BHUTAN POWER CORPORATION LIMITED
(An ISO 9001:2015, ISO 14001:2015 & OHSAS 18001:2007 Certified Company)
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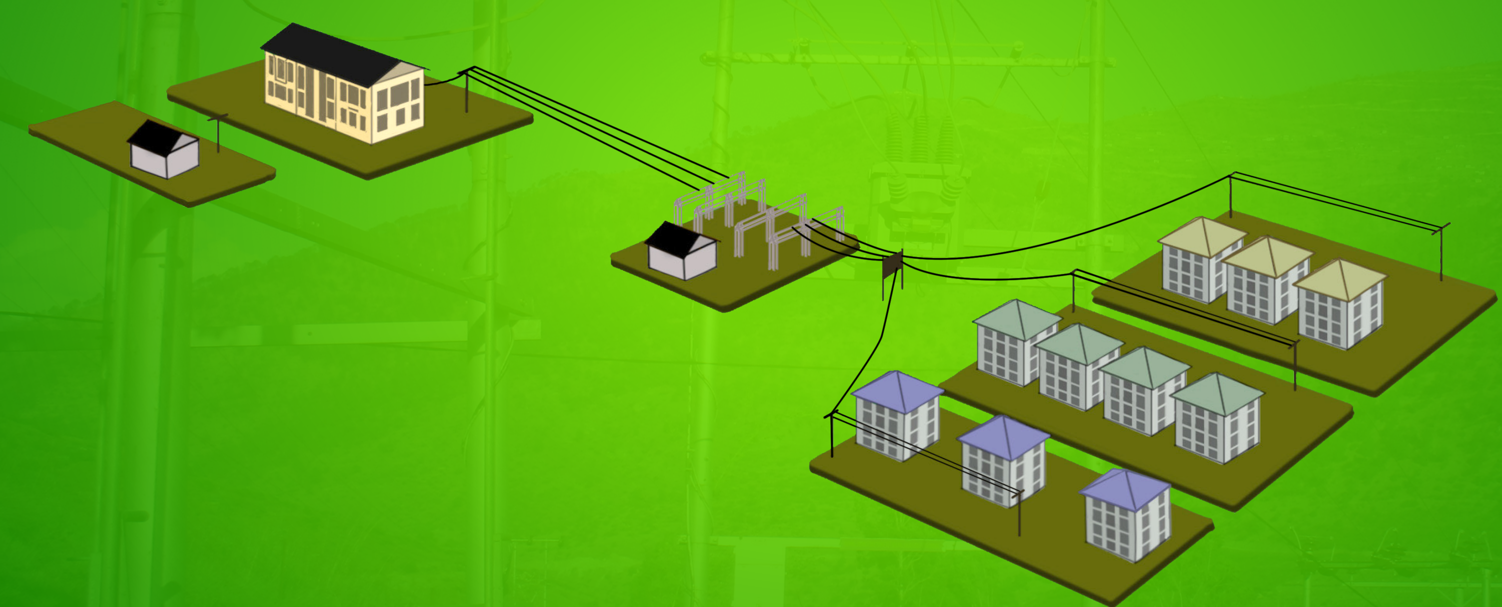
DISTRIBUTION SYSTEM MASTER PLAN (2020-2030)

DAGANA 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

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

Table of contents

List of Tables

List of Figures

Abbreviations

BPC: Bhutan Power Corporation Limited

ESD: Electricity Services Division

DSMP: Distribution System Master Plan

GIS: Geographical Information System

SLD: Single Line Diagram

ETAP: Electrical Transient and Analysis Program

IS: Indian Standard on Transformers

IEC: International Electro-Technical Commission

IP: Industrial Park

DT: Distribution Transformer

TSA: Time Series Analysis

LRM: Linear Regression Method

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

DDCS: Distribution Design and Construction Standards

kVA: Kilo Volt Ampere

W: Watt

kWh: Kilo Watt Hour

RMU: Ring Main Unit

ARCB: Auto Recloser Circuit Breaker

ISD: Intelligent Switching Device

FPI: Fault Passage Indicator

ICT: Interconnecting Transformer

Definitions

Asset Life: The period (or the 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 services, such as during short-term emergencies or longer unplanned outages and during periods of scheduled maintenance when the units must be shut down. 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 can 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 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 are interconnected with several 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 is 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 for 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 are not online, it is said to be "down."

Outage - Interruption of service to an electric consumer.

Overload - Operation of equipment over normal, full-load rating, or of a conductor above 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 can maintain its delivery of electric energy within the tolerable limits of voltage and without outages or other problems that 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 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 networks established across the country. Towards realizing the mission, vision and destination statement of BPC as outlined in the Corporate Strategic Plan (2019-2030), there is a need to carry out comprehensive studies of the distribution system to address the system deficiencies as the ground realities are different triggered by technological advancement and economic growth.

The existing distribution networks are modeled and accordingly, the technical evaluation is carried out adopting the generally accepted load forecasting framework i.e. Time Series Analysis in conjunction with Linear Regression Method, the power requirement for the 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 Plan2019 including the investment (2020-2027). The identification of the system deficiencies and qualitative remedial measures that would require system automation and remote control as per the existing and projected load is 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 include but are not limited to a reliable power supply to the customers, reduction of distribution losses, and network capability with the anticipated load growth, optimization of the resources and to develop an 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) are 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;

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

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 the 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.

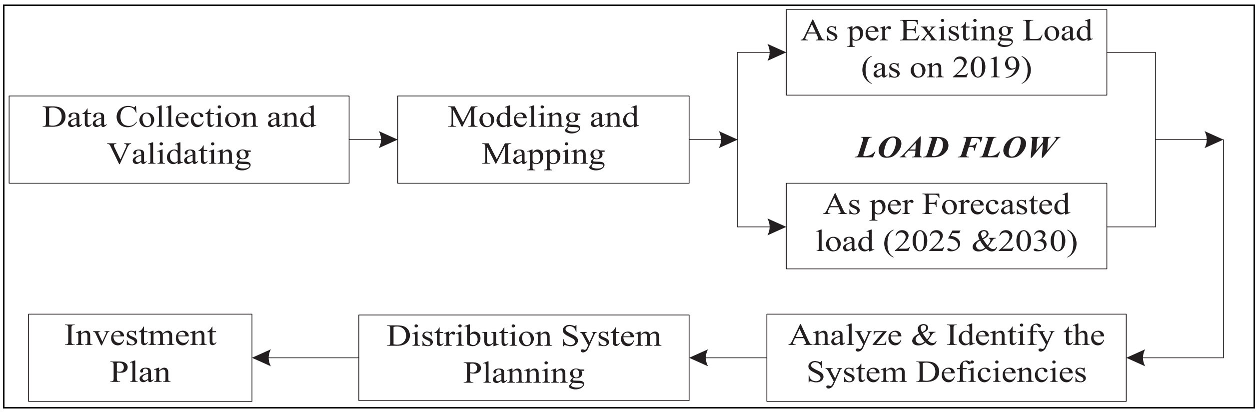


Figure 1: Block diagram for distribution system planning for thematic studies

5.1 Data Collection and Validation

To carry out the detailed studies with greater accuracy, complete and reliable data for the existing distribution infrastructure is required. Therefore, an intensive field investigation was carried out during January 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 the 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 with 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 the 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 2020-2024) have been validated based on the outcome of the system studies and accordingly, the yearly investment plans are outlined as per the priority matrix as detailed in **Section 9.**

6. Existing Electricity Distribution Network

6.1 Overview of Power Supply Sources

The power supply to eleven (11) Gewogs (Goshi, Tshendagang, Gaserling, Dorona, Tashiding, Khebisa, Tseza, Kana, Tshangkha, Drujaygang, and Lhajab) of Dagana Dzongkhag is from 220/33kV, 20MVA Dagapela and 66/33kV, 2x5MVA Dharjey substations. The basic electricity distribution network model as seen from the source at Dagapela, Dharjey, and Darachu generation is illustrated in the schematic diagram shown in **Figure 2.**

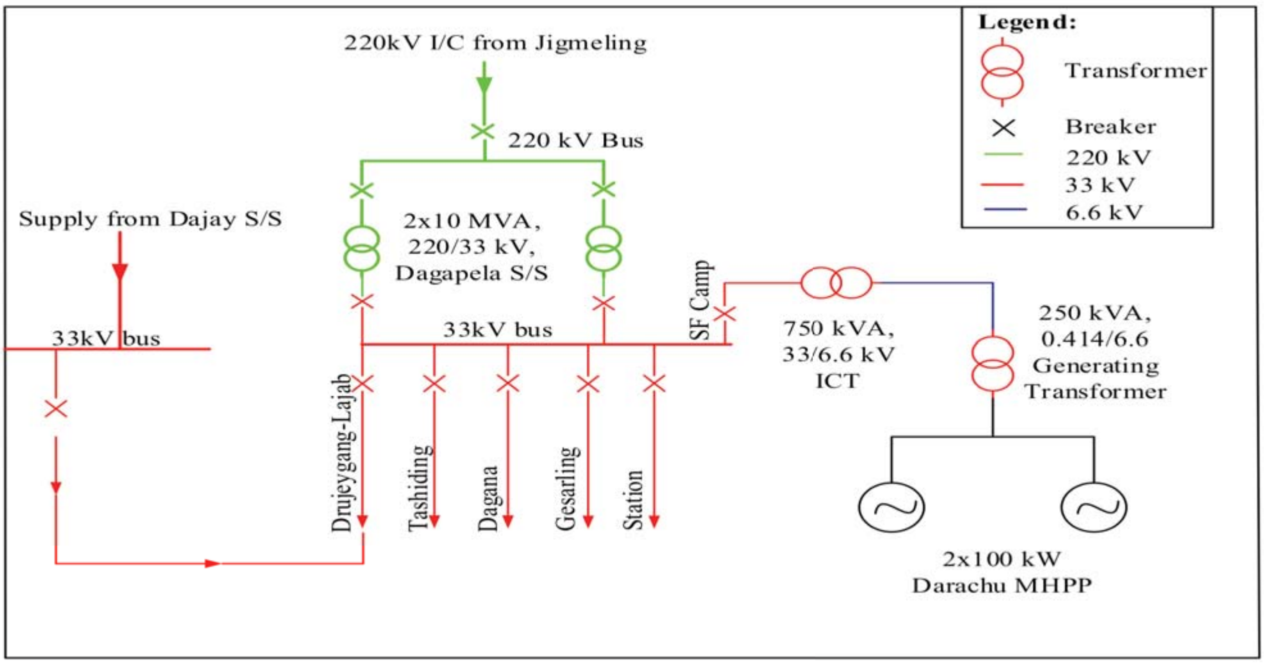


Figure 2: Electricity distribution schematic diagram

Prior to commissioning of 220/33kV, 2x10 MVA Dagapela substation, the power supply was arranged through 33kV feeder of 220/66/33kV, 2x5 MVA Dharjey substation, which is further distributed to various parts of Dzongkhag through five (5) 33kV outgoing feeders. However, with the commissioning of 220/33kV, 2x10MVA Dagapela substation in the year 2019, the substation is the primary source to the Dzongkhag. While the Dharjey substation is provisioned as a contingency source, part of the Dagana (Tsangkha, Lhajab, and Drujaygang gewogs) is still catered from the Dharjey substation.

Further, the power generated from 200kW Darachu Mini Hydel is sync to the grid and interconnected to 33kV SF6 feeder through 750 kVA, 6.6/33kV ICT.

6.2 Electricity Distribution Lines

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

Table1: MV and LV Line Infrastructure Details

Sl.No.	33 kV line length (km)		6.6 kV line Length (km)		Total MV line (km)		LV lines (km)		Total LV Length (km)
	OH	UG	OH	UG	OH	UG	OH	UG	
1	256.98	-	39.71	-	296.69	-	429.96	-	429.96

The MV line length is 296.69 km and the total LV line length is 429.96km. The ratio of LV to MV line length is 1.45:1 which reflects a high proportion of power distribution through LV network. While the ratio of LV to MV line length would vary according to the site conditions, as a general rule, 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 33 kV and 6.6 kV 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 Feeders	Feeder Length (km)	DTs (Nos.)	Connected (kVA)	Customers (Nos.)
Dagapela 220/33kV SS	2x10	33kV S.F Camp feeder	7.56	7	2,314.00	675
		33kV Gaserling feeder	40.68	20	710.00	478
		33kV Dagana feeder	73.68	51	2,400.00	1,368
		33kV Tashiding feeder	34.68	36	1,476.00	746
		33kV Drujeygang-Lhajab feeder	100.38	99	9,086	2,173
Darachu Mini Hydel	200kW	6.6 kV S.F Camp feeder	39.71	18	1,684	266
		Total	**296.69**	**231**	**17,670.00**	**5,706.00**

As of July 2020, there were 231 distribution transformers with a total installed capacity of 17,670.00kVA. As can be inferred from **Table 2,** the installed capacity of the transformer per customer is 3.10kVA.

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 has been carried out bifurcating HV and MV substations as detailed below.

7.1.1 HV Substation (220/33/kV)

The 220/33kV, 2x10MVA Dagapela substation is the primary power source and 220/66/33kV, 2x5 MVA Dharjey substations as an alternate source for the Dzongkhag.

Table 3: Peak load of Dagapela substation

Sl. No.	Name of Source	Voltage Level (kV)	Installed Capacity		Peak Load (MW)	Forecasted Load (MW)		Remarks
			MVA	MW*	2019	2025	2030	
1	Dagapela Substation	220/33	2x10	17	3.07	4.67	6.28	Including Lhamoizingkha Load
2	Darachu Mini Hydel	6.6/0.415		0.200	0.17	0.17	0.17	
Total Load (MW)					**3.24**	**4.84**	**6.45**	
1	Dagapela Substation	220/33	2x10	17	2.62	3.73	4.77	Excluding Lhamoizingkha Load
2	Darachu Mini Hydel	6.6/0.415		0.200	0.17	0.17	0.17	
Total Load (MW)					**2.79**	**3.90**	**4.94**	

Pf of 0.85 is considered for study purpose

As evident from **Table 3,** the recorded peak load at 220/33kV Dagapela substation in the year 2019-2020 is 3.24MW including the load shared by Darachu Mini Hydel and is forecasted to reach 6.45MW by 2030 (including the load of Lhamoizingkha Dungkhag and that of the LAP) against the installed capacity of 17MW. Therefore, the substation would be adequate to meet the power requirement of the Dzongkhag.

7.1.2 MV Substation

There is no MV substation under the administration of the Dzongkhag.

7.2 Assessment of MV Feeders

Feeder wise planning is necessary to ensure that the power delivery capacity, power quality and reliability requirements of the customers are met. In distribution system, capacity assessment of existing MV feeders is important to ensure that feeders are adequate to transmit the peak demand of the customers. 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 historical peak demand recorded at the source is presented in **Table 4** and the corresponding feeder-wise annual load curve is presented in **Figure 3.**

Table 4: Historical feeder wise peak power demand

Sl. No	Power Source	Name of Feeder	Peak Load (MW)					
			2014	2015	2016	2017	2018	2019
1	Dagapela 2x10MVA,220/ 33kV s/s	33kV S.F Camp feeder	0.47	0.47	0.48	0.48	0.49	0.49
2		33kV Geasarling feeder	0.64	0.66	0.68	0.71	0.73	0.76
3		33kV Dagana feeder	0.43	0.47	0.51	0.55	0.59	0.63
4		33kV Tashiding feeder	0.59	0.61	0.63	0.65	0.68	0.70

Sl. No	Power Source	Name of Feeder	Peak Load (MW)					
			2014	2015	2016	2017	2018	2019
5		33kV Drujeygang-Lhajab feeder	0.41	0.52	0.62	0.72	0.82	0.93
6	Darachu Mini Hydel, 200MW	6.6 kV S.F Camp feeder	0.10	0.12	0.13	0.15	0.12	0.12

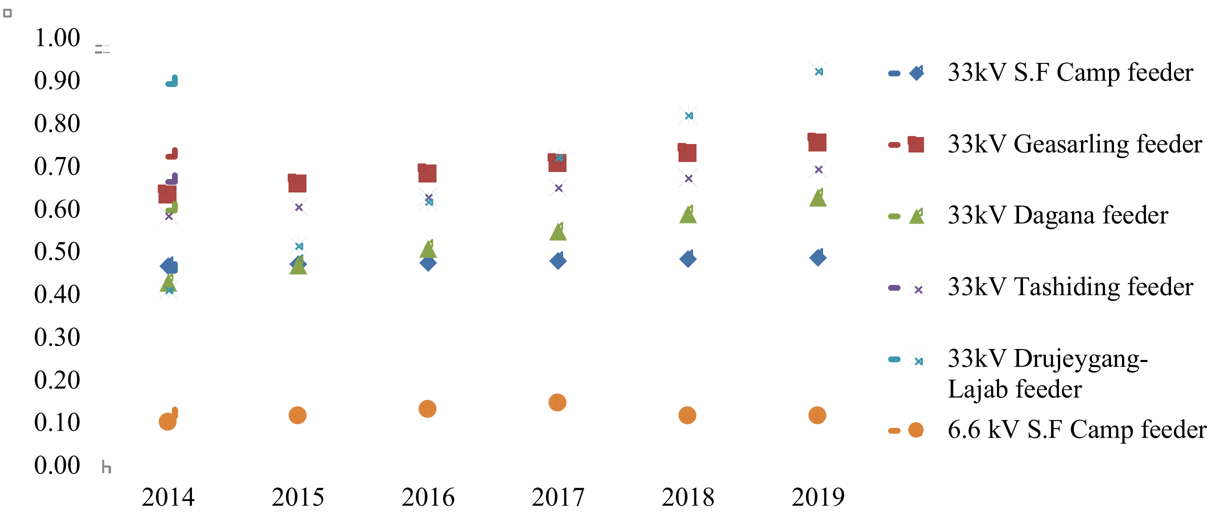


Figure 3: Feeder wise peak load

As can be inferred from **Figure 3,** the feeder wise peak load has grown steadily over the years. The 33kV Drujeygang-Lhajab feeder has seen significant increase in the power requirement and in fact the increase is 100% (from 0.41MW in 2014 to 0.93MW in 2019) in the span of five years. As evident from **Figure 4,** the peak power requirement for 33kV Drujeygang-Lhajab feeder has decreased significantly in 2020 from 2019. This is due to the feeder being the main incomer prior to 2020. From 2020 onwards, the feeder has been exclusively used as the outgoing feeder to cater the load to the customers.

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: When the Darachu is non-operational

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 load as per the thermal capacity of the different conductor sizes as shown in **Table 5.** The voltage profile is as shown in **Table 6**.

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.

Table 6: Voltage profile of the feeders

Feeder Name	Load (MW)	Bus Voltage (%)	End Voltage (%)

Feeder Name	Load (MW)	Bus Voltage (%)	End Voltage (%)
33kV Dagapela Bus	**1.693**	**99.75**	
33kV Drujeygang-Lhajab	0.743	99.75	99.52
33kV Dagana	0.442	99.75	99.25
33kV Tashiding	0.112	99.75	99.74
33kV Gaserling	0.087	99.75	99.75
33kV SF6 Feeder	0.317	99.75	99.25
6.6KkV Darachu Darachu Bus	**0.037**	**99.39**	
6.6kV Line towards Dagana	0.024	99.39	99.09
6.6kV Line towards Dagapela	0.013	99.39	99.26

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

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

The peak power demand from 2014-2019 has been considered to forecast the peak power demand for the next 10 years (2020-2030) as shown in **Table 7** and **Figure 4** adopting the commonly practiced methodology of LRM and TSA with the help of ETAP. The detailed simulation result is attached as **Annexure-4.**

Table 7: Feeder wise load forecast (2020-2030)

Name of Feeder	Forecasted Load (MW)										
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
33kV S.F Camp feeder	0.49	0.50	0.50	0.51	0.51	0.51	0.52	0.52	0.53	0.53	0.53
33kV Geasarling feeder	0.78	0.80	0.83	0.85	0.88	0.90	0.92	0.95	0.97	1.00	1.02
33kV Dagana feeder	0.67	0.71	0.75	0.79	0.83	0.87	0.91	0.95	0.99	1.03	1.07
33kV Tashiding feeder	0.72	0.74	0.76	0.79	0.81	0.83	0.85	0.87	0.90	0.92	0.94
33kV Drujeygang-Lhajab feeder	0.55	0.60	0.64	0.69	0.74	0.78	0.83	0.87	0.92	0.97	1.01
6.6 kV S.F Camp feeder	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.21	0.22	0.23

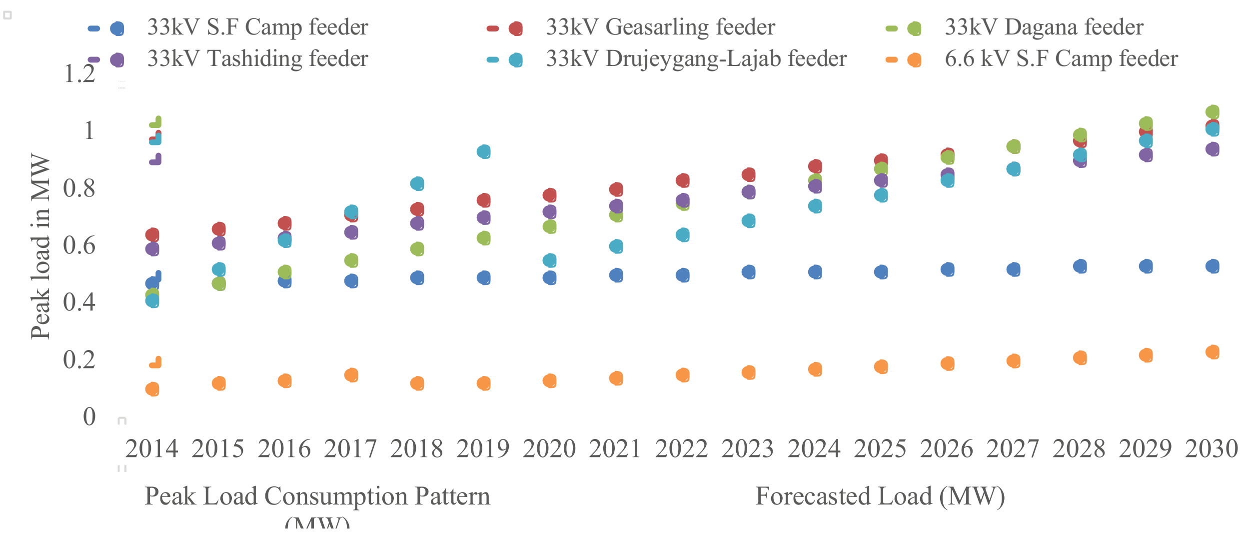


Figure 4: Plot of feeder wise peak power demand forecast

The simulation results for the feeders with marginal and critical voltage profile is tabulated in **Table 8** which is based on 2025 & 2030 forecasted load. Therefore, MV feeders will not require any augmentation or reconfiguration of the network to improve the voltage profile.

Table 8: Voltage profile of the feeders

Feeder Name	2025 Load (MW) and Voltage (%)			2030 Load (MW) and Voltage		
	Load	Bus	End	Load	Bus	End
33kV Dagapela Bus	**3.597**	**99.34**		**4.602**	**99.12**	
33kV Drujeygang-Lhajab	1.462	99.34	98.69	2.105	99.12	98.15
33kV Dagana	0.813	99.34	98.26	0.996	99.12	97.77
33kV Tashiding	0.432	99.34	99.25	0.513	99.12	99.01
33kV Gaserling	0.262	99.34	99.26	0.295	99.12	99.02
33kV SF6 Feeder	0.570	99.34	98.00	0.605	99.12	97.47
6.6KkV Darachu Bus	**0.092**	**98.36**		**0.106**	**97.9**	
6.6kV Line towards Dagana	0.031	98.36	97.59	0.076	97.9	96.92
6.6kV Line towards Dagapela	0.061	98.36	98.02	0.040	97.9	97.47

c) Darachu Mini Hydropower Plant Non-Operational

The power requirement of the village under Tseza and Goshi Gewogs is met from a 2x100 kW Darachu power plant when it is operational. The generation is interconnected with 33 kV SF6 feeder through 750 kVA, 6.6/33 kV ICT. A system study was carried out to check the behavior of the distribution network when the Darachu power plant is non-operational. From the power flow analysis, it was found that the customers connected to SF6 feeder would experience marginal voltage drop by 2025 and critical voltage by 2030 as shown in **Table 9.** However, the critical voltage profile is not so significant and the same can be improved by utilizing the tap changers of DT which has the allowable range of ±5%. While the voltage profile can be resolved by changing the tap position of the affected distribution transformers, the long term alternative solution would be to convert the existing 6.6 kV to 33 kV distribution network.

Table 9: Voltage profile of the SF6 feeder when the Darachu Mini Hydel is non-operational

Feeder Name	2025				2030			
	Load (MW)	Bus Voltage (%)	End Voltage (%)	% Voltage Drop	Load (MW)	Bus Voltage (%)	End Voltage (%)	% Voltage Drop
33kV SF6 Feeder	0.659	99.27	91.77	-7.55	0.716	99.09	89.58	-9.59

However, there will be additional capex for replacing all the 6.6 kV DTs with the 33 kV DTs. Therefore, the Division needs to come up with proper replacement framework considering the functionality and asset life the 6.6kV distribution network. There are seventeen (17) numbers of 6.6 kV DTs with total installed capacity of 1,684.00 kVA for 266 customers. The detailed study on the conversion of 6.6kV to 33kV distribution network is attached as Annexure-9.

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 of Dagana is as **Table 10** and **Figure 5.**

Table 10: Energy sales, purchase and loss

Sl. No.	Particulars	2015	2016	2017	2018	2019	Average
1	**Energy Requirement (MU)**						
i)	Purchase from GenCos as per TD bill	6.58	6.71	6.70	7.85	8.70	
ii)	Mini/Mini Hydel Generation	0.30	0.38	0.49	0.18	0.32	
iii)	Export	-	-	-	(0.57)	(1.54)	
iv)	HV Purchase		0.002	(0.003)	0.010	0.001	
	Total	**6.89**	**7.10**	**7.19**	**7.45**	**7.48**	
	% growth over previous year	-	3.08%	1.21%	3.66%	0.44%	**2.10%**
2	**Energy Sales (MU)**						
i)	LV Total	5.19	5.67	5.82	6.29	6.45	
ii)	Medium Voltage	0.74	0.56	0.04	-	-	
iii)	High Voltage	0.01	0.00	0.00	0.01	0.00	
	Total Energy Sales	**5.95**	**6.23**	**5.86**	**6.29**	**6.45**	
	% growth over previous year	-	4.87%	-6.04%	7.46%	2.54%	**2.21%**
3	Energy Loss (MU)	0.94	0.86	1.33	1.15	1.03	**1.06**
4	Energy Loss (%)	13.68%	12.18%	18.48%	14.38%	11.37%	**14.02%**

Source: Adapted from Power Data Book 2019, BPC

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

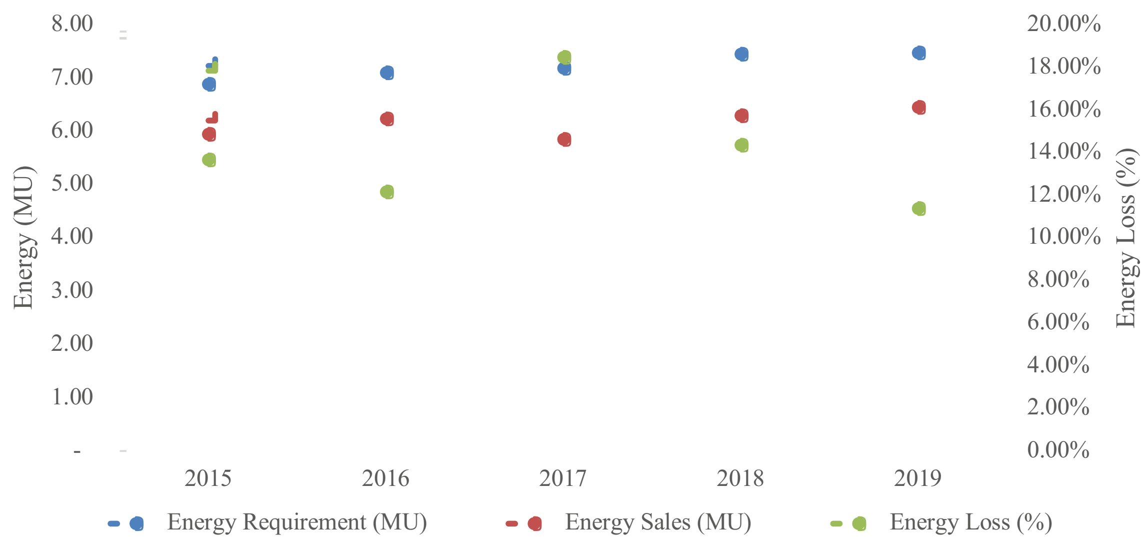


Figure 5: Energy sales, purchase and loss trend

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 losses) 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 14.02% (1.06 million units on average) indicating that there is significantly high commercial loss. Therefore, the Division requires in-depth study and strategies to reduce the commercial loss. However, it is inspiring to note that the loss has reduced significantly from 18.48% in 2017 to 11.37% in 2019. The feeder wise energy loss for 2020 (January to June) is as tabulated in **Table 11** and **Figure 6.**

Table 11: Feeder wise energy loss (2020)

Sl. No.	Name of Feeder	Energy Purchase (MU)	Energy Sales (MU)	Energy Loss (%)
1	33kV SF6 Feeder	0.75	0.73	2.58%
2	33kV Tashiding	0.40	0.36	9.40%
3	33kV Gaserling	1.16	1.11	4.74%

4	33kV Dagana	1.07	0.95	11.10%
5	33kV Drujaygang feeder	1.25	1.16	7.08%
6	6.6 SF6 Feeder	0.18	0.13	26.47%

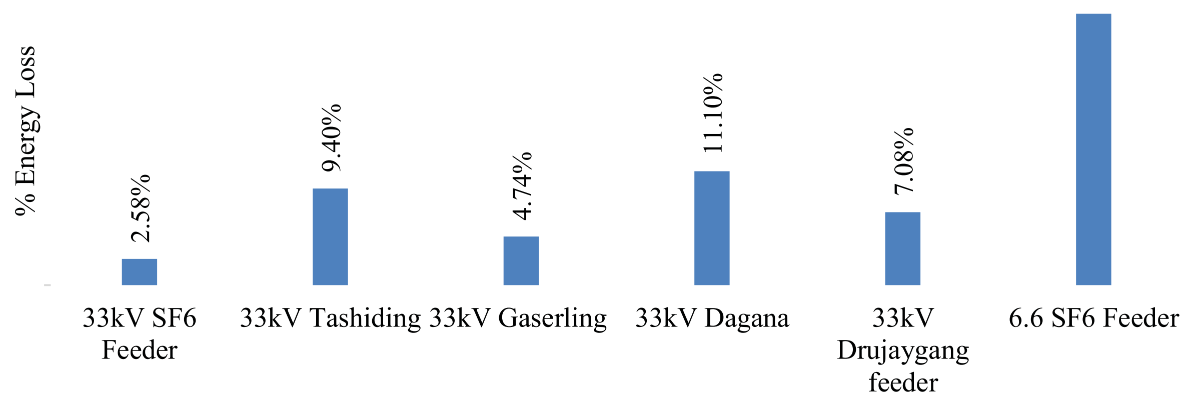


Figure 6: Feeder wise energy loss

As evident from **Figure 6,** the 6.6 kV SF6 feeder has contributed the maximum loss of 26.47 % from January to June 2020. Hypothetically, the high loss could be due to unbalanced load and 6.6kkV system being quite old compared to other feeders. It may be also due to its system voltage being low compared to 11kV and 33kV system (60% of 11kV and 20% of 33kV). Therefore, it is recommended to reduce the unbalanced load, optimize the loading of the DTs and opt to replace the 6.6kV by 33kV system.

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 0.89 % loss out of 14.02% as technical loss due to MV lines and DT and rest (13.13%) is due to LV and commercial loss. The feeder wise MV and DT technical loss is as shown in **Table 12.**

Table 12: Feeder wise power loss (Technical)

Sl. No.	Feeder Name	Total Load (MW)	Loss (MW)	Loss (%)
1	33kV Drujeygang-Lhajab	0.746	0.005	0.67%

Sl. No.	Feeder Name	Total Load (MW)	Loss (MW)	Loss (%)
2	33kV Dagana	0.424	0.005	1.18%
3	33kV Tashiding	0.112	0.00	0.00%
4	33kV Gaserling	0.088	0.001	1.14%
5	33kV SF6 Feeder	0.355	0.003	0.85%
6	6.6kV Line	0.063	0.002	3.17%
	Total	**1.788**	**0.016**	**0.89%**

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. The yearly average feeder reliability assessment (2017-2019) is summarized in **Table 13.** The individual feeder reliability details used to derive the 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 53.58 & 59.56 respectively which indicates that the power supply to the customers of the Dzongkhag is unreliable.

Table 13: Feeder wise reliability indices (2017-2019)

Name of Feeders	2017		2018		2019		Average	
	SAIFI	SAIDI	SAIFI	SAIDI	SAIFI	SAIDI	SAIFI	SAIDI

Name of Feeders	2017		2018		2019		Average	
	SAIFI	SAIDI	SAIFI	SAIDI	SAIFI	SAIDI	SAIFI	SAIDI
33kV Drujeygang-Lhajab	60.89	28.69	37.41	36.13	9.87	22.65	36.06	29.16
33kV S.F Camp feeder	2.69	4.94	4.14	3.19	2.98	2.52	3.27	3.55
33kV Dagana feeder	6.62	21.19	7.25	6.44	3.04	2.72	5.64	10.12
33kV Gaserling feeder	3.59	11.68	4.65	6.11	3.27	2.33	3.84	6.71
33kV Tashiding feeder	5.99	22.87	5.83	3.84	2.51	3.38	4.78	10.03
Total SAIFI & SAIDI	**79.79**	**89.37**	**59.27**	**55.71**	**21.68**	**33.61**	**53.58**	**59.56**

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.

As seen in **Table 13** and **Figure 7**, the 33 kV Drujeygang-Lhajab feeder has the highest interruption and duration index which is exceptionally high while the reliability indices for rest of the feeders are within the acceptable range. The poor power reliability could be attributed due to feeder passing through dense forest and rugged terrains. The feeder has the longest circuit line length and is also associated with many spur lines.

However, it is inspiring to note that the power supply reliability in the Dzongkhag has significantly improved by almost four (4) times in terms of interruptions and three (3) times the outage duration per customer per year between 2017 and 2019.

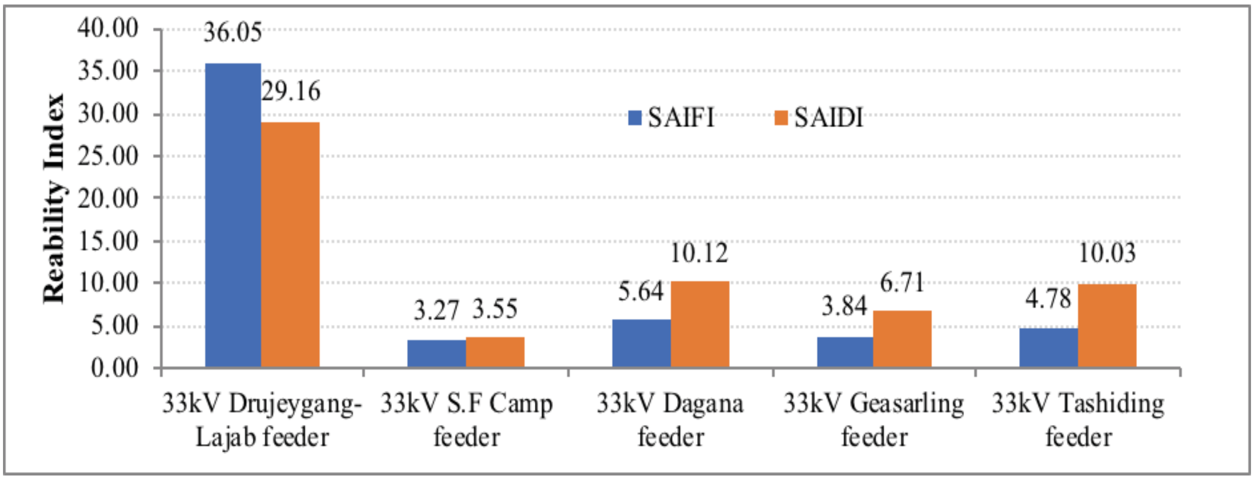
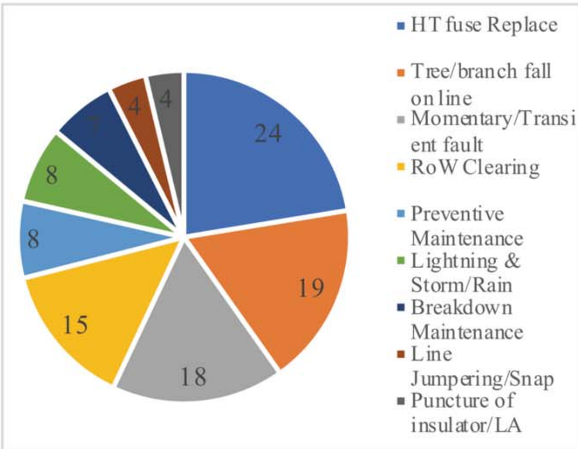


Figure 7: Graphical representation of reliability indices

To get a better understanding of the reliability index, the detailed root cause analysis for the feeders are carried and the inputs are as shown in in **Table 14.**

Table 14: The root cause analysis data

Root Causes	**Frequency**	**Interruption %**
HT fuse Replace	24	22%
Tree/branch fall on line	19	17%
Momentary/Transient fault	18	16%
RoW Clearing	15	14%
Preventive Maintenance	8	7%
Lightning & Storm/Rain	8	7%
Breakdown Maintenance	7	6%
Line Jumpering/Snap	4	4%
Puncture of insulator/LA	4	4%
Others	3	3%
	110	**100%**



Others: Birds/animals falling on line, fire, landslide.

The power outages are mainly due to shutdown undertaken to replace the HT fuse (22 %), trees and branches falling on the line (17%), transient fault (16 %) and RoW (14%). It is 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. Since, the Dzongkhag falls in the tropical region, the growth rate is higher compared to that of high altitude areas. Most of the transient faults are directly associated with the RoW clearing for the distribution lines.

In order to improve the reliability, the Division is recommended to increase the frequency of ROW clearing, make the non-working ARCBs functional and install FPIs to locate the faults and early restoration. Additional line LA could also be installed at critical locations to minimize the power interruptions due to lightning.

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 significantly improve the power quality to the customers.

7.2.4. Single Phase to Three Phase Conversion

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

a) Alternative -I

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

b) Alternative -II

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

c) Alternative -III

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

The total single phase line length required to be converted to three-phase in the Dzongkhag is 30.53km 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 the Existing 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 15**. The individual DT loading details used to derive the summary is attached as **Annexure-7.**

Table 15: List of overloaded distribution transformers

Sl. No.	**Transformer Name/Location**	**Capacity (kVA)**	**Loading (%)**			**Remark**
6.6kV SF6 Feeder			**2019**	**2025**	**2030**	
1	Nindukha	20	41.01%	107.52%	137.55%	Up-grade to 63kVA by 2030
2	Lower Dogap	16	78.05%	204.65%	261.81%	Up-grade to 25kVA by 2025
3	Bichgoan	16	58.73%	153.97%	196.98%	Up-grade to 63kVA by 2025
33kV SF6 Feeder						
1	Goshi Town	250	52.03%	90.94%	94.48%	Up-grade to 500kVA by 2025
33kV Drujaygang-Lhajab feeder						
1	Tshangkha School	25	57.34%	119.23%	158.98%	Up-grade to 63kVA by 2025
33kV Dagana Feeder						
1	Bjurugang A (School)	25	69.27%	144.10%	177.22%	Up-grade to 63kVA by 2025
2	Upper Khagochen	63	42.35%	88.10%	108.34%	Up-grade to 125kVA by 2030
3	Gangjab B	16	45.42%	94.50%	116.20%	Up-grade to 25kVA by 2030. Replace with 25kVA of Namgaygang DT.
4	Namjaygang	25	48.00%	99.80%	122.80%	Up-grade to 63kVA by 2030. Replace with 63kVA Upper Khagochen DT.
33kV Tashiding Feeder						
1	Norbuzingkha A	63	29.72%	134%	158.68%	Up-grade to 125kVA by 2030
2	Namchella D	25	18.87%	85%	100.77%	Up-grade to 63kVA by 2030. Replace with 63kVA of Norbuzingkhag A DT.
3	Mid Gangzur	25	19.37%	87%	103.41%	Up-grade to 63kVA by 2030

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 twelve (12) transformers as tabulated in **Table 15**. However, cross-swapping the existing transformers prior to procurement of new transformers would mean that, only nine (9) 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 16**, 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 16: List of outlived distribution transformers

Sl. No.	DT Locaiton Name	Asset Code	Operation/MFD Year	Service Life (Yrs)		
				2020	2025	2030
1	Tshanglakha	1501860	1992	28	33	38
2	Tashigang	-	1992	28	33	38
3	Samay	1501862	1992	28	33	38
4	Gemjaygang	1501868	1992	28	33	38
5	Lhaling near High way	1501869	1992	28	33	38

7.3.3 Replacement of Single Phase Transformer

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

There are 48 single phase transformers in the Dzongkhag and the estimate for up-grading all the single to three-phase transformers would require Nu. 10.24 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 only LAP under Dagana Dzongkhag is identified at Dagapela which is approved by the National Consultative Committee for Human Settlement (NCCHS) in 2018. As per the LAP report, the total LAP area is 336.87 acres and consists of 499 plots. The total power demand of 5.98 MW is anticipated when all the LAPs are fully developed and realized assuming a coincidental peak of 2 kW per unit. The zone-wise estimated power demand is tabulated in **Table 17.**

Table 17: Zone wise power estimation

Area	No. of Plots	No. of Units	Power Required (MW)
Zone-1	150	6	1.8
Zone-2	166	6	1.99
Zone-3	183	6	2.19
Total	**499**		**5.98**

However, on the flip side, Dagana apparently does not have much development potential in terms of industries and commercial centers as evident from the relatively low growth of power demand. Therefore, load factor of 21 % (1.26 MW) only of the total estimated power demand is considered when forecasting the load which is further distributed over ten (10) year period.

The pictorial view of existing distribution infrastructures available within the boundary of the LAP area is shown in **Figure 8.** Further, the detail of the power infrastructure requirement for the identified LAPs is tabulated in **Table 18.**

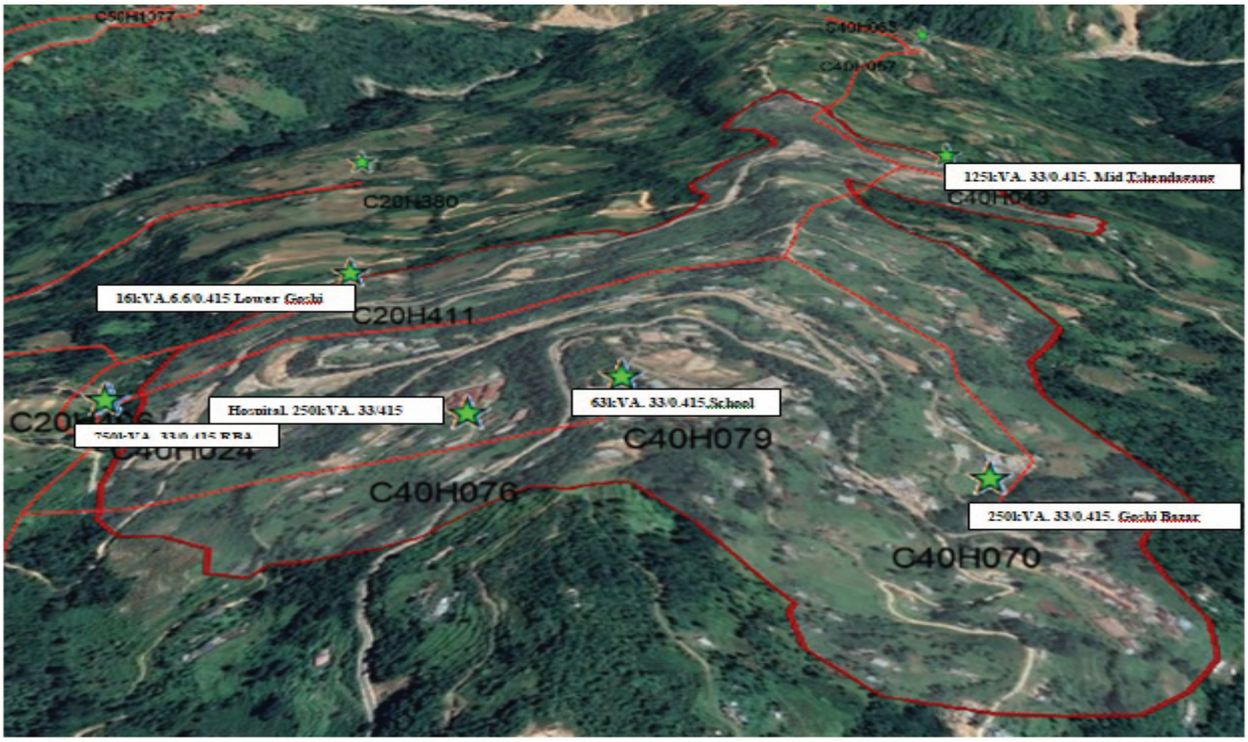


Figure 8: Existing Distribution Infrastructure within the Boundary of LAPs

Table 18: Power requirement for the town

Particulars	**Existing Power infrastructures**			**Additional Requirement**		
1. Distribution Transformer						
Area	**Nos.**	**Capacity (kVA)**	**Location**	**Nos.**	**Capacity (kVA)**	**Location**
Zone-1	1	250	Goshi Town (C40T5)	1	500	Goshi Town & near hospital area each
Zone-2	1	125	Mid Tshendagang (C40T2)	2	250	Tshendagang and PWD area each
Zone-3	1	750	RBA (C40T1)	1	500	Near Artificial Trough
	1	250	Hospital (C40T6)			
	1	63	School (C40T7)			

Particulars	Existing Power infrastructures			Additional Requirement		
	1	16	Lower Goshi (C40T8)			
Total	**6**	**1,454**		**4**	**1,250**	
2. Distribution Lines						
Area	**Line Length (km)**			**Line Length (km)**		
	33kV Line	**6.6kV line**	**0.415kV Line**	**33kV Line**	**6.6kV line**	**0.415kV Line**
Zone-1	1.81		4.5	0.60		3.5
Zone-2	0.755		5.5	0.42		2.5
Zone-3	1.65	0.575	7.3	0.53		3.5
Total	**4.22**	**0.58**	**17.30**	**1.55**		**9.5**

The identified location for the installation of additional distribution transformer is as shown in **Figure 9** with particular captions indicated.

Figure 9: Proposed location the installation of additional DTs

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,** the 10 MVA, 220/33kV Dagapela substation would be adequate to meet the present and forecasted power demand.

8.1.2 MV Substation

As detailed in **Section 7.1.2,** Dagana does not have any MV substation.

8.2 MV Lines

The detailed MV line assessment made in **Section 7.2** shows that the MV distribution lines of the Dzongkhag is adequate to cater the existing as well as future load growth until 2030. However, up-gradation of 6.6kV to 33kV would require augmentation of the lines and its accessories.

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 20 kVA, 6.6/0.415 kV transformer at Nindukha to 63 kVA.

b) Up-grade 16 kVA, 6.6/0.415 kV transformer at Lower Dogap to 63 kVA.

c) Up-grade 16 kVA, 6.6/0.415 kV transformer at Bichgoan to 63 kVA.

d) Up-grade 250 kVA, 33/0.415 kV transformer at Goshi Town to 500 kVA.

e) Up-grade 25 kVA, 33/0.415 kV transformer at Tshangkha Schoo1 to 63 kVA.

f) Up-grade 25 kVA, 33/0.415 kV transformer at Bjurungang A (School) to 63 kVA.

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

h) Up-grade 16 kVA, 33/0.415 kV transformer at Gangjab B to 63 kVA.

i) Up-grade 25 kVA, 33/0.415 kV transformer at Namjaygang to 63 kVA.

j) Up-grade 63 kVA, 33/0.415 kV transformer at Norbuzingkha A to 125 kVA.

k) Up-grade 25 kVA, 33/0.415 kV transformer at Namchella D to 63 kVA.

l) Up-grade 25 kVA, 33/0.415 kV transformer at Mid Gangzur to 63 kVA.

m) Construction of 500 kVA substation at Goshi town.

n) Construction of 500 kVA substation near an artificial trough.

o) Construction of 250 kVA substation at Tshendagang.

p) Construction of 250 kVA substation at PWD camp.

8.4 Switching and Control

Switching and control system is required to take care of the system during faulty situations which ultimately is going to take care of the failure rate, repair and restoration time. This in turn would improve the reliability, safety of the equipment and online staff, optimizes the resource usage and more importantly the revenue generation will be enhanced. In order to capture the real time data and information, it is inevitable to have automated and smart distribution system. The feeders which are more susceptible to faults are identified with proposed restorative measures through the studies. With the exception of tripping of breakers in the sending end substations, existing distribution network is neither automated nor smart to detect the faults and respond in real-time manner. Therefore, 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 Drujeygang-Lhajab feeder is more susceptible to power interruptions. There are ARCB and LBS installed in this feeder. However, to further improve the reliability of the feeders, it proposed to revive the ARCBs and install sectionalizers and FPIs in strategic locations.

In order to improve reliability and power quality of the 33kV feeder, 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 10** shows the list of proposed switching devices for easing operation and maintenance and for improving the reliability of the power supply for the Dzongkhag.

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

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 19 : List of switching equipment (additional)

Name of Feeder	**Location**	**ARCB (Nos)**	**LBS (Nos)**	**FPI's (Nos)**
33kV Drujeygang-Lhajab	At Drujaygang CS tapping point	-	1	
	Chapdara tapping point towards Phunsumgang	-	1	
	LhajabYetsephu towards Balung	-	1	
	Geepsa main trunk line		1	
	At Tshangkha for Lhajab T-off feeder	1	-	1
	At Thangna for Phaparkhei T-off feeder	-	1	1
33kV Dagana	Dalaythang main trunk line	-	1	
	Toward Khagochen tapping point	-	1	
	Kanaka tapping point	-	1	
	Tongsho main trunk line	-	1	
	Dogap top	-	-	2
33kV Tashiding	Gopeni Top	-	1	
	Samdolay	-	-	2
33kV Gaserling	Samtengang tapping toward Nimtola	-	1	
	Samtengang towards Mamaythang	-	1	
	Hathidara Tapping towards Thulo Dorona	-	1	
	Hatidara Tapping towards Sanu Dorona	-	1	
	Lower Gaserling	-	-	2
33kV SF6 Feeder	Lower Tsendagang below BoD	-	1	-

8.4.2 Distribution System Smart Grid

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

9. Investment Plan

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

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).

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

Figure 10: Priority Matrix

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

According to the investment prioritization matrix framework, the yearly investment plan along with the cost estimation is derived and is consolidated in **Table 20** 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 Dagana Dzongkhag is Nu. 51.04 million (Nu. 5.104 million per year).

Table 20: Investment Plan till 2030

Sl.No.	Activities	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total (million)
1	**MV Lines**	-	-	-	-	-	-	-	-	-	-	-	-
1.1	Extension of 33kV line at Daga Dzong (0.8km)	-	-		-	-	-	-	-	0.53	-	-	**0.53**
1.2	Extension of 33kV Line at Khamey (0.35km)	-	-	-	-	0.23	-	-	-	-	-	-	**0.23**
1.3	Extension of 33kVline at Tashigang, Dagana (0.23)	-	-	-	-	-	-	-	-	0.15	-	-	**0.15**
1.4	Extension of 33kV line at Shamay (0.4km)	-	-		0.27	-	-	-	-	-	-	-	**0.27**
1.5	Extension of 33kV line at Nindukha (0.35km)	-	-	-		-	-	0.23	-	-	-	-	**0.23**
1.6	Extension of 33kV line at Dolopchen (1km)	-	-	-			-	0.67		-	-	-	**0.67**
1.7	Extension of 33kV Line at Upper and Lower Dogap (0.6km)	-	-		-	-	-	0.40	-	-	-	-	**0.40**
1.8	Re-conductering of 6.6 kV insulated overhead line with AAAC 50 sq.mm conductor for supply of 33kV line at Garigoan and Bichgang,	-	-	-	-	-	-	-	5.00	-	-	-	**5.00**
1.9	Extension of 33kV line for Dagapela LAP area,1.55			0.28			0.40					0.35	
2	**Distribution Transformers**	-	-	-	-	-	-	-	-	-	-	-	-
2.1	Up-grade 20kVA, 6.6/0.415kV transformer with 63kVA at Nindukha	-	-	-	-	-	-	0.31	-	-	-	-	**0.31**
2.2	Up-grade 16kVA, 6.6/0.415kV transformer with 63kVA at Lower Dogap	-	-	-	-	-	-	0.31	-	-	-	-	**0.31**
2.3	Up-grade 16kVA, 6.6/0.415kV transformer with 63kVA at Lower Bichgoan	-	-	-	-	-	-	-	0.31	-	-	-	**0.31**
2.4	Up-grade 250kVA, 33/0.415kV transformer with 500kVA at Goshi Bazar	-	-	0.50	-	-	-	-	-	-	-	-	**0.50**
2.5	Up-grade 25kVA, 33/0.415kV transformer with 63kVA at Tshangkha School	-	-	-	-	0.31	-	-	-	-	-	-	**0.31**

Sl.No.	Activities	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total (million)
2.6	Up-grade 63kVA, 33/0.415kV transformer with 125kVA at Upper Khagochen	-	-	-	0.31	-	-	-	-	0.23	-	-	**0.54**
2.7	Up-grade 16kVA, 33/0.415kV transformer with 63kVA at Gangjab	-	-	-	-	-	-	-	-	-	-	0.31	**0.31**
2.8	Up-grade 25kVA, 33/0.415kV transformer with 63kVA at Namjeygang	-	-	-	-	-	-	-	-	-		0.31	**0.31**
2.9	Up-grade 25kVA, 33/0.415kV transformer with 63kVA at Norbuzinkha A	-	-	-	-	-	-	-	-	-	0.31		**0.31**
2.10	Up-grade 25kVA, 33/0.415kV transformer with 63kVA at Namchella D	-	-	-	-	-	-	-	-	-	-	0.31	**0.31**
2.11	Up-grade 25kVA, 33/0.415kV transformer with 63kVA at Mid Gangzur	-	-	-	-	-	-	-	-	-	0.31		**0.31**
2.12	Construction of 250kVA, 33/0.415kV for LAP Zone-2	-	-	-	-	-	0.41	-	-	-	-	0.41	**0.82**
2.13	Construction of 500kVA, 33/0.415kV for LAP Zone-3	-	-	0.50	-	-	-	-	-	-	-	-	**0.50**
3	**LV Lines**	-	-	-	-	-	-	-	-	-	-	-	**-**
3.1	LV Line Extension for Dagapela LAP			1.52	1.52	1.52	1.52	2.08	2.08	2.08	2.08	2.08	**16.48**
4	**Switching and Control**	-	-	-	-	-	-	-	-	-	-	-	**-**
4.1	Installation of 33kV FPI	-	-	-	-	-	-	-	-	-	-	-	**0.00**
4.2	Procurement of 11kV ARCB	-	-	-	-	-	-	-	-	-	-	-	**0.00**
	Installation of 33kV LBS		0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	**6.90**
5	Others												
5.1	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**
5.2	Single Phase Transformer to Three Phase conversion	-	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	**10.20**
	Total	**0.00**	**2.09**	**4.89**	**4.19**	**4.15**	**4.42**	**6.09**	**9.48**	**5.08**	**4.79**	**5.86**	**51.04**

10. Conclusion

Based on the inputs from the Divisional office, validated data, assessment of the existing distribution network, and the reliability analysis, recommendations are made for system modifications and improvements. Costs associated with each recommendation 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 network where all the MV lines will have to be converted to three phase and replacing the single phase by three phase transformers on need basis.

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

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

11. Recommendation

Sl. No.	Parameters	Recommendations
A. Power Supply Sources		
1	HV Substations	The Dagapela substation would be adequate to meet the power requirement.
2	MV Substations	There is no MV substation in Dagana Dzongkhag.
B. MV Lines		
1	Extension of Lines	Extension of MV lines in various areas/feeders needs to be implemented.
C. Distribution Transformers		
1	Distribution Transformers	As reflected in **Section 7.3.1** of this report, it is proposed to regularly monitor the loading pattern especially of the urban transformers. It is desired to load the transformers less than 85% so as to ensure that transformer is operated at maximum efficiency. As the system study is restricted to DTs, the loads need to be uniformly distributed amongst the LV feeders to balance the load.
2	Single to Three Phase Transformers	As reported in the "Technical and Financial Proposal on Converting Single Phase Power Supply to Three Phase in Rural Areas", it is recommended to replace the single to three phase transformers on need basis.
D. Switching and Control Equipment		
1	Switching and Control Equipment	It is recommended to install Intelligent Switching Devices (ISD) like ARCBs, Sectionalizers and FPIs as proposed which would reduce the downtime for clearing faults. 1) Install FPI, Sectionalizes and ARCBs at various identified locations. 2) Installation of 11kV& 33kV RMUs at various identified locations.
E. others		
1	Investment Plan	As reflected in **Section 9** of this report, overall investment plan as proposed is recommended.
2	Review of the DSMP	Practically the projections will hold only true in the nearest future therefore, it is strongly recommended to review the DSMP in 2025 (after five years)

Sl. No.	Parameters	Recommendations
		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 and 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. Annexure

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

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

Annexure-3: The details on load forecast methodology.

Annexure-4: Detailed Simulation Results.

Annexure 5: Feeder Wise Reliability Indices.

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

Annexure 7: Distribution Transformer loading.

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

Annexure-9: Proposal to upgrade 6.6kV Line to 33kV

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. Dagana 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.

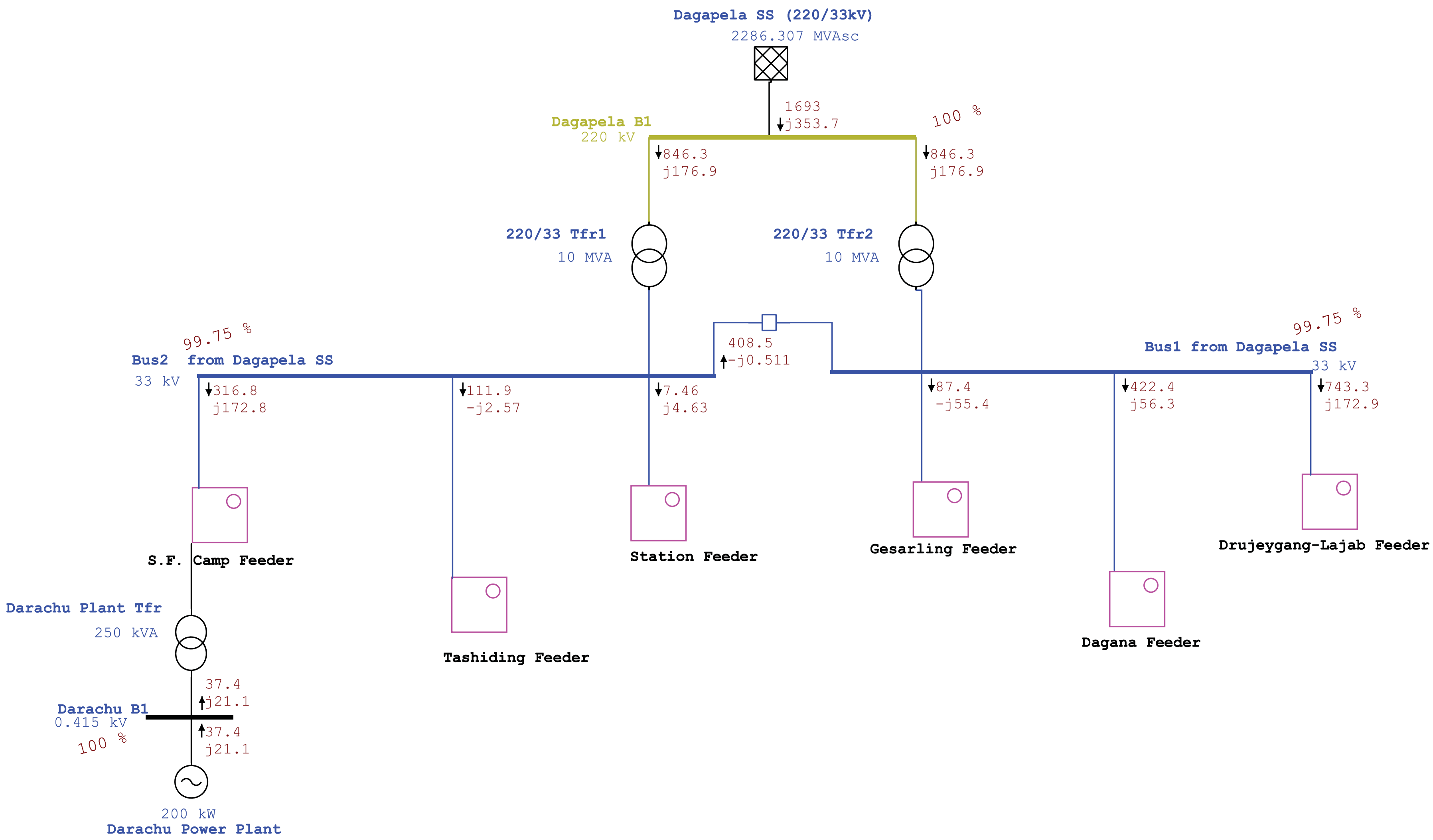
15. Challenges

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

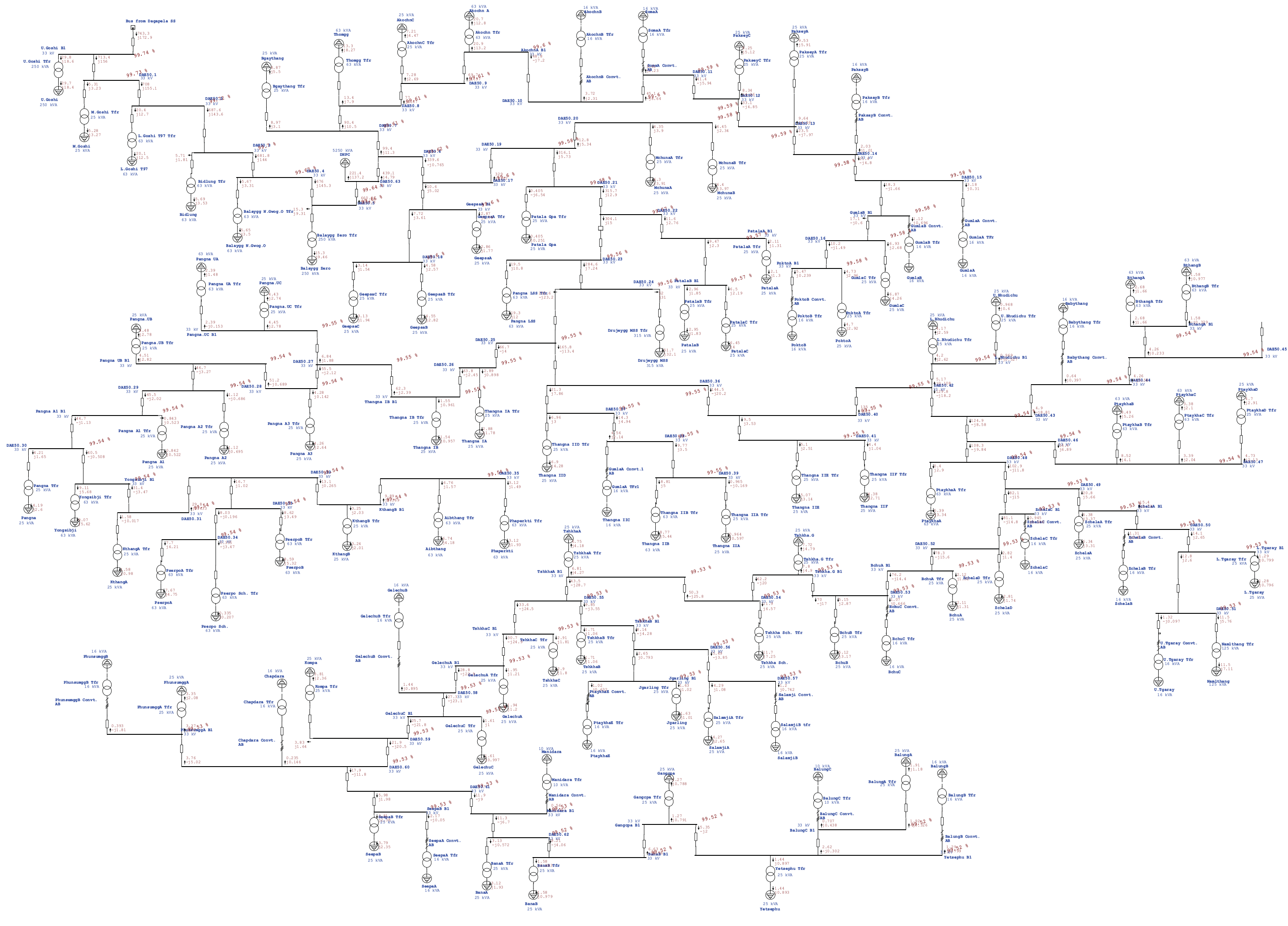
12. Annexures

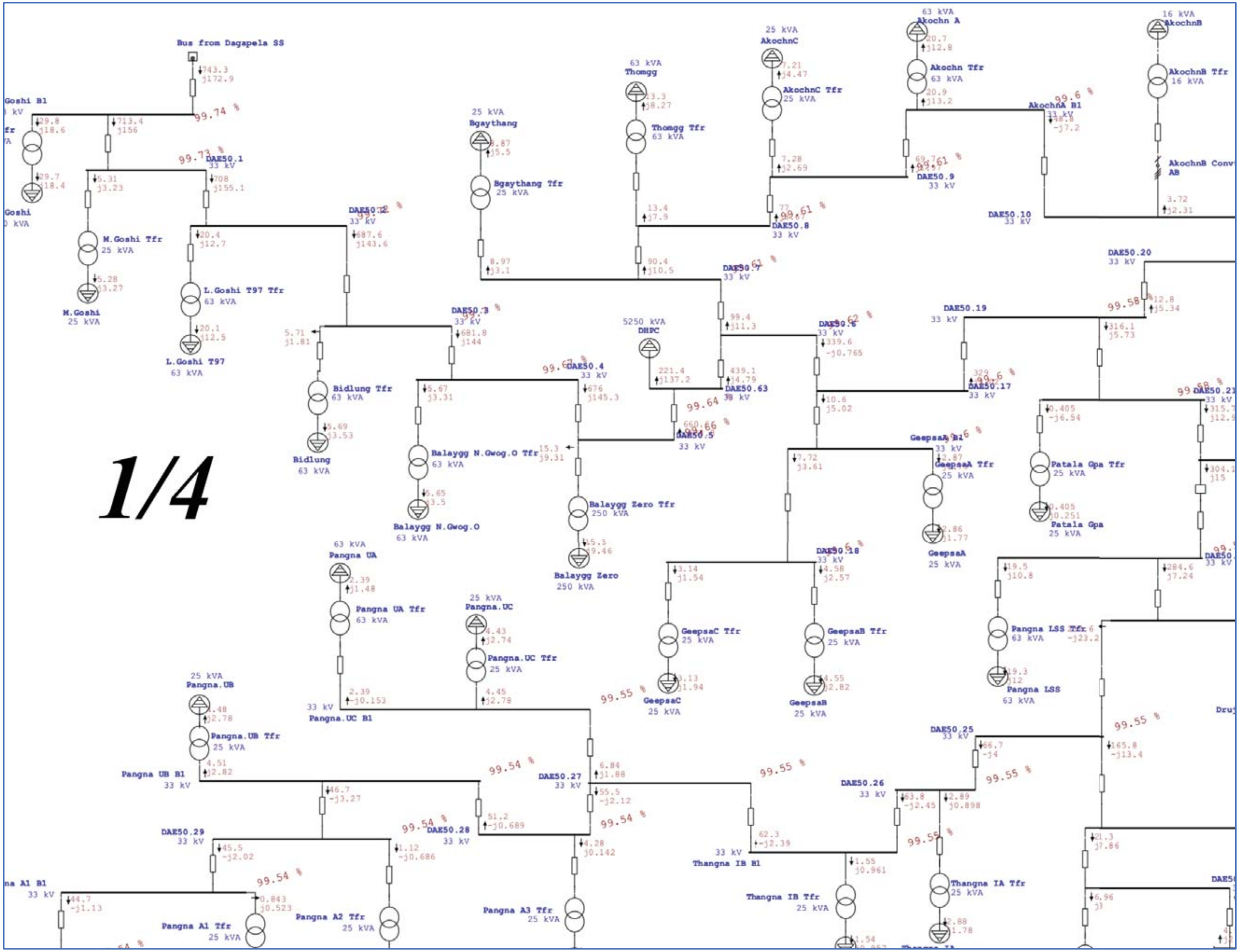
Annexure-1: MV Line Details and Single Line Diagram

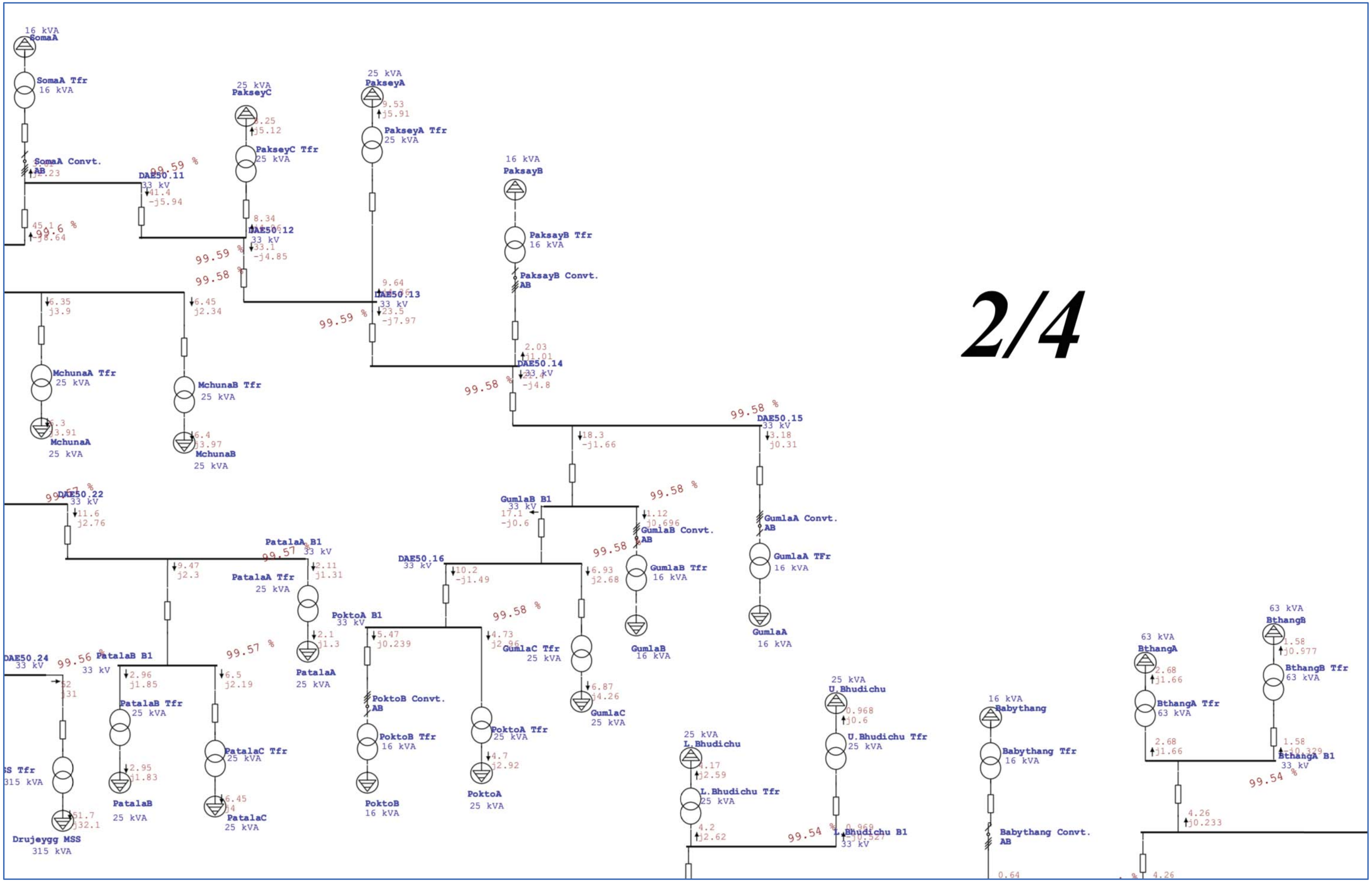
One-Line Diagram - OLV1 (Load Flow Analysis)

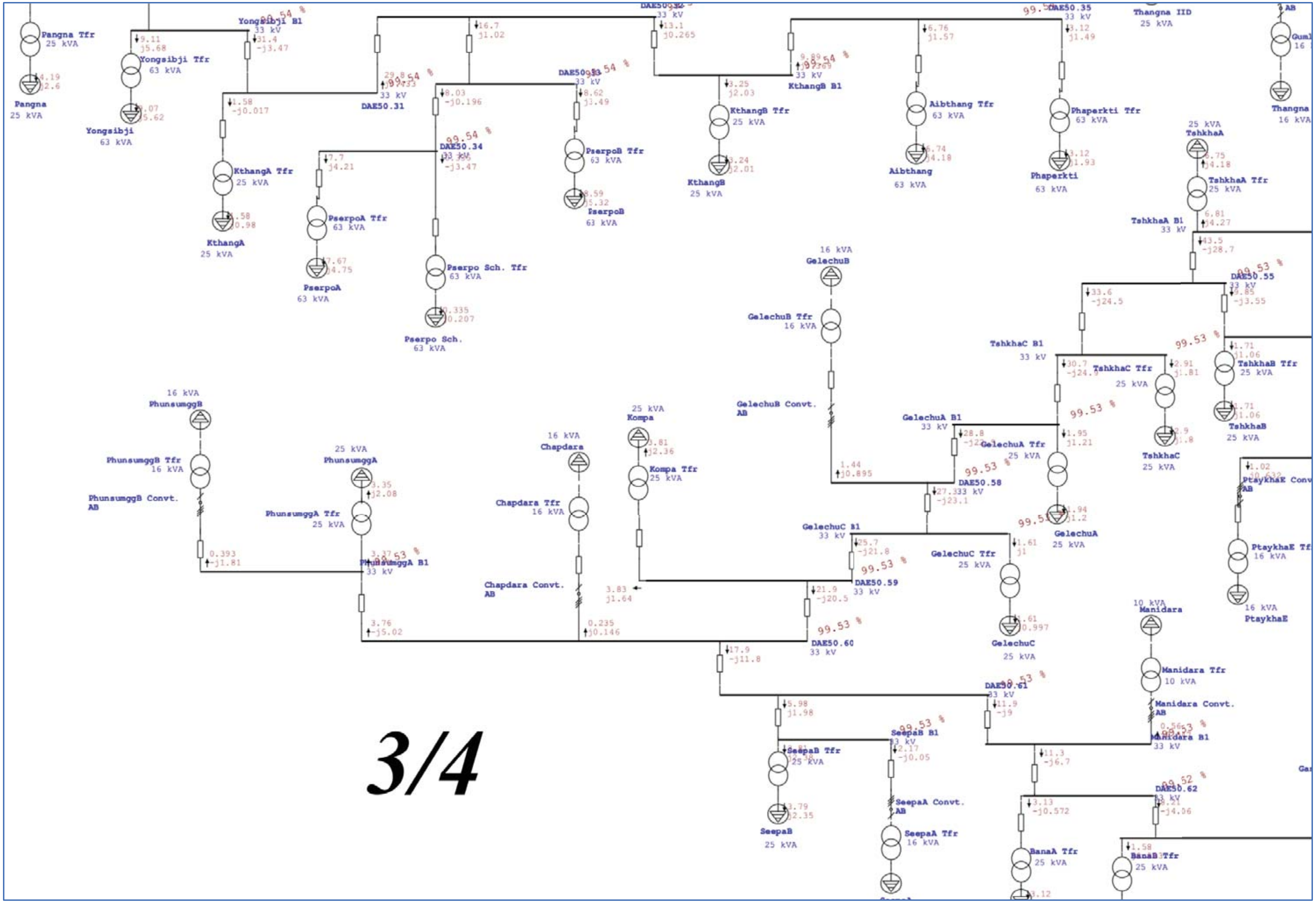


One-Line Diagram - OLV1=>Drujeygang-Lajab Feeder (Load Flow Analysis)

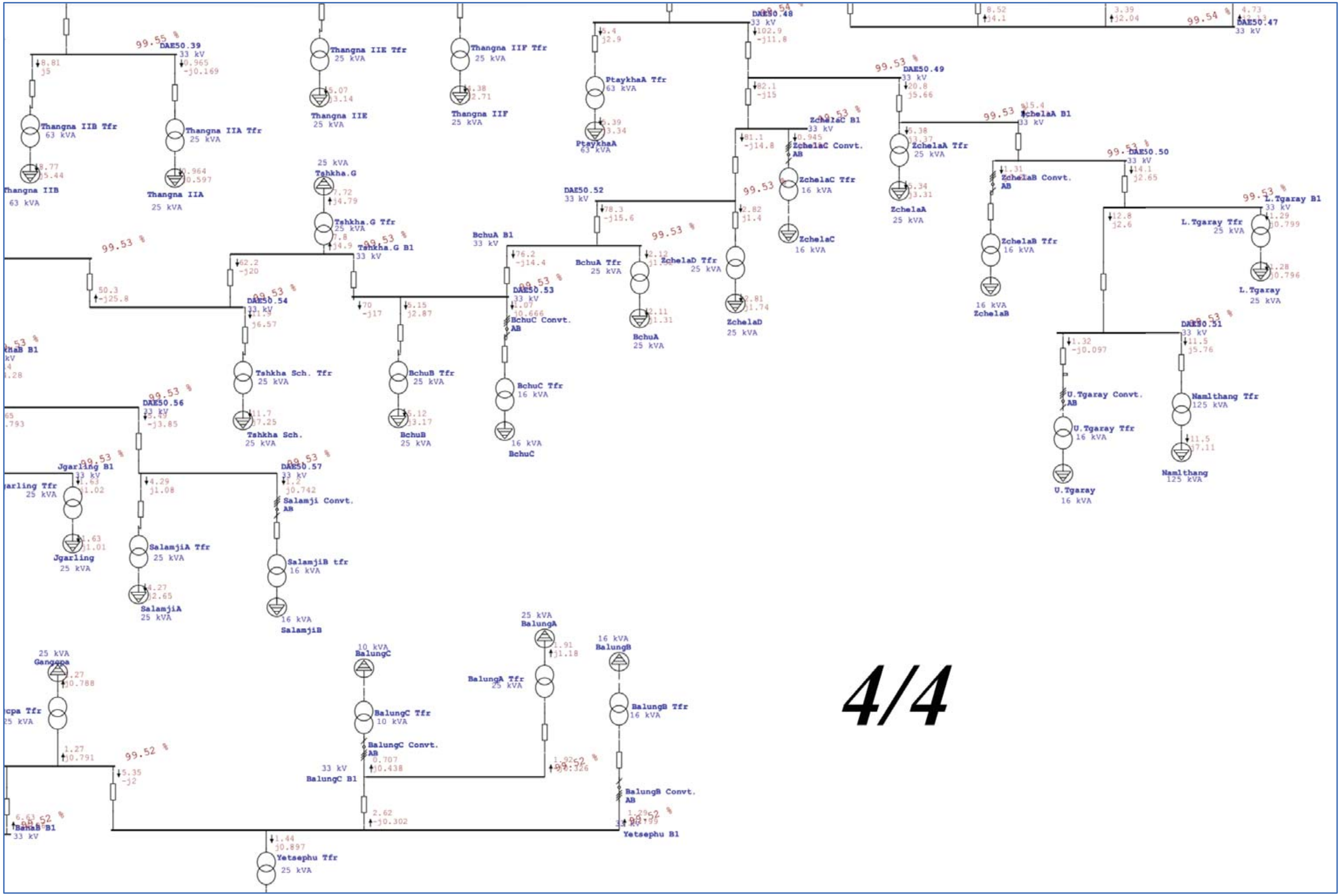



1/4
Bus from Dagapela SS
Goshi B1
DAE50.1
33 kV
M.Goshi Tfr
25 kVA
M.Goshi
L.Goshi T97 Tfr
63 kVA
L.Goshi T97
DAE50.2
DAE50.3
Bidlung Tfr
Bidlung
DAE50.4
Balaygg N.Gwog.O Tfr
Balaygg N.Gwog.O
DAE50.5
Balaygg Zero Tfr
250 kVA
Balaygg Zero
5250 kVA
DHPC
DAE50.63
DAE50.6
DAE50.7
Bgaythang
Bgaythang Tfr
Thomgg
Thomgg Tfr
DAE50.8
AkochnC
AkochnC Tfr
DAE50.9
Akochn A
Akochn Tfr
AkochnA B1
AkochnB
AkochnB Tfr
16 kVA
DAE50.10
DAE50.17
DAE50.18
DAE50.19
DAE50.20
DAE50.21
GeepsaA B1
GeepsaA Tfr
GeepsaA
GeepsaB Tfr
GeepsaB
GeepsaC Tfr
GeepsaC
Patala Gpa Tfr
Patala Gpa
Pangna LSS Tfr
Pangna LSS
Pangna UA
Pangna UA Tfr
Pangna.UC
Pangna.UC Tfr
Pangna.UC B1
Pangna.UB
Pangna.UB Tfr
Pangna UB B1
DAE50.25
DAE50.26
DAE50.27
DAE50.28
DAE50.29
Thangna IB B1
Thangna IB Tfr
Thangna IA Tfr
Pangna A1 Tfr
Pangna A2 Tfr
Pangna A3 Tfr


2/4
SomaA
16 kVA
SomaA Tfr
16 kVA
SomaA Convt.
AB
DAE50.11
33 kV
99.59 %
PakseyC
25 kVA
PakseyC Tfr
25 kVA
DAE50.12
33 kV
PakseyA
25 kVA
PakseyA Tfr
25 kVA
DAE50.13
33 kV
PaksayB
16 kVA
PaksayB Tfr
16 kVA
PaksayB Convt.
AB
DAE50.14
33 kV
99.58 %
DAE50.15
33 kV
MchunaA Tfr
25 kVA
MchunaA
25 kVA
MchunaB Tfr
25 kVA
MchunaB
25 kVA
GumlaB B1
33 kV
GumlaB Convt.
AB
GumlaB Tfr
16 kVA
GumlaB
16 kVA
GumlaA Convt.
AB
GumlaA TFr
16 kVA
GumlaA
16 kVA
DAE50.16
33 kV
GumlaC Tfr
25 kVA
GumlaC
25 kVA
DAE50.22
33 kV
PatalaA B1
33 kV
PatalaA Tfr
25 kVA
PatalaA
25 kVA
PoktoA B1
33 kV
PoktoB Convt.
AB
PoktoB Tfr
16 kVA
PoktoB
16 kVA
PoktoA Tfr
25 kVA
PoktoA
25 kVA
DAE50.24
33 kV
PatalaB B1
33 kV
99.56 %
PatalaB Tfr
25 kVA
PatalaB
25 kVA
PatalaC Tfr
25 kVA
PatalaC
25 kVA
99.57 %
Drujeygg MSS
315 kVA
L.Bhudichu
25 kVA
L.Bhudichu Tfr
25 kVA
U.Bhudichu
25 kVA
U.Bhudichu Tfr
25 kVA
L.Bhudichu B1
33 kV
99.54 %
Babythang
16 kVA
Babythang Tfr
16 kVA
Babythang Convt.
AB
BthangA
63 kVA
BthangA Tfr
63 kVA
BthangB
63 kVA
BthangB Tfr
63 kVA
BthangA B1
33 kV
99.54 %

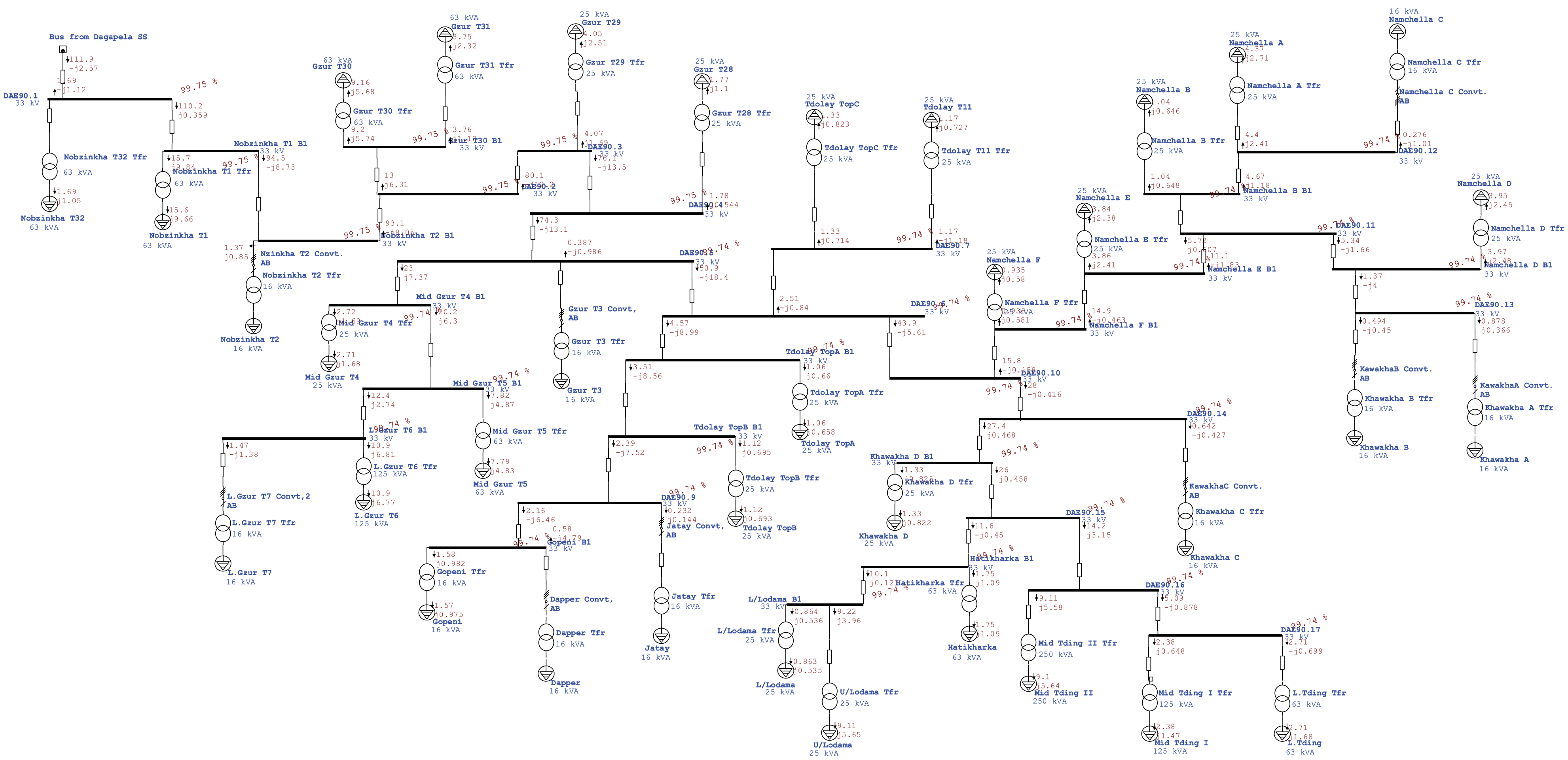

Pangna Tfr
25 kVA
Pangna
25 kVA
Yongsibji Tfr
63 kVA
Yongsibji
63 kVA
Yongsibji B1
33 kV
DAE50.31
KthangA Tfr
25 kVA
KthangA
25 kVA
DAE50.34
PserpoA Tfr
63 kVA
PserpoA
63 kVA
Pserpo Sch. Tfr
63 kVA
Pserpo Sch.
63 kVA
PserpoB Tfr
63 kVA
PserpoB
63 kVA
KthangB B1
33 kV
KthangB Tfr
25 kVA
KthangB
25 kVA
Aibthang Tfr
63 kVA
Aibthang
63 kVA
DAE50.35
33 kV
Phaperkti Tfr
63 kVA
Phaperkti
63 kVA
Thangna IID
25 kVA
Thangna
16 kVA
TshkhaA
25 kVA
TshkhaA Tfr
25 kVA
TshkhaA B1
33 kV
DAE50.55
33 kV
TshkhaC B1
33 kV
TshkhaC Tfr
25 kVA
TshkhaC
25 kVA
TshkhaB Tfr
25 kVA
TshkhaB
25 kVA
GelechuB
16 kVA
GelechuB Tfr
16 kVA
GelechuB Convt.
AB
GelechuA B1
33 kV
GelechuA Tfr
25 kVA
GelechuA
25 kVA
DAE50.58
33 kV
GelechuC B1
33 kV
GelechuC Tfr
25 kVA
GelechuC
25 kVA
DAE50.59
33 kV
DAE50.60
33 kV
PtaykhaE Tfr
16 kVA
PtaykhaE
16 kVA
PhunsumggB
16 kVA
PhunsumggB Tfr
16 kVA
PhunsumggB Convt.
AB
PhunsumggA
25 kVA
PhunsumggA Tfr
25 kVA
PhunsumggA B1
33 kV
Chapdara
16 kVA
Chapdara Tfr
16 kVA
Chapdara Convt.
AB
Kompa
25 kVA
Kompa Tfr
25 kVA
DAE50.61
33 kV
SeepaB Tfr
25 kVA
SeepaB
25 kVA
SeepaB B1
33 kV
SeepaA Convt.
AB
SeepaA Tfr
16 kVA
Manidara
10 kVA
Manidara Tfr
10 kVA
Manidara Convt.
AB
Manidara B1
33 kV
BanaA Tfr
25 kVA
DAE50.62
33 kV
BanaB Tfr
25 kVA

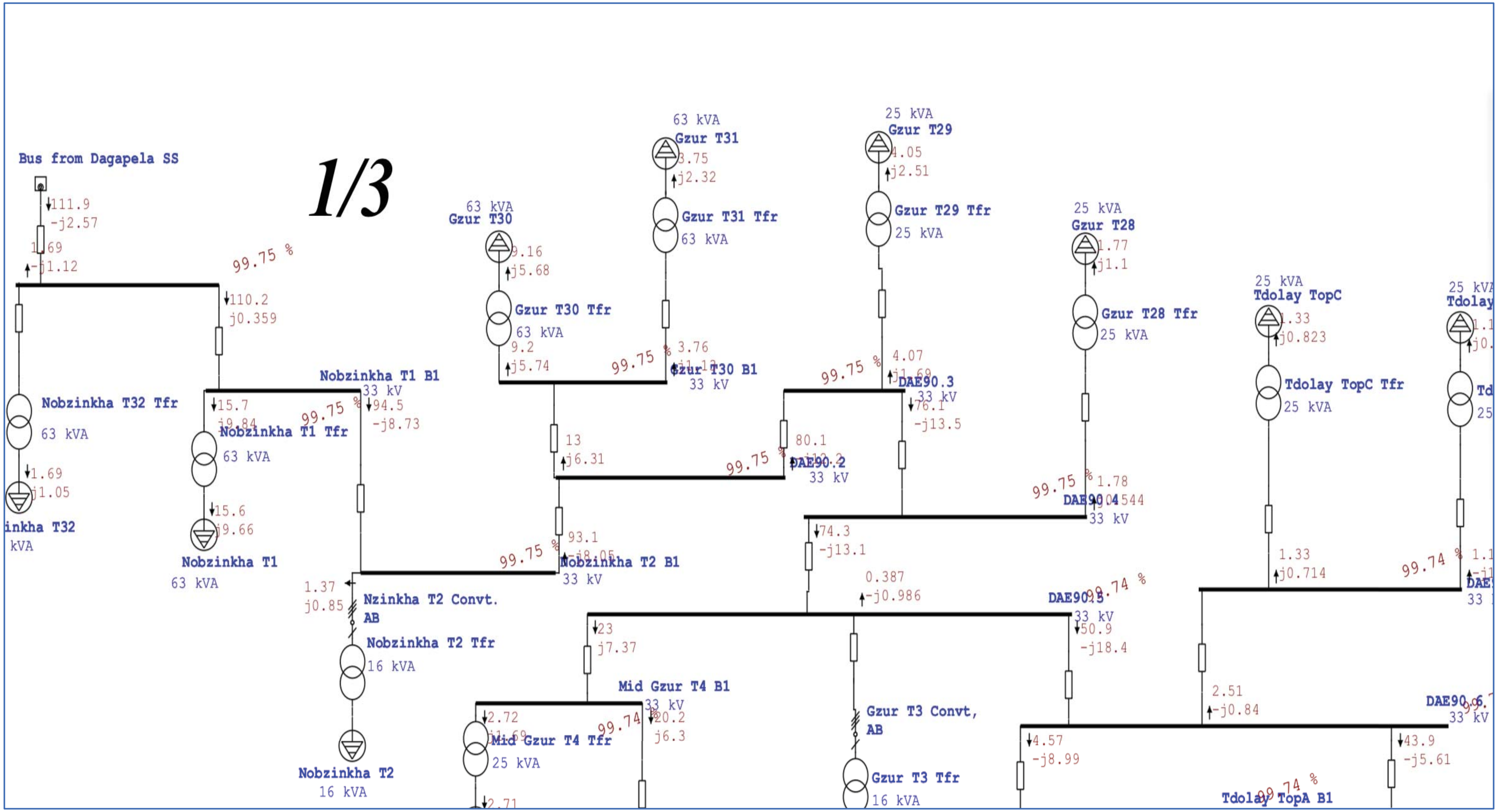
3/4

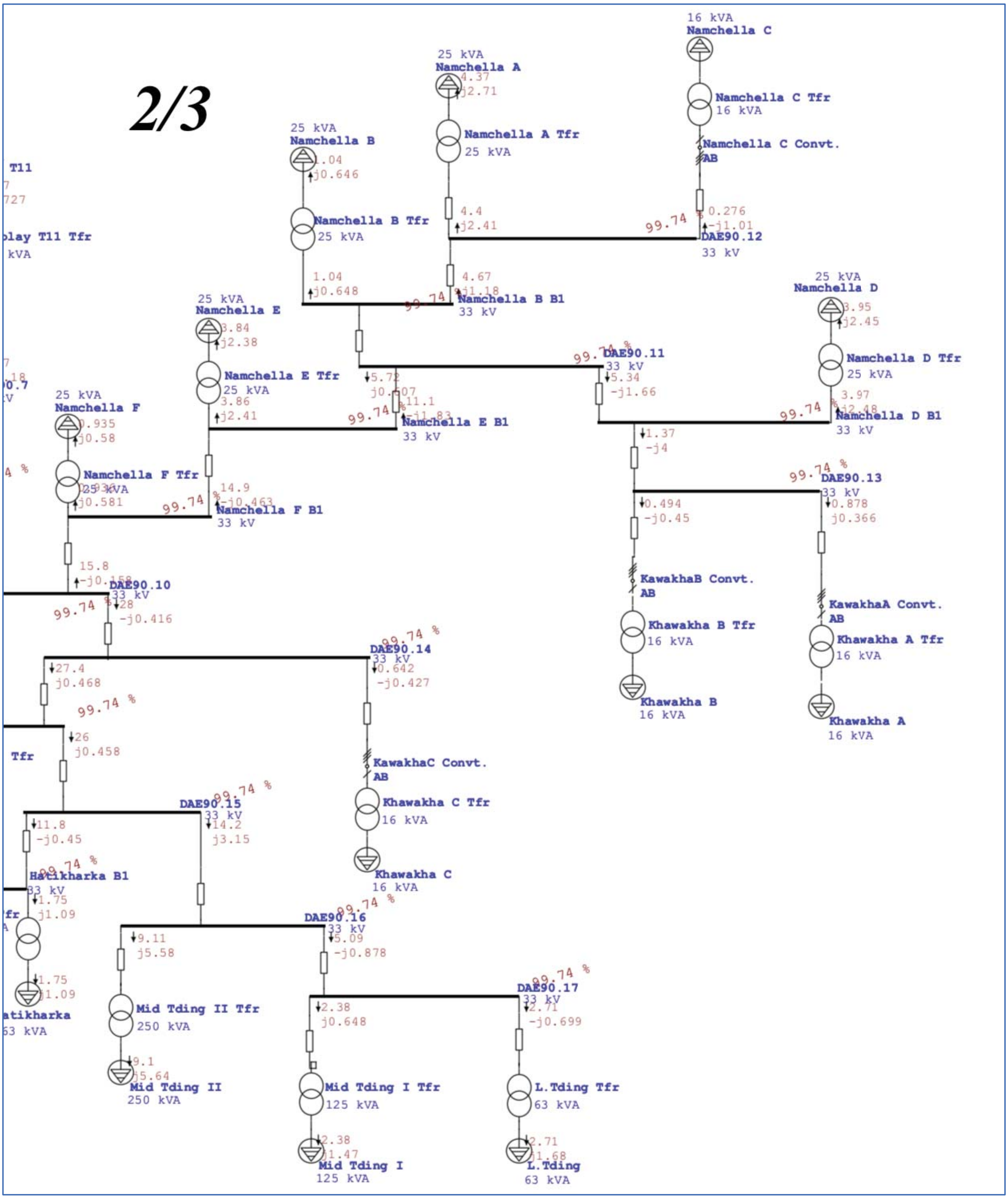


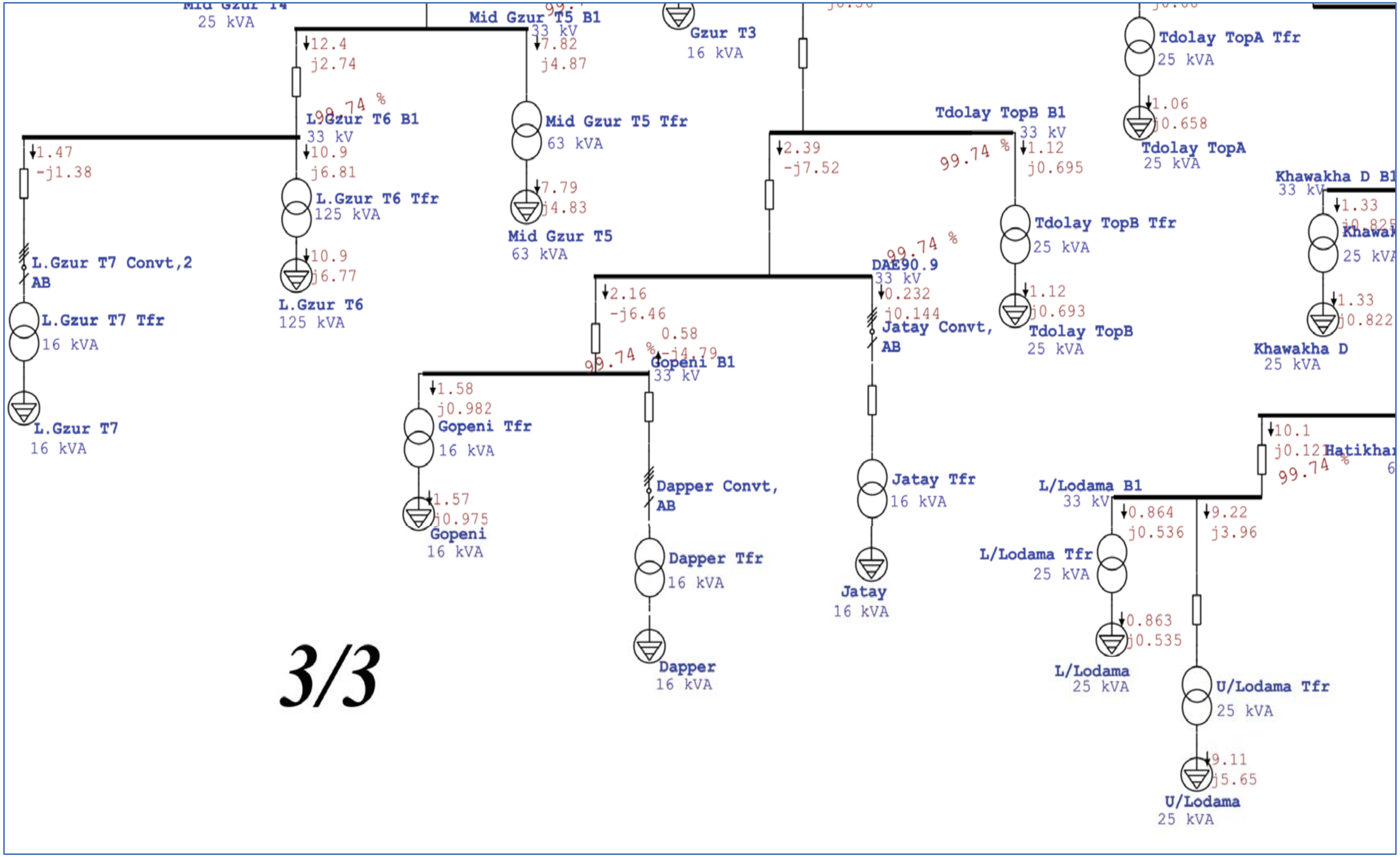
DAE50.47
33 kV
99.54 %
DAE50.48
33 kV
DAE50.39
33 kV
99.55 %
Thangna IIB Tfr
63 kVA
Thangna IIB
63 kVA
Thangna IIA Tfr
25 kVA
Thangna IIA
25 kVA
Thangna IIE Tfr
25 kVA
Thangna IIE
25 kVA
Thangna IIF Tfr
25 kVA
Thangna IIF
25 kVA
PtaykhaA Tfr
63 kVA
PtaykhaA
63 kVA
DAE50.49
33 kV
99.53 %
ZchelaA Tfr
25 kVA
ZchelaA
25 kVA
ZchelaA B1
33 kV
DAE50.50
33 kV
ZchelaB Convt.
AB
ZchelaB Tfr
16 kVA
ZchelaB
16 kVA
L.Tgaray B1
33 kV
L.Tgaray Tfr
25 kVA
L.Tgaray
25 kVA
DAE50.51
33 kV
U.Tgaray Convt.
AB
U.Tgaray Tfr
16 kVA
U.Tgaray
16 kVA
Namlthang Tfr
125 kVA
Namlthang
125 kVA
ZchelaC B1
33 kV
ZchelaC Convt.
AB
ZchelaC Tfr
16 kVA
ZchelaC
16 kVA
DAE50.52
33 kV
ZchelaD Tfr
25 kVA
ZchelaD
25 kVA
BchuA B1
33 kV
BchuA Tfr
25 kVA
BchuA
25 kVA
DAE50.53
33 kV
BchuC Convt.
AB
BchuC Tfr
16 kVA
BchuC
16 kVA
BchuB Tfr
25 kVA
BchuB
25 kVA
Tshkha.G
25 kVA
Tshkha.G Tfr
25 kVA
Tshkha.G B1
33 kV
DAE50.54
33 kV
Tshkha Sch. Tfr
25 kVA
Tshkha Sch.
25 kVA
DAE50.56
33 kV
Jgarling B1
33 kV
Jgarling
25 kVA
SalamjiA Tfr
25 kVA
SalamjiA
25 kVA
DAE50.57
33 kV
Salamji Convt.
AB
SalamjiB tfr
16 kVA
SalamjiB
16 kVA
Gangapa
25 kVA
99.52 %
BalungC
10 kVA
BalungC Tfr
10 kVA
BalungC Convt.
AB
BalungC B1
33 kV
BalungA
25 kVA
BalungA Tfr
25 kVA
BalungB
16 kVA
BalungB Tfr
16 kVA
BalungB Convt.
AB
Yetsephu B1
Yetsephu Tfr
25 kVA
4/4

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




1/3
Bus from Dagapela SS
Nobzinkha T32 Tfr
63 kVA
Nobzinkha T1 B1
33 kV
Nobzinkha T1 Tfr
63 kVA
Nobzinkha T1
63 kVA
Nzinkha T2 Convt. AB
Nobzinkha T2 Tfr
16 kVA
Nobzinkha T2
16 kVA
Nobzinkha T2 B1
33 kV
Gzur T30
63 kVA
Gzur T30 Tfr
63 kVA
Gzur T30 B1
33 kV
Gzur T31
63 kVA
Gzur T31 Tfr
63 kVA
Gzur T29
25 kVA
Gzur T29 Tfr
25 kVA
DAE90.3
33 kV
DAE90.2
33 kV
Gzur T28
25 kVA
Gzur T28 Tfr
25 kVA
DAE90.4
33 kV
DAE90.5
33 kV
Tdolay TopC
25 kVA
Tdolay TopC Tfr
25 kVA
Mid Gzur T4 B1
33 kV
Mid Gzur T4 Tfr
25 kVA
Gzur T3 Convt, AB
Gzur T3 Tfr
16 kVA
Tdolay TopA B1
DAE90.6
33 kV
99.75 %
99.74 %
111.9
-j2.57
110.2
j0.359
15.7
94.5
-j8.73
1.69
j1.05
15.6
j9.66
1.37
j0.85
9.16
j5.68
9.2
j5.74
3.75
j2.32
3.76
13
j6.31
93.1
4.05
j2.51
4.07
80.1
-j13.5
1.77
j1.1
1.78
74.3
-j13.1
0.387
-j0.986
50.9
-j18.4
1.33
j0.823
1.33
j0.714
23
j7.37
2.72
20.2
j6.3
2.51
-j0.84
4.57
-j8.99
43.9
-j5.61

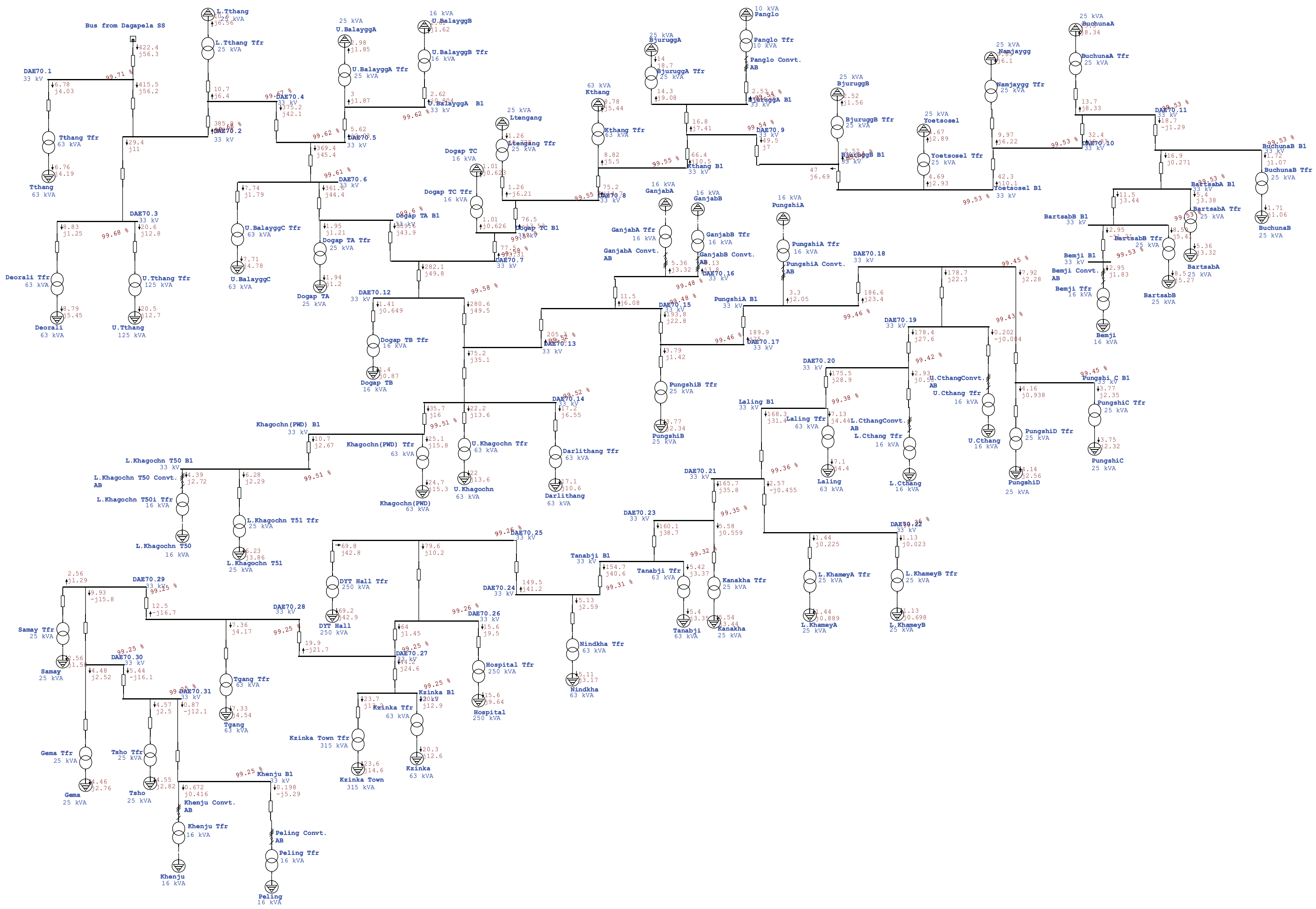

2/3
16 kVA
Namchella C
Namchella C Tfr
16 kVA
Namchella C Convt.
AB
0.276
-j1.01
DAE90.12
33 kV
25 kVA
Namchella A
4.37
j2.71
Namchella A Tfr
25 kVA
4.4
j2.41
4.67
j1.18
Namchella B B1
33 kV
25 kVA
Namchella B
1.04
j0.646
Namchella B Tfr
25 kVA
1.04
j0.648
25 kVA
Namchella E
3.84
j2.38
Namchella E Tfr
25 kVA
3.86
j2.41
5.72
j0.607
11.1
-j1.83
Namchella E B1
33 kV
DAE90.11
33 kV
5.34
-j1.66
25 kVA
Namchella D
3.95
j2.45
Namchella D Tfr
25 kVA
3.97
j2.48
Namchella D B1
33 kV
1.37
-j4
DAE90.13
33 kV
0.494
-j0.45
0.878
j0.366
KawakhaB Convt.
AB
Khawakha B Tfr
16 kVA
Khawakha B
16 kVA
KawakhaA Convt.
AB
Khawakha A Tfr
16 kVA
Khawakha A
16 kVA
25 kVA
Namchella F
0.935
j0.58
Namchella F Tfr
25 kVA
j0.581
14.9
-j0.463
Namchella F B1
33 kV
15.8
DAE90.10
33 kV
28
-j0.416
DAE90.14
33 kV
0.642
-j0.427
27.4
j0.468
26
j0.458
KawakhaC Convt.
AB
Khawakha C Tfr
16 kVA
Khawakha C
16 kVA
DAE90.15
33 kV
11.8
-j0.45
14.2
j3.15
Hatikharka B1
33 kV
1.75
j1.09
DAE90.16
33 kV
9.11
j5.58
5.09
-j0.878
Mid Tding II Tfr
250 kVA
9.1
j5.64
Mid Tding II
250 kVA
DAE90.17
33 kV
2.38
j0.648
2.71
-j0.699
Mid Tding I Tfr
125 kVA
L.Tding Tfr
63 kVA
2.38
j1.47
Mid Tding I
125 kVA
2.71
j1.68
L.Tding
63 kVA
99.74 %

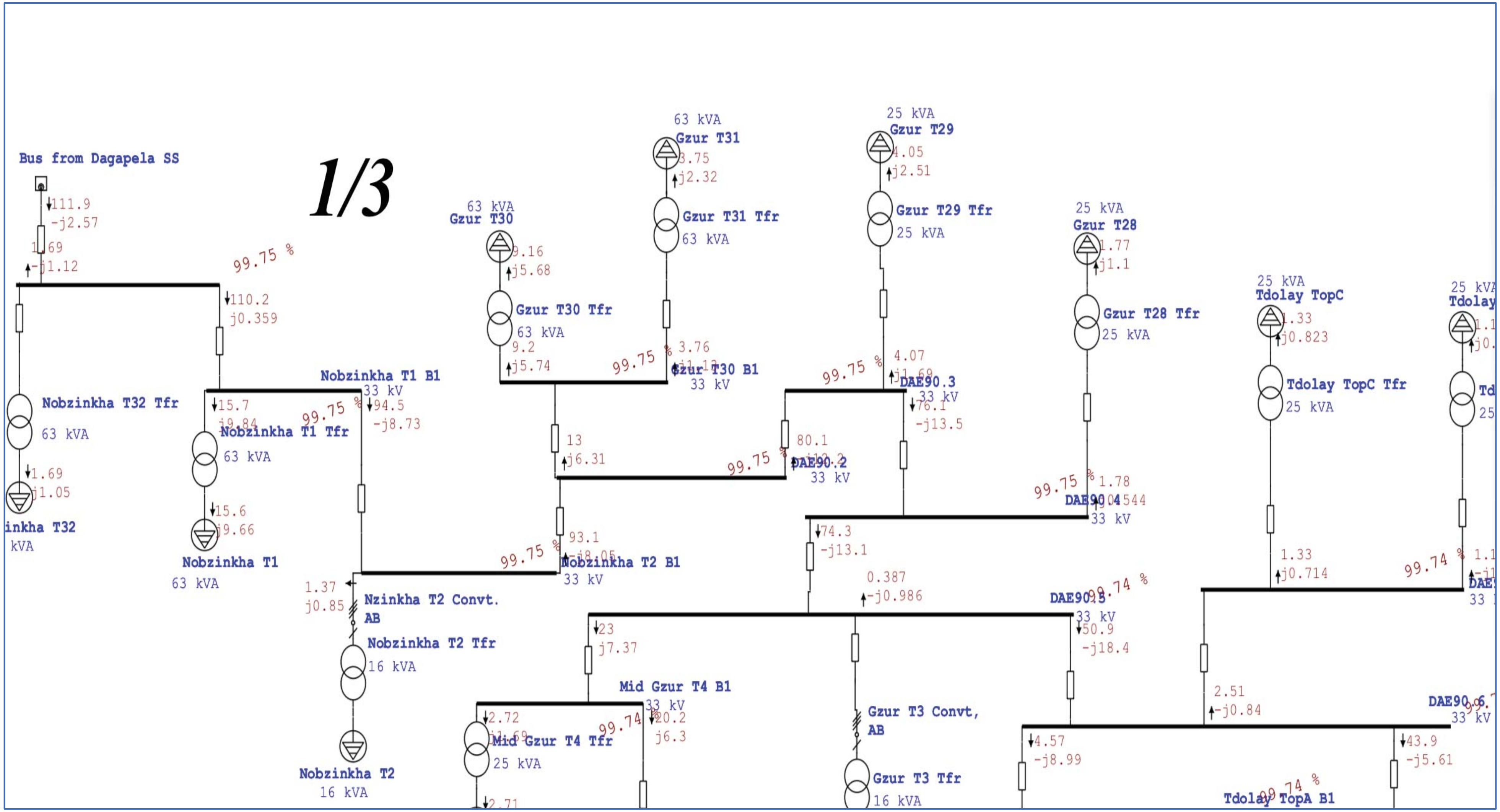


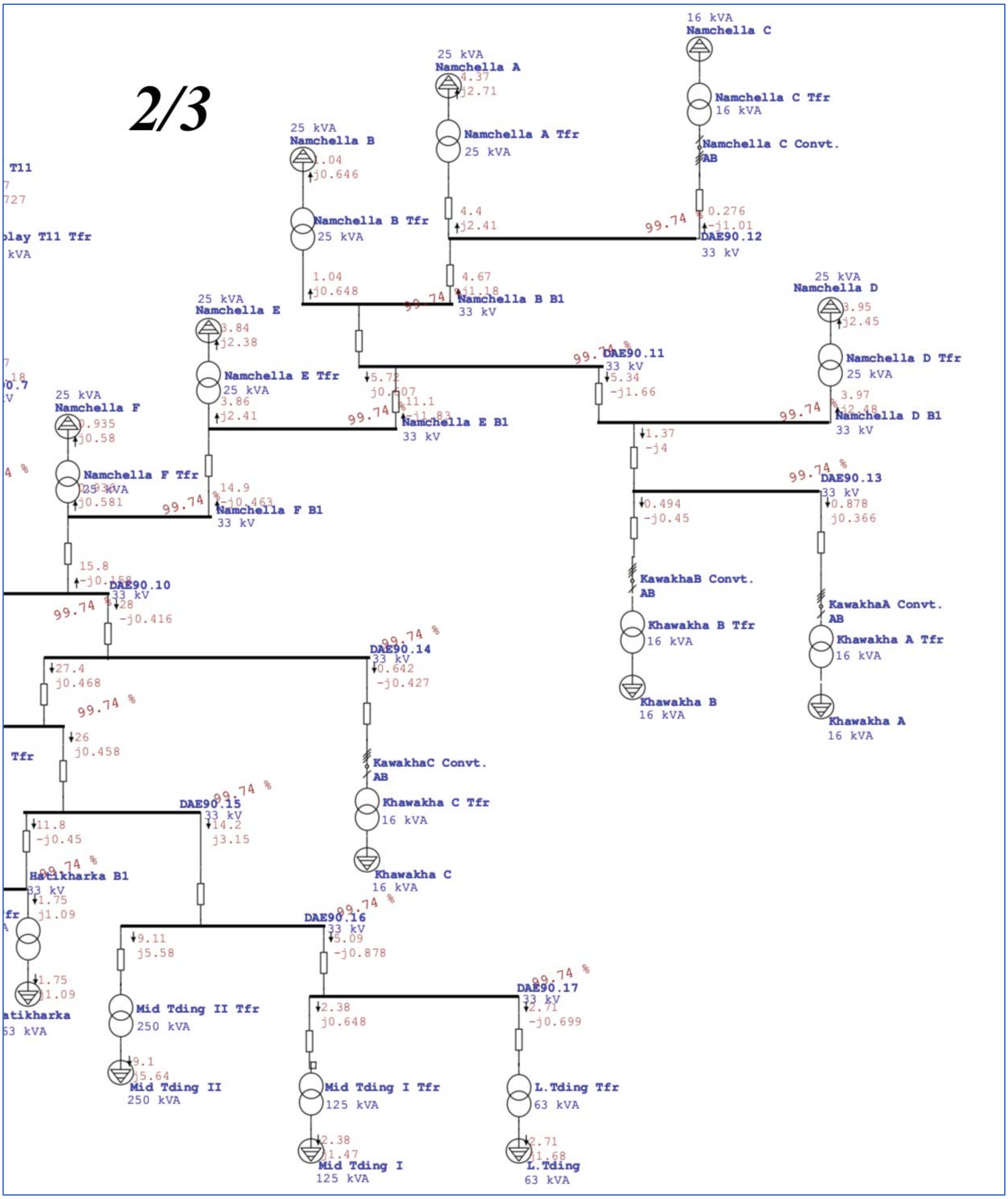
25 kVA
Mid Gzur T5 B1
33 kV
12.4
j2.74
7.82
j4.87
Gzur T3
16 kVA
Tdolay TopA Tfr
25 kVA
1.06
j0.658
Tdolay TopA
25 kVA
L.Gzur T6 B1
99.74 %
33 kV
10.9
j6.81
Mid Gzur T5 Tfr
63 kVA
7.79
j4.83
Mid Gzur T5
63 kVA
1.47
-j1.38
L.Gzur T6 Tfr
125 kVA
10.9
j6.77
L.Gzur T6
125 kVA
L.Gzur T7 Convt,2
AB
L.Gzur T7 Tfr
16 kVA
L.Gzur T7
16 kVA
Tdolay TopB B1
33 kV
2.39
-j7.52
99.74 %
1.12
j0.695
Tdolay TopB Tfr
25 kVA
1.12
j0.693
Tdolay TopB
25 kVA
Khawakha D B1
33 kV
1.33
25 kVA
1.33
j0.822
Khawakha D
25 kVA
DAE90.9
99.74 %
33 kV
0.232
j0.144
Jatay Convt,
AB
Jatay Tfr
16 kVA
Jatay
16 kVA
2.16
-j6.46
0.58
-j4.79
99.74 %
Gopeni B1
33 kV
1.58
j0.982
Gopeni Tfr
16 kVA
1.57
j0.975
Gopeni
16 kVA
Dapper Convt,
AB
Dapper Tfr
16 kVA
Dapper
16 kVA
10.1
j0.12
99.74 %
L/Lodama B1
33 kV
0.864
j0.536
9.22
j3.96
L/Lodama Tfr
25 kVA
0.863
j0.535
L/Lodama
25 kVA
U/Lodama Tfr
25 kVA
9.11
j5.65
U/Lodama
25 kVA

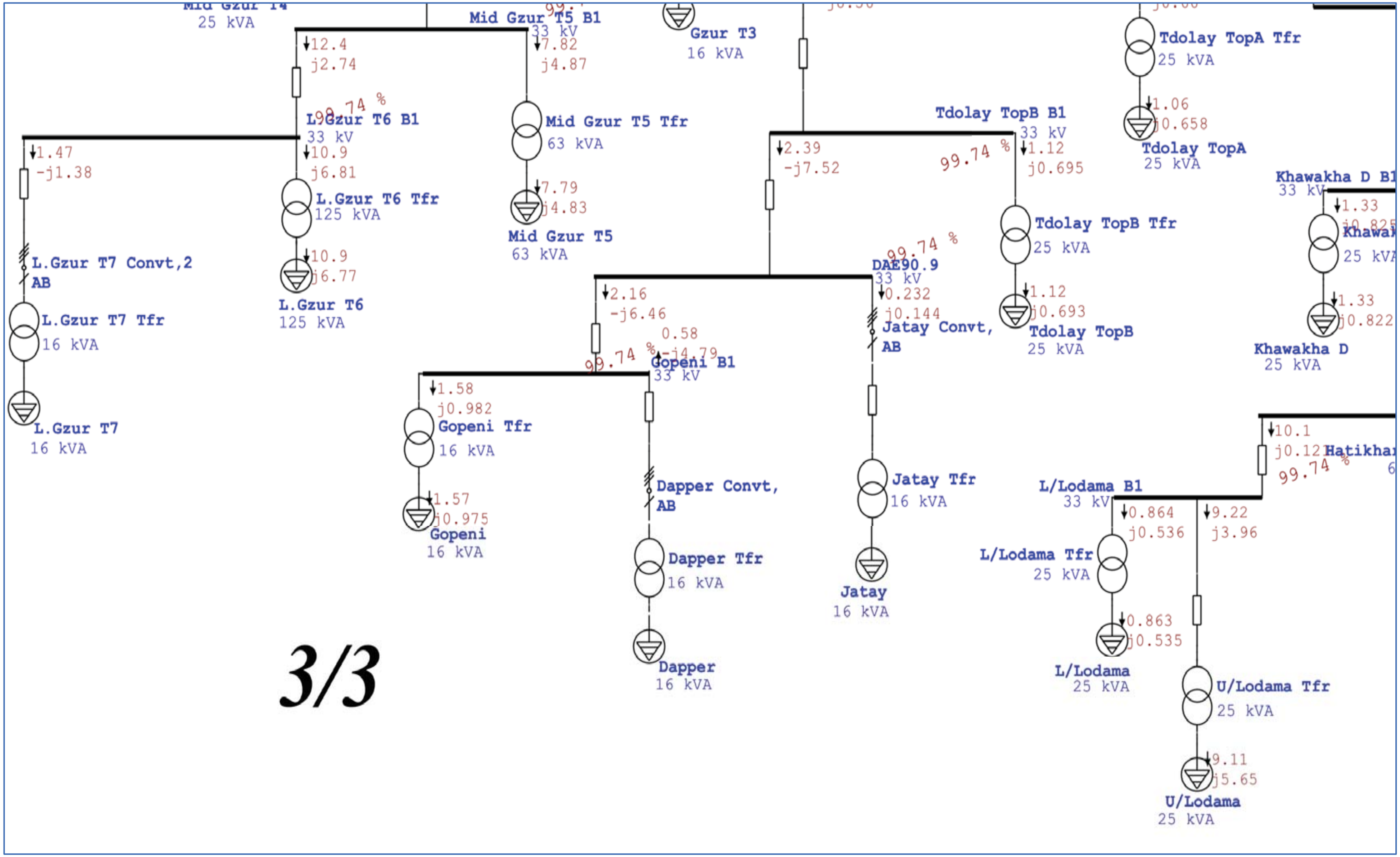
3/3

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

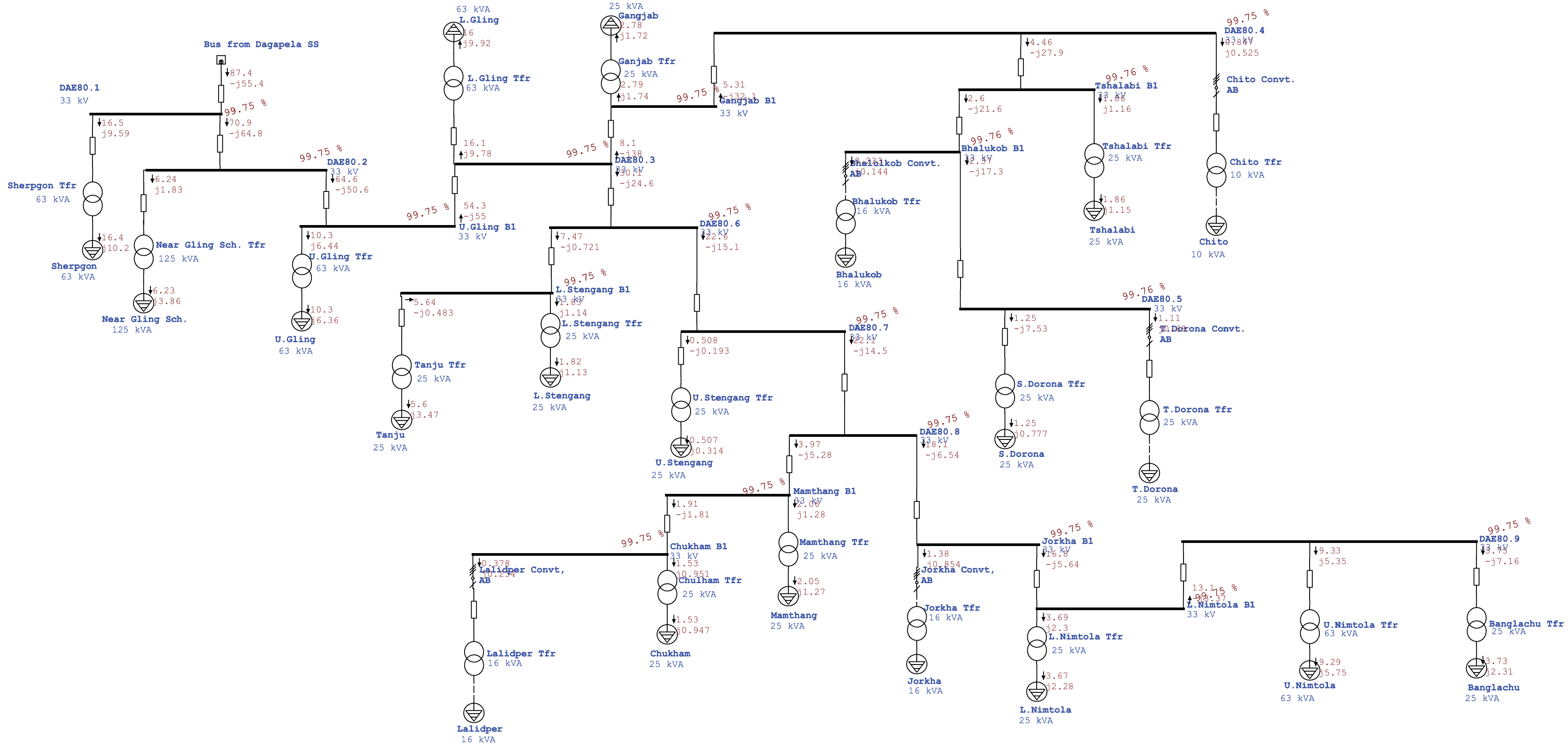



1/3
Bus from Dagapela SS
111.9
-j2.57
1.69
-j1.12
99.75 %
110.2
j0.359
Nobzinkha T32 Tfr
63 kVA
1.69
j1.05
Nobzinkha T1 B1
33 kV
15.7
94.5
-j8.73
Nobzinkha T1 Tfr
63 kVA
15.6
j9.66
Nobzinkha T1
63 kVA
Gzur T30
63 kVA
9.16
j5.68
Gzur T30 Tfr
63 kVA
9.2
j5.74
Gzur T31
63 kVA
3.75
j2.32
Gzur T31 Tfr
63 kVA
3.76
Gzur T30 B1
33 kV
13
j6.31
93.1
Nobzinkha T2 B1
33 kV
1.37
j0.85
Nzinkha T2 Convt.
AB
Nobzinkha T2 Tfr
16 kVA
Nobzinkha T2
16 kVA
Gzur T29
25 kVA
4.05
j2.51
Gzur T29 Tfr
25 kVA
4.07
DAE90.3
33 kV
76.1
-j13.5
80.1
DAE90.2
33 kV
Gzur T28
25 kVA
1.77
j1.1
Gzur T28 Tfr
25 kVA
1.78
DAE90.4
33 kV
74.3
-j13.1
0.387
-j0.986
DAE90.5
33 kV
50.9
-j18.4
99.74 %
23
j7.37
Mid Gzur T4 B1
33 kV
2.72
20.2
j6.3
Mid Gzur T4 Tfr
25 kVA
Gzur T3 Convt,
AB
Gzur T3 Tfr
16 kVA
Tdolay TopC
25 kVA
1.33
j0.823
Tdolay TopC Tfr
25 kVA
1.33
j0.714
2.51
-j0.84
4.57
-j8.99
43.9
-j5.61
DAE90.6
33 kV
Tdolay TopA B1

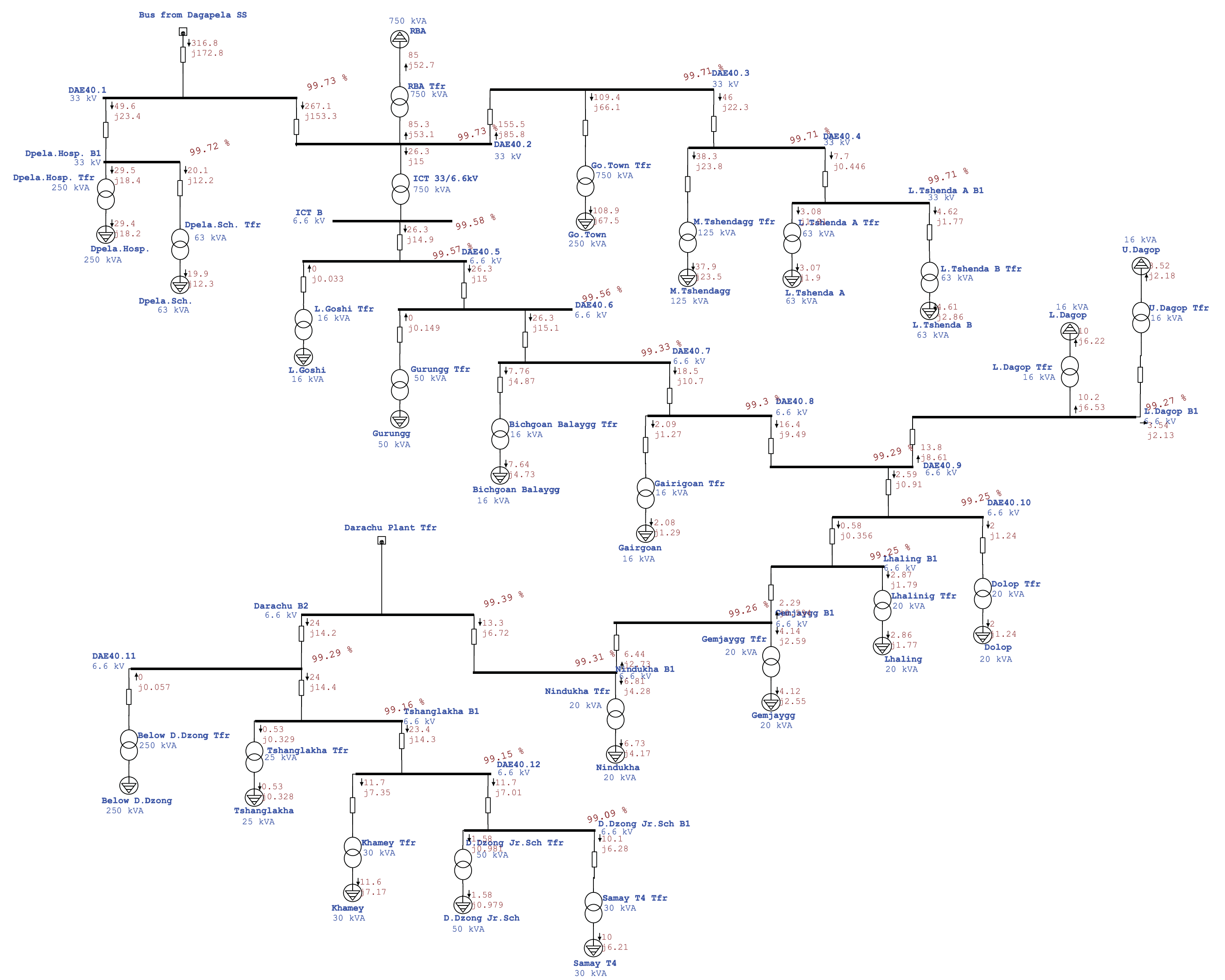

2/3
16 kVA
Namchella C
Namchella C Tfr
16 kVA
Namchella C Convt.
AB
0.276
-j1.01
DAE90.12
33 kV
25 kVA
Namchella A
4.37
j2.71
Namchella A Tfr
25 kVA
4.4
j2.41
4.67
j1.18
25 kVA
Namchella B
1.04
j0.646
Namchella B Tfr
25 kVA
1.04
j0.648
Namchella B B1
33 kV
DAE90.11
33 kV
5.34
-j1.66
25 kVA
Namchella D
3.95
j2.45
Namchella D Tfr
25 kVA
3.97
j2.48
Namchella D B1
33 kV
1.37
-j4
DAE90.13
33 kV
0.494
-j0.45
0.878
j0.366
KawakhaB Convt.
AB
Khawakha B Tfr
16 kVA
Khawakha B
16 kVA
KawakhaA Convt.
AB
Khawakha A Tfr
16 kVA
Khawakha A
16 kVA
25 kVA
Namchella E
3.84
j2.38
Namchella E Tfr
25 kVA
3.86
j2.41
5.72
11.1
Namchella E B1
33 kV
25 kVA
Namchella F
0.935
j0.58
Namchella F Tfr
25 kVA
j0.581
14.9
-j0.463
Namchella F B1
33 kV
15.8
DAE90.10
33 kV
28
-j0.416
27.4
j0.468
DAE90.14
33 kV
0.642
-j0.427
KawakhaC Convt.
AB
Khawakha C Tfr
16 kVA
Khawakha C
16 kVA
26
j0.458
DAE90.15
33 kV
11.8
-j0.45
14.2
j3.15
Hatikharka B1
33 kV
1.75
j1.09
DAE90.16
33 kV
9.11
j5.58
5.09
-j0.878
Mid Tding II Tfr
250 kVA
9.1
j5.64
Mid Tding II
250 kVA
DAE90.17
33 kV
2.38
j0.648
2.71
-j0.699
Mid Tding I Tfr
125 kVA
L.Tding Tfr
63 kVA
2.38
j1.47
Mid Tding I
125 kVA
2.71
j1.68
L.Tding
63 kVA
99.74 %

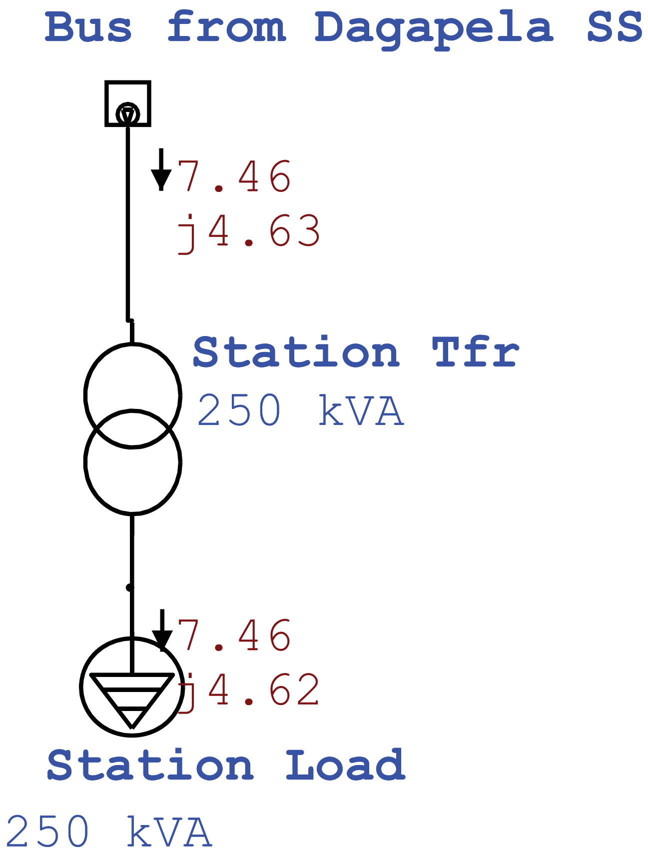

Mid Gzur T4
25 kVA
Mid Gzur T5 B1
33 kV
12.4
j2.74
7.82
j4.87
Gzur T3
16 kVA
Tdolay TopA Tfr
25 kVA
1.06
j0.658
Tdolay TopA
25 kVA
L.Gzur T6 B1
33 kV
99.74 %
10.9
j6.81
Mid Gzur T5 Tfr
63 kVA
7.79
j4.83
Mid Gzur T5
63 kVA
1.47
-j1.38
L.Gzur T6 Tfr
125 kVA
10.9
j6.77
L.Gzur T6
125 kVA
L.Gzur T7 Convt,2
AB
L.Gzur T7 Tfr
16 kVA
L.Gzur T7
16 kVA
Tdolay TopB B1
33 kV
2.39
-j7.52
99.74 %
1.12
j0.695
Tdolay TopB Tfr
25 kVA
1.12
j0.693
Tdolay TopB
25 kVA
Khawakha D B1
33 kV
1.33
25 kVA
1.33
j0.822
Khawakha D
25 kVA
DAE90.9
33 kV
99.74 %
0.232
j0.144
Jatay Convt,
AB
Jatay Tfr
16 kVA
Jatay
16 kVA
2.16
-j6.46
0.58
-j4.79
Gopeni B1
33 kV
99.74 %
1.58
j0.982
Gopeni Tfr
16 kVA
1.57
j0.975
Gopeni
16 kVA
Dapper Convt,
AB
Dapper Tfr
16 kVA
Dapper
16 kVA
10.1
j0.12
99.74 %
L/Lodama B1
33 kV
0.864
j0.536
9.22
j3.96
L/Lodama Tfr
25 kVA
0.863
j0.535
L/Lodama
25 kVA
U/Lodama Tfr
25 kVA
9.11
j5.65
U/Lodama
25 kVA
3/3

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



One-Line Diagram - OLV1=>S.F. Camp Feeder (Load Flow Analysis)




Bus from Dagapela SS
7.46
j4.63
Station Tfr
250 kVA
7.46
j4.62
Station Load
250 kVA

MV line details for Dagana Dzongkhag

SL No#	Source Substation like TD or 33/11kV substation	Feeder Details					Conductor Length (km)						
		Feeder Name	Voltage level(kV)	Location	Section	Conductor size(sq.mm)	UG	WOLF	DOG	RAB	Insulated RAB	AAAC	Cumulative Length (km)
1	220/33kV Dagapela SS & 220/66/33kV Dajay SS	33kV Drujeygang Laja Feeder	33	Dagapela-Sunkosh	C50H339 to C50H000	150		22.3					22.3
2	220/33kV Dagapela SS & 220/66/33kV Dajay SS	33kV Drujeygang Laja Feeder	33	Khebisa Tapping-Pokto	C50H923 to C50H1073	50				19.326			19.326
8	220/33kV Dagapela SS & 220/66/33kV Dajay SS	33kV Drujeyganf Laja Feeder	33	Lower Goshi to Bidulung	C50H298 to C50H431	50				0.662			0.662
11	220/33kV Dagapela SS & 220/66/33kV Dajay SS	33kV Drujeygang Laja Feeder	33	Goshi Gewog center	C50H274 to C50H432	50				0.0752			0.0752
15	220/33kV Dagapela SS & 220/66/33kV Dajay SS	33kV Drujeygang Laja Feeder	33	Babethang	C50H006 to C50H423	100			0.825				0.825
16	220/33kV Dagapela SS & 220/66/33kV Dajay SS	33kV Drujeygang Laja Feeder	33	Patala/Pangna	C50H134 to C50H398	50				5.146			5.146
17	220/33kV Dagapela SS & 220/66/33kV Dajay SS	33kV Drujeygang Laja Feeder	33	Drujeygang	C50H799 to C50H922	100			10.177				10.177
18	220/33kV Dagapela SS & 220/66/33kV Dajay SS	33kV Drujeygang Laja Feeder	33	Pangna/Thangna	C50H075 to C50H799	100			6.215				6.215
19	220/33kV Dagapela SS & 220/66/33kV Dajay SS	33kV Drujeygang Laja Feeder	33	Geepsa	C50H184 to C50H716	100			0.532				0.532
21	220/33kV Dagapela SS & 220/66/33kV Dajay SS	33kV Drujeygang-Laja Feeder	33	Tshangkha	C50H043 to C50H0580	100			15.674				15.674
22	220/33kV Dagapela SS & 220/66/33kV Dajay SS	33kV Drujeygang-Laja Feeder	33	Laja	C50H585 to C50H706	100/50			18.754				18.754
26	220/33kV Dagapela SS & 220/66/33kV Dajay SS	33kV Drujeygang-Laja Feeder	33	Budichu	C50H0046 to C50H0083	50				1.147			1.147
27	220/33kV Dagapela SS & 220/66/33kV Dajay SS	33kV Drujeygang-Laja Feeder	33	Babethang	C50H0026 to C50H0087	50				0.503			0.503
44	220/33kV Dagapela SS & 220/66/33kV Dajay SS	33kV Drujeygang Laja Feeder	33	Upper Goshi	C50H330 to na	100			0.045				0.045
Total Drujeygang Laja Feeder Length:													**101.3812**
4	220/33kV Dagapela SS & 220/66/33kV Dajay SS	33kV Tashiding Feeder	33	Namchalla to Lodoma	C90H111 to C90H219	50/100			8.392				8.392
5	220/33kV Dagapela SS & 220/66/33kV Dajay SS	33kV Tashiding Feeder	33	Dagapela to Namchalla	C90H000 to C90H111	50/100			10.7992				10.7992
20	220/33kV Dagapela SS	33kV Tashiding Feeder	33	Gangzur	C90H025 to C90H231	100			1.402				1.402
35	220/33kV Dagapela SS & 220/66/33kV Dajay SS	33 KV ACSR Lines at Tashiding Gewog, Dagana	33	Gupeni	C90H085 to C90H093	50				8.988			8.988
37	220/33kV Dagapela SS & 220/66/33kV Dajay SS	33kV Tashiding Feeder	33	Toisang to Lodoma	na to C90H212	50				5.101			5.101
Total Tashiding Feeder Length:													**34.6822**

3	220/33kV Dagapela SS	33kV Dagana Feededr	33	Khogechen-Dareythang	C70H259 to C70H652	50				1.57			1.57
7	220/33kV Dagapela SS	33kV Dagana Feeder	33	Tashithang	C70H000 to C70H062	50				6.984			6.984
10	220/33kV Dagapela SS	33kV Dagana Feeder	33	Pungsi	C70H035 to C70H332	50				8.475			8.475
12	220/33kV Dagapela SS	33kV Dagana Feeder	33	Dogap	C70H112 to C70H118	50				5.016			5.016
13	220/33kV Dagapela SS	33kV Dagana Feeder	33	Bjurugang/Panglo	C70H118 to C70H203	50				10.325			10.325
14	220/33kV Dagapela SS	33kV Dagana Feeder	33	Khagochen/Lhaling /Kanakha	C70H364 to C70H368	50				13.325			13.325
23	220/33kV Dagapela SS	33kV Dagana Feeder	33	Tseza	C70H465 to C70H583	50				11.41			11.41
28	220/33kV Dagapela SS	33kV Dagana Feeder	33	Ayetoshel-Bemji	C70H674 to C70H718	50				8.64			8.64
29	220/33kV Dagapela SS	33kV Dagana Feeder	33	Tongsho-Peling	C70H582 to C70H639	50				7.025			7.025
36	220/33kV Dagapela SS	33kV Dagana Feeder	33	Lhaling-Khamey - Dagachu Dam	C70H411 to na	50				2.1			2.1
Total Dagana Feeder Length:													**74.87**
6	220/33kV Dagapela SS	33kV Geserling Feeder	33	Dagapela to Deorali	C80H000 to C80H033	100			4.52				4.52
24	220/33kV Dagapela SS	33kV Geserling Feeder	33	Geserling	C80H044 to C80H158	100			10.397				10.397
25	220/33kV Dagapela SS	33kV Geserling Feeder	33	Dorona	C80H163 to C80H220	100			7.046				7.046
30	220/33kV Dagapela SS	33kV Geserling Feeder	33	Nimtola - Banglachu	C80H218 to C80H241	100			2.766				2.766
31	220/33kV Dagapela SS	33kV Geserling Feeder	33	Bhalukhop - Sanu Dorona	C80H254 to C80H298	100			6.076				6.076
32	220/33kV Dagapela SS	33kV Geserling Feeder	33	Tharpudara (T-Off Point) - Thulo dorona	C80H280 to C80H325	100			3.57				3.57
33	220/33kV Dagapela SS	33kV Geserling Feeder	33	Tshalabji - Bhalukhop	C80H111 to C80H254	100			1.492				1.492
34	220/33kV Dagapela SS	33kV Geserling Feeder	33	Kusumbotey (T-Off Point) - Tshalabji	C80H098 to C80H111	100			2.85				2.85
39	220/33kV Dagapela SS	33kV Geserling Feeder	33	Deorali-Geserling	C80H033 to C80H049	100			1.665				1.665
43	220/33kV Dagapela SS	33kV Geserling Feeder	33	Sherpalakha	C80H001 to C80H004	100			0.3				0.3
Total Geserling Feeder Length:													**40.682**
38	220/33kV Dagapela SS & 200kW Darachu MH	33kV SF Feeder	33	Dgapela S/S to SF Camp	C40H000 to C40H024	100			1.5				1.5
9	220/33kV Dagapela SS & 200kW Darachu MH	33kV SF Feeder	33	Dagapela Town and Tsendagang	C40H024 to C40H070/ C40H063	100			3.86				3.86
40	220/33kV Dagapela SS & 200kW Darachu MH	6.6kV SF Feeder	33	Gari Gaon/Beach Gaon	C20H308 to C20H436	50 (AAAC)						0.75	0.75
41	220/33kV Dagapela SS & 200kW Darachu MH	6.6kV SF Feeder	33	6.6kV at Garigoan	C20H308 to C20H436	50 (AAAC)						0.311	0.311

42	220/33kV Dagapela SS & 200kW Darachu MH	6.6kV SF Feeder	33	6.6kV READB, Dogag, Khagochen, Baleygang & Lower Goshi"	C20H361 to C20H380	50 (Insulated)					2.512		2.512
45	220/33kV Dagapela SS & 200kW Darachu MH	6.6kV SF Feeder	6.6	6.6kV line from Darachu to Lhaling	C20H000 to C20H0143	50 (Insulated)					11.24		11.24
46	220/33kV Dagapela SS & 200kW Darachu MH	6.6kV SF Feeder	6.6	6.6kV line from Lhaling to Dagapela	C20H0143 to C20H0405	50 (Insulated)					17.34		17.34
47	220/33kV Dagapela SS & 200kW Darachu MH	6.6kV SF Feeder	6.6	6.6KV Dzong-Daga CS	C10H033 to C10H046	50				0.7			0.7
48	220/33kV Dagapela SS & 200kW Darachu MH	6.6kV SF Feeder	6.6	6.6kV line from Darachu to Dzong (Darachu- Dzong)	C10H000 to C10H033	50 (Insulated)					2.11		2.11
49	220/33kV Dagapela SS & 200kW Darachu MH	6.6kV SF Feeder	6.6	6.6kV line from Darachu to Dzong (Daga CS-Samay)	C10H046 to C10H121	50				4			4
50	220/33kV Dagapela SS & 200kW Darachu MH	6.6kV SF Feeder	6.6	6.6kV line from Darachu to Dzong (Kanakha-Kanakha)	C10H072 to C10H126	50				0.3			0.3
51	220/33kV Dagapela SS & 200kW Darachu MH	6.6kV SF Feeder	6.6	6.6kV line for S/stations near G/House, below RBP resident,DYT hall and ROP	C10H033 to C10H132	50				0.45			0.45
Total 6.6kV SF Feeder Length:													**45.073**
Total MV Line:													**296.6884**

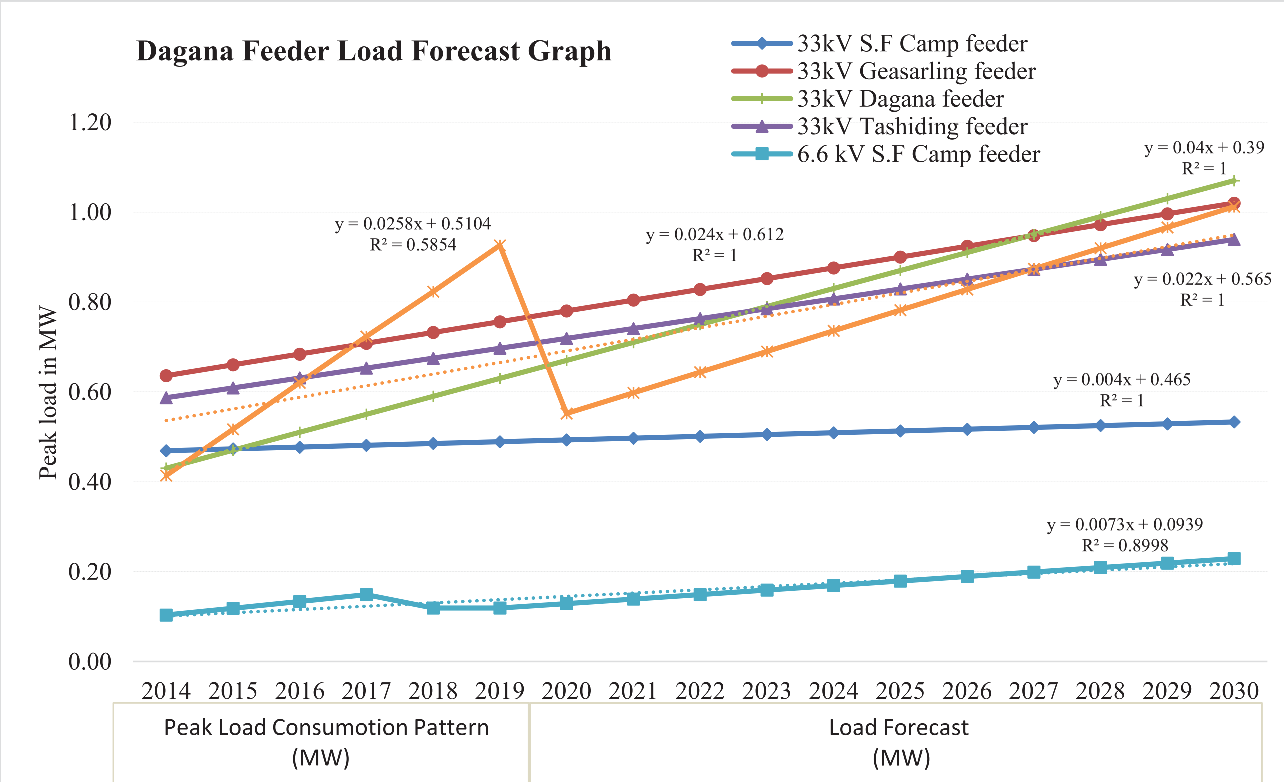
Annexure-2: IS 2026, IEC 60076 (Technical parameters for Distribution Lines and Transformers)

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

Dagana Feeder Load Forecast using LRM & TSA

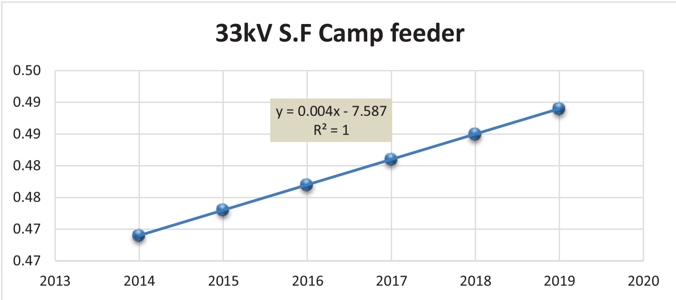
Sl.No	Name of Feeders	Peak Load (MW)																
		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1	33kV S.F Camp feeder	0.47	0.473	0.477	0.481	0.485	0.489	0.493	0.497	0.501	0.505	0.509	0.513	0.517	0.521	0.525	0.529	0.533
2	33kV Geasarling feeder	0.636	0.660	0.684	0.708	0.732	0.756	0.780	0.804	0.828	0.852	0.876	0.900	0.924	0.948	0.972	0.996	1.020
3	33kV Dagana feeder	0.430	0.470	0.510	0.550	0.590	0.630	0.670	0.710	0.750	0.790	0.830	0.870	0.910	0.950	0.990	1.030	1.070
4	33kV Tashiding feeder	0.587	0.609	0.631	0.653	0.675	0.697	0.719	0.741	0.763	0.785	0.807	0.829	0.851	0.873	0.895	0.917	0.939
5	6.6 kV S.F Camp feeder	0.10	0.12	0.13	0.15	0.12	0.12	0.129	0.139	0.149	0.159	0.169	0.179	0.189	0.199	0.209	0.219	0.229
6	33kV Drujeygang-Lajab feeder	0.41	0.52	0.62	0.72	0.82	0.93	0.552	0.598	0.644	0.69	0.736	0.782	0.828	0.874	0.92	0.966	1.012



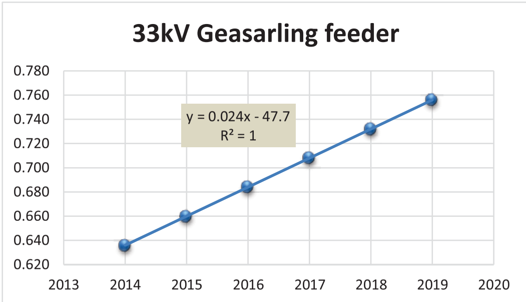
Load forecast for Dagana Dzongkhag

Feeder Wise Load Forecast using LRM & TSA

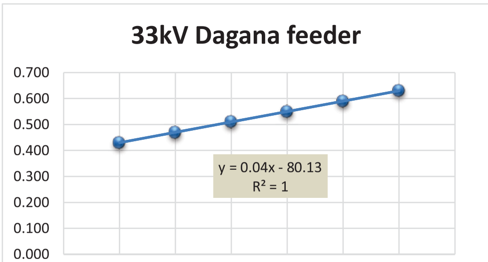
Sl.No	Name of Feeders	Peak Load (MW)																
		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1	33kV S.F Camp feeder	0.47	0.473	0.477	0.481	0.485	0.489	0.493	0.497	0.501	0.505	0.509	0.513	0.517	0.521	0.525	0.529	0.533

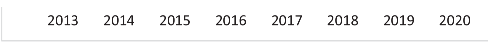


Sl.No	Name of Feeders	Peak Load (MW)																
		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
2	33kV Geasarling feeder	0.636	0.660	0.684	0.708	0.732	0.756	0.780	0.804	0.828	0.852	0.876	0.900	0.924	0.948	0.972	0.996	1.020

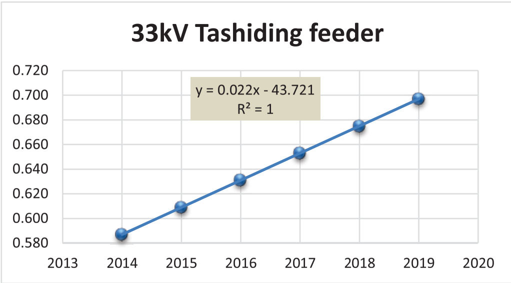


Sl.No	Name of Feeders	Peak Load (MW)																
		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
3	33kV Dagana feeder	0.430	0.470	0.510	0.550	0.590	0.630	0.670	0.710	0.750	0.790	0.830	0.870	0.910	0.950	0.990	1.030	1.070





Sl.No	Name of Feeders	Peak Load (MW)																
		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
4	33kV Tashiding feeder	0.587	0.609	0.631	0.653	0.675	0.697	0.719	0.741	0.763	0.785	0.807	0.829	0.851	0.873	0.895	0.917	0.939



Load forecast methodology

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.**

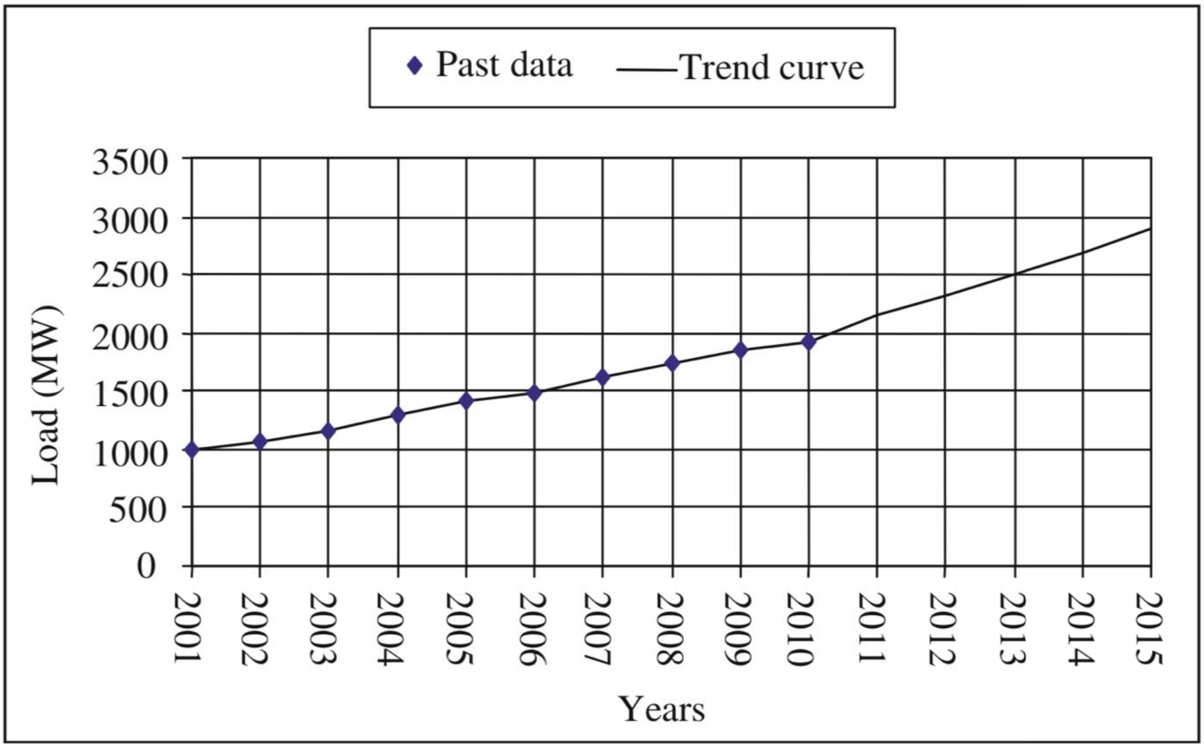


Figure 1: Typical trend curve[1]

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.

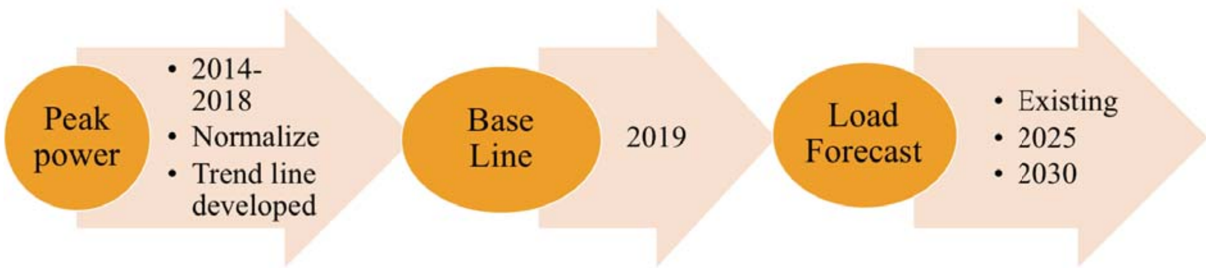


Figure 2: Flow diagram for load forecast

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**

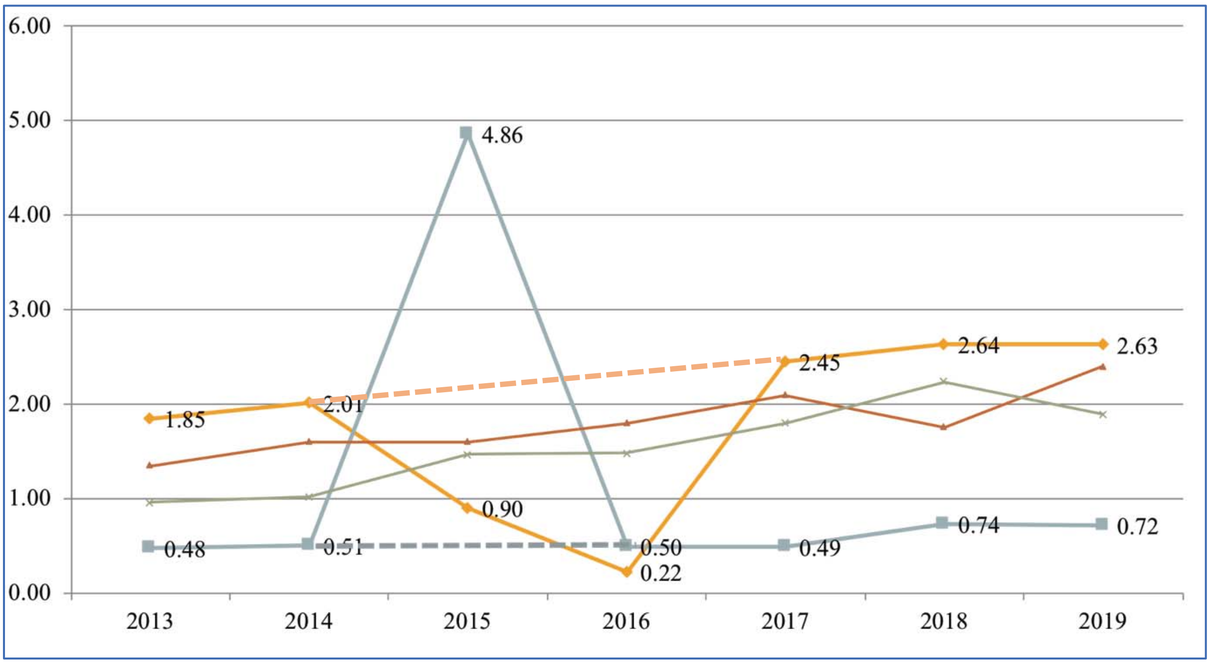


Figure 3: Actual data of Punakha Dzongkhag

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

$Where:$

$x\ is\ the\ normalized\ data$

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.**

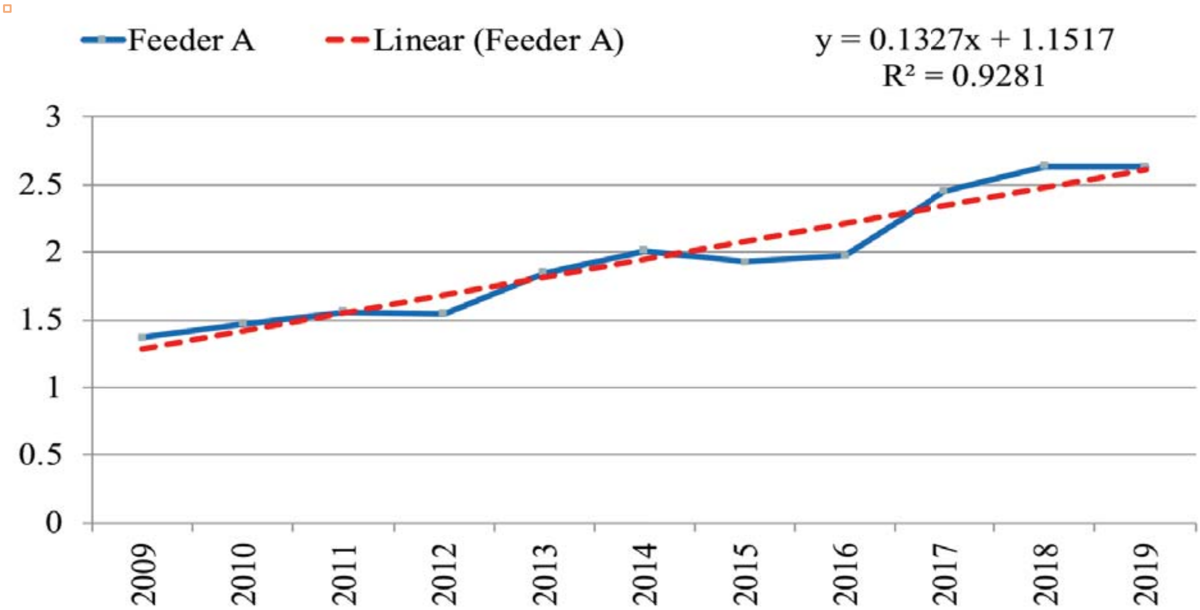


Figure 4: Trend line and load forecast for Punakha Dzongkhag

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.

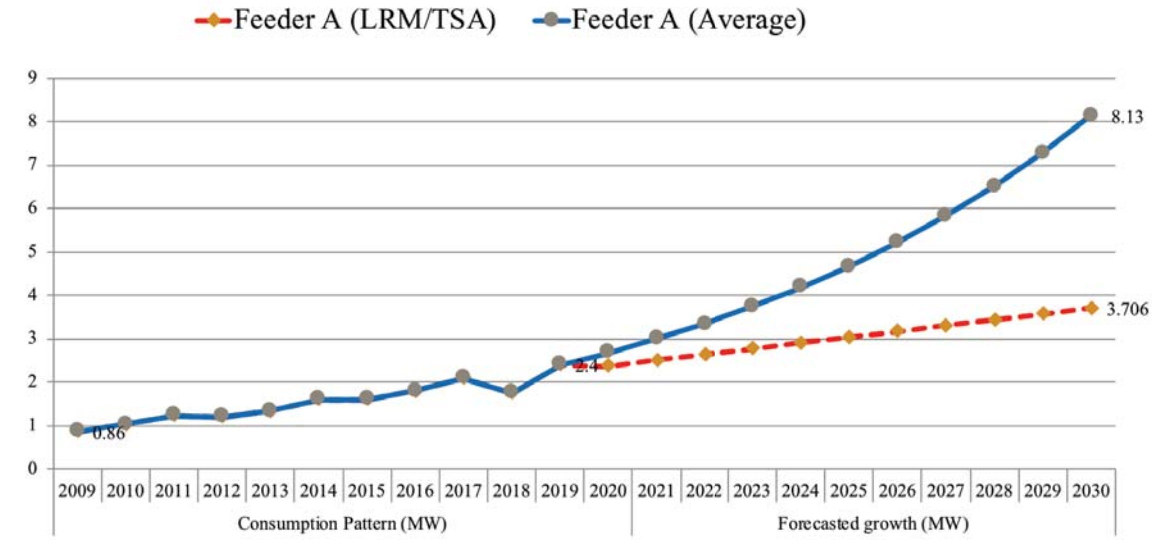


Figure 5: Forecasted load (trend line with red shows the linear regression and one with blue shows the forecast with average method)

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.

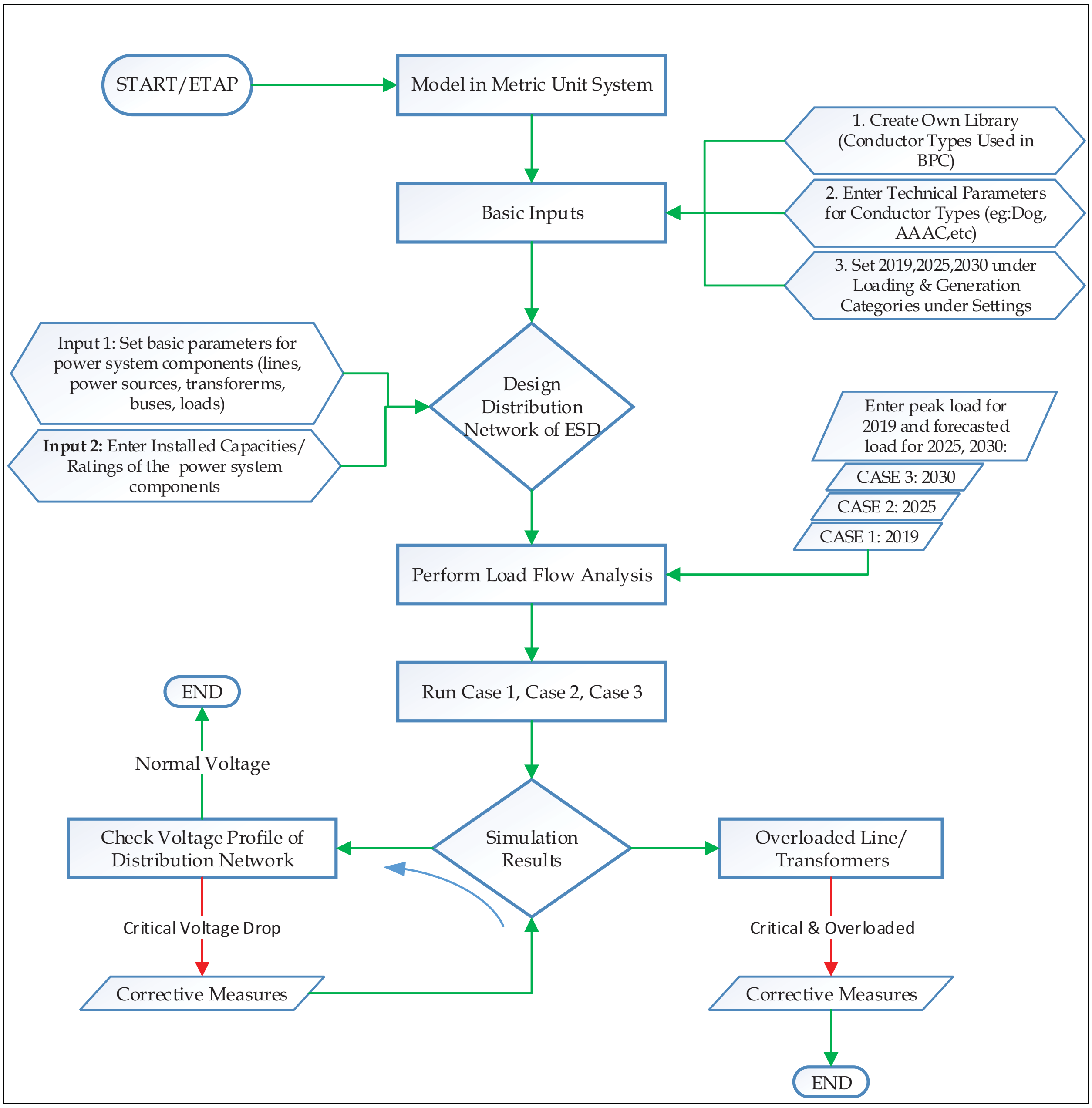


Figure 6: Flow Chart for Network Modelling & Load Flow Analysis (ETAP)

[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					Percent
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Loading
Aibthang B1	33.000										0.022	84.7	0.4	
Aibthang B2	0.415		0.004	0.002	0.014	0.009					0.021	85.0	30.5	
Akochn B2	0.415		0.012	0.007	0.042	0.026					0.064	85.0	93.8	
AkochnA B1	33.000										0.204	91.5	3.6	
AkochnC B1	33.000										0.023	84.2	0.4	
AkochnC B2	0.415		0.004	0.003	0.015	0.009					0.022	85.0	32.6	
Balaygg N.Gwog.O B1	33.000										0.018	84.7	0.3	
Balaygg N.Gwog.O B2	0.415		0.003	0.002	0.012	0.008					0.018	85.0	25.6	
Balaygg Zero B1	33.000										0.049	84.8	0.9	
Balaygg Zero B2	0.415		0.009	0.005	0.033	0.020					0.049	85.0	69.0	
BalungA B1	33.000										0.006	84.8	0.1	
BalungA B2	0.415		0.001	0.001	0.004	0.003					0.006	85.0	8.6	
BalungC B1	33.000		0.000	0.000	0.002	0.001					0.008	92.3	0.1	
BanaA B1	33.000										0.010	84.6	0.2	
BanaA B2	0.415		0.002	0.001	0.007	0.004					0.010	85.0	14.1	
BanaB B1	33.000										0.023	97.0	0.4	
BanaB B2	0.415		0.001	0.001	0.003	0.002					0.005	85.0	7.1	
Banglachu B1	33.000										0.015	84.5	0.3	
Banglachu B2	0.415		0.003	0.002	0.010	0.006					0.015	85.0	21.0	
BartsabA B1	33.000										0.045	87.9	0.8	
BartsabA B2	0.415		0.003	0.002	0.010	0.006					0.015	85.0	21.2	
BartsabB B1	33.000										0.030	88.5	0.5	
BartsabB B2	0.415		0.004	0.003	0.015	0.009					0.023	85.0	33.5	
BchuA B1	33.000										0.228	94.3	4.1	
BchuA B2	0.415		0.001	0.001	0.004	0.003					0.007	85.0	9.5	
BchuB B1	33.000										0.016	84.4	0.3	
BchuB B2	0.415		0.003	0.002	0.011	0.007					0.016	85.0	23.1	
Below D.Dzong B1	6.600												-	
Below D.Dzong B2	0.415													
Bemji B1	33.000		0.001	0.001	0.006	0.003					0.008	85.0	0.1	
Bgaythang B1	33.000										0.028	84.0	0.5	
Bgaythang B2	0.415		0.005	0.003	0.018	0.011					0.027	85.0	40.1	
Bhalukob B1	33.000		0.000	0.000	0.001	-					0.016	55.2	0.3	
Bichgoan Balaygg B1	6.600										0.029	83.3	2.6	
Bichgoan Balaygg B2	0.415		0.005	0.003	0.018	0.011					0.027	85.0	41.5	
Bidlung B1	33.000										0.018	84.7	0.3	
Bidlung B2	0.415		0.003	0.002	0.012	0.008					0.018	85.0	25.8	
BjuruggA B1	33.000										0.045	86.5	0.8	
BjuruggA B2	0.415		0.007	0.004	0.024	0.015					0.037	85.0	55.6	

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
BjuruggB B1	33.000										0.121	91.6	2.1	
BjuruggB B2	0.415		0.001	0.001	0.005	0.003					0.007	85.0	9.9	
BthangA B1	33.000										0.013	89.0	0.2	
BthangA B2	0.415		0.002	0.001	0.006	0.004					0.009	85.0	12.1	
BthangB B1	33.000										0.005	84.9	0.1	
BthangB B2	0.415		0.001	0.001	0.003	0.002					0.005	85.0	7.1	
BuchunaA B1	33.000										0.038	83.6	0.7	
BuchunaA B2	0.415		0.007	0.004	0.023	0.015					0.036	85.0	53.2	
BuchunaB B1	33.000										0.047	92.8	0.8	
BuchunaB B2	0.415		0.001	0.001	0.003	0.002					0.005	85.0	6.8	
Bus1 from Dagapela SS	33.000										3.736	90.9	65.9	
Bus2 from Dagapela SS	33.000										2.538	90.1	44.8	
Chukham B1	33.000		0.000	0.000	0.001	0.001					0.008	84.8	0.1	
Chukham B2	0.415		0.001	0.001	0.004	0.003					0.006	85.0	8.6	
D.Dzong Jr.Sch B1	6.600										0.044	84.0	4.0	
D.Dzong Jr.Sch B2	0.415		0.001	0.001	0.004	0.002					0.006	85.0	8.6	
DAE40.1	33.000										0.703	86.1	12.4	
DAE40.2	33.000										0.603	85.7	10.6	
DAE40.3	33.000										0.324	85.8	5.7	
DAE40.4	33.000										0.095	86.6	1.7	
DAE40.5	6.600										0.100	85.8	8.8	
DAE40.6	6.600										0.100	85.8	8.8	
DAE40.7	6.600										0.099	85.6	8.9	
DAE40.8	6.600										0.070	86.4	6.3	
DAE40.9	6.600										0.062	86.6	5.6	
DAE40.10	6.600										0.011	93.5	1.0	
DAE40.11	6.600										0.090	84.2	8.1	
DAE40.12	6.600										0.088	84.0	7.9	
DAE50.1	33.000										2.256	89.7	39.9	
DAE50.2	33.000										2.239	89.7	39.6	
DAE50.3	33.000										2.174	89.8	38.5	
DAE50.4	33.000										2.156	89.8	38.2	
DAE50.5	33.000										2.138	89.8	37.9	
DAE50.6	33.000										1.286	92.3	22.8	
DAE50.7	33.000										0.293	90.9	5.2	
DAE50.8	33.000										0.267	91.0	4.7	
DAE50.9	33.000										0.225	91.8	4.0	
DAE50.10	33.000		0.002	0.001	0.008	0.005					0.139	94.1	2.5	
DAE50.11	33.000		0.002	0.001	0.008	0.005					0.129	93.5	2.3	
DAE50.12	33.000										0.120	92.5	2.1	
DAE50.13	33.000										0.095	93.9	1.7	
DAE50.14	33.000										0.067	94.5	1.2	

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
DAE50.15	33.000										0.062	93.4	1.1	
DAE50.16	33.000										0.050	91.8	0.9	
DAE50.17	33.000										0.995	92.3	17.7	
DAE50.18	33.000										0.024	85.8	0.4	
DAE50.19	33.000										0.965	92.2	17.2	
DAE50.20	33.000										0.040	86.2	0.7	
DAE50.21	33.000										0.929	92.1	16.5	
DAE50.22	33.000										0.929	91.9	16.5	
DAE50.23	33.000										0.895	91.9	15.9	
DAE50.24	33.000										0.835	92.3	14.9	
DAE50.25	33.000										0.675	93.5	12.0	
DAE50.26	33.000										0.193	93.0	3.4	
DAE50.27	33.000										0.181	92.8	3.2	
DAE50.28	33.000										0.161	92.8	2.9	
DAE50.29	33.000										0.135	93.4	2.4	
DAE50.30	33.000										0.130	92.4	2.3	
DAE50.31	33.000										0.091	92.6	1.6	
DAE50.32	33.000										0.087	92.2	1.6	
DAE50.33	33.000										0.050	90.3	0.9	
DAE50.34	33.000										0.025	86.6	0.4	
DAE50.35	33.000										0.030	89.0	0.5	
DAE50.36	33.000										0.483	93.4	8.6	
DAE50.37	33.000										0.065	88.0	1.2	
DAE50.38	33.000										0.044	87.8	0.8	
DAE50.39	33.000										0.030	86.4	0.5	
DAE50.40	33.000										0.419	94.0	7.5	
DAE50.41	33.000										0.029	87.9	0.5	
DAE50.42	33.000										0.391	94.1	7.0	
DAE50.43	33.000										0.378	93.8	6.7	
DAE50.44	33.000		0.000	0.000	0.001	0.001					0.013	99.7	0.2	
DAE50.45	33.000										0.013	92.2	0.2	
DAE50.46	33.000										0.367	92.8	6.5	
DAE50.47	33.000										0.052	86.3	0.9	
DAE50.48	33.000										0.317	93.4	5.6	
DAE50.49	33.000										0.301	93.5	5.4	
DAE50.50	33.000		0.001	0.000	0.003	0.002					0.046	90.1	0.8	
DAE50.51	33.000										0.040	87.2	0.7	
DAE50.52	33.000										0.236	94.4	4.2	
DAE50.53	33.000		0.001	0.000	0.002	0.001					0.222	94.4	4.0	
DAE50.54	33.000										0.180	95.6	3.2	
DAE50.55	33.000										0.125	98.2	2.2	
DAE50.56	33.000										0.029	94.6	0.5	

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					Percent
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Loading
DAE50.57	33.000		0.001	0.000	0.003	0.002					0.017	88.6	0.3	
DAE50.58	33.000		0.001	0.000	0.003	0.002					0.078	99.2	1.4	
DAE50.59	33.000										0.070	99.1	1.2	
DAE50.60	33.000		0.000	0.000	0.001	-					0.060	99.0	1.1	
DAE50.61	33.000										0.050	96.8	0.9	
DAE50.62	33.000										0.032	96.9	0.6	
DAE50.63	33.000		0.141	0.087	0.549	0.340					2.089	89.8	37.0	
DAE70.1	33.000										1.085	91.7	19.2	
DAE70.2	33.000										1.055	91.8	18.7	
DAE70.3	33.000										0.080	86.9	1.4	
DAE70.4	33.000										0.977	92.0	17.3	
DAE70.5	33.000										0.949	92.0	16.8	
DAE70.6	33.000										0.934	92.0	16.6	
DAE70.7	33.000										0.909	92.0	16.1	
DAE70.8	33.000										0.190	91.3	3.4	
DAE70.9	33.000										0.165	90.7	2.9	
DAE70.10	33.000										0.104	89.4	1.9	
DAE70.11	33.000										0.083	90.5	1.5	
DAE70.12	33.000										0.723	91.3	12.8	
DAE70.13	33.000										0.721	90.9	12.8	
DAE70.14	33.000										0.202	86.5	3.6	
DAE70.15	33.000										0.523	91.9	9.3	
DAE70.16	33.000		0.006	0.003	0.022	0.013					0.032	85.0	0.6	
DAE70.17	33.000										0.493	91.9	8.8	
DAE70.18	33.000										0.474	92.0	8.4	
DAE70.19	33.000										0.455	91.6	8.1	
DAE70.20	33.000										0.455	91.5	8.1	
DAE70.21	33.000										0.432	90.9	7.7	
DAE70.22	33.000										0.007	92.7	0.1	
DAE70.23	33.000										0.427	90.5	7.6	
DAE70.24	33.000										0.401	89.8	7.2	
DAE70.25	33.000										0.392	88.7	7.0	
DAE70.26	33.000										0.202	91.9	3.6	
DAE70.27	33.000										0.162	92.3	2.9	
DAE70.28	33.000										0.047	97.6	0.8	
DAE70.29	33.000										0.030	97.4	0.5	
DAE70.30	33.000										0.026	90.5	0.5	
DAE70.31	33.000										0.017	75.6	0.3	
DAE80.1	33.000										0.305	96.6	5.4	
DAE80.2	33.000										0.247	97.0	4.4	
DAE80.3	33.000										0.192	95.6	3.4	
DAE80.4	33.000		0.001	0.000	0.002	0.001					0.028	65.8	0.5	

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					Percent
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Loading
DAE80.5	33.000		0.001	0.000	0.003	0.002					0.010	82.6	0.2	
DAE80.6	33.000										0.106	95.8	1.9	
DAE80.7	33.000										0.079	96.8	1.4	
DAE80.8	33.000										0.078	95.9	1.4	
DAE80.9	33.000										0.048	91.5	0.9	
DAE90.1	33.000										0.575	89.4	10.1	
DAE90.2	33.000										0.478	89.9	8.4	
DAE90.3	33.000										0.409	90.5	7.2	
DAE90.4	33.000										0.389	90.6	6.9	
DAE90.5	33.000										0.380	90.6	6.7	
DAE90.6	33.000										0.242	92.0	4.3	
DAE90.7	33.000										0.012	91.4	0.2	
DAE90.9	33.000		0.000	0.000	0.001	0.001					0.011	98.7	0.2	
DAE90.10	33.000										0.214	89.7	3.8	
DAE90.11	33.000										0.053	90.4	0.9	
DAE90.12	33.000										0.024	86.3	0.4	
DAE90.13	33.000										0.007	90.6	0.1	
DAE90.14	33.000										0.136	89.6	2.4	
DAE90.15	33.000										0.127	88.7	2.2	
DAE90.16	33.000										0.071	87.3	1.3	
DAE90.17	33.000										0.025	90.1	0.4	
Dagapela B1	220.000										5.121	89.9	13.4	
Dapper B1	33.000		0.001	0.000	0.002	0.001					0.003	85.0	0.1	
Darachu B1	0.415										0.142	83.0	197.5	
Darachu B2	6.600										0.139	83.5	12.4	
Darlithang B1	33.000										0.048	84.3	0.8	
Darlithang B2	0.415		0.008	0.005	0.031	0.019					0.046	85.0	67.5	
Deorali B1	33.000										0.025	84.6	0.4	
Deorali B2	0.415		0.004	0.003	0.016	0.010					0.024	85.0	34.7	
Dogap TA B1	33.000										0.914	92.0	16.2	
Dogap TA B2	0.415		0.001	0.001	0.004	0.002					0.005	85.0	7.6	
Dogap TB B1	33.000										0.004	84.8	0.1	
Dogap TB B2	0.415		0.001	0.000	0.003	0.002					0.004	85.0	5.5	
Dogap TC B1	33.000										0.187	94.3	3.3	
Dolop B1	6.600										0.008	84.6	0.7	
Dolop B2	0.415		0.001	0.001	0.005	0.003					0.008	85.0	10.9	
Dpela.Hosp. B1	33.000										0.104	84.8	1.8	
Dpela.Hosp. B2	0.415		0.011	0.007	0.042	0.026					0.062	85.0	87.4	
Dpela.Sch. B1	33.000										0.042	84.4	0.7	
Dpela.Sch. B2	0.415		0.007	0.005	0.028	0.017					0.041	85.0	59.6	
Drujeygg MSS B1	33.000										0.165	84.5	2.9	
Drujeygg MSS B2	0.415		0.029	0.018	0.109	0.067					0.162	85.0	234.0	

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					Percent
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Loading
DYT Hall B1	33.000										0.192	84.3	3.4	
DYT Hall B2	0.415		0.034	0.021	0.124	0.077					0.186	85.0	273.2	
Gairigoan B1	6.600										0.008	84.5	0.7	
Gairigoan B2	0.415		0.001	0.001	0.005	0.003					0.008	85.0	11.4	
Gangcpa B1	33.000										0.019	94.8	0.3	
Gangcpa B2	0.415		0.001	0.000	0.003	0.002					0.004	85.0	5.8	
Gangjab B1	33.000										0.036	76.0	0.6	
Gangjab B2	0.415		0.002	0.001	0.007	0.005					0.011	85.0	15.7	
GeepsaA B1	33.000										0.033	86.1	0.6	
GeepsaA B2	0.415		0.002	0.001	0.006	0.004					0.009	85.0	13.0	
GeepsaB B1	33.000										0.015	84.5	0.3	
GeepsaB B2	0.415		0.003	0.002	0.010	0.006					0.014	85.0	20.6	
GeepsaC B1	33.000										0.010	84.6	0.2	
GeepsaC B2	0.415		0.002	0.001	0.007	0.004					0.010	85.0	14.2	
GelechuA B1	33.000										0.084	98.9	1.5	
GelechuA B2	0.415		0.001	0.001	0.004	0.003					0.006	85.0	8.8	
GelechuC B1	33.000										0.074	99.2	1.3	
GelechuC B2	0.415		0.001	0.001	0.003	0.002					0.005	85.0	7.3	
Gema B1	33.000										0.012	84.5	0.2	
Gema B2	0.415		0.002	0.001	0.008	0.005					0.012	85.0	17.6	
Gemjaygg B1	6.600										0.023	78.3	2.1	
Gemjaygg B2	0.415		0.003	0.002	0.010	0.006					0.015	85.0	22.5	
Go.Town B1	33.000										0.231	84.7	4.1	
Go.Town B2	0.415		0.040	0.025	0.154	0.095					0.228	85.0	324.5	
Gopeni B1	33.000										0.010	90.7	0.2	
Gopeni B2	0.415		0.001	0.001	0.005	0.003					0.008	85.0	11.6	
GumlaA B1	33.000		0.002	0.001	0.007	0.004					0.010	85.0	0.2	
GumlaA B3	33.000		0.003	0.002	0.010	0.006					0.015	85.0	0.3	
GumlaB B1	33.000		0.001	0.000	0.002	0.002					0.053	92.6	0.9	
GumlaC B1	33.000										0.022	84.2	0.4	
GumlaC B2	0.415		0.004	0.002	0.014	0.009					0.021	85.0	31.1	
Gurungg B1	6.600												-	
Gurungg B2	0.415													
Gzur T3 B1	33.000		0.000	0.000	0.002	0.001					0.002	85.0	-	
Gzur T28 B1	33.000										0.009	84.7	0.2	
Gzur T28 B2	0.415		0.002	0.001	0.006	0.004					0.009	85.0	13.0	
Gzur T29 B1	33.000										0.021	84.2	0.4	
Gzur T29 B2	0.415		0.004	0.002	0.014	0.008					0.020	85.0	29.5	
Gzur T30 B1	33.000										0.070	85.2	1.2	
Gzur T30 B2	0.415		0.008	0.005	0.031	0.019					0.046	85.0	66.9	
Gzur T31 B1	33.000										0.023	84.7	0.4	
Gzur T31 B2	0.415		0.004	0.003	0.015	0.010					0.023	85.0	32.6	

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
Hatikharka B1	33.000										0.058	88.2	1.0	
Hatikharka B2	0.415		0.002	0.001	0.006	0.004					0.009	85.0	13.0	
Hospital B1	33.000										0.043	84.8	0.8	
Hospital B2	0.415		0.008	0.005	0.029	0.018					0.043	85.0	61.3	
ICT B	6.600										0.100	85.9	8.8	
Jgarling B1	33.000		0.001	0.000	0.002	0.001					0.015	84.7	0.3	
Jgarling B2	0.415		0.002	0.001	0.008	0.005					0.012	85.0	16.8	
Jorkha B1	33.000		0.001	0.001	0.004	0.002					0.065	93.7	1.2	
Kagochn(PWD) B2	0.415		0.012	0.008	0.044	0.027					0.066	85.0	97.8	
Kanakha B1	33.000										0.015	84.4	0.3	
Kanakha B2	0.415		0.003	0.002	0.010	0.006					0.015	85.0	21.9	
Khagochn(PWD) B1	33.000										0.097	86.0	1.7	
Khamey B1	6.600										0.044	83.6	4.0	
Khamey B2	0.415		0.008	0.005	0.027	0.017					0.041	85.0	62.9	
Khawakha A B1	33.000		0.001	0.000	0.003	0.002					0.005	85.0	0.1	
Khawakha B B1	33.000		0.000	0.000	0.002	0.001					0.003	85.0	-	
Khawakha C B1	33.000		0.001	0.000	0.003	0.002					0.004	85.0	0.1	
Khawakha D B1	33.000										0.133	89.2	2.3	
Khawakha D B2	0.415		0.001	0.001	0.005	0.003					0.007	85.0	9.6	
Khenju B1	33.000		0.000	0.000	0.001	0.001					0.005	38.1	0.1	
Kompa B1	33.000										0.012	84.6	0.2	
Kompa B2	0.415		0.002	0.001	0.008	0.005					0.012	85.0	17.2	
Kthang B1	33.000										0.188	90.8	3.3	
Kthang B2	0.415		0.004	0.003	0.016	0.010					0.024	85.0	34.6	
KthangA B1	33.000										0.005	84.8	0.1	
KthangA B2	0.415		0.001	0.001	0.003	0.002					0.005	85.0	7.2	
KthangB B1	33.000										0.039	90.6	0.7	
KthangB B2	0.415		0.002	0.001	0.007	0.004					0.010	85.0	14.7	
Kzinka B1	33.000										0.121	85.1	2.2	
Kzinka B2	0.415		0.010	0.006	0.036	0.022					0.054	85.0	80.2	
Kzinka Town B1	33.000										0.065	84.8	1.2	
Kzinka Town B2	0.415		0.012	0.007	0.044	0.027					0.065	85.0	93.1	
L.Bhudichu B1	33.000										0.016	87.6	0.3	
L.Bhudichu B2	0.415		0.002	0.001	0.009	0.005					0.013	85.0	18.9	
L.Cthang B1	33.000		0.001	0.001	0.006	0.003					0.008	85.0	0.1	
L.Dagop B1	6.600										0.052	83.2	4.6	
L.Dagop B2	0.415		0.007	0.004	0.022	0.014					0.035	85.0	54.5	
L.Gling B1	33.000										0.064	84.1	1.1	
L.Gling B2	0.415		0.011	0.007	0.041	0.026					0.062	85.0	90.2	
L.Goshi B1	6.600												-	
L.Goshi B2	0.415													
L.Goshi T97 B1	33.000										0.065	84.1	1.1	

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Percent Loading
L.Goshi T97 B2	0.415		0.011	0.007	0.042	0.026					0.062	85.0	91.3	
L.Gzur T6 B1	33.000										0.075	85.9	1.3	
L.Gzur T6 B2	0.415		0.012	0.007	0.044	0.028					0.066	85.0	94.7	
L.Gzur T7 B1	33.000		0.002	0.001	0.006	0.004					0.009	85.0	0.2	
L.Khagochn T50 B1	33.000		0.002	0.001	0.008	0.005					0.029	87.0	0.5	
L.Khagochn T51 B1	33.000										0.017	84.4	0.3	
L.Khagochn T51 B2	0.415		0.003	0.002	0.011	0.007					0.017	85.0	24.6	
L.KhameyA B1	33.000										0.004	84.9	0.1	
L.KhameyA B2	0.415		0.001	0.000	0.003	0.002					0.004	85.0	5.7	
L.KhameyB B1	33.000										0.003	84.9	0.1	
L.KhameyB B2	0.415		0.001	0.000	0.002	0.001					0.003	85.0	4.4	
L.Nimtola B1	33.000										0.062	91.8	1.1	
L.Nimtola B2	0.415		0.003	0.002	0.010	0.006					0.014	85.0	20.7	
L.Stengang B1	33.000										0.028	90.2	0.5	
L.Stengang B2	0.415		0.001	0.001	0.005	0.003					0.007	85.0	10.3	
L.Tding B1	33.000										0.014	84.8	0.3	
L.Tding B2	0.415		0.002	0.002	0.009	0.006					0.014	85.0	19.9	
L.Tgaray B1	33.000										0.042	89.9	0.8	
L.Tshenda A B1	33.000										0.016	87.8	0.3	
L.Tshenda A B2	0.415		0.001	0.001	0.004	0.003					0.006	85.0	9.1	
L.Tshenda B B1	33.000										0.010	84.9	0.2	
L.Tshenda B B2	0.415		0.002	0.001	0.007	0.004					0.010	85.0	13.7	
L.Tthang B1	0.415		0.005	0.003	0.019	0.012					0.028	85.0	41.8	
L.Tthang B2	33.000										0.030	83.9	0.5	
L/Lodama B1	33.000										0.050	85.0	0.9	
L/Lodama B2	0.415		0.001	0.000	0.003	0.002					0.004	85.0	6.2	
Laling B1	33.000										0.450	90.9	8.0	
Laling B2	0.415		0.003	0.002	0.013	0.008					0.020	85.0	28.0	
Lhaling B1	6.600										0.011	82.7	1.0	
Lhaling B2	0.415		0.002	0.001	0.007	0.004					0.011	85.0	15.6	
Ltengang B1	33.000										0.004	84.9	0.1	
Ltengang B2	0.415		0.001	0.000	0.002	0.001					0.003	85.0	4.9	
M.Goshi B1	33.000										0.017	84.4	0.3	
M.Goshi B2	0.415		0.003	0.002	0.011	0.007					0.017	85.0	23.9	
M.Tshendagg B1	33.000										0.081	84.4	1.4	
M.Tshendagg B2	0.415		0.014	0.009	0.053	0.033					0.079	85.0	113.5	
Mamthang B1	33.000										0.015	92.6	0.3	
Mamthang B2	0.415		0.001	0.001	0.005	0.003					0.008	85.0	11.6	
Manidara B1	33.000		0.000	0.000	0.001	0.001					0.033	97.9	0.6	
MchunaA B1	33.000										0.020	84.3	0.4	
MchunaA B2	0.415		0.004	0.002	0.013	0.008					0.020	85.0	28.5	
MchunaB B1	33.000										0.020	84.3	0.4	

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
MchunaB B2	0.415		0.004	0.002	0.013	0.008					0.020	85.0	29.0	
Mid Gzur T4 B1	33.000										0.138	86.4	2.4	
Mid Gzur T4 B2	0.415		0.003	0.002	0.011	0.007					0.016	85.0	23.5	
Mid Gzur T5 B1	33.000										0.122	86.2	2.2	
Mid Gzur T5 B2	0.415		0.008	0.005	0.031	0.019					0.047	85.0	67.4	
Mid Tding I B1	33.000										0.012	84.9	0.2	
Mid Tding I B2	0.415		0.002	0.001	0.008	0.005					0.012	85.0	17.2	
Mid Tding II B2	0.415		0.008	0.005	0.031	0.019					0.046	85.0	65.4	
Miid Tding II B2	33.000										0.047	84.8	0.8	
Namchella A B1	33.000										0.023	84.2	0.4	
Namchella A B2	0.415		0.004	0.002	0.015	0.009					0.022	85.0	31.9	
Namchella B B1	33.000										0.029	86.9	0.5	
Namchella B B2	0.415		0.001	0.001	0.004	0.002					0.005	85.0	7.6	
Namchella C B1	33.000		0.000	0.000	0.001	0.001					0.001	85.0	-	
Namchella D B1	33.000										0.026	90.4	0.5	
Namchella D B2	0.415		0.004	0.002	0.013	0.008					0.020	85.0	28.9	
Namchella E B1	33.000										0.073	89.3	1.3	
Namchella E B2	0.415		0.004	0.002	0.013	0.008					0.019	85.0	28.2	
Namchella F B1	33.000										0.077	89.6	1.4	
Namchella F B2	0.415		0.001	0.001	0.003	0.002					0.005	85.0	6.9	
Namjaygg B1	33.000										0.022	84.2	0.4	
Namjaygg B2	0.415		0.004	0.002	0.014	0.009					0.021	85.0	30.5	
Namlthang B1	33.000										0.037	84.7	0.7	
Namlthang B2	0.415		0.006	0.004	0.024	0.015					0.036	85.0	51.9	
Near Gling Sch. B1	33.000										0.025	84.8	0.4	
Near Gling Sch. B2	0.415		0.004	0.003	0.017	0.010					0.025	85.0	35.2	
Nindkha B1	33.000										0.014	84.8	0.3	
Nindkha B2	0.415		0.003	0.002	0.009	0.006					0.014	85.0	20.2	
Nindukha B1	6.600										0.049	81.7	4.4	
Nindukha B2	0.415		0.005	0.003	0.016	0.010					0.024	85.0	36.7	
Nobzinkha T1 B1	33.000										0.566	89.3	10.0	
Nobzinkha T1 B2	0.415		0.014	0.009	0.051	0.032					0.077	85.0	113.5	
Nobzinkha T2 B1	33.000		0.001	0.001	0.006	0.004					0.486	90.0	8.6	
Nobzinkha T32 B1	33.000										0.010	84.9	0.2	
Nobzinkha T32 B2	0.415		0.002	0.001	0.007	0.004					0.010	85.0	14.7	
PaksayB B1	33.000		0.001	0.001	0.004	0.003					0.006	85.0	0.1	
PakseyA B1	33.000										0.031	83.9	0.5	
PakseyA B2	0.415		0.005	0.003	0.019	0.012					0.029	85.0	43.1	
PakseyC B1	33.000										0.026	84.0	0.5	
PakseyC B2	0.415		0.005	0.003	0.017	0.010					0.025	85.0	37.4	
Panglo B1	33.000		0.001	0.001	0.005	0.003					0.007	85.0	0.1	
Pangna A1 B1	33.000										0.132	92.9	2.4	

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
Pangna A1 B2	0.415		0.000	0.000	0.002	0.001					0.003	85.0	3.8	
Pangna A2 B1	33.000										0.004	84.9	0.1	
Pangna A2 B2	0.415		0.001	0.000	0.002	0.001					0.004	85.0	5.1	
Pangna A3 B1	33.000										0.014	84.5	0.2	
Pangna A3 B2	0.415		0.002	0.001	0.009	0.006					0.013	85.0	19.3	
Pangna B1	33.000										0.013	84.5	0.2	
Pangna B2	0.415		0.002	0.001	0.009	0.005					0.013	85.0	18.9	
Pangna LSS B1	33.000										0.062	84.1	1.1	
Pangna LSS B2	0.415		0.011	0.007	0.040	0.025					0.060	85.0	87.5	
Pangna UA B1	33.000										0.008	84.9	0.1	
Pangna UA B2	0.415		0.001	0.001	0.005	0.003					0.008	85.0	10.8	
Pangna UB B1	33.000										0.148	92.8	2.6	
Pangna.UB B2	0.415		0.003	0.002	0.009	0.006					0.014	85.0	20.3	
Pangna.UC B1	33.000										0.021	87.9	0.4	
Pangna.UC B2	0.415		0.003	0.002	0.009	0.006					0.014	85.0	20.0	
Patala Gpa B1	33.000										0.001	85.0	-	
Patala Gpa B2	0.415		0.000	0.000	0.001	0.001					0.001	85.0	1.8	
PatalaA B1	33.000										0.035	88.7	0.6	
PatalaA B2	0.415		0.001	0.001	0.004	0.003					0.007	85.0	9.5	
PatalaB B1	33.000										0.029	87.1	0.5	
PatalaB B2	0.415		0.002	0.001	0.006	0.004					0.009	85.0	13.4	
PatalaC B1	33.000										0.021	84.2	0.4	
PatalaC B2	0.415		0.004	0.002	0.013	0.008					0.020	85.0	29.2	
Peling B1	33.000		0.000	0.000	0.000	-					0.001	85.0	-	
Phaperkti B1	33.000										0.010	84.9	0.2	
Phaperkti B2	0.415		0.002	0.001	0.007	0.004					0.010	85.0	14.1	
PhunsumggA B1	33.000										0.012	87.1	0.2	
PhunsumggA B2	0.415		0.002	0.001	0.007	0.004					0.011	85.0	15.2	
PhunsumggB B1	33.000		0.000	0.000	0.001	0.001					0.001	85.0	-	
PoktoA B1	33.000										0.031	88.9	0.6	
PoktoA B2	0.415		0.003	0.002	0.010	0.006					0.015	85.0	21.3	
PoktoB B1	33.000		0.003	0.002	0.012	0.007					0.018	85.0	0.3	
Pserpo Sch. B1	33.000										0.001	85.0	-	
Pserpo Sch. B2	0.415		0.000	0.000	0.001	-					0.001	85.0	1.5	
PserpoA B1	33.000										0.024	84.6	0.4	
PserpoA B2	0.415		0.004	0.003	0.016	0.010					0.024	85.0	34.7	
PserpoB B1	33.000										0.027	84.6	0.5	
PserpoB B2	0.415		0.005	0.003	0.018	0.011					0.027	85.0	38.8	
PtaykhaA B1	33.000										0.017	84.8	0.3	
PtaykhaA B2	0.415		0.003	0.002	0.011	0.007					0.017	85.0	24.4	
PtaykhaB B1	33.000										0.027	84.6	0.5	
PtaykhaB B2	0.415		0.005	0.003	0.018	0.011					0.027	85.0	38.4	

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
PtaykhaC B1	33.000										0.011	84.8	0.2	
PtaykhaC B2	0.415		0.002	0.001	0.007	0.004					0.011	85.0	15.3	
PtaykhaD B1	33.000										0.015	84.5	0.3	
PtaykhaD B2	0.415		0.003	0.002	0.010	0.006					0.015	85.0	21.2	
Pungshi C B1	33.000										0.021	87.9	0.4	
PungshiA B1	33.000		0.002	0.001	0.006	0.004					0.483	91.9	8.6	
PungshiB B1	33.000										0.011	84.6	0.2	
PungshiB B2	0.415		0.002	0.001	0.007	0.004					0.010	85.0	14.9	
PungshiC B2	0.415		0.002	0.001	0.007	0.004					0.010	85.0	14.8	
PungshiD B1	33.000										0.012	84.6	0.2	
PungshiD B2	0.415		0.002	0.001	0.008	0.005					0.011	85.0	16.3	
RBA B2	0.415		0.031	0.019	0.121	0.075					0.179	85.0	253.1	
S.Dorona B1	33.000										0.005	84.8	0.1	
S.Dorona B2	0.415		0.001	0.001	0.003	0.002					0.005	85.0	7.1	
SalamjiA B1	33.000										0.014	84.5	0.2	
SalamjiA b2	0.415		0.002	0.001	0.009	0.006					0.013	85.0	19.3	
Samay B1	33.000										0.007	84.7	0.1	
Samay B2	0.415		0.001	0.001	0.005	0.003					0.007	85.0	10.1	
Samay T4 B1	6.600										0.038	83.8	3.4	
Samay T4 B2	0.415		0.007	0.004	0.024	0.015					0.036	85.0	54.6	
SeepaA B1	33.000		0.001	0.001	0.005	0.003					0.007	85.0	0.1	
SeepaB B1	33.000										0.018	87.9	0.3	
SeepaB B2	0.415		0.002	0.001	0.008	0.005					0.012	85.0	17.1	
Sherpgon B1	33.000										0.066	84.1	1.2	
Sherpgon B2	0.415		0.012	0.007	0.042	0.026					0.063	85.0	92.4	
Station B1	0.415		0.012	0.007	0.045	0.028					0.067	85.0	95.1	
T.garay B2	0.415		0.001	0.000	0.003	0.002					0.004	85.0	5.8	
Tanabji B1	33.000										0.415	89.9	7.4	
Tanabji B2	0.415		0.003	0.002	0.010	0.006					0.015	85.0	21.3	
Tanju B1	33.000										0.022	84.2	0.4	
Tanju B2	0.415		0.004	0.002	0.015	0.009					0.022	85.0	31.6	
Tdolay T11 B1	33.000										0.006	84.8	0.1	
Tdolay T11 B2	0.415		0.001	0.001	0.004	0.003					0.006	85.0	8.6	
Tdolay TopA B1	33.000										0.021	98.9	0.4	
Tdolay TopA B2	0.415		0.001	0.001	0.004	0.002					0.006	85.0	7.9	
Tdolay TopB B1	33.000										0.016	98.1	0.3	
Tdolay TopB B2	0.415		0.001	0.001	0.004	0.002					0.006	85.0	8.3	
Tdolay TopC B1	33.000										0.007	84.8	0.1	
Tdolay TopC B2	0.415		0.001	0.001	0.005	0.003					0.007	85.0	9.6	
Tgang B1	33.000										0.020	84.7	0.4	
Tgang B2	0.415		0.004	0.002	0.013	0.008					0.020	85.0	28.9	
Thangna IA B1	33.000										0.009	84.7	0.2	

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Percent Loading
Thangna IA B2	0.415		0.002	0.001	0.006	0.004					0.009	85.0	13.0	
Thangna IB B1	33.000										0.185	93.0	3.3	
Thangna IB B2	0.415		0.001	0.001	0.003	0.002					0.005	85.0	7.0	
Thangna IIA B1	33.000										0.003	84.9	0.1	
Thangna IIA B2	0.415		0.001	0.000	0.002	0.001					0.003	85.0	4.4	
Thangna IIB B1	33.000										0.028	84.6	0.5	
Thangna IIB B2	0.415		0.005	0.003	0.018	0.011					0.028	85.0	39.7	
Thangna IID B1	33.000										0.022	84.2	0.4	
Thangna IID B2	0.415		0.004	0.002	0.014	0.009					0.021	85.0	31.2	
Thangna IIE B1	33.000										0.016	84.4	0.3	
Thangna IIE B2	0.415		0.003	0.002	0.011	0.007					0.016	85.0	22.9	
Thangna IIF B1	33.000										0.014	84.5	0.2	
Thangna IIF B2	0.415		0.002	0.002	0.009	0.006					0.014	85.0	19.8	
Thomgg B1	33.000										0.043	84.4	0.8	
Thomgg B2	0.415		0.008	0.005	0.028	0.017					0.042	85.0	60.4	
Tshalabi B1	33.000										0.023	66.0	0.4	
Tshalabi B2	0.415		0.001	0.001	0.005	0.003					0.007	85.0	10.5	
Tshanglakha B1	6.600										0.090	84.0	8.1	
Tshanglakha B2	0.415		0.000	0.000	0.001	0.001					0.002	85.0	2.9	
Tshkha Sch. B1	33.000										0.037	83.6	0.7	
Tshkha Sch. B2	0.415		0.007	0.004	0.023	0.014					0.035	85.0	52.9	
Tshkha.G B1	33.000										0.204	94.7	3.6	
Tshkha.G B2	0.415		0.004	0.003	0.016	0.010					0.024	85.0	34.9	
TshkhaA B1	33.000										0.145	97.2	2.6	
TshkhaA B2	0.415		0.004	0.002	0.014	0.009					0.021	85.0	30.5	
TshkhaB B1	33.000										0.034	94.5	0.6	
TshkhaB B2	0.415		0.001	0.001	0.004	0.002					0.005	85.0	7.7	
TshkhaC B1	33.000										0.092	98.8	1.6	
TshkhaC B2	0.415		0.002	0.001	0.006	0.004					0.009	85.0	13.1	
Tsho B1	33.000										0.013	84.5	0.2	
Tsho B2	0.415		0.002	0.001	0.008	0.005					0.012	85.0	17.9	
Tthang B1	33.000										0.030	84.6	0.5	
Tthang B2	0.415		0.005	0.003	0.020	0.012					0.030	85.0	42.2	
U.BalayggA B1	33.000										0.015	87.0	0.3	
U.BalayggA B2	0.415		0.001	0.001	0.006	0.003					0.008	85.0	11.8	
U.BalayggB B1	33.000										0.007	84.6	0.1	
U.BalayggB B2	0.415		0.001	0.001	0.005	0.003					0.007	85.0	10.3	
U.BalayggB B3	0.415		0.000	0.000	0.002	0.001					0.003	85.0	4.0	
U.BalayggC B1	33.000										0.022	84.7	0.4	
U.BalayggC B2	0.415		0.004	0.002	0.014	0.009					0.021	85.0	30.4	
U.Bhudichu B1	33.000										0.003	84.9	0.1	
U.Bhudichu B2	0.415		0.001	0.000	0.002	0.001					0.003	85.0	4.3	

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
U.Cthang B1	33.000		0.000	0.000	0.000	-					0.001	85.0	-	
U.Dagop B1	6.600										0.013	84.2	1.2	
U.Dagop B2	0.415		0.002	0.002	0.009	0.005					0.013	85.0	19.2	
U.Gling B1	33.000										0.224	97.4	4.0	
U.Gling B2	0.415		0.007	0.004	0.027	0.017					0.040	85.0	57.9	
U.Goshi B1	33.000										2.351	89.5	41.5	
U.Goshi B2	0.415		0.017	0.010	0.064	0.039					0.094	85.0	134.5	
U.Khagochn B1	33.000										0.061	84.1	1.1	
U.Khagochn B2	0.415		0.011	0.007	0.039	0.024					0.059	85.0	86.7	
U.Nimtola B1	33.000										0.037	84.5	0.7	
U.Nimtola B2	0.415		0.007	0.004	0.024	0.015					0.036	85.0	52.4	
U.Stengang B1	33.000										0.002	84.9	-	
U.Stengang B2	0.415		0.000	0.000	0.001	0.001					0.002	85.0	2.9	
U.Tgaray B1	33.000		0.001	0.000	0.003	0.002					0.004	85.0	0.1	
U.Tthang B1	33.000										0.057	84.6	1.0	
U.Tthang B2	0.415		0.010	0.006	0.038	0.024					0.056	85.0	80.8	
U/Lodama B1	33.000										0.047	83.3	0.8	
U/Lodama B2	0.415		0.008	0.005	0.029	0.018					0.044	85.0	66.0	
Yetsephu B1	33.000		0.001	0.000	0.003	0.002					0.016	89.7	0.3	
Yetsephu B2	0.415		0.001	0.001	0.003	0.002					0.005	85.0	6.5	
Yoetsosel B1	33.000										0.116	89.9	2.1	
Yoetsosel B2	0.415		0.002	0.001	0.009	0.005					0.013	85.0	18.4	
Yongsibji B1	33.000										0.118	92.1	2.1	
Yongsibji B2	0.415		0.005	0.003	0.019	0.012					0.028	85.0	41.0	
ZchelaA B1	33.000										0.063	89.1	1.1	
ZchelaA B2	0.415		0.003	0.002	0.011	0.007					0.017	85.0	24.2	
ZchelaC B1	33.000		0.001	0.000	0.002	0.001					0.239	94.3	4.3	
ZchelaD B1	33.000										0.009	84.7	0.2	
ZchelaD B2	0.415		0.002	0.001	0.006	0.004					0.009	85.0	12.7	

* 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	%
220/33 Tfr1	Transformer				10.000	2.560	25.6	2.538	25.4
220/33 Tfr2	Transformer				10.000	2.560	25.6	2.538	25.4
Aibthang Tfr	Transformer				0.063	0.022	34.2	0.021	33.7
* Akochn Tfr	Transformer				0.063	0.066	105.5	0.064	101.3
AkochnC Tfr	Transformer				0.025	0.023	92.5	0.022	89.3
Balaygg N.Gwog.O Tfr	Transformer				0.063	0.018	28.9	0.018	28.6
Balaygg Zero Tfr	Transformer				0.250	0.049	19.6	0.049	19.5
BalungA Tfr	Transformer				0.025	0.006	24.4	0.006	24.2
BanaA Tfr	Transformer				0.025	0.010	39.8	0.010	39.2
BanaB Tfr	Transformer				0.025	0.005	20.2	0.005	20.0
Banglachu Tfr	Transformer				0.025	0.015	59.9	0.015	58.6
BartsabA Tfr	Transformer				0.025	0.015	59.9	0.015	58.6
BartsabB Tfr	Transformer				0.025	0.024	95.0	0.023	91.6
BchuA Tfr	Transformer				0.025	0.007	26.9	0.007	26.7
BchuB Tfr	Transformer				0.025	0.016	65.3	0.016	63.7
Below D.Dzong Tfr	Transformer				0.250				
* Bgaythang Tfr	Transformer				0.025	0.028	113.8	0.027	108.9
* Bichgoan Balaygg Tfr	Transformer				0.016	0.029	182.3	0.027	169.6
Bidlung Tfr	Transformer				0.063	0.018	29.1	0.018	28.8
* BjuruggA Tfr	Transformer				0.025	0.039	157.5	0.037	148.1
BjuruggB Tfr	Transformer				0.025	0.007	28.1	0.007	27.8
BthangA Tfr	Transformer				0.063	0.009	13.6	0.009	13.5
BthangB Tfr	Transformer				0.063	0.005	8.0	0.005	8.0
* BuchunaA Tfr	Transformer				0.025	0.038	150.8	0.036	142.2
BuchunaB Tfr	Transformer				0.025	0.005	19.1	0.005	19.0
Chulham Tfr	Transformer				0.025	0.006	24.6	0.006	24.4
D.Dzong Jr.Sch Tfr	Transformer				0.050	0.006	12.0	0.006	12.0
Darachu Plant Tfr	Transformer				0.250	0.142	56.8	0.139	55.6
Darlithang Tfr	Transformer				0.063	0.048	75.8	0.046	73.7
Deorali Tfr	Transformer				0.063	0.025	39.1	0.024	38.6
Dogap TA Tfr	Transformer				0.025	0.005	21.7	0.005	21.5
Dogap TB Tfr	Transformer				0.016	0.004	24.5	0.004	24.3
Dogap TC Tfr	Transformer				0.016	0.003	17.6	0.003	17.4

CKT / Branch		Cable & Reactor			Transformer				
						Loading (input)		Loading (output)	
ID	Type	Ampacity (Amp)	Loading Amp	%	Capability (MVA)	MVA	%	MVA	%
Dolop Tfr	Transformer				0.020	0.008	38.2	0.008	37.7
Dpela.Hosp. Tfr	Transformer				0.250	0.062	24.9	0.062	24.6
Dpela.Sch. Tfr	Transformer				0.063	0.042	67.3	0.041	65.6
Drujeygg MSS Tfr	Transformer				0.315	0.165	52.5	0.162	51.5
DYT Hall Tfr	Transformer				0.250	0.192	76.8	0.186	74.6
Gairigoan Tfr	Transformer				0.016	0.008	49.8	0.008	48.8
Gangcpa Tfr	Transformer				0.025	0.004	16.2	0.004	16.1
Ganjab Tfr	Transformer				0.025	0.011	44.7	0.011	44.0
GeepsaA Tfr	Transformer				0.025	0.009	36.7	0.009	36.2
GeepsaB Tfr	Transformer				0.025	0.015	58.3	0.014	57.0
GeepsaC Tfr	Transformer				0.025	0.010	40.1	0.010	39.5
GelechuA Tfr	Transformer				0.025	0.006	24.8	0.006	24.6
GelechuC Tfr	Transformer				0.025	0.005	20.5	0.005	20.4
Gema Tfr	Transformer				0.025	0.012	49.4	0.012	48.5
Gemjaygg Tfr	Transformer				0.020	0.016	78.7	0.015	76.3
Go.Town Tfr	Transformer				0.750	0.231	30.8	0.228	30.4
Gopeni Tfr	Transformer				0.016	0.008	51.6	0.008	50.6
GumlaC Tfr	Transformer				0.025	0.022	87.9	0.021	85.0
Gurungg Tfr	Transformer				0.050				
Gzur T28 Tfr	Transformer				0.025	0.009	37.1	0.009	36.6
Gzur T29 Tfr	Transformer				0.025	0.021	84.1	0.020	81.5
Gzur T30 Tfr	Transformer				0.063	0.048	75.6	0.046	73.4
Gzur T31 Tfr	Transformer				0.063	0.023	36.8	0.023	36.3
Hatikharka Tfr	Transformer				0.063	0.009	14.7	0.009	14.6
Hospital Tfr	Transformer				0.250	0.043	17.2	0.043	17.1
ICT 33/6.6kV	Transformer				0.750	0.100	13.3	0.100	13.3
Jgarling Tfr	Transformer				0.025	0.012	47.3	0.012	46.5
Kanakha Tfr	Transformer				0.025	0.015	61.6	0.015	60.2
* Khagochn(PWD) Tfr	Transformer				0.063	0.069	109.9	0.066	105.3
* Khamey Tfr	Transformer				0.030	0.044	146.3	0.041	138.0
Khawakha D Tfr	Transformer				0.025	0.007	27.4	0.007	27.1
Kompa Tfr	Transformer				0.025	0.012	48.6	0.012	47.7
Kthang Tfr	Transformer				0.063	0.025	38.9	0.024	38.3
KthangA Tfr	Transformer				0.025	0.005	20.2	0.005	20.1
KthangB Tfr	Transformer				0.025	0.010	41.4	0.010	40.7

CKT / Branch		Cable & Reactor			Transformer				
					Capability	Loading (input)		Loading (output)	
ID	Type	Ampacity (Amp)	Loading Amp	%	(MVA)	MVA	%	MVA	%
Kzinka Tfr	Transformer				0.063	0.056	89.4	0.054	86.4
Kzinka Town Tfr	Transformer				0.315	0.065	20.8	0.065	20.6
L.Bhudichu Tfr	Transformer				0.025	0.013	53.3	0.013	52.3
* L.Dagop Tfr	Transformer				0.016	0.038	238.6	0.035	216.7
* L.Gling Tfr	Transformer				0.063	0.064	101.9	0.062	98.0
* L.Goshi T97 Tfr	Transformer				0.063	0.065	103.1	0.062	99.1
L.Goshi Tfr	Transformer				0.016				
L.Gzur T6 Tfr	Transformer				0.125	0.067	53.9	0.066	52.9
L.Khagochn T51 Tfr	Transformer				0.025	0.017	69.6	0.017	67.8
L.KhameyA Tfr	Transformer				0.025	0.004	15.9	0.004	15.9
L.KhameyB Tfr	Transformer				0.025	0.003	12.5	0.003	12.4
L.Nimtola Tfr	Transformer				0.025	0.015	59.0	0.014	57.7
L.Stengang Tfr	Transformer				0.025	0.007	29.3	0.007	29.0
L.Tding Tfr	Transformer				0.063	0.014	22.5	0.014	22.3
L.Tgaray Tfr	Transformer				0.025	0.004	16.4	0.004	16.3
L.Tshenda A Tfr	Transformer				0.063	0.006	10.3	0.006	10.3
L.Tshenda B Tfr	Transformer				0.063	0.010	15.5	0.010	15.4
* L.Tthang Tfr	Transformer				0.025	0.030	118.9	0.028	113.6
L/Lodama Tfr	Transformer				0.025	0.004	17.6	0.004	17.5
Laling Tfr	Transformer				0.063	0.020	31.3	0.020	31.0
Lhalinig Tfr	Transformer				0.020	0.011	54.7	0.011	53.5
Ltengang Tfr	Transformer				0.025	0.004	14.0	0.003	13.9
M.Goshi Tfr	Transformer				0.025	0.017	68.0	0.017	66.3
M.Tshendagg Tfr	Transformer				0.125	0.081	64.6	0.079	63.1
Mamthang Tfr	Transformer				0.025	0.008	33.0	0.008	32.6
MchunaA Tfr	Transformer				0.025	0.020	80.7	0.020	78.2
MchunaB Tfr	Transformer				0.025	0.020	81.9	0.020	79.4
Mid Gzur T4 Tfr	Transformer				0.025	0.017	66.8	0.016	65.1
Mid Gzur T5 Tfr	Transformer				0.063	0.048	76.2	0.047	74.0
Mid Tding I Tfr	Transformer				0.125	0.012	9.8	0.012	9.8
Mid Tding II Tfr	Transformer				0.250	0.047	18.6	0.046	18.5
Namchella A Tfr	Transformer				0.025	0.023	90.7	0.022	87.6
Namchella B Tfr	Transformer				0.025	0.005	21.6	0.005	21.4
Namchella D Tfr	Transformer				0.025	0.021	82.2	0.020	79.7
Namchella E Tfr	Transformer				0.025	0.020	80.3	0.019	77.9

CKT / Branch		Cable & Reactor			Transformer				
						Loading (input)		Loading (output)	
ID	Type	Ampacity (Amp)	Loading Amp	%	Capability (MVA)	MVA	%	MVA	%
Namchella F Tfr	Transformer				0.025	0.005	19.6	0.005	19.5
Namjaygg Tfr	Transformer				0.025	0.022	86.4	0.021	83.6
Namlthang Tfr	Transformer				0.125	0.037	29.3	0.036	29.0
Near Gling Sch. Tfr	Transformer				0.125	0.025	20.1	0.025	19.9
Nindkha Tfr	Transformer				0.063	0.014	22.5	0.014	22.3
* Nindukha Tfr	Transformer				0.020	0.026	128.7	0.024	122.3
* Nobzinkha T1 Tfr	Transformer				0.063	0.081	128.4	0.077	122.2
Nobzinkha T32 Tfr	Transformer				0.063	0.010	16.6	0.010	16.5
* PakseyA Tfr	Transformer				0.025	0.031	122.1	0.029	116.5
* PakseyC Tfr	Transformer				0.025	0.026	105.8	0.025	101.6
Pangna A1 Tfr	Transformer				0.025	0.003	10.8	0.003	10.7
Pangna A2 Tfr	Transformer				0.025	0.004	14.3	0.004	14.3
Pangna A3 Tfr	Transformer				0.025	0.014	54.4	0.013	53.3
Pangna LSS Tfr	Transformer				0.063	0.062	98.1	0.060	94.5
Pangna Tfr	Transformer				0.025	0.013	53.5	0.013	52.4
Pangna UA Tfr	Transformer				0.063	0.008	12.1	0.008	12.1
Pangna.UB Tfr	Transformer				0.025	0.014	57.3	0.014	56.0
Pangna.UC Tfr	Transformer				0.025	0.014	56.6	0.014	55.4
Patala Gpa Tfr	Transformer				0.025	0.001	5.2	0.001	5.2
PatalaA Tfr	Transformer				0.025	0.007	26.9	0.007	26.6
PatalaB Tfr	Transformer				0.025	0.009	37.8	0.009	37.2
PatalaC Tfr	Transformer				0.025	0.021	82.5	0.020	79.9
Phaperkti Tfr	Transformer				0.063	0.010	15.8	0.010	15.7
PhunsumggA Tfr	Transformer				0.025	0.011	42.8	0.011	42.1
PoktoA Tfr	Transformer				0.025	0.015	60.3	0.015	58.9
Pserpo Sch. Tfr	Transformer				0.063	0.001	1.7	0.001	1.7
PserpoA Tfr	Transformer				0.063	0.024	38.9	0.024	38.3
PserpoB Tfr	Transformer				0.063	0.027	43.5	0.027	42.8
PtaykhaA Tfr	Transformer				0.063	0.017	27.3	0.017	27.0
PtaykhaB Tfr	Transformer				0.063	0.027	43.0	0.027	42.3
PtaykhaC Tfr	Transformer				0.063	0.011	17.2	0.011	17.0
PtaykhaD Tfr	Transformer				0.025	0.015	60.0	0.015	58.6
PungshiB Tfr	Transformer				0.025	0.011	42.0	0.010	41.4
PungshiC Tfr	Transformer				0.025	0.010	41.8	0.010	41.1
PungshiD Tfr	Transformer				0.025	0.012	46.1	0.011	45.3

CKT / Branch		Cable & Reactor			Transformer				
						Loading (input)		Loading (output)	
ID	Type	Ampacity (Amp)	Loading Amp	%	Capability (MVA)	MVA	%	MVA	%
RBA Tfr	Transformer				0.750	0.180	24.0	0.179	23.8
S.Dorona Tfr	Transformer				0.025	0.005	20.2	0.005	20.0
SalamjiA Tfr	Transformer				0.025	0.014	54.5	0.013	53.3
* Samay T4 Tfr	Transformer				0.030	0.038	126.6	0.036	120.4
Samay Tfr	Transformer				0.025	0.007	28.3	0.007	28.0
SeepaB Tfr	Transformer				0.025	0.012	48.3	0.012	47.5
* Sherpgon Tfr	Transformer				0.063	0.066	104.5	0.063	100.5
Station Tfr	Transformer				0.250	0.068	27.1	0.067	26.8
Tanabji Tfr	Transformer				0.063	0.015	23.8	0.015	23.6
Tanju Tfr	Transformer				0.025	0.022	89.9	0.022	86.9
Tdolay T11 Tfr	Transformer				0.025	0.006	24.5	0.006	24.3
Tdolay TopA Tfr	Transformer				0.025	0.006	22.5	0.006	22.3
Tdolay TopB Tfr	Transformer				0.025	0.006	23.5	0.006	23.3
Tdolay TopC Tfr	Transformer				0.025	0.007	27.4	0.007	27.1
Tgang Tfr	Transformer				0.063	0.020	32.2	0.020	31.8
Thangna IA Tfr	Transformer				0.025	0.009	36.8	0.009	36.3
Thangna IB Tfr	Transformer				0.025	0.005	19.7	0.005	19.6
Thangna IIA Tfr	Transformer				0.025	0.003	12.3	0.003	12.3
Thangna IIB Tfr	Transformer				0.063	0.028	44.5	0.028	43.7
Thangna IID Tfr	Transformer				0.025	0.022	88.2	0.021	85.3
Thangna IIE Tfr	Transformer				0.025	0.016	64.8	0.016	63.2
Thangna IIF Tfr	Transformer				0.025	0.014	55.9	0.014	54.8
Thomgg Tfr	Transformer				0.063	0.043	67.9	0.042	66.2
Tshalabi Tfr	Transformer				0.025	0.007	29.9	0.007	29.5
Tshanglakha Tfr	Transformer				0.025	0.002	8.1	0.002	8.1
* Tshkha Sch. Tfr	Transformer				0.025	0.037	149.4	0.035	140.9
Tshkha.G Tfr	Transformer				0.025	0.025	98.6	0.024	94.9
TshkhaA Tfr	Transformer				0.025	0.022	86.2	0.021	83.4
TshkhaB Tfr	Transformer				0.025	0.005	21.8	0.005	21.6
TshkhaC Tfr	Transformer				0.025	0.009	37.0	0.009	36.5
Tsho Tfr	Transformer				0.025	0.013	50.4	0.012	49.4
Tthang Tfr	Transformer				0.063	0.030	47.7	0.030	46.9
U.BalayggA Tfr	Transformer				0.025	0.008	33.4	0.008	33.0
U.BalayggB Tfr	Transformer				0.016	0.007	45.6	0.007	44.8
U.BalayggC Tfr	Transformer				0.063	0.022	34.3	0.021	33.8

CKT / Branch		Cable & Reactor			Transformer				
						Loading (input)		Loading (output)	
ID	Type	Ampacity (Amp)	Loading Amp	%	Capability (MVA)	MVA	%	MVA	%
U.Bhudichu Tfr	Transformer				0.025	0.003	12.2	0.003	12.1
U.Dagop Tfr	Transformer				0.016	0.013	84.1	0.013	81.4
U.Gling Tfr	Transformer				0.063	0.041	65.4	0.040	63.8
U.Goshi Tfr	Transformer				0.250	0.096	38.3	0.094	37.8
U.Khagochn Tfr	Transformer				0.063	0.061	97.4	0.059	93.9
U.Nimtola Tfr	Transformer				0.063	0.037	59.2	0.036	57.9
U.Stengang Tfr	Transformer				0.025	0.002	8.2	0.002	8.2
U.Tthang Tfr	Transformer				0.125	0.057	45.9	0.056	45.2
* U/Lodama Tfr	Transformer				0.025	0.047	187.9	0.044	174.7
Yetsephu Tfr	Transformer				0.025	0.005	18.4	0.005	18.3
Yoetsosel Tfr	Transformer				0.025	0.013	52.1	0.013	51.1
Yongsibji Tfr	Transformer				0.063	0.029	46.0	0.028	45.2
ZchelaA Tfr	Transformer				0.025	0.017	68.2	0.017	66.5
ZchelaD Tfr	Transformer				0.025	0.009	35.9	0.009	35.4

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

Branch Losses Summary Report

	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
Branch ID	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
DAE50.35-Aibthang	-0.018	-0.011	0.018	0.009	0.0	-2.6	98.2	98.2	0.00
Aibthang Tfr	0.018	0.011	-0.018	-0.011	0.2	0.3	98.2	97.0	1.27
Akochn Tfr	-0.054	-0.034	0.056	0.036	1.6	2.4	94.6	98.5	3.91
AkochnA-DAE50.10	0.131	0.046	-0.131	-0.047	0.0	-0.8	98.5	98.5	0.00
DAE50.9-AkochnA	-0.187	-0.082	0.187	0.078	0.0	-3.9	98.5	98.6	0.02
DAE50.9-AkochnC	-0.019	-0.012	0.019	0.011	0.0	-1.8	98.6	98.6	0.00
AkochnC Tfr	0.019	0.012	-0.019	-0.012	0.5	0.7	98.6	95.1	3.43
DAE50.4-Balaygg N.Gwog.O	-0.015	-0.010	0.015	0.009	0.0	-0.2	98.8	98.8	0.00
Balaygg N.Gwog.O Tfr	0.015	0.010	-0.015	-0.009	0.1	0.2	98.8	97.7	1.06
DAE50.5-Balaygg Zero	-0.042	-0.026	0.042	0.026	0.0	-0.2	98.7	98.7	0.00
Balaygg Zero Tfr	0.042	0.026	-0.041	-0.026	0.2	0.3	98.7	98.0	0.72
Balung(C-A)	-0.005	-0.003	0.005	0.002	0.0	-1.5	98.2	98.2	0.00
BalungA Tfr	0.005	0.003	-0.005	-0.003	0.0	0.1	98.2	97.2	0.91
Yetsephu-BalungC	-0.007	-0.003	0.007	0.003	0.0	-0.4	98.2	98.2	0.00
DAE50.62-BanaA	-0.008	-0.005	0.008	0.003	0.0	-2.5	98.2	98.2	0.00
BanaA Tfr	0.008	0.005	-0.008	-0.005	0.1	0.1	98.2	96.7	1.48
BanaB-Gangcpa	0.018	0.003	-0.018	-0.006	0.0	-3.1	98.2	98.2	0.00
DAE50.62-BanaB	-0.022	-0.006	0.022	0.005	0.0	-0.7	98.2	98.2	0.00
BanaB Tfr	0.004	0.003	-0.004	-0.003	0.0	0.0	98.2	97.4	0.75
DAE80.9-Banglachu	-0.013	-0.008	0.013	-0.001	0.0	-9.4	99.0	99.0	0.00
Banglachu Tfr	0.013	0.008	-0.012	-0.008	0.2	0.3	99.0	96.8	2.21
Bartsab(A-B)	0.027	0.013	-0.027	-0.014	0.0	-0.7	98.5	98.5	0.00
BuchunaB-BartsabA	-0.040	-0.021	0.040	0.015	0.0	-6.4	98.5	98.5	0.01
BartsabA Tfr	0.013	0.008	-0.012	-0.008	0.2	0.3	98.5	96.3	2.22
BartsabB-Bemji	0.007	0.001	-0.007	-0.004	0.0	-3.0	98.5	98.5	0.00
BartsabB Tfr	0.020	0.013	-0.019	-0.012	0.5	0.8	98.5	95.0	3.52
BchuA-DAE50.53	0.210	0.073	-0.210	-0.074	0.0	-1.0	98.2	98.2	0.00
DAE50.52-BchuA	-0.215	-0.076	0.215	0.074	0.0	-2.4	98.2	98.2	0.01
BchuA Tfr	0.006	0.004	-0.006	-0.004	0.0	0.1	98.2	97.2	1.00
DAE50.53-BchuB	-0.014	-0.009	0.014	0.008	0.0	-0.3	98.2	98.2	0.00
BchuB Tfr	0.014	0.009	-0.014	-0.008	0.2	0.4	98.2	95.8	2.43
DAE40.11-Below D.Dzong	0.000	0.000	0.000	0.000	0.0	-0.1	97.6	97.6	0.00
Below D.Dzong Tfr	0.000	0.000	0.000	0.000			97.6	97.6	
DAE50.7-Bgaythang	-0.024	-0.015	0.024	0.013	0.0	-2.5	98.6	98.6	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
Bgaythang Tfr	0.024	0.015	-0.023	-0.014	0.7	1.1	98.6	94.3	4.22
Bhalukob-DAE80.5	0.008	-0.013	-0.008	0.003	0.0	-10.3	99.0	99.0	0.00
Tshalabi-Bhalukob	-0.009	0.013	0.009	-0.017	0.0	-4.4	99.0	99.0	0.00
DAE40.7-Bichgoan Balaygg	-0.024	-0.016	0.024	0.016	0.0	0.0	97.7	97.7	0.02
Bichgoan Balaygg Tfr	0.024	0.016	-0.023	-0.014	1.2	1.9	97.7	90.9	6.84
DAE50.3-Bidlung	-0.016	-0.010	0.016	0.008	0.0	-1.7	98.9	98.9	0.00
Bidlung Tfr	0.016	0.010	-0.015	-0.010	0.1	0.2	98.9	97.9	1.07
BjurunggA-Panglo	0.006	0.001	-0.006	-0.004	0.0	-2.8	98.6	98.6	0.00
DAE70.9-BjuruggA	-0.039	-0.023	0.039	0.022	0.0	-0.4	98.6	98.6	0.00
BjuruggA Tfr	0.033	0.022	-0.031	-0.020	1.4	2.1	98.6	92.7	5.85
BjurungB-Yoetsosel	0.104	0.045	-0.104	-0.051	0.0	-6.2	98.5	98.5	0.02
DAE70.9-BjuruggB	-0.110	-0.048	0.110	0.047	0.0	-1.2	98.5	98.6	0.00
BjuruggB Tfr	0.006	0.004	-0.006	-0.004	0.0	0.1	98.5	97.5	1.04
Bthang(A-B)	0.004	0.001	-0.004	-0.003	0.0	-1.3	98.3	98.3	0.00
DAE50.45-BthangA	-0.012	-0.006	0.012	0.005	0.0	-1.1	98.3	98.3	0.00
BthangA Tfr	0.007	0.005	-0.007	-0.004	0.0	0.0	98.3	97.8	0.50
BthangB Tfr	0.004	0.003	-0.004	-0.003	0.0	0.0	98.3	98.0	0.30
DAE70.11-BuchunaA	-0.032	-0.021	0.032	0.020	0.0	-0.4	98.5	98.5	0.00
BuchunaA Tfr	0.032	0.021	-0.030	-0.019	1.3	1.9	98.5	92.9	5.60
DAE70.11-BuchunaB	-0.044	-0.018	0.044	0.015	0.0	-2.6	98.5	98.5	0.00
BuchunaB Tfr	0.004	0.003	-0.004	-0.003	0.0	0.0	98.5	97.8	0.71
L1-DAE70.1	0.996	0.429	-0.995	-0.432	1.2	-3.4	99.1	99.0	0.12
L1-DAE80.1	0.295	0.079	-0.295	-0.079	0.0	-0.1	99.1	99.1	0.00
L1-U.Goshi	2.105	1.048	-2.104	-1.049	0.7	-0.7	99.1	99.1	0.04
220/33 Tfr2	-2.286	-1.101	2.301	1.123	14.5	21.8	99.1	100.0	0.88
L1-DAE40.1	0.605	0.355	-0.605	-0.358	0.2	-3.6	99.1	99.1	0.04
L1-DAE90	0.514	0.256	-0.514	-0.257	0.1	-1.7	99.1	99.1	0.02
220/33 Tfr1	-2.286	-1.101	2.301	1.123	14.5	21.8	99.1	100.0	0.88
Station Tfr	0.057	0.036	-0.057	-0.035	0.4	0.6	99.1	98.1	1.00
Mamthang-Chukham	-0.007	-0.004	0.007	0.001	0.0	-2.9	99.0	99.0	0.00
Chulham Tfr	0.005	0.003	-0.005	-0.003	0.0	0.1	99.0	98.1	0.90
D.Dzong Jr.Sch -Samay T4	0.032	0.021	-0.032	-0.021	0.0	-0.1	96.9	96.9	0.07
DAE40.12-D.Dzong Jr.Sch.	-0.037	-0.024	0.037	0.024	0.1	-0.2	96.9	97.1	0.21
D.Dzong Jr.Sch Tfr	0.005	0.003	-0.005	-0.003	0.0	0.0	96.9	96.5	0.45
DAE40(1-2)	0.516	0.310	-0.516	-0.311	0.0	-0.6	99.1	99.1	0.01
DAE40.1-Dpela.Hosp.	0.089	0.048	-0.089	-0.055	0.0	-7.1	99.1	99.1	0.02
DAE40(2-3)	0.278	0.163	-0.278	-0.166	0.1	-2.6	99.1	99.0	0.02

Branch ID	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
ICT 33/6.6kV	0.086	0.052	-0.086	-0.051	0.3	0.5	99.1	98.6	0.49
RBA Tfr	0.153	0.096	-0.152	-0.094	1.0	1.5	99.1	98.2	0.88
DAE40(3-4)	0.082	0.045	-0.082	-0.047	0.0	-2.0	99.0	99.0	0.01
DAE40.3-Go.Town	0.196	0.121	-0.196	-0.123	0.0	-2.1	99.0	99.0	0.01
DAE40.4-L.Tshendagg	0.014	0.004	-0.014	-0.008	0.0	-3.2	99.0	99.0	0.00
DAE40.4-Tshendagg	0.068	0.043	-0.068	-0.043	0.0	-0.2	99.0	99.0	0.00
DAE40(5-6)	0.085	0.051	-0.085	-0.051	0.0	0.0	98.5	98.5	0.02
DAE40.5-L.Goshi	0.000	0.000	0.000	0.000	0.0	0.0	98.5	98.5	0.00
ICT B-DAE40.4	-0.085	-0.051	0.086	0.051	0.0	0.0	98.5	98.6	0.06
DAE40(6-7)	0.085	0.051	-0.085	-0.051	0.7	0.0	98.5	97.7	0.76
DAE40.6-Gurungg	0.000	0.000	0.000	0.000	0.0	-0.1	98.5	98.5	0.00
DAE40(7-8)	0.061	0.035	-0.060	-0.035	0.1	0.0	97.7	97.6	0.11
DAE40(8-9)	0.054	0.031	-0.054	-0.031	0.0	0.0	97.6	97.6	0.03
DAE40.8-Gairigoan	0.007	0.004	-0.007	-0.004	0.0	0.0	97.6	97.6	0.00
DAE40(9-10)	0.011	0.002	-0.011	-0.003	0.0	-0.7	97.6	97.5	0.13
DAE40.9-L.Dagop	0.043	0.029	-0.043	-0.029	0.0	0.0	97.6	97.6	0.04
DAE40.10-Dolop	0.006	0.004	-0.006	-0.004	0.0	0.0	97.5	97.5	0.00
DAE40.10-Lhaling	0.004	-0.001	-0.004	0.000	0.0	-0.6	97.5	97.4	0.03
DAE40.11-Tshanglakha	0.076	0.049	-0.076	-0.049	0.3	-0.1	97.6	97.2	0.41
Darachu-DAE40.11	-0.076	-0.049	0.076	0.049	0.3	-0.1	97.6	97.9	0.32
DAE40.12-Khamey	0.037	0.024	-0.037	-0.024	0.0	0.0	97.1	97.1	0.03
Tshanglakha-DAE40.12	-0.074	-0.048	0.074	0.048	0.0	0.0	97.1	97.2	0.04
DAE50(1-2)	2.008	0.990	-2.008	-0.991	0.4	-0.5	99.0	99.0	0.03
DAE50.1-M.Goshi	0.014	0.009	-0.014	-0.009	0.0	-0.1	99.0	99.0	0.00
U.Goshi-DAE50.1	-2.022	-0.999	2.023	0.998	0.9	-1.1	99.0	99.1	0.06
DAE50.1-L.Goshi T97	0.055	0.035	-0.055	-0.035	0.0	-0.1	99.0	99.0	0.00
DAE50(2-3)	1.953	0.956	-1.952	-0.957	0.8	-1.1	99.0	98.9	0.06
DAE50(3-4)	1.937	0.949	-1.935	-0.951	1.5	-2.3	98.9	98.8	0.11
DAE50(4-5)	1.920	0.942	-1.919	-0.943	0.9	-1.4	98.8	98.7	0.07
DAE50(63-5)	1.877	0.917	-1.876	-0.919	1.0	-1.7	98.7	98.7	0.08
DAE50(6-7)	0.267	0.120	-0.267	-0.123	0.1	-2.2	98.6	98.6	0.02
DAE50(6-17)	0.919	0.376	-0.919	-0.382	0.5	-6.0	98.6	98.5	0.07
DAE50(6-63)	-1.186	-0.496	1.187	0.491	0.7	-4.7	98.6	98.7	0.08
DAE(7-8)	0.243	0.110	-0.243	-0.111	0.0	-1.1	98.6	98.6	0.01
DAE(8-9)	0.207	0.088	-0.207	-0.089	0.0	-1.0	98.6	98.6	0.01
DAE50.8-Thomgg	0.036	0.022	-0.036	-0.023	0.0	-0.5	98.6	98.6	0.00
DAE50(10-11)	0.121	0.041	-0.121	-0.046	0.0	-4.8	98.5	98.5	0.02

	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
DAE50(11-12)	0.111	0.040	-0.111	-0.046	0.0	-5.9	98.5	98.5	0.02
DAE50(12-13)	0.089	0.031	-0.089	-0.033	0.0	-1.2	98.5	98.5	0.00
DAE50.12-PakseyC	0.022	0.014	-0.022	-0.014	0.0	-0.3	98.5	98.5	0.00
DAE50(13-14)	0.063	0.018	-0.063	-0.022	0.0	-4.1	98.5	98.5	0.01
DAE50.13-PakseyA	0.026	0.015	-0.026	-0.017	0.0	-1.7	98.5	98.5	0.00
DAE50(14-15)	0.058	0.019	-0.058	-0.022	0.0	-3.4	98.5	98.5	0.01
DAE50.14-PaksayB	0.006	0.003	-0.006	-0.003	0.0	-0.2	98.5	98.5	0.00
DAE50.15-GumlaA	0.009	0.004	-0.009	-0.005	0.0	-1.6	98.5	98.5	0.00
DAE50.15-GumlaB	0.049	0.018	-0.049	-0.020	0.0	-1.7	98.5	98.5	0.00
DAE50.16-GumlaC	0.019	0.010	-0.019	-0.012	0.0	-1.6	98.5	98.5	0.00
DAE50.16-PoktoA	0.028	0.010	-0.028	-0.014	0.0	-4.6	98.5	98.5	0.00
GumlaB-DAE50.16	-0.046	-0.020	0.046	0.018	0.0	-1.8	98.5	98.5	0.00
DAE50(17-19)	0.890	0.365	-0.890	-0.374	0.7	-8.9	98.5	98.4	0.10
DAE50.17-GeepsaA	0.029	0.016	-0.029	-0.017	0.0	-0.4	98.5	98.5	0.00
DAE50.18-GeepsaB	0.012	0.008	-0.012	-0.008	0.0	-0.3	98.5	98.5	0.00
DAE50.18-GeepsaC	0.008	0.005	-0.008	-0.005	0.0	-0.4	98.5	98.5	0.00
GeepsaA-DAE50.19	-0.021	-0.012	0.021	0.012	0.0	-0.5	98.5	98.5	0.00
DAE50(19-20)	0.034	0.019	-0.034	-0.020	0.0	-0.9	98.4	98.4	0.00
DAE50(19-21)	0.855	0.355	-0.855	-0.355	0.0	-0.6	98.4	98.4	0.01
DAE50.20-MchunaA	0.017	0.011	-0.017	-0.011	0.0	-0.1	98.4	98.4	0.00
DAE50.20-MchunaB	0.017	0.009	-0.017	-0.011	0.0	-1.7	98.4	98.4	0.00
DAE50(21-22)	0.854	0.361	-0.854	-0.366	0.3	-4.3	98.4	98.4	0.05
DAE50.21-Patala Gpa	0.001	-0.006	-0.001	-0.001	0.0	-6.6	98.4	98.4	0.00
DAE50(22-23)	0.823	0.350	-0.823	-0.353	0.2	-2.7	98.4	98.3	0.03
DAE50.22-PatalaA	0.031	0.015	-0.031	-0.016	0.0	-0.8	98.4	98.4	0.00
DAE50(23-24)	0.771	0.321	-0.771	-0.322	0.0	-0.5	98.3	98.3	0.01
DAE50.23-Pangna LSS	0.052	0.032	-0.052	-0.033	0.0	-1.4	98.3	98.3	0.00
DAE50(24-25)	0.631	0.235	-0.631	-0.240	0.2	-5.3	98.3	98.3	0.04
DAE50.24-Drujeygg MSS	0.140	0.087	-0.140	-0.088	0.0	-1.4	98.3	98.3	0.00
DAE50(25-26)	0.180	0.069	-0.180	-0.071	0.0	-2.4	98.3	98.3	0.01
DAE50(25-36)	0.451	0.171	-0.451	-0.172	0.0	-1.0	98.3	98.3	0.01
DAE50.26-Thangna IA	0.008	0.004	-0.008	-0.005	0.0	-0.9	98.3	98.3	0.00
DAE50.27-Thanga IB	0.172	0.067	-0.172	-0.068	0.0	-1.0	98.3	98.3	0.00
DAE50(27-28)	0.149	0.058	-0.149	-0.060	0.0	-1.5	98.3	98.3	0.00
DAE50.28-Pangna.UC	0.018	0.009	-0.018	-0.010	0.0	-0.7	98.3	98.3	0.00
Thangna IB-DAE5.27	-0.168	-0.068	0.168	0.065	0.0	-2.1	98.3	98.3	0.01
DAE5.28-Pangna UB	0.138	0.055	-0.138	-0.055	0.0	-0.2	98.3	98.3	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
DAE50.29-Pangna A3	0.011	0.005	-0.011	-0.007	0.0	-2.5	98.3	98.3	0.00
DAE50.29-Pangna A1	0.123	0.048	-0.123	-0.049	0.0	-1.4	98.3	98.3	0.00
DAE50.29-Pangna A2	0.003	0.001	-0.003	-0.002	0.0	-1.3	98.3	98.3	0.00
Pangna UB-DAE50.29	-0.126	-0.048	0.126	0.048	0.0	-0.6	98.3	98.3	0.00
DAE50.30-Pangna	0.011	0.006	-0.011	-0.007	0.0	-1.0	98.3	98.3	0.00
DAE50.30-Yongsibji	0.109	0.044	-0.109	-0.046	0.0	-2.6	98.3	98.3	0.01
Pangna A1-DAE50.30	-0.120	-0.050	0.120	0.048	0.0	-2.2	98.3	98.3	0.00
DAE50(31-32)	0.080	0.033	-0.080	-0.034	0.0	-0.8	98.2	98.2	0.00
DAE50.31-KthangA	0.004	0.002	-0.004	-0.003	0.0	-1.0	98.2	98.2	0.00
Yongsibji-DAE50.31	-0.085	-0.035	0.085	0.031	0.0	-3.8	98.2	98.3	0.01
DAE50(32-33)	0.045	0.019	-0.045	-0.021	0.0	-2.2	98.2	98.2	0.00
DAE50(32-KthangB)	0.035	0.015	-0.035	-0.017	0.0	-2.1	98.2	98.2	0.00
DAE50(33-34)	0.022	0.009	-0.022	-0.009	0.0	-0.9	98.2	98.2	0.00
DAE50.33-PserpoB	0.023	0.013	-0.023	-0.015	0.0	-1.8	98.2	98.2	0.00
DAE50.34-Pserpo Sch.	0.001	-0.003	-0.001	-0.001	0.0	-3.6	98.2	98.2	0.00
DAE50.34-PserpoA	0.021	0.012	-0.021	-0.013	0.0	-0.6	98.2	98.2	0.00
DAE50.35-Phaperkti	0.008	0.005	-0.008	-0.005	0.0	-0.4	98.2	98.2	0.00
KthangB-DAE50.35	-0.027	-0.014	0.027	0.011	0.0	-2.6	98.2	98.2	0.00
DAE50(36-37)	0.057	0.031	-0.057	-0.031	0.0	-0.1	98.3	98.3	0.00
DAE50(36-40)	0.394	0.141	-0.394	-0.143	0.0	-1.7	98.3	98.3	0.01
DAE50(37-38)	0.039	0.020	-0.039	-0.021	0.0	-0.7	98.3	98.3	0.00
DAE50.37-Thangna IID	0.019	0.011	-0.019	-0.012	0.0	-1.3	98.3	98.3	0.00
DAE50(38-39)	0.026	0.014	-0.026	-0.015	0.0	-1.3	98.3	98.3	0.00
DAE50.38-Thangna IIC	0.012	0.007	-0.012	-0.008	0.0	-0.7	98.3	98.3	0.00
DAE50.39-Thangna IIA	0.003	0.001	-0.003	-0.002	0.0	-0.7	98.3	98.3	0.00
DAE50.39-Thangna IIB	0.024	0.014	-0.024	-0.015	0.0	-0.5	98.3	98.3	0.00
DAE50(40-41)	0.025	0.014	-0.025	-0.014	0.0	0.0	98.3	98.3	0.00
DAE50(40-42)	0.368	0.129	-0.368	-0.133	0.0	-3.7	98.3	98.3	0.02
DAE50.41-Thangna IIE	0.014	0.008	-0.014	-0.009	0.0	-0.7	98.3	98.3	0.00
DAE50.41-Thangna IIF	0.012	0.006	-0.012	-0.007	0.0	-1.7	98.3	98.3	0.00
DAE50(42-43)	0.354	0.127	-0.354	-0.128	0.0	-0.8	98.3	98.3	0.00
DAE50.42-L.Bhudichu	0.014	0.006	-0.014	-0.008	0.0	-1.9	98.3	98.3	0.00
DAE50(43-44)	0.013	-0.003	-0.013	0.000	0.0	-3.5	98.3	98.3	0.00
DAE50(43-46)	0.341	0.131	-0.341	-0.137	0.1	-5.4	98.3	98.2	0.03
DAE50(44-45)	0.012	-0.001	-0.012	-0.003	0.0	-4.3	98.3	98.3	0.00
DAE50.45-IC Line	0.000	-0.001	0.000	0.000	0.0	-1.3	98.3	98.3	0.00
DAE50(46-47)	0.045	0.025	-0.045	-0.026	0.0	-1.3	98.2	98.2	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
DAE50(46-48)	0.296	0.112	-0.296	-0.113	0.0	-0.9	98.2	98.2	0.00
DAE50.47-PtaykhaB	0.023	0.013	-0.023	-0.014	0.0	-1.2	98.2	98.2	0.00
DAE50.47-PtaykhaC	0.009	0.006	-0.009	-0.006	0.0	-0.1	98.2	98.2	0.00
DAE50.47-PtaykhaD	0.013	0.007	-0.013	-0.008	0.0	-0.8	98.2	98.2	0.00
DAE50(48-49)	0.282	0.104	-0.282	-0.107	0.0	-2.4	98.2	98.2	0.01
DAE50.48-PtaykhaA	0.015	0.009	-0.015	-0.009	0.0	-0.5	98.2	98.2	0.00
DAE50.49-ZchelaA	0.056	0.028	-0.056	-0.029	0.0	-0.4	98.2	98.2	0.00
DAE50.49-ZchelaC	0.226	0.078	-0.226	-0.079	0.0	-0.8	98.2	98.2	0.00
DAE50.50-L.Tgaray	0.038	0.018	-0.038	-0.019	0.0	-0.7	98.2	98.2	0.00
ZchelaA-DAE50.50	-0.042	-0.020	0.042	0.019	0.0	-0.7	98.2	98.2	0.00
DAE50.51-Namlthang	0.031	0.018	-0.031	-0.019	0.0	-1.4	98.2	98.2	0.00
DAE50.51-U.Tgaray	0.004	0.001	-0.004	-0.002	0.0	-0.9	98.2	98.2	0.00
L.Tgaray-DAE50.51	-0.035	-0.019	0.035	0.016	0.0	-3.0	98.2	98.2	0.00
DAE50.52-ZchelaD	0.008	0.004	-0.008	-0.005	0.0	-0.4	98.2	98.2	0.00
ZchelaC-DAE50.52	-0.223	-0.078	0.223	0.078	0.0	-0.6	98.2	98.2	0.00
DAE50.53-Tshkha G	0.193	0.063	-0.193	-0.065	0.0	-1.8	98.2	98.2	0.01
DAE50.54-Tshkha Sch.	0.031	0.020	-0.031	-0.020	0.0	-0.9	98.2	98.2	0.00
DAE50.54-TshkhaA	0.141	0.033	-0.141	-0.034	0.0	-1.3	98.2	98.2	0.00
Tshkha.G-DAE50.54	-0.172	-0.053	0.172	0.052	0.0	-0.8	98.2	98.2	0.00
DAE50.55-TshkhaB	0.032	0.011	-0.032	-0.011	0.0	-0.3	98.2	98.2	0.00
DAE50.55-TshkhaC	0.091	0.013	-0.091	-0.014	0.0	-1.4	98.2	98.2	0.00
TshkhaA-DAE50.55	-0.123	-0.023	0.123	0.023	0.0	-0.6	98.2	98.2	0.00
DAE50(56-57)	0.015	0.002	-0.015	-0.008	0.0	-5.5	98.2	98.2	0.00
DAE50.56-Jgarling	0.013	0.007	-0.013	-0.008	0.0	-0.8	98.2	98.2	0.00
TshkhaB-DAE50.56	-0.028	-0.009	0.028	0.008	0.0	-1.2	98.2	98.2	0.00
DAE50.57-SalamjiA	0.012	0.006	-0.012	-0.007	0.0	-1.6	98.2	98.2	0.00
DAE50.58-GelechuC	0.074	0.007	-0.074	-0.009	0.0	-2.2	98.2	98.2	0.00
GelechuA-DAE50.58	-0.078	-0.010	0.078	0.009	0.0	-0.7	98.2	98.2	0.00
DAE50(59-60)	0.059	0.004	-0.059	-0.008	0.0	-3.8	98.2	98.2	0.00
DAE50.59-Kompa	0.010	0.006	-0.010	-0.006	0.0	-0.7	98.2	98.2	0.00
GelechuC-DAE50.59	-0.069	-0.009	0.069	0.007	0.0	-2.9	98.2	98.2	0.00
DAE50(60-61)	0.048	0.008	-0.048	-0.013	0.0	-4.6	98.2	98.2	0.00
DAE50.60-PhunsumggA	0.010	-0.001	-0.010	-0.004	0.0	-5.2	98.2	98.2	0.00
DAE50.61-Manidara	0.032	0.004	-0.032	-0.007	0.0	-2.6	98.2	98.2	0.00
DAE50.61-SeepaB	0.016	0.008	-0.016	-0.009	0.0	-0.3	98.2	98.2	0.00
Manidara-DAE50.62	-0.031	-0.008	0.031	0.006	0.0	-2.0	98.2	98.2	0.00
DAE70(1-2)	0.970	0.416	-0.969	-0.418	0.7	-2.2	99.0	98.9	0.08

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
DAE70.1-TTthang	0.025	0.016	-0.025	-0.016	0.0	-0.2	99.0	99.0	0.00
DAE70(2-3)	0.069	0.036	-0.069	-0.039	0.0	-3.0	98.9	98.9	0.01
DAE70(2-4)	0.900	0.382	-0.899	-0.382	0.2	-0.6	98.9	98.9	0.02
DAE70.3-Deorali	0.021	0.009	-0.021	-0.013	0.0	-4.2	98.9	98.9	0.00
DAE70.3-U.Tthang	0.049	0.031	-0.049	-0.031	0.0	-0.1	98.9	98.9	0.00
DAE70(4-5)	0.874	0.367	-0.873	-0.371	1.2	-4.7	98.9	98.8	0.15
DAE70.4-L.Tthang	0.025	0.016	-0.025	-0.016	0.0	-0.4	98.9	98.9	0.00
DAE70(5-6)	0.860	0.364	-0.860	-0.365	0.2	-0.7	98.8	98.7	0.02
DAE70.5-U.BalayggA	0.013	0.007	-0.013	-0.008	0.0	-0.6	98.8	98.8	0.00
DAE70.5-U.BalayggC	0.018	0.008	-0.018	-0.011	0.0	-3.0	98.7	98.7	0.00
DAE70.6-Dogap TA	0.842	0.357	-0.841	-0.357	0.1	-0.6	98.7	98.7	0.02
DAE70(7-12)	0.660	0.295	-0.660	-0.295	0.0	-0.3	98.6	98.6	0.01
DAE70.7-Dogap TC	0.176	0.062	-0.176	-0.062	0.0	-0.4	98.6	98.6	0.00
Dogap TA-DAE70.7	-0.836	-0.357	0.837	0.354	0.5	-2.2	98.6	98.7	0.07
DAE70.8-Kthang	0.170	0.077	-0.170	-0.079	0.0	-1.3	98.6	98.6	0.01
DAE70.8-Ltengang	0.003	-0.005	-0.003	-0.002	0.0	-6.9	98.6	98.6	0.00
Dogap TC-DAE70.8	-0.173	-0.072	0.173	0.061	0.1	-11.8	98.6	98.6	0.06
Kthang-DAE70.9	-0.150	-0.069	0.150	0.066	0.0	-3.8	98.6	98.6	0.02
DAE70(10-11)	0.075	0.035	-0.075	-0.035	0.0	-0.2	98.5	98.5	0.00
DAE70.10-Namjaygg	0.018	0.012	-0.018	-0.012	0.0	-0.1	98.5	98.5	0.00
Yoetsosel-DAE70.10	-0.093	-0.047	0.093	0.044	0.0	-2.9	98.5	98.5	0.01
DAE70(12-13)	0.657	0.293	-0.656	-0.300	1.0	-6.7	98.6	98.5	0.15
DAE70.12-Dogap TB	0.003	0.002	-0.003	-0.002	0.0	-0.2	98.6	98.6	0.00
DAE70(13-14)	0.175	0.100	-0.175	-0.101	0.0	-1.0	98.5	98.5	0.01
DAE70(13-15)	0.481	0.200	-0.480	-0.206	0.5	-6.9	98.5	98.4	0.11
DAE70.14-Darlithang	0.040	0.022	-0.040	-0.026	0.0	-4.2	98.5	98.5	0.01
DAE70.14-U.Khagochn	0.052	0.033	-0.052	-0.033	0.0	-0.3	98.5	98.5	0.00
DAE70.24-Khagochn(PWD)	0.083	0.047	-0.083	-0.049	0.0	-2.4	98.5	98.5	0.01
DAE70(15-16)	0.027	0.016	-0.027	-0.017	0.0	-1.0	98.4	98.4	0.00
DAE70(15-17)	0.453	0.191	-0.453	-0.194	0.2	-3.5	98.4	98.3	0.05
DAE70.17-PungshiA	0.444	0.189	-0.444	-0.190	0.0	-0.4	98.3	98.3	0.01
DAE70.17-PungshiB	0.009	0.005	-0.009	-0.006	0.0	-0.9	98.3	98.3	0.00
DAE70(18-19)	0.418	0.177	-0.417	-0.182	0.3	-5.1	98.3	98.2	0.07
DAE70.18-PungshiC	0.019	0.009	-0.019	-0.010	0.0	-1.0	98.3	98.3	0.00
PungshiA-DAE70.18	-0.436	-0.186	0.436	0.185	0.1	-1.1	98.3	98.3	0.02
DAE70(19-20)	0.417	0.182	-0.417	-0.184	0.1	-1.7	98.2	98.2	0.02
DAE70.19-U.Cthang	0.000	0.000	0.000	0.000	0.0	-0.1	98.2	98.2	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
DAE70.20-L.Cthang	0.007	0.003	-0.007	-0.004	0.0	-1.3	98.2	98.2	0.00
DAE70.20-Laling	0.410	0.181	-0.409	-0.187	0.4	-6.6	98.2	98.1	0.09
DAE70(21-23)	0.386	0.179	-0.386	-0.182	0.2	-3.3	98.1	98.0	0.04
DSE70(21-22)	0.006	0.002	-0.006	-0.002	0.0	-0.7	98.1	98.1	0.00
Laing-DAE70.21	-0.392	-0.180	0.393	0.177	0.2	-3.8	98.1	98.1	0.05
DAE70.22-L.KhameyA	0.003	0.001	-0.003	-0.002	0.0	-0.7	98.1	98.1	0.00
DAE70.22-L.KhameyB	0.003	0.001	-0.003	-0.002	0.0	-0.7	98.1	98.1	0.00
DAE70.23-Kanakha	0.013	0.005	-0.013	-0.008	0.0	-2.9	98.0	98.0	0.00
DAE70.23-Tanabji	0.373	0.177	-0.373	-0.182	0.2	-5.0	98.0	98.0	0.06
DAE70(24-25)	0.348	0.170	-0.348	-0.181	0.5	-11.3	97.9	97.8	0.13
DAE70.24-Nindkha	0.012	0.007	-0.012	-0.008	0.0	-0.6	97.9	97.9	0.00
Tanabji-DAE70.24	-0.360	-0.177	0.360	0.174	0.1	-3.0	97.9	98.0	0.04
DAE70(25-26)	0.186	0.079	-0.186	-0.079	0.0	-0.8	97.8	97.8	0.00
DAE70.25-DYT Hall	0.162	0.102	-0.162	-0.103	0.0	-1.0	97.8	97.8	0.01
DAE70(26-27)	0.149	0.057	-0.149	-0.058	0.0	-1.4	97.8	97.8	0.01
DAE70.26-Hospital	0.037	0.023	-0.037	-0.023	0.0	-0.2	97.8	97.8	0.00
DAE70(26-27)1	0.103	0.062	-0.103	-0.064	0.0	-1.4	97.8	97.8	0.01
DAE70(27-28)	0.046	-0.004	-0.046	-0.005	0.0	-8.9	97.8	97.8	0.01
DAE70(28-29)	0.029	-0.005	-0.029	0.003	0.0	-2.1	97.8	97.8	0.00
DAE70.28-Tgang	0.017	0.010	-0.017	-0.011	0.0	-0.4	97.8	97.8	0.00
DAE70(29-30)	0.023	-0.007	-0.023	0.005	0.0	-2.1	97.8	97.8	0.00
DAE70.29-Samay	0.006	0.003	-0.006	-0.004	0.0	-0.3	97.8	97.8	0.00
DAE70(30-31)	0.013	-0.011	-0.013	0.005	0.0	-6.3	97.8	97.8	0.00
DAE70.30-Gema	0.010	0.006	-0.010	-0.007	0.0	-0.3	97.8	97.8	0.00
DAE70.31-Khenju	0.002	-0.011	-0.002	0.004	0.0	-7.0	97.8	97.8	0.00
DAE70.31-Tsho	0.011	0.006	-0.011	-0.007	0.0	-0.4	97.8	97.8	0.00
DAE80(1-2)	0.239	0.044	-0.239	-0.060	0.1	-15.7	99.1	99.1	0.06
DAE80.1-Sherpgon	0.055	0.035	-0.055	-0.036	0.0	-0.8	99.1	99.1	0.00
DAE80.2-Near Gling Sch.	0.021	0.011	-0.021	-0.013	0.0	-2.0	99.1	99.1	0.00
DAE80.2-U.Gling	0.218	0.049	-0.218	-0.051	0.0	-2.1	99.1	99.1	0.01
DAE80(3-6)	0.102	0.022	-0.102	-0.030	0.0	-8.6	99.0	99.0	0.01
DAE80.3-Gangjab	0.028	-0.025	-0.028	0.018	0.0	-7.6	99.0	99.0	0.00
DAE80.3-L.Gling	0.054	0.034	-0.054	-0.035	0.0	-0.3	99.0	99.0	0.00
U.Gling-DAE80.3	-0.183	-0.031	0.183	0.029	0.0	-2.1	99.0	99.1	0.01
DAE80.4-Tshalabi	0.015	-0.021	-0.015	0.013	0.0	-7.4	99.0	99.0	0.00
Gangjab-DAE80.4	-0.018	0.019	0.018	-0.024	0.0	-4.6	99.0	99.0	0.00
DAE80.5-S.Dorona	0.004	-0.006	-0.004	-0.003	0.0	-8.2	99.0	99.0	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
DAE80(6-7)	0.077	0.020	-0.077	-0.020	0.0	-0.4	99.0	99.0	0.00
DAE80.6-L.Stengang	0.025	0.011	-0.025	-0.012	0.0	-1.4	99.0	99.0	0.00
DAE80(7-8)	0.075	0.019	-0.075	-0.022	0.0	-2.6	99.0	99.0	0.00
DAE80.7-U.Stengang	0.002	0.001	-0.002	-0.001	0.0	-0.5	99.0	99.0	0.00
DAE80.8-Jorkha	0.061	0.021	-0.061	-0.023	0.0	-1.7	99.0	99.0	0.00
DAE80.8-Mamthang	0.013	0.001	-0.013	-0.005	0.0	-4.7	99.0	99.0	0.00
DAE80.9-U.Nimtola	0.032	0.020	-0.032	-0.020	0.0	-0.5	99.0	99.0	0.00
L.Nimtola-DAE80.9	-0.044	-0.018	0.044	0.017	0.0	-1.5	99.0	99.0	0.00
DAE90.1-Nobzinkha T1	0.505	0.254	-0.505	-0.255	0.0	-0.7	99.1	99.1	0.01
DAE90.1-Nobzinkha T32	0.009	0.003	-0.009	-0.006	0.0	-2.1	99.1	99.1	0.00
DAE90(2-3)	0.370	0.174	-0.370	-0.174	0.0	-0.4	99.1	99.1	0.00
DAE90.2-Gzur T30	0.060	0.036	-0.060	-0.037	0.0	-0.6	99.1	99.1	0.00
Nobzinkha T2-DAE90.2	-0.430	-0.210	0.430	0.208	0.1	-2.1	99.1	99.1	0.02
DAE90(3-4)	0.352	0.163	-0.352	-0.164	0.0	-0.9	99.1	99.1	0.01
DAE90.3-Gzur T29	0.018	0.010	-0.018	-0.011	0.0	-0.8	99.1	99.1	0.00
DAE90(4-5)	0.344	0.160	-0.344	-0.161	0.0	-1.1	99.1	99.1	0.01
DAE90.4-Gzur T28	0.008	0.004	-0.008	-0.005	0.0	-0.6	99.1	99.1	0.00
DAE90(5-6)	0.223	0.092	-0.223	-0.095	0.0	-2.9	99.1	99.0	0.01
DAE90.5-Gzur T3	0.002	0.000	-0.002	-0.001	0.0	-1.2	99.1	99.1	0.00
DAE90.5-Mid Gzur T4	0.119	0.069	-0.119	-0.069	0.0	-0.6	99.1	99.0	0.00
DAE90(6-7)	0.011	0.005	-0.011	-0.005	0.0	-0.4	99.0	99.0	0.00
DAE90 (6-10)	0.192	0.089	-0.192	-0.094	0.0	-4.9	99.0	99.0	0.02
DAE90.6-Tdolay TopA	0.020	0.001	-0.020	-0.002	0.0	-1.1	99.0	99.0	0.00
DAE90.7-Tdolay T11	0.005	0.001	-0.005	-0.003	0.0	-1.9	99.0	99.0	0.00
DAE90.7-Tdolay TopC	0.006	0.004	-0.006	-0.004	0.0	-0.1	99.0	99.0	0.00
DAE90.9-Gopeni	0.010	-0.002	-0.010	-0.001	0.0	-2.6	99.0	99.0	0.00
Tdolay TopB-DAE90.9	-0.011	0.001	0.011	-0.002	0.0	-1.2	99.0	99.0	0.00
DAE90 (10-14)	0.122	0.060	-0.122	-0.061	0.0	-0.5	99.0	99.0	0.00
DAE90.10-Namchella F	0.069	0.034	-0.069	-0.034	0.0	-0.3	99.0	99.0	0.00
DAE90.11-Namchella B	0.025	0.013	-0.025	-0.014	0.0	-1.2	99.0	99.0	0.00
DAE90.11-Namchella D	0.023	0.010	-0.023	-0.010	0.0	-0.1	99.0	99.0	0.00
Namchella E-DAE90.11	-0.048	-0.023	0.048	0.022	0.0	-0.8	99.0	99.0	0.00
DAE90.12-Namchella A	0.019	0.012	-0.019	-0.012	0.0	-0.3	99.0	99.0	0.00
DAE90.12-Namchella C	0.001	0.000	-0.001	-0.001	0.0	-1.2	99.0	99.0	0.00
Namchella B-DAE90.12	-0.020	-0.011	0.020	0.011	0.0	-0.2	99.0	99.0	0.00
DAE90.13-Khawakha A	0.004	0.002	-0.004	-0.002	0.0	-0.2	99.0	99.0	0.00
DAE90.13-Khawakha B	0.002	0.001	-0.002	-0.001	0.0	-0.7	99.0	99.0	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
Namchella D-DAE90.13	-0.006	-0.003	0.006	-0.001	0.0	-3.9	99.0	99.0	0.00
DAE90.14-Khawakha C	0.004	0.002	-0.004	-0.002	0.0	-0.8	99.0	99.0	0.00
DAE90.14-Khawakha D	0.119	0.059	-0.119	-0.060	0.0	-0.8	99.0	99.0	0.00
DAE90(15-16)	0.062	0.033	-0.062	-0.035	0.0	-1.5	99.0	99.0	0.00
DAE90.15-Hatikharka	0.051	0.025	-0.051	-0.027	0.0	-1.6	99.0	99.0	0.00
Khawakha D-DAE90.15	-0.113	-0.059	0.113	0.056	0.0	-2.2	99.0	99.0	0.00
DAE90(16-17)	0.022	0.010	-0.022	-0.011	0.0	-0.8	99.0	99.0	0.00
DAE90.16-Mid-Tding II	0.039	0.025	-0.039	-0.025	0.0	-0.1	99.0	99.0	0.00
DAE90.17-L Tding	0.012	0.005	-0.012	-0.008	0.0	-2.3	99.0	99.0	0.00
DAE90.17-Mid-Tding I	0.010	0.006	-0.010	-0.006	0.0	-0.8	99.0	99.0	0.00
Gopeni-Dapper	-0.003	-0.002	0.003	-0.004	0.0	-5.1	99.0	99.0	0.00
Darachu Plant Tfr	0.118	0.079	-0.116	-0.076	1.8	2.7	100.0	97.9	2.10
Nindukha-Darachu	0.040	0.028	-0.040	-0.028	0.1	-0.2	97.9	97.7	0.25
Darlithang Tfr	0.040	0.026	-0.039	-0.024	0.8	1.2	98.5	95.7	2.81
Deorali Tfr	0.021	0.013	-0.021	-0.013	0.2	0.3	98.9	97.5	1.44
Dogap TA Tfr	0.005	0.003	-0.005	-0.003	0.0	0.0	98.7	97.9	0.80
Dogap TB Tfr	0.003	0.002	-0.003	-0.002	0.0	0.0	98.6	97.7	0.91
Dogap TC Tfr	0.002	0.001	-0.002	-0.001	0.0	0.0	98.6	98.0	0.65
Dolop Tfr	0.006	0.004	-0.006	-0.004	0.1	0.1	97.5	96.0	1.43
Dpela(Hosp.-Sch.)	0.036	0.022	-0.036	-0.023	0.0	-0.4	99.1	99.1	0.00
Dpela.Hosp. Tfr	0.053	0.033	-0.052	-0.032	0.3	0.5	99.1	98.1	0.91
Dpela.Sch. Tfr	0.036	0.023	-0.035	-0.022	0.6	1.0	99.1	96.6	2.48
Drujeygg MSS Tfr	0.140	0.088	-0.138	-0.085	2.0	3.0	98.3	96.4	1.95
DYT Hall Tfr	0.162	0.103	-0.158	-0.098	3.4	5.1	97.8	94.9	2.87
Gairigoan Tfr	0.007	0.004	-0.007	-0.004	0.1	0.1	97.6	95.8	1.86
Gangcpa-Yetsephu	0.014	0.004	-0.014	-0.007	0.0	-3.3	98.2	98.2	0.00
Gangcpa Tfr	0.003	0.002	-0.003	-0.002	0.0	0.0	98.2	97.6	0.60
Ganjab Tfr	0.009	0.006	-0.009	-0.006	0.1	0.2	99.0	97.4	1.64
GeepsaA Tfr	0.008	0.005	-0.008	-0.005	0.1	0.1	98.5	97.2	1.36
GeepsaB Tfr	0.012	0.008	-0.012	-0.008	0.2	0.3	98.5	96.4	2.16
GeepsaC Tfr	0.008	0.005	-0.008	-0.005	0.1	0.1	98.5	97.0	1.48
TshkhaC-GelechuA	-0.083	-0.012	0.083	0.009	0.0	-3.2	98.2	98.2	0.00
GelechuA Tfr	0.005	0.003	-0.005	-0.003	0.0	0.1	98.2	97.3	0.92
GelechuC Tfr	0.004	0.003	-0.004	-0.003	0.0	0.0	98.2	97.4	0.76
Gema Tfr	0.010	0.007	-0.010	-0.006	0.1	0.2	97.8	95.9	1.84
Gemjaygg-Nindukha	-0.018	-0.014	0.018	0.014	0.0	-0.4	97.5	97.7	0.18
Lhaling-Gemjaygg	0.005	0.006	-0.005	-0.006	0.0	-0.3	97.5	97.4	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
Gemjaygg Tfr	0.013	0.008	-0.013	-0.008	0.3	0.4	97.5	94.5	2.95
Go.Town Tfr	0.196	0.123	-0.194	-0.120	1.6	2.4	99.0	97.9	1.13
Gopeni Tfr	0.007	0.004	-0.007	-0.004	0.1	0.1	99.0	97.1	1.90
GumlaC Tfr	0.019	0.012	-0.018	-0.011	0.4	0.7	98.5	95.2	3.26
Gurungg Tfr	0.000	0.000	0.000	0.000			98.5	98.5	
Gzur T28 Tfr	0.008	0.005	-0.008	-0.005	0.1	0.1	99.1	97.7	1.37
Gzur T29 Tfr	0.018	0.011	-0.017	-0.011	0.4	0.6	99.1	96.0	3.10
Gzur(T30-T31)	0.020	0.011	-0.020	-0.012	0.0	-1.2	99.1	99.1	0.00
Gzur T30 Tfr	0.040	0.026	-0.039	-0.024	0.8	1.2	99.1	96.3	2.78
Gzur T31 Tfr	0.020	0.012	-0.019	-0.012	0.2	0.3	99.1	97.7	1.36
Hatikharka-L/Lodama	0.043	0.022	-0.043	-0.027	0.0	-4.3	99.0	99.0	0.00
Hatikharka Tfr	0.008	0.005	-0.008	-0.005	0.0	0.0	99.0	98.5	0.54
Hospital Tfr	0.037	0.023	-0.036	-0.023	0.2	0.3	97.8	97.1	0.64
Jgarling Tfr	0.010	0.006	-0.010	-0.006	0.1	0.2	98.2	96.4	1.76
Jorkha-L.Nimtola	0.057	0.020	-0.057	-0.025	0.0	-4.5	99.0	99.0	0.00
Khagochn(PWD) Tfr	-0.056	-0.035	0.058	0.038	1.7	2.6	94.4	98.5	4.08
Kanakha Tfr	0.013	0.008	-0.013	-0.008	0.2	0.3	98.0	95.7	2.29
Khagochen-L.Khagochen T50	0.025	0.012	-0.025	-0.014	0.0	-2.3	98.5	98.5	0.00
Khamey Tfr	0.037	0.024	-0.035	-0.022	1.5	2.3	97.1	91.6	5.52
Khawakha D Tfr	0.006	0.004	-0.006	-0.004	0.0	0.1	99.0	98.0	1.01
Khenju-Peling	0.000	-0.005	0.000	0.000	0.0	-5.3	97.8	97.8	0.00
Kompa Tfr	0.010	0.006	-0.010	-0.006	0.1	0.2	98.2	96.4	1.81
Kthang Tfr	0.021	0.013	-0.021	-0.013	0.2	0.3	98.6	97.1	1.44
KthangA Tfr	0.004	0.003	-0.004	-0.003	0.0	0.0	98.2	97.5	0.75
KthangB Tfr	0.009	0.006	-0.009	-0.005	0.1	0.1	98.2	96.7	1.54
Kzinka-Kzinka Town	0.055	0.033	-0.055	-0.035	0.0	-1.5	97.8	97.8	0.00
Kzinka Tfr	0.047	0.030	-0.046	-0.029	1.2	1.8	97.8	94.4	3.34
Kzinka Town Tfr	0.055	0.035	-0.055	-0.034	0.3	0.5	97.8	97.0	0.77
Bhudichu(L-U)	0.003	0.001	-0.003	-0.002	0.0	-1.1	98.3	98.3	0.00
L.Bhudichu Tfr	0.011	0.007	-0.011	-0.007	0.2	0.2	98.3	96.3	1.98
Dagop(L-U)	0.011	0.007	-0.011	-0.007	0.0	-0.1	97.6	97.5	0.02
L.Dagop Tfr	0.032	0.021	-0.029	-0.018	2.1	3.2	97.6	88.6	8.99
L.Gling Tfr	0.054	0.035	-0.052	-0.033	1.5	2.2	99.0	95.3	3.76
L.Goshi Tfr	0.000	0.000	0.000	0.000			98.5	98.5	
L.Goshi T97 Tfr	0.055	0.035	-0.053	-0.033	1.5	2.3	99.0	95.2	3.80
L.Gzur (T6-T7)	0.008	0.003	-0.008	-0.005	0.0	-2.3	99.0	99.0	0.00
Mid Gzur T5-L.Gzur T6	-0.065	-0.039	0.065	0.036	0.0	-2.6	99.0	99.0	0.01

Branch ID	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop
	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
L.Gzur T6 Tfr	0.057	0.036	-0.056	-0.035	0.8	1.2	99.0	97.1	1.99
L.Khagochen (T50-T51)	0.015	0.008	-0.015	-0.009	0.0	-1.6	98.5	98.5	0.00
L.Khagochn T51 Tfr	0.015	0.009	-0.014	-0.009	0.3	0.4	98.5	95.9	2.58
L.KhameyA Tfr	0.003	0.002	-0.003	-0.002	0.0	0.0	98.1	97.5	0.59
L.KhameyB Tfr	0.003	0.002	-0.003	-0.002	0.0	0.0	98.1	97.6	0.46
L.Nimtola Tfr	0.012	0.008	-0.012	-0.008	0.2	0.3	99.0	96.9	2.17
Stengang-Tanju	0.019	0.008	-0.019	-0.012	0.0	-4.0	99.0	99.0	0.00
L.Stengang Tfr	0.006	0.004	-0.006	-0.004	0.0	0.1	99.0	98.0	1.08
L.Tding Tfr	0.012	0.008	-0.012	-0.007	0.1	0.1	99.0	98.2	0.83
L.Tgaray Tfr	0.003	0.002	-0.003	-0.002	0.0	0.0	98.2	97.6	0.61
L.Tshenda(A-B)	0.008	0.004	-0.008	-0.005	0.0	-1.1	99.0	99.0	0.00
L.Tshenda A Tfr	0.006	0.003	-0.006	-0.003	0.0	0.0	99.0	98.7	0.38
L.Tshenda B Tfr	0.008	0.005	-0.008	-0.005	0.0	0.1	99.0	98.5	0.57
L.Tthang Tfr	-0.024	-0.015	0.025	0.016	0.8	1.2	94.5	98.9	4.40
Lodama(L-U)	0.039	0.024	-0.039	-0.026	0.0	-1.8	99.0	99.0	0.00
L/Lodama Tfr	0.004	0.002	-0.004	-0.002	0.0	0.0	99.0	98.4	0.65
Laling Tfr	0.017	0.010	-0.017	-0.010	0.1	0.2	98.1	97.0	1.16
Lhalinig Tfr	0.009	0.006	-0.009	-0.006	0.1	0.2	97.4	95.4	2.05
Ltengang Tfr	0.003	0.002	-0.003	-0.002	0.0	0.0	98.6	98.1	0.52
M.Goshi Tfr	0.014	0.009	-0.014	-0.009	0.3	0.4	99.0	96.5	2.51
M.Tshendagg Tfr	0.068	0.043	-0.067	-0.042	1.2	1.8	99.0	96.7	2.38
Mamthang Tfr	0.007	0.004	-0.007	-0.004	0.1	0.1	99.0	97.8	1.22
MchunaA Tfr	0.017	0.011	-0.017	-0.010	0.4	0.6	98.4	95.4	2.99
MchunaB Tfr	0.017	0.011	-0.017	-0.010	0.4	0.6	98.4	95.4	3.04
Mid Gzur (T4-T5)	0.105	0.060	-0.105	-0.062	0.0	-1.3	99.0	99.0	0.00
Mid Gzur T4 Tfr	0.014	0.009	-0.014	-0.009	0.3	0.4	99.0	96.6	2.46
Mid Gzur T5 Tfr	0.040	0.026	-0.040	-0.025	0.8	1.2	99.0	96.2	2.81
Mid Tding I Tfr	0.010	0.006	-0.010	-0.006	0.0	0.0	99.0	98.6	0.36
Mid Tding II Tfr	-0.039	-0.024	0.039	0.025	0.2	0.3	98.3	99.0	0.69
Namchella A Tfr	0.019	0.012	-0.019	-0.012	0.5	0.7	99.0	95.7	3.35
Namchella B Tfr	0.005	0.003	-0.005	-0.003	0.0	0.0	99.0	98.2	0.79
Namchella D Tfr	0.017	0.011	-0.017	-0.010	0.4	0.6	99.0	96.0	3.03
Namchella (F-E)	-0.065	-0.033	0.065	0.032	0.0	-1.0	99.0	99.0	0.00
Namchella E Tfr	0.017	0.011	-0.017	-0.010	0.4	0.5	99.0	96.1	2.96
Namchella F Tfr	0.004	0.003	-0.004	-0.003	0.0	0.0	99.0	98.3	0.72
Namjaygg Tfr	0.018	0.012	-0.018	-0.011	0.4	0.6	98.5	95.3	3.20
Namlthang Tfr	0.031	0.019	-0.031	-0.019	0.2	0.4	98.2	97.1	1.09

	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
Near Gling Sch. Tfr	0.021	0.013	-0.021	-0.013	0.1	0.2	99.1	98.3	0.74
Nindkha Tfr	0.012	0.008	-0.012	-0.007	0.1	0.1	97.9	97.1	0.84
Nindukha Tfr	0.022	0.014	-0.021	-0.013	0.8	1.2	97.7	92.8	4.82
DAE90.1-Nobzinkha T2	0.437	0.211	-0.437	-0.212	0.0	-1.5	99.1	99.1	0.01
Nobzinkha T1 Tfr	0.068	0.044	-0.065	-0.041	2.3	3.5	99.1	94.4	4.74
Nobzinkha T32 Tfr	0.009	0.006	-0.009	-0.005	0.0	0.1	99.1	98.5	0.61
PakseyA Tfr	0.026	0.017	-0.025	-0.015	0.9	1.3	98.5	94.0	4.53
PakseyC Tfr	0.022	0.014	-0.022	-0.013	0.6	1.0	98.5	94.6	3.93
Pangna A1 Tfr	0.002	0.001	-0.002	-0.001	0.0	0.0	98.3	97.9	0.40
Pangna A2 Tfr	0.003	0.002	-0.003	-0.002	0.0	0.0	98.3	97.7	0.53
Pangna A3 Tfr	0.011	0.007	-0.011	-0.007	0.2	0.3	98.3	96.2	2.02
Pangna Tfr	0.011	0.007	-0.011	-0.007	0.2	0.2	98.3	96.3	1.99
Pangna LSS Tfr	0.052	0.033	-0.051	-0.031	1.4	2.1	98.3	94.7	3.65
Pangna(UC-UA)	-0.006	-0.004	0.006	0.002	0.0	-1.6	98.3	98.3	0.00
Pangna UA Tfr	0.006	0.004	-0.006	-0.004	0.0	0.0	98.3	97.8	0.45
Pangna.UB Tfr	0.012	0.008	-0.012	-0.007	0.2	0.3	98.3	96.1	2.13
Pangna.UC Tfr	0.012	0.008	-0.012	-0.007	0.2	0.3	98.3	96.2	2.10
Patala Gpa Tfr	0.001	0.001	-0.001	-0.001	0.0	0.0	98.4	98.2	0.19
Patala(A-B)	0.025	0.013	-0.025	-0.014	0.0	-1.7	98.4	98.4	0.00
PatalaA Tfr	0.006	0.004	-0.006	-0.004	0.0	0.1	98.4	97.4	1.00
Patala(B-C)	0.017	0.009	-0.017	-0.011	0.0	-1.8	98.4	98.4	0.00
PatalaB Tfr	0.008	0.005	-0.008	-0.005	0.1	0.1	98.4	97.0	1.40
PatalaC Tfr	0.017	0.011	-0.017	-0.011	0.4	0.6	98.4	95.3	3.06
Phaperkti Tfr	0.008	0.005	-0.008	-0.005	0.0	0.1	98.2	97.7	0.59
DAE50.60-PhunsumggB	0.001	-0.001	-0.001	-0.001	0.0	-2.0	98.2	98.2	0.00
PhunsumggA Tfr	0.009	0.006	-0.009	-0.006	0.1	0.2	98.2	96.6	1.59
Pokto(A-B)	0.015	0.006	-0.015	-0.009	0.0	-3.1	98.5	98.5	0.00
PoktoA Tfr	0.013	0.008	-0.013	-0.008	0.2	0.3	98.5	96.2	2.23
Pserpo Sch. Tfr	0.001	0.001	-0.001	-0.001	0.0	0.0	98.2	98.2	0.06
PserpoA Tfr	0.021	0.013	-0.021	-0.013	0.2	0.3	98.2	96.8	1.44
PserpoB Tfr	0.023	0.015	-0.023	-0.014	0.3	0.4	98.2	96.6	1.62
PtaykhaA Tfr	0.015	0.009	-0.014	-0.009	0.1	0.2	98.2	97.2	1.01
PtaykhaB Tfr	0.023	0.014	-0.023	-0.014	0.3	0.4	98.2	96.6	1.60
PtaykhaC Tfr	0.009	0.006	-0.009	-0.006	0.0	0.1	98.2	97.6	0.64
PtaykhaD Tfr	0.013	0.008	-0.012	-0.008	0.2	0.3	98.2	96.0	2.23
Pungshi(C-D)	0.010	0.005	-0.010	-0.006	0.0	-1.6	98.3	98.3	0.00
PungshiC Tfr	0.009	0.006	-0.009	-0.005	0.1	0.2	98.3	96.8	1.55

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
PungshiB Tfr	0.009	0.006	-0.009	-0.005	0.1	0.2	98.3	96.8	1.56
PungshiD Tfr	0.010	0.006	-0.010	-0.006	0.1	0.2	98.3	96.6	1.71
S.Dorona Tfr	0.004	0.003	-0.004	-0.003	0.0	0.0	99.0	98.3	0.74
SalamjiA Tfr	0.012	0.007	-0.011	-0.007	0.2	0.3	98.2	96.2	2.02
Samay Tfr	0.006	0.004	-0.006	-0.004	0.0	0.1	97.8	96.7	1.05
Samay T4 Tfr	0.032	0.021	-0.031	-0.019	1.1	1.7	96.9	92.1	4.78
Seepa(B-A)	-0.006	-0.004	0.006	0.002	0.0	-1.4	98.2	98.2	0.00
SeepaB Tfr	0.010	0.006	-0.010	-0.006	0.1	0.2	98.2	96.4	1.80
Sherpgon Tfr	0.055	0.036	-0.054	-0.033	1.6	2.3	99.1	95.3	3.85
Tanabji Tfr	0.013	0.008	-0.013	-0.008	0.1	0.1	98.0	97.1	0.88
Tanju Tfr	0.019	0.012	-0.018	-0.011	0.5	0.7	99.0	95.7	3.31
Tdolay T11 Tfr	0.005	0.003	-0.005	-0.003	0.0	0.1	99.0	98.1	0.90
Tdolay Top (A-B)	0.016	-0.001	-0.016	-0.001	0.0	-1.7	99.0	99.0	0.00
Tdolay TopA Tfr	0.005	0.003	-0.005	-0.003	0.0	0.0	99.0	98.2	0.83
Tdolay TopB Tfr	0.005	0.003	-0.005	-0.003	0.0	0.0	99.0	98.2	0.86
Tdolay TopC Tfr	0.006	0.004	-0.006	-0.004	0.0	0.1	99.0	98.0	1.01
Tgang Tfr	0.017	0.011	-0.017	-0.011	0.2	0.2	97.8	96.6	1.20
Thangna IA Tfr	0.008	0.005	-0.008	-0.005	0.1	0.1	98.3	96.9	1.36
Thangna IB Tfr	0.004	0.003	-0.004	-0.003	0.0	0.0	98.3	97.5	0.73
Thangna IIA Tfr	0.003	0.002	-0.003	-0.002	0.0	0.0	98.3	97.8	0.46
Thangna IIB Tfr	0.024	0.015	-0.023	-0.015	0.3	0.4	98.3	96.6	1.65
Thangna IID Tfr	0.019	0.012	-0.018	-0.011	0.4	0.7	98.3	95.0	3.28
Thangna IIE Tfr	0.014	0.009	-0.013	-0.008	0.2	0.4	98.3	95.9	2.41
Thangna IIF Tfr	0.012	0.007	-0.012	-0.007	0.2	0.3	98.3	96.2	2.08
Thomgg Tfr	0.036	0.023	-0.035	-0.022	0.7	1.0	98.6	96.0	2.51
Tshalabi Tfr	0.006	0.004	-0.006	-0.004	0.1	0.1	99.0	97.9	1.10
Tshanglakha Tfr	0.002	0.001	-0.002	-0.001	0.0	0.0	97.2	96.9	0.30
Tshkha Sch. Tfr	0.031	0.020	-0.030	-0.019	1.3	1.9	98.2	92.6	5.57
Tshkha.G Tfr	0.021	0.013	-0.020	-0.012	0.6	0.8	98.2	94.5	3.67
TshkhaA Tfr	0.018	0.012	-0.018	-0.011	0.4	0.6	98.2	95.0	3.21
TshkhaB Tfr	0.005	0.003	-0.005	-0.003	0.0	0.0	98.2	97.4	0.81
TshkhaC Tfr	0.008	0.005	-0.008	-0.005	0.1	0.1	98.2	96.8	1.37
Tsho Tfr	0.011	0.007	-0.011	-0.007	0.1	0.2	97.8	95.9	1.88
Tthang Tfr	0.025	0.016	-0.025	-0.016	0.3	0.5	99.0	97.2	1.76
U.Balaygg(A-B)	0.006	0.003	-0.006	-0.004	0.0	-0.8	98.8	98.8	0.00
U.BalayggA Tfr	0.007	0.004	-0.007	-0.004	0.1	0.1	98.8	97.5	1.23
U.BalayggB Tfr	0.006	0.004	-0.006	-0.004	0.1	0.1	98.8	97.1	1.68

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
U.BalayggC Tfr	0.018	0.011	-0.018	-0.011	0.2	0.3	98.7	97.5	1.26
U.Bhudichu Tfr	0.003	0.002	-0.003	-0.002	0.0	0.0	98.3	97.8	0.45
U.Dagop Tfr	0.011	0.007	-0.011	-0.007	0.3	0.4	97.5	94.4	3.15
U.Gling Tfr	0.035	0.022	-0.034	-0.021	0.6	0.9	99.1	96.6	2.41
U.Goshi Tfr	0.081	0.051	-0.080	-0.050	0.8	1.2	99.1	97.7	1.41
U.Khagochn Tfr	0.052	0.033	-0.050	-0.031	1.4	2.1	98.5	94.9	3.61
U.Nimtola Tfr	0.032	0.020	-0.031	-0.019	0.5	0.8	99.0	96.8	2.18
U.Stengang Tfr	0.002	0.001	-0.002	-0.001	0.0	0.0	99.0	98.7	0.30
U.Tthang Tfr	0.049	0.031	-0.048	-0.030	0.6	0.9	98.9	97.2	1.69
U/Lodama Tfr	0.039	0.026	-0.037	-0.023	2.0	3.0	99.0	92.1	6.96
Yetsephu Tfr	0.004	0.002	-0.004	-0.002	0.0	0.0	98.2	97.5	0.68
Yoetsosel Tfr	0.011	0.007	-0.011	-0.007	0.2	0.2	98.5	96.6	1.93
Yongsibji Tfr	0.025	0.015	-0.024	-0.015	0.3	0.5	98.3	96.5	1.71
ZchelaA Tfr	0.014	0.009	-0.014	-0.009	0.3	0.4	98.2	95.7	2.54
ZchelaD Tfr	0.008	0.005	-0.008	-0.005	0.1	0.1	98.2	96.9	1.33
					118.4	-526.4			

Alert Summary Report

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

Critical Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
Akochn Tfr	Transformer	Overload	0.063	MVA	0.066	105.5	3-Phase
Bgaythang Tfr	Transformer	Overload	0.025	MVA	0.03	113.8	3-Phase
Bichgoan Balaygg Tfr	Transformer	Overload	0.016	MVA	0.03	182.3	3-Phase
BjuruggA Tfr	Transformer	Overload	0.025	MVA	0.04	157.5	3-Phase
BuchunaA Tfr	Transformer	Overload	0.025	MVA	0.04	150.8	3-Phase
Khagochn(PWD) Tfr	Transformer	Overload	0.063	MVA	0.07	109.9	3-Phase
Khamey Tfr	Transformer	Overload	0.030	MVA	0.04	146.3	3-Phase
L.Dagop B2	Bus	Under Voltage	0.415	kV	0.37	88.6	3-Phase
L.Dagop Tfr	Transformer	Overload	0.016	MVA	0.04	238.6	3-Phase
L.Gling Tfr	Transformer	Overload	0.063	MVA	0.06	101.9	3-Phase
L.Goshi T97 Tfr	Transformer	Overload	0.063	MVA	0.06	103.1	3-Phase
L.Tthang Tfr	Transformer	Overload	0.025	MVA	0.03	118.9	3-Phase
Nindukha Tfr	Transformer	Overload	0.020	MVA	0.03	128.7	3-Phase
Nobzinkha T1 Tfr	Transformer	Overload	0.063	MVA	0.08	128.4	3-Phase
PakseyA Tfr	Transformer	Overload	0.025	MVA	0.03	122.1	3-Phase

Critical Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
PakseyC Tfr	Transformer	Overload	0.025	MVA	0.026	105.8	3-Phase
Samay T4 Tfr	Transformer	Overload	0.030	MVA	0.04	126.6	3-Phase
Sherpgon Tfr	Transformer	Overload	0.063	MVA	0.07	104.5	3-Phase
Tshkha Sch. Tfr	Transformer	Overload	0.025	MVA	0.04	149.4	3-Phase
U/Lodama Tfr	Transformer	Overload	0.025	MVA	0.05	187.9	3-Phase

Marginal Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
Akochn B2	Bus	Under Voltage	0.415	kV	0.393	94.6	3-Phase
BartsabB B2	Bus	Under Voltage	0.415	kV	0.39	95.0	3-Phase
Bgaythang B2	Bus	Under Voltage	0.415	kV	0.39	94.3	3-Phase
Bichgoan Balaygg B2	Bus	Under Voltage	0.415	kV	0.38	90.9	3-Phase
BjuruggA B2	Bus	Under Voltage	0.415	kV	0.38	92.7	3-Phase
BuchunaA B2	Bus	Under Voltage	0.415	kV	0.39	92.9	3-Phase
DYT Hall B2	Bus	Under Voltage	0.415	kV	0.39	94.9	3-Phase
Gemjaygg B2	Bus	Under Voltage	0.415	kV	0.39	94.5	3-Phase
Kagochn(PWD) B2	Bus	Under Voltage	0.415	kV	0.39	94.4	3-Phase
Khamey B2	Bus	Under Voltage	0.415	kV	0.38	91.6	3-Phase
Kzinka B2	Bus	Under Voltage	0.415	kV	0.39	94.4	3-Phase
L.Tthang B1	Bus	Under Voltage	0.415	kV	0.39	94.5	3-Phase
Nindukha B2	Bus	Under Voltage	0.415	kV	0.39	92.8	3-Phase
Nobzinkha T1 B2	Bus	Under Voltage	0.415	kV	0.39	94.4	3-Phase
PakseyA B2	Bus	Under Voltage	0.415	kV	0.39	94.0	3-Phase
PakseyC B2	Bus	Under Voltage	0.415	kV	0.39	94.6	3-Phase
Pangna LSS B2	Bus	Under Voltage	0.415	kV	0.39	94.7	3-Phase
Pangna LSS Tfr	Transformer	Overload	0.063	MVA	0.06	98.1	3-Phase
Samay T4 B2	Bus	Under Voltage	0.415	kV	0.38	92.1	3-Phase
Tshkha Sch. B2	Bus	Under Voltage	0.415	kV	0.38	92.6	3-Phase
Tshkha.G B2	Bus	Under Voltage	0.415	kV	0.39	94.5	3-Phase
Tshkha.G Tfr	Transformer	Overload	0.025	MVA	0.02	98.6	3-Phase
TshkhaA B2	Bus	Under Voltage	0.415	kV	0.39	95.0	3-Phase
U.Dagop B2	Bus	Under Voltage	0.415	kV	0.39	94.4	3-Phase
U.Khagochn B2	Bus	Under Voltage	0.415	kV	0.39	94.9	3-Phase
U.Khagochn Tfr	Transformer	Overload	0.063	MVA	0.06	97.4	3-Phase
U/Lodama B2	Bus	Under Voltage	0.415	kV	0.38	92.1	3-Phase

SUMMARY OF TOTAL GENERATION , LOADING & DEMAND

	MW	Mvar	MVA	% PF
Source (Swing Buses):	4.720	2.325	5.261	89.70 Lagging
Source (Non-Swing Buses):	0.000	0.000	0.000	
Total Demand:	4.720	2.325	5.261	89.70 Lagging
Total Motor Load:	0.972	0.603	1.144	85.00 Lagging
Total Static Load:	3.629	2.249	4.269	85.00 Lagging
Total Constant I Load:	0.000	0.000	0.000	
Total Generic Load:	0.000	0.000	0.000	
Apparent Losses:	0.118	-0.526		
System Mismatch:	0.000	0.000		

Number of Iterations: 3

Annexure 5: Feeder Wise Reliability Indices

Reason for outages for feeders

Feeder Name: 33kV Drujeygang-Lajab 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				1	1	1				**4**													**0**
2	Line Jumpering													**0**									1				**1**
3	Collaps of Pole-Breakdown													**0**								2					**2**
4	Snap of Conductor			1										**1**													**0**
5	Puncture of insulator/Leakage	1												**1**													**0**
6	Puncture of LA/LA Maintenance													**0**													**0**
7	Ligtining & Strom/Rain				1			3		2				**6**		4	1	1									**6**
8	Tree/branch fall on line		2						1					**3**													**0**
9	RoW Clearing					1						4		**5**					1							1	**2**
10	Land Slide													**0**													**0**
11	Forest fire													**0**													**0**
12	Preventive Maintenance of Line/LBS/GO/ARCB						1		2				1	**4**													**0**
13	Preventive Maintenance of substation/Switchyard											1		**1**													**0**
14	Breakdown Maintenance of Line/LBS/GO/ARCB								2					**2**													**0**
15	Breakdown Maintenance of Substation/Switchyard													**0**													**0**
16	SMD Planned shutdown				4									**4**													**0**
17	Adhoc Shutdown (Tapping, Emergency request)													**0**						1	2						**3**
18	Momentary/Traisent fault			1		2	4			2				**9**										1			**1**
19	Trace of fault on line													**0**													**0**
20	Because of Bird/Animals													**0**										1			**1**
21	Close and Open of GO/LBS													**0**													**0**

Feeder Name:33kV S.F Camp 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		**6**		1						1					**2**
2	Line Jumpering		1											**1**													**0**
3	Collaps of Pole-Breakdown													**0**													**0**
4	Snap of Conductor													**0**													**0**
5	Puncture of insulator/Leakage													**0**													**0**
6	Puncture of LA/LA Maintenance													**0**													**0**
7	Ligtining & Strom/Rain													**0**													**0**
8	Tree/branch fall on line													**0**	1				1	1		1		1			**5**
9	RoW Clearing					1	1					1		**3**					1								**1**
10	Land Slide													**0**													**0**
11	Forest fire													**0**													**0**
12	Preventive Maintenance of Line/LBS/GO/ARCB			1	4	1	1					1	1	**9**	2												**2**
13	Preventive Maintenance of substation/Switchyard											1		**1**													**0**
14	Breakdown Maintenance of Line/LBS/GO/ARCB													**0**			1										**1**
15	Breakdown Maintenance of Substation/Switchyard					2								**2**													**0**
16	SMD Planned shutdown													**0**													**0**
17	Adhoc Shutdown (Tapping, Emergency request)													**0**													**0**
18	Momentary/Traisent fault													**0**													**0**
19	Trace of fault on line													**0**													**0**
20	Because of Bird/Animals													**0**													**0**
21	Close and Open of GO/LBS													**0**													**0**

Feeder Name:33kV Dagana 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	3	8	3	2	2	1		1		1	1	**25**				2				1					**3**
2	Line Jumpering													**0**							1						**1**
3	Collaps of Pole-Breakdown													**0**													**0**
4	Snap of Conductor													**0**													**0**
5	Puncture of insulator/Leakage													**0**													**0**
6	Puncture of LA/LA Maintenance													**0**													**0**
7	Ligtining & Strom/Rain													**0**													**0**
8	Tree/branch fall on line					1								**1**													**0**
9	RoW Clearing						1	2	1			3		**7**			4			1	1						**6**
10	Land Slide													**0**													**0**
11	Forest fire													**0**	1												**1**
12	Preventive Maintenance of Line/LBS/GO/ARCB					2						1		**3**						1							**1**
13	Preventive Maintenance of substation/Switchyard												1	**1**								1					**1**
14	Breakdown Maintenance of Line/LBS/GO/ARCB					1			1					**2**	1						1						**2**
15	Breakdown Maintenance of Substation/Switchyard													**0**													**0**
16	SMD Planned shutdown													**0**													**0**
17	Adhoc Shutdown (Tapping, Emergency request)													**0**													**0**
18	Momentary/Traisent fault													**0**													**0**
19	Trace of fault on line													**0**													**0**
20	Because of Bird/Animals													**0**													**0**
21	Close and Open of GO/LBS													**0**													**0**

Feeder Name: 33kV Geasarling 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			6	2	1	2		3					**14**	1	1		3		4	2	2					**13**
2	Line Jumpering								2					**2**													**0**
3	Collaps of Pole-Breakdown													**0**									1				**1**
4	Snap of Conductor													**0**													**0**
5	Puncture of insulator/Leakage													**0**					1								**1**
6	Puncture of LA/LA Maintenance													**0**								1					**1**
7	Ligtining & Strom/Rain							4						**4**													**0**
8	Tree/branch fall on line		1		1				1	1			2	**6**								1		1			**2**
9	RoW Clearing					2	1		3	1	2	2		**11**			6		3	1							**10**
10	Land Slide													**0**													**0**
11	Forest fire													**0**													**0**
12	Preventive Maintenance of Line/LBS/GO/ARCB					3			1					**4**													**0**
13	Preventive Maintenance of substation/Switchyard			2	1									**3**													**0**
14	Breakdown Maintenance of Line/LBS/GO/ARCB	1												**1**				3									**3**
15	Breakdown Maintenance of Substation/Switchyard										1			**1**													**0**
16	SMD Planned shutdown													**0**													**0**
17	Adhoc Shutdown (Tapping, Emergency request)	2		1				1						**4**													**0**
18	Momentary/Traisent fault													**0**													**0**
19	Trace of fault on line													**0**													**0**
20	Because of Bird/Animals													**0**													**0**
21	Close and Open of GO/LBS													**0**													**0**

Feeder Name: 33kV Tashiding 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	6	6	1	1	3	3	3	1	3		**29**	1		1		2	4		1	2				**11**
2	Line Jumpering				1									**1**													**0**
3	Collaps of Pole-Breakdown													**0**													**0**
4	Snap of Conductor													**0**													**0**
5	Puncture of insulator/Leakage					1								**1**													**0**
6	Puncture of LA/LA Maintenance													**0**													**0**
7	Ligtining & Strom/Rain							2						**2**													**0**
8	Tree/branch fall on line													**0**								1					**1**
9	RoW Clearing						4			1	2			**7**													**0**
10	Land Slide													**0**													**0**
11	Forest fire													**0**				1									**1**
12	Preventive Maintenance of Line/LBS/GO/ARCB			1	1									**2**					1								**1**
13	Preventive Maintenance of substation/Switchyard													**0**			1				1						**2**
14	Breakdown Maintenance of Line/LBS/GO/ARCB			1										**1**													**0**
15	Breakdown Maintenance of Substation/Switchyard		1											**1**						1							**1**
16	SMD Planned shutdown													**0**													**0**
17	Adhoc Shutdown (Tapping, Emergency request)													**0**										1			**1**
18	Momentary/Traisent fault													**0**													**0**
19	Trace of fault on line													**0**													**0**
20	Because of Bird/Animals													**0**													**0**
21	Close and Open of GO/LBS													**0**													**0**

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

Sl.No	Feeder code	DT Code	Transformer Name/Location	Capacity(kVA)	Voltage Level	2019	2025	2030
1) 6.6 SF6 Feeder							**2.622**	**3.354**
1	DAE10	DAE10T1	Darachu	**250**	0.415/6.6kV			
2	DAE10	DAE10T2	Tshanglakha A	25	6.6/0.415kV	2.53%	6.65%	8.50%
3	DAE10	DAE10T3	Daga Dzong Jr.School	50	6.6/0.415kV	3.78%	9.91%	12.68%
4	DAE10	DAE10T4	Samay	30	6.6/0.415kV	40.87%	107.14%	137.07%
5	DAE10	DAE10T5	Tshanglakha B (Khamay)	30	6.6/0.415kV	47.25%	123.87%	158.47%
6	DAE10	DAE10T6	Below Daga Dzong	250	6.6/0.415kV	0.00%	0.00%	0.00%
7	DAE10	DAE10T7	Daga Central School	75	6.6/0.415kV			
8	DAE20	DAE20T1	Nindukha	20	6.6/0.415kV	41.01%	107.52%	137.55%
9	DAE20	DAE20T2	Gemjaygang	20	6.6/0.415kV	24.87%	65.20%	83.42%
10	DAE20	DAE20T3	Lhaling	20	6.6/0.415kV	17.19%	45.07%	57.66%
11	DAE20	DAE20T4	Dolopchen	20	6.6/0.415kV	11.98%	31.40%	40.17%
12	DAE20	DAE20T5	Gairigoan	16	6.6/0.415kV	15.59%	40.88%	52.30%
13	DAE20	DAE20T6	Gurunggoan	50	6.6/0.415kV	0.00%	0.00%	0.00%
14	DAE20	DAE20T7	Dagapela RBA	750	33/6.6kV	0.00%	0.00%	0.00%
15	DAE20	DAE20T8	Lower Goshi	16	6.6/0.415kV	0.00%	0.00%	0.00%
16	DAE20	DAE20T9	Lower Dogap	16	6.6/0.415kV	78.05%	204.65%	261.81%
17	DAE20	DAE20T10	Upper Dogap	30	6.6/0.415kV	26.58%	69.70%	89.17%
18	DAE20	DAE20T11	Bichgoan	16	6.6/0.415kV	58.73%	153.97%	196.98%
				1,434.00		**5.60%**		
2) 33kV SF6 Feeder							**1.75**	**1.82**
1	DAE40	DAE05T1	RBA Dagapela	750	33/0.415kV	13.50%	23.598%	24.52%
2	DAE40	DAE05T2	Mid Tsendagang	125	33/0.415kV	36.65%	64.063%	66.56%
3	DAE40	DAE05T3	Lower Tsendagang A	63	33/0.415kV	5.78%	10.110%	10.50%
4	DAE40	DAE05T4	Lower Tsendagang B	63	33/0.415kV	8.70%	15.213%	15.81%
5	DAE40	DAE05T5	Goshi Town	250	33/0.415kV	52.03%	90.937%	94.48%
6	DAE40	DAE05T6	Dagapela Hospital	250	33/0.415kV	13.99%	24.444%	25.40%
7	DAE40	DAE05T7	Dagapela School	63	33/0.415kV	38.20%	66.766%	69.37%
				1,564.00		**22.08%**		

3) 33kV Dagapela I Feeder							2.079	2.773
1	DAE50	DAE50T1	Drujeygang School	315	33/0.415kV	19.68%	40.93%	54.57%
2	DAE50	DAE50T2	Pangna School	63	33/0.415kV	37.16%	77.26%	103.02%
3	DAE50	DAE50T9	Babeythang A	63	33/0.415kV	5.05%	10.51%	14.01%
4	DAE50	DAE50T10	Babeythang B	63	33/0.415kV	2.97%	6.18%	8.24%
5	DAE50	DAE50T13	Petaykha C	63	33/0.415kV	6.39%	13.29%	17.72%
6	DAE50	DAE50T14	Petaykha D	25	33/0.415kV	22.57%	46.93%	62.57%
7	DAE50	DAE50T15	Petaykha B	63	33/0.415kV	16.12%	33.53%	44.70%
8	DAE50	DAE50T16	Petaykha A	63	33/0.415kV	10.20%	21.22%	28.29%
9	DAE50	DAE50T17	Zinchela A	25	33/0.415kV	25.72%	53.48%	71.30%
10	DAE50	DAE50T18	Zinchela B	16	33/0.240kV	9.68%	20.12%	26.82%
11	DAE50	DAE50T19	L-Tisgharay	25	33/0.415kV	6.11%	12.70%	16.93%
12	DAE50	DAE50T20	Up-Tisgharay	16	33/0.240kV	9.78%	20.34%	27.12%
13	DAE50	DAE50T21	Zinchela C	16	33/0.240kV	7.00%	14.56%	19.42%
14	DAE50	DAE50T22	Zinchela D	25	33/0.415kV	13.44%	27.95%	37.27%
15	DAE50	DAE50T23	Banderchu A	25	33/0.415kV	10.07%	20.93%	27.91%
16	DAE50	DAE50T24	Banderchu C	16	33/0.240kV	7.96%	16.56%	22.07%
17	DAE50	DAE50T25	Banderchu B	25	33/0.415kV	24.61%	51.17%	68.23%
18	DAE50	DAE50T26	Tshangkha Gewog	25	33/0.415kV	37.42%	77.81%	103.75%
19	DAE50	DAE50T27	Tshangkha School	25	33/0.415kV	57.34%	119.23%	158.98%
20	DAE50	DAE50T28	Tshangkha A	25	33/0.415kV	32.63%	67.85%	90.46%
21	DAE50	DAE50T29	Tshangkha B	25	33/0.415kV	8.13%	16.91%	22.54%
22	DAE50	DAE50T30	Jegaring	25	33/0.415kV	17.77%	36.95%	49.26%
23	DAE50	DAE50T31	Petaykha E	16	33/0.240kV	7.56%	15.73%	20.97%
24	DAE50	DAE50T32	Salambji B	16	33/0.240kV	8.87%	18.45%	24.60%
25	DAE50	DAE50T33	Salambji A	25	33/0.415kV	20.48%	42.58%	56.77%
26	DAE50	DAE50T34	Tshangkha C	25	33/0.425kV	13.86%	28.83%	38.44%
27	DAE50	DAE50T35	Gelechu A	25	33/0.415kV	9.26%	19.25%	25.67%
28	DAE50	DAE50T36	Gelechu B	16	33/0.240kV	10.70%	22.24%	29.65%
29	DAE50	DAE50T37	Gelechu C	25	33/0.415kV	7.66%	15.93%	21.24%

30	DAE50	DAE50T38	Kompa	25	33/0.415kV	18.25%	37.96%	50.61%
31	DAE50	DAE50T40	Campdara	16	33/0.240kV	1.74%	3.62%	4.83%
32	DAE50	DAE50T41	Phunsumgang A	25	33/0.415kV	16.05%	33.37%	44.49%
33	DAE50	DAE50T42	Phunsumgang B	16	33/0.240kV	2.91%	6.05%	8.07%
34	DAE50	DAE50T43	Seepa B	25	33/0.415kV	18.16%	37.75%	50.34%
35	DAE50	DAE50T44	Seepa A	16	33/0.240kV	16.06%	33.40%	44.54%
36	DAE50	DAE50T45	Manidara	10	33/0.240kV	6.64%	13.81%	18.41%
37	DAE50	DAE50T46	Bana A	25	33/0.415kV	14.93%	31.04%	41.39%
38	DAE50	DAE50T47	Bana B	25	33/0.415kV	7.52%	15.65%	20.86%
39	DAE50	DAE50T48	Gangchusepa	25	33/0.415kV	6.05%	12.59%	16.78%
40	DAE50	DAE50T49	Yetsephu	25	33/0.415kV	6.86%	14.26%	19.02%
41	DAE50	DAE50T50	Balung B	16	33/0.240kV	9.55%	19.85%	26.47%
42	DAE50	DAE50T51	Balung C	10	33/0.240kV	8.38%	17.42%	23.23%
43	DAE50	DAE50T52	Balung A	25	33/0.415kV	9.11%	18.94%	25.26%
44	DAE50	DAE50T57	Thangna IIF	25	33/0.415kV	21.00%	43.68%	58.23%
45	DAE50	DAE50T58	Thangna IIE	25	33/0.415kV	24.38%	50.71%	67.61%
46	DAE50	DAE50T59	Thangna IID	25	33/0.415kV	33.36%	69.37%	92.50%
47	DAE50	DAE50T60	Thangna IIC	16	33/0.240kV	33.78%	70.24%	93.65%
48	DAE50	DAE50T61	Thangna IIB	63	33/0.415kV	16.66%	34.65%	46.20%
49	DAE50	DAE50T62	Thangna IIA	25	33/0.415kV	4.58%	9.53%	12.70%
50	DAE50	DAE50T63	Thangna IA	25	33/0.415kV	13.76%	28.62%	38.15%
51	DAE50	DAE50T64	Thangna IB	25	33/0.415kV	7.35%	15.29%	20.38%
52	DAE50	DAE50T65	Pangna Urban C	25	33/0.415kV	21.24%	44.16%	58.89%
53	DAE50	DAE50T66	Pangna Urban A	63	33/0.415kV	4.51%	9.38%	12.51%
54	DAE50	DAE50T67	Pangna A3	25	33/0.415kV	20.43%	42.47%	56.63%
55	DAE50	DAE50T68	Pangna Urban B	25	33/0.415kV	21.51%	44.73%	59.64%
56	DAE50	DAE50T69	Pangna A2	25	33/0.415kV	5.33%	11.09%	14.79%
57	DAE50	DAE50T70	Pangna A1	25	33/0.415kV	4.00%	8.32%	11.09%
58	DAE50	DAE50T71	Pangna	25	33/0.415kV	20.09%	41.77%	55.70%
59	DAE50	DAE50T72	Yungsibji	63	33/0.415kV	17.23%	35.84%	47.78%
60	DAE50	DAE50T73	Kareythang A	63	33/0.415kV	7.53%	15.66%	20.88%
61	DAE50	DAE50T74	Pangserpo B	63	33/0.415kV	16.31%	33.92%	45.23%
62	DAE50	DAE50T75	Pangserpo A	63	33/0.415kV	14.55%	30.25%	40.34%

63	DAE50	DAE50T76	Kareythang B	25	33/0.415kV	15.50%	32.22%	42.97%
64	DAE50	DAE50T77	Pharperkheti	63	33/0.415kV	5.89%	12.25%	16.34%
65	DAE50	DAE50T78	Aibumthang	63	33/0.415kV	12.77%	26.55%	35.40%
66	DAE50	DAE50T93	L-Budhichu	25	33/0.415kV	20.02%	41.63%	55.50%
67	DAE50	DAE50T94	Up-Budhichu	25	33/0.415kV	4.60%	9.56%	12.75%
68	DAE50	DAE50T95	Babaythang	16	33/0.240kV	4.74%	9.86%	13.14%
69	DAE50	DAE50T98	Pangserpo	63	33/0.415kV	0.63%	1.31%	1.75%
70	DAE50	DAE50T99	Namlaythang	125	33/0.415kV	10.95%	22.77%	30.35%
4) 33kV Dagapela-Drujaygang feeder								
1	DAE50	DAE50T3	Patala A	25	33/0.415kV	10.02%	20.84%	27.79%
2	DAE50	DAE50T4	Patala B	25	33/0.415kV	14.11%	29.34%	39.12%
3	DAE50	DAE50T5	Patala C	25	33/0.415kV	31.12%	64.71%	86.28%
4	DAE50	DAE50T6	Patalagoenpa	25	33/0.415kV	1.92%	3.99%	5.32%
5	DAE50	DAE50T7	Menchuna A	25	33/0.415kV	30.40%	63.21%	84.28%
6	DAE50	DAE50T8	Menchuna B	25	33/0.415kV	30.88%	64.20%	85.61%
7	DAE50	DAE50T11	Bidlung	63	33/0.415kV	10.75%	22.34%	29.79%
8	DAE50	DAE50T12	Goshi Gewog,Balaygang	63	33/0.415kV	10.68%	22.21%	29.61%
9	DAE50	DAE50T39	Upper Goshi	250	33/0.415kV	14.15%	29.41%	39.22%
10	DAE50	DAE50T53	Geepsa A	25	33/0.415kV	13.67%	28.42%	37.89%
11	DAE50	DAE50T54	Balaygang Zero	250	33/0.415kV	7.25%	15.07%	20.09%
12	DAE50	DAE50T55	Geepsa B	25	33/0.415kV	21.82%	45.37%	60.50%
13	DAE50	DAE50T56	Geepsa C	25	33/0.415kV	14.95%	31.09%	41.45%
14	DAE50	DAE50T79	Bagaythang	25	33/0.415kV	43.06%	89.54%	119.38%
15	DAE50	DAE50T80	Thomgang	63	33/0.415kV	25.45%	52.92%	70.56%
16	DAE50	DAE50T81	Akochen C	25	33/0.415kV	34.84%	72.45%	96.60%
17	DAE50	DAE50T82	Akochen A	63	33/0.415kV	39.87%	82.90%	110.54%
18	DAE50	DAE50T83	Akochen B	16	33/0.240kV	27.56%	57.31%	76.41%
19	DAE50	DAE50T84	Soma	16	33/0.240kV	26.69%	55.50%	74.00%
20	DAE50	DAE50T85	Paksey C	25	33/0.415kV	40.02%	83.22%	110.97%
21	DAE50	DAE50T86	Paksey A	25	33/0.415kV	46.37%	96.41%	128.55%
22	DAE50	DAE50T87	Paksey B	16	33/0.240kV	14.99%	31.17%	41.56%
23	DAE50	DAE50T88	Gumla A	16	33/0.240kV	23.55%	48.97%	65.30%
24	DAE50	DAE50T89	Gumla B	16	33/0.240kV	8.31%	17.28%	23.04%

25	DAE50	DAE50T90	Gumla C (School)	25	33/0.425kV	33.16%	68.94%	91.92%
26	DAE50	DAE50T91	Pokto A	25	33/0.415kV	22.58%	46.95%	62.60%
27	DAE50	DAE50T92	Pokto B	16	33/0.240kV	40.49%	84.19%	112.26%
28	DAE50	DAE50T96	Middle Goshi	25	33/0.415kV	25.31%	52.64%	70.18%
29	DAE50	DAE50T97	L-Goshi	25	33/0.415kV	38.65%	80.38%	107.17%
99		DHPC		5250		4.99%	10.38%	13.85%
				9086		**9.62%**		
5) 33kV Gaserling feeder							**3.06**	**3.46**
1	DAE80	DAE80T1	Sherpagoan	63	33/0.415kV	31.32%	95.72%	108.48%
2	DAE80	DAE80T2	Gesarling (School)	125	33/0.415kV	5.91%	18.06%	20.47%
3	DAE80	DAE80T3	U-Gesarling	63	33/0.415kV	19.45%	59.45%	67.38%
4	DAE80	DAE80T4	U-Gangjab	25	33/0.415kV	13.23%	40.44%	45.83%
5	DAE80	DAE80T5	Tshalabji	25	33/0.415kV	8.82%	26.94%	30.54%
6	DAE80	DAE80T6	Chito	10	33/0.240kV	10.00%	30.57%	34.64%
7	DAE80	DAE80T7	L-Geasarling	63	33/0.415kV	30.54%	93.36%	105.80%
8	DAE80	DAE80T8	L-Samtengang	25	33/0.415kV	8.65%	26.45%	29.98%
9	DAE80	DAE80T9	Tanju	25	33/0.415kV	26.88%	82.16%	93.11%
10	DAE80	DAE80T10	U-Samtengang	25	33/0.415kV	2.40%	7.35%	8.33%
11	DAE80	DAE80T11	Mamaythang	25	33/0.415kV	9.76%	29.82%	33.79%
12	DAE80	DAE80T12	Chukam	25	33/0.415kV	7.25%	22.15%	25.11%
13	DAE80	DAE80T13	Lalid Dapper	16	33/0.240kV	2.79%	8.52%	9.65%
14	DAE80	DAE80T14	Jorkharka	16	33/0.240kV	10.17%	31.09%	35.23%
15	DAE80	DAE80T15	L-Nimtola	25	33/0.415kV	17.53%	53.57%	60.71%
16	DAE80	DAE80T16	U-Nimtola	63	33/0.415kV	17.59%	53.78%	60.95%
17	DAE80	DAE80T17	Banglachu	25	33/0.415kV	17.81%	54.42%	61.68%
18	DAE80	DAE80T18	Balukhop	16	33/0.240kV	1.72%	5.26%	5.96%
19	DAE80	DAE80T19	Sanu Dorona	25	33/0.240kV	5.94%	18.17%	20.59%
20	DAE80	DAE80T20	Thulo Dorona	25	33/0.240kV	5.26%	16.09%	18.24%
				710		**14.64%**		

6) 33kV Dagana Feeder							2.080	2.558
1	DAE70	DAE70T1	Tashithang (Garamala)	63	33/0.415kV	12.77%	26.6%	55.3%
2	DAE70	DAE70T2	Lower Tashithang	25	33/0.415kV	51.58%	107.3%	131.95%
3	DAE70	DAE70T3	Upper Tashithang	125	33/0.415kV	19.61%	40.8%	50.16%
4	DAE70	DAE70T4	Deorali	63	33/0.415kV	16.67%	34.7%	42.66%
5	DAE70	DAE70T5	Upper Balaygang A	25	33/0.415kV	14.25%	29.6%	36.45%
6	DAE70	DAE70T6	Upper Balaygang B	16	33/0.415kV	19.50%	40.6%	49.89%
7	DAE70	DAE70T7	Balaygang C	63	33/0.415kV	14.62%	30.4%	37.41%
8	DAE70	DAE70T8	Dogap Top A	25	33/0.415kV	9.24%	19.2%	23.63%
9	DAE70	DAE70T9	Dogap Top B	16	33/0.415kV	10.46%	21.8%	26.75%
10	DAE70	DAE70T10	Dogap Top C	16	33/0.415kV	7.48%	15.6%	19.13%
11	DAE70	DAE70T11	Lungtengang	25	33/0.415kV	5.97%	12.4%	15.28%
12	DAE70	DAE70T12	Kashithang	63	33/0.415kV	16.67%	34.7%	42.65%
13	DAE70	DAE70T13	Bjurugang B	25	33/0.415kV	12.01%	25.0%	30.73%
14	DAE70	DAE70T14	Bjurugang A (School)	25	33/0.415kV	69.27%	144.1%	177.22%
15	DAE70	DAE70T15	Panglo	10	33/0.240kV	30.00%	62.4%	76.75%
16	DAE70	DAE70T16	Upper Khagochen	63	33/0.415kV	42.35%	88.1%	108.34%
17	DAE70	DAE70T17	Khagochen (PWD)	63	33/0.415kV	47.88%	99.6%	122.50%
18	DAE70	DAE70T18	Darlithang(NEW)	25	33/0.415kV	32.80%	68.2%	83.91%
19	DAE70	DAE70T19	Gangjab A	16	33/0.240kV	39.73%	82.6%	101.63%
20	DAE70	DAE70T20	Gangjab B	16	33/0.240kV	45.42%	94.5%	116.20%
21	DAE70	DAE70T21	Pungshi B	25	33/0.415kV	18.09%	37.6%	46.29%
22	DAE70	DAE70T22	Pungshi A	16	33/0.240kV	24.51%	51.0%	62.71%
23	DAE70	DAE70T23	Pungshi C	25	33/0.415kV	17.98%	37.4%	46.01%
24	DAE70	DAE70T24	Pungshi D	25	33/0.415kV	19.86%	41.3%	50.81%
25	DAE70	DAE70T25	Upper Chinathang	16	33/0.240kV	1.50%	3.1%	3.84%
26	DAE70	DAE70T26	Lower Chinathang	16	33/0.240kV	21.76%	45.3%	55.68%
27	DAE70	DAE70T27	Lhaling	63	33/0.415kV	13.50%	28.1%	34.53%
28	DAE70	DAE70T28	Lhalingkhamey B	25	33/0.415kV	5.37%	11.2%	13.73%
29	DAE70	DAE70T29	Lhalingkhamey A	25	33/0.415kV	6.85%	14.3%	17.53%
30	DAE70	DAE70T30	Kanakha	25	33/0.415kV	26.78%	55.7%	68.51%

31	DAE70	DAE70T31	Tanabji	63	33/0.415kV	10.26%	21.3%	26.25%
32	DAE70	DAE70T32	Nindukha	63	33/0.415kV	9.71%	20.2%	24.85%
33	DAE70	DAE70T33	Dagana (DT)	250	33/0.415kV	33.61%	69.9%	85.97%
34	DAE70	DAE70T34	Kalizingkha	63	33/0.415kV	39.25%	81.6%	100.41%
35	DAE70	DAE70T35	Dagana Town	315	33/0.415kV	8.97%	18.7%	22.96%
36	DAE70	DAE70T36	Bazingkha	25	33/0.415kV	21.50%	44.7%	55.00%
37	DAE70	DAE70T37	Samay	25	33/0.415kV	12.26%	25.5%	31.36%
38	DAE70	DAE70T38	Tashigang	63	33/0.415kV	13.97%	29.1%	35.74%
39	DAE70	DAE70T39	Tongsho	25	33/0.415kV	21.94%	45.6%	56.12%
40	DAE70	DAE70T40	Khenju	16	33/0.240kV	5.00%	10.4%	12.79%
41	DAE70	DAE70T41	Peling	16	33/0.240kV	1.47%	3.1%	3.77%
42	DAE70	DAE70T42	Ayetosel	25	33/0.415kV	22.41%	46.6%	57.32%
43	DAE70	DAE70T43	Namjaygang	25	33/0.415kV	48.00%	99.8%	122.80%
44	DAE70	DAE70T44	Buchuna A	25	33/0.415kV	66.28%	137.9%	169.58%
45	DAE70	DAE70T45	Buchuna B	25	33/0.415kV	8.17%	17.0%	20.90%
46	DAE70	DAE70T46	Bartshap A	25	33/0.415kV	25.81%	53.7%	66.03%
47	DAE70	DAE70T47	Bartshap B	25	33/0.415kV	41.23%	85.8%	105.49%
48	DAE70	DAE70T48	Bembay	16	33/0.240kV	21.88%	45.5%	55.96%
49	DAE70	DAE70T49	Dagana (BHU)	250	33/0.415kV	7.44%	15.5%	19.04%
50	DAE70	DAE70T50	Lower Khagochen	16	33/0.240kV	32.53%	67.7%	83.23%
51	DAE70	DAE70T51	Lower Khagochen	25	33/0.415kV	30.07%	62.6%	76.94%
7) 33kV Tashiding Feeder							**4.51**	**5.34**
1	DAE90	DAE90T1	Norbuzingkha A	63	33/0.415kV	29.72%	134%	158.68%
2	DAE90	DAE90T2	Norbuzingkha B	16	33/0.240kV	10.12%	46%	54.03%
3	DAE90	DAE90T3	Ganuzur Top	16	33/0.240kV	2.86%	13%	15.25%
4	DAE90	DAE90T4	Mid-Ganuzur	25	33/0.415kV	12.89%	58%	68.83%
5	DAE90	DAE90T5	Mid-Ganuzur (Near School)	63	33/0.415kV	14.73%	66%	78.65%
6	DAE90	DAE90T6	L-Ganuzur A	125	33/0.415kV	10.38%	47%	55.44%
7	DAE90	DAE90T7	L-Ganuzur B	16	33/0.240kV	10.88%	49%	58.08%

8	DAE90	DAE90T8	Shamdolay Top A	25	33/0.415kV	5.03%	23%	26.86%
9	DAE90	DAE90T9	Shamdolay Top B	25	33/0.415kV	5.30%	24%	28.30%
10	DAE90	DAE90T10	Shamdolay Top C	25	33/0.415kV	6.30%	28%	33.63%
11	DAE90	DAE90T11	L-Shamdolay	25	33/0.415kV	5.56%	25%	29.69%
12	DAE90	DAE90T12	Namchella F	25	33/0.415kV	4.43%	20%	23.66%
13	DAE90	DAE90T13	Namchella E	25	33/0.415kV	18.33%	83%	97.91%
14	DAE90	DAE90T14	Namchella B	25	33/0.415kV	4.94%	22%	26.38%
15	DAE90	DAE90T15	Namchella A	25	33/0.415kV	20.91%	94%	111.65%
16	DAE90	DAE90T16	Namchella C	16	33/0.240kV	2.04%	9%	10.90%
17	DAE90	DAE90T17	Namchella D	25	33/0.415kV	18.87%	85%	100.77%
18	DAE90	DAE90T18	Kawakha A	16	33/0.240kV	6.48%	29%	34.62%
19	DAE90	DAE90T19	Kawakha B	16	33/0.240kV	3.65%	16%	19.46%
20	DAE90	DAE90T20	Kawakha C	16	33/0.240kV	4.74%	21%	25.31%
21	DAE90	DAE90T21	Kawakha D	25	33/0.415kV	6.29%	28%	33.57%
22	DAE90	DAE90T22	Mid Tashiding II (PWD Camp)	250	33/0.415kV	4.31%	19%	23.01%
23	DAE90	DAE90T23	L-Tashiding	63	33/0.415kV	5.09%	23%	27.17%
24	DAE90	DAE90T24	Mid-Tashiding I	125	33/0.415kV	2.25%	10%	12.02%
25	DAE90	DAE90T25	Hathikharka	63	33/0.415kV	3.29%	15%	17.59%
26	DAE90	DAE90T26	L-Lodoma	25	33/0.415kV	4.09%	18%	21.85%
27	DAE90	DAE90T27	Up-Lodoma	25	33/0.415kV	44.19%	199%	235.96%
28	DAE90	DAE90T28	Gangzur Top	25	33/0.415kV	8.42%	38%	44.95%
29	DAE90	DAE90T29	Mid Gangzur	25	33/0.415kV	19.37%	87%	103.41%
30	DAE90	DAE90T30	Gangzur Top (Above School)	63	33/0.415kV	17.35%	78%	92.67%
31	DAE90	DAE90T31	Gangzur Top	63	33/0.415kV	7.06%	32%	37.70%
32	DAE90	DAE90T32	Norbuzingkha	63	33/0.415kV	3.17%	14%	16.93%
33	DAE90	DAE90T33	Jatay	16	33/0.240kV	1.71%	8%	9.13%
34	DAE90	DAE90T34	Gopeni	16	33/0.415kV	11.69%	53%	62.40%
35	DAE90	DAE90T35	Dapper	16	33/0.240kV	4.28%	19%	22.83%
36	DAE90	DAE90T51	L-Khagochen	25	33/0.415kV	32.80%	148%	175.14%
				1501.00		9.39%	42%	50.16%

	8) 33kV Station Feeder							
1	DAE60	DAE60T1	ESD Dagapela	250	33/0.415kV	3.53%	16%	18.84%

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**

Annexure-9: Proposal to up-grade the 6.6kV line to 33kV

Proposal to upgrade 6.6kV Line to 33kV

A. Existing Scenario

200kW Darachu Micro Hydel at Dagana caters the power to customers at 6.6kV voltage level and also further connects to the 33kV grid through 750kVA ICT transformer. However, at present, the ICT transformer is under breakdown and thus, the Darachu plant caters the power only to the customer of 6.6kV voltage level. The 6.6kV line consists of 39.713km and other connected infrastructures and customers are as tabulated below:

Sl.No.	Transformer	Capacity (kVA)	Customer (Nos)	Remarks
1	Darachu	250	6	Used as back up when 33kV Dagana grid feeder fails
2	Tshanglakha A	25	36	
3	Daga Dzong Jr.School	50	18	
4	Samay	30	38	
5	Tshanglakha B (Khamay)	30	10	
6	Below Daga Dzong	250	0	
7	Daga Central School	75	0	
8	Nindukha	20	28	
9	Gemjaygang	20	31	
10	Lhaling	20	16	
11	Dolopchen	20	4	
12	Gairigoan	16	18	
13	Gurunggoan	50	18	
14	Dagapela RBA (ICT)	750	0	
15	Lower Goshi (Ideal)	16	0	
16	Lower Dogap	16	5	
17	Upper Dogap	30	1	
18	Bichgoan	16	37	
Total:		**1684**	**266**	

B. Issues

1. Darachu plant without Grid connection:

1.1. Generation loss

When the power demand is less than the generation from the plant, generation loss is high as is evident from the generation data of 2020 as shown below:

Particulars	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Energy Generated (kWh)	65,210	62,170	62,520	56,890	54,720	51,320	51,110	51,070
Energy Delivered (kWh)	32,534	29,932	29,961	28,769	27,738	30,179	29,882	30,697
Energy Loss (kWh)	32,676	32,238	32,559	28,121	26,982	21,141	21,228	20,373
Energy loss (%)	**50**	**52**	**52**	**49**	**49**	**41**	**42**	**40**

1.2. Power Supply Reliability

When Darachu generation fails, the 6.6kV line customers have to remain without power supply.

2. With Grid Connected to Darachu Plant

Due to frequent failure of ICT, it was challenge for the Division to synchronize with the plant with the grid. The ICT was installed in the year 2010 and so far, it has experienced five major breakdowns including the current one.

C. Proposal

1. Option 1

To install **ICT** transformer near Darachu plant and provide grid connect from 33kV grid line (Dagana feeder). Currently the ICT transformer is installed 40 km away from plant providing grid line from 33kV SF6 feeder. The breakdown of ICT transformer could be due to line fault occurring on the line in-between.

Figure 1: Existing Scenario

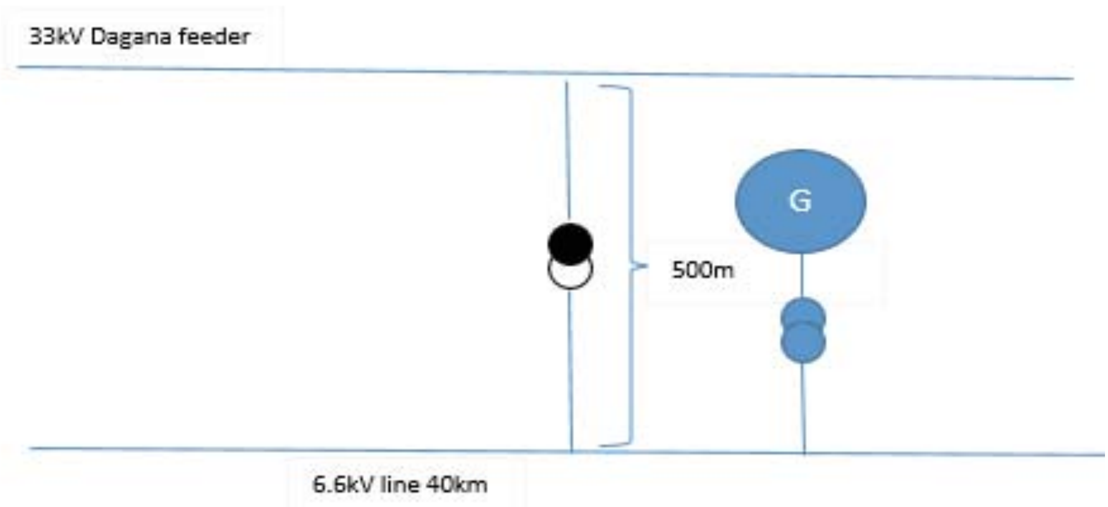


Figure 2: Proposed Configuration

1.1.Issues on option 1

The issue of realignment works is being expected in future once the road widening work starts along Dagana primary high way. The whole stretch of 6.6kV line is along the highway.

2. Option 2

To install 250kVA, 0.415/33kVkV ICT transformer near Darachu plant to provide 33kV grid connection to the plant from 33kV Dagana feeder. With this proposal, we need to upgrade the existing 6.6kV infrastructures. Therefore, to upgrade the line to 33kV we are required to construct 33kV line extension from Dagana feeder. To implement this and to reduce the up-front cost, it is recommended to strategize in phase wise manner. Regarding distribution transformer, we can cross-swap the overloaded transformer that is as per the DT forecasted load until 2030. Further, it would also mean that the generating transformer has to be changed from 0.415/6.6kV to 0.415/33kV which would increase the initial capex.