Performance Evaluation Report of Transmission Companies 2022-23

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
PERFORMANCE EVALUATION REPORT (2022-23)

Executive Summary:

To ensure the efficient and reliable transmission of electric power across the country, the Performance Standards (Transmission) Rules, 2005 (PSTR 2005) were notified in the Gazette of Pakistan vide S.R.O. 1138(I)/ 2005, dated 15th November 2005. These rules have established benchmarks for key parameters (i.e. System Reliability, Security of Supply, and Quality of Supply) associated with the transmission of electric power in the country.

The performance standards as set out in these rules shall be applicable to all transmission and Special Purpose Transmission Licence holders (SPTL) who shall annually report the operational performance of their transmission system according to the criteria laid down in these rules. The formats for reporting performance is shown in Performance Standards Forms as set out in Appendix- I to these rules.

The APRs for the fiscal year 2022-23, submitted by National Transmission & Despatch Company (NTDC), K-Electric (KE), Fatima Transmission Company Limited (FTCL) & Sindh Transmission & Despatch Company (Pvt) Limited (ST&DCPL) have been reviewed with reference to System Reliability, Security of Supply, and Quality of Supply of the transmission network of the licensees during the reporting period. Accordingly, a comprehensive Performance Evaluation Report (PER) has been compiled for Authority's consideration and subsequent publication to all the stakeholders through the NEPRA website.

The Performance Evaluation Report (PER) for transmission licensees presents an assessment of the performance of the NTDC, KE, FTCL & ST&DCPL in accordance with the performance parameters as laid down in PSTR 2005 such as System Reliability, Security of Supply, and Quality of Supply of the transmission networks of the licensees during the reporting period. This report highlights the key aspects of these performance parameters, their impact on the transmission sector, and provides insights into their implementation and effectiveness.

This report comprises five sections, including conclusion and recommendations. A brief summary is provided below:

Section-I focuses on the performance of NTDC reported for FY 2022-23 and it shows reduction in System Interruptions duration and decrease in violation of voltage limits in comparison to the year 2021-22. However, an increase in Energy Not Served (ENS), loss of supply incidents, and violation of frequency limits was witnessed during the reporting period. A brief overview of the stated performance is as follows:

- The System Interruption Duration shows a 20% decrease as compared to the previous year.
- Incidents of voltage violations were reduced by 31.59% from the previous year.
- Energy Not Served (ENS) significantly deteriorated, experiencing a 100% increase.
- There were 55 incidents of loss of supply resulting in a financial impact of Rs. 1247.9 million on end consumers.
- Frequency violations exceeded the limits 15 times, with the highest recorded frequency being 50.66 Hz for a total of 102 minutes.

Section-II focuses on the performance of K-Electric (excluding 132 kV & 66 kV network). As per provided data the report in terms of System Interruption duration, Voltage violations, Energy Not Served (ENS), and loss of supply incidents remained satisfactory. However, a slight frequency variation for a short duration was witnessed during the reporting period. Tie lines in KE

transmission system comprise of four (04) 220kV circuits which connect KE network with NTDC network. Two tie lines are under the maintenance of NTDC and two tie lines are under the jurisdiction of KE. A brief overview of the stated performance w.r.t. 220 kV network and tie lines are as follows:

- No system interruptions were recorded during the reporting period.
- There was zero Energy Not Served (ENS) throughout the reporting period.
- Voltage violations decreased by 4.34%.
- Four occurrences of frequency variation were observed within the year, accumulating a total time duration of 26.88 minutes.

Reliability of Tie Line:

- Total number of outages reported on tie lines was 8 , experienced a total of 19.58 hours of outages
- Total System Duration Interruption was 4.90. The contribution of System Duration of Interruption for the tie line managed by NTDC was 1.25 and for the tie line managed by KE was 2.25.
- System Frequency of Interruption was 2.0. System Frequency of interruption on tie line under NTDC jurisdiction was 1.25 and for the tie lines under KE the System Frequency Interruption was 0.75.

Section III focuses on the performance of Fatima Transmission & Company Limited reported for FY 2022-23. A brief overview of the stated performance is as follows:

- Total number of outages recorded at all interconnection points was 5 with total 17 Hrs outages Hrs.
- System Duration of Interruption for FY 2022-23 was 8.5 Hrs/point
- System Frequency of interruption was 2.5
- Energy Not Served was 918 MWh
- The highest voltage violation recorded as 144.93 kV.
- Total 29 times the frequency of FTPL was outside the permissible limits with the total duration of 208 minutes.

Section IV focuses on the performance of Sindh Transmission & Despatch Company (Pvt) limited reported for FY 2022-23. A brief overview of the stated performance is as follows:

- Total number of outages recorded at all interconnection points was 07 with total 35 Hrs and 25 Minutes outages Hrs.
- System duration of interruption was 17.71 Hrs./point
- System frequency of interruption was reported as 3.5 no. /circuit.
- Energy Not Served was 3579.21 MWh
- Total 04 times the frequency of ST&DCPL was outside the permissible limits.

Section-V identifies the issues and challenges of transmission licensees such as:

System Constraints:

Delay in removal of system constraints is a serious issue and results in expensive power production. (Refer: Section 13.1).

Frequent Tower Collapses:

The recent phenomena of frequent tower collapse especially in the South region is impacting the supply of affordable and reliable power to the National Grid. The Authority directed the NTDC to

prioritize measures like enhanced maintenance, network reviews, proper site patrolling, weather monitoring, emergency response planning, and staff training. To ensure stability, comprehensive policy for power supply in Pakistan are being formulated (Details are discussed in section 13.2)

Timely completion of new projects and Interim Arrangements:

Efficient power transmission infrastructure completion within stipulated timelines remains a challenge for NTDC. Notably, interim arrangements, as observed with the 500 kV K2/K3 Port Qasim transmission line, have been implemented, leading to challenges like a partial blackout that occurred in October 13, 2022 due to a broken conductor. After the detailed inquiry of the partial blackout (https://nepra.org.pk/publications/Reports/NEPRA%20Inquiry%20Report%20Partial%20System%20Collapse%20Oct%2013%202022.pdf), the Authority, initiated legal proceedings to reinforce interim arrangements, ensure periodic maintenance, complete dedicated transmission lines, and address communication, system reliability, and security issues. (Refer: Section 13.3 & 13.5)

Total Power System Collapse

The total power blackout on January 23, 2023, emphasized the urgency of addressing transmission network issues. An Inquiry Committee in its report (https://nepra.org.pk/publications/Reports/Jan%2023%20Blackout%20Report.pdf) identified operational deficiencies within NTDC, NPCC, and various power plants as the root cause. Legal proceedings were initiated, and the Authority issued directives for VAR compensation studies, HVDC system stability assurance, SCADA system implementation, and improvements in black start facilities (Refer: Section 13.5 and 13.8).

SCADA System Up gradation:

The Supervisory Control and Data Acquisition (SCADA) system is used across the world for the purpose of efficient control, monitoring and reporting of the entire system including generation, transmission and distribution. NTDC also have SCADA system available since 1992, however it could not be utilized due to delayed completion of the system.

Recently, the upgraded SCADA-III system project (supported by the ADB) has been initiated to enhance the operational and monitoring capabilities. KE despite having a smaller transmission network has been utilizing SCADA system for the last many years. (Refer: Section 13.6)

Fatal and Non-fatal Incidents in Pakistan's Transmission Line Network

As per the provided data by NTDC & KE for the last financial year i.e. June 2022 to June 2023, 2 Fatal & 1 Non-Fatal incidents of NTDC employees occurred. Whereas, KE reported total 11 incidents 4 Fatal & 7 Non-Fatal Incidents within its transmission network.

Signing of EPA/PPA, CA between CPPA-G, KE & NTDC:

The Authority has consistently stressed the importance of establishing distinct contractual arrangements like EPA/PPA & CA between CPPA-G, KE & NTDC aiming to establish a legal and financial framework governing the buying and selling of electricity between these two entities.

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INTRODUCTION

1. Introduction:

1.1 Transmission Licensees:

In pursuance of Section 17 of the NEPRA Act, 1997, NEPRA granted a transmission license to NTDC on 31st December 2002, allowing it to engage exclusively in the transmission business for thirty (30) years. Similarly, NEPRA granted a transmission license to KE in June 2010 to conduct transmission activities within the territory specified in the license for thirty (30) years.

Under Section 19 of the NEPRA Act, 1997, the Authority is empowered to grant a Special Purpose Transmission License to any entity, authorizing it to engage in the construction, ownership, maintenance and operation of specific transmission facilities in the exclusive territory of NTDC. In this regard, NEPRA granted a Special Purpose Transmission license to Fatima Transmission Company Limited (FTCL) to engage in the special purpose power transmission business for a term of thirty (30) years.

In 2018, the NEPRA Act underwent a significant amendment that brought about transformative changes in the regulatory framework of the electricity power sector. One of the critical changes was the provision of a Provincial Grid Company (PGC) in each province. In exercise of the powers conferred under Section -18A of the NEPRA Act 1997, Provincial Grid Company licenses were granted to Sindh Transmission & Dispatch Company (Private) Limited (ST&DCPL) on November 05, 2019, Khyber Pakhtunkhwa Transmission and Grid System Company (Private) Limited (KPKT&GSCPL) on February 26, 2021. License application of Punjab Grid Company Limited (PGCL) is under process.

1.2 Performance Standards (Transmission) Rules, 2005

In exercise of the powers conferred by section 46 of the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997 (XL of 1997), read with clause (c) of sub-section (2) of section 7 and section 34 thereof, the National Electric Power Regulatory Authority, with the approval of Federal Government made the Performance Standards (Transmission) Rules, 2005 to ensure transmission system reliability and security within prescribed parameters.

System Reliability - Rule 3 of the NEPRA PSTR-2005 states that the reliability of a transmission system shall be monitored by recording loss of supply incidents. Loss of supply incidents shall be reported individually with details of location, time, duration of incident and maximum demand lost as per the following indices**:**

a) System Duration of Interruption
b) System Frequency of Interruption

Tie Line Reliability - Rule 4 of the NEPRA PSTR-2005 states that Reliability Indices for Tie Lines shall be the same as that given for System Reliability under rule 3.

System Security (Energy Not Served) - Rule 5 of the NEPRA PSTR-2005 states that – for the purpose of system security measurements, the estimates of the total energy not served during the year shall be reported

Quality of Supply - Rule 6 of PSTR-2005 defines that the quality of supply shall be measured with reference to system voltage and system frequency, as set out in PSTR-2005

System Voltage - Rule 7 of PSTR is reproduced as under 2005:

1. Under normal conditions, the voltage variations of plus or minus ±5% of the nominal voltage for voltages of 132kV (where applicable) and above shall be permitted.

2. Under (N-1) contingency conditions voltage variations of plus or minus ±10% of the nominal voltage for voltages of 132kV (where applicable) and above shall be permitted.

3. The criteria for reporting voltage variations outside the limits specified in sub-Rules (2) and (3) only apply when the duration of variation exceeds a continuous period of thirty (30) Minutes.

System Frequency- Rule 8 of PSTR 2005 is as under:

1. The frequency variations of plus or minus ±1% of the nominal frequency of 50 Hertz shall be permitted, i.e. frequency to remain within the frequency limits of 49.50 to 50.50 Hertz at all times.

2. The criteria for reporting frequency variations outside the limits specified in sub-rule (1) only apply when the duration of the variation exceeds a continuous period of five (5) minutes.

1.3 Reporting of Performance Report – Rule 9 of PSTR-2005 states that the licensee shall submit to the Authority every year, before the 31st of August of the succeeding year, an annual performance report. The annual performance report shall contain all relevant information for compliance with these rules during the year, including a statement of comparison with the compliance reporting achieved during the preceding year.

1.4 Compliance by the Transmission Licensees: In compliance with Rule 9 of the PSTR-2005, NTDC, K-Electric, FTCL & ST&DCPL submitted the Performance Reports for FY 2022-23, the same has been reviewed and a comprehensive Performance Evaluation Report of NTDC & KE has been prepared.

This Performance Evaluation Report (PER) provides information on the performance of the transmission licensees i.e. National Transmission & Despatch Company (NTDC), K-Electric (KE), Fatima Transmission Company Limited (FTCL) & Sindh Transmission & Despatch Company (ST&DCPL) and as per National Electric Power Regulatory Authority (NEPRA) Performance Standards (Transmission) Rules (PSTR) 2005, based on their reported data for the year 2022- 23. The document considers System Reliability, System Security & Quality of Supply of the transmission network of the licensees that occurred during the reporting period. Additionally, a five year trend analysis has also been discussed in this report.

SECTION I

NATIONAL TRANSMISSION & DESPATCH COMPANY LIMITED (NTDC)

2. Brief Introduction of NTDC:

NTDC was incorporated on 6th November, 1998, under the Companies Ordinance 1984 and commenced commercial operation on 24th December, 1998. This initiative was taken by the Government of Pakistan as result of structural reforms in power sector. The major responsibility of NTDC is to construct, operate, and maintain transmission lines of 220 kV and 500 kV, and above voltage levels as well as associated substations.

2.1 License:

In pursuance of Section 17 of the NEPRA Act, 1997, NEPRA granted a transmission license to NTDC on 31st December 2002, allowing it to engage exclusively in the transmission business for thirty (30) years.

2.2 Transmission Network:

As of June 30, 2023, NTDC operates and maintains nineteen (19) 500 kV and fifty (50) 220 kV grid stations with 8,825 km of 500 kV transmission lines and 11,637 km of 220 kV transmission lines. NTDC's transmission system is illustrated in Figure 2.1.

Figure 2.1: NTDC Transmission System

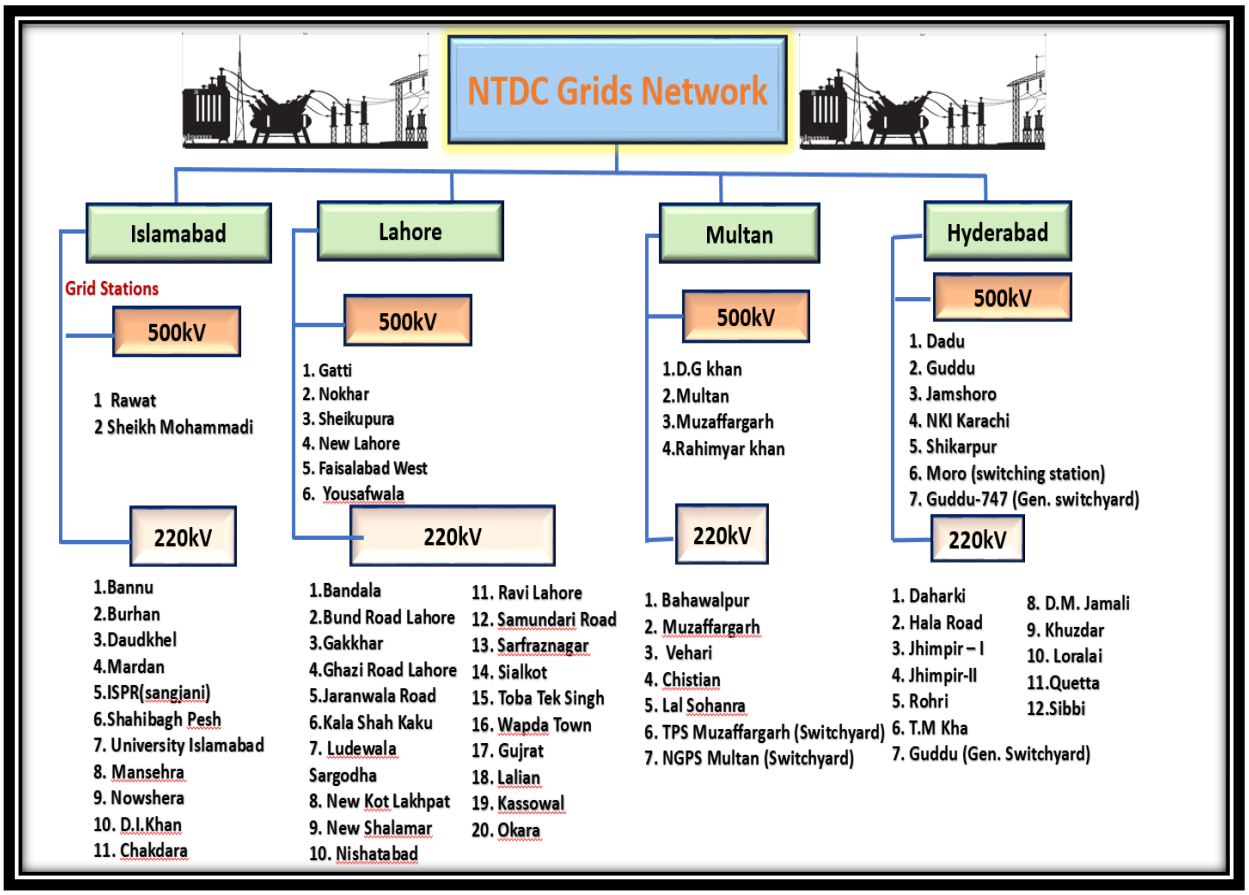


Table 2.1: Progressive NTDC Network Statistics

Description		2018-19	2019-20	2020-21	2021-22	Total as of June 2023
No. of Existing Grid Stations	500 kV	16	16	16	19	19
	Added	0	0	0	3	0
	220 kV	44	45	45	50	50
	Added	0	1	0	5	0
	Total	**60**	**61**	**61**	**69**	**69**
Length of Transmission Line (Circuit km)	500 kV	5,970	7,470	8,059	8,431	8,825
	Added	198	1,500	589	372	394
	220 kV	11,322	11,281	11,438	11,565	11,637
	Added	569	-41	157	127	72
	Total	**17,292**	**18,751**	**19,497**	**19,996**	**20,462**
Transformation Capacity (MVA)	500 kV	22,350	24,000	30,610	25,500	25,950
	Added	1500	1,650	6,610	-5,110	450
	220 kV	31,060	31,900	25,770	35,360	37,190
	Added	2450	840	-6,130	9,590	1,830
	Total	53,410	55,900	56,380	60,860	63,140

The table above shows that in FY 2022-23, no new grid station was added to NTDC's infrastructure. However, the length of transmission lines increased by 394 km in 500 kV network and 72 km in 220 kV network. Transformation capacity also grew by 450 MVA in the 500 kV network and 1830 MVA in the 220 kV network.

From the above table, it is also observed that in the last 5 years, only three 500kV grid stations were added and total six 220kV grid stations were added. Similarly, the length of 500 kV & 220kV transmission lines increased by 3,053 km and 884 km respectively. Whereas, transformation capacity also grew by 5,100 MVA in the 500 kV network and 8,580 MVA in the 220 kV network in last five years.

2.3 Performance of NTDC under PSTR - 2005:

This section provides a comprehensive assessment of NTDC's performance in terms of System Reliability, System Security, and Quality of Supply. Each performance parameter is discussed below:

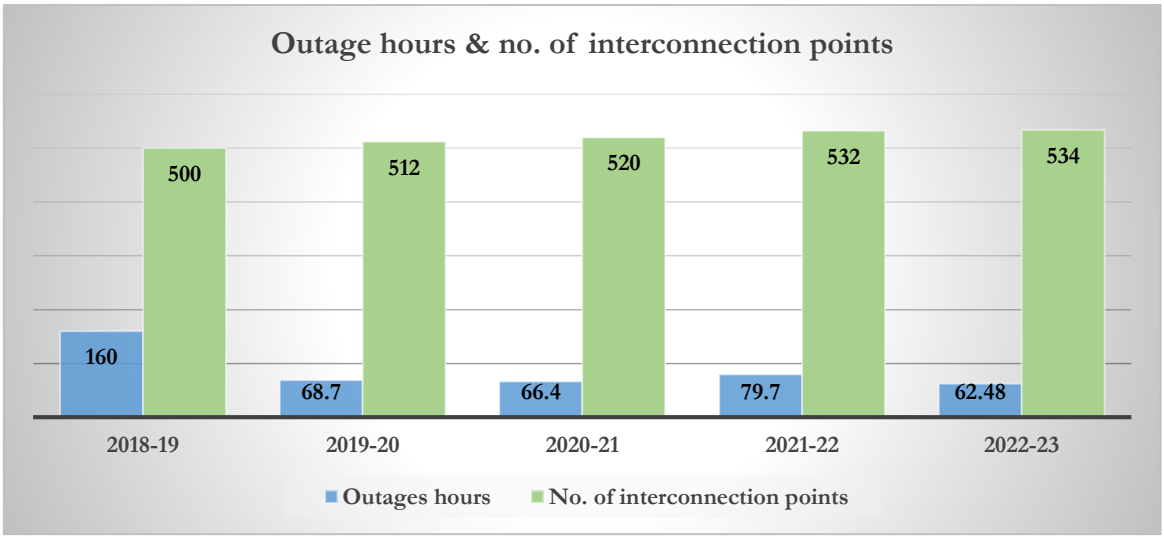
3. System Reliability:

3.1 Average Duration of Interruption:

1. Total outage hours recorded at all interconnection points (excluding 132 kV line tripping) = 62.48 Hrs.
2. Total number of interconnection points = 534
3. System duration of interruption = 0.12 Hrs. /point i.e. 7.2 min.
   20% decrease to the previous year i.e. 0.15 Hrs. /point

During the reported period, 62.48 outage hours were at all interconnection points (excluding 132 kV line tripping). This represents a 22% decrease as compared to the previous year's 79.7 hours. Also, two interconnection points were added to the system, resulting in a total of 534 interconnection points, as shown in Figure 3.1.

Figure 3.1: Outages hours & no. of interconnection points



From the figure above, it is noted that the number of outage hours varied over the past five years, with the highest being in 2018-19 and 2021-22, at 160 hours and 79.7 hours respectively. However, the number of interconnection points increased each year showing growth in network.

Figure 3.2: System Duration of Interruption (Hrs. /Point)

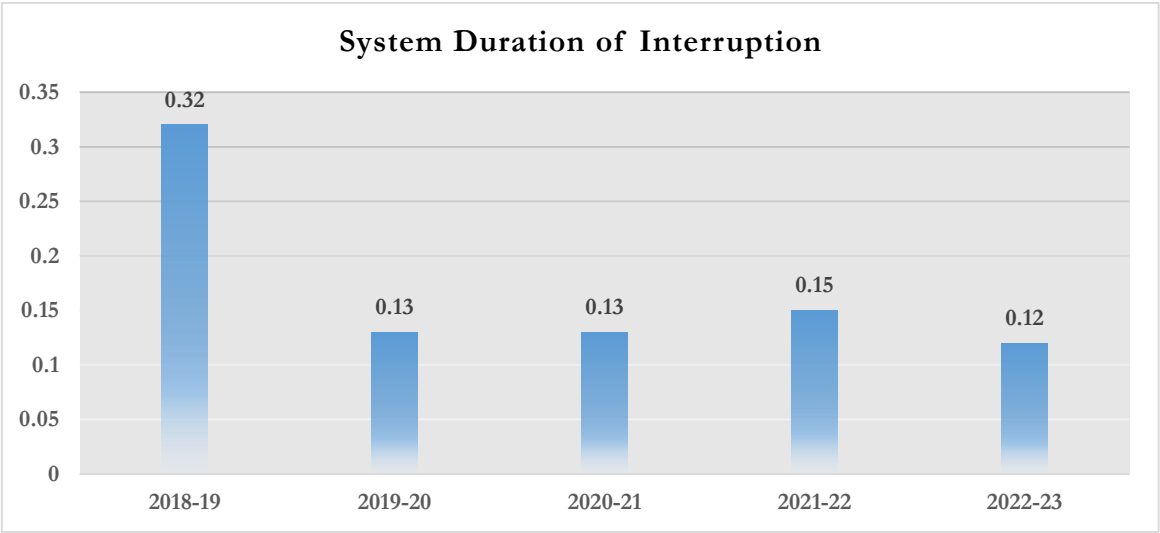
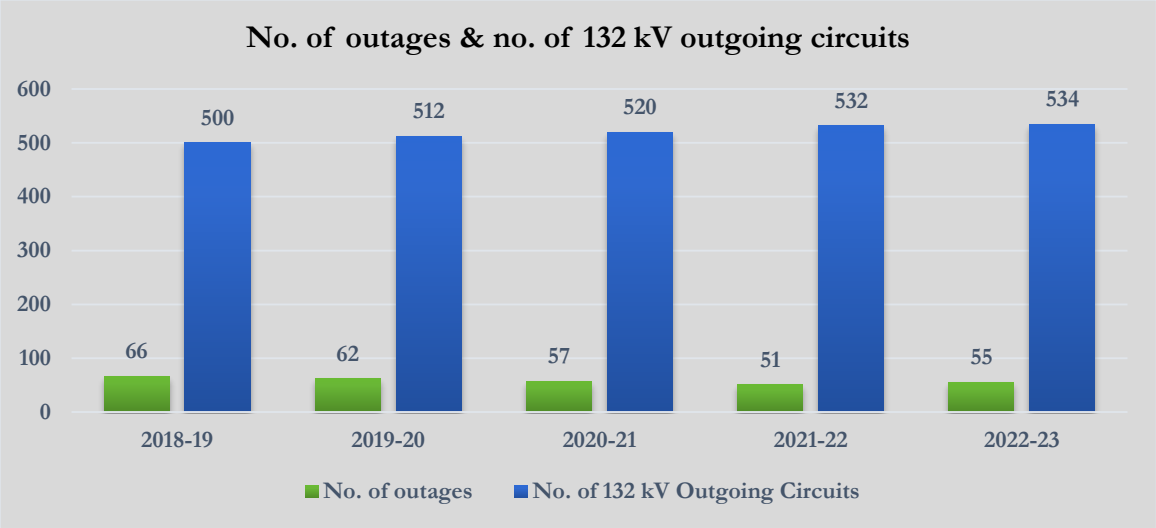


Figure 3.2 shows that there was an Average Interruption Duration of 0.12 hours per interconnection point during the reported period. This resulted in a 20% decrease in the number of hours compared to the previous year, which was 0.15 hours. It is also noted that during this year, NTDC has reported the lowest interruption duration in the last five years.

3.2 System Frequency of Interruption:

1. Total number of outages recorded at all 132 kV outgoing circuits (excluding 132 kV line tripping) = 55
2. Total number of 132 kV circuits = 534
3. System frequency of interruption = 0.10 no. /circuit.
   Same as the previous year i.e. 0.10 nos. /circuit

Figure 3.3: No. of outages & No. of 132kV outgoing circuits



During FY 2022-23, the total 55 numbers of outages were reported i.e an increase of approximately 8% from the 51 outages experienced in the previous year, as shown in Figure 3.3. However, over the five years, the graph indicates a decreasing trend in outages.

3.3 System Frequency of Interruption (Nos. /Circuit):

It is noted from Figure 3.4 that during FY 2022-23, the average number of interruptions per circuit remained at 0.10 which is same as the previous year.

Figure 3.4: System Frequency of Interruption (nos. /circuit)

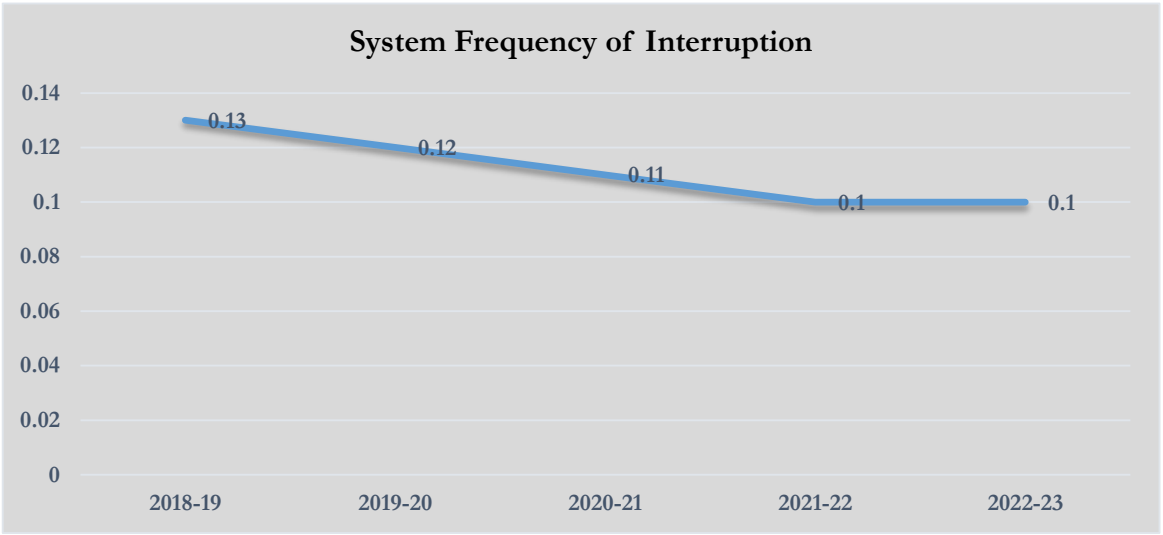


Figure 3.4 shows that over the five (05) years, the continuous reduction in the frequency of interruptions shows that NTDC has taken some effective measures to enhance system reliability.

4. System Security:

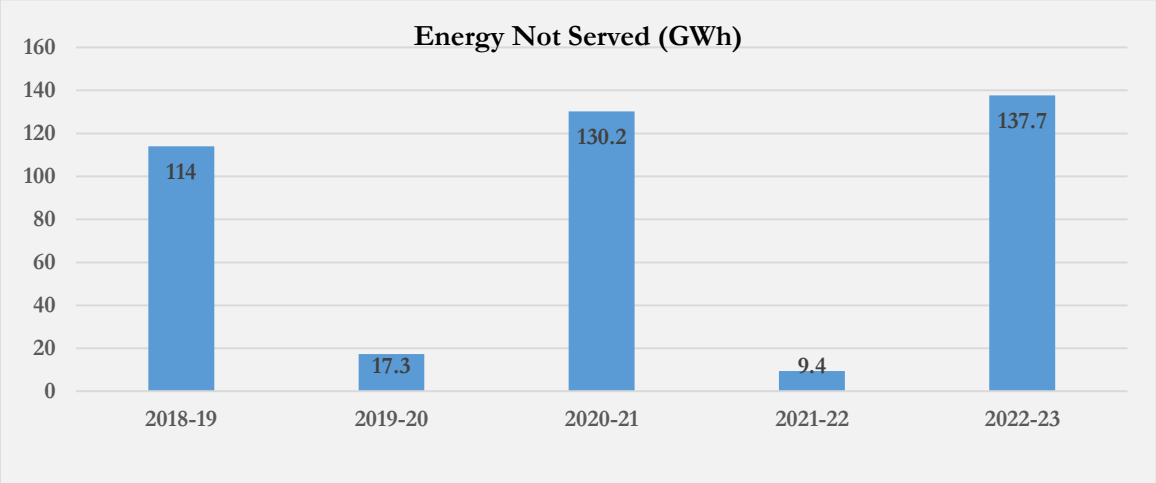
4.1 Energy Not Served (ENS):

1. Total ENS = 137.66 Million kWh
2. Number of incidents, where there has been a loss of supply = 55
3. Average ENS per incident = 2.5 Million kWh
4. Average duration per incident = 1.136Hrs (1 Hr. & 36 min)
5. The financial impact of ENS : Rs. 1247.9 Million
6. Financial impact per incident = Rs. 22.69 Million

Table 4.1: Loss of Supply Incidents, Average ENS, Duration & Financial Impact per Incident

Description / Unit / Year	Unit	2018-19	2019-20	2020-21	2021-22	2022-23
Loss of Supply Incidents	Nos.	66	62	57	51	55
Average ENS per Incident	Million kWh	1.7	0.3	2.3	0.2	2.50
Average Duration per Incident	Hrs. : Min	02: 24	01: 06	01: 12	01: 36	1.136
Financial Impact per Incident	Rs. (Mil)	9.7	1.4	15.6	1.8	22.69

Figure: 4.1 Energy Not Served in GWH



The data reveals an unpredictable trend in ENS over the past five years, with significant fluctuations from one year to another. NTDC needs to investigate the root causes of these fluctuations in ENS, such as aging infrastructure, extreme weather events, and maintenance practices.

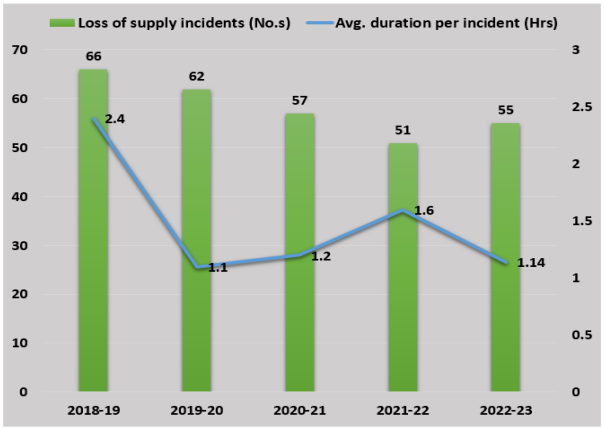


Figure 4.2: Loss of supply incidents & duration per incident

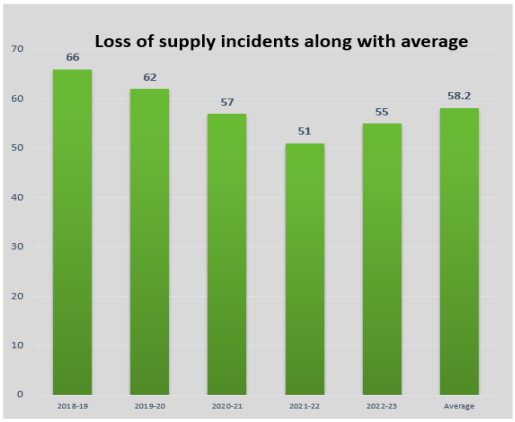
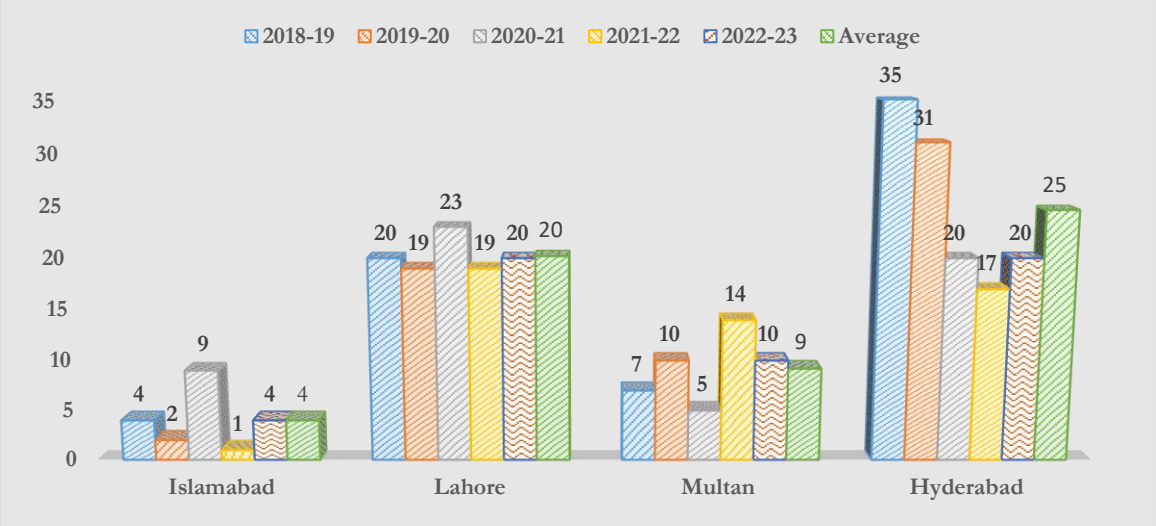


Figure 4.3: Loss of supply incidents along with average

In the last five (05) years from 2018-19 to 2022-23, there has been an overall positive trend in reducing the number of loss of supply incidents and the average duration per incident, as seen in Figure 4.2.

Figure 4.3 shows that the number of loss of supply incidents increased to 55, whereas, it was 51 during FY 2021-22. On average, there were around 58 incidents per year.

Figure 4.4: Region-wise loss of supply incidents



It is noted from Figure 4.4 above that over the past five years, the Lahore and Hyderabad regions consistently had the highest number of incidents. During FY 2022-23, both regions reported 20 incidents, whereas the Islamabad region had the lowest number of incidents, though it showed variation from year to year. However, the number of incidents in Multan varied over the past years, with the highest number of 14 incidents in 2021-22.

Figure 4.5: Seasonal trend of Loss of Supply incident

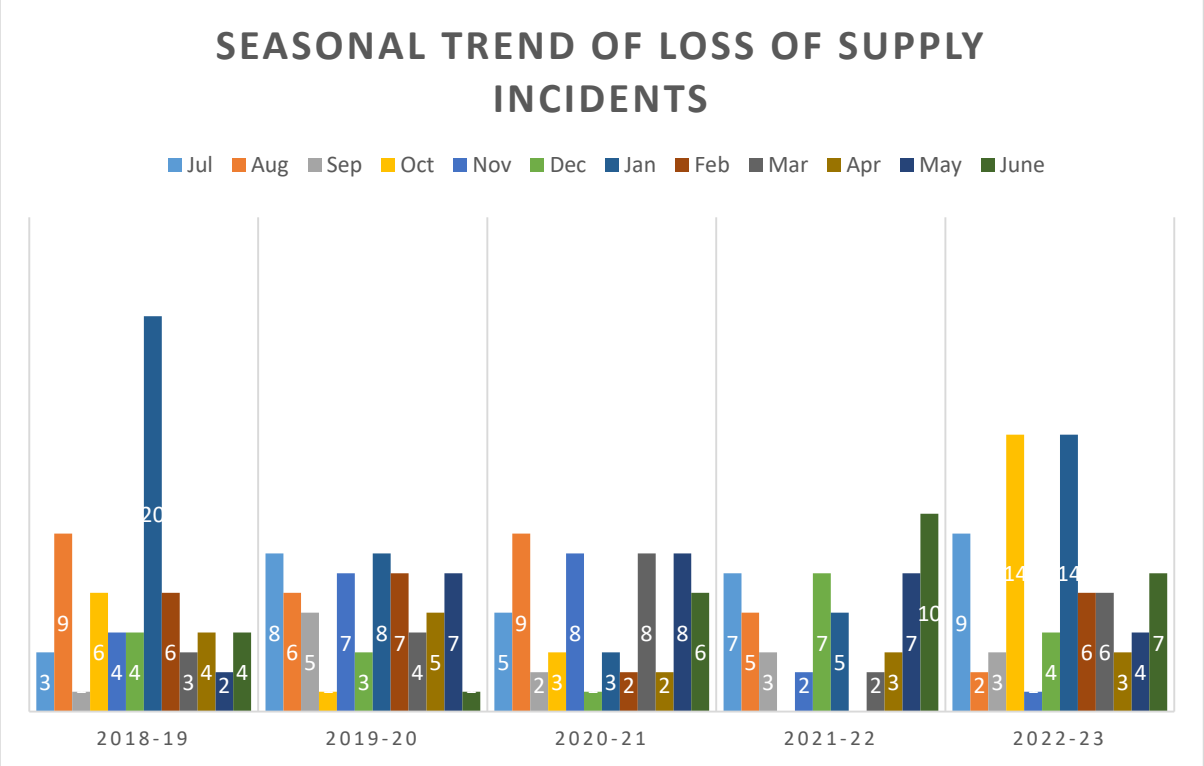


Figure 4.5 shows the seasonal trend of loss of supply incidents, there are variations in incident numbers from month to month. January seems to have relatively higher number of incident in multiple years. In last five years July and August had the highest incident counts, indicating potential seasonal variation. To improve incident management and prevention strategies, NTDC should conduct a thorough investigation into the causes of these trends, considering seasonal factors and external influences.

4.2 Major System Disturbances:

The NTDC reported two major system disturbances in FY 2022-23. The details are provided in table 4.2:

Table 4.2: Major System Disturbances

Sr.No	Date	Loading at Interruption Time	Duration of Interruption	Remarks
1	13-Oct-2022	1660 MW	447 min	**Partial System Blackout** 500 NKI-K2K3 and 500 kV K2K3 - Jamshoro transmission lines tripped due to conductor breakdown on red phase (both circuits are on the same tower) at loc # 26 A to 27 & 26 to 26 A respectively as reported by concerned T/L staff.
2	23-Jan-2023	12021 MW	19hrs 47mins	**Total System Blackout** All systems from Sheikh Muhammadi to K-Electric went under dark from 07:34:15 hrs. System frequency went up to 50.75 Hz and severe hunting was observed on 500 kV transmission lines. As a result, the following 500 kV Transmission lines tripped which resulted in the isolation of the North and South systems followed by the blocking of the HVDC system •500 kV Muzaffargarh- DG Khan •500 kV Guddu-Muzaffargarh circuit •500 kV Guddu- DG Khan circuit •500 kV Rahim Yar Khan- Guddu 747 circuit •500 kV Guddu Old- Guddu 747 circuit

The first event occurred on 13 October 2022 and lasted for 447 minutes, causing a partial system blackout. The second incident occurred on 23 January, 2023 and lasted for 19 hours and 47 minutes, causing a complete power system blackout. In response to these disturbances, an Inquiry Committee was formed by NEPRA to investigate the reasons for breakdowns. The report and recommendations of the inquiry committee are discussed in detail in Section-V of this report.

Table 4.3: Locational trend of outages provides an overview of the outages across different grids and plants between 2018-19 and 2022-23.

Table 4.3: Locational trend of outages

S. No.	Grid/ Plant Name	2018-19	2019-20	2020-21	2021-22	2022-23
1	220 KV Loralai	-	-	-	-	2
2	500 KV Multan	-	-	-	-	2
3	220 KV Deharki	-	-	-	-	2
4	220 KV Hala Road	5	2	1	-	4
5	220 KV NGPS Multan	1	2		5	2
6	500 KV Dadu	2	5	3	-	2
7	220 KV Quetta	4	9	2	6	-
8	220 KV Ghazi Road	6	3	-	-	-
9	220 KV Quetta Industrial-II	-	-	-	-	1
10	220 KV Rohri New	-	-	-	-	2
11	220 KV Sibbi	5	2	1	-	
12	500 KV Lahore Sheikupura	-	-	-	-	2
13	500 KV Shikarpur New	-	-	-	-	2
14	220 KV Gakkhar	3	6	5	-	3
15	220 KV T. T. Singh	-	3	3	2	1
16	220 KV Muzaffargarh New	-	-	-	-	1
17	220 KV Okara	1	2	-	1	4
18	220 KV Bund Road	2	3	3	-	2
19	220 KV Khuzdar	5	6	-	3	3
20	220 KV Khuzdar New	-	-	-	-	1
21	220 KV Ludewala	-	-	1	-	
22	220 KV NKLP	2	-	4	-	3
23	550 KV Rawat	1	1	1	-	1
24	500 KV Jamshoro	1	3	2	2	2
25	500 KV Peshawar	-	-	2	1	1
26	220 KV Bahawalpur	1	-	-	2	-
27	220 KV Bahawalpur New	-	-	-	-	3
28	500 KV Shikarpur	4	2	4	1	2
29	500 KV DG Khan	-	-	-	-	2
30	220 KV Vehari	1	5	3	1	-
31	220 KV Sarfraz Nagar	3	1	1	1	2
32	220 KV Bandala	1	1	-	-	-
33	220 KV Bannu	-	-	2	-	-
34	220 KV Nishatabad	-	-	1	3	-
35	500 KV Guddu	-	1	5	1	2
36	220 KV Kala Shah Kaku	2	-	2	2	2
37	220 KV Jaranwala Road	-	-	-	2	-
38	220 KV Ravi	2	-	1	2	1
39	220 KV Burhan	-	-	1	-	2
40	220 KV Shalamar	2	-	-	-	-
41	220 KV T. M. Khan	1	2	1	-	4
42	220 KV Jhimpir-I	1	-	-	-	4
43	220 KV Sialkot	2	2	1	3	-
44	220 KV Daudkhel	1	1	-	-	-
45	220 KV Gujrat	2	-	-	-	-
46	220 KV Samundri	2	-	-	-	-
47	500 kV Switching station Moro	-	-	-	-	2
48	500 Kv NKI	-	-	-	-	2
49	220 kV Jhimpir -II	-	-	-	-	4
50	500 kV Guddu 747	2	-	1	-	2
51	220 kV switchyard Guddu	-	-	-	-	2

5. Quality of Supply:

The Quality of Supply (QoS) is measured with reference to System Voltage and System Frequency. The analysis of the data as submitted by NTDC is given hereunder:

5.1 System Frequency:

It is observed from the said data that the frequency was outside of permissible limits on 15 occasions with a total duration of 102 minutes. The yearly average frequency is 50.66 Hz with a maximum variation of 1.32 %.

Table 5.1: System frequency statistics

Month	Number of days/hours for a month over a year		Frequency violation recorded (Hz)		Duration of variation		Variation (%)			The number of times frequency remained outside the limits
	Days	Hours	Highest	Lowest	Mins.	Hrs.	Highest	Lowest	Period	Nos.
1	2	3	4	5	6	7	8= (4-50)/ 50*100	9=(5-50)/ 50*100	10=7/3 *100	11
July	31	744	50.66	Nil	13	0.22	1.32	Nil	0.029	2
Aug	31	744	50.61	Nil	7	0.12	1.22	Nil	0.016	1
Sep	30	720	50.65	Nil	6	0.1	1.3	Nil	0.014	1
Oct	31	744	Nil	Nil	0	Nil	Nil	Nil	Nil	Nil
Nov	30	720	Nil	Nil	0	Nil	Nil	Nil	Nil	Nil
Dec	31	744	50.53	Nil	6	0.1	1.06	Nil	0.013	1
Jan	31	744	50.57	Nil	39	0.65	1.14	Nil	0.087	5
Feb	28	672	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Mar	31	744	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Apr	30	720	50.57	Nil	6	0.1	1.14	Nil	0.014	1
May	31	744	50.55	Nil	13	0.22	1.1	Nil	0.029	2
June	30	720	50.56	Nil	12	0.2	1.12	Nil	0.028	2
Year	**365**	**8760**	**50.66**	**Nil**	**102**	**1.71**	**1.32**	**Nil**	**0.02**	**15**

Table 5.2 shows a comparison of system frequency details for the years 2018-19, 2019-20, 2020-21, 2021-22, and 2022-23.

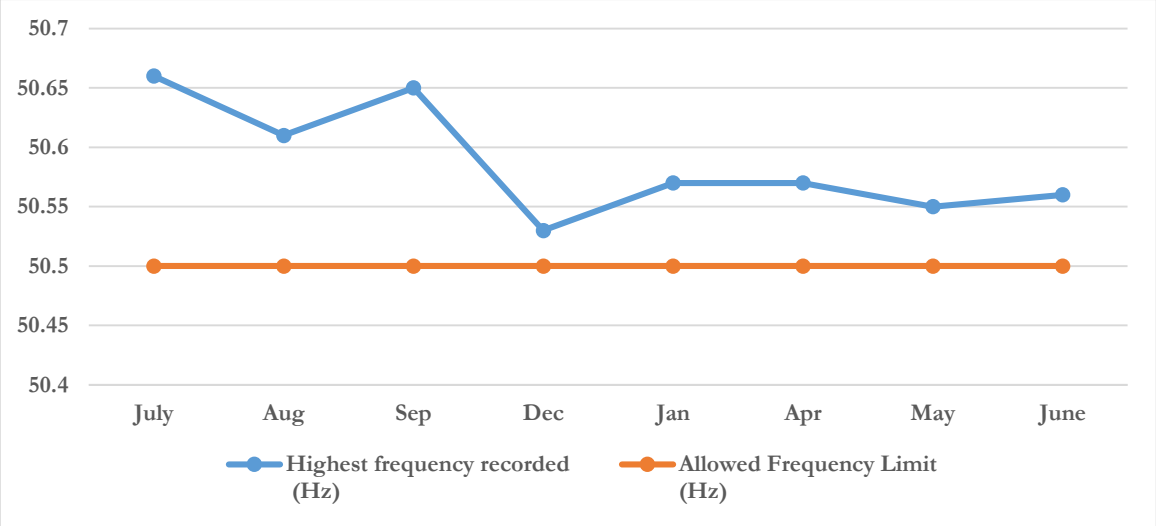
Table 5.2: System frequency details with comparison

Description / Unit / Year	Unit	2018-19	2019-20	2020-21	2021-22	2022-23
The number of times Frequency remained outside the Limits in a Year	In a year	25	9	4	3	15
	Average/month	2.1	0.8	0.3	0.25	1.25
	Average/day	0.068	0.024	0.01	0.01	0.04
Time duration the Frequency remained outside the Limits in a Year	Days	0.12	0.03	0.02	0.02	0.07
	Hours	2.98	0.8	0.6	0.4	1.7
	%age of year	0.034	0.009	0.007	0.005	0.02

Overall, the table shows an improvement in the stability of the power supply system during 2018-19 and 2021-22 with fewer instances of frequency violations. However, there was a slight increase in violations in 2022-23. The daily and monthly averages remained low, indicating a relatively stable power supply with short-duration deviations.

Figure 5.1 depicts months with the highest frequency of incidents exceeding the permissible limit in the year 2022-23. The dotted red line shows the upper limit (50.5 Hz). As reported, the lower limit has not been violated.

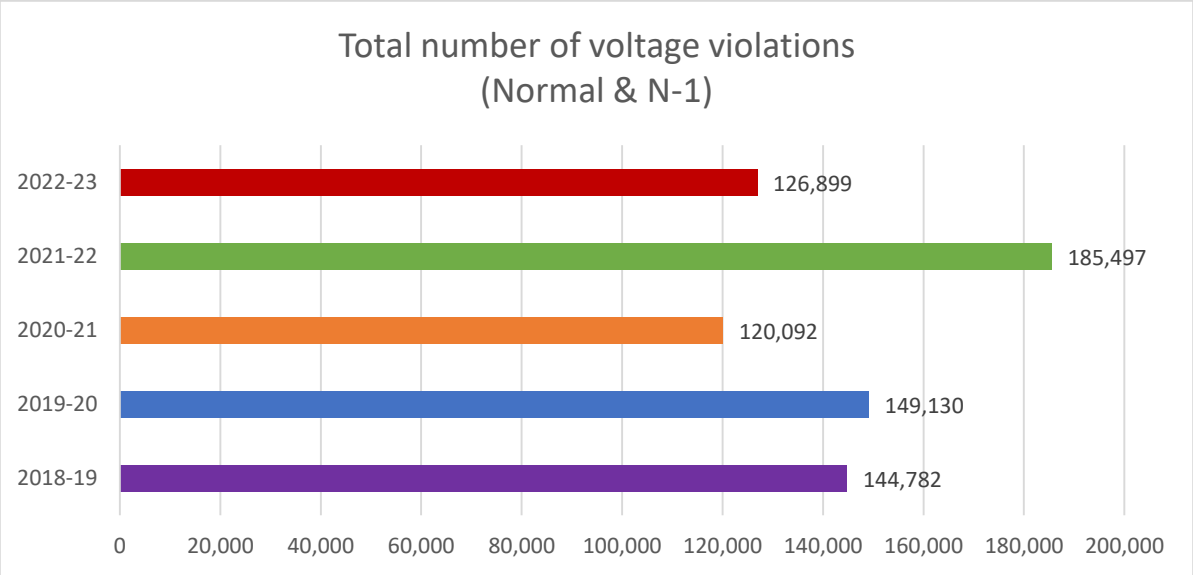
Figure 5.1: Highest frequency recorded (Hz)



5.2 System Voltage:

According to Rule 7 of PSTR-2005, voltage variation of plus or minus ±5% is allowed under normal conditions, while under (N-1) contingency conditions, variation of plus or minus ±10% is permitted. The criteria for reporting voltage variations outside the limits specified in Sub-Rules (2) and (3) of PSTR-2005 can only be applied when the duration of variation exceeds a continuous period of thirty (30) Minutes.

Figure 5.2: Number of voltage violations



The data on the number of voltage violations was analyzed and it is observed that their performance has improved by 31.59 % in 2022-23 as compared to the previous year (as shown in Figure 5.2). Region-wise detail of voltage violations is given hereunder;

Table 5.3: Number of voltage violations

System Condition	NTDC Region	2018-19	2019-20	2020-21	2021-22	2022-23
Normal	Islamabad	30,185	29,577	21,710	28,147	18,101
	Lahore	64,105	50,776	53,741	73,697	38,974
	Multan	11,202	9,048	5,493	7,949	6,805
	Hyderabad	33,850	52,698	38,811	70,304	61,548
Total (Normal)		**139,342**	**142,099**	**119,755**	**180,097**	**125,428**
N-1	Islamabad	–	–	–	–	–
	Lahore	3,395	5,017	–	444	43
	Multan	1737	1,762	203	1,805	548
	Hyderabad	308	252	134	3,151	880
Total (N-1)		**5,440**	**7,031**	**337**	**5,400**	**1,471**
Total (Normal & N-1)		**144,782**	**149,130**	**120,092**	**185,497**	**126,899**

The above table shows that under "Normal" system conditions, the total number of voltage violations across all regions have increased over the past five years. However, during FY 2022-23, the number of violations has decreased as compared to the previous year.

In the "N-1" system condition, the total number of voltage violations decreased from 5,410 in 2021-2022 to 1,471 in 2022-23. This indicates an overall improvement in voltage stability under both conditions.

5.3 Region-wise voltage violation of each grid station:

The grid station-wise breakup for each region is given below:

Table 5.4: Number of voltage violations (Islamabad Region)

Sr. No.	Grid Station	2018-19	2019-20	2020-21	2021-22	2022-23
1	500kV Rawat	5,165	6,768	4,298	3,464	2,048
2	500kV Sheikh Muhammadi Peshawar	772	2,275	1,417	4,357	3,491
3	220 kV Bannu	1,195	716	664	1,915	3,787
4	220 kV Burhan	265	1,032	644	468	72
5	220 kV Daudkhel	906	684	243	12	399
6	220kV ISPR (Sangjani)	470	1,364	582	1,422	533
7	220kV Mardan	13,513	5,460	3,999	6,279	3,907
8	220kV Nowshera	Nil	1,357	628	2,301	1,264
9	220kV New Shahibagh peshawar	2,816	3,620	4,350	4,770	1,714
10	220kV University	2,812	2,541	2,363	1,469	618
11	220kV Mansehra	124	56	312	178	54
12	220kV Chakdara	317	578	368	366	170
13	220kV D. I. Khan	1,830	3,126	1,842	1,146	44
Total		**30,185**	**29,577**	**21,710**	**28,147**	**18,101**

During FY 2022-23, 500 kV Sheikh Muhammadi Peshawar grid station recorded the highest voltage violation i.e. 3,491. However, over the last five years, the worst performing grid station is 500 kV Rawat grid with a total of 21,743 violations. The grid station-wise data in Table 5.4 shows that 220 kV Mardan recorded the highest number of voltage violations in FY 2022-23 i.e. 3907. Over the last five years, the worst performing grid station is 220 kV Mardan, with a total of 33,158 violations.

Table 5.5: Number of voltage violations (Lahore Region)

Sr. No.	Grid Station	2018-19	2019-20	2020-21	2021-22	2022-23
1	500 kV Gatti	796	1,026	254	871	833
2	500 kV Nokhar	738	3,012	602	245	1,655
3	500 kV Shiekhupura	8,706	693	173	356	100
4	500 kV New Lahore	1,966	3,694	886	1,566	2,545
5	500 kV West FSD	-	-	-	1,496	7,982
6	220 kV Bund	4,664	6,450	3,420	8,412	2,248
7	220 kV Ghakkar	10,357	661	6,584	3,526	236
8	220 kV Jaranwala	340	4,219	52	268	3
9	220 kV Kala Shah Kaku	4,754	411	4,454	6,471	639
10	220 kV Ludewala	376	3,822	157	757	285
11	220 kV New Kot lakhpat	3,646	1,559	4,735	4,649	1,787
12	220 kV Shalamar	1,522	268	1,902	1,897	1,232
13	220 kV Nishatabad	48	4,746	28	12	6
14	220 kV Ravi	4,462	606	2,912	3,493	538
15	220 kV Samundari	52	3,266	224	1,552	350
16	220 kV Safraznagar	2,546	2,420	6,162	7,460	4,441
17	220 kV Sialkot	2,425	960	2,350	2,833	1,454
18	220 kV Wapda Town	1,392	8,932	1,238	937	412
19	220 kV Ghazi	6,940	1,800	12,862	12,085	8,806
20	220 kV Bandala	1,192	940	656	456	134
21	220 kV T.T.Singh	1,418	2,632	448	3,171	1,470
22	220 kV Gujrat	5,401	1,026	3,294	3,696	1,851
23	220 kV Lalian	-	-	-	-	10
24	500 kV Yousafwala	1,601	1,320	–	6,126	2,993
25	220 kV Kassowal	1,274	1,100	144	1,200	520
26	220 kV Okara	884	408	204	606	606
Total		**67,500**	**55,971**	**53,741**	**74,141**	**43,136**

It is noted from the above table that 500 kV Faisalabad West grid station reported the highest number of voltage violations i.e. 7,982 during FY 2022-23. However, 500 kV Yousafwala grid station had the highest number of violations over the last five years, with a total of 12,040.

In the case of 220 kV grid stations, 220 kV Ghazi Road grid station reported a significant number of violations in the fiscal year 2023 with 8,806 incidents. This grid station also had a high cumulative number of violations over the last five years totaling 42,493. This indicates a critical issue in voltage stability at this particular station.

Table 5.6: Number of voltage violations (Multan Region)

Sr. No.	Grid Station	2018-19	2019-20	2020-21	2021-22	2022-23
1	500 kV Multan	20	28	55	24	851
2	500 kV Muzaffargarh	–	–	–	–	–
3	500 kV D.G.Khan	194	225	185	233	133
4	220 kV Rahimyar Khan	6	–	–	–	–
5	220 kV Bahawalpur	836	1,673	833	1,502	641
6	220 kV Muzzaffargarh	463	416	329	462	371
7	220 kV Vehari	6,659	2,870	1,659	2,279	2,048
8	220 kV Chistian	4,761	4,867	2,427	5,054	3,210
9	220 kV Lal Sohanra	–	731	208	202	99
Total		**12,939**	**10,810**	**5,696**	**9,756**	**7,353**

During FY 2022-23, 500 kV Multan reported the highest no. of violation i.e. 851, while 220 kV Chishtian reported 3,210 number of voltage violations. Similarly, during the period 2017-18 to 2022-23, the highest total number of violations was accumulated by 500 kV Multan grid station with 978 violations, while 220 kV Chishtian grid station recorded a high number of voltage violations of 20,319.

Table 5.7: Number of voltage violations (Hyderabad Region)

Sr. No.	Grid Station	2018-19	2019-20	2020-21	2021-22	2022-23
1	500kV Dadu	152	113	53	10	44
2	500kV Guddu	46	260	114	165	1,646
3	500kV Jamshoro	5,755	4,583	6,086	16,220	7,141
4	500kV NKI Karachi	29	106	-	-	123
5	500kV Shikarpur	7,258	9,602	10,311	13,494	11,270
6	220kV Daharki	-	1,912	1,165	1,178	1,245
7	220kV Hala road	20	10	2	-	1
8	220kV Quetta Industrial-II	8,758	10,936	5,702	15,034	1,948
9	220 kV Rohri	200	968	1,500	5,104	2,597
10	220 kV Sibbi	4,579	9,186	7,200	9,407	8,375
11	220 kV T.M.Khan Road	2,818	5,208	1,824	2,372	1,430
12	220kV Khuzdar	246	1,966	2,722	4	1,100
13	220kV Loralai	2,290	2,440	2,064	3,266	2,204
14	220 kV Jhimpir	888	830	202	410	
15	220kV Dera Murad Jamali	1,119	4,830	NP	3,275	1,497
16	500kV 747 MW Guddu	-	-	-	-	17,878
17	220 kV Jhimpir 1	-	-	-	-	303
18	220 kV Jhimpir 2	-	-	-	-	396
19	220kV Switchyard Guddu	-	-	-	-	3,230
Total		**34,158**	**52,950**	**38,945**	**73,455**	**62,428**

The data of the above table reveals that during FY 2022-23, the 500 kV 747 MW Guddu reported the highest numbers of voltage violations i.e. 17,878. While over the last five years 500 kV Shikarpur grid station also had a high number of violations, with a recorded accumulative 51,935 violations.

During FY 2022-23, the 220 kV Sibbi station had the highest number of voltage violations with a total of 8,375 violations. 220 kV Quetta Industrial-II had a high number of violations over the past five years, with a recorded total of 42,378 violations.

5.4. Grid wise voltage variation of 500 kV and 220 kV grid stations under Normal & N-1 condition:

Following are the permissible voltage limits for 500 kV and 220 kV grid stations under normal and N-1 conditions.

For 500 kV Grid stations allowable voltage variations up to 30 minutes are:

Under normal condition = ±5% (i.e.525 kV & 475 kV)
Under (N-1) contingency conditions = ±10% (i.e. 550 KV and 450 KV)

For 220 kV grid stations, the permitted voltage limits up to 30 minutes are:

Under normal condition = ±5% (i.e.231 kV & 209 kV)
Under (N-1) contingency conditions = ±10% (i.e. 242 kV and 198 kV).

Figure 5.3: Highest voltage (kV) recorded at 500 kV grid stations under Normal conditions

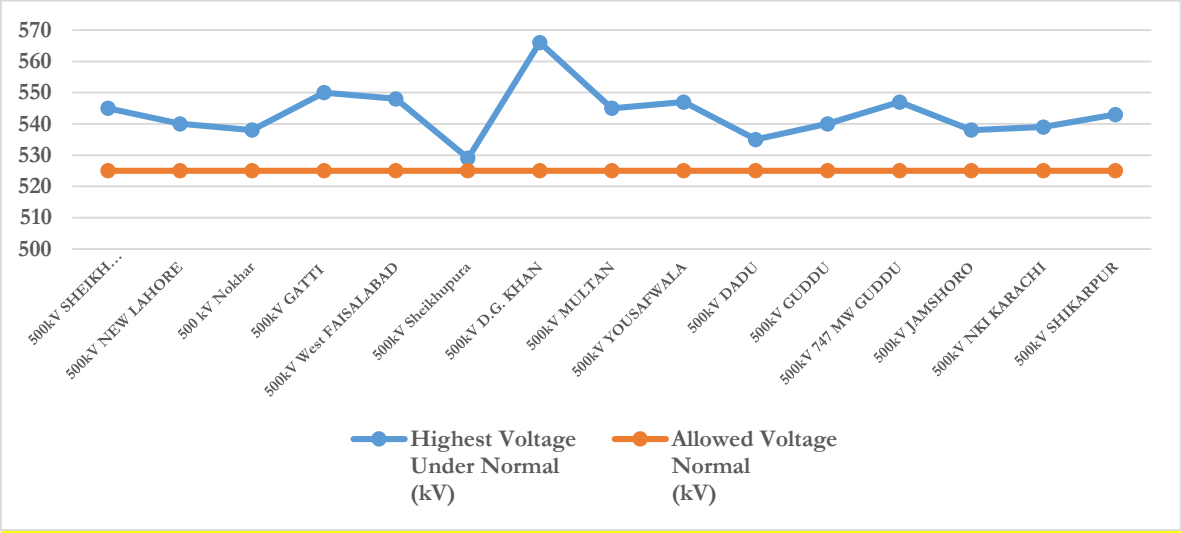


Table 5.8: Highest voltage incidents recorded in 500 kV grid station under Normal condition

Sr. No.	Grid Stations	Highest Voltage (kV)	Duration (Min)	Deviation w.r.t Allowed Limit (%)
Multan	500kV D.G. Khan	566	60	7.81
Lahore	500kV Gatti	550	60	4.76
Lahore	500kV West Faisalabad	548	120	4.38
Lahore	500kV Yousafwala	547	60	4.19
Hyderabad	500kV 747 MW Guddu	547	60	4.19
Islamabad	500kV Sheikh Muhammadi Peshawar	545	60	3.81
Multan	500kV Multan	545	60	3.81
Hyderabad	500kV Shikarpur	543	**120**	3.43
Lahore	500kV New Lahore	540	60	2.86
Hyderabad	500kV Guddu	540	**960**	2.86
Hyderabad	500kV NKI Karachi	539	60	2.67
Lahore	500 kV Nokhar	538	120	2.48
Hyderabad	500kV Jamshoro	538	30	2.48
Hyderabad	500kV Dadu	535	120	1.90
Lahore	500kV Sheikhupura	529	60	0.76

The highest voltage violation of 566 kV was recorded at D.G. Khan indicating a deviation of 7.8% from the allowed limit of +5% (525 kV) under normal conditions. For detailed information on the highest voltage incidents at 500 kV grid stations under normal conditions, please refer to the table above.

Moreover, it is pertinent to mention here that no highest voltage incidents have been recorded in 500kV grid stations under N-1 conditions.

Figure 5.4: Highest voltage (kV) recorded at 220 kV grid stations under Normal condition

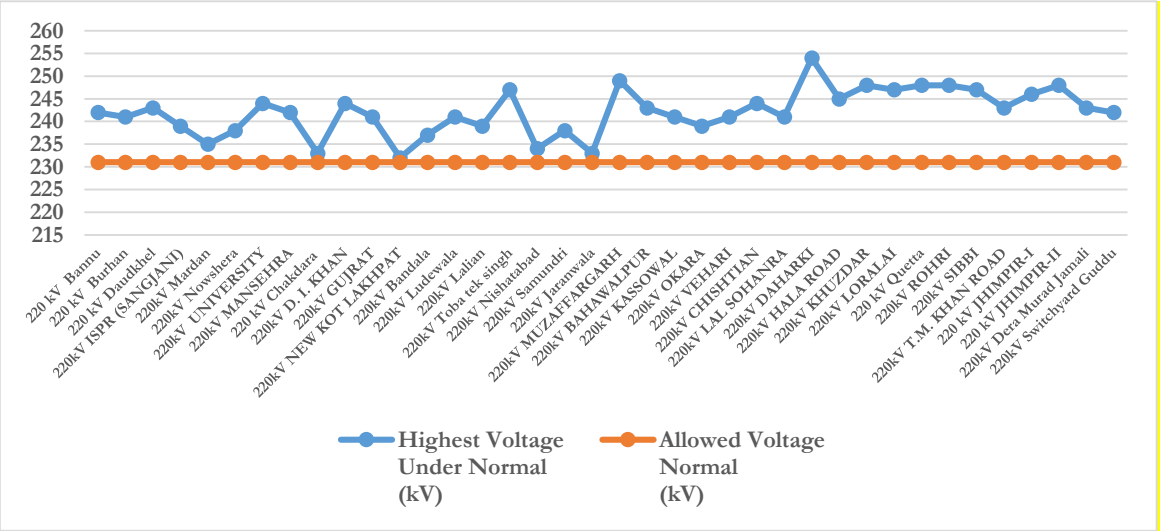


Table 5.9: Highest voltage (kV) recorded at 220 kV grid stations under Normal condition

Region	Grid Stations	Highest Voltage (kV)	Duration (Min)	Deviation w.r.t Allowed Limit (%)
Hyderabad	220KV Daharki	254	60	9.96
Multan	220KV Muzaffargarh	249	600	7.79
Hyderabad	220KV Khuzdar	248	60	7.36
Hyderabad	220 KV Quetta	248	60	7.36
Hyderabad	220KV Rohri	249	120	7.79
Hyderabad	220 KV Jhimpir-II	246	60	6.49
Lahore	220KV Toba Tek Singh	247	330	6.93
Hyderabad	220KV Loralai	247	120	6.93
Hyderabad	220KV Sibbi	247	60	6.93
Hyderabad	220 KV Jhimpir-I	246	60	6.49
Hyderabad	220KV Hala Road	245	90	6.06
Islamabad	220KV University	244	120	5.63
Islamabad	220KV D. I. Khan	244	60	5.63
Multan	220KV Chishtian	244	30	5.63
Islamabad	220 KV Daudkhel	243	120	5.19
Multan	220KV Bahawalpur	243	60	5.19
Hyderabad	220KV T.M. Khan Road	243	60	5.19
Hyderabad	220KV Dera Murad Jamali	243	60	5.19
Islamabad	220 KV Bannu	242	60	4.76
Islamabad	220KV Mansehra	242	60	4.76
Hyderabad	220KV Switchyard Guddu	242	240	4.76
Islamabad	220 KV Burhan	241	60	4.33
Lahore	220KV Gujrat	241	30	4.33
Region	**Grid Stations**	**Highest Voltage (kV)**	**Duration (Min)**	**Deviation w.r.t Allowed Limit (%)**
Lahore	220KV Ludewala	241	90	4.33
Lahore	220KV Kassowal	241	60	4.33
Multan	220KV Vehari	241	150	4.33
Multan	220KV Lal Sohanra	241	60	4.33
Islamabad	220KV Ispr (Sangjani)	239	120	3.46
Lahore	220KV Lalian	239	120	3.46
Lahore	220KV Okara	239	30	3.46
Islamabad	220KV Nowshera	238	60	3.03
Lahore	220kV Samundri	238	60	3.03
Lahore	220kV Bandala	237	120	2.60
Islamabad	220kV Mardan	235	60	1.73
Lahore	220kV Nishatabad	234	60	1.30
Islamabad	220 kV Chakdara	233	90	0.87
Lahore	220kV Jaranwala	233	57	0.87
Lahore	220kV New Kot Lakhpat	232	90	0.43

The 220 kV Daharki grid station recorded the highest voltage of 254 kV, indicating a deviation of 9.96% from the allowed limit (+5% = 231 kV). In the Multan region, the highest voltage of 249 kV was recorded at 220KV Muzaffargarh grid station, with a deviation of 7.79% from the allowed limit. The other grid stations in Hyderabad, Multan, Lahore, and Islamabad regions also recorded high voltages under normal conditions.

Figure 5.5: Highest voltage (kV) recorded at 220 kV grid stations under N-1 condition

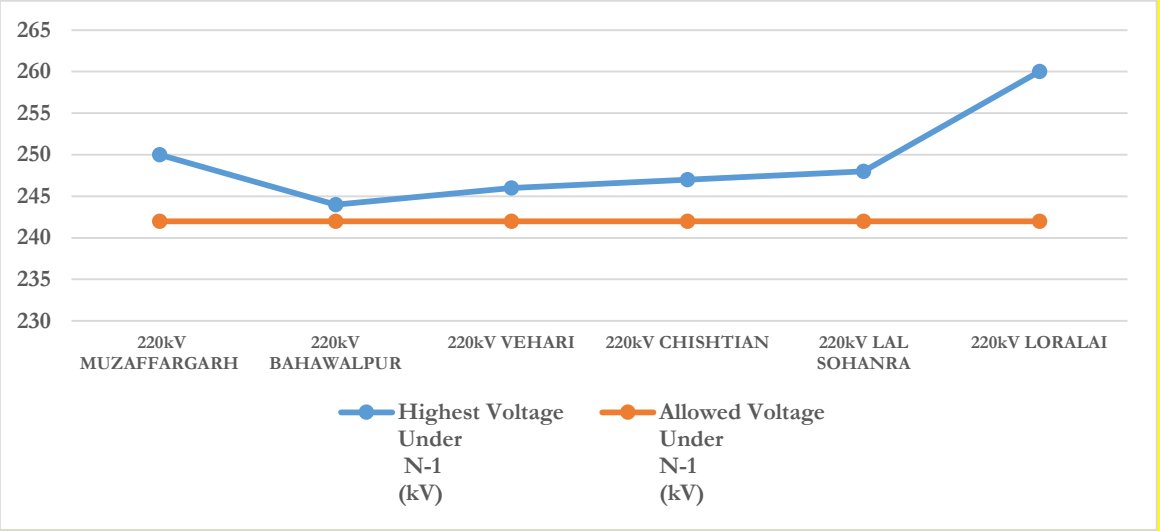


Table 5.10: Highest voltage (kV) recorded at 220 kV grid stations under N-1 condition

Sr. No.	Grid Stations	Highest Voltage (kV)	Duration (Min)	Deviation w.r.t Allowed Limit (%)
Hyderabad	220kV Loralai	260	60	7.44
Multan	220kV Muzaffargarh	250	420	3.31
Multan	220kV Lal Sohanra	248	60	2.48
Multan	220kV Chishtian	247	30	2.07
Multan	220kV Vehari	246	270	1.65
Multan	220kV Bahawalpur	244	30	0.83

The table and figure above show the highest voltage recorded at 220 kV grid stations under N-1 conditions. The highest voltage of 260 kV was recorded at Loralai, which indicates a 7.4% deviation from the allowed limit of 242 kV (+10%). The table provides a detailed overview of the highest voltage incidents at 220 kV grid stations under N-1 conditions. The table shows that thin the Multan region, 220 kV Muzaffargarh grid station recorded the highest voltage deviation of 3.31% (250 kV) for a duration of 420 Minutes.

Table 5.11: Lowest voltage (kV) recorded at 500 kV grid stations under Normal condition

Sr. No.	Grid Stations	Lowest Voltage (kV)	Duration	Deviation w.r.t Allowed Limit (%)
Islamabad	500kV Sheikh Muhammadi Peshawar	473	60	0.42

At Sheikh Muhammadi Peshawar, the lowest voltage of 473 kV was recorded. This indicates a deviation of 0.42% from the allowed limit of -5%, which is 475 kV. The duration of this incident was 60 seconds.

Figure 5.6: Lowest voltage (kV) recorded at 220 kV grid stations under Normal condition

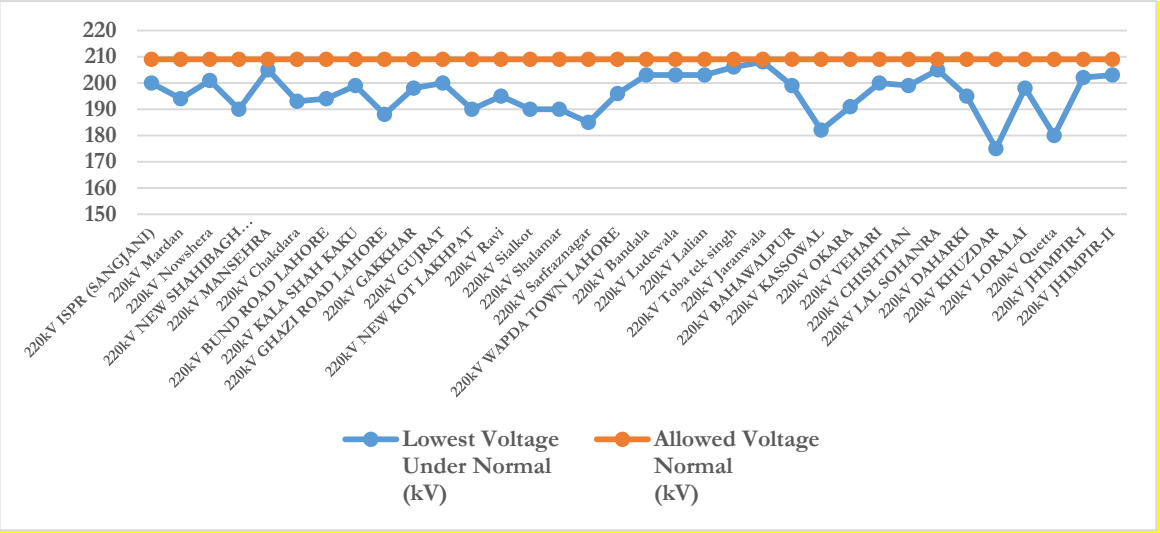


Table 5.12: Lowest voltage (kV) recorded at 220 kV grid stations under Normal condition

Sr. No.	Grid Stations	Lowest Voltage (Kv)	Duration (Min)	Deviation w.r.t Allowed Limit (%)
Hyderabad	220kV Khuzdar	175	60	16.27
Hyderabad	220kV Quetta	180	60	13.88
Lahore	220kV Kassowal	182	60	12.92
Lahore	220kV Sarfraznagar	185	60	11.48
Lahore	220kV Ghazi Road Lahore	188	60	10.05
Islamabad	220kV New Shahibagh Peshawar	190	120	9.09
Lahore	220kV New Kot Lakhpat	190	90	9.09
Lahore	220kV Sialkot	190	210	9.09
Lahore	220kV Shalamar	190	90	9.09
Lahore	220kV Okara	191	1200	8.61
Islamabad	220kV Chakdara	193	60	7.66
Islamabad	220kV Mardan	194	60	7.18
Lahore	220kV Bund Road Lahore	194	150	7.18
Lahore	220kV Ravi	195	90	6.70
Hyderabad	220kV Daharki	195	60	6.70
Lahore	220kV Wapda Town Lahore	196	150	6.22
Lahore	220kV Gakkhar	198	60	5.26
Hyderabad	220kV Loralai	198	180	5.26
Lahore	220kV Kala Shah Kaku	199	60	4.78
Multan	220kV Bahawalpur	199	30	4.78
Multan	220kV Chishtian	199	120	4.78
Islamabad	220kV Ispr (Sangjani)	200	120	4.31
Lahore	220kV Gujrat	200	60	4.31
Multan	220kV Vehari	200	330	4.31
Islamabad	220kV Nowshera	201	60	3.83
Hyderabad	220kV Jhimpir-I	202	60	3.35
Lahore	220kV Bandala	203	90	2.87
Lahore	220kV Ludewala	204	90	2.39
Lahore	220kV Lalian	203	180	2.87
Hyderabad	220kV Jhimpir-II	203	60	2.87
Islamabad	220kV Mansehra	205	60	1.91
Multan	220kV Lal Sohanra	205	60	1.91
Lahore	220kV Toba Tek Singh	206	60	1.44
Lahore	220kV Jaranwala	208	206	0.48

The lowest voltage of 175 kV was recorded at 220kV Khuzdar grid station resulting in a 16.3% deviation from the allowed limit (-5% = 209 kV).

Figure 5.7: Lowest voltage (kV) recorded at 220 kV grid stations under N-1 condition

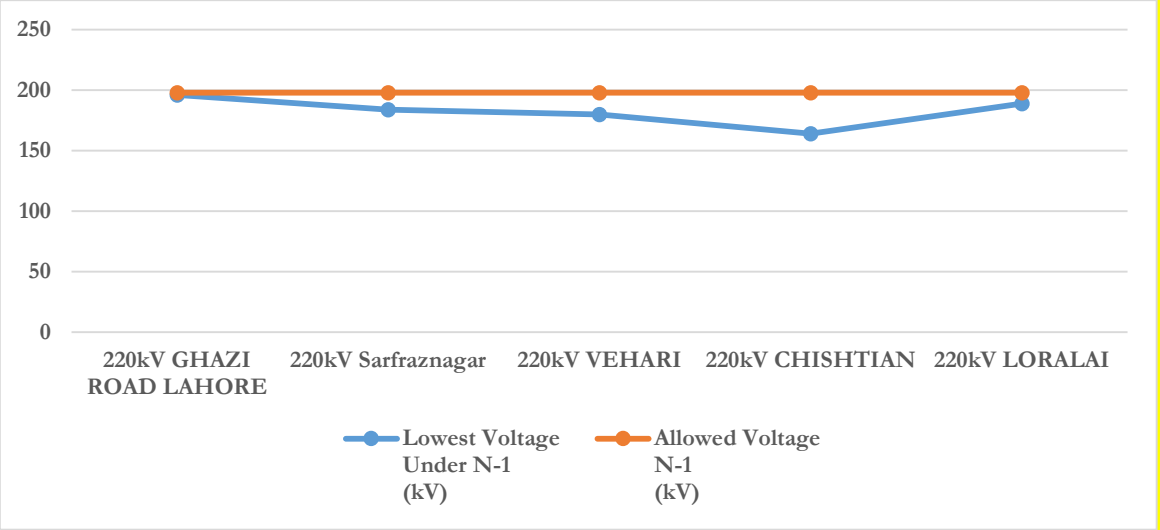


Table 5.13: Lowest voltage (kV) recorded at 220 kV grid stations under N-1 condition

Sr. No.	Grid Stations	Lowest Voltage (kV)	Duration (Min)	Deviation w.r.t Allowed Limit (%)
Multan	220kV Chishtian	164	30	17.17
Multan	220kV Vehari	180	90	9.09
Lahore	220kV Sarfraznagar	184	30	7.07
Hyderabad	220kV Loralai	189	60	4.55
Lahore	220kV Ghazi Road Lahore	196	60	1.01

The lowest voltage of 163 kV was recorded at 220kV Chistian grid station. It indicates a 17.6% deviation from the allowed limit (-10% = 198 kV). It is also observed from the above table that the deviations from the allowed limit ranged from 1.01% to 17.6%, with the highest deviation recorded at 220kV Chishtian (30 duration). Meanwhile, the lowest deviation of 1.01% was recorded at 220kV Ghazi Road Lahore (60 duration).

SECTION II

K - ELECTRIC

6. Brief Introduction of K-Electric:

Under the Indian Companies Act of 1882, K-Electric (KE) was established on September 13, 1913 as Karachi Electric Supply Corporation (KESC) and it was re-privatized on November 29, 2005. In September 2008, the company was renamed as Karachi Electric Supply Company (KESC). During 2013-14, as part of company's 100 year celebrations, KESC was rebranded to K-Electric Limited (KEL).

6.1 Licence:

In pursuance of Section 17 of the NEPRA Act, 1997, NEPRA granted a transmission license to KE in June 2010 to conduct transmission activities within the territory specified in the license for thirty (30) years.

6.2 Transmission Network:

As of June 2023, KE transmission system consists of total 71 grid stations (66kV, 132kV & 220kV), 1,355 kM of transmission lines and 11,565 MVA transformation capacity. There are four 220 kV transmission circuits connecting KE grid to that of NTDC, namely:

i. KDA-NKI
ii. Baldia-NKI
iii. KDA - Jhimpir2 - 1
iv. KDA - Jhimpir2 - 2

Figure 6.1: KE transmission system

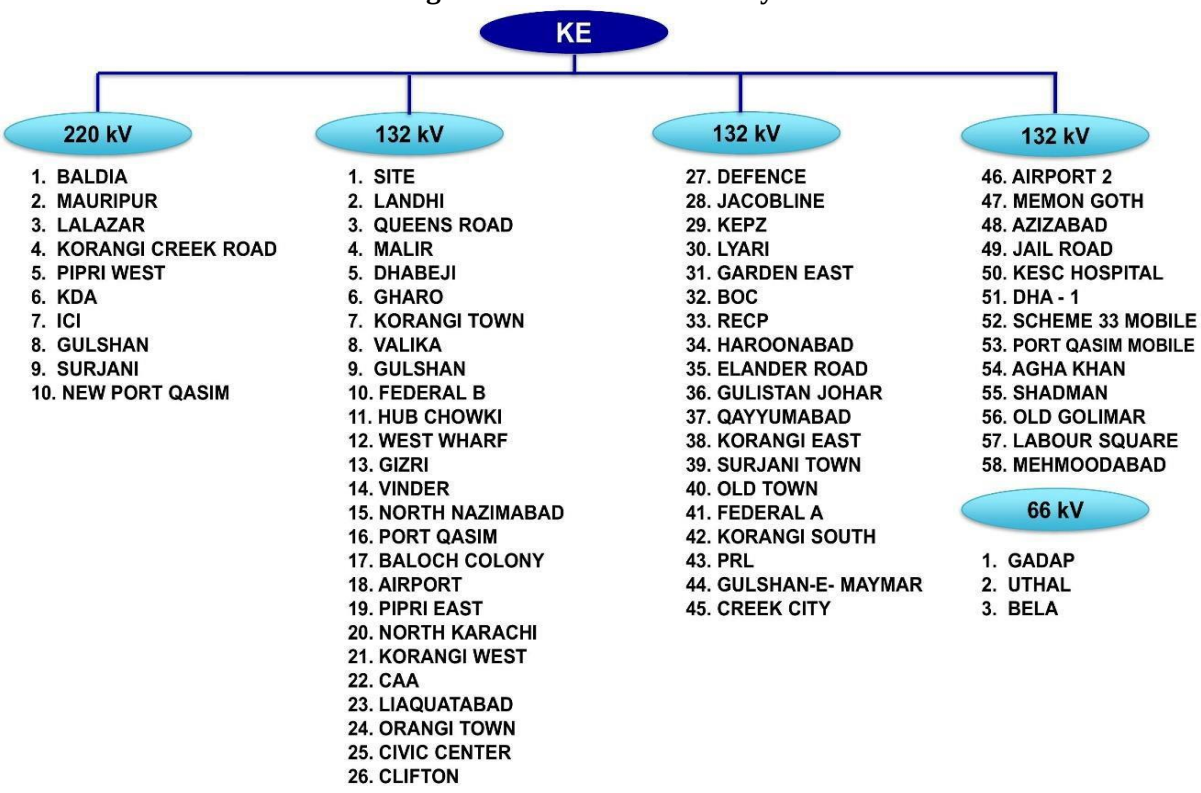


Table 6.1: KE Network Statistics

Description		2018-19	2019-20	2020-21	2021-22	2022-23
No. of Grid Stations	220 kV	9	10	10	10	10
	Added	2	1	0	0	0
	132 kV	56	57	58	58	58
	Added	2	1	0	0	0
	66 kV	3	3	3	3	3
	Added	0	0	0	0	0
	Total	**68**	**70**	**71**	**71**	**71**
Length of Transmission Line (Circuit km)	220 kV	336	365	365	364	364
	Added	-2	29	-1	0	0
	132 kV	798	801	833	838	838
	Added	31	3	35	2	0
	66 kV	150	153	153	153	153
	Added	1	3	-1	1	0
	Total	**1,284**	**1,319**	**1,352**	**1,355**	**1,355**
Transformation Capacity (MVA)	220 kV	3,500	4,500	4,500	4,500	4,500
	Added	500	1000	0	0	0
	132 kV	6,109	6,373	6,557	6,824	6,986
	Added	560	264	301	150	162
	66 kV	69	79	79	79	79
	Added	0	10	0	0	0
	Total	**9,678**	**10,952**	**11,136**	**11,403**	**11,565**

From the above table, it is noted that there is no increase in the transformation capacity of 220kV system since the year 2019-20 and there is slight increase in the 132kV transformation capacity i.e. from 6,109MVA to 6,986 MVA in last 5 years.

From the above table, it is also observed that in the last five years, only three 220 kV grid stations and 1500 MVA transformation capacity was added in the 220 kV network in last five years.

6.3 Performance of K-Electric under PSTR-2005:

This section provides a comprehensive assessment of KE performance in terms of System Reliability, System Security, and Quality of Supply. Each performance parameter is discussed below:

7. System Reliability:

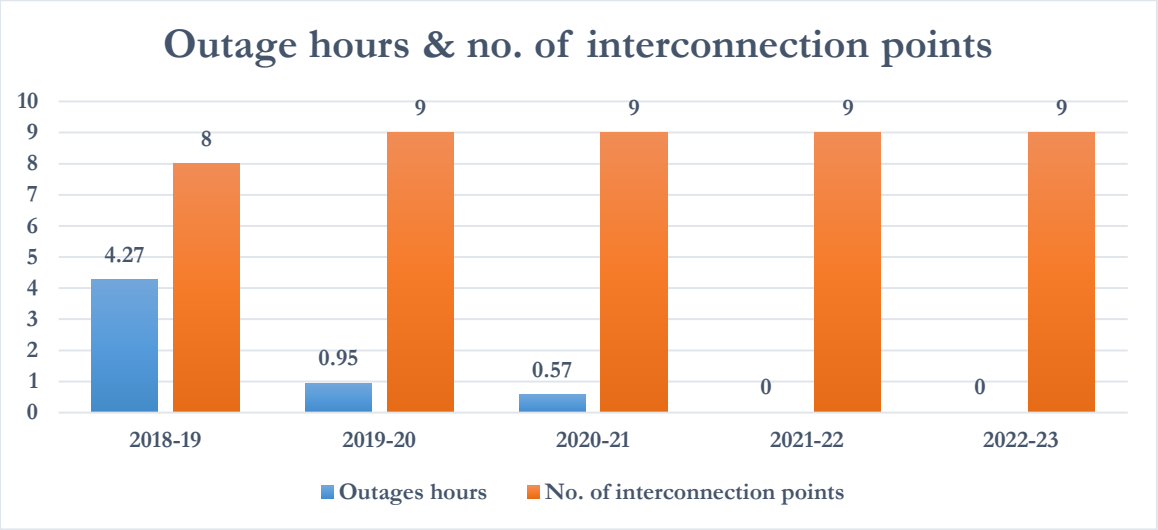
7.1 Average Duration of Interruption:

1. Total outage hours recorded at all interconnection points (excluding 132 kV line tripping) = 0 Hrs.
2. Total number of interconnection points = 9
3. System duration of interruption = 0 Hrs./point

Indicates the same results as in the previous year i.e. 0 Hrs. /point

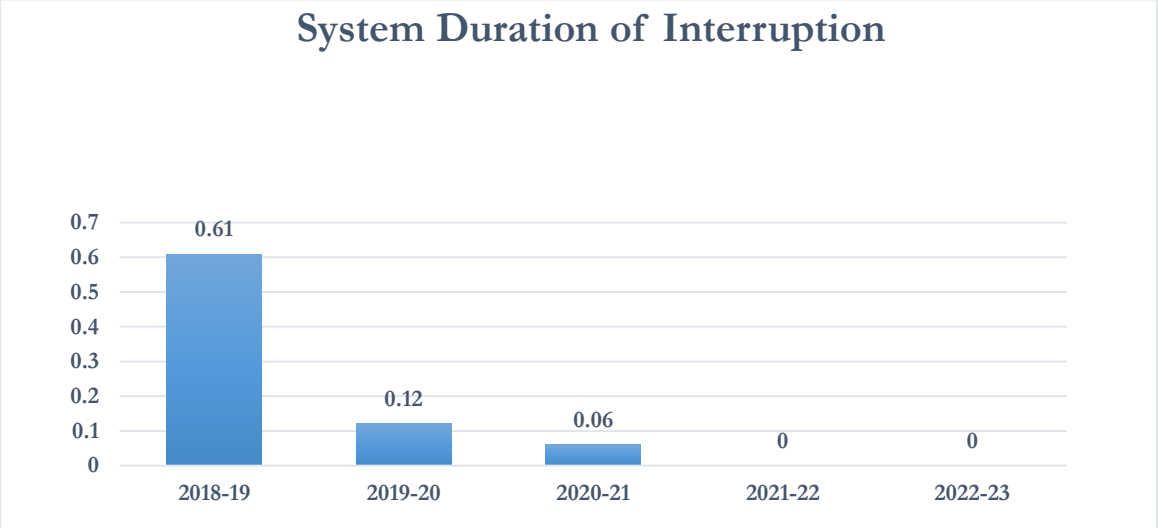
During the reporting period, there were no outages at any of the interconnection points. As compared to the previous year, when 0 hours were recorded, this represents the same numbers in 2022-23. It is pertinent to mention here that as per KE, any outages or tripping caused by NTDC network issues are not included in KE system reliability. Figure 5.1 shows that the number of interconnection points remained at nine (9).

Figure 7.1: Outages hours & no. of interconnection points



Interconnection points reported an average interruption duration of 0 hour. As shown in Figure 5.2, this is the same figure as reported during the previous year.

Figure 7.2: System Duration of Interruption (Hrs. /Point)



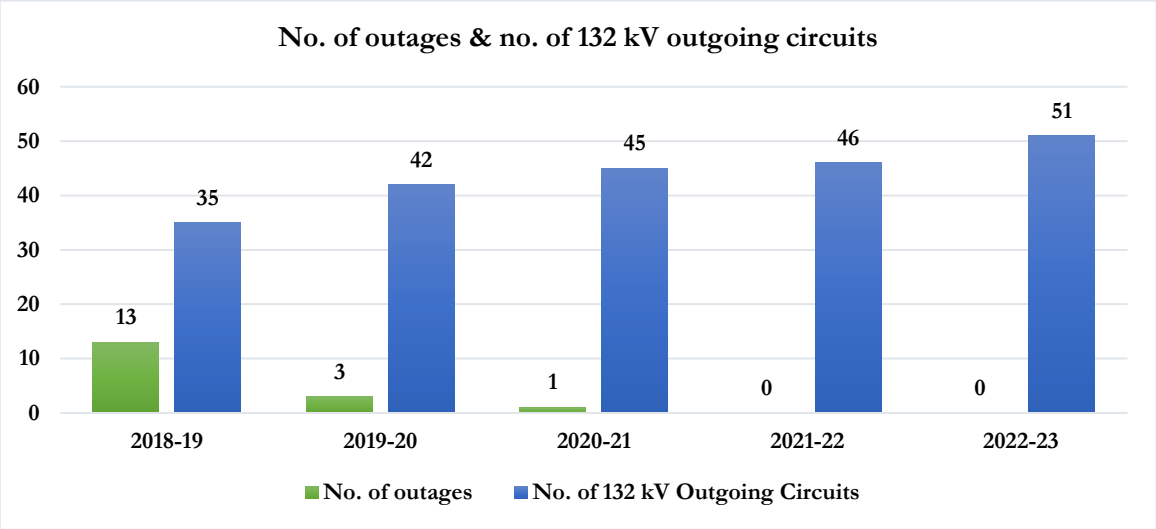
7.2 Average Frequency of Interruption:

1. Total number of outages recorded at all 132 kV outgoing circuits (excluding 132 kV line tripping) = 0
2. Total number of 132 kV circuits = 51
3. System frequency of interruption = 0 no. /circuit.

Indicates the same results as in the previous year i.e. 0 no. /circuit

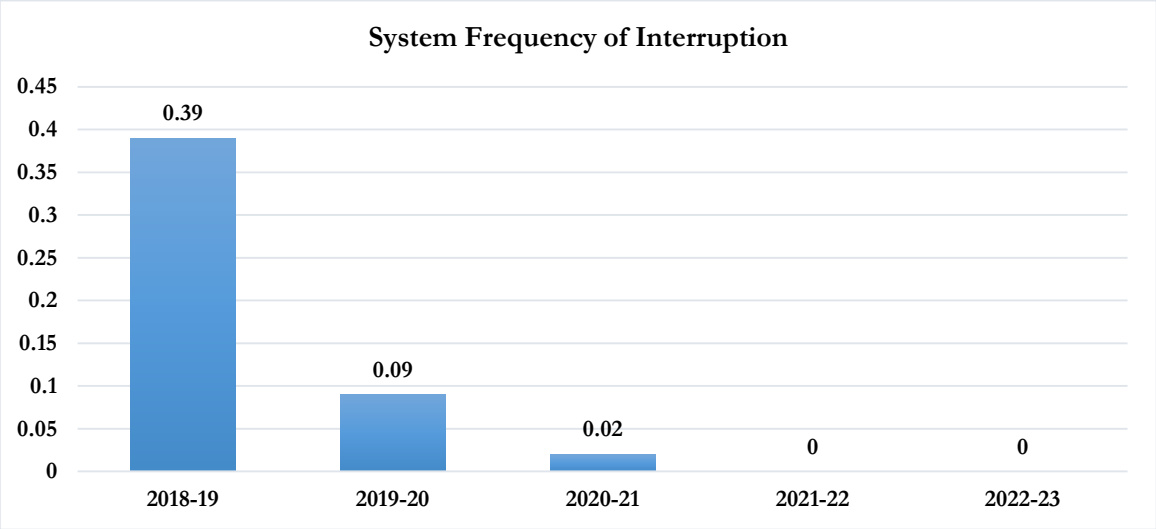
According to the following figure, the total number of outages remained 0 in 2022-23, which is the same as the previous year. However, 5 number of outgoing circuits have been added.

Figure 7.3: No. of outages & no. of 132kV outgoing circuits



The average number of interruptions per circuit during the reporting period remained at 0 indicating the same figure as in the preceding year.

Figure 7.4: System Frequency of Interruption (nos. /Circuit)



8. Tie Line Reliability:

Tie lines in KE transmission system comprise of four (04) 220kV circuits which connect KE network with NTDC network, namely.

i. KDA-NKI
ii. Baldia-NKI
iii. KDA-Jhimpir2-1
iv. KDA-Jhimpir2-2

Out of these four, both 220 kV KDA/Jhimpir2 circuits 1 and 2 are maintained by NTDC. On the other hand, 220 kV KDA-NKI and Balidia-NKI are maintained by KE as they come under KE jurisdiction.

8.1 System Duration of Interruption Tie Line:

The system duration of Interruption of Tie Lines between NTDC & KE is as under:

Table 8.1 System Duration of Interruption of Tie Line

Months	Total outages hours recorded on all tie line circuit	Total number of tie lines circuit	System Duration of Interruption
	(1)	(2)	(3=1/2)
Jul-22	4.6	4	1.14
Aug-22	--	4	--
Sep-22	--	4	--
Oct-22	--	4	--
Nov-22	--	4	--
Dec-22	--	4	--
Jan-23	12.5	4	3.12
Feb-23	--	4	--
Mar-23	2.5	4	0.63
Apr-23	--	4	--
May-23	--	4	--
Jun-23	--	4	--
Total	**19.58**	**4**	**4.90**

Based on the table above, it is observed that in FY 2022-23 all tie lines experienced total of 19.58 hours of outages while the System Duration Interruption was 4.90. According to the reported data from KE, System Duration of Interruption for the tie line managed by NTDC was 1.25 and for the tie line managed by KE was 2.25.

8.2 System Frequency of Interruption:

The data regarding System Frequency of Interruption of tie lines between NTDC & KE is as under:

8.2 System Frequency of Interruption of Tie Lines

Months	Total number of outages hours recorded on all tie line circuit	Total number of tie lines circuit	System Frequency of Interruption
	(1)	(2)	(3=1/2)
Jul-22	4.0	4	1.00
Aug-22	--	4	--
Sep-22	--	4	--
Oct-22	--	4	--
Nov-22	--	4	--
Dec-22	--	4	--
Jan-23	3.0	4	0.75
Feb-23	--	4	--
Mar-23	1.0	4	0.25
Apr-23	--	4	--
May-23	--	4	--
Jun-23	--	4	--
Total	8.00	4	2.00

During FY 2022-23, the total number of outages reported on tie lines was 8 and System Frequency of Interruption was 2.0. As per KE report, system Frequency of interruption on Tie line under NTDC jurisdiction was 1.25 and the System Frequency Interruption for the tie lines under KE was 0.75.

9. System Security:

Energy Not Served (ENS):

1. Total ENS = 0 kWh
2. Number of incidents, where there has been a loss of supply = 0
3. Average ENS per incident = 0 kWh
4. Average duration per incident = 0
5. The financial impact of ENS = 0
6. Financial impact per incident = 0

According to KE, the total ENS for the year is 0 million kWh, which is the same as the previous year. It is relevant to discuss here that as per KE, any outages or tripping caused by NTDC network issues are not included in KE system reliability, However, KE reported that two major incidents that occurred in NTDC network also effected the KE network and as result, 14,844 MWh Eergy Not Served due to 13th October 2022 partial blackout and due to the total blackout on January 2023, KE's Energy Not Served was 28,881 MWh.

Figure 9.1: Reported Energy Not Served

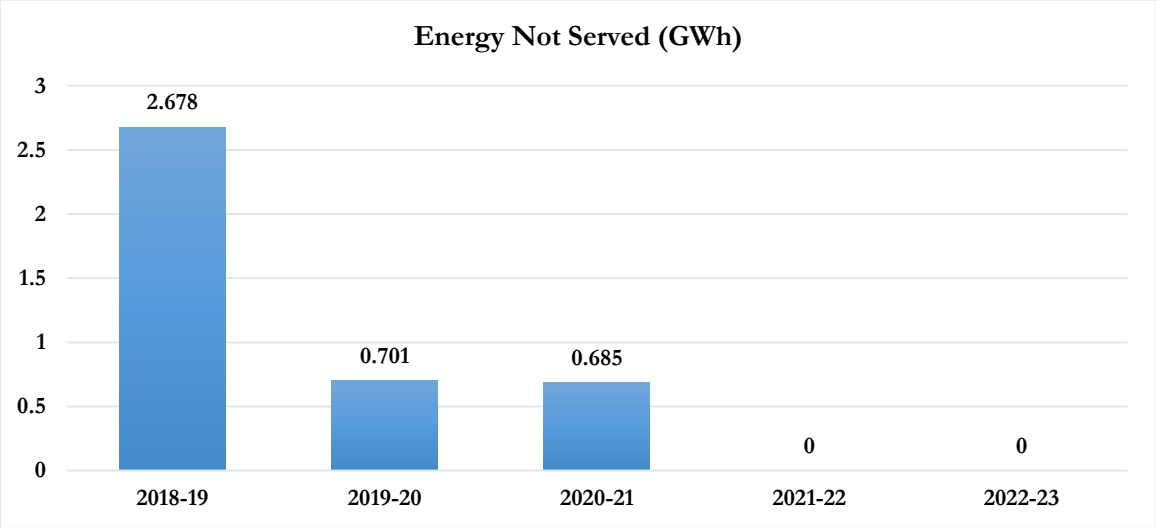


Figure 9.2: Loss of supply incidents & and duration per incident

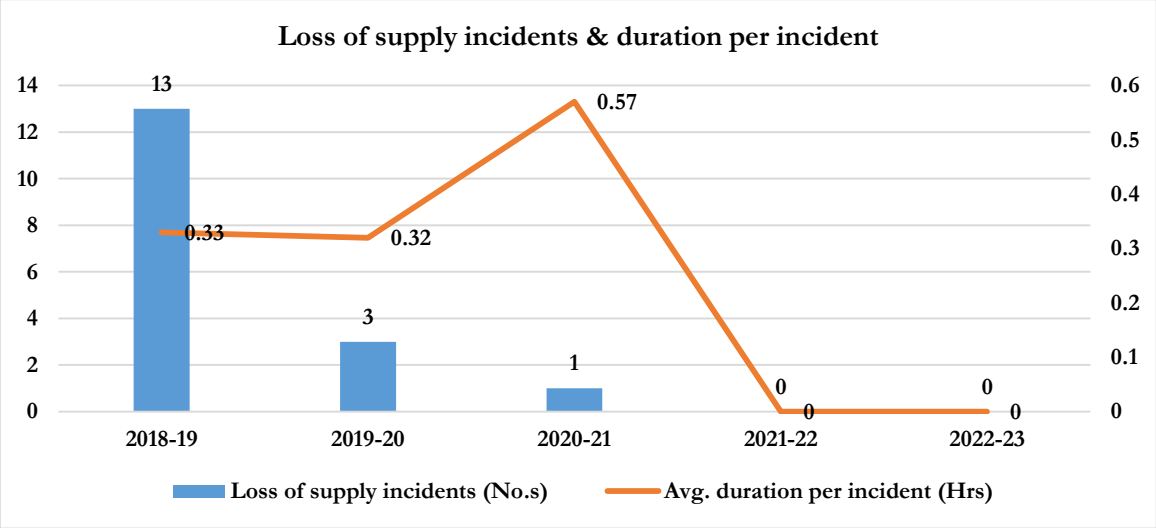


Figure 9.3: Loss of supply incidents along with average

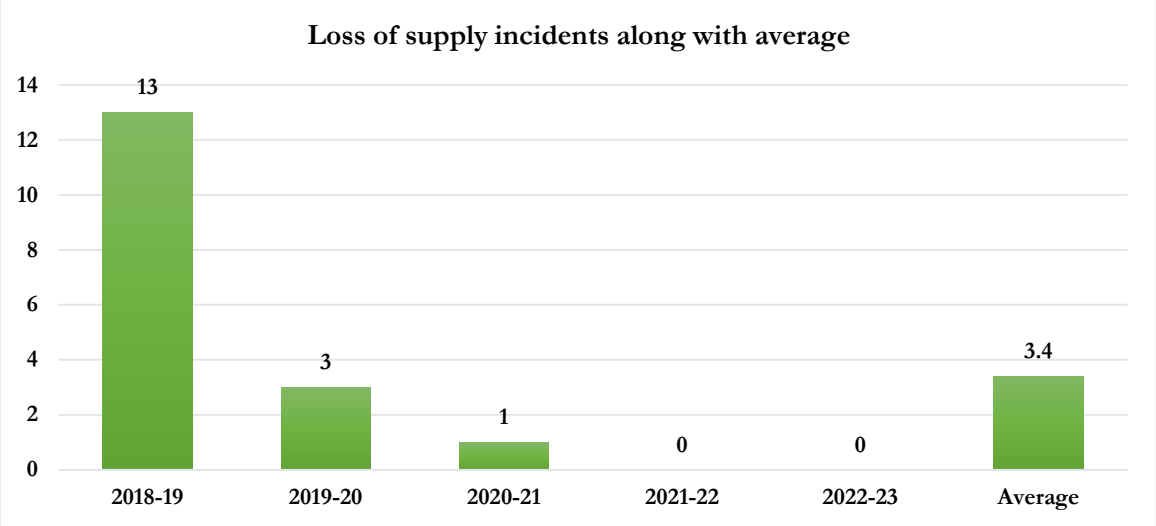


Table 9.1: Loss of supply incidents, average ENS, duration & financial impact per incident

Description	2018-19	2019-20	2020-21	2021-22	2022-23
Loss of Supply Incidents (Nos.)	13	3	1	0	0
Average ENS per Incident (Million kWh)	0.206	0.234	0.685	0	0
Average Duration per Incident (Hrs.: Min)	0:20	0:19	0.57	0	0
Financial Impact per Incident Rs. (Million)	2.6	2.2	6.85	0	0

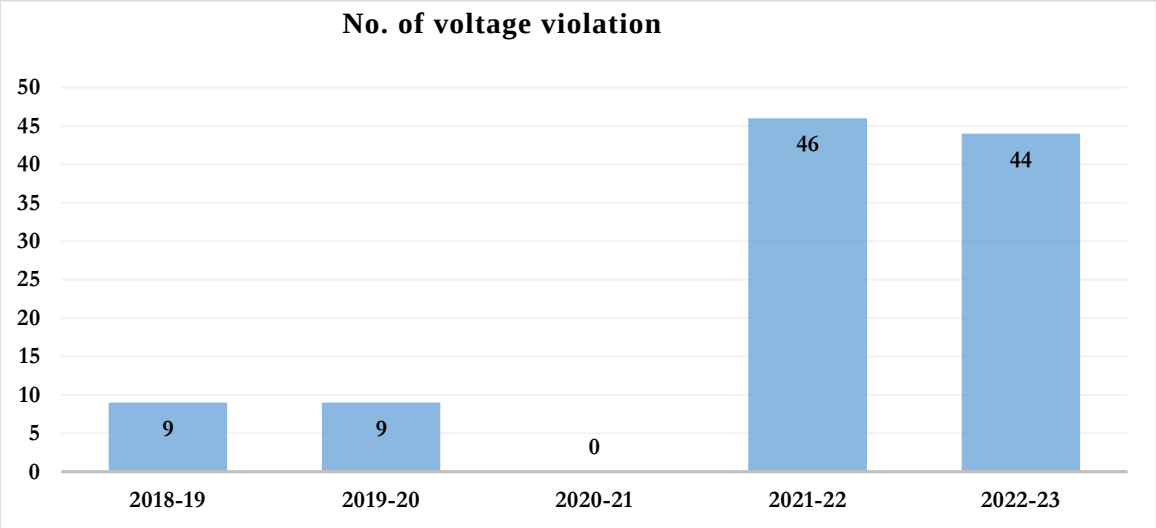
10. Quality of Supply:

10.1 System Voltage:

1. Total number of violations under Normal conditions = 44
2. Total number of violations under N-1 conditions = Nil
3. Total number of violations under Normal & N-1 conditions = 44

As compared to the previous year, KE has reported 44 voltage violations under normal conditions representing a decrease of 4.34%. The following figure illustrates the trend of last 5 years:

Figure 10.1: No. of voltage violations (KE)



10.2 Frequency:

1. Number of times frequency remained outside the limits in a year = 4
2. Time duration the frequency remained outside the limits in a year = 26.88 min.
3. %age time of the year the frequency remained outside the limits = 0.01% time of the year.
4. Highest frequency recorded = 50.51 Hz
5. No violation at the lower end.
6. Allowable limits: 49.5 Hz – 50.5 Hz

The data submitted by KE was analyzed and it was revealed that only 4 time frequency remained outside the prescribed limit for 26.88 minutes, which comes out to be approximately 0.01% of the reported period.

SECTION III

SPECIAL PURPOSE TRANSMISSION LICENSEE

FATIMA TRANSMISSION COMPANY LIMITED (FTCL)

11. Brief Introduction of FTCL:

Fatima Transmission Company Limited (FTCL) is a public non-listed company incorporated under Section 32 of the Companies Ordinance, 1984. The purpose for its special purpose transmission facilities is to connecting the generation facility /co-generation power plant of Fatima Energy Limited (Sanawan Kot Addu, Punjab) to 220/132 kV new Muzzafargarh grid station located in Punjab.

11.1 License:

Under Section 19 of the NEPRA Act, 1997 the Authority is empowered to grant a Special Purpose Transmission License to any entity, authorizing it to engage in construction, ownership, maintenance and operation of specific transmission facilities in the exclusive territory of NTDC. In exercise of the powers conferred above, NEPRA granted a Special Purpose Transmission license to Fatima Transmission Company Limited (FTCL) to engage in the special purpose power transmission business for a term of thirty (30) years.

11.2 Transmission Network

FTCL comprises a 37 km 132 kV double-circuit transmission line. The main purpose of this transmission line is to evacuate power from the 120 MW Fatima Energy power plant to the Muzaffargarh 220 kV Grid Station. Each circuit of the transmission line has the full capacity to evacuate the entire power output of the complex.

11.3 Performance of FTCL under PSTR-2005:

This section provides an assessment of FTCL performance in terms of System Reliability, System Security, and Quality of Supply. Each performance parameter is discussed below:

12. System Reliability:

12.1 System Duration of Interruption:

1. Total outage hours recorded at all interconnection points = 17 Hrs.
2. Total number of interconnection points = 2
3. System duration of interruption = 8.5 Hrs./point

During the reporting period, there were 17 hrs outages recorded at interconnection points. 8.5 hours per point were recorded as System Duration of Interruption. The total number of interconnection points are two (2).

12.2 System Frequency of Interruption:

1. Total number of outages recorded at all interconnection points= 5
2. Total number of 132 kV circuits = 2
3. System frequency of interruption = 2.5 no. /circuit.
4. During FY 2022-23, system frequency of Interruption was reported as 2.5

13. System Security:

Energy Not Served (ENS):

1. Total ENS = 918 MWh
2. Number of incidents, where there has been a loss of supply = 5

3. Average ENS per incident = 183.6 MWh
4. Average duration per incident = 3.4

14. Quality of Supply:

The Quality of Supply (QoS) is measured with reference to System Voltage and System Frequency. The analysis of the data as submitted by FTCL is given hereunder:

14.1 System Voltage:

The highest voltage violation of 144.93 kV was recorded under Normal condition however, Nil highest voltage was recorded under N-1 condition. The lowest voltage recorded under Normal and N-1 condition remained Nil.

Table 14.1: Voltage Violations

Sr. No.	Voltage Class (132 KV)	Highest voltage recorded (kV)	Duration of variation	% Variation	Lowest voltage recorded	Duration of variation	% Variation
1	Normal	144.93	1080	12.3%	Nil	Nil	Nil
2	N-1	Nil	Nil	0.0%	Nil	Nil	Nil

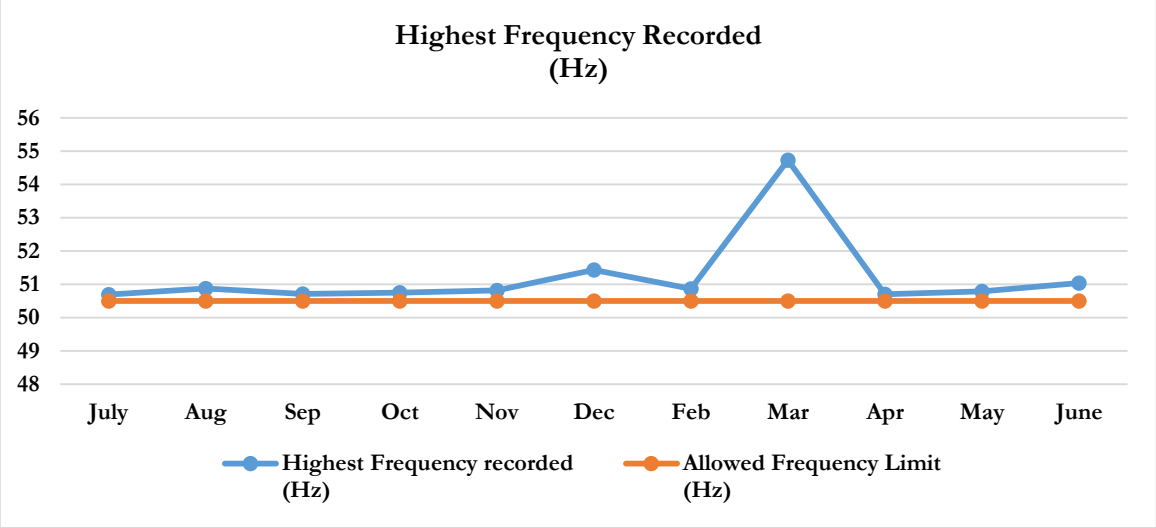
14.2. System Frequency:

It is observed from the data that the frequency was outside of permissible limits on 29 times with a total duration of 208 minutes. The yearly highest frequency is 54.73 Hz with variation of 9.46 % and lowest frequency of 49.12 Hz with a variation of -1.76 %.

Table 14.2: Frequency violations

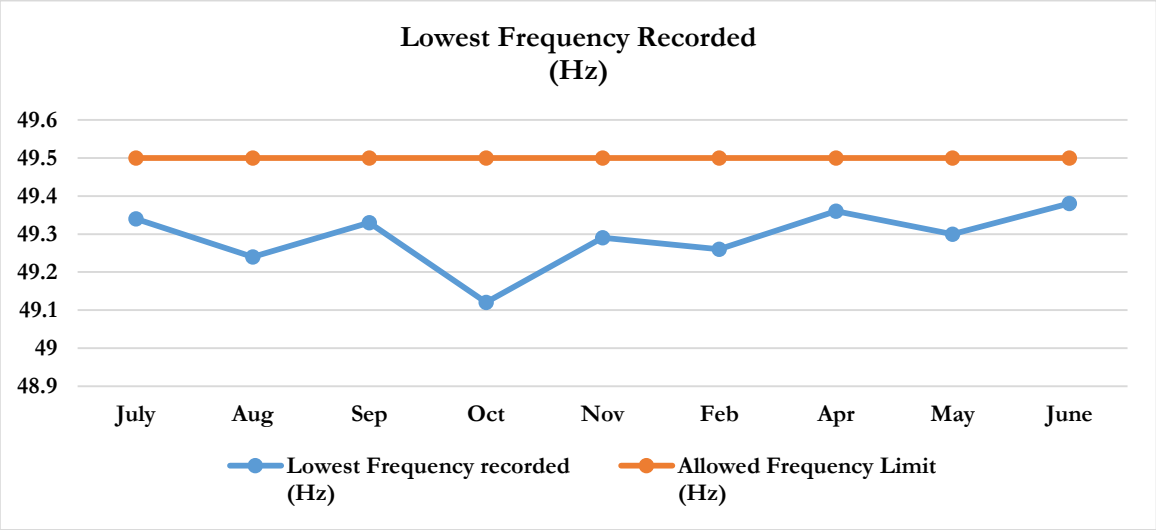
Sr.No.	Month	Number of days/hours for a month over a year		Frequency Violation recorded (Hz)		Duration of variation		% variation			Number of times frequency remained outside the limits Nos.
		Days	Hours	Highest	Lowest	Mins	Hrs	Highest	Lowest	Period	
	1	2	3	4	5	6	7	8= (4-50)/ 50*100	9= (5-50)/ 50*100	10=7/3*100	11
1	Jul-22	31.00	744	50.69	49.34	15	0.25	1.38	-1.32	0.03	2
2	Aug-22	31.00	744	50.88	49.24	22	0.37	1.76	-1.52	0.05	4
3	Sep-22	30.00	720	50.71	49.33	18	0.30	1.42	-1.34	0.04	3
4	Oct-22	31.00	744	50.75	49.12	24	0.40	1.50	-1.76	0.05	4
5	Nov-22	30.00	720	50.82	49.29	21	0.35	1.64	-1.42	0.05	4
6	Dec-22	31.00	744	51.43	Nil	22	0.37	2.86	-	0.05	1
7	Jan-23	31.00	744	Nil	Nil	0	0.00	-	-	0.00	1
8	Feb-23	28.00	672	50.87	49.26	14	0.23	1.74	-1.48	0.03	2
9	Mar-23	31.00	744	54.73	Nil	23	0.38	9.46	-	0.05	1
10	Apr-23	30.00	720	50.7	49.36	15	0.25	1.40	-1.28	0.03	2
11	May-23	31.00	744	50.79	49.3	18	0.30	1.58	-1.40	0.04	2
12	Jun-23	30.00	720	51.04	49.38	16	0.27	2.08	-1.24	0.04	3
Year		**365**	**8760**	**54.73**	**49.12**	**208**	**3.47**	**9.46**	**-1.76**	**0.04**	**29**

Figure 14.1: Highest Frequency Recorded (Hz)



The lowest frequency recorded during the financial year FY 2022-23 is shown below in the graph:

Figure 14.2: Lowest frequency recorded (Hz)



SECTION IV

PROVINCIAL GRID COMPANIES

SINDH TRANSMISSION & DISPATCH COMPANY (PVT) LIMITED (ST&DCPL)

15. Brief Introduction of ST&DCPL:

Sindh Transmission & Dispatch Company (Pvt.) Limited (ST&DCPL) was incorporated on 7th January, 2015 under Securities & Exchange Commission of Pakistan (SECP), Companies Ordinance, 1984 for the provision of extra high voltage electric power infrastructure. It is a subsidiary Company of Sindh Energy Holding Company (Pvt.) Limited.

ST&DCPL takes pride in 100 MW power evacuation from Sindh Nooriabad Power Company and delivering clean and safe power to K-Electric with maximum efficiency. Achieving commercial operation on January 2018, since than ST&DCPL is making sure of steady and continuous power transmission and has strict operation and maintenance policy.

15.1 License

Pursuant to section 19 of the NEPRA Act, 1997, NEPRA granted special purpose transmission line license to Sindh Transmission & Dispatch Company (Pvt.) Ltd (ST&DCPL) on 17th December 2015 to engage in the special purpose power transmission business for a term of thirty (30) years,

After amendment in NEPRA Act in the year of 2018, under Section 18-A of the NEPRA Act, NEPRA also granted the provincial grid company license to ST&DCPL on November 05, 2019 for the period of thirty (30) years.

15.2 Transmission Network

Sindh transmission & Dispatch Company (Pvt.) Ltd (ST&DCPL) transmission system comprises a total of 95.4 km of 132 kV double circuit transmission line. ST&DCPL transmission line is interconnected with the K-Electric grid system through two (02) 132 kV transmission line circuits viz Circuit-1 & Circuit-2.

15.3 Analysis of Annual Performance Report (APR)

The APR submitted by ST&DCPL has been evaluated in light of the PSTR 2005. The detail of which is as under:

16. System Reliability:

16.1. System Duration of Interruption:

1. Total outage hours recorded at all interconnection points = 35.42 Hrs.
2. Total number of interconnection points = 2
3. System duration of interruption = 17.71 Hrs./point

During the reporting period, the total interruption occurring at the one interconnection point (KE) is approximately 35.42 hrs. The System Duration of Interruption was reported as 17.71 hrs/point. The number of interconnection points are two (2).

16.2. System Duration of Frequency:

1. Total number of outages recorded at all interconnection points= 7
2. Total number of 132 kV circuits = 2

3. System frequency of interruption = 3.5 no. /circuit.

The total outages recorded as 7 and system frequency of Interruption was observed as 3.5

16.3. Tie lines reliability:

Sindh Transmission & Dispatch Company Pvt. Ltd and both the interconnected parties SNPC and K-Electric has mutually agreed to allow work to be undertaken simultaneously during outage/maintenance period to maximize the efficiency of the system and minimize the losses of availability based on work being carried out by parties on their assets.

17. System Security:

The total Energy Not Served (ENS) during the reported period is 3579.21 MWh approximately.

18. Quality of Supply (QoS)

Quality of supply is measured with reference to system voltage and system frequency. The analysis of QoS data as reported by ST&DCPL is given hereunder:

18.1 System Voltage

It is observed that during the reported period, there is no voltage violation occurred under normal as well as N-1 conditions.

18.2 System Frequency

As per data submitted by ST&DCPL it is observed that there were four frequency violation recorded for a total duration in the year 2022 -23. The following table shows statistics of system frequency over the reported period.

Table 18.1: Number of Frequency Variations Criteria

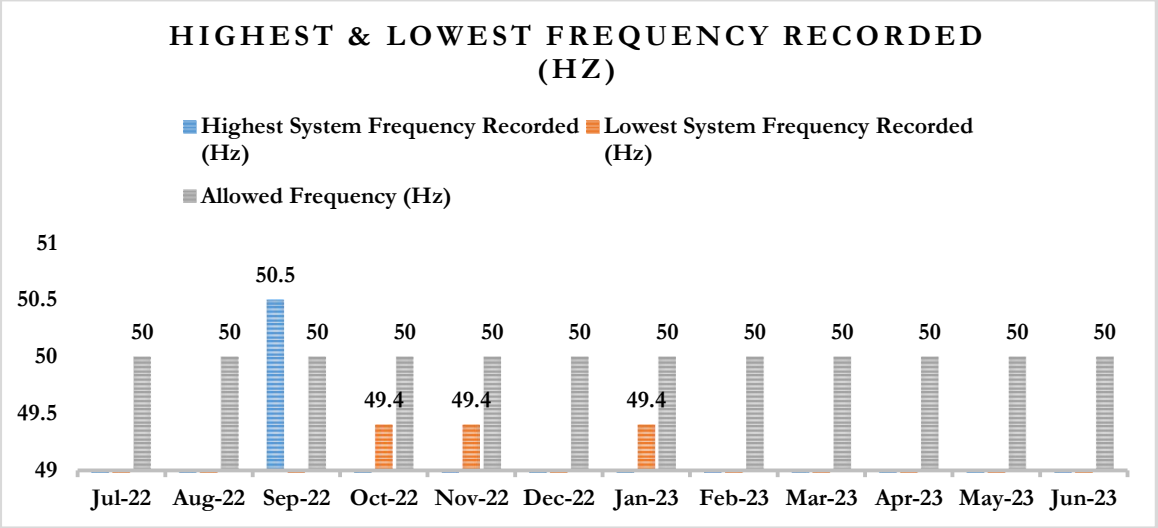
Month	Highest System Frequency Recorded Violating the prescribed Upper Limit1 (Hz)	Lowest System Frequency Recorded Violating the prescribed Lower Limit2 (Hz)	Number of times frequency remained outside the limits
	2022 - 23	2022 – 23	2022 - 23
July 2022	-	-	-
August 2022	-	-	-
September 2022	**50.50**	-	**1**
October 2022	-	**49.40**	**1**
November 2022	-	**49.40**	**1**
December 2022	-	-	-
January 2023	-	**49.40**	**1**
February 2023	-	-	-
March 2023	-	-	-
April 2023	-	-	-
May 2023	-	-	-
June 2023	-	-	-

K-Electric and NTDC are interconnected network. Hence, network frequency control is being governed by both the entities and not influenced by ST&DCPL.

During the financial year FY 2022-23 the highest frequency was recorded in the month of September 2022 however, rest of the year it remained. The lowest frequency recorded remained nil through the year except at three (3) instances where a lowest frequency of 49.4 Hz was recorded during the months of October, 2022, November, 2022 and January, 2023.

The above data in the table has also been shown in the graph below wherein the both the highest and lowest frequency recorded during the financial year FY 2022-23 has been shown along with the allowed frequency limit:

Figure 18.2: Highest & Lowest Frequency Recorded (Hz)



SECTION V

OTHER TECHNICAL ISSUES OF TRANSMISSION LICENSEES

19. Introduction:

Over the recent years, our power sector has faced a number of challenges and pressing issues that require immediate attention and effective solutions. This section will provide an in-depth analysis of key concerns that have significantly impacted the affordability and reliability of power transmission network.

19.1 System Constraints:

NTDC has been facing number of system constraints since past many years. In this regard, several meetings were held with NTDC to discuss issues faced in the smooth evacuation of power from existing and prospective power projects. These meetings aimed to check progress and encourage NTDC to finish projects on time.

As a result, 500 kV Transmission Line of the Shanghai Electric Company Limited Power Plant was finally energized in May 2023. Despite continuous efforts, many of the system constraints are still pending since 2017 and 2018 which are narrated hereunder:

- To fix the problem of overloading at the 500 kV New Rawat Grid Station, NTDC proposed the construction of 500 kV Chakwal Grid Station and 500 kV Islamabad West Grid Station. As per the provided data by NTDC, both of the Grid Stations are expected to be ready by 2024-25. A loan agreement has been signed for Chakwal Grid Station, and evaluation is ongoing for Islamabad West Grid Station. However, due to a delay in the completion of the 500kV Chakwal grid station, an expensive RFO-based power plant of Attock Gen. Ltd. has been committed.

- The addition of a 1x600 MVA transformer at Nokhar Grid Station has been pending since June 2018. The 220 kV transmission line of 500 kV Lahore North Grid Station was supposed to be completed by March 31, 2023, however the same is yet to be completed. Due to this, NPCC is constrained to utilize expensive power generation from HUBCO Narowal and Nandipur (Thermal) Power Plant.

- Slow progress has been noted in resolving the constraint of the addition 1x250 MVA transformer at the Islamabad University Grid Station.

- Since July 2018, 220 kV Sundar Grid Station and 220 kV Kasur Grid Station have been pending completion. However, the deadline for these grids is 2023-24 and 2024-25 respectively, leading to expensive power generation from Nishat Chunian, Nishat Power, and Kohinoor Power Plants.

- The augmentation of a transformer from 4x160 to 4x250 MVA at 500kV Sheikhupura Grid Station has been pending since August 2019. Slow progress by NTDC has been noted in the removal of the said constraint as it was supposed to be completed by the end of September 2023. Due to the said, expensive power from Saba, Halmore and Sapphire plants is being procured.

- The constraints at the 220 kV Daud Khel Grid Station and 220 kV Ludewala Grid Station have been pending since June 2018 and June 2017 respectively. The addition of a 1x160 MVA transformer at Daud Khel has also been delayed, and augmentation of 1x160 T/F with 1x250 MVA T/F at Ludewala is still pending, causing load shedding for the last 5-6 years.

- Constraints removal at 220 kV Kassowal, 500 kV Yousufwala, and 220 kV Vehari Grid Stations have been pending since June 2017 and June 2018, respectively. This has led to expensive power generation from Fauji Kabirwala and Saif Power due to delays in the construction of 220kV Arifwala Grid Stations and expected to be completed in the year 2023-24, however, unfortunately as per the reports of NTDC the said project has not even been started.

- To resolve the constraint pending since June 2017 at the 500 kV Jamshoro Grid Station, NTDC proposed completing the 220kV Mirpur Khas Grid Station and extension works at 220V Hala Road Grid Station. As on June 2023, the progress for these projects still remained as 40.03% and 59%, respectively. The said works were required to be completed by end of December 2023.

- A constraint at 220 kV Quetta Industrial has been pending since June 2017, as on June 2023, the case for allocation of budget for cost of land is under process also PC-I is in process of revision. This shows very slow progress despite the fact that it is due to be completed in year 2024-25.

Additionally, issues of interim arrangement for the evacuation of power from K2-K3 NPP have also been observed instead of construction of a dedicated 500 kV K2/K3 Port Qasim transmission line. Further, the damaged transformer for the last couple of years at NTDC 500kV Guddu Grid Station has increased the transmission losses for SEPCO. NTDC has been directed to resolve these issues urgently.

19.2 Frequent Collapses of Transmission Towers:

Transmission network plays a critical role in delivering electricity across long distances and their importance in supporting the functioning of economies and communities. However, it raises significant concerns regarding a growing trend of tower collapses in the recent past. These tower collapses have led to power outages, safety hazards and economic disruptions which are detrimental to both consumers and the overall infrastructure.

The data provided by NTDC & KE for the fiscal year 2022-23 reveals a total of 46 number of Transmission towers (500kV & 220kV) collapses with the majority occurring in the South region where 33 towers of 500 kV & 220 kV have collapsed. This region seems particularly vulnerable to tower collapses, as evident by multiple incidents involving various transmission lines. The T/lines where frequent tower collapse incidents are being reported are as under;

i. 500 kV Dadu – Jamhoro T/Line & 500 kV Jamshoro - Dadu T/Line
ii. 500 kV Port Qasim – Matiari T/Line
iii. 500 kV Dadu-Shikarpur & 500kV Dadu-Matiari T/Lines
iv. 500kV Guddu-Shikarpur T/Lines
v. 220 kV T/Line Guddu-Shikarpur & Guddu-Sibbi

Additionally, as per the reported data nine (09) 500 kV & 220 kV tower collapses were recorded in the North region, whereas four (04) 220kV & 132kV towers collapsed within K-Electric service area. The high number of tower collapses is a matter of great concern and highlights the urgent need for improved maintenance and resilience of the transmission infrastructure.

The Authority took serious action by directing NTDC to prioritize several important measures. These include regular inspection, maintenance, and a comprehensive review of

the transmission network, along with necessary upgrades based on the findings of a thorough investigation and independent study. Additionally, NTDC was instructed to develop robust weather monitoring systems, establish emergency response plans and invest in the training and capacity building of its engineers and line staff. Furthermore, NTDC was advised to engage with industry experts and adhere to best practices in transmission line design, construction and maintenance to enhance the reliability and safety of its transmission network.

19.3 Delayed Projects of NTDC:

Most of the projects in NTDC are facing significant delays (i.e. their expected completion date exceeds that of contractual completion date). From the detailed perusal, the delayed projects are listed below;

- 220 kV D/C T/L In/Out for KSK Ghazi Road S/C Transmission Line,
- 220 kV D/C T/L In/Out for KSK Ravi S/C Transmission Line,
- 220 kV D/C T/L In/Out for Lahore-Ravi Ghazi Road S/C Transmission Line,
- Extension at 220 kV Daud Khel,
- Augmentation of 220 kV Gakkhar Grid Station,
- Augmentation works at 220 kV Shikarpur Grid Station,
- Augmentation works at 220 kV Quetta Industrial Grid Station,
- Augmentation works at 220 kV g/s at Daharki & Bahawalpur and extension works at 220kV Rohri grid station,
- Augmentation works at 220 kV g/s at Sibbi & Loralai Grid Station,
- Augmentation works at 220 kV g/s at T.M Khan & Hala Road and extension works at 220 kV Jamshoro grid station.

500 kV K2/K3 Port Qasim T/L was expected to be completed on 21/04/2022. However, the same was energized through Interim Arrangement on 03/03/2022. NTDC has been enquired regarding the reasons behind the unprecedented delay and submit completion timelines along with cost overruns/escalation charges due to delay in the timely completion of the said T/L.

The contractual completion date of 220kV DI Khan-Zhob T/L, 220kV Zhob G/S, 220kV Mirpurkhas G/S & its associated T/Lines, 220kV Dhaabeji G/S and its T/Lines was 16/11/2021, 06/09/2022, 10/07/2021 & 09/10/2022 respectively. As per the provided data for June 2023, the revised expected completion dates of the said projects are 31/03/2023, 30/10/2023, 31/10/2023 & 30/06/2023 respectively. However, the projects are yet to be completed.

19.4 Theft of Braces on 500 kV/220 kV Transmission Line:

The high number of tower collapses is a matter of great concern and highlights the urgent need for improved maintenance and resilience of the transmission infrastructure. Ensuring the reliability and safety of these networks is crucial to prevent further power disruptions and hazards. The Authority has taken up the matter with NTDC and directed NTDC to investigate the root causes of these collapses and take proactive measures to mitigate the risks associated with tower failures. NTDC's position on this matter is that the theft of braces in the affected regions is the primary cause behind the increased incidents of tower collapses. In response to this issue, the Authority issued directives to NTDC, instructing them to establish policies and Standard Operating Procedures (SOPs), and ensure regular patrolling

in the affected areas. Nevertheless, despite numerous verbal and written reminders, the submission of an approved copy of the SOP by the Board of Directors (BoD) is still pending:

19.5 Interim Dispersal Arrangements for Power Plants:

On numerous occasions, NTDC has faced challenges in completing the necessary infrastructure for the efficient distribution of power within stipulated timelines. Consequently, NTDC has resorted to the practice of implementing interim power dispersal arrangements both in the past and during the current reporting period. Specifically, NTDC was unable to finalize the transmission line for power evacuation from the newly commissioned 1,320 MW power project operated by Thar Coal Block-I Power Generation Company (Pvt.) Limited in Block-I of Thar Coal. In response to this situation, NTDC opted to utilize an interim power dispersal arrangement. As a result, NTDC had to curtail power from other more cost-effective projects within Thar Coal Block-II, including the 660 MW Engro Powergen Thar (Pvt.) Limited, 330 MW Thar Energy Limited, and 330 MW Thal Nova Power Thar (Pvt.) Limited.

19.6 Implementation of Supervisory Control and Data Acquisition (SCADA) System:

NTDC has been utilizing SCADA since 1992. However, despite the availability of this system, several crucial components have fallen into despair due to a lack of technical hardware and software updates. In response to this issue, NTDC has launched the SCADA-III project, which is being undertaken with the assistance of the Asian Development Bank (ADB). The objective of this project is to enhance the operations and monitoring capabilities of the National Grid and establish real-time data metering from all power plants and critical points.

The SCADA-III project has been awarded to a consortium of China Machinery Engineering Corporation (CMEC) and Hitachi ABB Power Grids. It is of utmost importance that the SCADA-III project is completed and implemented in a timely manner, especially considering the anticipated expansion of the power system and its operational requirements. NEPRA is actively overseeing the progress of the SCADA-III project during NTDC's bi-monthly and quarterly meetings.

19.7 Inadequate Interconnection between NTDC and KE:

The existing interconnection capacity between NTDC and KE has a limitation, allowing the transport of approximately 1,100 MW. This capacity is facilitated through a network that links NTDC's system with KE's at 500kV Jamshoro and 500kV NKI grid stations. With the commissioning of new generation facilities such as K2 & K3 power plants operating on nuclear fuel, as well as power plants using imported coal like Port Qasim, China Power Hub Generation, and Lucky Electric (both imported and locally sourced), the need for infrastructure enhancements has arisen. In response to these developments, KE has submitted an investment plan. This plan includes proposals for the construction of a 500 kV grid station at KKI. Additionally, it suggests augmenting the 500 kV NKI grid station by installing an additional power transformer to address the increased power demand and supply requirements.

19.8 Signing of Energy Purchase Agreement/Power Purchase Agreement, Connection Agreement between CPPA-G, KE & NTDC:

Due to the power supply shortage experienced by KE, there was a need to bolster their supply from the National Grid. Consequently, a Power Purchase Agreement (PPA) has been

initiated between CPPA-G and KE. This PPA, securing a firm supply of 1,000 MW, aims to establish a legal and financial framework governing the buying and selling of electricity between these two entities. The Authority has consistently stressed the importance of establishing distinct contractual arrangements between CPPA-G, KE & NTDC as it causes ownership and governance issues.

19.9. Fatal and Non-fatal Incidents in Pakistan's Transmission Line Network

The extensive network of transmission lines (including KE) carrying electricity across the country faces the unfortunate reality of both fatal and non-fatal incidents. These occurrences are caused by various factors, including electrocution, Inadequate maintenance, deteriorated infrastructure and inadequate/poor safety measures adopted by the Licensees as lack of awareness about electrical safety, improper work practices, and negligence have contributed to fatal/non-fatal accidents involving individuals working at transmission lines or switchyards in the grid stations.

As per the provided data by NTDC & KE for the last financial year i.e. June 2022 to June 2023, 2 Fatal & 1 Non-Fatal incident involving Contractor's employee of NTDC employees occurred. Whereas, KE reported total ***11*** Fatal ***and*** Non-Fatal Incidents within its transmission network, which are as follows;

01 Non-Fatal incident involving contractor's employee
04 Fatal incidents involving the general public
01 Non-fatal incident involving KE employee
05 Non-Fatal incidents involving general public

While non-fatal incidents often result in injuries and require medical attention, they also highlight potential vulnerabilities in the system. Addressing these vulnerabilities through improved safety measures, infrastructure upgrades, and public awareness campaigns can significantly reduce the risk of both fatal and non-fatal accidents. The Authority has 0 tolerance policy w.r.t fatal/non-fatal incidents and has strictly directed transmission licensees to ensure the implementation of revised Power Safety Code.

19.10 Major System Disturbance Occurred During FY 2022-23:

a) Total Power Black Out of the System:

(https://nepra.org.pk/publications/Reports/Jan%2023%20Blackout%20Report.pdf)

Our country has been facing extensive blackouts over the past few years, with a notable blackout occurring on January 23, 2023. Recognizing the severity of the situation, the Authority promptly initiated an inquiry, convening a hearing with stakeholders to delve into the matter. As part of its investigative efforts, the Authority established an Inquiry Committee, comprising a panel of diverse experts, tasked with conducting a comprehensive review and offering recommendations. This committee meticulously examined the various operational procedures currently in practice and conducted on-site visits to multiple generation facilities, ultimately compiling a thorough report. Subsequently, upon reviewing the committee's findings, the Authority identified significant operational shortcomings within NTDC, NPCC, and various power plants.

In response to these findings, the Authority decided to commence legal proceedings against the aforementioned entities. Alongside this action, the Authority issued the number of directives to both NTDC and the power plants for compliance.

1

1 **Corrigendum Note:** Numbers marked in bold & Italic have been revised & included in Performance Evaluation Report (PER) on the request of KE.

b) Partial Power Blackout in the Country Occurred on 13 October 2022:

(https://nepra.org.pk/publications/Reports/NEPRA%20Inquiry%20Report%20Partial%20System%20Collapse%20Oct%2013%202022.pdf)

A partial blackout of the power supply occurred on October 13, 2022, due to a conductor breakdown on the red phase of the 500 kV NKI-K2/K3 interconnecting 500 kV K2/K3-Jamshoro Transmission Line through the interim arrangement. This incident plunged a substantial portion of the country into darkness. Following a thorough review of the Incident Report, the Authority decided to initiate legal proceedings against NTDC and involved power plants. Additionally, the Authority issued directions to NTDC and the relevant power plants for compliance.

20. Conclusion:

20.1 System Reliability:

NTDC has made some improvements in system reliability with reduction in both the Average Duration of Interruption (i.e. 0.12 Hrs. / point in 2022-23) and the Average Frequency of Interruptions over the years.

From the data provided by KE, it is concluded that KE has a reliable transmission network with zero interruptions and zero outages during FY 2022-23.

As per provided data of FTCL, system duration of interruption was 8.5 Hrs/point, similarly the System Frequency of Interruption was recorded as 2.5 no./circuit.

In case of ST&DCPL, the system duration was 17.71 Hrs./point whereas the system frequency of interruption reported as 3.5 no. /circuit.

20.2 System Security:

The increase in Energy Not Served (ENS) is a concern and requires immediate attention. NTDC should investigate the causes behind this increase and take corrective measures to ensure a more stable power supply. Two major disturbances also occurred in FY 2022-23. (see the link for report: https://nepra.org.pk/publications/Inquiry%20Reports.php).

System KE reported zero Energy Not Served (ENS) during the year. However KE submitted that:

During FY 2022-23, the total ENS of FTCL was 918 MWh. whereas the total ENS of ST&DCPL was 3579.21 MWh.

20.3 Quality of Supply:

The data shows that the system frequency has remained mostly stable with minor violations. The number of voltage violations has reduced in the "N-1" system condition. But still, there are some regions with a high number of voltage violations in normal conditions like 500 kV Grids namely Peshawar, Rawat, Faisalabad, Sheikhupura, Yousafwala, Shikarpur, and 220 kV grids i.e. Ghazi Road, Mardan, Sibi, and Chishtian, These grids need particular attention, to improve their performance.

In the area of quality of supply, the data reveals that K-Electric reported 44 voltage violations under normal conditions, which is a decrease of 4.34% compared to the previous year. Similarly, K-Electric experienced only 4 instances where frequency remained outside the prescribed limits with minimal duration.

FTCL reported the highest voltage violation as 144.93 kV. Similarly, the frequency was outside of permissible limits on 29 times with the total duration of 208 minutes.

In case of ST&DCPL, voltage violations reported as zero for both Normal and N-1 condition at 132 kV level whereas four frequency violations were recorded during the reported period.

In addition to the above performance data, NTDC is facing various issues in performing its duties as mandated under the NEPRA Act, Rules, Regulations, terms and conditions of License & Grid Code which include system constraints, overloaded grid stations & transmission lines, aging infrastructure and grid protections etc. In order to address these issues, NTDC has started a number of projects however, it is observed that these projects are facing consistent delays in their execution. It is imperative that NTDC expedites the completion of these pending projects to ensure more cost effective power generation.

Another major issue is the frequent collapses of transmission towers which has caused power outages and safety hazards. During FY 2022-23, a total 46 numbers of towers collapsed in the NTDC network.

It is also observed that projects i.e. construction of new grid stations and transmission lines are also facing unprecedented delays. It's important to expedite these projects and follow the revised timelines to improve the overall power system.

Implementation of the SCADA system is also a big challenge for NTDC. During FY 2022-23, NTDC faced two major power blackouts which raised critical concerns about the operational procedures and the overall reliability of the system.

21 Recommendations:

Following are the recommendations to improve the system conditions at NTDC & KE transmission network:

For Entire Transmission Sector:

- Assess seasonal variations in demand and external factors like weather events and develop specific strategies and maintenance schedules to address these seasonal challenges effectively.
- Perform risk analysis to determine the most likely causes of system interruptions, such as equipment failures, extreme weather events, and external threats. After identification, prioritize the most critical components of the grid, such as substations, transformers, and key transmission lines, based on their impact on system reliability;
- Install Wind Measuring devices that can predict severe weather events, such as storms, heavy winds, and ice accumulation, which pose a risk to tower stability.
- Increase interconnection capacity between KE and NTDC systems to facilitate unconstrained power flow, supply of cheap/economic power to KE and bolster system stability.
- Draft & implement transmission line security policy, and ensure regular patrolling to prevent theft of braces to ensure the reliability and safety of the transmission network.
- Upgrade grid infrastructure, especially in the area where frequent incidents are occurring repeatedly & prioritize replacement of ageing equipment in the grid infrastructure.
- To ensure the installation of modern technologies devices such as Wide Area Management (WAM) including Phasor Management Units (PMU) to detect oscillations instability which can be mitigated by Remedial Action Scheme (RAS).

For KE:

- Being responsible for providing reliable power to its customers, especially Karachi, the economic hub of the country, it is essential that KE takes measures/steps to operate in island mode in the event of external major incidents to avoid unnecessary power cuts.

For NTDC: Following are the specific recommendations for NTDC:

- Prioritize the completion of all pending projects to alleviate constraints and reduce the reliance on expensive power generation methods.
- Accelerate the implementation of Constraints Removal Schemes to address issues without further delay.
- Conduct a comprehensive reassessment of each delayed project to identify the primary causes of delays, and work with project managers and stakeholders to revise project schedule that is both realistic and aggressive
- Promote active engagement and collaboration with Provincial Grid Companies to strengthen the power network.
- Expand the number of Regional Control Centers to bolster system control and operation.
- The existing interim arrangement may immediately be reinforced with standard hardware. Aging factor of the conductor and quality of material before and proper workmanship during the execution of interim arrangement must be ensured.
- Periodic maintenance/monitoring activities, especially the interim arrangement designed for K2/K3 Circuits, must be ensured as per SOP.
- VAR compensations study shall be carried out and required measures in light of the study shall be taken to avoid Power Swing.
- Availability of required professionals and staff as per approved yardstick, along with required T&P including thermo vision camera, especially in southern region must be arranged on an urgent basis to ensure timely maintenance of existing network for system stability, reliability, and security.
- NTDC Telecom department's deficiencies must be addressed to ensure proper communication of inter grid signals and avoid transmission of false signals.
- Execution work of dedicated transmission lines shall be completed before the energization of transformation equipment (or) COD of Power Plants to avoid the LDs resultantly reducing the basket price for the consumer.
- A study shall be carried out to install additional Shunt Reactors at appropriate locations i.e. on the Grid Station Busbar.
- NTDC shall ensure the healthiness and operation of recently installed Out of Step devices, as the same did not operate during the event.

APPENDIX 1

Voltage violations data - detailed circuit wise analysis

NTDC Islamabad Region

1. 500 kV Rawat
2. 500 kV Peshawar
3. 220 kV Bannu
4. 220 kV Burhan
5. 220 kV Daudkhel
6. 220 kV ISPR (Sangjani)
7. 220 kV Mardan
8. 220 kV Nowshera
9. 220 kV Shahibagh
10. 220 kV University
11. 220 kV Mansehra
12. 220 kV Chakdara
13. 220 kV D. I. Khan

NTDC ISLAMABAD REGION

1. 500kV Grid Station Rawat

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500 kV Rawat - Barotha Ckt I & II	482	223	195	60	Nil	553	60	537	150	539	120	542	120	Nil	Nil	-	-	-	-	-	-	-	-	Nil	Nil
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	500 kV Rawat - Tarbela	481	223	195	-	Nil	553	60	537	150	539	120	542	120	Nil	Nil	-	-	-	-	-	-	-	-	Nil	Nil
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	500 kV Rawat - Neelum Jehlum	479	223	195	60	NII	553	60	537	150	539	120	-	-	Nil	Nil	-	-	-	-	-	-	-	-	Nil	Nil
N-1		-	-	-	-	NII	-	-	-	-	-	-	-	-	Nil	Nil	-	-	-	-	-	-	-	-	Nil	Nil
Normal	500 kV Rawat - Nokhar	481	223	195	60	Nil	553	60	537	150	539	120	542	120	Nil	Nil	-	-	-	-	-	-	-	-	Nil	Nil
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Rawat - ISPR Ckt I & II	534	1,469	879	821	512	246	60	245	180	245	240	248	120	246	60	-	-	-	-	-	-	-	-	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Rawat - Mangla Ckt I & II	1,068	1,469	879	821	512	246	60	245	180	245	240	248	90	246	60	-	-	-	-	-	-	-	-	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Rawat - Bahria Town Ckt I & II	589	1,469	881	821	512	246	60	245	180	245	240	248	120	246	60	-	-	-	-	-	-	-	-	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Rawat - University Ckt I & II	1,051	1,469	879	821	512	246	60	245	180	245	240	248	120	246	60	-	-	-	-	-	-	-	-	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Total No. of Variations (Normal)	5,165	6,768	4,298	3,464	2,048
Total No. of Variations (N-1)	-	-	-	-	-
Total (Normal & N-1)	5,165	6,768	4,298	3,464	2,048

Highest Voltage Under Normal Condition @220kV level

NTDC ISLAMABAD REGION

2. 500kV Grid Station SHEIKH MUHAMMADI PESHAWAR

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500 kV Tarbela - Peshawar	19	432	172	632	1,407	538	60	541	60	536	60	553	60	545	60	-	-	468	60	473	60	469	60	473	60
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Peshawar - Daudkhel Ckt I & 2	251	587	415	1,244	1,042	238	60	238	60	234	60	239	60	238	60	180	60	185	60	199	60	192	60	202	60
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Peshawar - Nowshera	42	635	415	1,240	521	-	-	238	60	234	60	239	239	238	60	180	60	186	60	199	60	192	60	202	60
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Peshawar - Shahibagh	251	621	415	1,241	521	238	60	238	60	234	60	-	-	238	60	180	60	185	60	199	60	-	-	204	60
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Total No. of Variations (Normal)	772	2,275	1,417	4,357	3,491
Total No. of Variations (N-1)	-	-	-	-	-
Total (Normal & N-1)	772	2,275	1,417	4,357	3,491

Highest Voltage Under Normal Condition @500kV level

Lowest Voltage Under Normal Condition @500kV level

Highest Voltage Under Normal Condition @220kV level

Lowest Voltage Under Normal Condition @220kV level

NTDC ISLAMABAD REGION

3. 220 kV Grid Station Bannu

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Daudkhel - Bannu Ckt I & II	586	358	332	1,238	1,893	241	60	240	60	241	60	240	60	242	60	-	-	-	-	-	-	-	-	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Chashma - Bannu Ckt I & II	609	358	332	677	1,894	241	60	240	60	241	60	240	60	242	60	-	-	-	-	-	-	-	-	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Total No. of Variations (Normal)	1,195	716	664	1,915	3,787
Total No. of Variations (N-1)	-	-	-	-	-
Total (Normal & N-1)	1,195	716	664	1,915	3,787

Highest Voltage Under Normal Condition @220kV level

NTDC ISLAMABAD REGION

4. 220 kV Grid Station Burhan

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Burhan - ISPR Ckt I & II	130	516	322	234	36	241	60	235	120	238	180	242	60	241	60	-	-	194	60	204	60	201	60	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Burhan - Tarbela Ckt I, II & III	135	516	322	234	36	241	60	235	120	238	180	242	60	241	60	206	60	194	60	204	60	201	60	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Total No. of Variations (Normal)	265	1,032	644	468	72
Total No. of Variations (N-1)	-	-	-	-	-
Total (Normal & N-1)	265	1,032	644	468	72

Highest Voltage Under Normal Condition @220kV level

NTDC Islamabad Region

5. 220 kV Grid Station Daudkhel

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Daudkhel - Peshawar Ckt I & 2	302	228	81	4	137	244	60	242	240	238	540	234	240	243	120	204	60	204	60	-	-	-	-	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Daudkhel - Chashma Ckt I & II	302	228	81	4	130	244	60	242	240	238	540	234	240	243	120	204	60	204	60	-	-	-	-	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Daudkhel - Bannu Ckt I & II	302	228	81	4	132	244	60	242	240	238	540	234	240	243	120	204	60	204	60	-	-	-	-	-	-
N-1		-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Total No. of Variations (Normal)	906	684	243	12	399
Total No. of Variations (N-1)	-	-	-	-	-
Total (Normal & N-1)	906	684	243	12	399

Highest Voltage Under Normal Condition @220kV level

NTDC Islamabad Region

6. 220kV Grid Station ISPR (SANGJANI)

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV ISPR - Burhan	43	259	102	306	124	235	120	232	30	-	-	236	60	-	-	204	60	190	60	196	60	195	180	200	120
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV ISPR - Tarbela	54	322	168	284	22	240	60	238	90	240	240	242	60	239	120	204	60	195	60	196	60	196	60	206	180
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV ISPR - Bahria Town	98	269	84	266	178	235	180	235	90	234	120	234	60	-	-	203	60	190	60	195	60	192	180	202	120
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV ISPR - Rawat	101	268	84	266	177	235	180	235	90	232	120	-	-	-	-	200	60	190	60	195	60	192	180	202	120
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV ISPR - Mansehra Ckt I	116	124	72	150	16	238	60	235	60	236	180	240	60	-	-	205	120	196	60	198	60	195	180	205	60
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV ISPR - Mansehra Ckt II	58	122	72	150	16	238	60	235	60	236	180	240	60	-	-	205	120	196	60	198	60	195	180	205	60
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Total No. of Variations (Normal)	470	1,364	582	1,422	533
Total No. of Variations (N-1)	-	-	-	-	-
Total (Normal & N-1)	470	1,364	582	1,422	533

Lowest Voltage Under Normal Condition @220kV level

Highest Voltage Under Normal Condition @220kV level

NTDC Islamabad Region

7. 220kV Grid Station Mardan

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Tarbela - Mardan Ckt I & II	6,875	1,820	1,333	2,093	1,953	-	-	-	-	-	-	-	-	235	60	188	60	181	60	185	60	185	60	194	60
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Mardan - Shahibagh Ckt I & II	747	-	-	NP	NP	-	-	-	-	-	-	NP	NP	NP	NP	185	150	-	-	-	-	NP	NP	NP	NP
N-1		-	-	-	NP	NP	-	-	-	-	-	-	NP	NP	NP	NP	-	-	-	-	-	-	NP	NP	NP	NP
Normal	220 kV Mardan - Nowshera Ckt I & II	-	1,820	1,333	2,093	977	-	-	-	-	-	-	-	-	235	60	-	-	181	60	185	60	185	60	194	60
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Mardan - Chakdara Ckt	2,546	1,820	1,333	2,093	977	-	-	-	-	-	-	-	-	235	60	190	60	181	60	185	60	185	60	194	60
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-

Doesn't exist, Now named as Mardan-Chakdara and Chakdara-ShahiBagh

Total No. of Variations (Normal)	13,513	5,460	3,999	6,279	3,907
Total No. of Variations (N-1)	-	-	-	-	-
Total (Normal & N-1)	13,513	5,460	3,999	6,279	3,907

Highest Voltage Under Normal Condition @220kV level

Lowest Voltage Under Normal Condition @220kV level

NTDC Islamabad Region

8. 220kV Grid Station Nowshera

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Nowshera - Mardan	Nil	338	215	767	316	Nil		240	60	238	60	238	60	238	60	Nil		199	30	200	60	195	60	201	60
N-1			-	-	-	-			-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-
Normal	220 kV Nowshera - Barotha 1 & 2	Nil	689	215	767	632	Nil		240	60	238	60	238	60	238	60	Nil		199	30	200	60	195	60	201	60
N-1			-	-	-	-			-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-
Normal	220 kV Nowshera - S. M Peshawar	Nil	330	198	767	316	Nil		240	60	238	60	238	60	238	60	Nil		199	30	200	60	195	60	201	60
N-1			-	-	-	-			-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-

Total No. of Variations (Normal)	Nil	1,357	628	2,301	1,264
Total No. of Variations (N-1)	-	-	-	-	-
Total (Normal & N-1)	Nil	1,357	628	2,301	1,264

Highest Voltage Under Normal Condition @220kV level

Lowest Voltage Under Normal Condition @220kV level

NTDC Islamabad Region

9. 220kV Grid Station NEW SHAHIBAGH PESHAWAR

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Shahibagh - Peshawar Ckt II	1,878	2,103	2,954	3,067	1,347	-	-	-	-	-	-	-	-	-	-	190	120	182	60	184	120	182	60	190	120
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Shahibagh - Chakdara	337	1,517	1,396	1,703	367	-	-	-	-	-	-	-	-	-	-	170	60	182	60	185	60	187	60	190	90
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Total No. of Variations (Normal)	2,816	3,620	4,350	4,770	1,714
Total No. of Variations (N-1)	-	-	-	-	-
Total (Normal & N-1)	2,816	3,620	4,350	4,770	1,714

Lowest Voltage Under Normal Condition @220kV level

NTDC Islamabad Region

10. 220kV Grid Station UNIVERSITY

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV University - Rawat Ckt I & II	2,832	2,812	2,363	1,469	618	250	60	246	240	249	120	249	60	244	120	202	60	202	120	-	-	203	120	-	-
N-1		-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Total No. of Variations (Normal)	2,832	2,812	2,363	1,469	618
Total No. of Variations (N-1)	-	-	-	-	-
Total (Normal & N-1)	2,832	2,812	2,363	1,469	618

Highest Voltage Under Normal Condition @220kV level

NTDC Islamabad Region

11. 220kV Grid Station MANSEHRA

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Mansehra - Allai Khwar 1 &2	62	28	156	92	27	241	60	235	120	238	180	242	60	242	60	-	-	194	60	198	50	200	60	205	60
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Mansehra - ISPR 1 & 2	62	28	156	86	27	241	60	235	120	238	180	242	60	242	60	-	-	194	60	198	50	-	-	205	60
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Total No. of Variations (Normal)	124	56	312	178	54
Total No. of Variations (N-1)	-	-	-	-	-
Total (Normal & N-1)	124	56	312	178	54

Highest Voltage Under Normal Condition @220kV level

Lowest Voltage Under Normal Condition @220kV level

NTDC Islamabad Region

12. 220kV Grid Station CHAKDARA

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Chakdara - Shahibagh	115	289	169	183	85	-	-	-	-	-	-	235	90	233	90	196	60	190	90	190	90	180	60	193	60
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Chakdara - Mardan	202	289	199	183	85	-	-	-	-	-	-	235	90	233	90	193	60	190	90	190	90	180	60	193	60
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Total No. of Variations (Normal)	317	578	368	366	170
Total No. of Variations (N-1)	-	-	-	-	-
Total (Normal & N-1)	317	578	368	366	170

Highest Voltage Under Normal Condition @220kV level

Lowest Voltage Under Normal Condition @220kV level

NTDC Islamabad Region

13. 220kV Grid Station D. I. KHAN

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV D. I. Khan - Chashma 1 &2	1,830	3,126	1,842	1,146	44	246	60	242	120	240	180	242	120	244	60	-	-	-	-	-	-	-	-	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Total No. of Variations (Normal)	1,830	3,126	1,842	1,146	44
Total No. of Variations (N-1)	-	-	-	-	-
Total (Normal & N-1)	1,830	3,126	1,842	1,146	44

Highest Voltage Under Normal Condition @220kV level

APPENDIX 2

Voltage violations data - detailed circuit wise analysis

NTDC Lahore Region

1. 500 kV Gatti
2. 500 kV West Faisalaabad
3. 500 kV Sheikhupura
4. 220 kV Bandala
5. 220 kV Ludewala
6. 220 kV Lalian
7. 500 kV New Lahore
8. 220 kV Faisalabad West
9. 220 kV Bund Road Lahore
10. 220 kV Gakkhar
11. 220 kV Ghazi Road
12. 220 kV Gujrat
13. 220 kV Jaranwala
14. 220 kV Kala Shah Kaku
15. 220 kV Nishatabad
16. 220 kV New Kot Lakhpat
17. 220 kV New Shalamar
18. 220 kV Ravi
19. 220 kV Samundri Road
20. 220 kV Sarfraz Nagar
21. 220 kV Sialkot
22. 220 kV Toba Tek Singh
23. 220 kV WAPDA Town
24. 500 kV Yousafwala
25. 220 kV Kassowal
26. 220 kV Okara

NTDC Lahore Region

1. 500kV Grid Station GATTI FAISALABAD

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500KV Gatti - Barotha CCT-I	NA					NA								–	–	NA								–	–
N-1															–	–									–	–
Normal	500KV Gatti - Barotha CCT-II	NA			1	1	NA						530	60	530	90	NA						–	–	–	–
N-1					–	–							–	–	–	–							–	–	–	–
Normal	500kV Gatti-Rousch	22	26	30	12	213	538	150	540	330	540	360	540	270	540	240	–	–	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500KV Gatti - H.B Shah 1	155	23	7	12	–	535	90	543	390	535	90	540	240	–	–	–	–	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500KV Gatti - H.B Shah 2	155	232	18	39	–	545	30	540	690	540	390	540	570	–	–	–	–	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500KV Gatti - Bhikhi Line	8	1	1	38	97	530	180	533	100	530	150	540	330	540	60	–	–	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500kV Gatti-West FSD	Added in 2021-22			78	307	Added in 2021-22						540	240	550	60	Added in 2021-22						–	–	–	–
N-1					–	–							–	–	–	–							–	–	–	–
Normal	220KV Gatti-Nishatabad CCT-I & II	144	84	18	64	15	243	90	234	120	236	240	236	70	234	210	–	–	203	330	207	60	204	120	205	180
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Condition	Name of Transmission ircuit(s) violating e voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220KV Gatti - Jaranwala Road CCT I & II	90	90	56	194	21	242	90	232	120	235	240	236	270	232	210	–	–	200	240	204	60	201	180	205	120
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220KV Gatti- Yousafwala CCT-I & II	NA	134	NP	454	21	NA	NA	231	90	NP	NP	235	270	–	–	NA	NA	200	60	NP	NP	195	390	204	540
N-1		NA	–	NP	–	–	NA	NA	–	–	NP	NP	–	–	–	–	NA	NA	–	–	NP	NP	–	–	–	–
Normal	220KV Gatti- Ludewala CCT-I & II	NA	182	82	316	61	NA	NA	–	–	–	–	–	–	–	–	NA	NA	201	330	203	120	200	180	202	540
N-1		NA	–	–	–	–	NA	NA	–	–	–	–	–	–	–	–	NA	NA	–	–	–	–	–	–	–	–
Normal	220KV Gatti - Bandala CCT-I & II	222	76	42	156	19	245	90	236	240	232	300	240	120	234	240	–	–	206	90	204	120	202	180	205	180
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220KV Gatti-Lalian CCT	Added in 2021-22			39	79	Added in 2021-22						–	–	–	–	Added in 2021-22						204	180	202	540
N-1					–	–							–	–	–	–							–	–	–	–

Reported in 2021-22

NP: Not Provided, NA: Not applicable

Condition	2018-19	2019-20	2020-21	2021-22	2022-23
Total No. of Variations (Normal)	796	848	254	1,402	833
Total No. of Variations (N-1)	–	–	–	–	–
Total (Normal & N-1)	796	848	254	1,402	833

Highest Voltage Under Normal Condition @500kV level

Highest Voltage Under Normal Condition @220kV level

Lowest Voltage Under Normal Condition @220kV level

NTDC Lahore Region

2. 500kV Grid West FAISALABAD

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500KV WFSD-Gatti	Added in 2021-22			738	2,314	Added in 2021-22						542	60	548	120	Added in 2021-22						–	–	–	–
N-1					–	–							–	–	–	–							–	–	–	–
Normal	500KV WFSD-HBS				738	2,313							542	60	548	120							–	–	–	–
N-1					–	–							–	–	–	–							–	–	–	–
Normal	220KV WFSD-TTS				10	3,355							235	180	249	60							–	–	–	–
N-1					–	–							–	–	–	–							–	–	–	–
Normal	220KV WFSD-Trimmu				10	NP							235	180	NP	NP							–	–	NP	NP
N-1					–	NP							–	–	NP	NP							–	–	NP	NP

Added in 2021-22

This CCT is mentioned as WFSD-PTPL in PSTR information already provided

Total No. of Variations (Normal)	-	-	-	1,496	7,982
Total No. of Variations (N-1)					-
Total (Normal & N-1)	-	-	-	1,496	7,982

Highest Voltage Under Normal Condition @500kV level

Highest Voltage Under Normal Condition @220kV level

NTDC Lahore Region

3. 500kV Grid Station Sheikhupura

Condition	Name of Transmission Circuit(s) violatin the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500KV SKP - Nokhar	30	8	7	NA	1	532	90	528	90	528	90	NA		528	120	–	–	–	–	–	–	NA		–	–
N-1		–	–	–	NA	–	–	–	–	–	–	–			–	–	–	–	–	–	–	–			–	–
Normal	500KV SKP - Bhiki	26	26	5	NA	1	535	60	540	60	526	120	NA		527	60	–	–	–	–	–	–	NA		–	–
N-1		–	–	–	NA	–	–	–	–	–	–	–			–	–	–	–	–	–	–	–			–	–
Normal	500KV SKP - New Lahore	52	5	NP	NP	NP	535	60	528	60	NP		NP		NP		–	–	–	–	NP		NP		NP	
N-1		–	–	NP	NP	NP	–	–	–	–							–	–	–	–						
Normal	500KV SKP - HVDC	Added in 2020-21		7	2	4	Added in 2020-21				526	90	525	60	529	60	Added in 2020-21				–	–	–	–	–	–
N-1				–	–	–					–	–	–	–	–	–					–	–	–	–	–	–
Normal	220KV SKP - WAPDA TOWN	986	283	17	52	7	–	–			–	–	230	60	232	120	198	60	197	90	202	60	197	60	203	120
N-1		30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	192	60	–	–	–	–	–	–	–	–
Normal	220KV SKP - NKLP	780	686	6	91	31	–	–	–	–	–	–	–	–	234	180	198	60	194	60	202	60	193	120	190	60
N-1		2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	196	60	–	–	–	–	–	–	–	–
Normal	220KV SKP: - Bund Road CCT-I, II, III & IV	4,509	582	57	156	38	–	–	–	–	–	–	232	60	238	150	198	60	197	60	202	90	200	90	199	60

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
N-1	220KV SKP: - Bund Road CCT-I, II, III & IV	89	–	–	–	–	–	–	–	–	–	–	–	–	–	–	192	60	–	–	–	–	–	–	–	–
Normal	220KV SKP - RAVI ROAD.	472	436	42	31	1	–	–	–	–	–	–	–	–	232	90	198	60	197	60	204	90	196	150	–	–
N-1	220KV SKP - RAVI ROAD.	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	197	90	–	–	–	–	–	–	–	–
Normal	220KV SKP - ATLAS P/H.	1,662	986	27	24	17	–	–	–	–	237	120	–	–	240	180	198	60	184	60	204	120	196	150	201	270
N-1		66	–	–	–	–	–	–	–	–	–	–	–	–	–	–	192	120	–	–	–	–	–	–	–	–

Added in 2020-21

Now there is HVDC-I and HVDC-II CCT instead of SKP- New Ihr cct, Its PSTR is already provided

Total No. of Variations (Normal)	8,517	3,012	168	356	100
Total No. of Variations (N-1)	189	-	-	-	-
Total (Normal & N-1)	8,517	3,012	168	356	100

Highest Voltage Under Normal Condition @500kV level

Highest Voltage Under Normal Condition @220kV level

Lowest Voltage Under Normal Condition @220kV level

NTDC Lahore Region

4. 220kV Grid Station Bandala

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV T/L Bandala-KSK I & II	596	900	520	228	67	–	–	241	90	240	120	–	–	237	120	199	60	202	60	201	180	190	60	203	90
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220kV T/L Bandala-Gatti I & II	596	900	136	228	67	–	–	241	90	–	–	–	–	237	120	199	60	202	60	201	180	190	60	203	90
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Total No. of Variations (Normal)	1,192	1,800	656	456	134
Total No. of Variations (N-1)	-	-	-	-	-
Total (Normal & N-1)	1,192	1,800	656	456	134

Highest Voltage Under Normal Condition @220kV level

Lowest Voltage Under Normal Condition @220kV level

NTDC Lahore Region

5. 220kV Grid Station Ludewala

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220KV Ludewala-Gatti	243	210	75	402	2	240	240	240	120	240	240	239	60	Nil	Nil	198	60	198	60	204	120	200	60	203	120
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220 KV CHASHMA-LUDEWALA CCT-1&2	133	201	82	354	144	238	120	238	120	240	210	238	120	240	90	–	–	198	90	202	60	199	60	204	90
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220KV Ludewala-Lalian	Reported in 2021-22			1	139	Reported in 2021-22						–	–	241	90	Reported in 2021-22						208	60	205	90
N-1					–	–							–	–	–	–							–	–	–	–

Reported in 2021-22

Total No. of Variations (Normal)	376	411	157	757	285
Total No. of Variations (N-1)	-	-	-	-	-
Total (Normal & N-1)	376	411	157	757	285

Highest Voltage Under Normal Condition @220kV level

Lowest Voltage Under Normal Condition @220kV level

NTDC Lahore Region

6. 220kV Grid Station Lalian

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220KV Lalian-Gatti	Added In 2022-23				5	Added In 2022-23								Nil	Nil	Added In 2022-23								203	180
N-1						–									–	–									–	–
Normal	220KV Lalian-Ludewala					5									239	120									203	180
N-1						–									–	–									–	–

Added in 2022-23

Total No. of Variations (Normal)	-	-	-	-	10
Total No. of Variations (N-1)	-	-	-	-	-
Total (Normal & N-1)	-	-	-	-	10

Highest Voltage Under Normal Condition @220kV level

Lowest Voltage Under Normal Condition @220kV level

NTDC Lahore Region

7. 220kV Grid Station Toba tek singh

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220KV Multan -Toba Tek Singh Circuit # 1&2	707	468	224	906	490	248	570	245	660	247	1,110	251	570	247	330	170	480	171	1,410	182	540	176	1,260	206	60
N-1		2	2	–	–	–	–	–	–	–	–	–	–	–	–	–	177	1,290	172	1,410	–	–	–	–	–	–
Normal	220KV Toba Tek Singh-Samundri Road Circuit #1&2	707	468	224	906	490	248	570	245	660	247	1,110	251	570	247	330	170	480	171	1,410	182	540	176	1,260	206	60
N-1		2	2	–	–	–	–	–	–	–	–	–	–	–	–	–	177	1,290	172	1,410	–	–	–	–	–	–
Normal	220KV Toba Tek Singh-PTPL Circuit #1,2,3&4.	Added in 2022-23				490	Added in 2022-23								247	330	Added in 2022-23								206	60
N-1						–									–	–									–	–

Added in 2022-23

Total No. of Variations (Normal)	1,414	936	448	1,812	1,470
Total No. of Variations (N-1)	4	4	-	-	-
Total (Normal & N-1)	1,418	940	448	1,812	1,470

Highest Voltage Under Normal Condition @220kV level

Lowest Voltage Under Normal Condition @220kV level

NTDC Lahore Region

8. 220kV Grid Station Nishatabad

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220KV Gatti-Nishatabad Circuit # I , II	24	134	28	6	3	234	120	–	–	235	90	235	60	234	60	–	–	203	60	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220KV Samundri Road-Nishatabad Circuit # I & II	24	134	–	6	3	234	120	–	–	–	–	235	60	234	60	–	–	203	60	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Total No. of Variations (Normal)	48	268	28	12	6
Total No. of Variations (N-1)	-	-	-	-	-
Total (Normal & N-1)	48	268	28	12	6

Highest Voltage Under Normal Condition @220kV level

NTDC Lahore Region

9. 220kV Grid Station Samundri

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220KV SAMUNDRI ROAD - NISHATABAD CCT. NO. I&II	14	402	200	576	175	241	150	239	90	241	210	242	180	238	60			205	210	204	90	204	210	–	–
N-1		12	2	–	–	–	–	–	–	–	–	–	–	–	–	–	180	90	179	90	–	–	–	–	–	–
Normal	220KV T.T.SINGH - SAMUNDRI ROAD CCT. NO. I&II	7	201	24	976	175	241	150	239	90	238	120	242	180	238	60			205	210	204	90	204	210	–	–
N-1		6	1	–	–	–	–	–	–	–	–	–	–	–	–	–	180	90	179	90	–	–	–	–	–	–

Total No. of Variations (Normal)	21	603	224	1,552	350
Total No. of Variations (N-1)	18	3	-	-	-
Total (Normal & N-1)	39	606	224	1,552	350

Highest Voltage Under Normal Condition @220kV level

NTDC Lahore Region

10. 220kV Grid Station Jaranwala

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220KV Gatti - JWR CCT-I & II.	340	661	52	268	3	238	90	242	62	234	35	–	–	233	57	–	–	–	–	206	159	202	70	208	206
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Total No. of Variations (Normal)	340	661	52	268	3
Total No. of Variations (N-1)	-	-	-	-	-
Total (Normal & N-1)	340	661	52	268	3

Highest Voltage Under Normal Condition @220kV level

Lowest Voltage Under Normal Condition @220kV level

NTDC Lahore Region

11. 220kV Grid Station BUND ROAD LAHORE

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Bund Road - NKLP I & II	1,147	875	841	2,070	562	–	–	–	–	–	–	–	–	–	–	184	90	188	90	198	90	184	90	194	150
N-1		17	10	–	22	–	–	–	–	–	–	–	–	–	–	–	186	270	190	150	–	–	191	90	–	–
Normal	220 kV Bund Road - KSK I & II	1,196	1,052	904	2,114	562	–	–	–	–	–	–	–	–	–	–	183	210	190	210	197	90	184	90	194	150
N-1		29	9	–	–	–	–	–	–	–	–	–	–	–	–	–	187	90	190	210	–	–	–	–	–	–
Normal	220 kV Bund Road - SKP I & II	1,119	852	833	2,114	562	–	–	–	–	–	–	–	–	–	–	183	90	188	90	198	90	184	90	194	150
N-1		21	11	–	–	–	–	–	–	–	–	–	–	–	–	–	187	90	192	150	–	–	–	–	–	–
Normal	220 kV Bund Road - SKP III & IV	1,119	874	842	2,114	562	–	–	–	–	–	–	–	–	–	–	184	90	188	90	198	90	184	90	194	150
N-1		16	11	–	–	–	–	–	–	–	–	–	–	–	–	–	188	90	192	150	–	–	–	–	–	–

Total No. of Variations (Normal)	4,581	3,653	3,420	8,412	2,248
Total No. of Variations (N-1)	83	41	–	22	–
Total (Normal & N-1)	4,664	3,694	3,420	8,434	2,248

Lowest Voltage Under Normal Condition @220kV level

NTDC Lahore Region

12. 220kV Grid Station KALA SHAH KAKU

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Kala Shah Kaku - Mangla - I,II&III	680	639	859	1,860	109	–	–	–	–	–	–	–	–	–	–	180	120	–	–	184	150	181	150	199	60
N-1		66	101	–	153	–	–	–	–	–	–	–	–	–	–	–	180	60	–	–	–	–	185	90	–	–
Normal	220 kV Kala Shah Kaku - Bund Road - I &II	768	560	622	1,110	108	–	–	–	–	–	–	–	–	–	–	184	90	184	90	188	60	188	90	199	60
N-1		88	117	–	62	–	–	–	–	–	–	–	–	–	–	–	187	90	180	90	–	–	189	150	–	–
Normal	220 kV Kala Shah Kaku - Ravi	756	639	972	638	105	–	–	–	–	–	–	–	–	–	–	184	90	184	90	173	90	174	150	199	60
N-1		86	115	–	57	–	–	–	–	–	–	–	–	–	–	–	180	90	181	90	–	–	184	90	–	–
Normal	220 kV Kala Shah Kaku - Sialkot	735	596	628	579	102	–	–	–	–	–	–	–	–	–	–	183	60	187	90	188	90	150	90	199	60
N-1		78	117	–	44	–	–	–	–	–	–	–	–	–	–	–	181	90	180	90	–	–	188	90	–	–
Normal	Kala Shah Kaku - Bandala I & II	566	457	600	1,115	105	–	–	–	–	–	–	–	–	–	–	187	120	189	120	189	150	185	60	199	60
N-1		77	73	–	31	–	–	–	–	–	–	–	–	–	–	–	187	90	188	120	–	–	189	90	–	–
Normal	220 kV Kala Shah Kaku - Ghazi Road	766	672	773	751	110	–	–	–	–	–	–	–	–	–	–	180	60	185	150	180	60	150	90	199	60
N-1		88	133	–	71	–	–	–	–	–	–	–	–	–	–	–	180	90	181	90	–	–	185	90	–	–

Total No. of Variations (Normal)	4,271	3,563	4,454	6,053	639
Total No. of Variations (N-1)	483	656	–	418	–
Total (Normal & N-1)	4,754	4,219	4,454	6,471	639

Lowest Voltage Under Normal Condition @220kV level

NTDC Lahore Region

13. 220kV Grid Station GHAZI ROAD LAHORE

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Ghazi - Shalamar	2,505	1,745	3,225	3,037	2,211	–	–	–	–	–	–	–	–	–	–	170	60	195	60	180	120	176	60	188	60
N-1		672	1,765	–	–	3	–	–	–	–	–	–	–	–	–	–	174	60	168	60	–	–	–	–	196	60
Normal	220 kV Ghazi - KSK	2,229	1,745	3,225	3,037	2,196	–	–	–	–	–	–	–	–	–	–	170	60	195	180	180	120	176	60	188	60
N-1		1,484	1,765	–	–	2	–	–	–	–	–	–	–	–	–	–	173	60	168	60	–	–	–	–	197	120
Normal	220 kV Ghazi Road - New Lahore	Added in 2019-20	771	3,201	3,035	2,211	Added in 2019-20		–	–	–	–	–	–	–	–	Added in 2019-20		198	180	180	120	176	60	188	60
N-1			185	–	–	3			–	–	–	–	–	–	–	–			184	60	–	–	–	–	196	60
Normal	220 kV Ghazi - Sarfaraznagar	Added in 2020-21		3,211	2,976	2,179	Added in 2020-21				–	–	–	–	–	–	Added in 2020-21				180	120	176	60	188	60
N-1				–	–	1					–	–	–	–	–	–					–	–	–	–	196	60

Added in 2019-20

Added in 2020-21

Total No. of Variations (Normal)	4,734	4,261	12,862	12,085	8,797
Total No. of Variations (N-1)	2,156	3,715	–	–	9
Total (Normal & N-1)	6,890	7,976	12,862	12,085	8,806

Lowest Voltage Under Normal Condition @220kV level

Lowest Voltage Under N-1 Condition @220kV level

NTDC Lahore Region

14. 220kV Grid Station GAKKHAR

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Gakkhar - Mangla Ckt	1,606	1,133	990	756	60	–	–	–	–	–	–	–	–	–	–	188	60	189	60	187	60	191	120	200	60
N-1		12	19	–	–	–	–	–	–	–	–	–	–	–	–	–	190	60	188	60	–	–	–	–	–	–
Normal	220 kV Gakkhar - Sialkot	1,626	1,147	1,016	770	60	–	–	–	–	–	–	–	–	–	–	183	60	189	60	187	60	191	120	200	60
N-1		19	19	–	–	–	–	–	–	–	–	–	–	–	–	–	186	60	186	60	–	–	–	–	–	–
Normal	220 kV Old Gakkhar - New Gakkhar (Nokhar)	1,898	895	1,299	1,000	NP	–	–	–	–	–	–	–	–	NP	NP	181	60	188	60	185	60	189	120	NP	NP
N-1		31	19	–	–	NP	–	–	–	–	–	–	–	–	NP	NP	184	60	184	60	–	–	–	–	NP	NP
Normal	220 kV Gakkhar - Gujrat	1,898	895	1,299	1,000	NP	–	–	–	–	–	–	–	–	NP	NP	181	60	188	60	185	60	189	120	NP	NP
N-1		31	19	–	–	NP	–	–	–	–	–	–	–	–	NP	NP	184	60	184	60	–	–	–	–	NP	NP
Normal	220KV Bus Bar - I & II	Added in 2022-23				116	Added in 2022-23								–	–	Added in 2022-23								198	60
N-1						–									–	–									–	–

Added in 2022-23

NOTE:-Only Bus Bar Voltage Meter work Properly. 220KV GKR-GUJRAT and 220KV GKR-N-GKR's Meters are Not Installed.

Total No. of Variations (Normal)	7,028	4,070	4,604	3,526	236
Total No. of Variations (N-1)	93	76	–	–	–
Total (Normal & N-1)	7,121	4,146	4,604	3,526	236

Lowest Voltage Under Normal Condition @220kV level

NTDC Lahore Region

15. 220kV Grid Station GUJRAT

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Gujrat - Old Gakkhar	2,815	876	1,087	924	617	238	60	241	60	239	60	239	60	241	30	189	60	193	60	191	150	187	30	200	60
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220 kV Gujrat - New Gakkhar	777	880	1,084	924	617	238	120	241	60	239	60	239	60	241	30	191	60	193	60	191	150	187	30	200	60
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220 kV Gujrat - Mangla 1 & 2	1,809	876	1,123	1,848	617	238	60	241	60	239	60	239	60	241	30	189	60	193	60	189	60	187	30	200	60
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Total No. of Variations (Normal)	5,401	2,632	3,294	3,696	1,851
Total No. of Variations (N-1)	–	–	–	–	–
Total (Normal & N-1)	5,401	2,632	3,294	3,696	1,851

Highest Voltage Under Normal Condition @220kV level

Lowest Voltage Under Normal Condition @220kV level

NTDC Lahore Region

16. 500kV Grid Station NEW LAHORE

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500 kV New Lahore - Balloki	214	110	94	226	416	542	60	534	60	534	120	540	120	540	60	–	–	464	60	473	60	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500 kV New Lahore - GAKKHAR	191	106	94	113	416	542	60	534	60	534	120	540	120	540	60	–	–	464	60	472	60	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500 kV New Lahore - CFPP Sahiwal	Added in 2019-20	111	93	113	416	Added in 2019-20		534	60	534	120	540	120	540	60	Added in 2019-20		464	60	473	60	–	–	–	–
N-1			–	–	–	–			–	–	–	–	–	–	–	–			–	–	–	–	–	–	–	–
Normal	500 kV New Lahore - HVDC Conv 1 & 2	Added in 2020-21		93	226	416	Added in 2020-21				534	120	540	120	540	60	Added in 2020-21				473	60	–	–	–	–
N-1				–	–	–					–	–	–	–	–	–					–	–	–	–	–	–
Normal	220 kV New Lahore - Ghazi Road	Added in 2019-20	11	202	222	294	Added in 2019-20		234	150	235	60	237	60	237	60	Added in 2019-20		207	20	202	60	200	60	206	60
N-1			–	–	–	–			–	–	–	–	–	–	–	–			–	–	–	–	–	–	–	–
Normal	220 kV New Lahore - New Kot Lakhpat- I&II	643	83	201	444	294	240	60	235	180	235	60	237	60	236	60	198	60	203	60	202	60	200	60	206	60
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220 kV New Lahore - SNR	627	71	NP	NP	NP	242	60	235	180	NP		NP		NP		198	60	203	60	NP		NP		NP	
N-1		–	–				–	–	–	–							–	–	–	–						

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
N-1			–	–	–	–	Added in 2019-20		–	–	–	–	–	–	–	–	Added in 2019-20		–	–	–	–	–	–	–	–

Added in 2019-20 Added in 2020-21 This circuit doesn't exist

Total No. of Variations (Normal)	1,675	582	979	1,566	2,545
Total No. of Variations (N-1)	–	–	–	–	–
Total (Normal & N-1)	1,675	582	979	1,566	2,545

Highest Voltage Under Normal Condition @500kV level

Highest Voltage Under Normal Condition @220kV level

Lowest Voltage Under Normal Condition @220kV level

NTDC Lahore Region

17. 220kV Grid Station NEW KOT LAKHPAT

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV NKLP - BDR - 1 & 2	1,220	2,084	2,294	1,778	562	–	–	–	–	–	–	–	–	–	–	185	150	185	90	185	90	180	150	193	210
N-1		56	–	–	–	–	–	–	–	–	–	–	–	–	–	–	185	90	–	–	–	–	–	–	–	–
Normal	220 kV NKLP - SKP Ckt	442	479	1,059	975	609	236	190	235	90	–	–	–	–	–	–	191	90	190	90	186	90	182	90	190	90
N-1		8	–	–	–	–	–	–	–	–	–	–	–	–	–	–	195	90	–	–	–	–	–	–	–	–
Normal	220 kV NKLP - SNR Ckt	539	474	691	582	281	–	–	–	–	–	–	–	–	232	90	187	90	195	150	187	150	185	90	198	210
N-1		15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	190	90	–	–	–	–	–	–	–	–
Normal	220 kV NKLP - New Lahore Ckt I & II	813	785	691	1,302	335	–	–	–	–	–	–	–	–	233	90	187	90	191	90	188	90	181	90	196	270
N-1		12	–	–	–	–	–	–	–	–	–	–	–	–	–	–	191	90	–	–	–	–	–	–	–	–

Total No. of Variations (Normal)	3,014	3,822	4,735	4,637	1,787
Total No. of Variations (N-1)	91	–	–	–	–
Total (Normal & N-1)	3,105	3,822	4,735	4,637	1,787

Highest Voltage Under Normal Condition @220kV level

Lowest Voltage Under Normal Condition @220kV level

NTDC Lahore Region

18. 500 kV Grid Station Nokhar

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500 kV New Gakkhar - Rawat I & II	154	64	56	42	45	535	150	537	90	536	120	534	180	531	120	465	90	472	180	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500 kV New Gakkhar - Lahore (SKP)	77	32	28	21	136	535	150	537	90	536	120	534	180	538	120	465	90	472	180	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500 kV New Gakkhar - New Lahore	77	32	28	21	136	535	150	537	90	536	120	534	180	538	120	465	90	472	180	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500 kV New Gakkhar - Neelum Jhelum	Added in 2021-22			42	136	Added in 2021-22						534	180	538	120	Added in 2021-22						–	–	–	–
N-1					–	–							–	–	–	–							–	–	–	–
Normal	500 kV New Gakkhar - Karot P P	Added in 2022-23				136	Added in 2022-23								538	120	Added in 2022-23								–	–
N-1						-									–	–									–	–
Normal	220 kV New Gakkhar - Old Gakkhar	215	449	245	161	533	236	90	241	150	240	120	238	180	240	120	200	210	197	90	202	270	201	120	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220 kV New Gakkhar - Gujrat	Added in 2021-22			161	533	Added in 2021-22						238	120	240	120	Added in 2021-22						201	120	–	–
N-1					–	–							–	–	–	–							–	–	–	–

Added in 2021-22

Added in 2022-23

Condition	2018-19	2019-20	2020-21	2021-22	2022-23
Total No. of Variations (Normal)	523	577	357	448	1,655
Condition	**2018-19**	**2019-20**	**2020-21**	**2021-22**	**2022-23**
Total No. of Variations (N-1)	–	–	–	–	–
Total (Normal & N-1)	523	577	357	448	1,655

Highest Voltage Under Normal Condition @500kV level.

Highest Voltage Under Normal Condition @220kV level.

NTDC Lahore Region

19. 220kV Grid Station Ravi

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Ravi - Atlas Power House	587	558	492	743	97	232	90	–	–	–	–	–	–	–	–	188	90	188	90	194	90	191	150	199	210
N-1		4	4	–	–	–	–	–	–	–	–	–	–	–	–	–	190	90	190	90	–	–	–	–	–	–
Normal	220 kV Ravi - Kala Shah Kaku	1,181	1,258	697	994	205	–	–	–	–	–	–	–	–	–	–	190	90	180	90	193	90	190	210	195	90
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220 kV Ravi - Sheikhupura	527	500	406	710	59	–	–	–	–	–	–	–	–	–	–	183	90	190	90	192	210	188	150	200	330
N-1		4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	192	90	–	–	–	–	–	–	–	–
Normal	220 kV Ravi - Shalamar	974	1,161	620	1,046	177	–	–	–	–	–	–	–	–	–	–	180	60	180	60	195	90	186	90	198	270
N-1		4	7	–	–	–	–	–	–	–	–	–	–	–	–	–	190	60	190	60	–	–	–	–	–	–

Condition	2018-19	2019-20	2020-21	2021-22	2022-23
Total No. of Variations (Normal)	3,269	3,477	2,215	3,493	538
Total No. of Variations (N-1)	12	11	–	–	–
Total (Normal & N-1)	3,281	3,488	2,215	3,493	538

Lowest Voltage Under Normal Condition @220kV level

NTDC Lahore Region

20. 220kV Grid Station Sialkot

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Sailkot - Gakkhar	1,219	1,224	1,174	1,410	721	–	–	–	–	–	–	–	–	–	–	170	150	180	90	180	330	180	330	190	210
N-1		–	–	–	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	190	150	–	–
Normal	220 kV Sailkot - Kala Shah Kaku	1,200	1,195	1,176	1,409	733	–	–	–	–	–	–	–	–	–	–	170	150	180	150	180	210	180	330	190	210
N-1		6	1	–	10	–	–	–	–	–	–	–	–	–	–	–	160	90	190	90	–	–	190	540	–	–

Total No. of Variations (Normal)	2,419	2,419	2,350	2,819	1,454
Total No. of Variations (N-1)	6	1	–	14	–
Total (Normal & N-1)	2,425	2,420	2,350	2,833	1,454

Lowest Voltage Under Normal Condition @220kV level

NTDC Lahore Region

21. 220kV Grid Station Shalamar

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Shalamar - Ravi	728	718	949	996	614	–	–	–	–	–	–	–	–	–	–	183	90	186	90	182	120	178	90	190	90
N-1		175	278	–	–	–	–	–	–	–	–	–	–	–	–	–	180	90	183	90	–	–	–	–	–	–
Normal	220 kV Shalamar - Ghazi Road	619	563	953	901	618	–	–	–	–	–	–	–	–	–	–	183	90	186	90	182	120	180	60	190	90
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Total No. of Variations (Normal)	1,347	1,281	1,902	1,897	1,232
Total No. of Variations (N-1)	175	278	–	–	–
Total (Normal & N-1)	1,522	1,559	1,902	1,897	1,232

Lowest Voltage Under Normal Condition @220kV level

NTDC Lahore Region

22. 220kV Grid Station Sarfraznagar

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Sarfraz Nagar - New Kot Lakhpat	630	814	1,556	1,853	1445	–	–	–	–	–	–	–	–	–	–	190	510	178	270	176	210	172	120	185	60
N-1		–	–	–	–	5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	190	420
Normal	220 kV Sarfraz Nagar - Okara-I&II	643	818	1,518	1,877	1498	–	–	–	–	–	–	–	–	–	–	190	510	178	270	176	210	172	120	185	60
N-1		–	–	–	–	17	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	184	30
Normal	Sarfarz Nagar-Ghazi Road	Added in 2019-20	345	1,532	1,853	1464	Added in 2019-20		–	–	–	–	–	–	–	–	Added in 2019-20		178	270	176	210	172	120	185	60
N-1			–	–	–	12			–	–	–	–	–	–	–	–			–	–	–	–	–	–	184	30

Added in 2019-20

Total No. of Variations (Normal)	1,273	1,977	4,606	5,583	4,407
Total No. of Variations (N-1)	–	–	–	–	34
Total (Normal & N-1)	1,273	1,977	4,606	5,583	4,441

Lowest Voltage Under Normal Condition @220kV level

Lowest Voltage Under N-1 Condition @220kV level

NTDC Lahore Region

23. 220kV Grid Station WAPDA TOWN LAHORE

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Wapda Town - Sheikhupura	681	518	639	485	210	–	–	–	–	–	–	–	–	–	–	180	90	193	90	190	90	187	90	196	150
N-1		2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	194	150	–	–	–	–	–	–	–	–
Normal	220 kV Wapda Town - New Lahore	Added in 2019-20	441	599	452	202	Added in 2019-20		–	–	–	–	–	–	–	–	Added in 2019-20		193	90	190	90	188	90	196	150
N-1			1	–	–	–			–	–	–	–	–	–	–	–			207	90	–	–	–	–	–	–

Added in 2019-20

Total No. of Variations (Normal)	681	959	1,238	937	412
Total No. of Variations (N-1)	2	1	–	–	–
Total (Normal & N-1)	683	960	1,238	937	412

Lowest Voltage Under Normal Condition @220kV level

NTDC Lahore Region

24. 500kV Grid Station YOUSAFWALA

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500 kV Yousafwala - Multan	500	693	NP	441	826	541	180	552	120	NP	NP	539	60	545	60	–	–	–	–	NP	NP	–	–	–	–
N-1		–	–	NP	–	–	–	–	–	–	NP	NP	–	–	–	–	–	–	–	–	NP	NP	–	–	–	–
Normal	500 kV Yousafwala - CFPP	554	184	NP	671	1,117	542	180	–	–	NP	NP	542	60	547	60	–	–	–	–	NP	NP	–	–	–	–
N-1		–	–	NP	–	–	–	–	–	–	NP	NP	–	–	–	–	–	–	–	–	NP	NP	–	–	–	–
Normal	220 kV Yousafwala - Gatti	156	167	NP	1,680	329	239	120	238	120	NP	NP	239	60	237	60	–	–	200	120	NP	NP	196	120	198	120
N-1		–	–	NP	–	–	–	–	–	–	NP	NP	–	–	–	–	–	–	–	–	NP	NP	–	–	–	–
Normal	220 kV Yousafwala - Kassowal	94	158	NP	1,726	398	237	120	236	120	NP	NP	237	60	235	60	198	120	198	120	NP	NP	194	120	198	120
N-1		–	–	NP	–	–	–	–	–	–	NP	NP	–	–	–	–	–	–	–	–	NP	NP	–	–	–	–
Normal	220 kV Yousafwala - Okara	297	118	NP	1,606	323	236	180	237	120	NP	NP	238	60	236	60	198	120	199	120	NP	NP	195	120	198	120
N-1	220 kV Yousafwala - Okara	–	–	NP	–	–	–	–	–	–	NP	NP	–	–	–	–	–	–	–	–	NP	NP	–	–	–	–

Total No. of Variations (Normal)	1,601	1,320	–	6,124	2,993
Total No. of Variations (N-1)	–	–	–	–	–
Total (Normal & N-1)	1,601	1,320	–	6,124	2,993

oltage Under Normal Condition @500kV level

oltage Under Normal Condition @220kV level.

Lowest Voltage Under Normal Condition @220kV level

NTDC Lahore Region

25. 220kV Grid Station KASSOWAL

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Kassowal-Vehari Circuits I & II	636	546	72	600	260	250	60	242	60	239	60	244	60	241	60	-	-	197	60	197	60	188	60	182	60
N-1		24	4	-	-	-	-	-	-	-	-	-	-	-	-	-	192	60	193	60	-	-	-	-	-	-
Normal	220 kV Kassowal-Yousafwala - I & II	598	546	72	600	260	250	60	242	60	239	60	244	60	241	60	197	60	197	60	197	60	188	60	182	60
N-1		16	4	-	-	-	-	-	-	-	-	-	-	-	-	-	192	60	193	60	-	-	-	-	-	-

Total No. of Variations (Normal)	1,234	1,092	144	1,200	520
Total No. of Variations (N-1)	40	8	–	–	–
Total (Normal & N-1)	1,274	1,100	144	1,200	520

Highest voltage under 220 kV level.

Lowest voltage under 220 kV level

NTDC Lahore Region

26. 220kV Grid Station OKARA

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Okara - Sarfaraznagar Ckt I & II	221	204	100	300	303	-	-	241	390	-	-	237	240	239	30	195	1380	195	1,440	195	1440	186	1,440	191	1,200
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Okara - Yousafwala Ckt I & II	221	204	104	306	303	-	-	241	390	-	-	237	240	239	30	195	1380	195	1,440	195	1440	186	1,440	191	1,200
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Total No. of Variations (Normal)	442	408	204	606	606
Total No. of Variations (N-1)	-	-	-	-	-
Total (Normal & N-1)	442	408	204	606	606

Highest voltage under 220 kV level

Lowest voltage under 220 kV level

APPENDIX 3

Voltage violations data - detailed circuit wise analysis

NTDC Multan Region

1. 500 kV D. G. Khan
2. 500 kV Multan
3. 500 kV Muzaffargarh
4. 500 kV Rahim Yar Khan
5. 220 kV Bahawalpur
6. 220 kV Muzaffargarh
7. 220 kV Vehari
8. 220 kV Chishtian
9. 220 kV Lal Sohanra

NTDC Multan Region

1. 500kV Grid Station D.G. KHAN

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500 kV D.G. Khan - Guddu	20	39	21	18	15	561	60	565	60	560	60	564	60	566	60	–	–	494	60	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500 kV D.G. Khan - Multan	20	38	8	NP	NP	561	60	565	60	560	60	NP	NP	NP	NP	–	–	494	60	–	–	NP	NP	NP	NP
N-1		–	–	–	NP	NP	–	–	–	–	–	–	NP	NP	NP	NP	–	–	–	–	–	–	NP	NP	NP	NP
Normal	220 kV D.G. Khan - Loralai cct I & II	154	148	156	200	117	251	60	252	60	250	60	252	60	247	180	NP	NP	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	NP	NP	–	–	–	–	–	–	–	–
Normal	500 kV D.G. Khan - Muzaffargarh	Added in 2021-22			5	1	Added in 2021-22						559	60	553	60	Added in 2021-22						–	–	–	–
N-1					–	–							–	–	–	–							–	–	–	–

Added in 2021-22

This circuit doesn't exist

Total No. of Variations (Normal)		194	225	185	223	133
Total No. of Variations (N-1)		–	–	–	–	–
Total (Normal & N-1)		194	225	185	223	133

Highest Voltage Under Normal Condition @500kV level

Highest Voltage Under Normal Condition @220kV level

NTDC Multan Region

2. 500kV Grid Station MULTAN

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500 kV Multan - Muzaffargarh	3	NIL	NA	NIL	NIL	560	30	NIL	NIL	NA	NA	NIL	NIL	NIL	NIL	–	–	NIL	NIL	NA	NA	NIL	NIL	NIL	NIL
N-1		–	NIL	NA	NIL	NIL	–	–	NIL	NIL	NA	NA	NIL	NIL	NIL	NIL	–	–	NIL	NIL	NA	NA	NIL	NIL	NIL	NIL
Normal	500 kV Multan - Yousafwala	NP	–	NP	NP	826	NP	NP	–	–	NP	NP	NP	NP	545	60	NP	NP	–	–	NP	NP	NP	NP	–	–
N-1		NP	–	NP	NP	–	NP	NP	–	–	NP	NP	NP	NP	–	–	NP	NP	–	–	NP	NP	NP	NP	–	–
Normal	500 kV Multan - Rousch	3	–	NP	NP	Nil	550	30	–	–	NP	NP	NP	NP	Nil	Nil	–	–	–	–	NP	NP	NP	NP	Nil	Nil
N-1		–	–	NP	NP	Nil	–	–	–	–	NP	NP	NP	NP	Nil	Nil	–	–	–	–	NP	NP	NP	NP	Nil	Nil
Normal	500 kV Multan - D.G. Khan	3	NIL	This circuit doesn't exist anymore			547	30	NIL	NIL	This circuit doesn't exist anymore						–	–	NIL	NIL	This circuit doesn't exist anymore					
N-1		–	NIL				–	–	NIL	NIL							–	–	NIL	NIL						
Normal	500 kV Multan - R Y Khan	3	NIL	NA	NIL	NIL	565	30	NIL	NIL	NA	NA	NIL	NIL	NIL	NIL	–	–	NA	NA	NA	NA	NIL	NIL	NIL	NIL
N-1		–	NIL	NA	NIL	NIL	–	–	NIL	NIL	NA	NA	NIL	NIL	NIL	NIL	–	–	NA	NA	NA	NA	NIL	NIL	NIL	NIL
Normal	500 kV Multan - HBS	3	–	NP	NP	Nil	560	30	–	–	NP	NP	NP	NP	Nil	Nil	–	–	–	–	NP	NP	NP	NP	Nil	Nil
N-1		–	–	NP	NP	Nil	–	–	–	–	NP	NP	NP	NP	Nil	Nil	–	–	–	–	NP	NP	NP	NP	Nil	Nil
Normal	220 kV Multan - Muzaffargarh 1	NP	2	NA	NIL	NIL	NP	NP	–	–	NA	NA	NIL	NIL	NIL	NIL	NP	NP	207	570	NA	NA	NIL	NIL	NIL	NIL
N-1		NP	–	NA	NIL	NIL	NP	NP	–	–	NA	NA	NIL	NIL	NIL	NIL	NP	NP	–	–	NA	NA	NIL	NIL	NIL	NIL
Normal	220 kV Multan - Muzaffargarh 2	NP	–	6	6	19	NP	NP	–	–	252	180	249	240	249	60	NP	NP	–	–	–	–	–	–	–	–
N-1		NP	–	–	–	–	NP	NP	–	–	–	–	–	–	–	–	NP	NP	–	–	–	–	–	–	–	–
Normal	220 kV Multan - Muzaffargarh 3	NP	1	3	4	1	NP	NP	–	–	NA	NA	–	–	246	120	NP	NP	207	240	NA	NA	208	450	–	–
N-1		NP	–	–	–	–	NP	NP	–	–	NA	NA	–	–	–	–	NP	NP	–	–	NA	NA	–	–	–	–

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Multan - Muzaffargarh 4	NP	2	NA	NIL	NIL	NP	NP	–	–	NA	NA	NIL	NIL	NIL	NIL	NP	NP	207	570	NA	NA	NIL	NIL	NIL	NIL
N-1		NP	–	NA	NIL	NIL	NP	NP	–	–	NA	NA	NIL	NIL	NIL	NIL	NP	NP	–	–	NA	NA	NIL	NIL	NIL	NIL
Normal	220 kV Multan - Kapco 3 & 4	NP	6	28	NIL	5	NP	NP	251	90	252	150	NIL	NIL	246	60	NP	NP	–	–	–	–	NIL	NIL	–	–
N-1		NP	–	–	NIL	–	NP	NP	–	–	–	–	NIL	NIL	–	–	NP	NP	–	–	–	–	NIL	NIL	–	–
Normal	220 kV Multan - Kapco 5 & 6	NP	NIL	NA	2	NIL	NP	NP	NIL	NIL	NA	NA	247	270	NIL	NIL	NP	NP	NIL	NIL	NA	NA	–	–	NIL	NIL
N-1		NP	NIL	NA	–	NIL	NP	NP	NIL	NIL	NA	NA	–	–	NIL	NIL	NP	NP	NIL	NIL	NA	NA	–	–	NIL	NIL
Normal	220 kV Multan - NGPS 1 & 2	NP	1	2	NIL	NIL	NP	NP	–	–	246	90	NIL	NIL	NIL	NIL	NP	NP	208	120	–	–	NIL	NIL	NIL	NIL
N-1		NP	–	–	NIL	NIL	NP	NP	–	–	–	–	NIL	NIL	NIL	NIL	NP	NP	–	–	–	–	NIL	NIL	NIL	NIL
Normal	220 kV Multan - Vehari 1 & 2	NP	9	12	6	NIL	NP	NP	250	210	250	290	250	240	NIL	NIL	NP	NP	208	60	–	–	–	–	NIL	NIL
N-1	220 kV Multan - Vehari 1 & 2	NP	–	–	–	NIL	NP	NP	–	–	–	–	–	–	NIL	NIL	NP	NP	–	–	–	–	–	–	NIL	NIL
Normal	220 kV Multan - T.T. Singh 1 & 2	NP	1	4	6	NIL	NP	NP	–	–	246	90	245	300	NIL	NIL	NP	NP	208	60	–	–	–	–	NIL	NIL
N-1		NP	–	–	–	NIL	NP	NP	–	–	–	–	–	–	NIL	NIL	NP	NP	–	–	–	–	–	–	NIL	NIL

NP: Not Provided

This circuit doesn't exist anymore

Condition	2018-19	2019-20	2020-21	2021-22	2022-23
Total No. of Variations (Normal)	15	22	55	24	851
Total No. of Variations (N-1)	–	–	–	–	–
Total (Normal & N-1)	15	22	55	24	851

Highest Voltage Under Normal Condition @220kV level

Highest voltage under Normal Condition @ 500 kV level

NTDC Multan Region

3. 500kV Grid Station MUZAFFARGARH

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500 kV Muzaffargarh - Gatti	NP	NA	NA	NIL	NP	NP	NP	NA	NA	NA	NA	NIL	NIL	NP	NP	NP	NP	NA	NA	NA	NA	NIL	NIL	NP	NP
N-1		NP	NA	NA	NIL	NP	NP	NP	NA	NA	NA	NA	NIL	NIL	NP	NP	NP	NP	NA	NA	NA	NA	NIL	NIL	NP	NP
Normal	500 kV Muzaffargarh - Guddu	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
N-1		Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Normal	500 kV Muzaffargarh - Multan	NP	NA	NA	NIL	NIL	NP	NP	NA	NA	NA	NA	NIL	NIL	NIL	NIL	NP	NP	NA	NA	NA	NA	NIL	NIL	NIL	NIL
N-1		NP	NA	NA	NIL	NIL	NP	NP	NA	NA	NA	NA	NIL	NIL	NIL	NIL	NP	NP	NA	NA	NA	NA	NIL	NIL	NIL	NIL
Normal	500 kV Muzaffargarh - Guddu 747	NP	NA	NA	NIL	NIL	NP	NP	NA	NA	NA	NA	NIL	NIL	NIL	NIL	NP	NP	NA	NA	NA	NA	NIL	NIL	NIL	NIL
N-1		NP	NA	NA	NIL	NIL	NP	NP	NA	NA	NA	NA	NIL	NIL	NIL	NIL	NP	NP	NA	NA	NA	NA	NIL	NIL	NIL	NIL
Normal	220 kV Muzaffargarh-D.G Khan	NA	NA	NA	NIL	NIL	NA	NA	NA	NA	NA	NA	NIL	NIL	NIL	NIL	NA	NA	NA	NA	NA	NA	NIL	NIL	NIL	NIL
N-1		NA	NA	NA	NIL	NIL	NA	NA	NA	NA	NA	NA	NIL	NIL	NIL	NIL	NA	NA	NA	NA	NA	NA	NIL	NIL	NIL	NIL

NP: Not Provided NA: Not Applicable

Condition	2018-19	2019-20	2020-21	2021-22	2022-23
Total No. of Variations (Normal)	–	–	–	–	–
Total No. of Variations (N-1)	–	–	–	–	–
Total (Normal & N-1)	–	–	–	–	–

NTDC Multan Region

4. 220kV Grid Station MUZAFFARGARH

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220KV Muzaffargarh - TPS Phase	199	179	165	162	166	244	60	245	60	248	60	247	540	249	600	–	–	–	–	–	–	–	–	–	–
N-1		29	29	–	69	9	250	270	247	120	–	–	250	300	248	180	–	–	–	–	–	–	–	–	–	–
Normal	220KV Muzaffargarh – Multan	207	179	164	150	188	244	60	242	210	248	60	241	540	241	720	–	–	–	–	–	–	–	–	–	–
N-1		28	29	–	81	8	250	270	247	120	–	–	250	300	250	420	–	–	–	–	–	–	–	–	–	–

Total No. of Variations (Normal)	406	358	329	312	354
Total No. of Variations (N-1)	57	58	–	150	17
Total (Normal & N-1)	463	416	329	462	371

Highest Voltage Under Normal Condition @220kV level

Highest Voltage Under N-1 Condition @220kV level

NTDC Multan Region

NTDC Multan Region

5. 500kV Grid Station RAHIM YAR KHAN

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500 kV Guddu 747 - RY Khan	3	NIL	NA	NIL	NIL	565	30	NIL	NIL	NA	NA	NIL	NIL	NIL	NIL	565	30	NIL	NIL	NA	NA	NIL	NIL	NIL	NIL
N-1		–	NIL	NA	NIL	NIL	–	–	NIL	NIL	NA	NA	NIL	NIL	NIL	NIL	–	–	NIL	NIL	NA	NA	NIL	NIL	NIL	NIL
Normal	500 kV Multan - RY Khan	3	NIL	NA	NIL	NIL	565	30	NIL	NIL	NA	NA	NIL	NIL	NIL	NIL	565	30	NIL	NIL	NA	NA	NIL	NIL	NIL	NIL
N-1		–	NIL	NA	NIL	NIL	–	–	NIL	NIL	NA	NA	NIL	NIL	NIL	NIL	–	–	NIL	NIL	NA	NA	NIL	NIL	NIL	NIL
Normal	500 kV RY Khan - Moro	Added in 2022-23				NIL	Added in 2022-23								NIL	NIL	Added in 2022-23								NIL	NIL
N-1						NIL									NIL	NIL									NIL	NIL

Added in 2022-23 NA: Not applicable

Total No. of Variations (Normal)	6	–	–	–	–
Total No. of Variations (N-1)	–	–	–	–	–
Total (Normal & N-1)	–	–	–	–	–

NTDC Multan Region

6. 220kV Grid Station BAHAWALPUR

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Bahawalpur - TPS Muzaffargarh Ckt I & II	657	806	660	948	473	242	30	242	180	252	30	242	120	243	60	–	–	197	30	–	–	195	30	199	30
N-1		179	226	108	200	3	251	60	252	90	247	60	250	120	244	30	–	–	190	30	192	30	196	60	–	–
Normal	220 kV Bahawalpur - Lal Sohanra Ckt I & II	657	505	59	306	161	242	30	242	30	240	60	241	90	242	30	–	–	197	30	201	60	195	30	–	–
N-1		179	136	6	48	4	251	60	250	90	245	30	–	–	244	30	–	–	190	30	195	30	196	60	–	–

Total No. of Variations (Normal)	1,314	1,311	719	1,254	634
Total No. of Variations (N-1)	358	362	114	248	7
Total (Normal & N-1)	1,672	1,673	833	1,502	641

Highest Voltage Under Normal Condition @220kV level

Lowest Voltage Under Normal Condition @220kV level

Highest Voltage Under N-1 Condition @220kV level

NTDC Multan Region

9. 220kV Grid Station OKARA

NTDC Multan Region

7. 220kV Grid Station VEHARI

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Vehari - Multan Ckt I & II	2,074	900	639	616	689	–	–	243	210	249	270	241	270	241	150	135	90	195	60	–	–	190	210	200	90
N-1		228	99	3	257	64	–	–	245	270	241	270	247	150	246	270	191	30	190	90	–	–	190	210	185	60
Normal	220 kV Vehari - Kassowal Ckt I & II	2,081	900	633	668	726	–	–	243	210	249	270	242	270	241	150	198	30	195	60	–	–	190	210	200	330
N-1		228	101	5	213	86	–	–	245	270	241	270	247	150	246	270	191	30	190	90	–	–	–	–	180	90
Normal	220 kV Vehari - Chishtian Ckt I & II	1,821	772	377	464	427	–	–	–	–	249	270	241	270	241	150	198	30	–	–	–	–	190	210	200	330
N-1		228	98	2	61	56	–	–	–	–	241	41	247	150	246	270	190	30	–	–	–	–	–	–	180	90

Total No. of Variations (Normal)	5,976	2,572	1,649	1,748	1,842
Total No. of Variations (N-1)	684	298	10	531	206
Total (Normal & N-1)	6,660	2,870	1,659	2,279	2,048

Highest Voltage Under Normal Condition @220kV level

Lowest Voltage Under Normal Condition @220kV level

Highest Voltage Under N-1 Condition @220kV level

Lowest Voltage Under N-1 Condition @220kV level

NTDC Multan Region

8. 220kV Grid Station CHISHTIAN

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Chishtian - Vehari Ckt I & II	3,944	3,923	2,389	4,192	2,898	-	-	242	90	249	150	246	120	244	30	198	60	197	30	194	120	182	30	199	120
N-1		817	944	83	862	312	-	-	250	30	247	30	245	30	247	30	189	30	190	60	-	-	179	60	164	30

Total No. of Variations (Normal)	3,944	3,923	2,389	4,192	2,898
Total No. of Variations (N-1)	817	944	83	862	312
Total (Normal & N-1)	4,761	4,867	2,472	5,054	3,210

Highest Voltage Under Normal Condition @220kV level

Lowest Voltage Under Normal Condition @220kV level

Highest Voltage Under N-1 Condition @220kV level

Lowest Voltage Under N-1 Condition @220kV level

NTDC Multan Region

9. 220kV Grid Station LAL SOHANRA

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Lal Sohanra - BWP Ckt I & II	Added in 2019-20	631	167	188	93	Added in 2019-20		242	90	250	60	248	30	241	60	Added in 2019-20		197	30	–	–	202	60	205	60
N-1			100	41	14	6			250	30	250	30	245	60	248	60			190	60	194	60	–	–	–	–

Added in 2019-20

Total No. of Variations (Normal)	–	631	167	188	93
Total No. of Variations (N-1)	–	100	41	14	6
Total (Normal & N-1)	–	731	208	202	99

Highest Voltage Under Normal Condition @220kV level

Lowest Voltage Under Normal Condition @220kV level

Highest Voltage Under N-1 Condition @220kV level

APPENDIX 4

Voltage violations data - detailed circuit wise analysis

NTDC Hyderabad Region

1. 500 kV Dadu
2. 500 kV Guddu
3. 500 kV Jamshoro
4. 220 kV NKI
5. 500 kV Shikarpur
6. 220 kV Dharki
7. 220 kV Hala Road
8. 220 kV Khuzdar
9. 220 kV Loralai
10. 220 kV Quetta Industrial-II
11. 220 kV Rohri
12. 220 kV Sibbi
13. 220 kV T. M. Khan Road
14. 220 kV Jhimpir
15. 220 kV Dera Murad Jama

NTDC Hyderabad Region

1. 500kV Grid Station DADU

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500 kV Dadu - Jamshoro	7	6	3	1	6	542	60	535	60	535	60	530	60	535	120	–	–	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500 kV Dadu - Guddu I	NP	–	NP	NP	NP	NP	NP	–	–	NP	NP	NP	NP	NP	NP	NP	NP	–	–	NP	NP	NP	NP	NP	NP
N-1		NP	–	NP	NP	NP	NP	NP	–	–	NP	NP	NP	NP	NP	NP	NP	NP	–	–	NP	NP	NP	NP	NP	NP
Normal	500 kV Dadu - Shikarpur I	10	6	3	1	6	542	60	535	60	535	60	530	60	535	120	–	–	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500 kV Dadu - Shikarpur II	10	6	3	1	6	542	60	535	60	535	60	530	60	535	120	–	–	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500 kV Dadu - Port Qasim	NA	6	2	NP	NP	NA	NA	535	60	530	60	NP	NP	NP	NP	NA	NA	–	–	–	–	NP	NP	NP	NP
N-1		NA	–	–	NP	NP	NA	NA	–	–	–	–	NP	NP	NP	NP	NA	NA	–	–	–	–	NP	NP	NP	NP
Normal	500 kV Dadu - Moro	34	6	3	1	6	535	60	535	60	535	60	530	60	535	120	NA	NA	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	NA	NA	–	–	–	–	–	–	–	–
Normal	220 kV Dadu - Khuzdar I	42	50	19	3	7	240	240	240	60	240	240	240	60	240	60	–	–	–	–	–	–	–	–	–	–
N-1	220 kV Dadu - Khuzdar I	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220 kV Dadu - Khuzdar II	42	33	19	3	7	240	240	240	60	240	240	240	60	240	60	–	–	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time

							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	**220 kV Dadu - Matiari**	Added in 2020-21		**1**	**NP**	**6**	Added in 2020-21				**535**	**60**	**NP**	**NP**	**535**	**120**	Added in 2020-21				–	–	**NP**	**NP**	–	–
N-1				–	**NP**	–					–	–	**NP**	**NP**	–	–					–	–	**NP**	**NP**	–	–

	Added in 2020-21
	Bifurcated in 500kV Dadu-Shikarpur-I & 500kV Guddu-Shikarpur-I
	Bifurcated in 500kV Dadu-Matiari & 500kv Port Qasim-Matiari
NP:	Not provided

Total No. of Variations (Normal)	145	113	53	10	44
Total No. of Variations (N-1)	–	–	–	–	–
Total (Normal & N-1)	145	113	53	10	44

Highest Voltage Under Normal Condition @500kV level

Highest Voltage Under Normal Condition @220kV level

NTDC Hyderabad Region

2. 500kV Grid Station GUDDU

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500 kV Guddu - Dadu I	NP	–	NP	NP	NP	NP	NP	–	–	NP	NP	NP	NP	NP	NP	NP	NP	–	–	NP	NP	NP	NP	NP	NP
N-1		NP	–	NP	NP	NP	NP	NP	–	–	NP	NP	NP	NP	NP	NP	NP	NP	–	–	NP	NP	NP	NP	NP	NP
Normal	500 kV Guddu - D.G. Khan (Old Multan)	10	48	33	41	333	535	300	538	420	538	360	540	60	540	960	–	–	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500 kV Guddu - 747 MW CCPP Guddu	NA	20	9	30	341	NA	NA	538	360	538	180	539	120	540	960	NA	NA	–	–	–	–	–	–	–	–
N-1		NA	–	–	–	–	NA	NA	–	–	–	–	–	–	–	–	NA	NA	–	–	–	–	–	–	–	–
Normal	500 kV Guddu - Muzaffargarh	13	101	23	29	320	535	120	540	240	538	360	538	360	540	240	–	–	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500 kV Guddu - Shikarpur I	NA	29	20	18	306	NA	NA	539	60	538	120	538	120	540	540	NA	NA	–	–	–	–	–	–	–	–
N-1		NA	–	–	–	–	NA	NA	–	–	–	–	–	–	–	–	NA	NA	–	–	–	–	–	–	–	–
Normal	500 kV Guddu - Shikarpur II	23	62	29	47	346	535	120	538	420	538	120	539	120	540	960	–	–	–	–	–	–	–	–	–	–
N-1	500 kV Guddu - Shikarpur II	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220 kV Guddu - Sibbi (D/Ckt)	NP	–	NP	NP	375	NP	NP	–	–	NP	NP	NP	NP	241	120	NP	NP	–	–	NP	NP	NP	NP	–	–

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
N-1	220 kV Guddu - Sibbi (D/Ckt)	NP	–	NP	NP	–	NP	NP	–	–	NP	NP	NP	NP	–	–	NP	NP	–	–	NP	NP	NP	NP	–	–
Normal	220 kV Guddu - Uch (P/H)	NP	–	NP	NP	NP	NP	NP	–	–	NP	NP	NP	NP	NP	NP	NP	NP	–	–	NP	NP	NP	NP	NP	NP
N-1	220 kV Guddu - Uch (P/H)	NP	–	NP	NP	NP	NP	NP	–	–	NP	NP	NP	NP	NP	NP	NP	NP	–	–	NP	NP	NP	NP	NP	NP

Bifurcated in 500kV Guddu-Shikarpur-I & 500kV Dadu-Shikarpur-I

Bifurcated in 220kV Shikarpur-Uch-I & 220kV Guddu-Shikarpur-I

NP: Not provided

Total No. of Variations (Normal)	46	260	114	165	2,021
Total No. of Variations (N-1)	–	–	–	–	–
Total (Normal & N-1)	46	260	114	165	2,021

Highest Voltage Under Normal Condition @500kV level

NTDC Hyderabad Region

3. 500kV Grid Station 747 MW GUDDU

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500KV 747MW Guddu-OLD Guddu	Added in 2022-23				4,181	Added in 2022-23								547	60	Added in 2022-23								–	–
N-1						–									–	–									–	–
Normal	500KV 747MW Guddu - Muzaffargarh					2960									546	60									–	–
N-1						–									–	–									–	–
Normal	500KV 747MW Guddu-Rahim yar Khan					2988									546	60									–	–
N-1						–									–	–									–	–

Added in 2022-23

Total No. of Variations (Normal)	–	–	–	–	10,129
Total No. of Variations (N-1)	–	–	–	–	–
Total (Normal & N-1)	–	–	–	–	10,129

Highest Voltage Under Normal Condition @500kV level

NTDC Hyderabad Region

4. 500kV Grid Station JAMSHORO

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)							
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Tim
Normal	500 kV Jamshoro - Dadu I	27	69	8	12	NP	543	60	535	60	530	60	539	30	NP	NP	–	–	–	–	–	–	–	–
N-1		–	–	–	–	NP	–	–	–	–	–	–	–	–	NP	NP	–	–	–	–	–	–	–	–
Normal	500 kV Jamshoro - Dadu II	27	69	NP	NP	NP	543	60	535	60	NP	NP	NP	NP	NP	NP	–	–	–	–	NP	NP	NP	NP
N-1		–	–	NP	NP	NP	–	–	–	–	NP	NP	NP	NP	NP	NP	–	–	–	–	NP	NP	NP	NP
Normal	500 kV Jamshoro - Dadu New	Added in 2022-23				143	Added in 2022-23								537	90	Added in 2022-23							
N-1						–									–	–								
Normal	500 KV Jamshoro-NKI	–	–	3	7	49	–	–	–	–	531	60	540	30	533	90	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500 kV Jamshoro - Hub (D/Ckt)		69	3	11	NP	543	60	535	60	525	60	528	30	NP	NP	–	–	–	–	–	–	–	–
N-1			–	–	–	NP	–	–	–	–	–	–	–	–	NP	NP	–	–	–	–	–	–	–	–
Normal	500 kV Jamshoro - Port Qasim	26	69	6	NP	NP	543	60	535	60	534	60	NP	NP	NP	NP	–	–	–	–	–	–	NP	NP
N-1		–	–	–	NP	NP	–	–	–	–	–	–	NP	NP	NP	NP	–	–	–	–	–	–	NP	NP
Normal	500 kV Jamshoro - Thar Engro	6	1	NP	NP	NP	535	60	528	30	NP	NP	NP	NP	NP	NP	–	–	–	–	NP	NP	NP	NP
N-1		–	–	NP	NP	NP	–	–	–	–	NP	NP	NP	NP	NP	NP	–	–	–	–	NP	NP	NP	NP
Normal	500kV K2/K3 - Jamshoro	Added in 2020-21		1	6	206	Added in 2020-21				529	60	530	60	538	30	Added in 2020-21				–	–	–	–
N-1				–	–	–					–	–	–	–	–	–					–	–	–	–

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)							
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Tim
Normal	500kV CPHGC - Jamshoro	Added in 2020-21		3	4	167	Added in 2020-21				530	60	530	60	538	30	Added in 2020-21				–	–	–	–
N-1				–	–	–					–	–	–	–	–	–					–	–	–	–
Normal	220 kV Jamshoro - KDA33 - I	378	702	928	2,049	NP	241	60	244	60	242	60	242	60	NP	NP	–	–	–	–	–	–	–	–
N-1		–	–	–	–	NP	–	–	–	–	–	–		–	NP	NP	–	–	–	–	–	–	–	–
Normal	220 kV Jamshoro - KDA33 - II	378	702	928	2,049	NP	241	60	244	60	242	60	242	60	NP	NP	–	–	–	–	–	–	–	–
N-1		–	–	–	–	NP	–	–	–	–	–	–	–	–	NP	NP	–	–	–	–	–	–	–	–
Normal	220kV Jamshoro-Hala Road- I & II	818	1,494	2,268	5,093	1493	241	60	244	60	244	60	250	30	254	60	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220 kV Jamshoro - T.M.Khan Road I & II	816	1,408	1,926	5,972	1740	242	60	241	60	244	60	245	60	243	180	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220 kV Jamshoro -Jhampir 2 Ckt- I & II	Added in 2021-22			986	1531	Added in 2021-22						240	60	244	60	Added in 2021-22						–	–
N-1					–	–							–	–	–	–							–	–
Normal	500 kV Jamshoro - Matiari - I	Added in 2020-21		3	15	206	Added in 2020-21				528	60	540	30	537	30	Added in 2020-21						–	–
N-1				–	–	–					–	–	–	–	–	–							–	–
Normal	500 kV Jamshoro - Matiari - II			9	16	247					532	60	540	30	535	90							–	–
N-1				–	–	–					–	–	–	–	–	–							–	–

Added in 2022-23

Added in 2019-20

Added in 2020-21

Added in 2021-22

NP: Not Provided

Changed to 500kV Jamshoro-Dadu

Bifurcated in 500kV Jamshoro- Matiari & 500kV Matairi-Dadu

Bifurcated in 500kV CPHGC-Hub & 500kv CPHGC-Jamshoro

Bifurcated in 500kV Jamshoro-Matiari-I & 500kV Port Qasim-Matiari-II

Changed to 500kV Thar-TEL-SECL-Matiari-Jamshoro

Bifurcated in 220kV Jhampir-II - KDA-I & 220kV Jamshoro-Jhampir-II-I

Bifurcated in 220kV Jhampir-II - KDA-II & 220kV Jamshoro-Jhampir-II-II

Condition	2018-19	2019-20	2020-21	2021-22	2022-23
Total No. of Variations (Normal)	2,476	4,583	6,086	16,220	5,782
Total No. of Variations (N-1)	–	–	–	–	–
Total (Normal & N-1)	2,476	4,583	6,086	16,220	5,782

Highest Voltage Under Normal Condition @500kV level

Highest Voltage Under Normal Condition @220kV level

NTDC Hyderabad Region

5. 500kV Grid Station NKI KARACHI

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500 kV NKI - Hub	6	1	NP	NP	NP	–	–	528	30	NP	NP	NP	NP	NP	NP	472	30	–	–	NP	NP	NP	NP	NP	NP
N-1		–	–	NP	NP	NP	–	–	–	–	NP	NP	NP	NP	NP	NP	–	–	–	–	NP	NP	NP	NP	NP	NP
Normal	500 kV NKI - Port Qasim	6	–	NA	NP	NP	–	–	–	–	NA	NA	NP	NP	NP	NP	472	30	–	–	NA	NA	NP	NP	NP	NP
N-1		–	–	NA	NP	NP	–	–	–	–	NA	NA	NP	NP	NP	NP	–	–	–	–	NA	NA	NP	NP	NP	NP
Normal	500 kV NKI - Jamshoro	Added in 2020-21		NA	NA	46	Added in 2020-21				NA	NA	NA	NA	539	60	Added in 2020-21				NA	NA	NA	NA	–	–
N-1				NA	NA	–					NA	NA	NA	NA	–	–					NA	NA	NA	NA	–	–
Normal	220 kV NKI - Baldia	8	21	NA	NA	18	240	30	234	150	NA	NA	NA	NA	238	300	–	–	208	30	NA	NA	NA	NA	–	–
N-1		–	–	NA	NA	–	–	–	–	–	NA	NA	NA	NA	–	–	–	–	–	–	NA	NA	NA	NA	–	–
Normal	220 kV NKI - KDA33	9	21	NA	NA	18	240	30	234	150	NA	NA	NA	NA	238	300	–	–	208	30	NA	NA	NA	NA	–	–
N-1		–	–	NA	NA	–	–	–	–	–	NA	NA	NA	NA	–	–	–	–	–	–	NA	NA	NA	NA	–	–

Normal	500 kV NKI - K2/K3		31	NA	NA	41			535	30	NA	NA	NA	NA	539	60			–	–	NA	NA	NA	NA	–	–
N-1			–	NA	NA	–			–	–	NA	NA	NA	NA	–	–			–	–	NA	NA	NA	NA	–	–

Added in 2020-21

Added in 2019-20

NP: Not Provided

Bifurcated in 500kV K2/K3-NKI & 500kV Hub-K2/K3

Changed to 500kV NKI-Jamhsoro

Condition	2018-19	2019-20	2020-21	021-2	2022-23
Total No. of Variations (Normal)	29	74	–	–	123
Total No. of Variations (N-1)	–	–	–	–	–
Total (Normal & N-1)	29	74	–	–	123

Highest Voltage Under Normal Condition @500kV level

Highest Voltage Under Normal Condition @220kV level

NTDC Hyderabad Region

6. 500kV Grid Station SHIKARPUR

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500 kV Shikarpur - Guddu Ckt I	1,120	970	827	1,051	822	544	90	545	120	550	180	543	120	543	180	–	–	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500 kV Shikarpur - Guddu Ckt II	1,177	973	828	1,035	845	542	210	545	120	550	180	543	120	543	180	–	–	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500 kV Shikarpur - Dadu Ckt I	82	965	832	1,043	849	540	450	548	120	550	180	543	120	543	180	–	–	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500 kV Shikarpur - Dadu Ckt II	1,133	905	829	1,034	819	541	270	548	120	550	180	543	120	543	180	–	–	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220 kV Shikarpur - Guddu Ckt I	548	869	1,249	1,486	1472	240	150	242	120	245	180	242	150	242	180	–	–	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220 kV Shikarpur - Guddu Ckt II	660	1,031	1,099	1,439	125	241	180	245	120	248	120	242	180	241	120	–	–	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220 kV Shikarpur - Uch Ckt I	506	831	1,278	1,529	1544	240	150	242	120	245	180	242	150	242	240	–	–	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220 kV Shikarpur - Uch Ckt II	657	1,029	1,131	1,595	1602	241	180	241	240	248	120	242	150	243	120	–	–	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220 kV Shikarpur - Rohri I	687	1,016	1,107	1,644	1595	241	180	242	120	247	120	242	180	243	120	–	–	–	–	–	–	–	–	–	–

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
N-1	220 kV Shikarpur - Rohri I	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220 kV Shikarpur - Rohri II	688	1,013	1,131	1,638	1601	241	180	242	330	248	120	242	180	243	120	–	–	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Total No. of Variations (Normal)	7,258	9,602	#####	#####	#####
Total No. of Variations (N-1)	–	–	–	–	–
Total (Normal & N-1)	7,258	9,602	#####	#####	#####

Highest Voltage Under Normal Condition @500kV level

Highest Voltage Under Normal Condition @220kV level

NTDC Hyderabad Region

7. 220kV Grid Station DAHARKI

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Dharki - Engro	NA	948	582	589	620	NA	NA	250	120	251	60	247	60	254	60	NA	NA	NA	NA	200	120	–	–	–	–
N-1		NA	–	–	–	–	NA	NA	–	–	–	–	–	–	–	–	NA	NA	NA	NA	–	–	–	–	–	–
Normal	220 kV Ddharki - FPCDL	NA	964	583	589	625	NA	NA	250	120	252	120	247	60	254	60	NA	NA	NA	NA	200	120	–	–	195	60
N-1		NA	–	–	–	–	NA	NA	–	–	–	–	–	–	–	–	NA	NA	NA	NA	–	–	–	–	–	–

Total No. of Variations (Normal)	–	1,912	1,165	1,178	1,245
Total No. of Variations (N-1)	–	–	–	–	–
Total (Normal & N-1)	–	1,912	1,165	1,178	1,245

Highest Voltage Under Normal Condition @220kV level

Lowest Voltage Under Normal Condition @220kV level

NTDC Hyderabad Region

8. 220kV Grid Station HALA ROAD

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Jamshoro - Hala Road Ckt I &II	20	10	2	NA	1	240	30	238	270	240	30	NA	NA	245	90	–	–	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	-	-	-	-	-	-	NA	NA	–	–	–	–	–	–	–	–	–	–	–	–

Total No. of Variations (Normal)	20	10	2	-	1
Total No. of Variations (N-1)	–	–	–	–	–
Total (Normal & N-1)	–	10	2	0	1

Highest Voltage Under Normal Condition @220kV level

NTDC Hyderabad Region

9. 220kV Grid Station KHUZDAR

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Dadu - Khuzdar I & II	246	1966	2,772	3,520	1100	250	35	248	60	250	60	245	60	248	60	180	30	180	60	-	-	178	60	175	60
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Total No. of Variations (Normal)	246	1,966	2,772	3,520	1,100
Total No. of Variations (N-1)	–	–	–	-	–
Total (Normal & N-1)	246	1,966	2,772	3,520	1,100

Highest Voltage Under Normal Condition @220kV level

Lowest Voltage Under Normal Condition @220kV level

NTDC Hyderabad Region

10. 220kV Grid Station LORALAI

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Loralai - D.G. Khan I & II	1982	2188	1,930	3,138	1324	242	240	250	120	245	60	256	120	247	120	143	180	195	60	-	-	198	60	198	180
N-1		308	252	134	128	880	255	60	255	60	250	60	255	60	260	60	190	60	190	180	-	-	190	120	189	60

Total No. of Variations (Normal)	1,982	2,188	1,930	3,138	1,324
Total No. of Variations (N-1)	308	252	134	128	880
Total (Normal & N-1)	2,290	2,440	2,064	3,266	2,204

Highest Voltage Under Normal Condition @220kV level

Lowest Voltage Under Normal Condition @220kV level

NTDC Hyderabad Region

11. 220kV Grid Station QUETTA INDUSTRIAL-II

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Sibbi - Quetta Ckt I & II	8758	10936	5,702	12,011	1948	280	60	-	-	239	60	242	60	248	60	178	60	176	60	180	60	170	60	180	60
N-1		-	-	4,848	3,023	-	-	-	-	-	245	60	-	-	-	-	-	-	-	-	170	60	168	60	-	-

Total No. of Variations (Normal)	8,758	10936	5,702	12011	1,948
Total No. of Variations (N-1)	-	-	4,848	3,023	-
Total (Normal & N-1)	8,758	10936	10550	15034	1,948

Highest Voltage Under Normal Condition @220kV level

Lowest Voltage Under Normal Condition @220kV level

NTDC Hyderabad Region

11. 220kV Grid Station ROHRI

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Rohri - Shikarpur I&II	166	920	1,088	2,552	1,541	232	60	246	60	247	60	244	120	248	120	-	-	-	-	-	-	-	-	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Rohri - Engro I & II	34	48	412	2,552	1,525	232	60	244	60	247	120	244	120	248	120	-	-	-	-	-	-	-	-	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Total No. of Variations (Normal)	200	968	1,500	5,104	3,066
Total No. of Variations (N-1)	-	-	-	-	-
Total (Normal & N-1)	200	968	1,500	5,104	3,066

Highest Voltage Under Normal Condition @220kV level

NTDC Hyderabad Region

12. 220kV Grid Station SIBBI

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Sibbi - Quetta Ckt I	410	777	700	811	800	246	60	241	60	243	60	244	60	245	60	207	60	205	60	-	-	200	120	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Sibbi - Quetta Ckt II	410	777	700	811	800	246	60	241	60	243	60	244	60	245	60	207	60	205	60	-	-	200	120	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220KV Uch-Sibbi-I	943	1554	1,160	1,557	1355	246	60	250	60	245	60	246	60	247	60	-	-	207	60	-	-	200	120	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Sibbi - Uch Ckt II	943	1554	1,160	1,557	NP	246	60	250	60	245	60	246	60	NP	NP	-	-	207	60	-	-	200	120	NP	NP
N-1		-	-	-	-	NP	-	-	-	-	-	-	-	-	NP	NP	-	-	-	-	-	-	-	-	NP	NP
Normal	220KV Guddu-Sibbi	931	1514	1,160	1,557	1355	246	60	250	60	245	60	246	60	247	60	-	-	207	60	-	-	200	120	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Sibbi - Uch DC Ckt	971	1505	1,160	1,557	-	246	60	250	60	245	60	246	60	-	-	-	-	206	60	-	-	200	120	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220KV D.M.Jamali-Sibbi	902	1505	1,160	1,557	1355	246	60	250	60	245	60	246	60	247	60	-	-	207	60	-	-	200	120	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220KV Uch-II Ckt-I	Added in 2022-23				1,355	Added in 2022-23								247	60	Added in 2022-23								-	-
N-1						-									-	-									-	-
Normal	220KV Uch-II Ckt-II					1,355									247	60									-	-

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
N-1	220KV Uch-II Ckt-II	Added in 2022-23				-	Added in 2022-23								-	-	Added in 2022-23								-	-

Added in 2022-23

The mentioned circuit from UCH-1 PP is in/out at 220kV Grid Station Dera Murad Jamali which further is bifurcated as 220kV Uch-DMJ and 220kV DMJ-Sibbi. Therefore,the requiste data of voltage violation has already been incorporated as 220kV DMJ-Sibbi Ckt in 220kV G/S Sibbi PSTR and 220kV Uch-DMJ Ckt in 220kV G/S DMJ PSTR.

Total No. of Variations (Normal)	5,510	9,186	7,200	9,407	8,375
Total No. of Variations (N-1)	-	-	-	-	-
Total (Normal & N-1)	5,510	9,186	7,200	9,407	8,375

Highest Voltage Under Normal Condition @220kV level

NTDC Hyderabad Region

13. 220kV Grid Station T.M. KHAN ROAD

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV T.M.Khan - Jamshoro I & II	1342	2568	912	1,186	707	247	60	243	60	245	60	242	60	243	60	-	-	-	-	-	-	-	-	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV T.M.Khan - Jhimpir I & II	1476	2640	912	1,186	722	247	60	243	60	245	60	242	60	243	60	-	-	-	-	-	-	-	-	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Total No. of Variations (Normal)	2,818	5,208	1,824	2,372	1,429
Total No. of Variations (N-1)	-	-	-	-	-
Total (Normal & N-1)	2,818	5,208	1,824	2,372	1,429

Highest Voltage Under Normal Condition @220kV level

NTDC Hyderabad Region

14. 220kV Grid Station JHIMPIR-I

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Jhimpir - T.M.Khan I	444	415	101	205	101	247	60	245	120	249	60	246	60	246	60	190	60	-	-	-	-	-	-	202	60
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Jhimpir - T.M.Khan II	444	415	101	205	101	247	60	245	120	249	60	246	60	246	60	190	60	-	-	-	-	-	-	202	60
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220KV JMP I - JMP-II	Added in 2022-23				101	Added in 2022-23								246	60	Added in 2022-23								202	60
N-1						-									-	-									-	-

Added in 2022-23

Total No. of Variations (Normal)	888	830	202	410	303
Total No. of Variations (N-1)	-	-	-	-	-
Total (Normal & N-1)	888	830	202	410	303

Highest Voltage Under Normal Condition @220kV level

Lowest Voltage Under Normal Condition @220kV level

NTDC Hyderabad Region

15. 220kV Grid Station JHIMPIR-I

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Jhimpir II - Jamshoro 1 & 2	Added in 2022-23				137	Added in 2022-23								248	60	Added in 2022-23								203	60
N-1						-									-	-									-	-
Normal	220KV Jhimpir 2 -KDA-I & 2					137									248	60									203	60
N-1						-									-	-									-	-
Normal	220 kV Jhimpir 2 - Jhimpir I					122									248	60									203	60
N-1						-									-	-									-	-
	Added in 2022-23																									
Total No. of Variations (Normal)		-	-	-	-	396																				
Total No. of Variations (N-1)		-	-	-	-	-																				
Total (Normal & N-1)		-	-	-	-	396																				

Highest Voltage Under Normal Condition @220kV level

Lowest Voltage Under Normal Condition @220kV level

NTDC Hyderabad Region

16. 220kV Grid Station Dera Murad Jamali

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV D. M. Jamali - Uch	1119	2205	NP	1,671	750	241	60	241	120	NP	NP	241	60	243	60	-	-	-	-	NP	NP	-	-	-	-
N-1		-	-	NP	-	-	-	-	-	-	NP	NP	-	-	-	-	-	-	-	-	NP	NP	-	-	-	-
Normal	220 kV D. M. Jamali - Sibbi		2625	NP	1,604	747	241	60	241	120	NP	NP	241	60	243	60	-	-	-	-	NP	NP	-	-	-	-
N-1			-	NP	-	-	-	-	-	-	NP	NP	-	-	-	-	-	-	-	-	NP	NP	-	-	-	-
	Only comparison reported						NP: Not provided																			
Total No. of Variations (Normal)		1119	4830	-	3275	1497																				
Total No. of Variations (N-1)		-	-	-	-	-																				
Total (Normal & N-1)		-	-	-	-	1,497																				

Highest Voltage Under Normal Condition @220kV level

NTDC Hyderabad Region

17. 220kV Grid Station Switchyard Guddu

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19		2019-20		2020-21		2021-22		2022-23		2018-19		2019-20		2020-21		2021-22		2022-23	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV Guddu-Shikarpur-I	Added in 2022-23				1474	Added in 2022-23								242	240	Added in 2022-23								-	-
N-1						-									-	-									-	-
Normal	220kV Guddu-Shikarpur-II					125									241	120									-	-
N-1						-									-	-									-	-
Normal	220kV Guddu-Sibbi D/Circuit					1541									242	240									-	-
N-1						-									-	-									-	-

Added in 2022-23

Total No. of Variations (Normal)	-	-	-	-	3140
Total No. of Variations (N-1)	-	-	-	-	-
Total (Normal & N-1)	-	-	-	-	3,140

Highest Voltage Under Normal Condition @220kV level