bus	Under Voltage	11.000	kV	10.10	91.9	3-Phase
Kheri B1	Bus	Under Voltage	11.000	kV	10.33	93.9	3-Phase
Kheri B2	Bus	Under Voltage	0.415	kV	0.38	92.6	3-Phase
Kheri Gonpa B2	Bus	Under Voltage	0.415	kV	0.39	94.6	3-Phase
Khonmari I B2	Bus	Under Voltage	0.415	kV	0.39	93.0	3-Phase
Khonmari I Tfr	Transformer	Overload	0.100	MVA	0.10	100.2	3-Phase
Khonmari II B1	Bus	Under Voltage	0.415	kV	0.38	92.3	3-Phase
Khonmari II Tfr	Transformer	Overload	0.100	MVA	0.12	117.4	3-Phase
Khonmari III B2	Bus	Under Voltage	0.415	kV	0.39	93.4	3-Phase
Khonmari IV B2	Bus	Under Voltage	0.415	kV	0.39	93.4	3-Phase
Khulngdrng B2	Bus	Under Voltage	0.415	kV	0.39	94.3	3-Phase
Kulung B2	Bus	Under Voltage	0.415	kV	0.39	93.4	3-Phase

Critical Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
L.Dezema B1	Bus	Under Voltage	11.000	kV	10.103	91.8	3-Phase
L.Khangma B2	Bus	Under Voltage	0.415	kV	0.39	94.7	3-Phase
L.Khar B2	Bus	Under Voltage	0.415	kV	0.39	92.9	3-Phase
L.Khar Tfr	Transformer	Overload	0.063	MVA	0.08	120.3	3-Phase
L.Kholomeri B2	Bus	Under Voltage	0.415	kV	0.39	94.2	3-Phase
L.Menchu B1	Bus	Under Voltage	11.000	kV	10.27	93.4	3-Phase
L.Menchu B2	Bus	Under Voltage	0.415	kV	0.38	92.7	3-Phase
L.Nangkor B1	Bus	Under Voltage	11.000	kV	10.35	94.1	3-Phase
L.Nangkor B2	Bus	Under Voltage	0.415	kV	0.38	90.6	3-Phase
L.Satshalo B1	Bus	Under Voltage	11.000	kV	10.09	91.7	3-Phase
L.Satshalo B2	Bus	Under Voltage	0.415	kV	0.38	90.7	3-Phase
L.Tshagtrie B1	Bus	Under Voltage	11.000	kV	10.14	92.2	3-Phase
L.Tshagtrie B2	Bus	Under Voltage	0.415	kV	0.38	91.9	3-Phase
L.Yangmalshg B2	Bus	Under Voltage	0.415	kV	0.39	93.2	3-Phase
Lashingrie B2	Bus	Under Voltage	0.415	kV	0.38	91.9	3-Phase
Lashingrie Tfr	Transformer	Overload	0.025	MVA	0.03	114.7	3-Phase
Lawoong B2	Bus	Under Voltage	0.415	kV	0.39	94.2	3-Phase
M.Dezema B1	Bus	Under Voltage	11.000	kV	10.10	91.8	3-Phase
M.Dezema B2	Bus	Under Voltage	0.415	kV	0.38	91.1	3-Phase
Marangdth B2	Bus	Under Voltage	0.415	kV	0.39	94.9	3-Phase
Martsala B2	Bus	Under Voltage	0.415	kV	0.39	93.7	3-Phase
Mongling B2	Bus	Under Voltage	0.415	kV	0.39	94.0	3-Phase
N.Yangkhar B1	Bus	Under Voltage	11.000	kV	10.33	93.9	3-Phase
N.Yangkhar B2	Bus	Under Voltage	0.415	kV	0.38	92.0	3-Phase
Nachubander B2	Bus	Under Voltage	0.415	kV	0.39	94.6	3-Phase
Nalung B2	Bus	Under Voltage	0.415	kV	0.39	94.9	3-Phase
Nangkor CS B1	Bus	Under Voltage	11.000	kV	10.35	94.1	3-Phase
Nangkor CS B2	Bus	Under Voltage	0.415	kV	0.37	90.2	3-Phase
Nangkor CS Tfr	Transformer	Overload	0.125	MVA	0.13	102.1	3-Phase
Nanong B2	Bus	Under Voltage	0.415	kV	0.38	92.6	3-Phase
NS Borang B2	Bus	Under Voltage	0.415	kV	0.38	92.7	3-Phase
Pakhurie B1	Bus	Under Voltage	11.000	kV	10.10	91.8	3-Phase
Pakhurie B2	Bus	Under Voltage	0.415	kV	0.38	90.6	3-Phase
Panbang B2	Bus	Under Voltage	0.415	kV	0.39	94.2	3-Phase
Pangthang B1	Bus	Under Voltage	11.000	kV	10.33	93.9	3-Phase
Pangthang B2	Bus	Under Voltage	0.415	kV	0.39	92.9	3-Phase

Critical Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
PEE20.1	Bus	Under Voltage	11.000	kV	10.358	94.2	3-Phase
PEE20.2	Bus	Under Voltage	11.000	kV	10.36	94.1	3-Phase
PEE20.3	Bus	Under Voltage	11.000	kV	10.33	93.9	3-Phase
PEE20.4	Bus	Under Voltage	11.000	kV	10.33	93.9	3-Phase
PEE20.5	Bus	Under Voltage	11.000	kV	10.33	93.9	3-Phase
PEE20.6	Bus	Under Voltage	11.000	kV	10.32	93.8	3-Phase
PEE20.7	Bus	Under Voltage	11.000	kV	10.32	93.8	3-Phase
PEE30.1	Bus	Under Voltage	11.000	kV	10.24	93.1	3-Phase
PEE30.2	Bus	Under Voltage	11.000	kV	10.16	92.3	3-Phase
PEE70.1	Bus	Under Voltage	11.000	kV	10.42	94.7	3-Phase
PEE70.2	Bus	Under Voltage	11.000	kV	10.27	93.4	3-Phase
PEE70.3	Bus	Under Voltage	11.000	kV	10.27	93.4	3-Phase
PEE70.4	Bus	Under Voltage	11.000	kV	10.19	92.6	3-Phase
PEE70.5	Bus	Under Voltage	11.000	kV	10.14	92.2	3-Phase
PEE70.6	Bus	Under Voltage	11.000	kV	10.11	91.9	3-Phase
PEE70.7	Bus	Under Voltage	11.000	kV	10.10	91.8	3-Phase
PEE70.8	Bus	Under Voltage	11.000	kV	10.09	91.7	3-Phase
PEE70.9	Bus	Under Voltage	11.000	kV	10.10	91.8	3-Phase
PEE80.1	Bus	Under Voltage	11.000	kV	10.44	94.9	3-Phase
PEE80.2	Bus	Under Voltage	11.000	kV	10.43	94.8	3-Phase
Phatowog B1	Bus	Under Voltage	11.000	kV	10.15	92.3	3-Phase
Phatowog B2	Bus	Under Voltage	0.415	kV	0.36	86.3	3-Phase
Phatowog Tfr	Transformer	Overload	0.315	MVA	0.47	149.7	3-Phase
Phumtseri B2	Bus	Under Voltage	0.415	kV	0.39	94.7	3-Phase
Pmathang B2	Bus	Under Voltage	0.415	kV	0.38	91.9	3-Phase
Pmathang Tfr	Transformer	Overload	0.025	MVA	0.03	116.5	3-Phase
Potanal B1	Bus	Under Voltage	11.000	kV	10.10	91.8	3-Phase
Potanala B2	Bus	Under Voltage	0.415	kV	0.38	91.0	3-Phase
Pthang B2	Bus	Under Voltage	0.415	kV	0.39	92.9	3-Phase
R Court USS B2	Bus	Under Voltage	0.415	kV	0.38	91.2	3-Phase
R.Court USS B	Bus	Under Voltage	11.000	kV	10.16	92.3	3-Phase
R.Court USS B1	Bus	Under Voltage	11.000	kV	10.15	92.3	3-Phase
RashiGonpa B2	Bus	Under Voltage	0.415	kV	0.39	94.9	3-Phase
Rebati B2	Bus	Under Voltage	0.415	kV	0.39	93.7	3-Phase
Rebati Sch. B2	Bus	Under Voltage	0.415	kV	0.39	94.6	3-Phase
Relakpo B2	Bus	Under Voltage	0.415	kV	0.37	88.6	3-Phase

Critical Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
Relakpo Tfr	Transformer	Overload	0.030	MVA	0.060	201.5	3-Phase
Resinang B2	Bus	Under Voltage	0.415	kV	0.39	95.0	3-Phase
Rhaling B2	Bus	Under Voltage	0.415	kV	0.39	94.1	3-Phase
Rinchenthang B1	Bus	Under Voltage	11.000	kV	10.10	91.8	3-Phase
Rinchenthang B2	Bus	Under Voltage	0.415	kV	0.38	91.7	3-Phase
Shali B1	Bus	Under Voltage	11.000	kV	10.33	93.9	3-Phase
Shali B2	Bus	Under Voltage	0.415	kV	0.38	91.9	3-Phase
Shenari B2	Bus	Under Voltage	0.415	kV	0.37	88.8	3-Phase
Shenari Tfr	Transformer	Overload	0.063	MVA	0.14	224.5	3-Phase
Sherkhakpa B1	Bus	Under Voltage	11.000	kV	10.32	93.8	3-Phase
Sherkhakpa B2	Bus	Under Voltage	0.415	kV	0.38	92.3	3-Phase
Shingchuri B2	Bus	Under Voltage	0.415	kV	0.39	93.4	3-Phase
Shumar B1	Bus	Under Voltage	11.000	kV	10.34	94.0	3-Phase
Shumar B2	Bus	Under Voltage	0.415	kV	0.38	92.2	3-Phase
Shumar Thung B2	Bus	Under Voltage	0.415	kV	0.39	94.8	3-Phase
SMCL B1	Bus	Under Voltage	0.415	kV	0.37	89.8	3-Phase
Sonamthg B2	Bus	Under Voltage	0.415	kV	0.38	91.9	3-Phase
Sonamthg Tfr	Transformer	Overload	0.063	MVA	0.07	111.7	3-Phase
Stone Crusher B2	Bus	Under Voltage	0.415	kV	0.38	90.9	3-Phase
Stone Crusher Tfr	Transformer	Overload	0.500	MVA	0.71	141.3	3-Phase
Sub B2	Bus	Under Voltage	11.000	kV	10.36	94.2	3-Phase
Sub Main B1	Bus	Under Voltage	11.000	kV	10.44	94.9	3-Phase
Sub Main B2	Bus	Under Voltage	11.000	kV	10.44	94.9	3-Phase
Tanzaima B1	Bus	Under Voltage	11.000	kV	10.08	91.7	3-Phase
Tanzaima B2	Bus	Under Voltage	0.415	kV	0.37	89.2	3-Phase
Telung B2	Bus	Under Voltage	0.415	kV	0.38	90.7	3-Phase
Telung Tfr	Transformer	Overload	0.025	MVA	0.04	144.7	3-Phase
Tephu B2	Bus	Under Voltage	0.415	kV	0.39	94.1	3-Phase
Thinleygg B2	Bus	Under Voltage	0.415	kV	0.39	93.9	3-Phase
Thongsa B2	Bus	Under Voltage	0.415	kV	0.38	92.6	3-Phase
Thongsa Tfr	Transformer	Overload	0.063	MVA	0.08	126.7	3-Phase
Tokaphu B1	Bus	Under Voltage	11.000	kV	10.19	92.6	3-Phase
Tokaphu B2	Bus	Under Voltage	0.415	kV	0.38	92.5	3-Phase
Totpolung B1	Bus	Under Voltage	11.000	kV	10.33	93.9	3-Phase
Totpolung B2	Bus	Under Voltage	0.415	kV	0.38	92.3	3-Phase
Tsangtsiri B2	Bus	Under Voltage	0.415	kV	0.39	94.8	3-Phase

Critical Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
Tsebar B2	Bus	Under Voltage	0.415	kV	0.381	91.9	3-Phase
Tsebar Tfr	Transformer	Overload	0.063	MVA	0.09	143.6	3-Phase
Tshagtrie B2	Bus	Under Voltage	0.415	kV	0.38	91.5	3-Phase
Tshenkri B1	Bus	Under Voltage	11.000	kV	10.42	94.7	3-Phase
Tshenkri B2	Bus	Under Voltage	0.415	kV	0.38	91.3	3-Phase
Tskeri A.Crusher B2	Bus	Under Voltage	0.415	kV	0.39	94.3	3-Phase
U.Dezema B1	Bus	Under Voltage	11.000	kV	10.10	91.8	3-Phase
U.Dezema B2	Bus	Under Voltage	0.415	kV	0.38	91.2	3-Phase
U.Khar B2	Bus	Under Voltage	0.415	kV	0.38	92.3	3-Phase
U.Khar Tfr	Transformer	Overload	0.063	MVA	0.09	136.2	3-Phase
U.Kholomeri B2	Bus	Under Voltage	0.415	kV	0.39	94.5	3-Phase
U.Menchu B1	Bus	Under Voltage	11.000	kV	10.27	93.4	3-Phase
U.Menchu B2	Bus	Under Voltage	0.415	kV	0.39	92.8	3-Phase
U.Satshalo B1	Bus	Under Voltage	11.000	kV	10.09	91.7	3-Phase
U.Satshalo B2	Bus	Under Voltage	0.415	kV	0.37	89.7	3-Phase
U.Tshagtrie B1	Bus	Under Voltage	11.000	kV	10.14	92.2	3-Phase
U.Yangmalshg B2	Bus	Under Voltage	0.415	kV	0.39	94.2	3-Phase
Woongchilo B2	Bus	Under Voltage	0.415	kV	0.39	93.9	3-Phase
Yangkhar B2	Bus	Under Voltage	0.415	kV	0.39	93.4	3-Phase
Yangkhar TFr	Transformer	Overload	0.063	MVA	0.07	105.8	3-Phase
Yelchen B2	Bus	Under Voltage	0.415	kV	0.38	92.3	3-Phase
Yelchen CS B2	Bus	Under Voltage	0.415	kV	0.39	94.2	3-Phase
Yongla B2	Bus	Under Voltage	0.415	kV	0.39	94.2	3-Phase
Yurung BHU B2	Bus	Under Voltage	0.415	kV	0.38	91.8	3-Phase
Yurung BHU Tfr	Transformer	Overload	0.063	MVA	0.09	149.4	3-Phase

Marginal Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
Babta B1	Bus	Under Voltage	33.000	kV	31.774	96.3	3-Phase
Bainang Gonpa B1	Bus	Under Voltage	33.000	kV	32.13	97.4	3-Phase
Bar Gonpa B1	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
Bartseri B1	Bus	Under Voltage	33.000	kV	32.17	97.5	3-Phase
Bartseri B2	Bus	Under Voltage	0.415	kV	0.40	96.0	3-Phase
BCI Tfr	Transformer	Overload	0.750	MVA	0.71	95.1	3-Phase
Bedungri B1	Bus	Under Voltage	33.000	kV	31.84	96.5	3-Phase
Bedungri B2	Bus	Under Voltage	0.415	kV	0.40	95.2	3-Phase

Marginal Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
BHU Area B1	Bus	Under Voltage	33.000	kV	31.771	96.3	3-Phase
Bongdala B1	Bus	Under Voltage	33.000	kV	32.14	97.4	3-Phase
Bongdala B2	Bus	Under Voltage	0.415	kV	0.40	96.4	3-Phase
Bongman B1	Bus	Under Voltage	33.000	kV	32.14	97.4	3-Phase
Bongman B2	Bus	Under Voltage	0.415	kV	0.40	96.8	3-Phase
BorangChilo B1	Bus	Under Voltage	33.000	kV	32.19	97.5	3-Phase
Borangchilo B2	Bus	Under Voltage	0.415	kV	0.40	97.0	3-Phase
Borangm BHU B1	Bus	Under Voltage	33.000	kV	31.83	96.5	3-Phase
Borangm BHU B2	Bus	Under Voltage	0.415	kV	0.40	95.3	3-Phase
Borangmo2 B1	Bus	Under Voltage	33.000	kV	31.83	96.5	3-Phase
Branphu B1	Bus	Under Voltage	33.000	kV	31.70	96.1	3-Phase
Changarzampa B1	Bus	Under Voltage	33.000	kV	31.69	96.0	3-Phase
Chimung Sch. B1	Bus	Under Voltage	33.000	kV	32.13	97.4	3-Phase
Chimung Sch. B2	Bus	Under Voltage	0.415	kV	0.40	96.0	3-Phase
Chokhorling Sc. B1	Bus	Under Voltage	33.000	kV	31.72	96.1	3-Phase
Chokhorling1 B1	Bus	Under Voltage	33.000	kV	31.72	96.1	3-Phase
Chokhorling1 B2	Bus	Under Voltage	0.415	kV	0.40	95.4	3-Phase
Chokhorling2 B1	Bus	Under Voltage	33.000	kV	31.72	96.1	3-Phase
Chokhorling3 B1	Bus	Under Voltage	33.000	kV	31.72	96.1	3-Phase
Chokhorling3 B2	Bus	Under Voltage	0.415	kV	0.40	95.8	3-Phase
Chshing Gonpa B1	Bus	Under Voltage	33.000	kV	32.09	97.3	3-Phase
Chshing Gonpa B2	Bus	Under Voltage	0.415	kV	0.40	95.2	3-Phase
Chungkhar B1	Bus	Under Voltage	33.000	kV	32.08	97.2	3-Phase
Chungkhar B2	Bus	Under Voltage	0.415	kV	0.40	95.7	3-Phase
DaiGonpa B1	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
DaiGonpa B2	Bus	Under Voltage	0.415	kV	0.40	96.1	3-Phase
Dalung B1	Bus	Under Voltage	33.000	kV	31.69	96.0	3-Phase
DCCL B1	Bus	Under Voltage	33.000	kV	31.94	96.8	3-Phase
DCCL B2	Bus	Under Voltage	0.415	kV	0.40	96.0	3-Phase
Denchi Lkhang B1	Bus	Under Voltage	33.000	kV	32.17	97.5	3-Phase
Denchi Lkhang B2	Bus	Under Voltage	0.415	kV	0.40	95.3	3-Phase
Denchi SS B1	Bus	Under Voltage	33.000	kV	32.16	97.5	3-Phase
Denchi SS B2	Bus	Under Voltage	11.000	kV	10.72	97.5	3-Phase
Druk Gy B2	Bus	Under Voltage	0.415	kV	0.39	95.1	3-Phase
Druk Gyp B1	Bus	Under Voltage	33.000	kV	31.73	96.1	3-Phase
Dungchilo B1	Bus	Under Voltage	33.000	kV	31.76	96.2	3-Phase

Marginal Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
Dungchilo B2	Bus	Under Voltage	0.415	kV	0.397	95.7	3-Phase
Dungchilopam B1	Bus	Under Voltage	33.000	kV	31.76	96.2	3-Phase
Dungchilopam B2	Bus	Under Voltage	0.415	kV	0.40	95.4	3-Phase
Dungkar Lkhang B1	Bus	Under Voltage	33.000	kV	32.14	97.4	3-Phase
Dungkar Lkhang B2	Bus	Under Voltage	0.415	kV	0.40	97.0	3-Phase
Dungmin I B1	Bus	Under Voltage	33.000	kV	32.09	97.2	3-Phase
Dungmin III B1	Bus	Under Voltage	33.000	kV	32.09	97.2	3-Phase
Durungree B1	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
Dzong B1	Bus	Under Voltage	11.000	kV	10.63	96.6	3-Phase
Dzong B2	Bus	Under Voltage	0.415	kV	0.40	95.2	3-Phase
Galabi B1	Bus	Under Voltage	33.000	kV	31.71	96.1	3-Phase
Gangtong B1	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
Gangtong B2	Bus	Under Voltage	0.415	kV	0.40	96.0	3-Phase
Gasharibali.A B1	Bus	Under Voltage	33.000	kV	31.76	96.2	3-Phase
Gasharibali.A B2	Bus	Under Voltage	0.415	kV	0.40	95.5	3-Phase
Gayri B1	Bus	Under Voltage	33.000	kV	31.72	96.1	3-Phase
Gayri B2	Bus	Under Voltage	0.415	kV	0.39	95.2	3-Phase
Gbrangsa B1	Bus	Under Voltage	33.000	kV	32.13	97.4	3-Phase
Gbrangsa B2	Bus	Under Voltage	0.415	kV	0.40	95.5	3-Phase
GO Khar B1	Bus	Under Voltage	33.000	kV	32.12	97.3	3-Phase
GO Khar B2	Bus	Under Voltage	0.415	kV	0.40	96.4	3-Phase
Gomtshang B1	Bus	Under Voltage	33.000	kV	32.14	97.4	3-Phase
Gomtshang B2	Bus	Under Voltage	0.415	kV	0.40	97.0	3-Phase
GonpaSingma B1	Bus	Under Voltage	33.000	kV	31.93	96.7	3-Phase
Gonpawong B1	Bus	Under Voltage	33.000	kV	31.77	96.3	3-Phase
Guyum B1	Bus	Under Voltage	33.000	kV	32.16	97.5	3-Phase
Guyum B2	Bus	Under Voltage	0.415	kV	0.40	96.4	3-Phase
Hospital B1	Bus	Under Voltage	11.000	kV	10.63	96.6	3-Phase
Hospital B2	Bus	Under Voltage	0.415	kV	0.40	96.5	3-Phase
Jirang B1	Bus	Under Voltage	33.000	kV	31.70	96.1	3-Phase
Kerong Sch. B1	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
Khaimma B1	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
Khengzor B1	Bus	Under Voltage	33.000	kV	32.11	97.3	3-Phase
Khengzor B2	Bus	Under Voltage	0.415	kV	0.40	96.8	3-Phase
Khengzor I B1	Bus	Under Voltage	33.000	kV	32.11	97.3	3-Phase
Khengzor I B2	Bus	Under Voltage	0.415	kV	0.40	96.2	3-Phase

Marginal Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
Khengzor II B1	Bus	Under Voltage	33.000	kV	32.107	97.3	3-Phase
Khengzor II B2	Bus	Under Voltage	0.415	kV	0.40	96.5	3-Phase
Kheri Gonpa B1	Bus	Under Voltage	33.000	kV	32.08	97.2	3-Phase
Kheydung B1	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
Kheydung B2	Bus	Under Voltage	0.415	kV	0.40	95.8	3-Phase
Khonmari B	Bus	Under Voltage	33.000	kV	31.93	96.7	3-Phase
Khonmari III B1	Bus	Under Voltage	33.000	kV	31.88	96.6	3-Phase
Khonmari IV B1	Bus	Under Voltage	33.000	kV	31.88	96.6	3-Phase
Khoripam B1	Bus	Under Voltage	11.000	kV	10.63	96.6	3-Phase
Khoripam B2	Bus	Under Voltage	0.415	kV	0.40	95.8	3-Phase
Khotakpa B1	Bus	Under Voltage	33.000	kV	32.17	97.5	3-Phase
Khotakpa B2	Bus	Under Voltage	0.415	kV	0.40	95.8	3-Phase
Khulngdrng B1	Bus	Under Voltage	33.000	kV	31.82	96.4	3-Phase
Kulung B1	Bus	Under Voltage	33.000	kV	31.68	96.0	3-Phase
L.Bangyul B1	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
L.Chiphung B1	Bus	Under Voltage	33.000	kV	32.13	97.4	3-Phase
L.Chiphung B2	Bus	Under Voltage	0.415	kV	0.40	96.7	3-Phase
L.Chshing B1	Bus	Under Voltage	33.000	kV	32.09	97.2	3-Phase
L.Chshing B2	Bus	Under Voltage	0.415	kV	0.40	97.0	3-Phase
L.Khangma B1	Bus	Under Voltage	33.000	kV	32.16	97.5	3-Phase
L.Khar B1	Bus	Under Voltage	33.000	kV	32.14	97.4	3-Phase
L.Khnadang B1	Bus	Under Voltage	33.000	kV	32.07	97.2	3-Phase
L.Khnadang B2	Bus	Under Voltage	0.415	kV	0.40	96.4	3-Phase
L.Kholomeri B1	Bus	Under Voltage	33.000	kV	31.76	96.2	3-Phase
L.Nmalam B1	Bus	Under Voltage	33.000	kV	31.92	96.7	3-Phase
L.Nmalam B2	Bus	Under Voltage	0.415	kV	0.40	95.7	3-Phase
L.Pthang B1	Bus	Under Voltage	33.000	kV	32.14	97.4	3-Phase
L.Yangmalshg B1	Bus	Under Voltage	33.000	kV	31.75	96.2	3-Phase
Labar B1	Bus	Under Voltage	33.000	kV	32.11	97.3	3-Phase
Labar B2	Bus	Under Voltage	0.415	kV	0.40	96.4	3-Phase
Laling B1	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
Laling B2	Bus	Under Voltage	0.415	kV	0.39	95.1	3-Phase
Lanangzor B1	Bus	Under Voltage	33.000	kV	32.17	97.5	3-Phase
Laneri Sch. B1	Bus	Under Voltage	33.000	kV	32.08	97.2	3-Phase
Laneri Sch. B2	Bus	Under Voltage	0.415	kV	0.40	96.8	3-Phase
Lasheringri B1	Bus	Under Voltage	33.000	kV	31.77	96.3	3-Phase

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Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
Lasheringri B2	Bus	Under Voltage	0.415	kV	0.397	95.6	3-Phase
Lashingrie B1	Bus	Under Voltage	33.000	kV	31.77	96.3	3-Phase
Lawoong B1	Bus	Under Voltage	33.000	kV	32.14	97.4	3-Phase
M.Banyul B1	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
Maan B1	Bus	Under Voltage	33.000	kV	31.81	96.4	3-Phase
Maan B2	Bus	Under Voltage	0.415	kV	0.40	96.0	3-Phase
Maendi B1	Bus	Under Voltage	33.000	kV	32.14	97.4	3-Phase
Maendi B2	Bus	Under Voltage	0.415	kV	0.40	96.5	3-Phase
Marangdth B1	Bus	Under Voltage	33.000	kV	31.71	96.1	3-Phase
Martsala B1	Bus	Under Voltage	33.000	kV	31.77	96.3	3-Phase
Mekuri B1	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
Mekuri Sch. B1	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
Mongling B1	Bus	Under Voltage	33.000	kV	31.96	96.8	3-Phase
Mukazor B1	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
Mukazor B2	Bus	Under Voltage	0.415	kV	0.40	95.4	3-Phase
Nachubander B1	Bus	Under Voltage	33.000	kV	31.77	96.3	3-Phase
Nalung B1	Bus	Under Voltage	33.000	kV	31.69	96.0	3-Phase
Namdeling B1	Bus	Under Voltage	33.000	kV	31.77	96.3	3-Phase
Namdeling B2	Bus	Under Voltage	0.415	kV	0.40	95.3	3-Phase
Nangkor SS B2	Bus	Under Voltage	33.000	kV	32.19	97.6	3-Phase
Nanong B1	Bus	Under Voltage	33.000	kV	31.68	96.0	3-Phase
Nganglam SS B2	Bus	Under Voltage	33.000	kV	31.95	96.8	3-Phase
Ngatseri B1	Bus	Under Voltage	33.000	kV	32.10	97.3	3-Phase
Ngatseri B2	Bus	Under Voltage	0.415	kV	0.40	95.9	3-Phase
Norbaii B1	Bus	Under Voltage	33.000	kV	31.77	96.3	3-Phase
Norbugang B1	Bus	Under Voltage	33.000	kV	31.77	96.3	3-Phase
Norbugang B2	Bus	Under Voltage	0.415	kV	0.40	95.7	3-Phase
NS Borang B1	Bus	Under Voltage	33.000	kV	31.80	96.4	3-Phase
NS Borang Tfr	Transformer	Overload	0.025	MVA	0.02	96.0	3-Phase
Nshing Lkhang B1	Bus	Under Voltage	33.000	kV	31.77	96.3	3-Phase
Pangbang B1	Bus	Under Voltage	33.000	kV	31.71	96.1	3-Phase
PEE10.1	Bus	Under Voltage	11.000	kV	10.66	96.9	3-Phase
PEE10.2	Bus	Under Voltage	11.000	kV	10.66	96.9	3-Phase
PEE10.3	Bus	Under Voltage	11.000	kV	10.63	96.6	3-Phase
PEE100.1	Bus	Under Voltage	33.000	kV	31.90	96.7	3-Phase
PEE100.10	Bus	Under Voltage	33.000	kV	31.77	96.3	3-Phase

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Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
PEE100.11	Bus	Under Voltage	33.000	kV	31.768	96.3	3-Phase
PEE100.12	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
PEE100.13	Bus	Under Voltage	33.000	kV	31.71	96.1	3-Phase
PEE100.14	Bus	Under Voltage	33.000	kV	31.71	96.1	3-Phase
PEE100.15	Bus	Under Voltage	33.000	kV	31.71	96.1	3-Phase
PEE100.16	Bus	Under Voltage	33.000	kV	31.70	96.1	3-Phase
PEE100.17	Bus	Under Voltage	33.000	kV	31.69	96.0	3-Phase
PEE100.18	Bus	Under Voltage	33.000	kV	31.69	96.0	3-Phase
PEE100.2	Bus	Under Voltage	33.000	kV	31.83	96.5	3-Phase
PEE100.3	Bus	Under Voltage	33.000	kV	31.83	96.5	3-Phase
PEE100.7	Bus	Under Voltage	33.000	kV	31.80	96.4	3-Phase
PEE100.9	Bus	Under Voltage	33.000	kV	31.77	96.3	3-Phase
PEE110.1	Bus	Under Voltage	33.000	kV	31.84	96.5	3-Phase
PEE110.2	Bus	Under Voltage	33.000	kV	31.76	96.2	3-Phase
PEE40.1	Bus	Under Voltage	33.000	kV	32.08	97.2	3-Phase
PEE40.10	Bus	Under Voltage	33.000	kV	31.80	96.4	3-Phase
PEE40.11	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
PEE40.12	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
PEE40.13	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
PEE40.14	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
PEE40.15	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
PEE40.16	Bus	Under Voltage	33.000	kV	31.72	96.1	3-Phase
PEE40.17	Bus	Under Voltage	33.000	kV	31.71	96.1	3-Phase
PEE40.18	Bus	Under Voltage	33.000	kV	31.70	96.1	3-Phase
PEE40.19	Bus	Under Voltage	33.000	kV	31.69	96.0	3-Phase
PEE40.2	Bus	Under Voltage	33.000	kV	32.08	97.2	3-Phase
PEE40.20	Bus	Under Voltage	33.000	kV	31.68	96.0	3-Phase
PEE40.21	Bus	Under Voltage	33.000	kV	31.68	96.0	3-Phase
PEE40.3	Bus	Under Voltage	33.000	kV	32.08	97.2	3-Phase
PEE40.4	Bus	Under Voltage	33.000	kV	32.08	97.2	3-Phase
PEE40.5	Bus	Under Voltage	33.000	kV	32.03	97.1	3-Phase
PEE40.6	Bus	Under Voltage	33.000	kV	31.96	96.8	3-Phase
PEE40.7	Bus	Under Voltage	33.000	kV	31.93	96.7	3-Phase
PEE40.8	Bus	Under Voltage	33.000	kV	31.92	96.7	3-Phase
PEE40.9	Bus	Under Voltage	33.000	kV	31.82	96.4	3-Phase
PEE50.1	Bus	Under Voltage	33.000	kV	32.17	97.5	3-Phase

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Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
PEE50.10	Bus	Under Voltage	33.000	kV	32.110	97.3	3-Phase
PEE50.11	Bus	Under Voltage	33.000	kV	32.11	97.3	3-Phase
PEE50.12	Bus	Under Voltage	33.000	kV	32.10	97.3	3-Phase
PEE50.13	Bus	Under Voltage	33.000	kV	32.10	97.3	3-Phase
PEE50.14	Bus	Under Voltage	33.000	kV	32.10	97.3	3-Phase
PEE50.15	Bus	Under Voltage	33.000	kV	32.09	97.2	3-Phase
PEE50.16	Bus	Under Voltage	33.000	kV	32.09	97.2	3-Phase
PEE50.2	Bus	Under Voltage	33.000	kV	32.17	97.5	3-Phase
PEE50.21	Bus	Under Voltage	33.000	kV	32.09	97.2	3-Phase
PEE50.22	Bus	Under Voltage	33.000	kV	32.09	97.2	3-Phase
PEE50.23	Bus	Under Voltage	33.000	kV	32.09	97.2	3-Phase
PEE50.25	Bus	Under Voltage	33.000	kV	32.08	97.2	3-Phase
PEE50.26	Bus	Under Voltage	33.000	kV	32.08	97.2	3-Phase
PEE50.3	Bus	Under Voltage	33.000	kV	32.15	97.4	3-Phase
PEE50.4	Bus	Under Voltage	33.000	kV	32.14	97.4	3-Phase
PEE50.5	Bus	Under Voltage	33.000	kV	32.14	97.4	3-Phase
PEE50.6	Bus	Under Voltage	33.000	kV	32.14	97.4	3-Phase
PEE50.7	Bus	Under Voltage	33.000	kV	32.14	97.4	3-Phase
PEE50.8	Bus	Under Voltage	33.000	kV	32.12	97.3	3-Phase
PEE50.9	Bus	Under Voltage	33.000	kV	32.11	97.3	3-Phase
PEE60.1	Bus	Under Voltage	33.000	kV	32.17	97.5	3-Phase
PEE60.11	Bus	Under Voltage	33.000	kV	32.13	97.4	3-Phase
PEE60.12	Bus	Under Voltage	33.000	kV	32.13	97.4	3-Phase
PEE60.13	Bus	Under Voltage	33.000	kV	32.13	97.4	3-Phase
PEE60.14	Bus	Under Voltage	33.000	kV	32.13	97.4	3-Phase
PEE60.15	Bus	Under Voltage	33.000	kV	32.17	97.5	3-Phase
PEE60.2	Bus	Under Voltage	33.000	kV	32.16	97.5	3-Phase
PEE60.3	Bus	Under Voltage	33.000	kV	32.14	97.4	3-Phase
PEE60.5	Bus	Under Voltage	33.000	kV	32.14	97.4	3-Phase
PEE60.6	Bus	Under Voltage	33.000	kV	32.14	97.4	3-Phase
PEE60.7	Bus	Under Voltage	33.000	kV	32.13	97.4	3-Phase
PEE90.1	Bus	Under Voltage	33.000	kV	31.89	96.6	3-Phase
PEE90.11	Bus	Under Voltage	33.000	kV	31.72	96.1	3-Phase
PEE90.12	Bus	Under Voltage	33.000	kV	31.72	96.1	3-Phase
PEE90.13	Bus	Under Voltage	33.000	kV	31.72	96.1	3-Phase
PEE90.16	Bus	Under Voltage	33.000	kV	31.72	96.1	3-Phase

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Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
PEE90.17	Bus	Under Voltage	33.000	kV	31.772	96.3	3-Phase
PEE90.18	Bus	Under Voltage	33.000	kV	31.77	96.3	3-Phase
PEE90.19	Bus	Under Voltage	33.000	kV	31.77	96.3	3-Phase
PEE90.2	Bus	Under Voltage	33.000	kV	31.84	96.5	3-Phase
PEE90.20	Bus	Under Voltage	33.000	kV	31.76	96.2	3-Phase
PEE90.22	Bus	Under Voltage	33.000	kV	31.76	96.2	3-Phase
PEE90.23	Bus	Under Voltage	33.000	kV	31.75	96.2	3-Phase
PEE90.24	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
PEE90.25	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
PEE90.26	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
PEE90.27	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
PEE90.28	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
PEE90.29	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
PEE90.3	Bus	Under Voltage	33.000	kV	31.78	96.3	3-Phase
PEE90.4	Bus	Under Voltage	33.000	kV	31.78	96.3	3-Phase
PEE90.5	Bus	Under Voltage	33.000	kV	31.77	96.3	3-Phase
PEE90.6	Bus	Under Voltage	33.000	kV	31.77	96.3	3-Phase
PEE90.7	Bus	Under Voltage	33.000	kV	31.75	96.2	3-Phase
PEE90.8	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
PEE90.9	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
Pemathang B1	Bus	Under Voltage	33.000	kV	31.77	96.3	3-Phase
Phadi B1	Bus	Under Voltage	33.000	kV	32.10	97.3	3-Phase
Phadi B2	Bus	Under Voltage	0.415	kV	0.40	96.2	3-Phase
Phakpalu B1	Bus	Under Voltage	33.000	kV	32.16	97.5	3-Phase
Phakpalu B2	Bus	Under Voltage	0.415	kV	0.40	96.0	3-Phase
Phumtseri B1	Bus	Under Voltage	33.000	kV	32.14	97.4	3-Phase
Phungshrang B1	Bus	Under Voltage	33.000	kV	31.78	96.3	3-Phase
PMSS B1	Bus	Under Voltage	11.000	kV	10.63	96.6	3-Phase
PMSS B2	Bus	Under Voltage	0.415	kV	0.40	95.8	3-Phase
Pthang B1	Bus	Under Voltage	33.000	kV	31.68	96.0	3-Phase
Pthang Daza B1	Bus	Under Voltage	33.000	kV	32.03	97.0	3-Phase
Pthang Daza B2	Bus	Under Voltage	0.415	kV	0.40	95.7	3-Phase
R.Manas.P 1	Bus	Under Voltage	33.000	kV	31.70	96.1	3-Phase
R.Manas.P 2	Bus	Under Voltage	33.000	kV	31.70	96.1	3-Phase
R.Manas.P 3	Bus	Under Voltage	33.000	kV	31.70	96.1	3-Phase
R.Manas.P 4	Bus	Under Voltage	33.000	kV	31.69	96.0	3-Phase

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Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
R.Manas.P 5	Bus	Under Voltage	0.415	kV	0.395	95.2	3-Phase
Raegi B1	Bus	Under Voltage	33.000	kV	32.14	97.4	3-Phase
Raegi B2	Bus	Under Voltage	0.415	kV	0.40	97.0	3-Phase
Rashi Gonpa B1	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
Rayzor B1	Bus	Under Voltage	33.000	kV	31.70	96.1	3-Phase
Rayzor B2	Bus	Under Voltage	0.415	kV	0.40	95.7	3-Phase
Rebati B1	Bus	Under Voltage	33.000	kV	31.69	96.0	3-Phase
Rebati Sch. B1	Bus	Under Voltage	33.000	kV	31.69	96.0	3-Phase
Relakpo B1	Bus	Under Voltage	33.000	kV	31.76	96.3	3-Phase
Resinang B1	Bus	Under Voltage	33.000	kV	31.88	96.6	3-Phase
Rhaling B1	Bus	Under Voltage	33.000	kV	31.69	96.0	3-Phase
Shenari B1	Bus	Under Voltage	33.000	kV	32.11	97.3	3-Phase
Shingchuri B1	Bus	Under Voltage	33.000	kV	31.77	96.3	3-Phase
Shumar Jug B1	Bus	Under Voltage	33.000	kV	32.08	97.2	3-Phase
Shumar Jug B2	Bus	Under Voltage	0.415	kV	0.40	95.9	3-Phase
Shumar Thung B1	Bus	Under Voltage	33.000	kV	32.08	97.2	3-Phase
Sonamthg B1	Bus	Under Voltage	33.000	kV	31.71	96.1	3-Phase
Stone Crusher B1	Bus	Under Voltage	33.000	kV	31.76	96.2	3-Phase
Sub B1	Bus	Under Voltage	11.000	kV	10.67	97.0	3-Phase
TCom B1	Bus	Under Voltage	11.000	kV	10.66	96.9	3-Phase
TCom B2	Bus	Under Voltage	0.415	kV	0.40	96.8	3-Phase
Telung B1	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
Tephu B1	Bus	Under Voltage	33.000	kV	31.71	96.1	3-Phase
Thinleygg B1	Bus	Under Voltage	33.000	kV	31.72	96.1	3-Phase
Thongknang B1	Bus	Under Voltage	33.000	kV	32.07	97.2	3-Phase
Thongsa B1	Bus	Under Voltage	33.000	kV	32.14	97.4	3-Phase
Thungo B1	Bus	Under Voltage	33.000	kV	32.14	97.4	3-Phase
Thungo B2	Bus	Under Voltage	0.415	kV	0.39	95.0	3-Phase
Tsangtsiri B1	Bus	Under Voltage	11.000	kV	10.63	96.6	3-Phase
Tsebar B1	Bus	Under Voltage	33.000	kV	32.10	97.3	3-Phase
Tshelingore B1	Bus	Under Voltage	33.000	kV	31.83	96.4	3-Phase
Tshelingore B2	Bus	Under Voltage	0.415	kV	0.40	95.7	3-Phase
Tshobalay B1	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
TshoGonpa B1	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
TshoGonpa B2	Bus	Under Voltage	0.415	kV	0.40	95.5	3-Phase
Tskeri A.Workshp B2	Bus	Under Voltage	0.415	kV	0.39	95.1	3-Phase

Marginal Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
Tskeri.A.Crusher B1	Bus	Under Voltage	33.000	kV	31.781	96.3	3-Phase
Tskeri.A.Workshp B1	Bus	Under Voltage	33.000	kV	31.77	96.3	3-Phase
Tungudpa B1	Bus	Under Voltage	33.000	kV	31.70	96.1	3-Phase
Tungudpa B2	Bus	Under Voltage	0.415	kV	0.40	95.3	3-Phase
U.Banyul B1	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
U.Chshing B1	Bus	Under Voltage	33.000	kV	32.09	97.2	3-Phase
U.Chshing B2	Bus	Under Voltage	0.415	kV	0.40	96.2	3-Phase
U.Khangma B1	Bus	Under Voltage	33.000	kV	32.16	97.5	3-Phase
U.Khangma B2	Bus	Under Voltage	0.415	kV	0.40	96.1	3-Phase
U.Khar B1	Bus	Under Voltage	33.000	kV	32.14	97.4	3-Phase
U.Khnadang B1	Bus	Under Voltage	33.000	kV	32.07	97.2	3-Phase
U.Khnadang B2	Bus	Under Voltage	0.415	kV	0.40	95.6	3-Phase
U.Kholomeri B1	Bus	Under Voltage	33.000	kV	31.76	96.2	3-Phase
U.Mekuri B1	Bus	Under Voltage	33.000	kV	31.74	96.2	3-Phase
U.Nangkor B2	Bus	Under Voltage	0.415	kV	0.40	95.3	3-Phase
U.Nangkor B1	Bus	Under Voltage	11.000	kV	10.66	96.9	3-Phase
U.Nmalam B1	Bus	Under Voltage	33.000	kV	31.92	96.7	3-Phase
U.Nmalam B2	Bus	Under Voltage	0.415	kV	0.39	95.2	3-Phase
U.Nyaskar B1	Bus	Under Voltage	33.000	kV	32.13	97.4	3-Phase
U.Pthang B1	Bus	Under Voltage	33.000	kV	32.14	97.4	3-Phase
U.Yangmalshg B1	Bus	Under Voltage	33.000	kV	31.75	96.2	3-Phase
Umdang B1	Bus	Under Voltage	33.000	kV	31.77	96.3	3-Phase
Umdang B2	Bus	Under Voltage	0.415	kV	0.40	95.2	3-Phase
Weling B1	Bus	Under Voltage	33.000	kV	32.13	97.4	3-Phase
Wololtang B1	Bus	Under Voltage	33.000	kV	31.80	96.4	3-Phase
Wooltang B2	Bus	Under Voltage	0.415	kV	0.40	95.5	3-Phase
Woongchilo B1	Bus	Under Voltage	33.000	kV	31.71	96.1	3-Phase
Y.Maan B1	Bus	Under Voltage	33.000	kV	32.18	97.5	3-Phase
Y.Maan B2	Bus	Under Voltage	0.415	kV	0.40	95.3	3-Phase
Yalang B1	Bus	Under Voltage	33.000	kV	32.17	97.5	3-Phase
Yalang B2	Bus	Under Voltage	0.415	kV	0.40	95.3	3-Phase
Yangkhar B1	Bus	Under Voltage	33.000	kV	32.14	97.4	3-Phase
Yelchen B1	Bus	Under Voltage	33.000	kV	31.69	96.0	3-Phase
Yelchen CS B1	Bus	Under Voltage	33.000	kV	31.68	96.0	3-Phase
Yelchen Tfr	Transformer	Overload	0.063	MVA	0.06	97.2	3-Phase
Yomzor B1	Bus	Under Voltage	33.000	kV	32.10	97.3	3-Phase

Marginal Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
Yomzor B2	Bus	Under Voltage	0.415	kV	0.396	95.3	3-Phase
Yongla B1	Bus	Under Voltage	33.000	kV	31.96	96.8	3-Phase
Yurung BHU B1	Bus	Under Voltage	33.000	kV	32.15	97.4	3-Phase
Zero Pt. B1	Bus	Under Voltage	11.000	kV	10.64	96.7	3-Phase
Zero Pt. B2	Bus	Under Voltage	0.415	kV	0.40	95.5	3-Phase
Zhingri B1	Bus	Under Voltage	33.000	kV	31.68	96.0	3-Phase
Zhingri B2	Bus	Under Voltage	0.415	kV	0.40	95.9	3-Phase
Zobel B1	Bus	Under Voltage	33.000	kV	31.92	96.7	3-Phase
Zobel B2	Bus	Under Voltage	0.415	kV	0.40	95.8	3-Phase
Zordug B1	Bus	Under Voltage	33.000	kV	32.11	97.3	3-Phase
Zordug B2	Bus	Under Voltage	0.415	kV	0.40	97.2	3-Phase

SUMMARY OF TOTAL GENERATION , LOADING & DEMAND

	MW	Mvar	MVA	% PF
Source (Swing Buses):	9.049	5.669	10.678	84.74 Lagging
Source (Non-Swing Buses):	0.000	0.000	0.000	
Total Demand:	9.049	5.669	10.678	84.74 Lagging
Total Motor Load:	2.432	1.507	2.862	85.00 Lagging
Total Static Load:	6.297	3.902	7.408	85.00 Lagging
Total Constant I Load:	0.000	0.000	0.000	
Total Generic Load:	0.000	0.000	0.000	
Apparent Losses:	0.320	0.259		
System Mismatch:	0.000	0.000		

Number of Iterations: 3

Annexure 5: Feeder Wise Reliability Indices

A.132/33/11kV Nangkor SS

Feeder Name: 33kV Nanong Feeder

Sl. No.	Cause of Outages	Frequency of Interuption (Times)																									
		2018													2019												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	HT fuse Replace	4	3	5	3	3	2		5	2	1	1		**29**	1	2		5	1	3	6	3	4	2	2	3	**32**
2	Line Jumpering										1			**1**	1			2							1	2	**6**
3	Collaps of Pole-Breakdown																										
4	Snap of Conductor						2							**2**													
5	Puncture of insulator/Leakage																										
6	Puncture of LA/LA Maintenance																	1			2				1		**4**
7	Ligtining & Strom/Rain			2	3									**5**			2	3									**5**
8	Tree/branch fall on line			1				3		1	1	3		**9**	1	1				1	3	1		3	1	1	**12**
9	RoW Clearing		1			1	2		1			1		**6**			3	7			1	2				1	**14**
10	Land Slide																										
11	Forest fire																										
12	Preventive Maintenance of Line/LBS/GO/ARCB		6			1	1					1		**9**	1				1	1	1			2			**6**
13	Preventive Maintenance of substation/Switchyard																					1					**1**
14	Breakdown Maintenance of Line/LBS/GO/ARCB				1									**1**													
15	Breakdown Maintenance of Substation/Switchyard																										
16	SMD Planned shutdown																										
17	Adhoc Shutdown (Tapping, Emergency request)								1					**1**											1		**1**
18	Momentary/Traisent fault			1	2					3	2		1	**9**		2	2			7		1					**12**
19	Trace of fault on line																						1				**1**
20	Because of Bird/Animals						1							**1**								1					**1**
21	Close and Open of GO/LBS										2			**2**													
	SAIFI	**4.000**	**3.430**	**1.980**	**2.200**	**1.360**	**2.380**	**1.020**	**2.380**	**2.040**	**2.440**	**2.050**	**0.340**		**0.000**	**2.300**	**2.220**	**5.760**	**0.660**	**4.070**	**4.410**	**3.060**	**1.710**	**2.390**	**2.060**	**2.400**	
	SAIDI	**0.290**	**1.750**	**3.850**	**0.560**	**0.540**	**10.760**	**0.200**	**0.840**	**0.900**	**1.480**	**0.560**	**0.020**		**0.000**	**0.630**	**1.680**	**4.410**	**0.230**	**1.680**	**5.290**	**2.340**	**2.350**	**5.490**	**5.300**	**1.540**	

Feeder Name: 33kV Tshebar Feeder

Sl. No.	Cause of Outages	Frequency of Interuption (Times)																									
		2018													2019												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	HT fuse Replace				1		3		1	1	2			**8**			1			2				1	1		**5**
2	Line Jumpering										1			**1**			1										**1**
3	Collaps of Pole-Breakdown																										
4	Snap of Conductor						3			1				**4**													
5	Puncture of insulator/Leakage		1											**1**													
6	Puncture of LA/LA Maintenance																					1					**1**
7	Ligtining & Strom/Rain			2	1			1		1				**5**			2		2	1							**5**
8	Tree/branch fall on line	1			2	13			2	1	2	4	1	**26**		1				2	1	2	1	1	2	1	**11**
9	RoW Clearing						2		1		1			**4**				2	1			1					**4**
10	Land Slide																										
11	Forest fire	1												**1**													
12	Preventive Maintenance of Line/LBS/GO/ARCB				1		1							**2**				1	1		1					2	**5**
13	Preventive Maintenance of substation/Switchyard			1										**1**		1											**1**

14	Breakdown Maintenance of Line/LBS/GO/ARCB																										
15	Breakdown Maintenance of Substation/Switchyard																										
16	SMD Planned shutdown																				1							**1**
17	Adhoc Shutdown (Tapping, Emergency request)				1							2	1	**4**	1								3	1			**5**
18	Momentary/Traisent fault			1		2	3			5	8		1	**20**					3	9	1	3			2		**18**
19	Trace of fault on line																										
20	Because of Bird/Animals																			1	1	1	2				**5**
21	Close and Open of GO/LBS					1					1		1	**3**													
	SAIFI	**0.580**	**0.290**	**0.750**	**1.130**	**4.550**	**3.410**	**0.290**	**0.580**	**2.600**	**4.290**	**1.740**	**1.150**		**0.290**	**0.570**	**1.150**	**0.860**	**2.020**	**4.030**	**1.150**	**2.300**	**1.900**	**0.820**	**1.360**	**0.340**	
	SAIDI	**0.370**	**0.460**	**0.290**	**1.350**	**4.980**	**10.740**	**3.620**	**0.510**	**1.160**	**1.440**	**0.200**	**2.030**		**0.110**	**1.090**	**1.620**	**3.490**	**1.790**	**3.340**	**2.800**	**7.480**	**6.870**	**2.130**	**1.070**	**1.450**	
		2	1	4	6	16	12	1	4	9	15	6	4	80													

Feeder Name: 33kV Yurung Feeder

Sl. No.	Cause of Outages	Frequency of Interuption (Times)																									
		2018													**2019**												
		Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
1	HT fuse Replace			4		2	3		1			1		**11**			1		2	4				2			**9**
2	Line Jumpering									1				**1**						1							**1**
3	Collaps of Pole-Breakdown																										
4	Snap of Conductor								1					**1**													
5	Puncture of insulator/Leakage							3	2					**5**													
6	Puncture of LA/LA Maintenance																										
7	Ligtining & Strom/Rain			1										**1**			1		1	3							**5**
8	Tree/branch fall on line				1			1		1		1		**4**		1	1					2					**4**
9	RoW Clearing						1			1	1	1		**4**				3	2			1					**6**
10	Land Slide																										
11	Forest fire			1										**1**													
12	Preventive Maintenance of Line/LBS/GO/ARCB														1		1	1	1	1							**5**
13	Preventive Maintenance of substation/Switchyard																		2								**2**
14	Breakdown Maintenance of Line/LBS/GO/ARCB																										
15	Breakdown Maintenance of Substation/Switchyard		1											**1**													
16	SMD Planned shutdown																										
17	Adhoc Shutdown (Tapping, Emergency request)																								1		**1**
18	Momentary/Traisent fault									2	2			**4**						5		1					**6**
19	Trace of fault on line																										
20	Because of Bird/Animals																				1						**1**
21	Close and Open of GO/LBS																										
	SAIFI	**0.000**	**0.150**	**0.760**	**0.100**	**0.160**	**0.640**	**0.640**	**0.320**	**0.320**	**0.310**	**0.320**	**0.000**		**0.000**	**0.160**	**0.630**	**0.640**	**1.280**	**2.250**	**0.160**	**0.480**	**0.000**	**0.160**	**0.160**	**0.000**	
	SAIDI	**0.000**	**0.080**	**0.120**	**0.050**	**0.020**	**0.410**	**1.790**	**3.570**	**3.930**	**3.570**	**1.440**	**0.000**		**0.300**	**0.570**	**0.640**	**4.350**	**1.770**	**2.000**	**0.120**	**0.310**	**0.000**	**0.070**	**0.130**	**0.000**	

Feeder Name: 11kV Nangkor Feeder

Sl. No.	Cause of Outages	Frequency of Interuption (Times)																									
		2018													**2019**												
		Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
1	HT fuse Replace	1		5	1	1	10	5	3			1		**27**		1	1	4	2	3	2	3	3	2	1		**22**
2	Line Jumpering																			1							**1**
3	Collaps of Pole-Breakdown																										
4	Snap of Conductor																										

5	Puncture of insulator/Leakage																			3							**3**
6	Puncture of LA/LA Maintenance																										
7	Ligtining & Strom/Rain																			1							**1**
8	Tree/branch fall on line	1						3		1				**5**					2	4							**6**
9	RoW Clearing																	1		1							**2**
10	Land Slide																										
11	Forest fire																										
12	Preventive Maintenance of Line/LBS/GO/ARCB							1	2					**3**				1									**1**
13	Preventive Maintenance of substation/Switchyard																1										**1**
14	Breakdown Maintenance of Line/LBS/GO/ARCB																										
15	Breakdown Maintenance of Substation/Switchyard																										
16	SMD Planned shutdown																										
17	Adhoc Shutdown (Tapping, Emergency request)																										
18	Momentary/Traisent fault			1										**1**		1	1		3	4							**9**
19	Trace of fault on line																										
20	Because of Bird/Animals																										
21	Close and Open of GO/LBS																	1									**1**
	SAIFI	**0.210**	**0.000**	**0.400**	**0.070**	**0.100**	**0.100**	**0.930**	**0.520**	**0.100**	**0.000**	**0.100**	**0.000**		**0.000**	**0.100**	**0.310**	**0.720**	**0.720**	**1.740**	**0.210**	**0.310**	**0.320**	**0.210**	**0.110**	**0.000**	
	SAIDI	**0.050**	**0.000**	**0.070**	**0.010**	**0.020**	**0.220**	**0.590**	**1.750**	**0.070**	**0.000**	**0.020**	**0.000**		**0.000**	**0.000**	**0.070**	**0.360**	**0.530**	**2.010**	**0.070**	**0.100**	**0.170**	**0.060**	**0.020**	**0.000**	

Feeder Name: 11kV POP Feeder

Sl. No.	Cause of Outages	Frequency of Interuption (Times)																									
		2018													2019												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	HT fuse Replace			1				1						**2**		1						1				1	**3**
2	Line Jumpering																										
3	Collaps of Pole-Breakdown																										
4	Snap of Conductor																1										**1**
5	Puncture of insulator/Leakage										1			**1**													
6	Puncture of LA/LA Maintenance																										
7	Ligtining & Strom/Rain																										
8	Tree/branch fall on line	1						1		1				**3**													
9	RoW Clearing								2					**2**		1	2			1		3				1	**8**
10	Land Slide																										
11	Forest fire																										
12	Preventive Maintenance of Line/LBS/GO/ARCB																										
13	Preventive Maintenance of substation/Switchyard																										
14	Breakdown Maintenance of Line/LBS/GO/ARCB																										
15	Breakdown Maintenance of Substation/Switchyard																										
16	SMD Planned shutdown																										
17	Adhoc Shutdown (Tapping, Emergency request)												1	**1**													
18	Momentary/Traisent fault																										
19	Trace of fault on line																										
20	Because of Bird/Animals									1				**1**													

21	Close and Open of GO/LBS									1				1													
	SAIFI	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**		**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.040**	
	SAIDI	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**		**0.000**	**0.000**	**0.010**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.010**	

Feeder Name: 11kV Pemagatshel Feeder

Sl. No.	Cause of Outages	Frequency of Interuption (Times)																									
		2018													2019												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	HT fuse Replace									1				**1**								1					**1**
2	Line Jumpering																										
3	Collaps of Pole-Breakdown																										
4	Snap of Conductor																										
5	Puncture of insulator/Leakage																										
6	Puncture of LA/LA Maintenance																										
7	Ligtining & Strom/Rain																										
8	Tree/branch fall on line			1					1					**2**									1				**1**
9	RoW Clearing	1				1			1		2			**5**		1		1		1		3		1			**7**
10	Land Slide																										
11	Forest fire																										
12	Preventive Maintenance of Line/LBS/GO/ARCB	2												**2**													
13	Preventive Maintenance of substation/Switchyard	1												**1**													
14	Breakdown Maintenance of Line/LBS/GO/ARCB																										
15	Breakdown Maintenance of Substation/Switchyard																										
16	SMD Planned shutdown																										
17	Adhoc Shutdown (Tapping, Emergency request)											1	1	**2**													
18	Momentary/Traisent fault									1				**1**													
19	Trace of fault on line																										
20	Because of Bird/Animals																										
21	Close and Open of GO/LBS																										
	SAIFI	**0.450**	**0.000**	**0.020**	**0.000**	**0.110**	**0.000**	**0.000**	**0.220**	**0.110**	**0.110**	**0.110**	**0.110**		**0.000**	**0.110**	**0.000**	**0.110**	**0.000**	**0.110**	**0.000**	**0.550**	**0.110**	**0.110**	**0.000**	**0.000**	
	SAIDI	**0.480**	**0.000**	**0.080**	**0.000**	**0.020**	**0.000**	**0.000**	**0.160**	**0.010**	**0.270**	**0.010**	**0.020**		**0.000**	**0.020**	**0.000**	**0.960**	**0.000**	**0.010**	**0.000**	**0.360**	**0.040**	**0.030**	**0.000**	**0.000**	

B.132/33/11kV Nganglam SS

Feeder Name: 33kV DCCL Feeder

Sl. No.	Cause of Outages	Frequency of Interuption (Times) 2018 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	2019 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	HT fuse Replace																										
2	Line Jumpering																										
3	Collaps of Pole-Breakdown																										
4	Snap of Conductor																										
5	Puncture of																										
6	Puncture of LA/LA																										
7	Ligtining & Strom/Rain																										
8	Tree/branch fall on line																						2					**2**
9	RoW Clearing								2				1	**3**				1									**1**
10	Land Slide																										
11	Forest fire																										
12	Preventive Maintenance of																					1	1		1		**3**
13	Preventive Maintenance of																										
14	Breakdown Maintenance of																										
15	Breakdown Maintenance of																										
16	SMD Planned shutdown																										
17	Adhoc Shutdown (Tapping,				3									**3**													
18	Momentary/Traisent fault																										
19	Trace of fault on line																										
20	Because of Bird/Animals																						1				**1**
21	Close and Open of GO/LBS																										
	SAIFI	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**		**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	
	SAIDI	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**6**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.010**	**0.020**	**0.000**	**0.010**	**0.000**	**7**

Feeder Name: 33kV Decheeling Feeder

Sl. No.	Cause of Outages	Frequency of Interuption (Times) 2018 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	2019 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	HT fuse Replace	1	2	10	1		2	2			1	3		**22**	2		3	4	5	5	4	3	11	3			**40**
2	Line Jumpering	3			1		3					2	2	**11**	1	1	1	3	3	3	1					4	**17**
3	Collaps of Pole-Breakdown																										
4	Snap of Conductor									1				**1**													
5	Puncture of				3									**3**													
6	Puncture of LA/LA																		2	2	2						**6**
7	Ligtining & Strom/Rain																				7						**7**
8	Tree/branch fall on line			2	9	5	3	4	6	9	12	1		**51**	1	3	3	3	5	4	1	2		6	1		**29**
9	RoW Clearing						14		4			1		**19**		1		11							4		**16**
10	Land Slide																										
11	Forest fire																										
12	Preventive Maintenance of			1			3		1					**5**			2				2	1					**5**
13	Preventive Maintenance of								1					**1**	3		1	1	1	1							**7**
14	Breakdown Maintenance of				1									**1**													
15	Breakdown Maintenance of				1									**1**													
16	SMD Planned shutdown																										
17	Adhoc Shutdown (Tapping,	1												**1**													
18	Momentary/Traisent fault				2		1							**3**													
19	Trace of fault on line						1							**1**													
20	Because of Bird/Animals																										
21	Close and Open of GO/LBS						1							**1**													
	SAIFI	**1.880**	**0.470**	**6.670**	**8.500**	**2.360**	**13.190**	**2.830**	**5.600**	**4.740**	**6.040**	**3.320**	**0.930**		**3.260**	**2.330**	**4.680**	**10.330**	**7.510**	**7.540**	**8.010**	**2.830**	**5.200**	**4.250**	**2.370**	**1.890**	
	SAIDI	**1.010**	**2.870**	**19.810**	**31.120**	**6.760**	**26.360**	**13.960**	**23.980**	**19.010**	**28.050**	**2.540**	**0.770**	121	**7.080**	**11.510**	**10.000**	**57.430**	**12.660**	**12.660**	**20.750**	**13.960**	**10.820**	**15.980**	**7.770**	**0.710**	127

Feeder Name: 33kV Panbang Feeder

Sl. No.	Cause of Outages	Frequency of Interuption (Times)																								
		2018													2019											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	HT fuse Replace				3		1	4	3			1		**12**	1		1				4			2	1		**9**
2	Line Jumpering				2		1						2	**5**				1			1						**2**
3	Collaps of Pole-Breakdown																										
4	Snap of Conductor																										
5	Puncture of																	1	1	1		1	2				**6**
6	Puncture of LA/LA																				2						**2**
7	Ligtining & Strom/Rain					1				2				**3**							3						**3**
8	Tree/branch fall on line		2	2	6	1	4	6	7	4	3	1		**36**			2	3	3	3	3		1	4	3		**22**
9	RoW Clearing		1	1			3		1					**6**				2	4	4			1			4	**15**
10	Land Slide																										
11	Forest fire																										
12	Preventive Maintenance of						2							**2**				1			2		7	1			**11**
13	Preventive Maintenance of								3				1	**4**								1			1		**2**
14	Breakdown Maintenance of																										
15	Breakdown Maintenance of																										
16	SMD Planned shutdown																										
17	Adhoc Shutdown (Tapping,																										
18	Momentary/Traisent fault									2				**2**													
19	Trace of fault on line																										
20	Because of Bird/Animals																										
21	Close and Open of GO/LBS																										
	SAIFI	**0.000**	**0.310**	**0.000**	**1.240**	**0.220**	**1.230**	**1.120**	**1.550**	**0.900**	**0.330**	**0.220**	**0.330**		**0.110**	**0.000**	**0.330**	**0.880**	**0.880**	**0.880**	**1.660**	**0.220**	**1.220**	**0.780**	**0.560**	**0.440**	
	SAIDI	**0.000**	**4.340**	**4.660**	**6.800**	**6.420**	**3.730**	**0.580**	**0.970**	**1.600**	**0.230**	**2.720**	**0.210**	**70**	**0.030**	**0.000**	**1.060**	**4.520**	**7.390**	**7.390**	**3.120**	**0.380**	**2.320**	**3.300**	**3.180**	**2.530**	**72**

Feeder Name: 33kV DGCL Feeder

Sl. No.	Cause of Outages	Frequency of Interuption (Times)																								
		2018													2019											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	HT fuse Replace									1	1	1		**3**				1				1					**2**
2	Line Jumpering															1							2		1	2	**6**
3	Collaps of Pole-Breakdown																										
4	Snap of Conductor																										
5	Puncture of																		2								**2**
6	Puncture of LA/LA																			1							**1**
7	Ligtining & Strom/Rain																										
8	Tree/branch fall on line				1		2	2	1	2	2			**10**		1	1				2			1			**5**
9	RoW Clearing							1	2			1		**4**	1			3			1					2	**7**
10	Land Slide																										
11	Forest fire																										
12	Preventive Maintenance of	1												**1**		1		1				1		1			**4**
13	Preventive Maintenance of												1	**1**													
14	Breakdown Maintenance of																										
15	Breakdown Maintenance of															1											**1**
16	SMD Planned shutdown																										
17	Adhoc Shutdown (Tapping,				1									**1**													
18	Momentary/Traisent fault																					1					**1**
19	Trace of fault on line																										
20	Because of Bird/Animals																										
21	Close and Open of GO/LBS																										
	SAIFI	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.150**	**0.160**	**0.160**	**0.110**	**0.060**		**0.060**	**0.230**	**0.060**	**0.310**	**0.120**	**0.120**	**0.190**	**0.190**	**0.120**	**0.120**	**0.060**	**0.250**	
	SAIDI	**0.000**	**0.000**	**0.000**	**0.010**	**0.000**	**0.000**	**0.000**	**0.940**	**0.110**	**0.100**	**0.100**	**0.030**	**20**	**0.010**	**0.300**	**0.080**	**1.690**	**0.240**	**0.240**	**0.770**	**0.120**	**0.070**	**0.490**	**0.040**	**1.070**	**29**

Feeder Name: 11kV Nganglam Feeder																											
Sl. No.	Cause of Outages	Frequency of Interuption (Times)																									
		2018													2019												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	HT fuse Replace	1		1	1		2	1	2	3	10	1	2	**24**		1		1	7	6	3	4		5			**27**
2	Line Jumpering						1	1	5	2				**9**		2	1	4	3	4	1	6				4	**25**
3	Collaps of Pole-Breakdown																										
4	Snap of Conductor				1									**1**							1	1					**2**
5	Puncture of																						1				**1**
6	Puncture of LA/LA						1							**1**				1									**1**
7	Ligtining & Strom/Rain				1									**1**													
8	Tree/branch fall on line							2	2			2		**6**				1									**1**
9	RoW Clearing						3	1	2					**6**				4	3	3				3			**13**
10	Land Slide																										
11	Forest fire																										
12	Preventive Maintenance of								3	1		1	1	**6**	1						2	1	5	5	2	2	**18**
13	Preventive Maintenance of	2						1	1					**4**					1	1			1				**3**
14	Breakdown Maintenance of																										
15	Breakdown Maintenance of																										
16	SMD Planned shutdown																										
17	Adhoc Shutdown (Tapping,									1				**1**													
18	Momentary/Traisent fault																										
19	Trace of fault on line																										
20	Because of Bird/Animals																										
21	Close and Open of GO/LBS																										
	SAIFI	**0.580**	**0.000**	**0.380**	**1.000**	**0.000**	**2.350**	**2.020**	**4.990**	**2.370**	**3.320**	**1.350**	**1.000**		**0.330**	**1.000**	**0.330**	**3.670**	4.72	**4.670**	**2.390**	**4.100**	**2.430**	**4.520**	**0.700**	**2.000**	
	SAIDI	**0.570**	**0.000**	**4.620**	**7.160**	**0.000**	**5.730**	**2.260**	**2.620**	**2.600**	**3.030**	**0.400**	**2.540**	**59**	**0.030**	**0.270**	**0.170**	**11.260**	1.94	**1.940**	**5.950**	**6.310**	**1.780**	**5.040**	**2.920**	**5.070**	**91**

Feeder Name: 11kV Gashari Feeder																											
Sl. No.	Cause of Outages	Frequency of Interuption (Times)																									
		2018													2019												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	HT fuse Replace									2				**2**	1		1						1	1			**4**
2	Line Jumpering																										
3	Collaps of Pole-Breakdown																										
4	Snap of Conductor																										
5	Puncture of																										
6	Puncture of LA/LA																										
7	Ligtining & Strom/Rain																										
8	Tree/branch fall on line									1				**1**													
9	RoW Clearing														1				1	1					1		**4**
10	Land Slide																										
11	Forest fire																										
12	Preventive Maintenance of								1					**1**										1	1		**2**
13	Preventive Maintenance of		1	1	1				1	1				**5**									1				**1**
14	Breakdown Maintenance of																										
15	Breakdown Maintenance of																										
16	SMD Planned shutdown																										
17	Adhoc Shutdown (Tapping,																										
18	Momentary/Traisent fault																										
19	Trace of fault on line																										
20	Because of Bird/Animals																										
21	Close and Open of GO/LBS																										
	SAIFI	**0.000**	**0.190**	**0.190**	**0.020**	**0.000**	**0.000**	**0.000**	**0.050**	**0.100**	**0.000**	**0.000**	**0.000**		**0.050**	**0.000**	**0.020**	**0.000**	**0.020**	**0.020**	**0.000**	**0.000**	**0.050**	**0.050**	**0.050**	**0.000**	
	SAIDI	**0.000**	**0.180**	**0.180**	**0.020**	**0.000**	**0.000**	**0.000**	**0.010**	**0.250**	**0.000**	**0.000**	**0.000**	**9**	**0.040**	**0.000**	**0.000**	**0.000**	**0.060**	**0.060**	**0.000**	**0.000**	**0.110**	**0.110**	**0.080**	**0.000**	**11**

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

A. 132/33/11kV Nangkor SS

TRANSFORMER LOADING

Srl. No	Name of Feeder	DT Location Name	Transformer Ratio	kVA	Installed Yr/MFD *	Serial Number	Trans ID	Total Apparent Power (kVA)	% Loading (Pt/kVA rating) x 100	Remarks	2025 kVA	2025 % loading	2030 kVA	2030 % loading
											394.1		448.24	
											0.949		1.216	
											1.949		2.216	
1	11kV Nangkor Feeder	Nangkor Higher Secondary School s/s	11/0.415kV	125	2004	28992	PEE20T1	65.02084	52.02%		126.72	101%	144.12	115%
2		Lower Nangkor substation	11/0.415kV	63	2004	2001-02.70	PEE20T2	29.2142	46.37%		56.93	90%	64.75	103%
3		Kangkaring substation	11/0.415kV	63	2007	2005	PEE20T3	5.66213	8.99%		11.03	18%	12.55	20%
4		Shumar substation	11/0.415kV	63	2007	29023	PEE20T4	15.06861	23.92%		29.37	47%	33.40	53%
5		Yangkhar substation	11/0.415kV	25	2007	29141	PEE20T12	6.3589	25.44%		12.39	50%	14.09	56%
6		Kheri substation	11/0.415kV	63	2007	29103	PEE20T13	10.5936	16.82%		20.65	33%	23.48	37%
7		Gomchu substation	11/0.415kV	63	2007	29102	PEE20T5	5.83778	9.27%		11.38	18%	12.94	21%
8		Pangthang substation	11/0.415kV	63	2007	29022	PEE20T6	7.7436	12.29%		15.09	24%	17.16	27%
10		Toepalung substation	11/0.415kV	25	2007	29158	PEE20T7	5.1103	20.44%		9.96	40%	11.33	45%
11		Shali substation	11/0.415kV	63	2007	29095	PEE20T8	16.6119	26.37%		32.37	51%	36.82	58%
12		Gonpung substation	11/0.415kV	25	2007	29134	PEE20T10	7.5867	30.35%		14.79	59%	16.82	67%
13		Sherkhapa substation	11/0.415kV	63	2007	29101	PEE20T11	12.58204	19.97%		24.52	39%	27.89	44%
14		Gamung substation	11/0.415kV	63	2007	29017	PEE20T9	14.8395	23.55%		28.92	46%	32.89	52%
								202.2301						
											2025		**2030**	
											kVA	**% loading**	**kVA**	**% loading**
											575.3		**644.71**	
											6.716		**7.648**	
											7.716		**8.648**	
18	11kV PoP Feeder	Hospital substation	11/0.415kV	63	2009	72277	PEE10T8	0	0.00%	Transformer idle (Pvt. Asset)	0	0	0	0
19		Denchi Dzong Construction SS	11/0.415kV	500	2017		PEE130T2	71.827576	14.37%		554.26	111%	621.13	124%
20		BPC Colony SS	11/0.415kV	63	2017		PEE130T1	2.7263	4.33%		21.04	33%	23.5757	37%
								74.553876						
											2025		**2030**	
											kVA	**% loading**	**kVA**	**% loading**
											289.2		**302.71**	
											-0.071		**-0.027**	
											0.929		**0.973**	
21	11kV Pemagatshel Feeder	Upper Nangkor substation	11/0.415kV	125	1997*	1997-18	PEE10T5	57.08229	45.67%		53.04	42%	55.52	44%
22		Telecom substation	11/0.415kV	25	1996*	90-43	PEE10T1	0	0.00%		0.00	0%	0.00	0%
23		Zero point substation	11/0.415kV	125	2004	KD 160/45	PEE10T7	44.35402	35.48%		41.21	33%	43.14	35%
24		Khoripam substation	11/0.415kV	63	2008	15214	PEE10T2	15.618936	24.97%		14.51	23%	15.19	24%
25		Dzong substation	11/0.415kV	250	1995*	W95FD-107107	PEE10T3	101.8176	40.73%		94.60	38%	99.03	40%
26		Tshangtsheri	11/0.415kV	63	2007	63/11	PEE10T6	32.470521	51.54%		30.17	48%	31.58	50%
27		School substation	11/0.415kV	250	2005*	95FD1073	PEE10T4	59.89892	23.96%		55.65	22%	58.26	23%
								311.242287						

										2025		2030	
										kVA	% loading	kVA	% loading
										1014.7		1184.71	
										1.208		1.578	
										2.208		2.578	
28		Gyelpobrangsa substation	33/0.415kV	63	2007	29268	PEE40T12	12.6053	20.01%		27.8281	44%	32.4904	52%
29		Kheri Gonpa substation	33/0.415kV	63	2004	KD2319/c	PEE40T1	18.152971	28.82%		40.0755	64%	46.7896	74%
30		Thongkenang substation	33/0.240kV	16	2015	33/1059	PEE40T50	1.196	7.48%		2.64035	17%	3.08271	19%
31		Shumar Thung substation	33/0.415kV	30	2007	29219	PEE40T10	7.992	26.64%		17.6436	59%	20.5995	69%
32		Shumar Juk substation	33/0.415kV	30	2007	29186	PEE40T11	4.341	14.47%		9.58343	32%	11.189	37%
33		Chungkhar substation	33/0.415kV	63	2004	KD2317/C	PEE10T2	10.0379227	15.93%		22.1603	35%	25.8729	41%
34		Lower Khenadrang substation	33/0.415kV	63	2011	1059	PEE10T49	5.41744	8.60%		11.9598	19%	13.9635	22%
35		Upper Khinadang substation	33/0.415kV	30	2011	1025	PEE10T50	5.28436	17.61%		11.666	39%	13.6205	45%
36		Pangthang Daza substation	33/0.415kV	63	2004	KD2296/C	PEE10T3	9.096313	14.44%		20.0815	32%	23.4459	37%
37		Mongling substation	33/0.415kV	63	2004	KD-2396/C	PEE40T4	20.03	31.79%		44.2193	70%	51.6277	82%
38		Yongla Gonpa substation	33/0.415kV	63	2013*	3875/13-14	PEE40T9	18.498	29.36%		40.8372	65%	47.6789	76%
39		Gonpasingma substation	33/0.415kV	63	2004	KD-2320/C	PEE40T5	28.669	45.51%		63.2912	100%	73.8948	117%
40		Khonmari substation-I	33/0.415kV	63	2015	29290	No GPS No	0	0.00%	no load connected	0	0%	0	0%
41		Khonmari substation-II	33/0.415kV	63	2015	KD-2397/C	No GPS No	0	0.00%	no load connected	0	0%	0	0%
42		Khonmari substation-III	33/0.415kV	100	2015	HTE/A091	No GPS No	0	0.00%	no load connected	0	0%	0	0%
43		Khonmari substation-IV	33/0.415kV	100	2015	HTE/A093	No GPS No	0	0.00%	no load connected	0	0%	0	0%
44		Zobel substation	33/0.415kV	63	2004	KD-2293/C	PEE40T6	6.50727	10.33%		14.3658	23%	16.7726	27%
45		Upper Ngangmalam s/stn.	33/0.415kV	63	2004	KD-2318/C	PEE40T7	10.85794	17.23%		23.9706	38%	27.9865	44%
46		Lower Ngangmalam s/stn.	33/0.415kV	63	2004	KD-2381/C	PEE40T8	6.878	10.92%		15.1842	24%	17.7282	28%
47		Resinang substation	33/0.415kV	63	2007	29253	PEE40T13	11.238	17.84%		24.8096	39%	28.9661	46%
48		Tshelingore substation	33/0.415kV	63	2007	29259	PEE40T14	4.9857	7.91%		11.0067	17%	12.8507	20%
49		Maan substation	33/0.415kV	63	2007	29260	PEE40T15	2.79517	4.44%		6.17077	10%	7.2046	11%
50		Wooligtang substation	33/0.415kV	30	2007	29216	PEE40T16	2.74888	9.16%		6.06858	20%	7.08528	24%
51		Ngangshing Lhakhang	33/0.240KV	16	2010	10913	PEE40T29	5.24076	32.75%		11.5698	72%	13.5081	84%
52		Bar Gonpa substaion	33/0.415kV	30	2006*	29225	PEE40T17	5.38183	17.94%		11.8812	40%	13.8718	46%
53	33kV Nanong Feeder	Rayzor substation	33/0.415kV	30	2006*	0	PEE40T21	1.21668	4.06%		2.68601	9%	3.13601	10%
54		Nanong substation	33/0.415kV	30	2006*	29221	PEE40T26	11.47751	38.26%		25.3384	84%	29.5835	99%
55		Kulung substation	33/0.415kV	30	2006*	29203	PEE40T27	8.56533	28.55%		18.9093	63%	22.0773	74%
56		Rashi Gonpa substation		25	2011	9132335	PEE40T46	3.53916	14.16%		7.81324	31%	9.12224	36%
57		Khedung substation		25	2011	9132329	PEE40T47	1.0008	4.00%		2.20942	9%	2.57958	10%
58		Dai Gonpa substation	33/0.415kV	63	2006*	29307	PEE40T52	0.43309	0.69%		0.95611	2%	1.1163	2%
59		Tsho Gonpa substation	33/0.415kV	63	2006*	29248	PEE40T53	4.79325	7.61%		10.5818	17%	12.3547	20%

60		Khai Manma substation	33/0.415kV	63	2006*	29326	PEE40T54	14.02519	22.26%		30.9628	49%	36.1502	57%
61		Gangtong substation	33/0.415kV	63	2010*	29284	PEE40T55	1.32162	2.10%		2.91768	5%	3.4065	5%
62		Gayri substation	33/0.415kV	63	2006*	29308	PEE40T18	6.57212	10.43%		14.509	23%	16.9397	27%
63		Brayphu substation	33/0.415kV	63	2006*	29316	PEE40T22	9.17561	14.56%		20.2566	32%	23.6503	38%
64		Raling substation	33/0.415kV	63	2006*	29313	PEE40T24	13.12769	20.84%		28.9814	46%	33.8368	54%
65		Yelchen substation	33/0.415kV	63	2006*	29281	PEE40T23	25.82984	42.00%		57.0234	91%	66.5768	106%
66		Zingri substation	33/0.415kV	63	2006*	29320	PEE40T25	0	0.00%		0	0%	0	0%
67		Pangthang substation	33/0.415kV	63	2006*	29322	PEE40T28	21.39517	33.96%		47.2331	75%	55.1464	88%
68		Yelchen Center School	33/0.415kV	125	2016	16624	PEE40T51	25.06063	20.05%		55.3252	44%	64.5942	52%
69		Tephu substation	33/0.415kV	63	2006*	29284	PEE40T19	13.64667	21.66%		30.1271	48%	35.1745	56%
70		Wongchilo substation	33/0.415kV	63	2009*	911280	PEE40T20	14.89753	23.65%		32.8886	52%	38.3986	61%
71		Mukazor substation	33/0.415kV	63	2006*	29284	PEE40T56	5.04825	8.01%		11.1448	18%	13.0119	21%
72		Khekhar Substation	33/0.240kV	16	2011	9112219	PEE40T30	2.297	14.36%		5.07098	32%	5.92056	37%
73		Tsatshi BHU substation	33/0.240kV	25	2011	9112803	PEE40T31	10.62285	42.49%		23.4516	94%	27.3806	110%
74		Tsatshi school Substation	33/0.240kV	25	2011	9112789	PEE40T32	9.12232	36.49%		20.1389	81%	23.5129	94%
75		Mongthong substation	33/0.240kV	25	2011	9112773	PEE40T33	2.8386	11.35%		6.26665	25%	7.31654	29%
76		Saremkha substation	33/0.240kV	25	2011	9112773	PEE40T34	3.06908	12.28%		6.77547	27%	7.9106	32%
77		Gumrong Substation	33/0.240kV	25	2011	9112794	PEE40T37	9.435188	37.74%		20.8296	83%	24.3194	97%
78		Dagor School substation	33/0.240kV	25	2011	9112794	PEE40T36	4.218	16.87%		9.31189	37%	10.872	43%
79		Dagor substation	33/0.240kV	25	2011	9112282	PEE40T35	6.75575	27.02%		14.9144	60%	17.4131	70%
80		Tsatshi substation	33/0.240kV	25	2011	8112772	PEE40T3838	1.9494	7.80%		4.3036	17%	5.02461	20%
81		Thongthong Gonpa substation	33/0.240kV	25	2011	9112689	PEE40T39	8.436	33.74%		18.6238	74%	21.7439	87%
82		Bainangchur substation	33/0.240kV	25	2011	9112288	PEE40T40	3.7909	15.16%		8.369	33%	9.77111	39%
83		Balangnang substation	33/0.240kV	25	2011	9112277	PEE40T41	4.761264	19.05%		10.5112	42%	12.2722	49%
84		Jangrey Substation	33/0.240kV	25	2011	9112797	PEE40T42	2.9832	11.93%		6.58587	26%	7.68925	31%
85		Sayul substation	33/0.240kV	25	2011	9112681	PEE40T43	3.47616	13.90%		7.67416	31%	8.95986	36%
86		Gashikhar substation	33/0.240kV	25	2011	9112687	PEE40T44	3.7125	14.85%		8.19592	33%	9.56903	38%
87		Muna substation	33/0.240kV	25	2011	9112607	PEE40T45	3.08256	12.33%		6.80523	27%	7.94535	32%
								459.6307687						
											2025		**2030**	
											kVA	**% loading**	**kVA**	**% loading**
											792.4		**929.41**	
											1.686		**2.150**	
											2.686		**3.150**	
88		Borang Chilo substation	33/0.415kV	63	2007	29107	PEE50T14	2.728316	4.33%		7.32733	12%	8.59478	14%
90		Denchi substation	33/0.415kV	63	2004	KD-2283/c	PEE50T1	11.38107	18.07%		30.5657	49%	35.8528	57%
91		Khothakpa substation	33/0.415kV	63	2004	KD-2294/c	PEE50T2	9.246123	14.68%		24.8319	39%	29.1273	46%
92		Yalang substation	33/0.415kV	63	2003*	KD-63/2571	PEE50T12	11.617305	18.44%		31.2001	50%	36.597	58%
93		Bartsheri substation	33/0.415kV	63	2004	KD-2280/C	PEE50T3	8.023254	12.74%		21.5477	34%	25.275	40%
94		Lower Khar substation	33/0.415kV	63	2004	24021	PEE50T4	23.668945	37.57%		63.5667	101%	74.5623	118%
95		Upper Khar substation	33/0.415kV	63	2004	2394/c	PEE50T5	26.554818	42.15%		71.3172	113%	83.6534	133%
96		Bogmaan substation	33/0.415kV	63	2003*	2574	PEE50T13	2.977471	4.73%		7.99647	13%	9.37968	15%
97		Dungkhar Lakhang substation	33/0.415kV	63	2009	1371	PEE50T26	2.066771	3.28%		5.55064	9%	6.51077	10%
98		Thongsa substation	33/0.415kV	63	2007	29266	PEE50T22	24.753078	39.29%		66.4783	106%	77.9775	124%

99		Mandi substation	33/0.415kV	63	2007	29329	PEE50T23	5.043125	8.00%		13.5441	21%	15.8869	25%
100		Reagi substation	33/0.415kV	63	2004	2572	PEE50T6	2.08599	3.31%		5.60226	9%	6.57132	10%
101		Khar Gewog Office	33/0.415kV	30	2006*	Nil	PEE50T25	2.30949	7.70%		6.2025	21%	7.27539	24%
102		Shenari substation	33/0.415kV	63	2004	KD-2401/C	PEE50T7	42.831822	67.99%		115.032	183%	134.929	214%
103		Zordung substation	33/0.415kV	63	2004	KD-2400/C	PEE50T8	0	0.00%	idle transformer (Load merged with 3P Xmer)	0	0%	0	0%
104		Tsebar substation	33/0.415kV	63	2004	39329	PEE50T10	28.070967	44.56%		75.389	120%	88.4296	140%
105		Fadi substation	33/0.415kV	63	2004	KD-2398/C	PEE50T9	6.079459	9.65%		16.3274	26%	19.1516	30%
106		Nagtsheri substation	33/0.415kV	63	2004	29269	PEE50T11	7.49196	11.89%		20.1208	32%	23.6013	37%
107		Yomzor substation	33/0.415kV	63	2007	33026	PEE50T18	10.31034	16.37%		27.6901	44%	32.4798	52%
108		Chongshing Gonpa s/stn.	33/0.415kV	30	2007	Nil	PEE50T19	5.226064	17.42%		14.0354	47%	16.4632	55%
109		Upper Chongshing s/stn.	33/0.415kV	63	2007	29261	PEE50T21	5.419618	8.60%		14.5552	23%	17.073	27%
110		Lower Chongshing s/stn.	33/0.415kV	63	2007	KT-63/2572	PEE50T20	1.25818	2.00%		3.37904	5%	3.96354	6%
111		Labor substation	33/0.415kV	63	2007	29293	PEE50T15	4.57692	7.26%		12.292	20%	14.4183	23%
112	33kV Tshebar Feeder	Khengzor substation - I	33/0.415kV	30	2007	29289	PEE50T17	2.895386	9.65%		7.77602	26%	9.12109	30%
113		Khengzor substation - II	33/0.415kV	63	2007	29217	PEE50T16	4.312492	6.85%		11.5819	18%	13.5853	22%
114		Khengzor CPS substation	33/0.415kV	63	2009	41920	PEE50T24	2.503503	3.97%		6.72355	11%	7.88658	13%
115		Dungmin substation - I	33/0.240kV	25	2013	9112858	PEE50T27	0	0.00%	idle transformer	0	0%	0	0%
116		Dungmin substation - II	33/0.240kV	25	2013	9112817	PEE50T28	0	0.00%	idle transformer	0	0%	0	0%
117		Dungmin substation - III	33/0.415kV	63	2016	15219	PEE50T29	12.16304	19.31%		32.6658	52%	38.3162	61%
118		Dungmin BHU substation	33/0.240kV	25	2013	9112914	PEE50T32	5.65964	22.64%		15.1999	61%	17.8291	71%
119		Dungmin Lakhang substation	33/0.240kV	25	2013	9112906	PEE50T30	1.448519	5.79%		3.89023	16%	4.56315	18%
120		Dungmin School substation	33/0.240kV	25	2013	9112936	PEE50T33	0	0.00%	idle transformer	0	0%	0	0%
121		Pewangrep substation	33/0.240kV	25	2013	9112815	PEE50T31	1.4773908	5.91%		3.96777	16%	4.6541	19%
122		Lower Zimzor substation	33/0.240kV	25	2013	9112939	PEE50T34	2.1147776	8.46%		5.67957	23%	6.66201	27%
123		Upper Zimzor substation	33/0.240kV	25	2013	9112920	PEE50T35	1.6382574	6.55%		4.3998	18%	5.16086	21%
124		Amshing Woong substation	33/0.240kV	10	2013	9112271	PEE50T36	0.3009952	3.01%		0.80837	8%	0.9482	9%
125		Nanong substation - Lanari	33/0.415kV	25	2013	9112878	PEE50T37	5.02635	20.11%		13.4991	54%	15.8341	63%
126		Lanari School substation	33/0.415kV	63	2013	16623	PEE50T38	2.14914	3.41%		5.77186	9%	6.77026	11%
127		Thimchung substation	33/0.240kV	25	2013	9112916	PEE50T41	2.14914	8.60%		5.77186	23%	6.77026	27%
128		Lower Lanari substation	33/0.415kV	63	2013	9112924	PEE50T39	1.11613	1.77%		2.99754	5%	3.51605	6%
129		Upper Lanari substation	33/0.240kV	25	2013	9112926	PEE50T40	0.95274	3.81%		2.55873	10%	3.00134	12%
130		Gonpa Zor	33/0.240kV	25	2015	B47	PEE50T42	1.36374	5.45%		3.66254	15%	4.29608	17%

131		Tomi	33/0.240kV	16	2015	B78	PEE50T43	0.6399	4.00%		1.71855	11%	2.01582	13%
132		Nomi	33/0.240kV	25	2015	B34	PEE50T45	0.97232	3.89%		2.61132	10%	3.06302	12%
133		Wongborang	33/0.240kV	25	2015	B80	PEE50T44	2.42658	9.71%		6.51697	26%	7.64425	31%
								295.031127						
											2025		**2030**	
											kVA	**% loading**	**kVA**	**% loading**
											431.8		**570.59**	
											1.702		**2.570**	
											2.702		**3.570**	
134	33kV Yurung Feeder	Maan substation	33/0.415kV	30	2007	29	PEE60T4	5.3008	17.67%		14.3209	48%	18.9254	63%
135		Lanangzor substation	33/0.240kV	25	2007	9112972	PEE60T5	1.77825	7.11%		4.80419	19%	6.34887	25%
136		Phakpalu substation	33/0.415kV	30	2007	29215	PEE60T8	3.366572	11.22%		9.09527	30%	12.0196	40%
137		Guyum substation	33/0.415kV	63	2007	29262	PEE60T9	5.2861	8.39%		14.2811	23%	18.8729	30%
138		Lower Khangma substation	33/0.415kV	63	2007	29162	PEE60T6	13.9022	22.07%		37.5588	60%	49.6349	79%
139		Upper Khangma substation	33/0.415kV	63	2007	29299	PEE60T7	6.65618	10.57%		17.9826	29%	23.7645	38%
140		Yangkhar subsation	33/0.415kV	63	2004	KD 1404/C	PEE60T1	19.9052	31.60%		53.7767	85%	71.0673	113%
141		Lawoong substation	33/0.415kV	63	2004	KD 2395/0	PEE60T2	16.03268	25.45%		43.3145	69%	57.2413	91%
142		Thoungo substation	33/0.415kV	63	2004	63/2729	PEE60T3	11.7402	18.64%		31.7178	50%	41.9159	67%
143		Lungkholom substation	33/0.240kV	25	2013	9112892	PEE60T13	3.16438	12.66%		8.54902	34%	11.2977	45%
144		Kalishong substation	33/0.240kV	25	2013	9112873	PEE60T14	0.77493	3.10%		2.09358	8%	2.76672	11%
145		Gomtshang substation	33/0.415kV	63	2007	29270	PEE60T12	1.8477	2.93%		4.99182	8%	6.59682	10%
146		Bangdala substation	33/0.415kV	30	2007	29231	PEE60T10	2.26672	7.56%		6.12386	20%	8.09284	27%
147		Phutsumri substation	33/0.415kV	30	2007	29200	PEE60T11	6.264	20.88%		16.9231	56%	22.3643	75%
148		Upper Pangthang	33/0.240kV	25	2013	9112913	PEE60T15	1.881982	7.53%		5.08444	20%	6.71922	27%
149		Lower Pangthang	33/0.240kV	10	2013	9112180	PEE60T16	0.419475	4.19%		1.13327	11%	1.49765	15%
150		School Area substation	33/0.415kV	63	2016	7-63/2652	PEE60T17	7.043176	11.18%		19.0281	30%	25.1462	40%
151		Reggi substation	33/0.240kV	25	2013	9112869	PEE60T18	1.779141	7.12%		4.8066	19%	6.35205	25%
152		Kheydong substation	33/0.240kV	25	2013	9112957	PEE60T19	1.871937	7.49%		5.0573	20%	6.68335	27%
153		Kheymung substation	33/0.240kV	25	2013	9112824	PEE60T20	0.792	3.17%		2.1397	9%	2.82767	11%
154		Barkong substation	33/0.240kV	25	2013	9112899	PEE60T21	1.133817	4.54%		3.06317	12%	4.04805	16%
155		Thungkhar substation	33/0.240kV	10	2013	9112937	PEE60T22	4.3659	43.66%		11.7951	118%	15.5875	156%
156		Lower Naskhar substation	33/0.240kV	25	2013	9112945	PEE60T23	3.493336	13.97%		9.43774	38%	12.4722	50%
157		Upper Naskhar substation	33/0.240kV	25	2013	9112923	PEE60T24	2.21135	8.85%		5.97427	24%	7.89516	32%
158		Lower Chipphung substation	33/0.415kV	63	2016	33/1361	PEE60T26	3.53078	5.60%		9.5389	15%	12.6059	20%
159		Upper Chipphung substation	33/0.240kV	16	2013	9112246	PEE60T27	1.8798	11.75%		5.07854	32%	6.71143	42%
160		Welling substation	33/0.240kV	10	2013	9112169	PEE60T25	0.41652	4.17%		1.12529	11%	1.4871	15%
161		Teptela substation	33/0.240kV	16	2013	9112274	PEE60T28	0.43524	2.72%		1.17586	7%	1.55393	10%
162		Bainang Gonpa substation	33/0.240kV	16	2013	9112262	PEE60T29	0.45067	2.82%		1.21755	8%	1.60902	10%
163		Mangthari substation	33/0.240kV	16	2013	9112248	PEE60T30	1.389992	8.69%		3.75526	23%	4.96267	31%
164		BHU, Yurung	33/0.415kV	63	2015	2810/9	No GPS No	28.4347	45.13%		76.8203	122%	101.52	161%
								159.815728						

B. 132/33/11kV Nganglam SS

TRANSFORMER LOADING

Srl. No	Name of Feeder	DT Location Name	Transformer Ratio	kVA	Installed Yr/MFD*	Serial Number	Trans ID	Total Apparent Power (kVA)	% Loading (Pt/kVA rating)	2025 kVA	2025 % loading	2030 kVA	2030 % loading
										1072.9		1268.24	
										1.086		1.465	
										2.086		2.465	
1	11kV Nganglam Feeder	Phatawoong, Nganglam	11/0.415kV	315	2012	11/1004	PEE70T3	225.383	71.55%	470.101	149%	555.67	176%
2		Nganglam Bazar(old DCCL colony)	11/0.415kV	315	2007	KT-315/293	PEE70T4	196.7284	62.45%	410.334	130%	485.02	154%
3		Rinchenthang (old Check Post Area)	11/0.415kV	100	1987	86-BD-160/4	PEE70T5	2.2067	2.21%	4.603	5%	5.44	5%
4		Pakhuri Village	11/0.415kV	25	2009	2009.25.11.10627	PEE70T6	3.6435	14.57%	7.600	30%	8.98	36%
5		Lower Satshalo	11/0.415kV	63	2009	2009.63.11.10451	PEE70T7	7.93892	12.60%	16.559	26%	19.57	31%
6		Upper Satshalo	11/0.415kV	63	2009	2009.63.11.10446	PEE70T8	14.87668	23.61%	31.030	49%	36.68	58%
7		Tenzama	11/0.415kV	63	2009	9132562	PEE70T19	18.53053	29.41%	38.651	61%	45.69	73%
8		Potanala new check post	11/0.415kV	125	2017	E-20744	PEE70T18	11.4425	9.15%	23.867	19%	28.21	23%
9		Kilikher, Thsenkeri	11/0.415kV	25	2009	9132409	PEE70T9	10.04524	40.18%	20.952	84%	24.77	99%
10		Lower Menchu	11/0.415kV	63	1976	224139/2	PEE70T1	5.09808	8.09%	10.634	17%	12.57	20%
11		Uper Menchu	11/0.415kV	25	2005	7507	PEE70T2	4.23286	16.93%	8.829	35%	10.44	42%
12		Tokaphu	11/0.415kV	25	2009	9132460	PEE70T10	0.5443	2.18%	1.135	5%	1.34	5%
13		Uper Tshagtshri	11/0.415kV	25	2009	9132460	PEE70T11	1.92138	7.69%	4.008	16%	4.74	19%
14		Lower Tshagthseri	11/0.415kV	25	2009	9132491	PPE70T12	0.8581	3.43%	1.790	7%	2.12	8%
15		Borkatshang, Nganglam	11/0.415kV	63	2006	11/994	PEE70T13	5.1456	8.17%	10.733	17%	12.69	20%
16		Lower Dezama	11/0.240k	25	2009	9132439	PEE70T15	1.159	4.64%	2.417	10%	2.86	11%
17		Middle Dezama	11/0.415kV	25	2009	9132439	PEE70T16	2.2237	8.89%	4.638	19%	5.48	22%
18		Uper Dezama	11/0.415kV	25	2009	9132492	PEE70T17	1.8068	7.23%	3.769	15%	4.45	18%
19		Khalatangzor, Dezama	11/0.240kV	16	2009	9113294	PEEE70T14	0.62036	3.88%	1.294	8%	1.53	10%
								514.40565					

Srl. No	Name of Feeder	DT Location Name	Transformer Ratio	kVA	Installed Yr/MFD*	Serial Number	Trans ID	Total Apparent Power (kVA)	% Loading (Pt/kVA rating)	2025 kVA	2025 % loading	2030 kVA	2030 % loading
										78.4		87.18	
										4.462		5.078	
										5.462		6.078	
1	11 kV Gashari Feeder	Gashari	11/0.415	125	2010	12317	PEE80T1	10.6335	8.51%	58.0848	46%	64.626	52%
2		Banjari	11/0.415	25	2002		PEE80T2	3.710459	14.84%	20.2681	81%	22.551	90%
								14.343959					

Srl. No	Name of Feeder	DT Location Name	Transformer Ratio	kVA	Installed Yr/MFD*	Serial Number	Trans ID	Total Apparent Power (kVA)	% Loading (Pt/kVA rating)	2025 kVA	2025 % loading	2030 kVA	2030 % loading
										3142.4		3265.88	
										66.592		69.249	
										67.592		70.249	
1	33kV Druk Gyp Feeder	Lower Gasharibali	33/0.415	63	2010	2010.125.33.12317	PEE110T3	11.947562	18.96%	807.555	12.818	839.3	13.322233
2		Uper Gasheribali	33/0.415	125	2010	5993	PEE110T1	34.542727	27.63%	2334.8	18.678	2426.6	19.412653
								46.490289					

										2025		2030	
										kVA	% loading	kVA	% loading
										790.6		1014.12	
										1.186		1.805	
										2.186		2.805	
1	33kV Dechenling Feeder	Bedungri	33/0.415	63	2006	9132409	PEE90T2	8.3861	13.31%	18.34	29%	23.52	37%
2		Bapta	33/0.415	63	2006	7600	PEE90T3	23.2304	36.87%	50.79	81%	65.15	103%
3		Martshala	33/0.415	63	2006	2005.63.33.7564	PEE90T4	16.5914	26.34%	36.28	58%	46.53	74%
4		Gonpawong	33/0.415	63	2006	2005.63.33.	PEE90T5	13.7958	21.90%	30.16	48%	38.69	61%
5		BHU area	33/0.415	63	2006	2005.63.33.7601	PEE90T6	10.48182	16.64%	22.92	36%	29.40	47%
6		Nachu Bandar	33/0.415	63	2006	2005.63.33.7600	PEE90T7	10.26788	16.30%	22.45	36%	28.80	46%
7		Shingchongri	33/0.415	63	2006	7564	PEE90T8	18.63849	29.58%	40.75	65%	52.27	83%
8		Namdhaling (Kulamati)	33/0.415	25	2014	B123	PEE90T18	2.38352	9.53%	5.21	21%	6.68	27%
9		Layshingri	33/0.415	25	2014	B123	PEE90T19	1.80635	7.23%	3.95	16%	5.07	20%
10		Lower Kholomri	33/0.415	25	2014	B88	PEE90T20	5.14101	20.56%	11.24	45%	14.42	58%
11		Dungchilo	33/0.415	25	2014	B88	PEE90T21	1.31214	5.25%	2.87	11%	3.68	15%
12		Dungchilo Pam	33/0.415	25	2014	B123	PEE90T22	2.1739	8.70%	4.75	19%	6.10	24%
13		Upper Kholomri	33/0.415	25	2014	B123	PEE90T23	4.35515	17.42%	9.52	38%	12.21	49%
14		Phungsharang	33/0.240	25	2009	9112853	PEE90T26	7.0328	28.13%	15.38	62%	19.72	79%
15		Bazor	33/0.240	16	2009	912843	PEE90T24	7.5999	47.50%	16.62	104%	21.31	133%
16		Rezomo	33/0.240	16	2009	9112844	PEE90T25	6.0865	38.04%	13.31	83%	17.07	107%
17		Monger	33/0.240	25	2009	9112966	PEE90T27	7.8858	31.54%	17.24	69%	22.12	88%
18		Nogndari	33/0.240	25	2009	9112268	PEE90T28	4.84671	19.39%	10.60	42%	13.59	54%
19		Norbali School	33/0.240	25	2009	9112903	PEE90T29	4.4736	17.89%	9.78	39%	12.55	50%
20		Relakpo	33/0.415	30	2016	17677	PEE90T30	23.9377	79.79%	52.34	174%	67.14	224%
21		Mandralgang	33/0.240	25	2009	9112885	PEE90T33	9.7875	39.15%	21.40	86%	27.45	110%
22		Lower Yangmalashing	33/0.240	25	2009	9132342	PEE90T31	7.774	31.10%	17.00	68%	21.80	87%
23		Upper Yangmalashing	33/0.240	25	2009	9132341	PEE90T32	5.0032	20.01%	10.94	44%	14.03	56%
24		Kerong Uper	33/0.240	25	2009	9112880	PEE90T37	1.2808215	5.12%	2.80	11%	3.59	14%
25		Kerong Lower	33/0.240	16	2009	9112256	PEE90T35	1.01881	6.37%	2.23	14%	2.86	18%
26		Kerong old School area	33/0.240	25	2009	9112883	PEE90T34	3.45898	13.84%	7.56	30%	9.70	39%
27		Kerong Middle	33/0.240	16	2009	9112264	PEE90T36	2.243475	14.02%	4.91	31%	6.29	39%
28		Gazawoong	33/0.240	25	2009	9112863	PEE90T38	4.65918	18.64%	10.19	41%	13.07	52%
29		Chhokhorling 2	33/0.240	25	2009	9112934	PEE90T44	6.396375	25.59%	13.99	56%	17.94	72%
30		Chhokhorling 4	33/0.240	25	2009	9112809	PEE90T41	1.92394	7.70%	4.21	17%	5.40	22%
31		Chhokhorling 5	33/0.240	25	2009	9112823	PEE90T40	3.3663	13.47%	7.36	29%	9.44	38%
32		Richam [Gewog Center]	33/0.240	25	2009	9112822	PEE90T48	3.0723	12.29%	6.72	27%	8.62	34%
33		Yarjaywoong-Lower	33/0.240	25	2009	9112959	PEE90T49	2.51899	10.08%	5.51	22%	7.06	28%
34		Yarjaywoong-Upper	33/0.240	16	2009	9112245	PEE90T50	1.12651	7.04%	2.46	15%	3.16	20%
35		Dongdongma/Tshekhorrabten	33/0.240	25	2009	9112818	PEE90T46	0.69	2.76%	1.51	6%	1.94	8%
36		Khalatsho/Arden	33/0.240	16	2009	9112241	PEE90T47	1.87839	11.74%	4.11	26%	5.27	33%
37		Chhokhorling 1	33/0.415	25	2009	9132313	PEE90T43	1.8021	7.21%	3.94	16%	5.05	20%
38		Chhokhorling 3	33/0.415	25	2009	9132320	PEE90T39	0.851	3.40%	1.86	7%	2.39	10%
39		Chhokhorling/School Area	33/0.415	25	2009	9132315	PEE90T45	7.070284	28.28%	15.46	62%	19.83	79%
40		Uper Bangyul	33/0.240	25	2009	9112876	PEE90T13	3.6934	14.77%	8.08	32%	10.36	41%
41		Middle Bangyul	33/0.240	25	2009	9112947	PEE90T12	2.691	10.76%	5.88	24%	7.55	30%
42		Lower Bangyul	33/0.240	25	2009	9112912	I90T14	2.173615	8.69%	4.75	19%	6.10	24%
43		Uper Mekuri	33/0.240	25	2009	9112927	PEE90T11	3.66135	14.65%	8.01	32%	10.27	41%
44		Lower Mekuri	33/0.240	25	2009	9112925	PEE90T9	4.838	19.35%	10.58	42%	13.57	54%

45		Middle Mekuri(School area)	33/0.240	25	2009	9112971	PEE90T10	5.5216	22.09%	12.07	48%	15.49	62%
46		Telung village	33/0.415	25	2015	1364	PEE90T17	14.14127	56.57%	30.92	124%	39.66	159%
47		Dungri/Durungri	33/0.240	25	2009	9112859	PEE90T15	7.66932	30.68%	16.77	67%	21.51	86%
48		Tsobali/Telung	33/0.240	10	2009	9112177	PEE90T16	0.7254	7.25%	1.59	16%	2.03	20%
49		Yangbari-Upper	33/0.240	25	2009	9112835	MOE90T3	6.99268	27.97%	15.29	61%	19.61	78%
50		Yangbari-Lower	33/0.240	16	2009	9112231	MOE90T4	5.14437	32.15%	11.25	70%	14.43	90%
51		Yangbari School area	33/0.240	25	2009	9112940	MOE90T1	4.0238	16.10%	8.80	35%	11.29	45%
52		Goingdung/Tung/patoong	33/0.240	25	2009	9112891	MOE90T5	5.819506	23.28%	12.72	51%	16.32	65%
53		Ballee	33/0.240	25	2009	9112260	MOE90T2	10.80887	43.24%	23.63	95%	30.31	121%
54		Kormi	33/0.240	10	2009	9112173	MOE90T6	3.0916	30.92%	6.76	68%	8.67	87%
55		Kezzella/Edhi	33/0.240	25	2009	9112961	MOE90T14	4.418108	17.67%	9.66	39%	12.39	50%
56		Bakla	33/0.240	25	2009	9112963	MOE90T13	4.4744	17.90%	9.78	39%	12.55	50%
57		Bogarbee	33/0.240	25	2009	9112182	MOE90T12	1.59605	6.38%	3.49	14%	4.48	18%
58		Daksa-I (upper	33/0.240	16	2009	9112275	MOE90T8	3.27453	20.47%	7.16	45%	9.18	57%
59		Daksa-II (mid	33/0.240	25	2009	9112826	MOE90T9	4.44431	17.78%	9.72	39%	12.46	50%
60		Daksa-III (Low	33/0.240	25	2009	9112827	MOE90T11	3.26025	13.04%	7.13	29%	9.14	37%
61		Daksa School Area	33/0.240	16	2009	9112240	MOE90T10	10.39405	64.96%	22.73	142%	29.15	182%
62		Gongdue	33/0.240	25	2009	9112902	MOE90T7	2.38238	9.53%	5.21	21%	6.68	27%
								361.5889845					
										2025		**2030**	
										kVA	**% loading**	**kVA**	**% loading**
										1137.1		**1375.29**	
										4.724		**5.923**	
										5.724		**6.923**	
1	33kV Panbang Feeder	Norbugang	33/0.415	25	2011	11100	PEE100T10	1.029752	4.12%	5.89425	24%	7.1292	29%
2		Pemathang	33/0.415	25	2011	9132321	PEE100T11	8.182146	32.73%	46.8342	187%	56.647	227%
3		Lashingri	33/0.415	25	2011	9132314	PEE100T15	8.050143	32.20%	46.0786	184%	55.733	223%
4		Uper Rinchenzor	33/0.240	16	2011	9112742	PEE100T12	4.11154	25.70%	23.5343	147%	28.465	178%
5		Middle Rinchenzor	33/0.240	16	2011	9112186	PEE100T13	2.999072	18.74%	17.1665	107%	20.763	130%
6		Menchu	33/0.240	16	2011	9112186	PEE100T14	1.873875	11.71%	10.726	67%	12.973	81%
7		Ningshingborang(school area)	33/0.415	25	2011	9112194	PEE100T7	6.683856	26.74%	38.2581	153%	46.274	185%
8		Geog office	33/0.240	25	2011	9112306	PEE100T8	11.45925	45.84%	65.5922	262%	79.335	317%
9		Rangthangwoong	33/0.240	25	2011	9132326	PEE100T9	1.36515	5.46%	7.81405	31%	9.4512	38%
10		Uper Borangmo	33/0.415	63	2014	33/1028	PEE100T1	5.396319	8.57%	30.8883	49%	37.36	59%
11		Lower Borangmo	33/0.415	25	2014	33/1366	PEE100T2	3.629615	14.52%	20.7757	83%	25.129	101%
12		Uper Tsheshingzor	33/0.240	25	2011	9112297	PEE100T5	5.48028	21.92%	31.3689	125%	37.941	152%
13		Lower Tsheshingzor	33/0.240	16	2011	2814/4	PEE100T6	2.54422	15.90%	14.563	91%	17.614	110%
14		Middle Tsheshingzor	33/0.240	16	2011	9112202	PEE100T4	5.167394	32.30%	29.5779	185%	35.775	224%
15		Tsheshingzor	33/0.240	25	2011	9112725	PEE100T3	4.4767	17.91%	25.6244	102%	30.993	124%
1	Panbang feeder	Umdang village	33/.415kV	25	2010	11	ZHE70T1	1.87		10.7038	43%	12.946	52%
2		Laling village	33/.415kV	25	2010	1117	ZHE70T2	1.98		11.3334	45%	13.708	55%
3		Thinleygang	33/.415kV	125	2012	33/1016	ZHE70T3	20.45		117.055	94%	141.58	113%
4		Sonamthang	33/.415kV	63	2012	33/1022	ZHE70T4	19.85		113.62	180%	137.43	218%
5		Marangduth	33/.415kV	25	2012	33/1053	ZHE70T5	2.22		12.7072	51%	15.37	61%
6		Panbang Bazar	33/.415kV	250	2010	12325	ZHE70T6	34.23		195.931	78%	236.98	95%
7		Tungudenpa	33/.415kV	25	2012	33/1052	ZHE70T7	1.49		8.52869	34%	10.316	41%
8		Jirang	33/.240kV	10	2011	10119820	ZHE70T8	2.92		16.7139	167%	20.216	202%
9		Rebati	33/.415kV	25	2011	10139890	ZHE70T9	4.24		24.2696	97%	29.354	117%

10		Rebati School	33/.240kV	25	2009	9112864	ZHE70T10	2.64		15.1112	60%	18.277	73%
11		Changerzam	33/.415kV	25	2011	10139893	ZHE70T11	5.19		29.7073	119%	35.932	144%
12		Royal Manas Park	33/.415kV	250	2017	20764	ZHE70T12	15.2		87.004	35%	105.23	42%
13		Dalung	33/.240kV	16	2011	10119833	ZHE70T14	2.22		12.7072	79%	15.37	96%
14		Nalung	33/.240kV	16	2011	10119834	ZHE70T15	1.31		7.49838	47%	9.0694	57%
15		Galabi	33/.415kV	63	2014	2810/11	ZHE70T16	10.39		59.4718	94%	71.932	114%
								198.649312					

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**