

Ministry of Energy and Natural Resource
Bhutan Power System Operator
Thimphu: Bhutan



Transmission System Performance Report
First Quarterly Report 2023



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1. Introduction

The electricity transmission network in Bhutan is solely owned by Bhutan Power Corporation limited (BPC) and electricity generation is solely owned by Druk Green Power Corporation Limited (DGPC). Bhutan Power System Operator (BPSO) under Ministry of Energy and Natural Resource is responsible for safe, secure and efficient operation of Bhutan transmission network and generation.

This quarterly report is prepared in compliance to the Grid Code Regulation (GCR) 2008, clause 6.14.1, and “System Operator has to submit a quarterly report covering the performance of the Transmission System to all Licensees, Authority and Ministry”. This transmission performance report contains summary of growth of peak demand, performance of generating stations (power and energy generation), energy availability and requirement for the country, export and import of electricity to/ from India, frequency profile of selected substation and voltage profile of few important substations.

All the index and other calculations in this report have been executed based on the data received from substations and generating plants.

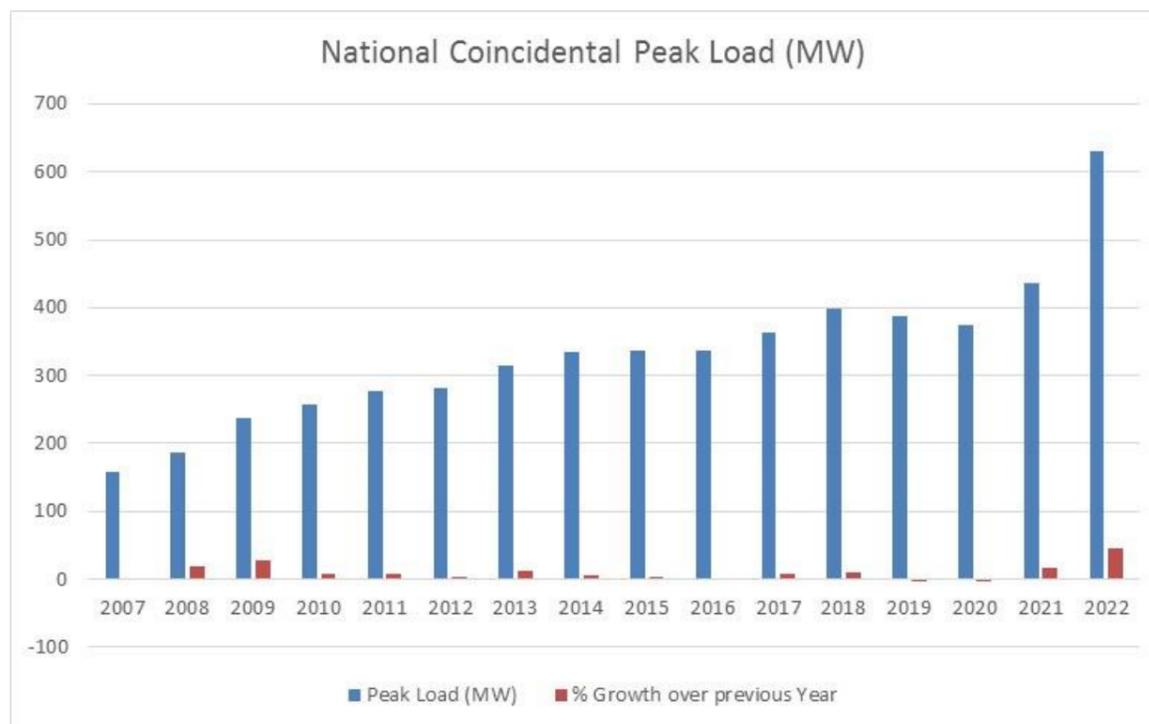
2. National Peak Demand

The national peak demand till now is recorded at **629.61MW** which was occurred on December 28, 2022 at 18:00 hours. This is calculated by summation of Generation minus Export/Import.

Table 2.1. The National Peak Demand since 2007

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Peak Load (MW)	157.36	187.05	237.17	256.95	276.24	282.44	313.94	333.41	336.52	335.87	362.09	399.35	387.66	374.53	435.35	629.61
% Growth over previous Year	-	18.87	26.79	8.34	7.51	2.24	11.15	6.20	0.93	-0.19	7.81	10.29	-2.93	-3.39	16.24	44.62

Graph 2.1. The growth in National Peak Demand since 2007



2.1. Power (MW) consumed by country

Following methods are used to calculate peak demand for the Eastern Grid, Western Grid and National demand.

1. **National Demand** = (Sum of all total generation)-(Sum of all Export or Import)
2. **National Demand** = (Sum of all feeders loading at hydropower station) – (Sum of all Export/Import)
3. **National Demand** = (Sum of all substation loading)

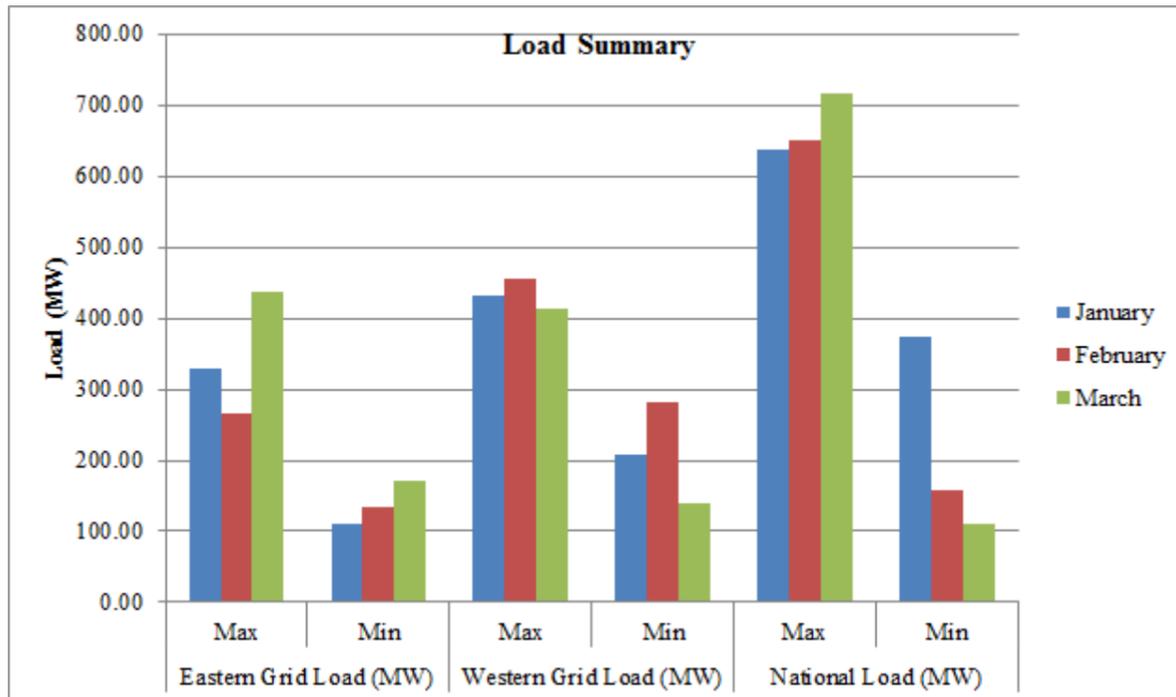
For this report, the National Demand was calculated using method-1.



Table 2.1.2. Domestic demand for Eastern Grid, Western Grid and National using method- 1

Grid	Eastern Grid Load (MW)		Western Grid Load (MW)		National Load (MW)	
	Max	Min	Max	Min	Max	Min
January	329.36	110	431.01	207.70	637.06	373.68
February	266.19	134.00	454.72	281.30	649.26	157.35
March	437.81	170.84	414.06	140.47	715.83	110.13

Graph 2.1.2. Domestic demand for Eastern Grid, Western Grid and National using method- 1



The national load pattern for the month of January to March, 2023 is calculated using method-1 is attached as **Annexure-II**

3. Energy Availability and Requirement for the country

3.1. Energy (MU) consumed by Country

The total energy consumed within Bhutan is computed from the total energy DGPC had sold to BPC including the royalty energy.

Table 3.1.1. Total Energy (MU) consumed

Month	Total Ex-bus (MU)	Total Export/Import (MU)	Total energy sold to BPC (MU)
January	329.51889502	21.62519792	309.48312824
February	262.74186086	16.84635736	247.17548312
March	312.24708932	24.01798240	289.67028497

Graph 3.1.1. Total Energy (MU) consumed

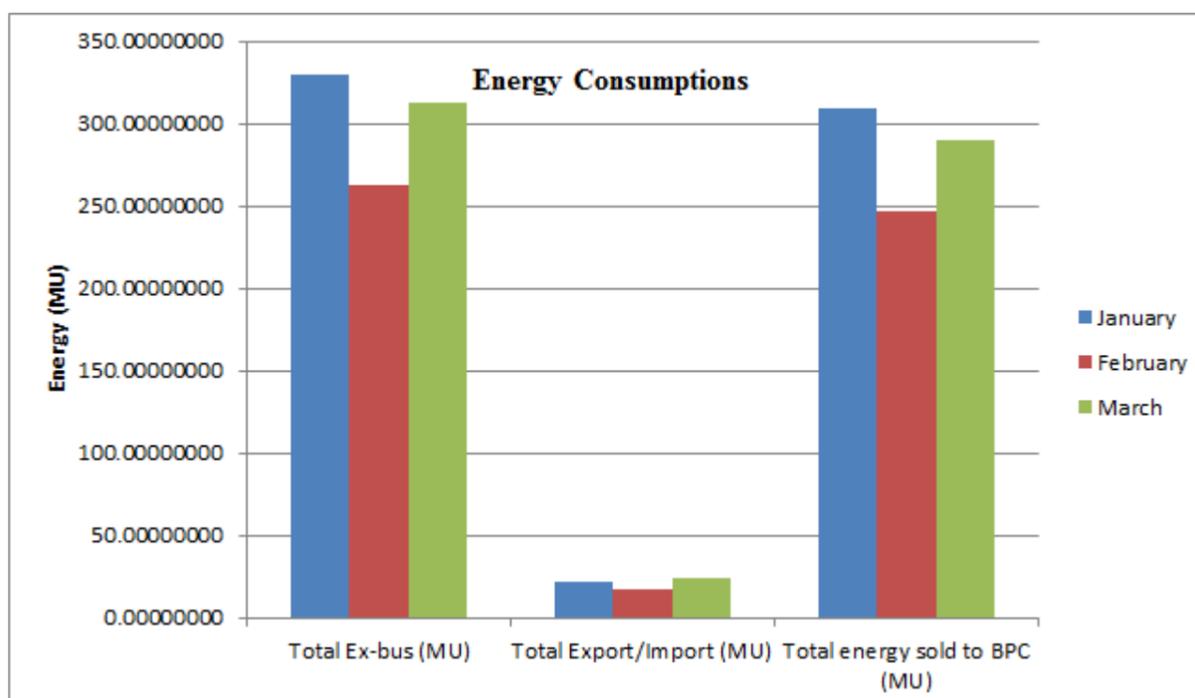
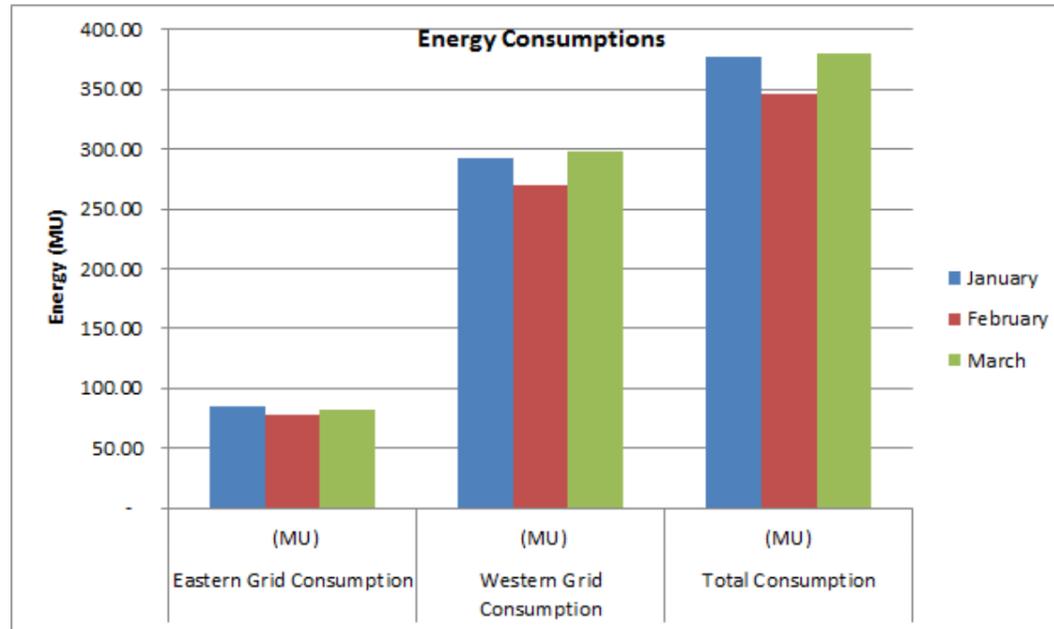




Table 3.1.2. Energy (MU) consumed

Grid	Eastern Grid Consumption	Western Grid Consumption	Total Consumption
Month	(MU)	(MU)	(MU)
January	84.87	291.94	376.82
February	77.46	269.21	346.67
March	81.57	298.52	380.09

Graph 3.1.2. Energy (MU) consumed



4. Performance of generating plants

4.1. Power and Energy Generation

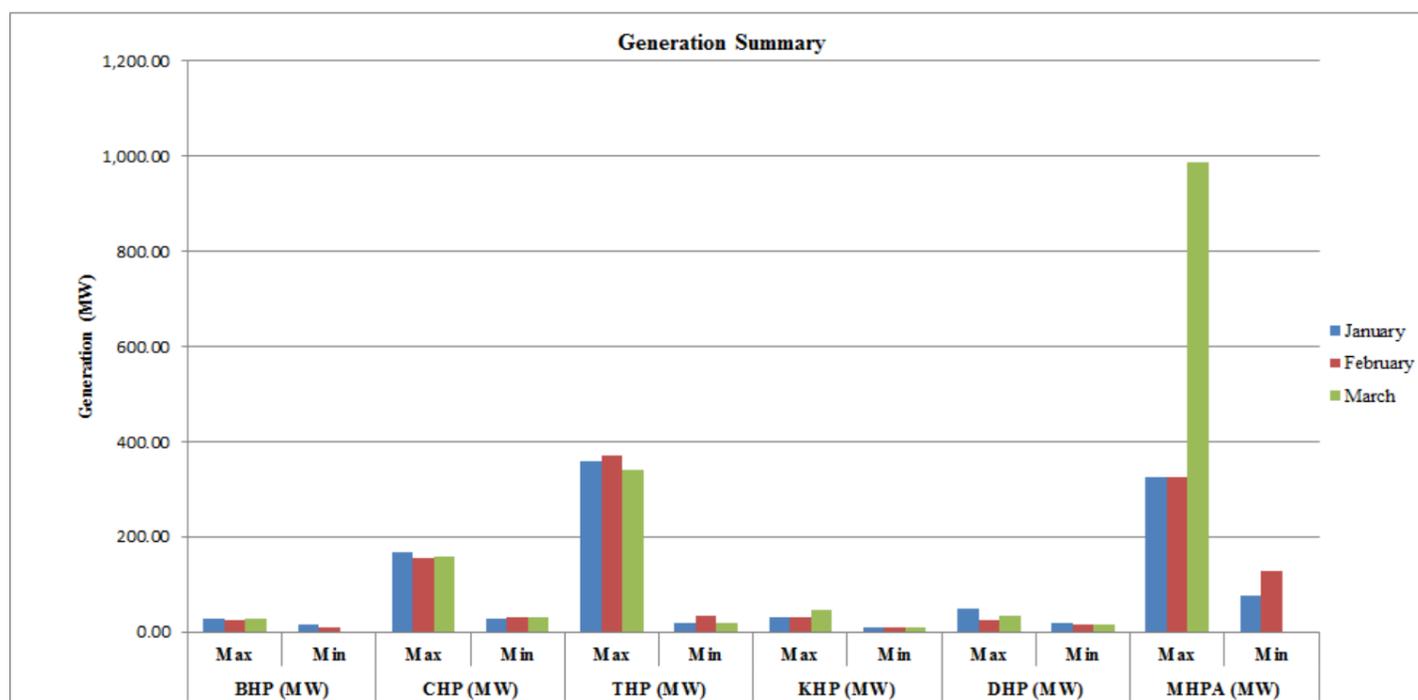
The maximum total generation for the fourth quarter of year 2023 was 1,592.94 MW in month of March and minimum generation was 932.42 MW in the February month.

Table: 4.1.1 Summary of maximum and minimum generation by various hydropower plant

Generation By	BHP (MW)		CHP (MW)		THP (MW)		KHP (MW)		DHP (MW)		MHPA (MW)		TOTAL (MW)	
	Max	Min	Max	Min	Max	Min								
January	26.70	14.70	167.36	28.50	360.00	20.00	32.22	10.01	49.11	19.33	325.11	75.37	960.50	167.91
February	26.30	10.30	155.42	30.12	370.00	35.00	31.58	10.01	24.01	17.06	325.11	127.63	932.42	230.12
March	28.90	0.00	157.62	31.00	340.00	20.00	45.39	10.05	35.30	15.15	985.73	0.00	1,592.94	76.20

Source: Hydropower Plants (DGPC)

Graph: 4.1.1 Summary of maximum and minimum generation by various hydropower plant





Daily maximum, minimum and average generation by each generating plant for the month of October to December, 2022 is attached as **Annexure-I**.

4.2.Plant Capacity Factor

The capacity factor of each generating plant was calculated as below:

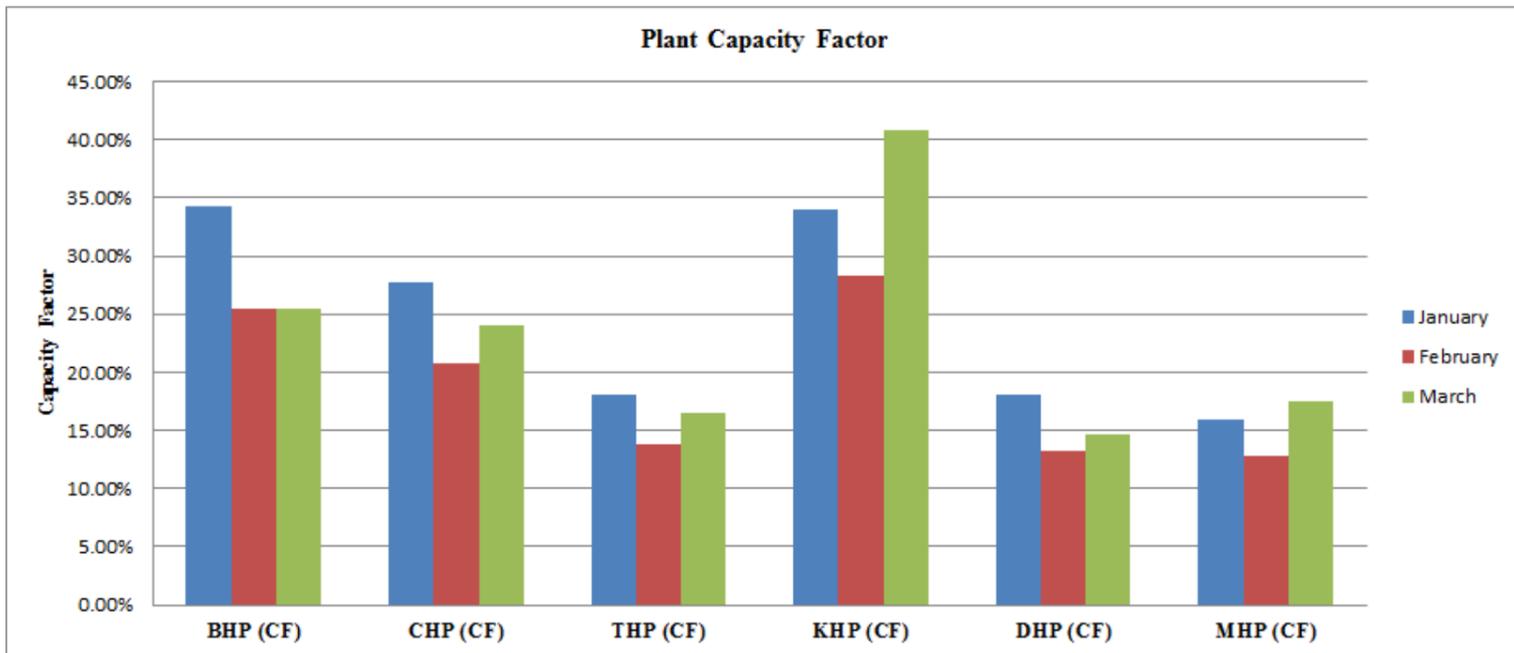
$$Capacity\ factor = \frac{Total\ energy\ plant\ has\ produce\ over\ a\ period}{Total\ energy\ plant\ would\ produce\ when\ operated\ at\ full\ capacity}$$

Table 4.2.1: Total generation and capacity factor of various hydropower plants

Month	BHP (MU)	BHP (CF)	CHP (MU)	CHP (CF)	THP (MU)	THP (CF)	KHP (MU)	KHP (CF)	DHP (MU)	DHP (CF)	MHP (MU)	MHP (CF)
January	15.75959	34.20%	66.94756	27.67%	133.122182	18.13%	14.687255	34.00%	16.43	18.11%	82.57	15.93%
February	12.14481	25.51%	51.76761	20.71%	104.819636	13.81%	12.622570	28.28%	12.43	13.26%	68.96	12.87%
March	11.70386	25.40%	58.22726	24.07%	120.73818	16.44%	17.600903	40.74%	13.24	14.60%	90.73	17.50%

Source: TD, BPC

Graph 4.2.1: Capacity factor of various hydropower plants



5. Export and Import of Electricity

Maximum export for the first quarter of year 2023 was 283.00 MW in the month of January to Binaguria substation in India. The minimum export recorded was 6.19 MW to Salakoti and Rangia substation in India during the month of February.

Table 5.1. Export of electricity to India

Export To	Binaguri (MW)		Birpara (MW)		Salakoti and Rangia (MW)		Alipurdur (MW)	
	Max	Min	Max	Min	Max	Min	Max	Min
January	283.00	0.55	0.00	0.00	9.25	0.01	10.14	1.82
February	257.18	0.09	0.00	0.00	6.19	0.27	172.45	1.36
March	257.64	0.82	9.26	8.92	13.82	0.02	214.21	0.16

Graph 5.1. Export of electricity to India

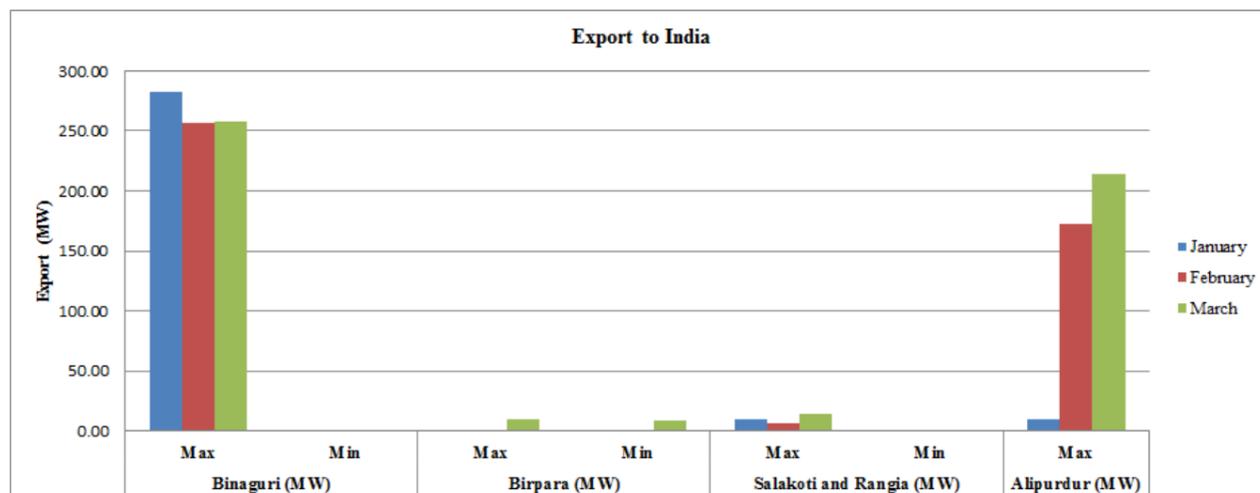
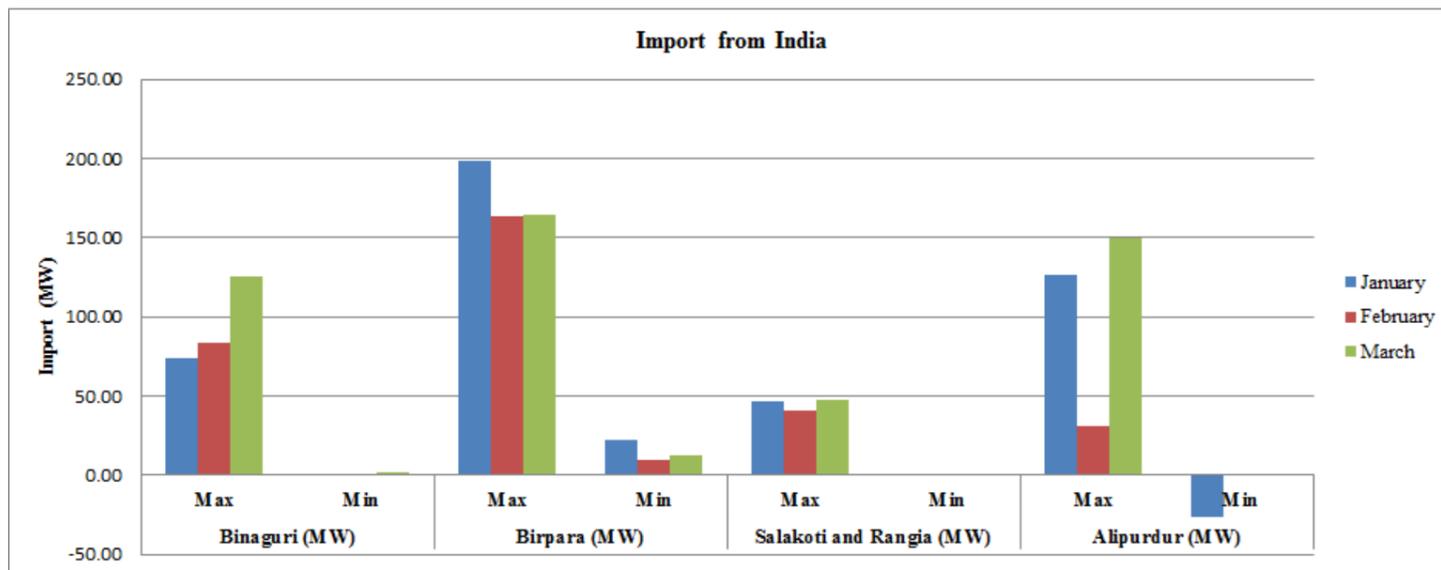


Table 5.2. Import of electricity from India.

Import From	Binaguri (MW)		Birpara (MW)		Salakoti and Rangia (MW)		Alipurdur (MW)	
	Max	Min	Max	Min	Max	Min	Max	Min
January	74.36	0.27	198.94	22.00	46.58	0.19	126.61	-26.14
February	83.36	0.27	163.95	9.73	41.20	0.10	31.46	0.40
March	125.45	1.82	164.76	12.27	47.34	0.04	149.66	0.11

Graph 5.2. Import of electricity from India



6. Frequency profile

The nominal allowed frequency range shall be 50Hz ± 1% in Bhutan. The system is normally managed such that frequency is maintained within operational limit of 49.5 Hz to 50.5 Hz. However, frequency may move outside these limit under faulty condition.

As per the Grid Code 2008, clause 6.4.1 the frequency is classified into three different bands as follows:

- a. Normal state
The transmission System frequency is within the limit of 49.5Hz to 50.5Hz.
- b. Alert state
The Transmission System frequency is beyond the normal operating limit but within 49.0Hz to 50.0Hz.
- c. Emergency state
There is generation deficiency and frequency is below 49.0Hz.

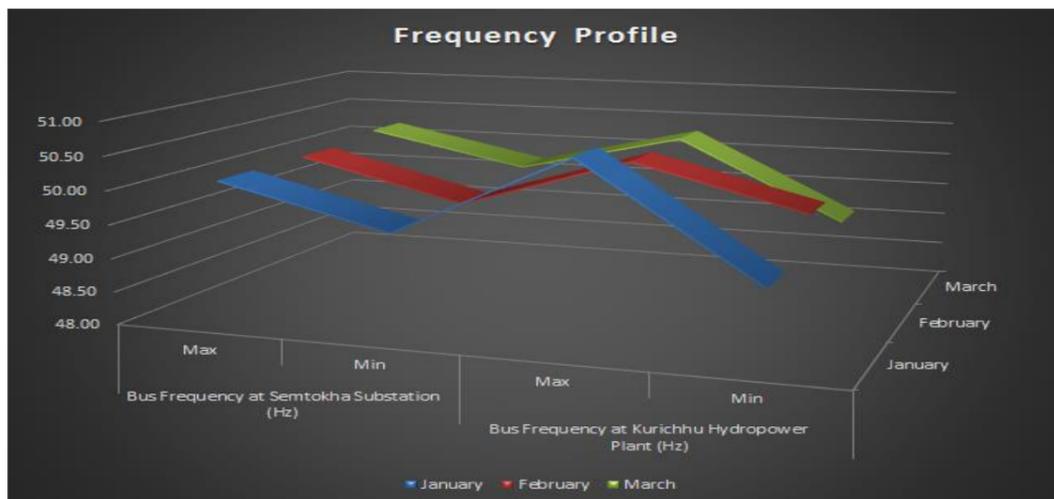
The frequency at 220kV Bus at 220/66/11kV Semtokha substation in the western grid and 132kV Bus at 60MW Kurichhu Hydropower Plant in the eastern grid is considered.

6.1.Frequency Summary for the month of January to March, 2023

Table 6.1.1. Frequency summary for the month of January to March, 2023.

Substation/Plant	Bus Frequency at Semtokha Substation (Hz)		Bus Frequency at Kurichhu Hydropower Plant (Hz)	
	Max	Min	Max	Min
January	50.10	49.50	50.70	49.09
February	50.10	49.50	50.28	49.65
March	50.20	49.70	50.29	49.08

Graph 6.1.2. Frequency summary for the month of January to March, 2023





Daily maximum, minimum and average Frequency of Semtokha substation in western grid and Kurichhu Hydro Power Plant in eastern grid for the month of January to March, 2023 is attached as **Annexure-III**

7. Voltage Profile of selected substation

As per the Grid Code 2008, clause 6.4.1 the voltage at all connection point is classified into three different bands as follows:

1. *Normal State*
The voltage at all connection points are within the limits of 0.95 times and 1.05 times of the normal values
2. *Alert State*
The voltage at all connection points are outside the normal limit but within the limits of 0.9 times and 1.1 times of the nominal values.
3. *Emergency State*
Transmission system voltages are outside the limit of 0.9 times and 1.1 times of nominal values.

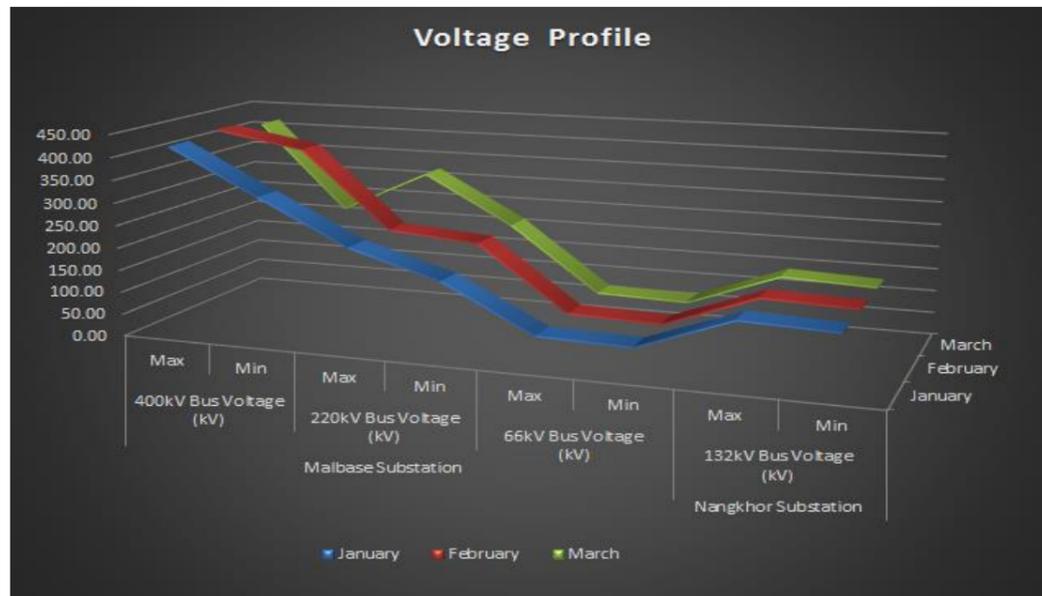
Due to the location of 400/22/66/11kV Malbase substation in western grid and 132/33/11kV Nangkhor substation in the eastern grid, the voltage profile of these substations are considered.

7.1.Voltage Summary for the Month of January to March, 2023

Table 7.1.1 Voltage Summary for the month of January to March, 2023

Substation	Malbase Substation						Nangkhor Substation	
	400kV Bus Voltage (kV)		220kV Bus Voltage (kV)		66kV Bus Voltage (kV)		132kV Bus Voltage (kV)	
	Max	Min	Max	Min	Max	Min	Max	Min
January	420.50	320.94	225.00	168.00	67.00	61.50	136.94	129.40
February	429.50	395.50	225.00	209.50	67.00	61.00	136.10	129.25
March	417.00	225.00	319.00	212.00	67.40	62.50	137.77	129.40

Graph 7.1.2 Voltage Summary for the month of January to March, 2023



Daily maximum, minimum and average bus voltage of Malbase substation in western grid and Nangkhor substation in eastern grid for the month of January to March, 2023 is attached as **Annexure-IV**

8. Major Outages of Feeders and Equipment

The transmission lines and equipment which were shut down for annual maintenance and hand/force trip are not considered in the report.

This year the transmission department has started uploading the tripping reports in the google sheet therefore all the details of the Major and Minor Outages of the feeders and the equipment’s of the Eastern and Western grid can be easily downloaded from the link below:

<https://sites.google.com/view/tomd-trip-record/trip-register>



Transmission System Performance Report

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Annexure-I

Table: Generation of January, 2023

Jan-23 Date	BHP (MW)			CHP (MW)			THP (MW)			KHP (MW)			DHP (MW)			MHP (MW)		
	Max	Min	Ava	Max	Min	Ava	Max	Min	Ava	Max	Min	Ava	Max	Min	Ava	Max	Min	Ava
1	16.10	16.00	16.00	130.54	70.36	108.52	290.00	120.00	202.83	32.16	10.34	23.35	25.68	24.98	25.39	280.86	270.40	276.94
2	23.80	23.20	23.57	131.44	51.73	105.39	290.00	100.00	210.21	30.59	11.09	21.41	25.50	25.17	25.26	280.17	200.71	265.98
3	23.90	22.80	23.56	136.49	52.54	102.70	320.00	120.00	203.88	32.22	10.37	22.04	25.30	24.63	24.92	270.39	152.65	257.03
4	0.00	22.70	22.93	145.91	51.17	107.04	310.00	105.00	198.67	30.03	10.37	22.01	25.01	23.98	24.65	260.80	255.50	256.53
5	0.00	21.80	22.62	140.48	45.49	100.92	360.00	100.00	203.33	30.11	10.04	21.66	24.62	24.02	24.51	250.84	240.34	244.63
6	0.00	22.10	22.51	145.77	50.05	99.51	275.00	100.00	203.96	30.13	10.05	21.46	24.38	23.77	24.16	275.27	200.55	242.00
7	26.30	21.40	22.02	131.38	40.35	95.22	265.00	100.00	201.67	32.13	10.07	22.64	23.90	23.44	23.76	290.84	229.57	240.62
8	21.90	21.60	21.76	141.35	37.41	94.48	280.00	80.00	185.83	30.19	10.07	22.75	23.90	23.38	23.63	249.80	230.27	239.44
9	26.60	21.50	21.89	140.67	40.74	94.40	270.00	90.00	182.50	30.08	10.07	19.40	23.61	23.43	23.54	230.56	230.27	230.37
10	21.70	21.20	21.56	167.36	40.45	97.24	300.00	90.00	186.25	30.23	10.04	20.78	23.50	23.19	23.36	325.11	190.26	233.63
11	21.70	21.30	21.54	140.73	40.63	87.66	300.00	80.00	183.08	30.23	10.04	20.50	23.32	22.99	23.14	228.35	190.25	218.67
12	26.50	21.30	21.61	155.00	40.78	97.26	310.00	80.00	200.21	30.33	10.41	20.97	23.05	22.79	22.91	229.78	219.81	224.41
13	25.80	20.80	21.31	145.90	35.87	92.81	340.00	80.00	196.25	30.24	10.43	20.53	22.83	22.41	22.72	230.08	224.88	226.34
14	26.10	20.80	21.48	130.90	39.94	89.96	290.00	80.00	199.38	30.22	10.09	21.06	22.74	22.51	22.68	230.07	210.19	216.36
15	21.60	20.40	20.83	126.52	40.49	88.44	310.00	80.00	189.79	30.20	10.08	20.10	22.72	22.49	22.62	220.26	210.16	215.45
16	26.70	20.40	21.34	134.12	40.01	91.52	275.00	80.00	177.92	30.43	10.03	21.80	22.72	22.17	22.48	225.02	180.61	215.36
17	24.90	20.10	20.74	150.71	40.16	84.47	330.00	40.00	181.71	30.21	10.01	20.18	22.33	22.15	22.27	250.23	195.07	207.42
18	24.50	20.00	20.31	151.29	40.16	82.71	270.00	20.00	132.92	30.25	10.08	20.51	22.10	21.27	21.78	230.09	195.23	214.26
19	20.20	19.90	20.08	146.81	38.93	76.87	250.00	20.00	135.83	30.04	10.03	16.53	22.01	21.37	21.80	205.42	200.25	204.08
20	20.10	19.90	20.03	131.00	40.39	75.89	290.00	20.00	127.50	30.29	10.08	19.89	21.78	21.15	21.50	209.63	195.37	203.72
21	25.00	14.80	20.12	142.06	39.15	92.85	310.00	40.00	183.13	30.16	10.06	19.05	21.68	21.09	21.38	200.13	195.08	198.80
22	20.70	14.70	19.96	136.06	31.67	78.68	305.00	30.00	156.04	30.38	10.07	20.41	21.69	21.15	21.45	199.90	190.21	192.02
23	20.10	19.50	19.74	121.61	40.54	91.01	315.00	40.00	190.54	25.16	10.09	18.19	21.51	20.45	21.15	190.43	183.30	188.31
24	20.20	19.40	19.93	140.45	39.29	85.28	280.00	30.00	157.04	25.12	10.08	18.72	21.66	20.74	21.29	199.61	183.24	186.97
25	20.10	19.90	19.96	141.45	40.37	87.88	290.00	30.00	178.54	30.39	10.08	19.02	21.07	20.71	20.91	239.80	127.63	195.67
26	20.10	19.40	19.72	136.62	36.09	82.83	315.00	35.00	159.17	30.20	10.02	19.92	20.77	20.50	20.57	180.42	180.25	180.34
27	24.50	19.30	19.64	136.00	28.50	84.01	270.00	35.00	156.25	30.14	10.07	20.13	20.80	20.50	20.69	180.44	175.24	179.30
28	19.50	19.30	19.40	145.40	40.22	88.74	310.00	50.00	187.29	30.43	10.08	21.87	20.48	20.24	20.30	175.49	142.40	173.98
29	19.50	19.10	19.33	145.51	40.02	83.45	280.00	40.00	156.88	30.16	10.08	19.09	20.68	20.32	20.37	175.41	175.24	175.34
30	20.30	19.30	19.59	126.53	44.94	84.10	305.00	50.00	181.46	30.11	10.10	20.92	20.36	19.95	20.05	234.75	75.37	179.95
31	19.40	18.90	19.20	123.33	40.55	87.46	312.00	50.00	173.88	30.11	10.04	20.40	49.11	19.33	21.97	0.00	No Generation	Error
Max	26.70			167.36			360.00			32.22			49.11			325.11		
Min	14.70			28.50			20.00			10.01			19.33			75.37		

Source: THP, CHP, BHP, KHP, MHP (DGPC)

Table: Generation for the month of February, 2023

Feb-23 Date	BHP (MW)			CHP (MW)			THP (MW)			KHP (MW)			DHP (MW)			MHP (MW)		
	Max	Min	Ava	Max	Min	Ava	Max	Min	Ava	Max	Min	Ava	Max	Min	Ava	Max	Min	Ava
1	12.80	12.50	12.78	126.57	40.84	82.79	310.00	60.00	164.58	30.20	10.07	18.26	20.19	19.67	19.80	280.86	270.40	276.94
2	18.70	18.40	18.57	121.68	40.28	78.13	280.00	70.00	179.88	30.33	10.04	20.94	19.71	19.52	19.66	280.17	200.71	265.98
3	18.60	18.40	18.54	121.04	39.06	81.25	340.00	55.00	178.13	30.17	10.02	19.47	19.75	19.16	19.44	270.39	152.65	257.03
4	0.00	18.40	18.51	143.12	38.32	81.29	270.00	40.00	160.00	30.12	10.02	18.63	19.50	19.16	19.31	260.80	255.50	256.53
5	0.00	18.40	18.48	140.32	41.01	82.31	260.00	50.00	152.08	30.22	10.07	18.18	19.50	19.14	19.32	250.84	240.34	244.63
6	0.00	18.10	18.48	130.99	40.03	82.05	285.00	50.00	166.04	30.12	10.09	19.76	19.71	19.13	19.23	275.27	200.55	242.00
7	18.20	18.00	18.08	129.78	40.54	80.81	320.00	40.00	165.83	30.13	10.07	18.04	19.44	19.14	19.21	290.84	229.57	240.62
8	21.70	18.00	19.19	126.94	39.58	73.61	305.00	35.00	145.42	30.43	10.02	18.25	20.67	19.32	19.76	249.80	230.27	239.44
9	26.30	18.00	19.55	139.99	40.53	84.69	370.00	60.00	175.83	30.36	10.08	20.87	19.68	19.25	19.50	230.56	230.27	230.37
10	19.40	17.37	18.54	133.98	33.15	75.63	310.00	40.00	154.50	30.22	10.05	17.84	24.01	19.31	20.95	325.11	190.26	233.63
11	19.30	17.27	18.41	135.25	30.12	73.23	310.00	35.00	166.46	30.08	10.06	15.89	20.66	19.15	19.89	228.35	190.25	218.67
12	18.80	17.70	18.23	126.31	40.28	81.27	310.00	40.00	153.33	30.21	10.03	18.86	19.63	18.65	19.31	229.78	219.81	224.41
13	18.10	17.90	17.98	126.92	39.41	80.94	315.00	35.00	171.04	30.40	10.08	18.33	19.70	18.63	18.96	230.08	224.88	226.34
14	23.70	17.50	18.42	144.07	39.99	81.59	315.00	35.00	169.79	30.42	10.05	19.10	19.19	18.43	18.88	230.07	210.19	216.36
15	17.70	17.50	17.57	130.61	40.05	71.18	330.00	40.00	143.75	31.58	10.06	19.35	23.21	18.37	18.86	220.26	210.16	215.45
16	17.60	17.40	17.48	130.10	39.90	75.22	335.00	40.00	152.92	30.17	10.06	19.63	18.69	18.36	18.51	225.02	180.61	215.36
17	17.50	17.30	17.44	155.42	39.03	74.78	285.00	40.00	123.96	30.21	10.01	19.64	18.69	18.36	18.51	250.23	195.07	207.42
18	17.50	17.00	17.30	127.24	39.42	80.65	305.00	40.00	151.67	31.16	10.01	20.78	18.21	17.88	18.05	230.09	195.23	214.26
19	17.40	17.20	17.28	129.73	41.10	70.87	290.00	40.00	154.38	30.18	10.01	19.69	18.48	17.88	18.16	205.42	200.25	204.08
20	18.60	17.40	18.18	145.63	40.67	84.30	295.00	40.00	173.54	30.21	10.02	20.16	20.22	18.15	19.05	209.63	195.37	203.72
21	18.90	17.80	18.33	120.32	41.02	74.07	280.00	40.00	159.79	30.13	20.44	23.38	19.59	18.47	19.12	200.13	195.08	198.80
22	17.80	17.00	17.58	132.64	45.07	83.94	315.00	45.00	168.54	30.22	20.04	23.25	20.20	18.18	18.71	199.90	190.21	192.02
23	17.10	16.90	17.00	112.78	40.69	71.41	310.00	40.00	165.83	30.10	10.08	21.40	18.40	17.58	17.98	190.43	183.30	188.31
24	25.70	15.00	17.66	115.84	40.61	84.24	320.00	40.00	179.58	30.22	10.08	22.52	18.21	17.66	17.90	199.61	183.24	186.97
25	17.10	10.90	16.34	122.87	31.66	67.92	275.00	40.00	132.96	30.08	15.02	19.86	18.51	17.39	17.66	239.80	127.63	195.67
26	17.30	10.30	16.72	123.55	35.74	69.48	275.00	35.00	107.50	30.10	10.04	17.25	19.10	17.18	17.83	180.42	180.25	180.34</



Transmission System Performance Report

First Quarterly Report-2023

Table: National demand for January, 2023

Graph: National Demand for January, 2023

Annexure-II

Jan-23	Max	Min	Ava
0:00	617.47	472.17	521.32
1:00	604.07	403.94	515.28
2:00	594.96	408.56	517.83
3:00	600.15	406.19	517.02
4:00	606.24	408.17	515.92
5:00	601.48	398.26	518.57
6:00	580.13	373.68	510.26
7:00	597.00	434.82	526.59
8:00	613.70	456.97	540.94
9:00	594.94	445.46	534.80
10:00	601.95	438.07	526.17
11:00	618.09	479.83	521.58
12:00	612.18	471.30	519.77
13:00	610.22	392.09	514.65
14:00	631.61	452.47	525.74
15:00	609.67	467.12	525.62
16:00	620.14	428.33	517.15
17:00	618.87	393.60	526.12
18:00	615.61	430.05	515.66
19:00	607.31	473.77	522.20
20:00	610.22	463.70	533.58
21:00	606.91	488.03	538.90
22:00	637.06	449.14	531.75
23:00	584.50	449.71	515.80
	637.06		
		373.68	

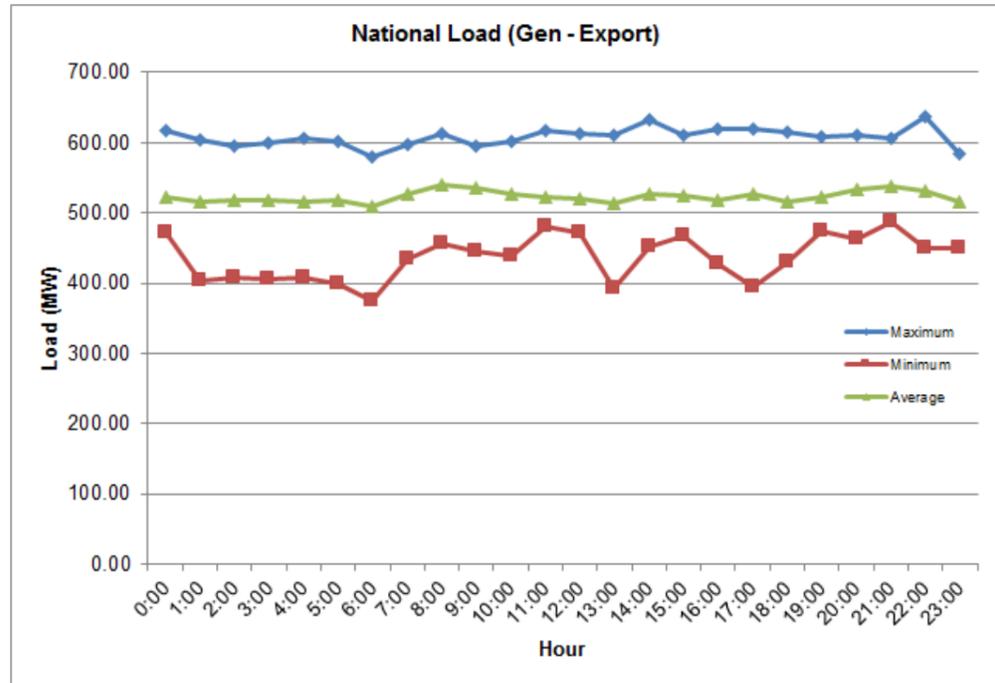


Table: National Demand for February, 2023

Graph: National Demand for February, 2023

Feb-23	Max	Min	Ava
0:00	423.66	331.23	373.47
1:00	493.82	329.31	392.96
2:00	503.42	340.38	399.39
3:00	493.42	299.64	395.66
4:00	502.07	321.89	399.87
5:00	502.78	309.58	418.33
6:00	571.80	295.48	451.14
7:00	600.78	428.11	502.74
8:00	548.23	427.85	490.62
9:00	571.83	443.37	490.82
10:00	649.26	426.43	494.98
11:00	634.00	350.35	477.75
12:00	622.28	253.05	440.16
13:00	644.71	223.35	376.78
14:00	539.55	291.40	370.89
15:00	463.79	290.29	364.50
16:00	453.65	301.52	370.54
17:00	554.12	295.97	415.32
18:00	558.43	430.44	489.52
19:00	568.07	403.54	480.28
20:00	544.37	395.27	475.20
21:00	571.04	355.63	461.68
22:00	557.12	157.35	378.77
23:00	516.18	233.28	357.46
	649.26		
		157.35	

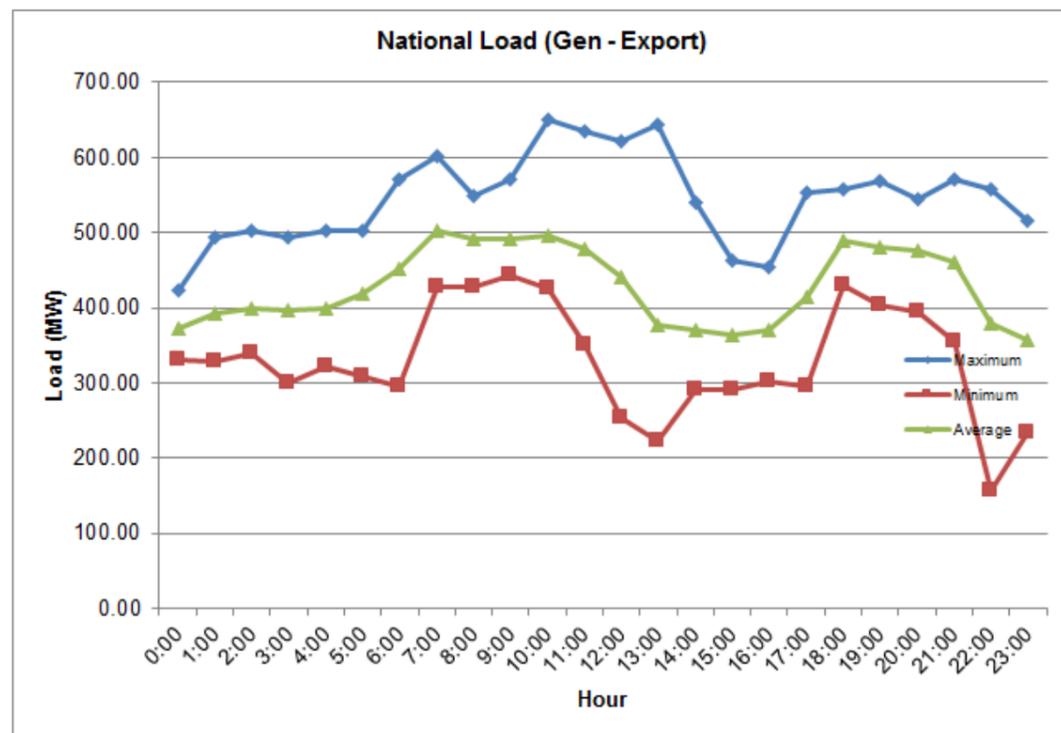
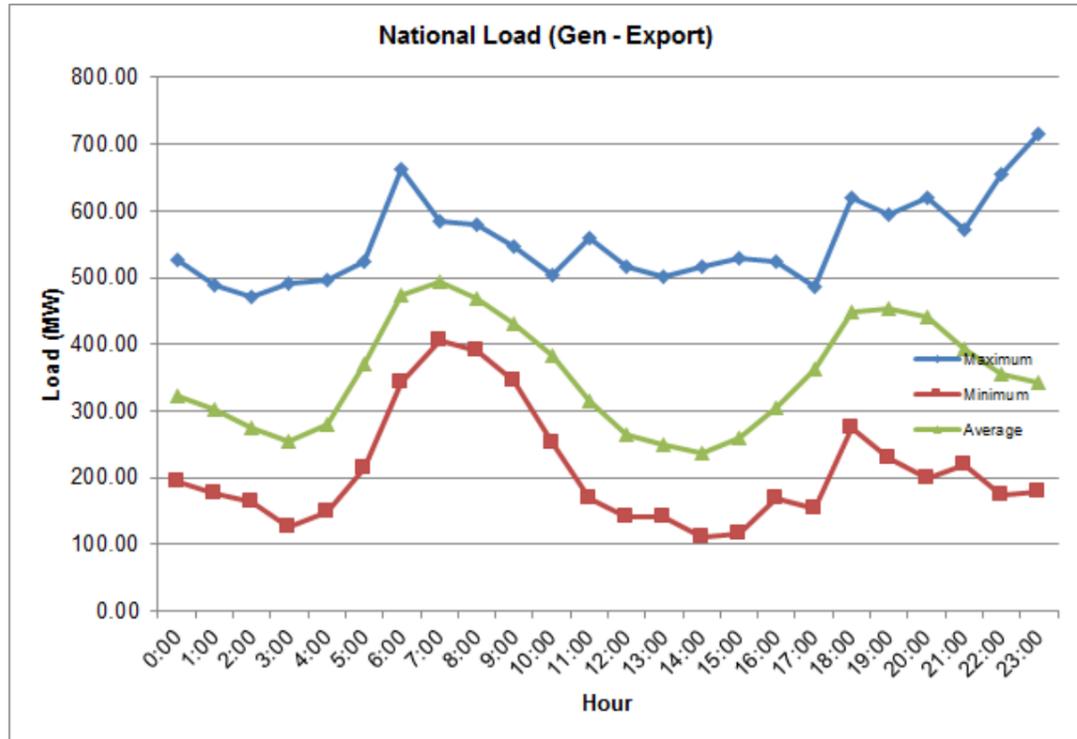




Table: National Demand for March, 2023

Mar-23	Max	Min	Ava
0:00	525.86	192.70	322.52
1:00	488.21	176.42	301.88
2:00	470.47	164.56	274.68
3:00	490.75	126.80	254.63
4:00	495.54	147.40	278.97
5:00	523.85	213.68	369.23
6:00	662.77	342.18	474.02
7:00	584.93	405.26	494.41
8:00	579.00	390.75	468.76
9:00	545.94	345.29	430.48
10:00	503.65	250.71	382.67
11:00	559.39	168.99	315.24
12:00	517.28	140.31	265.08
13:00	500.21	141.14	248.54
14:00	517.54	110.13	236.55
15:00	528.05	116.30	259.04
16:00	523.19	169.10	304.85
17:00	485.48	154.53	362.68
18:00	619.30	274.28	447.12
19:00	593.44	228.17	453.48
20:00	620.05	199.02	440.41
21:00	572.81	219.59	392.72
22:00	654.13	173.66	355.68
23:00	715.83	178.22	342.71
	715.83		
		110.13	

Graph: National Demand for March, 2023



Annexure-III

Table: Daily maximum, minimum and average frequency for the month of January, 2023

Jan-23	Bus Frequency at Semtokha Substation			Bus Frequency at Kurichhu Hydropower Plant		
	Max	Min	Ava	Max	Min	Ava
1	50.00	49.80	49.96	50.22	49.80	50.04
2	50.00	49.80	49.94	50.08	49.87	50.00
3	50.00	49.50	49.91	50.16	49.72	49.97
4	50.00	49.70	49.94	50.25	49.85	50.04
5	50.10	49.80	49.93	50.20	49.80	50.00
6	50.00	49.50	49.88	50.10	49.60	49.95
7	50.00	49.70	49.90	50.19	49.83	49.98
8	50.00	49.90	49.95	50.19	49.90	50.03
9	50.00	49.50	49.88	50.14	49.70	49.95
10	50.00	49.60	49.92	50.15	49.73	49.99
11	50.00	49.70	49.93	50.11	49.16	49.95
12	50.00	49.80	49.95	50.16	49.90	50.02
13	50.00	49.70	49.93	50.21	49.09	49.93
14	50.00	49.70	49.95	50.36	49.76	50.03
15	50.00	49.80	49.97	50.17	49.09	49.99
16	50.00	49.90	49.97	50.22	49.91	50.05
17	50.00	49.80	49.93	50.13	49.83	50.00
18	50.00	49.70	49.94	50.21	49.82	50.00
19	50.00	49.50	49.90	50.25	49.68	49.94
20	50.00	49.50	49.88	50.16	49.43	49.93
21	50.00	49.80	49.96	50.22	49.93	50.03
22	50.00	49.70	49.93	50.37	49.88	50.03
23	50.00	49.90	49.98	50.27	49.92	50.04
24	50.00	49.70	49.90	50.09	49.70	49.99
25	50.00	49.80	49.96	50.12	49.93	50.05
26	50.00	49.80	49.93	50.70	49.86	50.03
27	50.00	49.80	49.94	50.28	49.49	50.01
28	50.00	49.70	49.93	50.16	49.82	49.99
29	50.00	49.80	49.93	50.17	49.86	50.01
30	50.00	49.70	49.97	50.15	49.80	49.99
31	50.00	49.80	49.96	50.70	49.88	50.04
Max	50.10			50.70		
Min		49.50			49.09	

Source: TD (BPC), KHP (DGPC)



Table: Daily maximum, minimum and average frequency for the month of February, 2023

Date	Bus Frequency at Semtokha Substation			Bus Frequency at Kurichhu Hydropower Plant		
	Max	Min	Ava	Max	Min	Ava
1	50.00	49.80	49.96	50.15	49.82	50.02
2	50.00	49.80	49.94	50.20	49.89	50.01
3	50.00	49.50	49.91	50.17	49.75	50.02
4	50.00	49.70	49.94	50.09	49.86	49.98
5	50.10	49.80	49.93	50.28	49.88	50.04
6	50.00	49.50	49.88	50.24	49.76	50.02
7	50.00	49.70	49.90	50.15	49.75	49.99
8	50.00	49.90	49.95	50.10	49.89	50.00
9	50.00	49.50	49.88	50.22	49.79	50.03
10	50.00	49.60	49.92	50.16	49.65	50.00
11	50.00	49.70	49.93	50.19	49.81	50.01
12	50.00	49.80	49.95	50.24	49.92	50.05
13	50.00	49.70	49.93	50.14	49.89	50.01
14	50.00	49.70	49.95	50.17	49.79	49.99
15	50.00	49.80	49.97	50.12	49.77	50.00
16	50.00	49.90	49.97	50.15	49.90	50.00
17	50.00	49.80	49.93	50.17	49.92	50.03
18	50.00	49.70	49.94	50.17	49.88	50.01
19	50.00	49.50	49.90	50.20	49.93	50.02
20	50.00	49.50	49.88	50.19	49.93	50.03
21	50.00	49.80	49.96	50.16	49.87	49.99
22	50.00	49.70	49.93	50.18	49.92	50.03
23	50.00	49.90	49.98	50.14	49.93	50.03
24	50.00	49.70	49.90	50.11	49.80	50.02
25	50.00	49.80	49.96	50.13	49.89	50.02
26	50.00	49.80	49.93	50.15	49.89	50.02
27	50.00	49.80	49.94	50.15	49.89	50.01
28	50.00	49.70	49.93	50.10	49.73	49.98
29	50.00	49.80	49.93	0.00	Error	Error
30	50.00	49.70	49.97	0.00	Error	Error
31	50.00	49.80	49.96	0.00	Error	Error
Max	50.10			50.28		
Min		49.50			49.65	

Source: TD (BPC), KHP (DGPC)

Table: Daily maximum, minimum and average frequency for the month of March, 2023

Date	Bus Frequency at Semtokha Substation			Bus Frequency at Kurichhu Hydropower Plant		
	Max	Min	Ava	Max	Min	Ava
1	50.00	49.80	49.96	50.15	49.50	50.00
2	50.00	49.80	49.95	50.27	49.83	50.01
3	50.00	49.80	49.94	50.15	49.87	50.01
4	50.00	49.80	49.93	50.14	49.79	50.00
5	50.10	49.80	49.95	50.20	49.88	50.03
6	50.00	49.80	49.95	50.27	49.86	50.04
7	50.00	49.80	49.95	50.17	49.77	50.02
8	50.00	49.80	49.96	50.10	49.85	50.00
9	50.00	49.80	49.95	50.14	49.90	50.04
10	50.00	49.80	49.94	50.14	49.85	50.00
11	50.00	49.90	49.97	50.12	49.79	50.00
12	50.00	49.80	49.95	50.16	49.88	50.01
13	50.10	49.80	49.97	50.18	49.79	50.01
14	50.10	49.80	49.97	50.15	49.90	50.03
15	50.00	49.80	49.93	50.10	49.82	50.00
16	50.00	49.80	49.97	50.13	49.89	50.02
17	50.00	49.80	49.96	50.09	49.80	50.00
18	50.10	49.80	49.96	50.29	49.80	50.02
19	50.00	49.80	49.96	50.26	49.08	49.98
20	50.00	49.80	49.95	50.13	49.87	50.01
21	50.00	49.70	49.94	50.19	49.85	50.02
22	50.00	49.70	49.93	50.15	49.79	50.00
23	50.00	49.80	49.93	50.12	49.84	49.98
24	50.00	49.90	49.95	50.14	49.79	49.98
25	50.10	49.80	49.94	50.03	49.79	49.95
26	50.10	49.80	49.95	50.10	49.83	49.98
27	50.10	49.90	49.96	50.13	49.82	49.98
28	50.00	49.80	49.93	50.15	49.08	49.97
29	50.00	49.80	49.94	50.14	49.70	49.96
30	50.20	49.70	49.94	50.23	49.72	50.00
31	50.00	49.80	49.96	50.13	49.93	50.02
Max	50.20			50.29		
Min		49.70			49.08	

Source: TD (BPC), KHP (DGPC)



Transmission System Performance Report

First Quarterly Report-2023

Table: Daily maximum, minimum and average Voltage for the month of January, 2023

Jan-23 Date	Malbase Substation									Nangkhor Substation		
	400kV Bus Voltage (kV)			220kV Bus Voltage (kV)			66kV Bus Voltage (kV)			132kV Bus Voltage (kV)		
	Max	Min	Ava	Max	Min	Ava	Max	Min	Ava	Max	Min	Ava
1	418.00	404.00	411.65	224.00	214.50	220.02	66.70	62.50	64.77	134.86	131.12	133.24
2	417.00	404.50	410.70	225.00	214.00	219.15	66.00	63.00	64.46	135.90	131.32	133.34
3	416.50	406.00	410.44	221.75	215.50	218.70	65.60	63.00	64.33	135.69	130.91	133.19
4	420.50	405.50	412.08	224.50	216.00	219.77	67.00	63.00	64.91	135.27	130.10	133.03
5	419.50	407.00	412.10	225.00	215.00	220.19	66.00	64.00	65.02	134.29	132.16	133.09
6	419.50	403.00	409.92	224.00	214.50	218.79	66.50	63.00	64.70	134.23	131.12	132.50
7	420.50	402.00	408.98	224.50	168.00	216.25	67.00	63.00	64.63	134.86	130.80	132.63
8	414.50	404.00	408.98	221.00	214.00	218.63	66.00	63.00	64.45	134.44	130.30	132.40
9	415.00	404.00	408.94	222.00	213.00	218.29	65.00	63.00	64.31	134.37	130.40	132.34
10	417.00	403.00	409.19	223.50	213.00	218.67	66.00	62.50	64.50	135.07	129.40	132.72
11	414.00	403.50	408.63	224.00	215.00	218.71	66.00	63.50	64.49	134.65	130.49	132.90
12	414.50	402.50	408.17	221.00	214.50	217.73	65.00	62.00	63.75	135.69	131.74	133.75
13	413.50	402.00	408.77	222.50	213.50	218.29	65.00	63.00	63.92	134.86	131.53	132.90
14	419.00	320.94	368.62	224.50	211.50	218.04	66.00	61.50	64.01	135.28	131.74	133.69
15	413.50	404.30	408.93	222.00	215.50	219.23	66.00	63.20	64.67	135.07	131.95	133.73
16	413.50	401.50	408.94	222.50	214.00	218.58	65.80	63.00	64.44	135.07	131.32	133.13
17	414.00	402.00	408.48	223.00	214.50	218.46	66.73	63.00	64.02	135.07	130.30	132.71
18	415.00	403.50	410.35	223.50	212.00	218.25	65.85	62.00	64.14	134.23	131.10	133.07
19	414.50	403.50	409.38	224.00	216.00	219.60	66.20	63.75	64.80	135.07	131.74	133.64
20	414.50	402.00	408.79	223.50	214.00	219.08	66.35	62.50	64.17	136.94	131.95	133.95
21	414.50	405.00	410.00	223.50	217.50	220.04	66.00	63.45	64.63	135.28	132.57	133.93
22	415.50	404.50	410.58	223.00	216.00	219.71	66.00	63.00	64.83	135.48	131.80	134.10
23	415.50	405.00	410.58	224.00	215.50	219.92	66.20	63.00	64.48	136.52	131.53	134.43
24	415.50	404.50	410.67	224.30	215.50	219.76	66.00	63.30	64.75	136.11	131.50	133.89
25	415.50	404.00	410.54	222.50	216.00	219.52	66.20	63.00	64.51	135.07	131.12	133.18
26	415.50	404.50	410.90	223.50	216.50	220.35	66.00	63.00	64.82	135.69	131.95	134.20
27	415.50	406.50	412.33	224.00	217.50	220.85	66.10	64.00	64.97	136.73	132.00	134.45
28	415.50	405.00	411.00	224.50	216.50	220.15	66.00	63.60	64.80	135.09	131.74	133.57
29	415.50	403.50	411.54	223.50	215.50	220.42	66.00	64.00	65.01	134.86	131.74	133.63
30	415.50	405.00	410.67	224.00	216.00	219.94	66.00	63.50	64.69	134.86	131.32	133.14
31	415.00	403.00	409.71	223.50	215.50	219.55	66.00	64.00	64.76	135.07	131.90	133.40
Max	420.50			225.00			67.00			136.94		
Min		320.94			168.00			61.50			129.40	

Table: Daily maximum, minimum and average Voltage for the month of February, 2023

Feb-23 Date	Malbase Substation									Nangkhor Substation		
	400kV Bus Voltage (kV)			220kV Bus Voltage (kV)			66kV Bus Voltage (kV)			132kV Bus Voltage (kV)		
	Max	Min	Ava	Max	Min	Ava	Max	Min	Ava	Max	Min	Ava
1	415.00	402.00	410.04	223.00	216.00	219.82	66.00	63.00	65.20	135.28	131.50	133.35
2	415.50	402.50	410.27	224.50	215.00	220.31	66.50	63.00	65.03	134.65	131.50	133.05
3	415.50	404.50	411.48	223.50	216.00	220.96	66.35	64.00	65.28	134.86	131.54	133.43
4	416.00	403.00	410.79	225.00	216.00	220.73	66.50	63.00	65.19	136.10	131.53	133.59
5	415.00	404.00	410.69	224.00	216.00	220.31	66.00	62.50	64.71	135.69	132.78	133.30
6	429.50	402.50	411.88	225.00	215.50	219.96	66.50	63.50	64.91	135.69	132.57	134.12
7	416.00	401.00	410.19	224.00	214.00	219.92	66.00	62.00	64.68	135.27	131.20	133.76
8	410.50	400.50	406.22	222.00	214.33	218.20	66.00	62.84	64.36	134.86	131.74	133.39
9	416.50	397.00	405.73	223.50	212.50	218.10	65.50	62.00	63.79	135.48	131.32	133.30
10	410.00	398.00	405.32	222.70	213.50	218.34	65.94	62.00	63.94	134.86	130.70	133.35
11	412.50	395.50	404.48	223.50	211.50	217.48	65.00	61.00	63.73	134.86	131.20	133.06
12	417.50	401.50	411.13	224.50	215.50	219.71	67.00	62.00	64.69	135.90	130.00	133.37
13	417.00	397.50	408.13	223.00	210.50	217.44	65.50	61.53	63.54	135.69	131.53	133.83
14	413.50	402.00	407.10	222.00	209.50	216.72	66.00	61.32	63.60	134.45	129.25	132.55
15	414.50	401.10	407.39	225.00	212.06	217.93	66.00	61.79	63.82	134.23	130.29	132.11
16	412.00	400.81	407.39	222.00	213.02	217.91	65.15	62.46	64.10	135.27	131.00	133.03
17	412.50	401.50	407.10	221.00	213.50	217.19	66.73	63.00	64.03	134.23	130.29	132.60
18	412.00	401.50	407.38	221.50	214.46	218.26	65.34	62.28	63.84	134.10	130.70	132.45
19	413.00	401.50	407.83	222.00	214.00	218.77	65.50	63.00	64.43	135.48	130.80	132.74
20	411.00	402.00	406.42	221.00	215.00	217.40	65.00	62.80	63.79	134.44	130.60	132.38
21	410.50	402.00	407.02	223.00	215.50	218.21	65.00	62.50	63.97	134.65	132.16	133.27
22	412.00	402.50	407.58	221.50	214.00	218.03	66.00	62.90	64.36	133.82	131.53	132.95
23	412.00	402.00	407.08	221.00	214.50	217.85	65.00	62.00	63.98	134.24	131.00	132.86
24	412.00	402.00	407.50	220.50	213.00	217.39	65.00	61.70	63.86	134.86	130.70	132.57
25	416.50	405.00	410.46	222.50	215.00	218.23	66.00	63.00	64.73	134.86	131.10	132.87
26	413.50	405.50	409.71	221.50	215.50	218.17	66.00	63.00	64.60	135.48	131.12	133.44
27	413.50	403.00	408.81	221.50	213.50	218.06	66.00	63.50	64.85	134.23	131.00	132.71
28	414.00	400.00	407.25	221.50	213.50	217.41	65.80	62.50	64.23	135.07	131.32	133.11
29	0.00	Error	Error	0.00	Error	Error	0.00	Error	Error	0.00	Error	Error
30	0.00	Error	Error	0.00	Error	Error	0.00	Error	Error	0.00	Error	Error
31	0.00	Error	Error	0.00	Error	Error	0.00	Error	Error	0.00	Error	Error
Max	429.50			225.00			67.00			136.10		
Min		395.50			209.50			61.00			129.25	

Source: TD, BPC



Transmission System Performance Report

First Quarterly Report-2023

Table: Daily maximum, minimum and average Voltage for the month of March, 2023

Nov-22 Date	Malbase Substation									Nangkhor Substation		
	400kV Bus Voltage (kV)			220kV Bus Voltage (kV)			66kV Bus Voltage (kV)			132kV Bus Voltage (kV)		
	Max	Min	Ava	Max	Min	Ava	Max	Min	Ava	Max	Min	Ava
1	413.00	401.50	406.63	220.50	213.50	217.00	66.00	63.00	64.36	135.07	131.32	133.34
2	415.50	404.00	409.67	224.00	214.00	218.42	67.00	62.50	64.69	135.07	131.00	133.37
3	413.00	404.00	408.31	221.50	214.00	218.04	66.00	62.96	64.83	135.28	129.40	132.47
4	415.00	404.60	409.48	222.00	214.50	217.92	66.50	63.50	64.90	134.24	131.32	133.14
5	415.00	405.50	409.79	223.00	216.50	219.56	66.55	64.00	65.22	135.48	131.12	133.40
6	414.00	402.50	409.24	222.50	214.00	219.16	67.10	63.40	65.25	135.69	130.00	132.91
7	416.50	404.00	410.27	223.00	213.50	218.18	66.50	63.60	64.90	135.10	132.00	133.71
8	414.50	408.00	411.51	221.50	217.50	219.95	66.20	64.00	65.51	135.27	130.40	133.15
9	416.00	405.00	411.15	319.00	216.00	223.67	67.00	64.00	65.25	136.94	131.90	134.45
10	414.00	404.50	410.29	222.50	216.50	219.81	67.00	64.98	65.78	136.11	130.20	133.48
11	415.50	403.50	409.38	223.00	215.50	218.67	66.00	63.50	65.02	135.27	130.91	133.20
12	413.50	403.50	409.25	220.50	215.00	218.13	66.00	63.95	65.14	134.44	131.12	132.94
13	414.50	403.00	408.46	222.50	214.00	218.21	66.00	64.00	65.03	135.27	131.10	133.60
14	414.00	403.00	408.98	222.00	215.00	218.54	66.00	64.00	64.96	135.12	131.00	133.71
15	413.00	406.00	409.65	222.50	215.50	218.79	66.58	64.80	65.51	136.94	131.70	133.82
16	412.50	401.50	408.63	222.50	215.00	219.31	66.50	64.00	65.43	136.73	131.12	134.06
17	414.00	405.50	409.69	223.00	215.00	219.19	66.73	63.68	65.24	135.48	131.95	133.60
18	414.00	404.50	409.08	222.50	215.00	218.69	66.00	63.45	65.03	136.94	130.91	134.50
19	417.00	225.00	403.94	224.50	216.00	220.42	67.00	65.00	65.57	136.52	130.91	133.99
20	417.00	404.50	411.17	225.50	215.50	220.46	67.00	64.00	65.98	137.77	132.78	134.61
21	417.00	404.50	410.25	223.50	214.00	219.21	67.00	64.00	65.46	137.35	133.40	134.72
22	414.00	400.40	408.40	223.50	215.50	218.87	67.40	64.00	65.48	137.00	133.40	134.79
23	412.00	403.00	407.67	220.50	213.50	217.85	66.12	63.00	65.03	135.69	132.90	134.38
24	412.00	404.00	408.75	221.00	216.00	218.44	66.00	64.00	65.32	136.31	132.78	134.75
25	412.00	404.00	408.31	221.50	214.50	217.92	66.50	63.58	64.99	136.11	131.80	134.48
26	413.50	402.00	408.77	221.50	214.00	218.40	67.00	64.00	65.24	136.52	132.99	134.83
27	413.00	401.50	407.63	220.00	212.50	217.21	66.00	63.00	64.51	137.25	132.45	134.42
28	411.50	402.50	407.15	220.50	214.00	217.10	66.00	64.00	64.88	135.90	132.85	134.35
29	411.00	402.50	406.85	220.00	213.00	216.54	66.00	63.00	64.55	136.94	132.36	134.31
30	411.00	403.00	406.67	221.00	212.00	216.13	66.18	63.00	64.54	136.73	131.32	133.66
31	414.00	405.00	408.56	222.50	214.50	218.10	66.20	63.80	64.93	135.69	132.50	134.05
Max	417.00			319.00			67.40			137.77		
Min		225.00			212.00			62.50			129.40	

Source: TD, BPC

