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Performance
Evaluation Report
NTDC & K-Electric



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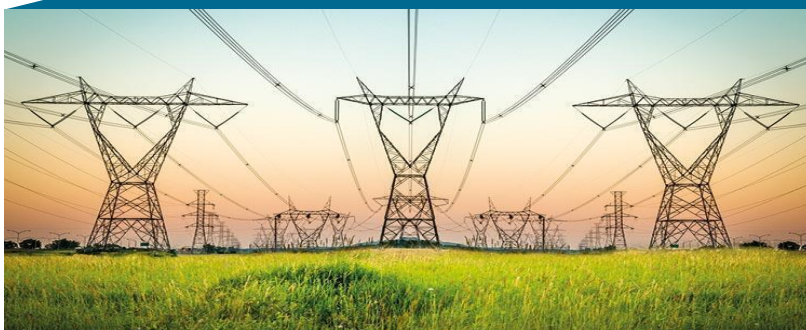
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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

National Electric Power Regulatory Authority (NEPRA) is the sole regulator of power sector in Pakistan. Provision of safe, reliable, efficient and affordable electric power to the electricity consumers is an integral part of NEPRA's regulatory regime.

NEPRA has framed the Performance Standards (Transmission) Rules 2005 (PSTR)¹ in order to encourage safe, efficient and reliable transmission service. Under PSTR, a transmission licensee is required to submit to NEPRA an Annual Performance Report (APR) in a manner as prescribed in PSTR. NEPRA analyzes these performance reports in light of the performance parameters such as System Duration of Interruption, System Frequency of Interruption, Energy Not Served (ENS), Loss of Supply Incidents along with its financial impact, System Disturbances (if any), Voltage and Frequency Violation Limits prescribed under the PSTR, and Highest and Lowest Voltage Recorded at National Transmission & Despatch Company (NTDC) 500 kV and 220 kV grid stations under Normal system conditions.

The APRs for the year 2020-21, submitted by NTDC and K-Electric have been reviewed on the basis of above-mentioned parameters. Highlights of the analysis/findings are given in succeeding paras: -

¹ Under section 46 of the Regulation of Generation, Transmission and Distribution of Electric Power Act 1997 (XL of 1997), read with section 7 (2) (c) and section 34 thereof, the National Electric Power Regulatory Authority, with the approval of Federal Government, has made the Performance Standards (Transmission) Rules (PSTR) notified vide S.R.O 1138(I)/2005 dated 15th November, 2005.

PERFORMANCE OF NTDC

System Duration of Interruption

System duration of interruption is a reliability indicator that measures the average outage duration that an interconnection point observes in a year. The interruption was witnessed around 0.13 hours (8 minutes) in the year 2020-21 maintaining the status quo situation.

System Frequency of Interruption

System frequency of interruption is a reliability parameter that measures the average number of outages per circuit in a year. During 2020-21 the average number of outages per circuit for NTDC remained 0.11, showing a decrease of 8.3% over the previous year i.e. 0.12.

Energy Not Served (ENS)

In order to gauge system security, the estimates of total ENS during the year as reported by the licensees have been analyzed. The total ENS as reported by NTDC in 2020-21 is **130.2 million kWh** that indicates around 652% increase over the previous year i.e. 17.3 million kWh. Based on the capacity charge², the financial impact amounts to around **Rs. 888 million**.

² Capacity charge = Rs. 6.82/kWh.

Loss of Supply Incidents

NTDC reported 57 loss of supply incidents during the year 2020-21 which

translates into total duration of 66.4 hours. The average ENS per incident along with duration and subsequent financial impact has been assessed in the following table.

▼ Description / Unit / Year ►	Unit	2016-17	2017-18	2018-19	2019-20	2020-21
Loss of Supply Incidents	Nos.	165	142	66	62	57
Average ENS per Incident	Million kWh	0.454	3.3	1.7	0.3	2.3
Average Duration per Incident	Hrs : Min	03 : 07	02 : 06	02 : 24	01 : 06	01 : 12
Financial Impact per Incident	Rs. (Million)	2.5	17.5	9.7	1.4	15.6

Major System Disturbances

As reported by NTDC, these outages include 6 major disturbances in the year

2020-21. The details are summarized below: -

S. No.	Date	Loading at Interruption time	Duration of Interruption	Remarks
1	23-Aug-2020	345 MW	1 Hr & 44 min	500/220 kV, 450 MVA Auto Transformer T-1, T2 & T3 were affected.
2	23-Aug-2020	110 MW	2 Hrs & 10 min	220 kV Guddu-Shikarpur circuit # 01 & 02, 220 kV Guddu-Sibbi circuit affected.
3	09-Jan-2021	10311 MW	20 Hrs	Major System Blackout 500 kV circuits Guddu – Shikarpur 1, Guddu – Shikarpur 2, Guddu – D.G. Khan, Guddu – Muzaffargarh, Guddu – 747 and 500/220 kV, 450 MVA T-2 Transformer at Guddu were affected.
4	29-Apr-2021	590 MW	31 min	Tripping of KAPCO Power Plant and associated transmission lines 220 kV Muzaffargarh Phase-I – KAPCO circuit 1 along with 220 kV Bus Bar 2 at Kapco, 220 kV circuits KAPCO – Multan 4, KAPCO – Multan 5 and KAPCO – Multan 6 tripped.
5	22-May-2021	2097 MW	35 min	Tripping of lines and tower collapse of 500kV Port Qasim – Matiari Circuit 1 & 2 220 kV circuits NKI – Baldia, NKI – KDA, and 500 kV circuits NKI – Jamshoro, Dadu – Matiari, Dadu – Jamshoro and Matiari – Port Qasim circuit 1 & 2 were affected.
6	25-May-2021	850 MW	17 min	Tripping at 220kV TPS Muzaffargarh (Phase-I) and associated transmission lines 220 kV circuits Muzaffargarh Phase-I – Multan 4, Muzaffargarh Phase-I – Muzaffargarh Phase-II, Muzaffargarh Phase-I – Bahawalpur 2, Muzaffargarh Phase-II – Pakgen, Muzaffargarh Phase-I – Lalpir 1, Muzaffargarh Phase-II – Lalpir 2 and 220 kV Bus Bar 1 & 2 at Muzaffargarh Phase-I and 500/220 kV Transformer T1 at 500 kV Muzaffargarh tripped.

Voltage Violations

NEPRA has prescribed limits for voltage variations in PSTR. Number of voltage violations for NTDC remained 120,092 for the year 2020-21 that indicate 19.5% decrease as compared to 149,130 violations in the preceding year.

Highest and Lowest Voltage Recorded Under Normal System Condition

The highest voltage recorded beyond permissible limits at 500 kV voltage class was 560 kV for time duration of 60 minutes,

recorded at D. G. Khan. The voltage of 560 kV shows approximately 6.7% variation with respect to allowed limit ($\pm 5\%$ = 525/475 kV). Detail is given in section 3.3.1 (figure 3.15).

Similarly, at 220 kV level, highest voltage was 252 kV recorded at Dharki for time duration of 120 minutes. Voltage of 252 kV indicates approximately 9.1% variation with respect to allowed limit ($+5\%$ = 231 kV). Detail of highest voltage incidents is given in section 3.3.1 (figure 3.16). Grid stations with highest voltage incidents are given below: -

S. No.	Name of Grid Station	Highest Voltage Recorded (kV)	Duration of Variation (min)	Variation w.r.t Allowed Limit (%)
1	220 kV Dharki	252	120	9.1%
2	220 kV Lal Sohanra 220 kV Khuzdar	250	60	8.2%
3	220 kV University 220 kV Jhimpir	249	120 60	7.8%
4	220 kV Muzaffargarh	248	60	7.4%
5	220 kV Rohri	247	120	6.9%
6	220 kV Sibbi 220 kV T. M. Khan	245	60	6.1%
7	220 kV Bannu 220 kV Samundri Road	241	60 210	4.3%
8	220 kV ISPR	240	240	3.9%
9	220 kV Burhan 220 kV Nowshera 220 kV Mansehra	238	180 180 60	3.0%

On the lower side, the voltage remained as low as 173 kV that indicates 17.2% variation with respect to allowed limit (-5% = 209 kV) which may affect the consumer

end voltages and consequently equipment damage. Grid stations with lowest voltage incidents are given hereunder: -

S. No.	Name of Grid Station	Highest Voltage Recorded (kV)	Duration of Variation (min)	Variation w.r.t Allowed Limit (%)
1	220 kV Kala Shah Kaku	173	90	17.2%
2	220 kV Sarfaraznagar	176	210	15.8%
3	220 kV Quetta 220 kV Sialkot	180	60 330	13.9%
4	220 kV Toba Tekh Singh 220 kV New Shalamar	182	540 120	12.9%
5	220 kV Shahibagh	184	120	12%
6	220 kV New Kot Lakhpat 220 kV Gakkhar 220 kV Mardan	185	90 60 60	11.5%

S. No.	Name of Grid Station	Highest Voltage Recorded (kV)	Duration of Variation (min)	Variation w.r.t Allowed Limit (%)
7	220 kV Gujrat	189	60	9.6%
8	220 kV WAPDA Town 220 kV Chakdara	190	90 90	9.1%
9	220 kV Ravi	192	210	8.1%
10	220 kV Chishtian	194	120	7.2%
11	220 kV Okara 220 kV ISPR	195	1440 60	6.7%
12	220 kV Kassowal 220 kV Bund Road Lahore	197	60 90	5.7%
13	220 kV Mansehra	198	50	5.3%
14	220 kV Nowshera	200	60	4.3%

In order to diagnose the root cause of low voltage, monitoring activities are carried out by NEPRA on regular basis to avoid any undesirable condition on the system and ensure continuity and stability of supply to the electricity consumers of Pakistan.

Frequency Violations

NEPRA has prescribed limits for frequency variations under the Rules.

The frequency data as reported by NTDC indicated variation in frequency limits beyond the upper permissible limit of 50.5 Hz and highest frequency recorded was 50.72 Hz that comes out to be 1.4% variation against the allowed limit of 1% in the year 2020-21. However, NTDC has violated the prescribed limits 4 times which shows improvement in comparison to the preceding year. Detail is given below: -

Description / Unit / Year	Unit	2016-17	2017-18	2018-19	2019-20	2020-21
Number of times Frequency remained outside the Limits in a Year	In a year	35	25	25	9	4
	Average/month	2.9	2.1	2.1	0.8	0.3
	Average/day	0.096	0.068	0.068	0.024	0.01
Time duration the Frequency remained outside the Limits in a Year	Days	0.18	0.17	0.12	0.03	0.02
	Hours	4.2	4.1	2.98	0.8	0.6
	%age of year	0.048	0.047	0.034	0.009	0.007
Maximum continuous period of Deviation	Hours	0.25	0.18	-	-	-
	Minutes	15	11	-	-	-

Conclusion

Slight improvement has been shown by NTDC in reliability indicator 'system frequency of interruption' whereas, the Energy Not Served (ENS) has increased by 652% in 2020-21 as compared to preceding year. The voltage violations have been lowered by 19.5% however, low

voltage profile is still a question mark and NTDC needs to improve its functions of planning, operation, protection, augmentation & expansions and rehabilitation to overcome these issues.

PERFORMANCE OF K-ELECTRIC

System Duration of Interruption

System duration of interruption was witnessed on average around 0.06 Hours (4 minutes) which shows a decrease of 50% as compared to preceding year's average of 0.12 Hours (7 minutes).

System Frequency of Interruption

System frequency of interruption was observed on average around 0.02 number of outages per circuit. It indicates a decrease of 77% over the previous year i.e. 0.09.

Energy Not Served (ENS)

In order to gauge system security, the estimates of total energy not served (ENS) during the reported period has been analyzed. The total ENS as reported by KE is 0.685 million kWh. Based on the average energy sale rate of KE³, the financial impact of 0.685 million kWh, amounts to approximately Rs. 6.85 million. The detail is given hereunder: -

Description	2016-17	2017-18	2018-19	2019-20	2020-21
Loss of Supply Incidents (Nos.)	10	8	13	3	1
Average ENS per Incident (Million kWh)	0.285	0.323	0.206	0.234	0.685
Average Duration per Incident (Hrs : Min)	00 : 43	00 : 25	00 : 20	00 : 19	00 : 34
Financial Impact per Incident Rs. (Million)	3.65	4.1	2.6	2.2	6.85

Frequency Violations

KE has reported none voltage violations under both normal and N-1 contingency conditions. The following figure shows the trend, whereas detailed circuit wise analysis is given at appendix 5.

System Frequency

During 2020-21, there was no reportable frequency violation by KE.

Conclusion

Improvement has been shown by KE in reliability and quality of supply indicators as compared to preceding year.

³ KE's average energy sale rate = Rs. 10/kWh.



I N T R O D U C T I O N

1 Introduction

This Performance Evaluation Report (PER) provides information on the performance of the transmission licensees i.e. National Transmission & Despatch Company (NTDC) and K-Electric (KE) as per National Electric Power Regulatory Authority (NEPRA) Performance Standards (Transmission) Rules (PSTR) 2005⁴, based on their reported data for the year 2020-21.

The document, further, takes account of system reliability, security of supply and quality of supply of the transmission network of the licensees during the reported period. Trend analysis in terms of comparison over the last five years has also been provided in this regard.

1.1 Reporting Requirement

Pursuant to Rule 9 of the PSTR, the licensee shall submit to the Authority every year, before the 31st of August of the succeeding year, an Annual Performance Report (APR). The APR shall contain all relevant information with respect to compliance with these rules during the year, including a statement of comparison with the compliance reporting achieved during the preceding year. The reporting guidelines are provided under Rule 10 of PSTR 2005.

1.2 Compliance

Pursuant to Rule 6 of PSTR 2005, the quality of supply shall be measured with reference to system voltage and system frequency. The system voltage and frequency requirements are provided in

Rule 7 and 8 of PSTR 2005 which read as follows:

Rule 7 of PSTR 2005 (System Voltage)

- 1) *Under normal conditions the voltage variations of plus or minus $\pm 5\%$ 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 $\pm 10\%$ of the nominal voltage for voltages of the 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.*

Rule 8 of PSTR 2005 (System Frequency)

- 1) *The frequency variations of plus or minus $\pm 1\%$ 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.*

⁴ Available at:

[https://nepra.org.pk/Legislation/2-Rules/2.7%20NEPRA%20Performance%20Standards%20\(Transmission\)%20Rules,%20202005/Performance%20Standards%20\(Transmission\)%20Rules%202005.pdf](https://nepra.org.pk/Legislation/2-Rules/2.7%20NEPRA%20Performance%20Standards%20(Transmission)%20Rules,%20202005/Performance%20Standards%20(Transmission)%20Rules%202005.pdf)



N T D C

2 Brief about NTDC

NTDC was incorporated under the Companies Ordinance 1984 on November 6, 1998 as a result of structural reforms introduced by the Government of Pakistan in the Power Sector. The principal business of NTDC is to own, operate and build infrastructure for transmission system of 220 kV, 500 kV and above transmission Lines and associated Sub-stations.

NTDC commenced its commercial operation on 1st of March 1999 and was organized to take over the properties, assets, rights, obligations and liabilities of transmission network all over Pakistan previously owned by Pakistan Water and Power Development Authority (WAPDA), except the area served by K-Electric.

2.1 Licence

NTDC was granted Transmission Licence on 31st December 2002 by NEPRA to engage exclusively in the transmission business for a term of thirty (30) years, pursuant to Section 17 of the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997.

2.2 Transmission Network

NTDC operates & maintains sixteen (16) 500 kV and forty-five (45) 220 kV Grid Stations with 8,059 km of 500 kV and 11,438 km of 220 kV transmission lines as of June, 2021. Figure 2.1 shows detail of NTDC transmission system.

Figure 2.1: NTDC Grid Stations

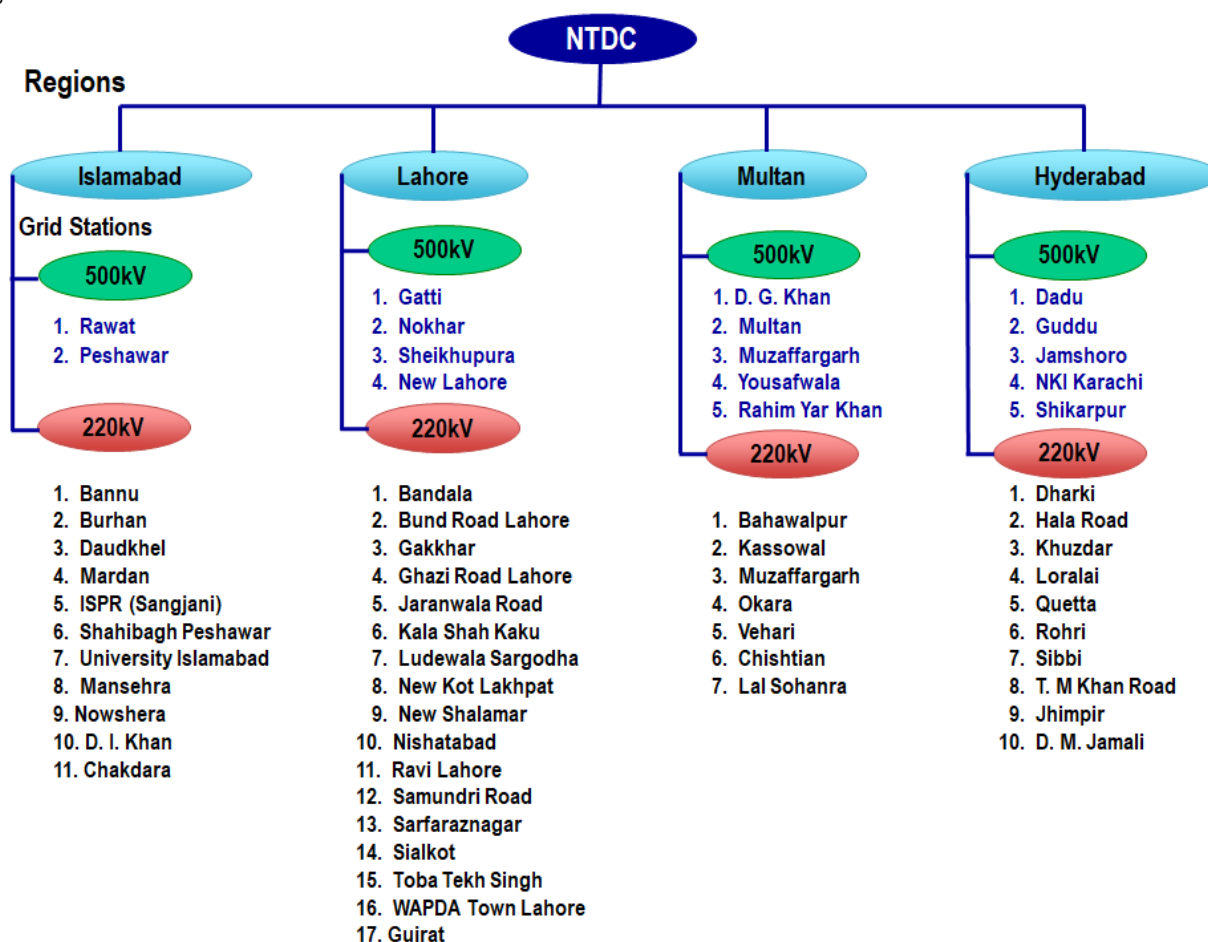


Table 2.1: Addition of Grids, Transmission Lines (km) & MVA Capacity

Description		2016-17	2017-18	2018-19	2019-20	2020-21
No. of Grid Stations	500 kV	14	16	16	16	16
	220 kV	38	40	44	45	45
	Total	52	56	60	61	61
Length of Transmission Line (Circuit km)	500 kV	5,253	5,772	5,970	7470	8059
	220 kV	9,814	10,753	11,322	11281	11438
	Total	15,067	16,525	17,292	18,751	19,497
Transformation Capacity (MVA)	500 kV	18,624	20,850	22,350	24000	30610
	220 kV	25,660	28,610	31,060	31900	25770
	Total	44,284	49,460	53,410	55,900	56,380

During review of annual performance report of NTDC it has been observed that no 500 kV grid station exist in the province of Balochistan. Currently five 220 kV grid stations i.e. 220 kV Quetta, Sibbi, Khuzdar, Loralai and Dera Murad Jamali grid stations are operational in Balochistan. However, it is noteworthy to mention that 220 kV Quetta and Sibbi grid stations are suffering from constraints since 2017 thereby voltages as low as 180 kV are observed on these grid stations. The proposed way forward by NTDC includes augmentation of transformers at these grid stations and construction of two 220 kV grid stations namely Zhob and Mastung with expected completion timelines of 2022-23 and 2023-24 respectively.

Gwadar area is also of vital importance, however, it is pertinent to highlight that 132 kV grid of Makran/Gwadar is not connected with the national grid and is being fed from Iran through 132 kV transmission line as per tariff determination of NTDC for the years 2019-20, 2020-21 & 2021-22.

The aforesaid determination also highlights NTDC's concept clearance paper for connection of Makran/Gwadar grid with NTDC network through 220 kV transmission lines from Khuzdar to

Gwadar via Punjgur in year 2025 & onwards with estimated cost of Rs. 30 billion. Accordingly, the Authority has directed NTDC to submit a comprehensive plan along with clear timelines for completion of the aforesaid lines in next petition along with the progress details.

2.3 Performance at a Glance

An overview of the performance of NTDC is given hereunder in light of the reported data;

System Reliability

Average Duration of Interruption

1. Total outages hours recorded at all interconnection points (excluding 132 kV line tripping) = **66.4 Hrs**
2. Total number of interconnection points = **520**
3. System duration of interruption = $66.4 \div 520$ = **0.13 Hrs/point** i.e. **8 min.**

Maintained status quo position.

Average Frequency of Interruption

1. Total number of outages recorded at all 132 kV outgoing circuits (excluding 132 kV line tripping) = **57**
2. Total number of 132 kV circuits = **520**
3. System frequency of interruption = $57 \div 520$ = **0.11 Nos./circuit.**

Indicates 8.3% decrease over the previous year i.e. 0.12 Nos./circuit

System Security

Energy Not Served (ENS)

1. Total ENS = **130.2 Million kWh**
2. Number of incidents, where there has been a loss of supply = **57**
3. Average ENS per incident = **2.3 Million kWh**
4. Average duration per incident = $66.4 \div 57$ = **1.2 Hrs (1 Hr & 12 min)**
5. Financial impact of ENS = **Rs. 888 Million**
6. Financial impact per incident = $888 \div 57$ = **Rs. 15.6 Million.**

ENS of 130.2 Million kWh indicates around 652% increase over the previous year i.e. 17.3 Million kWh.

Rs. 888 Million indicates 932% increase than the previous year's impact of Rs. 86 Million.

Voltage

1. Total number of violations under normal conditions = **119,755**
2. Total number of violations under N-1 conditions = **337**
3. Total number of violations under Normal & N-1 conditions = **120,092**
4. Highest voltage recorded under normal conditions; @500 kV level: **560 kV** for 60 min. at D.G Khan; @220kV level: **252 kV** for 60 min. at Dharki.
5. Lowest voltage recorded under normal conditions; @220kV level: **173 kV** for 90 min. at Kala Shah Kaku.

Violations of 120,092, indicates 19.5% decrease over the previous year's 149,130.

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 = **35 min.**
3. %age time of the year the frequency remained outside the limits = **0.007% time of the year.**

4. Highest frequency recorded = **50.72 Hz**
5. No violation at lower end.

Allowable limits: 49.5 Hz – 50.5 Hz

3 Analysis of NTDC's Annual Performance Report (APR)

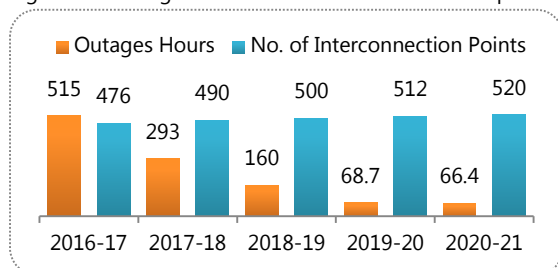
The Annual Performance Report submitted by NTDC has been analyzed in light of the PSTR 2005. The detail is given hereunder;

3.1 System Reliability

3.1.1 System Duration of Interruption

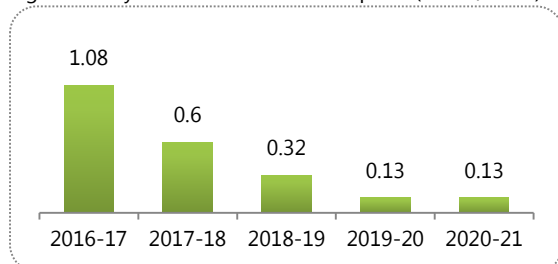
The total outages hours recorded at all interconnection points are 66.4 during the reported period, indicating a 3.4% decrease in comparison to the preceding year's 68.7 hours. Similarly, 08 number of interconnection points have been added to the system resulting into 520 in total. The same has been shown in figure 3.1.

Figure 3.1: Outages hours & No. of interconnection points



The average duration of interruption per interconnection point during the reported period remained 0.13 hours (8 minutes). This indicates that NTDC has maintained status quo position. The same has been shown in figure 3.2.

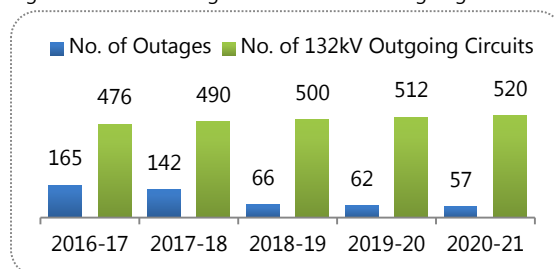
Figure 3.2: System duration of interruption (Hours/Point)



3.1.2 System Frequency of Interruption

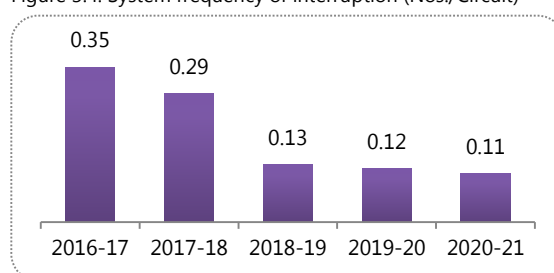
The total number of outages remained 57 in the year 2020-21 that shows a reduction of around 8.1% as compared to preceding year's 62 outages as shown in the flowing figure.

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



Average number of interruptions per circuit during the reported period remained 0.11 indicating 8.3% improvement in comparison to the preceding year's 0.12 as shown in figure 3.4.

Figure 3.4: System frequency of interruption (Nos./Circuit)



3.2 System Security

In order to gauge system security, the estimates of total energy not served (ENS) during the reported period has been analyzed. The total ENS as reported by NTDC is 130.2 million kWh. Based on the capacity charge⁵, the financial impact of 130.2 million kWh, amounts to approximately Rs. 888 million. The detail is given hereunder;

Figure 3.5: Reported ENS

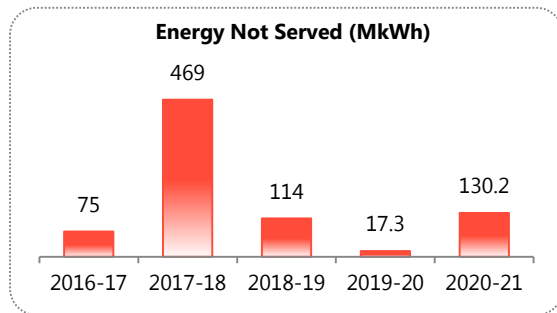


Figure 3.6: Loss of supply incidents & duration per incident

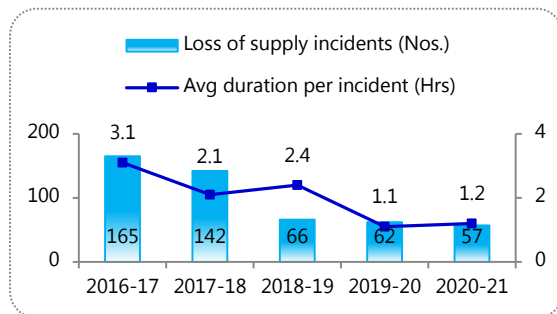


Figure 3.7: Loss of supply incidents along with average

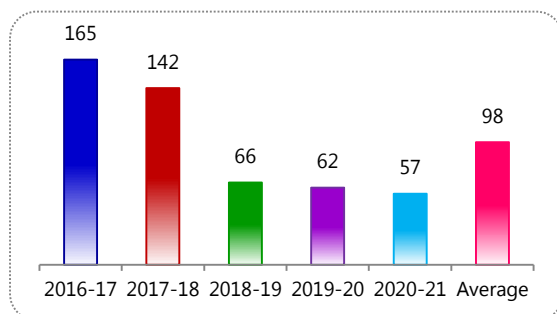


Figure 3.8: Region wise loss of supply incidents

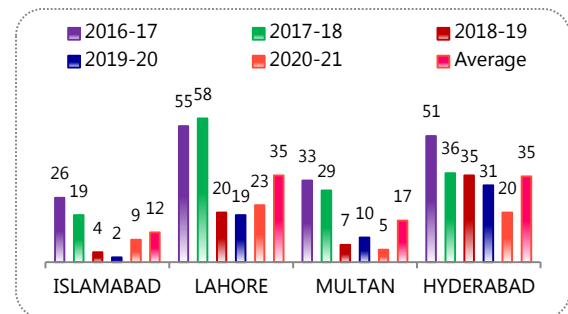
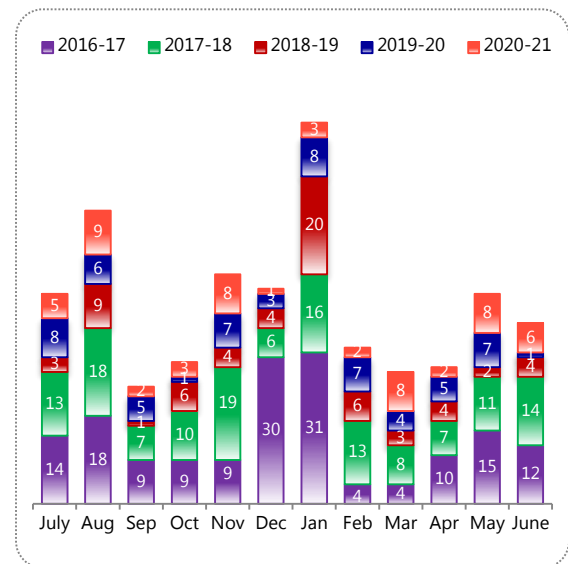


Figure 3.9: Seasonal trend of loss of supply incidents



⁵ Capacity charge = Rs. 6.82/kWh.

Table 3.1: Loss of supply incidents, average ENS, duration & financial impact per incident

▼ Description / Unit / Year ►	Unit	2016-17	2017-18	2018-19	2019-20	2020-21
Loss of Supply Incidents	Nos.	165	142	66	62	57
Average ENS per Incident	Million kWh	0.454	3.3	1.7	0.3	2.3
Average Duration per Incident	Hrs : Min	03 : 07	02 : 06	02 : 24	01 : 06	01 : 12
Financial Impact per Incident	Rs. (Million)	2.5	17.5	9.7	1.4	15.6

3.2.1 Major System Disturbances

As reported by NTDC, these outages include 6 major disturbances in the year 2020-21. The detail is summarized below: -

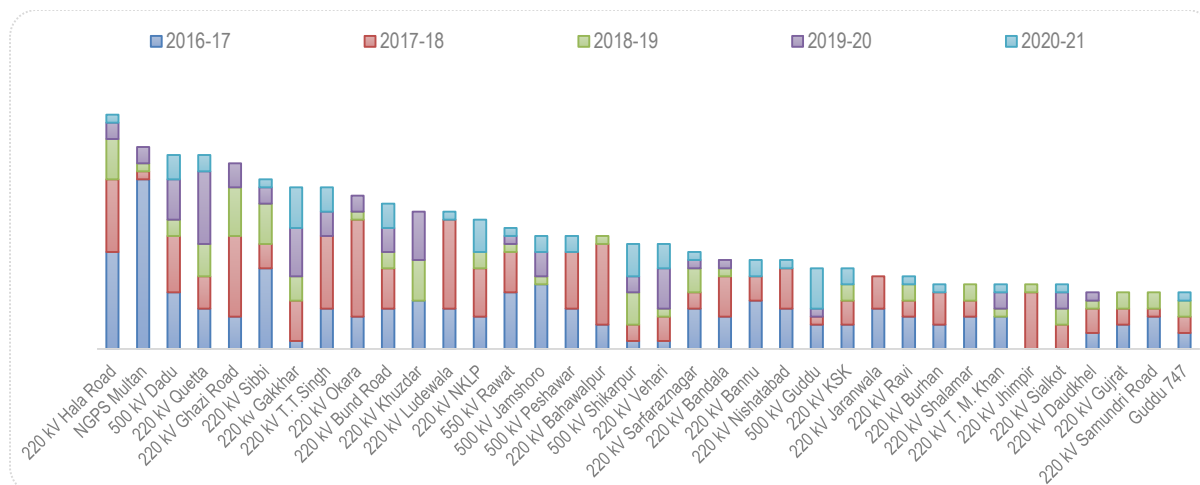
Table 3.2: Major system disturbances

S. No.	Date	Loading at Interruption time	Duration of Interruption	Remarks
1	23-Aug-2020	345 MW	1 Hr & 44 min	500/220 kV, 450 MVA Auto Transformer T-1, T2 & T3 were affected.
2	23-Aug-2020	110 MW	2 Hrs & 10 min	220 kV Guddu-Shikarpur circuit # 01 & 02, 220 kV Guddu-Sibbi circuit affected.
3	09-Jan-2021	10311 MW	20 Hrs	Major System Blackout 500 kV circuits Guddu – Shikarpur 1, Guddu – Shikarpur 2, Guddu – D.G. Khan, Guddu – Muzaffargarh, Guddu – 747 and 500/220 kV, 450 MVA T-2 Transformer at Guddu were affected.
4	29-Apr-2021	590 MW	31 min	Tripping of KAPCO Power Plant and associated transmission lines 220 kV Muzaffargarh Phase-I – KAPCO circuit 1 along with 220 kV Bus Bar 2 at Kapco, 220 kV circuits KAPCO – Multan 4, KAPCO – Multan 5 and KAPCO – Multan 6 tripped.
5	22-May-2021	2097 MW	35 min	Tripping of lines and tower collapse of 500kV Port Qasim – Matiari Circuit 1 & 2 220 kV circuits NKI – Baldia, NKI – KDA, and 500 kV circuits NKI – Jamshoro, Dadu – Matiari, Dadu – Jamshoro and Matiari – Port Qasim circuit 1 & 2 were affected.
6	25-May-2021	850 MW	17 min	Tripping at 220kV TPS Muzaffargarh (Phase-I) and associated transmission lines 220 kV circuits Muzaffargarh Phase-I – Multan 4, Muzaffargarh Phase-I – Muzaffargarh Phase-II, Muzaffargarh Phase-I – Bahawalpur 2, Muzaffargarh Phase-II – Pakgen, Muzaffargarh Phase-I – Lalpir 1, Muzaffargarh Phase-II – Lalpir 2 and 220 kV Bus Bar 1 & 2 at Muzaffargarh Phase-I and 500/220 kV Transformer T1 at 500 kV Muzaffargarh tripped.

Table 3.3: Locational trend of loss of supply incidents

S. No.	Grid/ Plant Name	2016-17	2017-18	2018-19	2019-20	2020-21	Total
1	220 kV Hala Road	12	9	5	2	1	29
2	NGPS Multan	21	1	1	2	0	25
3	500 kV Dadu	7	7	2	5	3	24
4	220 kV Quetta	5	4	4	9	2	24
5	220 kV Ghazi Road	4	10	6	3	0	23
6	220 kV Sibbi	10	3	5	2	1	21
7	220 kV Gakkhar	1	5	3	6	5	20
8	220 kV T. T. Singh	5	9	0	3	3	20
9	220 kV Okara	4	12	1	2	0	19
10	220 kV Bund Road	5	5	2	3	3	18
11	220 kV Khuzdar	6	0	5	6	0	17
12	220 kV Ludewala	5	11	0	0	1	17
13	220 kV NKLP	4	6	2	0	4	16
14	550 kV Rawat	7	5	1	1	1	15
15	500 kV Jamshoro	8	0	1	3	2	14
16	500 kV Peshawar	5	7	0	0	2	14
17	220 kV Bahawalpur	3	10	1	0	0	14
18	500 kV Shikarpur	1	2	4	2	4	13
19	220 kV Vehari	1	3	1	5	3	13
20	220 kV Sarfaraznagar	5	2	3	1	1	12
21	220 kV Bandala	4	5	1	1	0	11
22	220 kV Bannu	6	3	0	0	2	11
23	220 kV Nishatabad	5	5	0	0	1	11
24	500 kV Guddu	3	1	0	1	5	10
25	220 kV Kala Shah Kaku	3	3	2	0	2	10
26	220 kV Jaranwala	5	4	0	0	0	9
27	220 kV Ravi	4	2	2	0	1	9
28	220 kV Burhan	3	4	0	0	1	8
29	220 kV Shalamar	4	2	2	0	0	8
30	220 kV T. M. Khan	4	0	1	2	1	8
31	220 kV Jhampir	0	7	1	0	0	8
32	220 kV Sialkot	0	3	2	2	1	8
33	220 kV Daudkhel	2	3	1	1	0	7
34	220 kV Gujrat	3	2	2	0	0	7
35	220 kV Samundri Road	4	1	2	0	0	7
36	Guddu 747	2	2	2	0	1	7
Major System Disturbances/Blackouts/Breakdowns/System Splitting(s)							
37	Nos.	10	4	13	5	6	38

Figure 3.10: Locational trend of loss of supply incidents



The above table and figure shows the locational trend of outages over the period of five years. Among which the Hala Road, Guddu, Jamshoro, Dadu, Shikarpur and Gakkhar areas are most vulnerable to frequent outages leading to major system disturbances that often result in major system blackouts, collapses and breakdowns. NTDC needs to improve its functions of planning, operation, protection, augmentation & expansions and rehabilitation so that such disturbances may not occur in future.

Considering the fact that transmission network being the backbone of the country's electric power supply system, the Authority allowed a colossal amount to NTDC under the head of repair & maintenance (R&M) to ensure and attain optimal level of network reliability and sustainability. The detail is given hereunder;

R&M Allowed		Rs. In Millions			
2016-17	2017-18	2018-19	2019-20	2020-21	
947	671	988	655	719	

3.3 Quality of Supply

Quality of supply (QoS) is measured with reference to system voltage and system frequency. The analysis of QoS data as reported by the licensee is given in next sub-sections: -

3.3.1 System Voltage

The data pertaining to number of voltage violations as submitted by NTDC was analyzed and it was observed that NTDC's performance has improved by 19.5% in the year 2020-21 as compared to preceding year as shown in figure 3.10. Region wise detail of voltage violations is as under;

Figure 3.11: Number of voltage violations (NTDC)

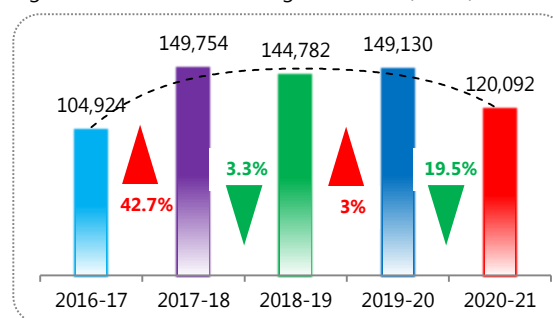


Table 3.4: Number of voltage violations (NTDC Region wise)

System Condition	NTDC Region	2016-17	2017-18	2018-19	2019-20	2020-21
Normal	Islamabad	27,776	28,978	30,185	29,577	21,710
	Lahore	52,005	74,718	60,386	47,956	53,393
	Multan	8,455	10,800	14,921	11,868	5,841
	Hyderabad	15,582	25,826	33,850	52,698	38,811
Total (Normal)		103,818	140,322	139,342	142,099	119,755
N-1	Islamabad	–	–	–	–	–
	Lahore	1,029	8,506	3,355	5,009	–
	Multan	75	926	1777	1,770	203
	Hyderabad	2	–	308	252	134
Total (N-1)		1,106	9,432	5,440	7,031	337
Total (Normal & N-1)		104,924	149,754	144,782	149,130	120,092

The grid station wise breakup for each region is given hereunder:

Table 3.5: Number of voltage violations (NTDC Islamabad Region)

S. No.	Grid Station	2016-17	2017-18	2018-19	2019-20	2020-21
1	500 kV Rawat	6,611	6,202	5,165	6,768	4,298
2	500 kV Peshawar	4,239	2,212	772	2,275	1,417
3	220 kV Bannu	3,394	1,256	1,195	716	664
4	220 kV Burhan	1,184	219	265	1,032	644
5	220 kV Daudkhel	5,631	1,421	906	684	243
6	220 kV ISPR	269	773	470	1,364	582
7	220 kV Mardan	4,008	11,359	13,513	5,460	3,999
8	220 kV Shahibagh	806	2,703	2,816	3,620	4,350
9	220 kV University	1,634	2,832	2,812	2,541	2,363
10	220 kV Mansehra	4-4-2018	1	124	56	312
11	220 kV Nowshera	19-4-2019	NA	1357	NA	628
12	220 kV Chakdara	16-9-2018	317	578	317	368
13	220 kV D. I. Khan	18-2-2019	1,830	3126	1,830	1,842
14	Total	27,776	28,978	30,185	29,577	21,710

Date commissioned/energized NA: Not applicable

Figure 3.12: Number of voltage violations (NTDC Islamabad Region)

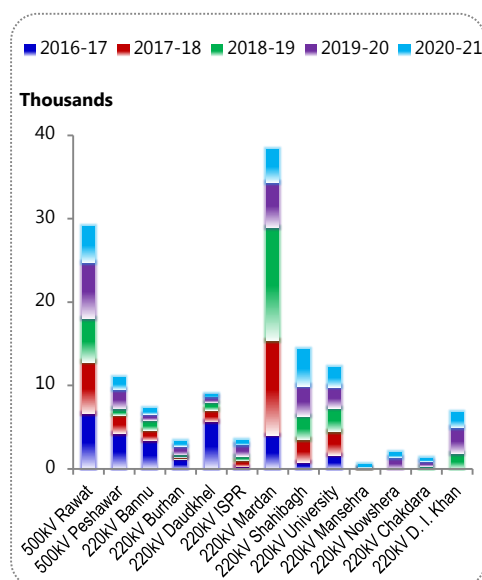


Table 3.6: Number of voltage violations (NTDC Lahore Region)

S. No.	Grid Station	2016-17	2017-18	2018-19	2019-20	2020-21
1	500 kV Gatti	3,223	3,155	796	1,026	254
2	500 kV Nokhar	318	710	738	3,012	602
3	500 kV Sheikhpura	15,365	33,604	8,706	693	173
4	500 kV New Lahore	1-11-2017	1,474	1,966	3,694	886
5	220 kV Bund Road	2,045	5,502	4,664	6,450	3420
6	220 kV Gakkhar	6,569	6,544	10,357	661	6584
7	220 kV Jaranwala	372	836	340	4,219	52
8	220 kV Kala Shah Kaku	4,690	4,629	4,754	411	4454
9	220 kV Ludewala	486	590	376	3,822	157
10	220 kV New Kot Lakhpat	3,140	4,285	3,646	1,559	4735
11	220 kV New Shalamar	1,236	1,777	1,522	268	1902
12	220 kV Nishatabad	NA	128	48	4,746	28
13	220 kV Ravi	6,857	3,693	4,462	606	2912
14	220 kV Samundri Road	324	156	52	3,266	224
15	220 kV Sarfaraznagar	3,548	2,968	2,546	2,420	6162
16	220 kV Sialkot	2,252	2,352	2,425	960	2350
17	220 kV WAPDA Town	1,267	2,039	1,392	8,932	1238
18	220 kV Ghazi Road	—	2,578	6,940	1,800	12862
19	220 kV Bandala	441	1,683	1,192	940	656
20	220 kV Toba Tekh Singh	850	910	1,418	2,632	448
21	220 kV Gujrat	51	3,611	5,401	1,026	3294
22	Total	53,034	83,224	63,741	52,965	53,393

Date commissioned/energized

NA: Not applicable

Figure 3.13: Number of voltage violations (NTDC Lahore Region)

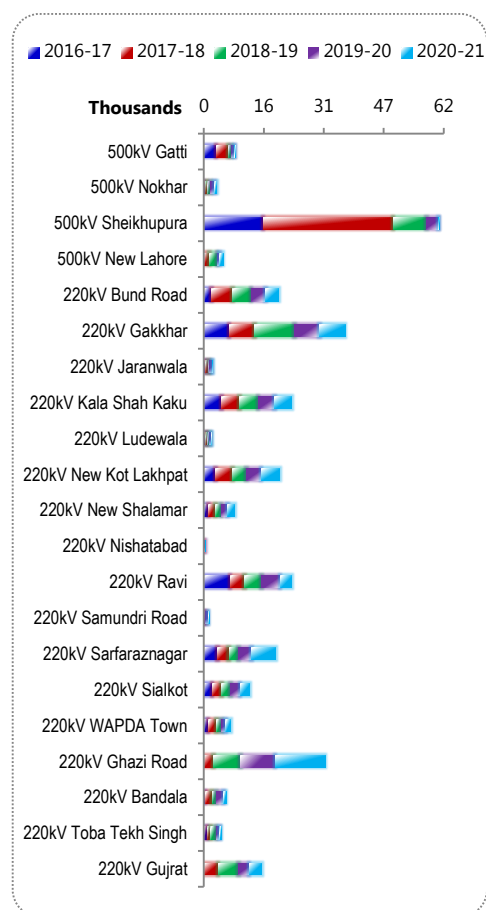


Table 3.7: Number of voltage violations (NTDC Multan Region)

S. No.	Grid Station	2016-17	2017-18	2018-19	2019-20	2020-21
1	500 kV Multan	3	-	20	28	55
2	500 kV Muzaffargarh	-	-	-	NIL	NA
3	500 kV Yousafwala	126	543	1,601	1320	NP
4	500 kV D.G. Khan	722	27	194	225	185
5	500 kV Rahim Yar Khan		NIL	6	NIL	NA
6	220 kV Bahawalpur	20	21	836	1673	833
7	220 kV Muzaffargarh	-	650	463	416	329
8	220 kV Vehari	2,519	5,335	6,659	2870	1659
9	220 kV Okara	526	365	884	408	204
10	220 kV Kassowal	3,822	998	1,274	1100	144
11	220 kV Chishtian	792	3,787	4,761	4867	2427
12	220 kV Lal Sohanra		15-2-2018		731	
13	Total	8,530	11,726	16,698	13,638	6,044

Date commissioned/energized

NA: Not applicable

NP: Not provided

Figure 3.14: Number of voltage violations (NTDC Multan Region)

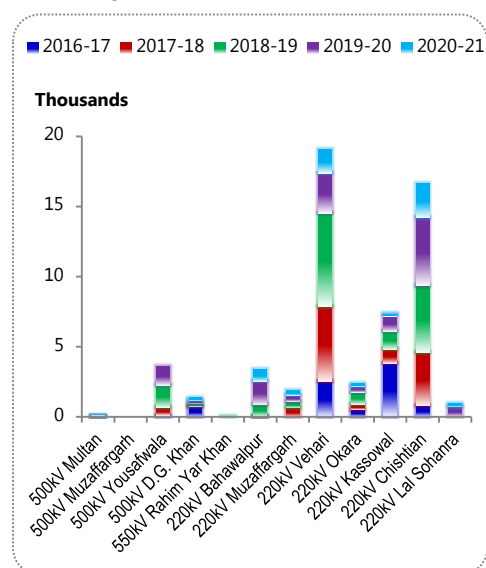


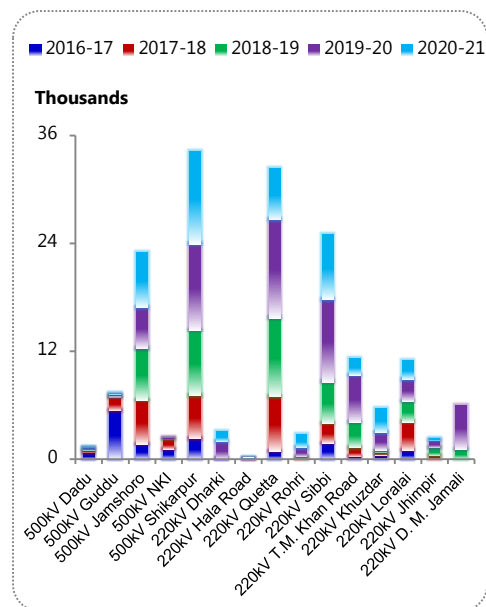
Table 3.8: Number of voltage violations (NTDC Hyderabad Region)

S. No.	Grid Station	2016-17	2017-18	2018-19	2019-20	2020-21
1	500kV Dadu	733	265	152	113	53
2	500 kV Guddu	5,433	1,494	46	260	114
3	500 kV Jamshoro	1,688	4,874	5,755	4,583	6,086
4	500 kV NKI	1,106	1,118	29	106	NA
5	500 kV Shikarpur	2,242	4,842	7,258	9,602	10,311
6	220kV Dharki	2	NA	NA	1,912	1,165
7	220kV Hala Road	10	56	20	10	2
8	220kV Quetta	890	6,044	8,758	10,936	5,702
9	220kV Rohri	-	70	200	968	1,500
10	220kV Sibbi	1,768	2,239	4,579	9,186	7,200
11	220 kV T. M. Khan Road	244	1054	2,818	5,208	1,824
12	220 kV Khuzdar	458	282	246	1,966	2,722
13	220 kV Loralai	1,010	3,140	2,290	2,440	2,064
14	220 kV Jhimpir	2017	348	888	830	202
15	220 kV D. M. Jamali	2018-19	1,119	4,830	NP	
16	Total	15,584	25,826	34,158	52,950	38,945

Date commissioned/energized

NA: Not applicable

Figure 3.15: Number of voltage violations (NTDC Hyderabad Region)



The detailed circuit wise analysis for each region is given at appendix 1 through appendix 4.

Figure 3.16: Highest voltage (kV) recorded at 500 kV grid stations under Normal condition

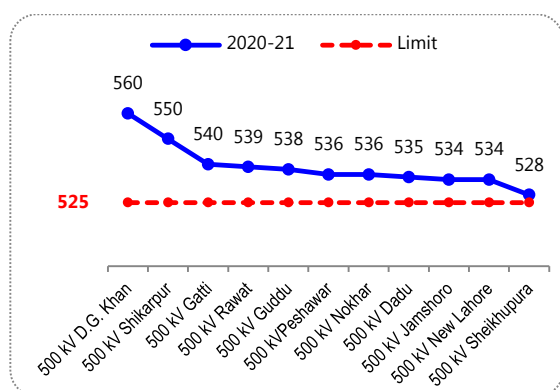


Figure 3.17: Highest voltage (kV) recorded at 220 kV grid stations under Normal condition

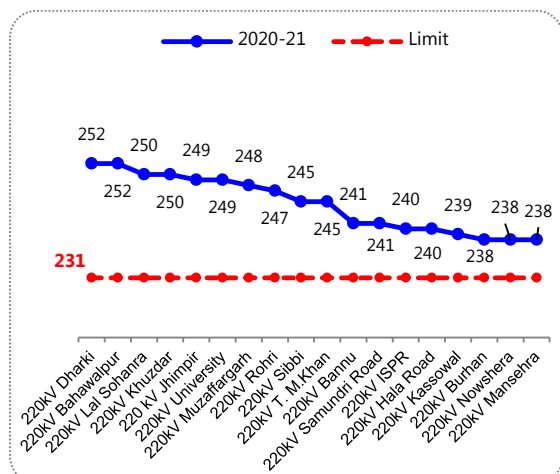
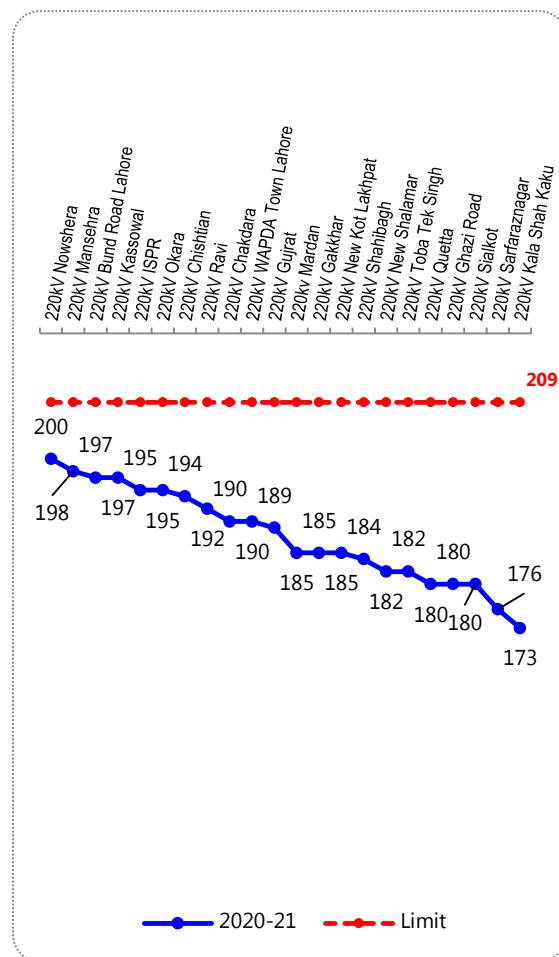


Figure 3.18: Lowest voltage (kV) recorded at 220 kV grid stations under Normal condition



By linking the above-mentioned analysis of voltage violations and voltage profile with system constraints and annual system reliability assessment and

improvement report submitted by NTDC, it has been observed that most of these grid stations are overloaded. The detail is summarized in the following table;

Table 3.9: Linkage with System Constraints and Annual System Reliability and Assessment Report

S. No.	Grid Station	Constraint Since	Interim Arrangement	Proposed Way Forward	Completion
1	500 kV Sheikhpura (110.57%)	Aug 2019	- X-Trip Scheme implemented to avoid overloading. - Load shifting for short duration keeping in view the loading of Ravi, KSK & SKP. - Generation of Saba, Halmore & Sapphire provides support.	- Augmentation of 4x600 MVA to 4x750 MVA Transformers OR - Addition of 5th 600 MVA Transformer 500 kV Lahore North Grid Station	2023-24 - Dec 2023
2	500 kV Gatti (111.39%)	June 2017	- X-Trip Scheme implemented to cover contingency. - Commitment of generation at Liberty Tech. power house.	600 MVA Transformer at Gatti - Commissioning of Trimmu P/H 500 kV Faisalabad West Grid Station	- May 2019 - Mar 2022 - Dec 2021 - Feb 2022
3	500 kV Peshawar (106.98%)	-	Load sharing by 500/220 kV Transformer at Ghazi Barotha.	- Addition of 1x450 MVA Transformer 500 kV Nowshera Grid Station	- Aug 2023 - Sep 2023
4	500 kV Rawat (122.6% to 172.56%)	June 2017	- X-Trip Scheme implemented to avoid overloading. - Load sharing by Transformers at 220 kV ISPR & University Grid Stations.	1x160 MVA Transformer 500 kV Islamabad West Grid Station 500 kV Chakwal Grid Station	- Mar 2021 - Dec 2023 2024-25
5	500 kV Nokhar (132.48% to 172.56%)	June 2018	- X-Trip Scheme implemented to avoid overloading. - Must generation at Nandipur & HUBCO till commissioning of 220 kV Gujranwala II Substation.	- Addition of 1x600 MVA Transformer 500 kV Lahore North Grid Station - Augmentation from 3x160 MVA Transformers to 3x250 MVA Transformers 220 kV Gujranwala II Substation	- Aug 2023 - Nov 2023 - Aug 2023 2024-25
6	500 kV Dadu (100.29% to 111.59%)	-	- X-Trip Scheme implemented to avoid overloading. - Load sharing by Transformers at 500 kV Jamshoro Grid Station.	Addition of 1x450 MVA Transformer	2023-24
7	220 kV Sarfaraznagar	June 2018	- Load sharing by Transformers at 500 kV Jamshoro Grid Station. - Commitment of generation at Nishat Chunian, Nishat Power and Kohinoor Plants.	- Completion of 220 kV Sundar Grid Station - Completion of 220 kV Kasur Grid Station	2023-24 2024-25
8	220 kV New Kot Lakhat (128.09%)	June 2019	Load shifting for short duration keeping on view the loading of Bund Road, WAPDA Town, Shalamar, Ghazi Road, Ravi & NKLP.	- Addition of 1x250 MVA Transformer 220 kV Punjab University Grid Station	- July 2023 2023-24
9	220 kV WAPDA Town (128.05%)	June 2019	Load shifting for short duration keeping on view the loading of Bund Road, WAPDA Town, Shalamar, Ghazi Road, Ravi & NKLP.	Augmentation of 3x10 MVA Transformers to 3x250 MVA Transformers	Feb 2023
10	220 kV Chishtian (167.15%)	June 2018	Load shifting for short duration keeping on view the loading of Vehari, Bahawalpur & Yousafwala.	Addition of 1x160 MVA Transformer	Jan 2022

S. No.	Grid Station	Constraint Since	Interim Arrangement	Proposed Way Forward	Completion
11	220 kV Quetta Industrial	June 2017	• X-Trip Scheme implemented. • Load shifting for short duration keeping in view the loading of Quetta, Khuzdar & Loralai.	• Augmentation of 4x600 MVA to 4x750 MVA Transformers OR • Addition of 5th 600 MVA Transformer • 500 kV Lahore North Grid Station	• 2023-24 • Dec 2023
12	220 kV Sibbi (103.13%)	-	• X-Trip Scheme implemented. • Load sharing by Quetta & Loralai.	• Addition of 1160 MVA Transformer • 220 kV Mastung Grid Station	• Dec 2022 • 2023-24
13	220 kV ISPR Sangjani (117.88%)	June 2018	• Load shifting for short duration keeping in view the loading of Burhan, ISPR, University & Rawat.	• 500 kV Islamabad West Grid Station • 220 kV Zero Point Grid Station	• Dec 2023 • 2023-24
14	220 kV University (156.20%)	June 2018	• Load shifting for short duration keeping in view the loading of Burhan, ISPR, University & Rawat.	• Addition of 1x250 MVA Transformer • 500 kV Islamabad West Grid Station	• July 2023 • Dec 2023
15	220 kV Kassowal (156.63%)	June 2017	• X-Trip Scheme working. • Load shifting for short duration keeping in the loading of Jaranwala, Vehari, NGPS & T. T. Singh. • Commitment of generation at Fauji Kabirwala P/H.	• Addition of 1x160 MVA Transformer • 220 kV Arifwala Grid Station	• Jan 2022 • 2023-24

Note: The percentages indicated in the above table is the ratio of Estimated Peak Sub-station Demand to Transformer Capacity as prescribed in PC 2.2.1 of the Grid Code. If the ratio of Estimated Peak Sub-station Demand to Firm Substation Capacity is 80% (Single Transformer sub-station) or 100% (more than one Transformer sub-station) then the NTDC shall include a description of its plans, together with cost and in-service date, to either add additional transformer capacity or to shift load from/to other substations. Where;

Firm Sub-station Capacity MVA is the Total Installed Transformer Capacity less the largest transformer based on its Nameplate MVA rating;

In the case of single transformer Sub-station, the Firm Capacity of the Sub-station is 80% of Transformer's Nameplate Rating.

3.3.2 System Frequency

The data submitted by NTDC was analyzed and it revealed that a total of 4 times frequency remained outside the

prescribed limits and that comes out to be approximately 0.007% of the reported period. The following table shows statistics of system frequency over the reported period.

Table 3.10: System frequency stats (2020-21)

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
	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	50.72	Nil	28	0.47	1.44	Nil	0.06	3
Aug	31	744	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Sep	30	720	50.54	Nil	7	0.12	1.08	Nil	0.02	1
Oct	31	744	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Nov	30	720	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Dec	31	744	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Jan	31	744	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
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	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
May	31	744	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
June	30	720	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Year	365	8760	50.72	Nil	35	0.59	1.44	Nil	0.007	4

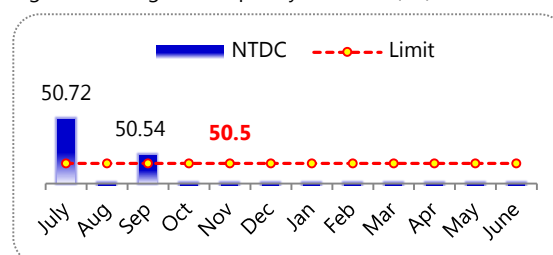
Other details assessed pertaining to system frequency with a comparison to the preceding years is given in the following table;

Table 3.11: System frequency details with comparison

▼ Description / Unit / Year ►	Unit	2016-17	2017-18	2018-19	2019-20	2020-21
Number of times Frequency remained outside the Limits in a Year	In a year	35	25	25	9	4
	Average/month	2.9	2.1	2.1	0.8	0.3
	Average/day	0.096	0.068	0.068	0.024	0.01
Time duration the Frequency remained outside the Limits in a Year	Days	0.18	0.17	0.12	0.03	0.02
	Hours	4.2	4.1	2.98	0.8	0.6
	%age of year	0.048	0.047	0.034	0.009	0.007
Maximum continuous period of Deviation	Hours	0.25	0.18	-	-	-
	Minutes	15	11	-	-	-

The following figure shows month wise highest frequency incidents beyond the permissible limit for the year 2020-21. The dotted red line shows the upper limit (50.5 Hz). As reported, lower limit has not been violated. Historical data as reported by NTDC is given at appendix 6.

Figure 3.19: Highest frequency recorded (Hz)





K - E l e c t r i c

4 Brief about KE

K-Electric (KE) formerly known as Karachi Electric Supply Company was established on September 13, 1913 under the Indian Companies Act of 1882 as the Karachi Electric Supply Corporation (KESC). The entity was nationalized in 1952 and re-privatized on November 29, 2005. In September, 2008 it was renamed as Karachi Electric Supply Company (KESC). Thereafter, it was rebranded as K-Electric (KE).

4.1 Licence

KE was granted Transmission Licence on 10th June 2010 by NEPRA to engage in the transmission business within the territory as specified in its license for a term of thirty (30) years, pursuant to Section 17 of the Regulation of Generation

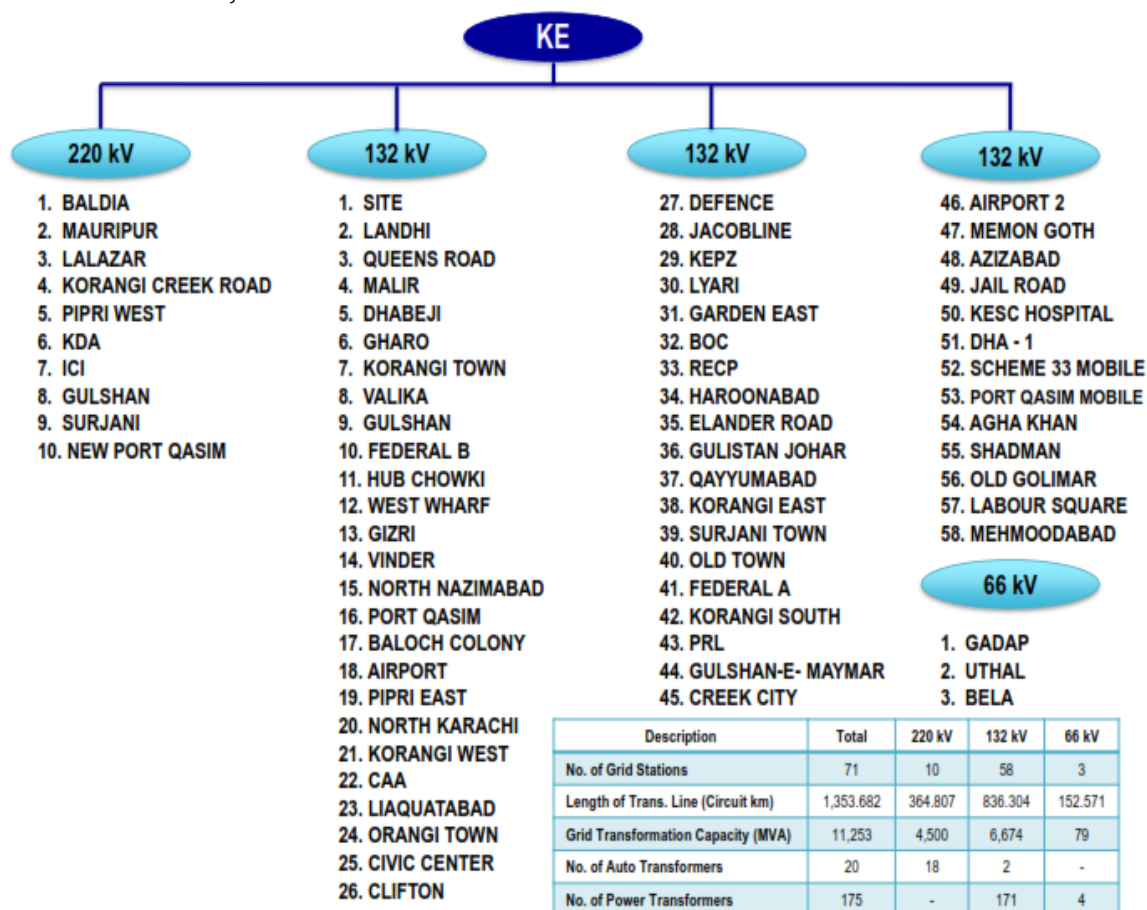
Transmission and Distribution of Electric Power Act, 1997.

4.2 Transmission Network

KE's transmission system comprises a total of 1,350 km of 220 kV, 132 kV and 66 kV transmission lines, 71 grid stations, 20 Auto Transformers and 172 power transformers, as of June 2020. K-Electric grid is interconnected with the NTDC grid system through four (04) 220 kV transmission circuits, namely;

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

Figure 4.1: KE transmission system



4.3 Performance at a Glance

An overview of the performance of KE is given hereunder in light of the reported data;

System Reliability

Average Duration of Interruption

1. Total outages hours recorded at all interconnection points (excluding 132 kV line tripping) = **0.57 Hrs**
2. Total number of interconnection points = 9
3. System duration of interruption = $0.57 \div 9 =$ **0.06 Hrs/point** i.e. **4 min.**

*Indicates an 50% decrease over the previous year i.e. **0.12 Hrs/point***

Average Frequency of Interruption

1. Total number of outages recorded at all 132 kV outgoing circuits (excluding 132 kV line tripping) = **1**
2. Total number of 132 kV circuits = **45**
3. System frequency of interruption = $1 \div 45 =$ **0.02 Nos./circuit.**

*Indicates a 77% decrease over the previous year i.e. **0.09 Nos./circuit***

System Security

Energy Not Served (ENS)

1. Total ENS = **0.685 million kWh**
2. Number of incidents, where there has been a loss of supply = **1**
3. Average ENS per incident = **0.685 million kWh**
4. Average duration per incident = $0.57 \div 1 =$ **0.57 Hrs (34 min)**
5. Financial impact of ENS = **Rs. 6.85 Million**
6. Financial impact per incident = $6.85 \div 1 =$ **Rs. 6.85 Million.**

Rs. 6.85 Million indicates 2.2% increase than the previous year's impact of Rs. 6.7 Million.

Quality of Supply

Voltage

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

Frequency

As reported, the frequency remained within the limits.

5 Analysis of KE's Annual Performance Report (APR)

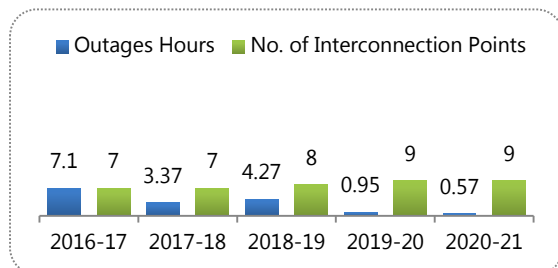
The Annual Performance Report submitted by KE has been analyzed in light of the PSTR 2005. The detail is given hereunder;

5.1 System Reliability

5.1.1 System Duration of Interruption

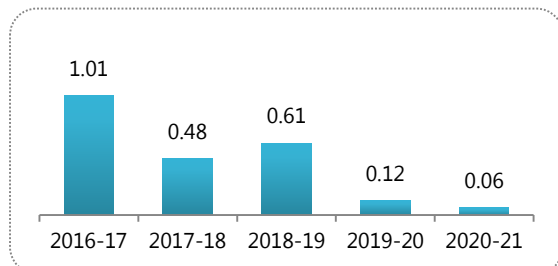
The total outages hours recorded at all interconnection points are 0.57 during the reported period, indicating a 40% decrease in comparison to the preceding year's 0.95 hours. Number of interconnection points remained the same i.e. 9. The same has been shown in figure 5.1.

Figure 5.1: Outages hours & No. of interconnection points



The average duration of interruption per interconnection point during the reported period remained 0.06 hours (4 minutes). This indicates 50% decrease over the previous year i.e. 0.12 hours (7 minutes) as shown in figure 3.2.

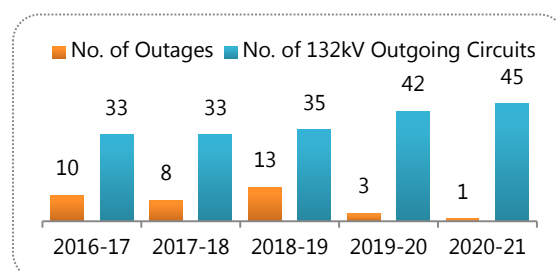
Figure 5.2: System duration of interruption (Hours/Point)



5.1.2 System Frequency of Interruption

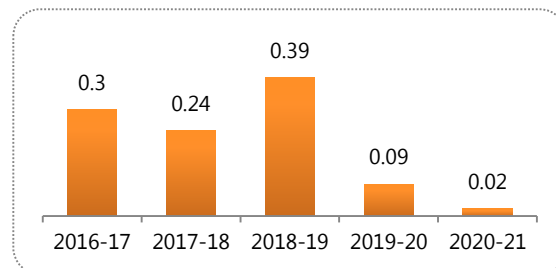
The total number of outages remained 1 in the year 2020-21 that shows a reduction of around 66.7% as compared to preceding year's 3 outages as shown in the flowing figure.

Figure 5.3: No. of outages & No. of 132kV outgoing circuits



Average number of interruptions per circuit during the reported period remained 0.02 indicating 77.8% improvement in comparison to the preceding year's 0.09 as shown in figure 3.4.

Figure 5.4: System frequency of interruption (Nos./Circuit)



5.2 System Security

In order to gauge system security, the estimates of total energy not served (ENS) during the reported period has been analyzed. The total ENS as reported by KE is 0.685 million kWh. Based on the average energy sale rate of KE⁶, the financial impact of 0.685 million kWh, amounts to approximately Rs. 6.85 million. The detail is given hereunder: -

Figure 5.5: Reported ENS

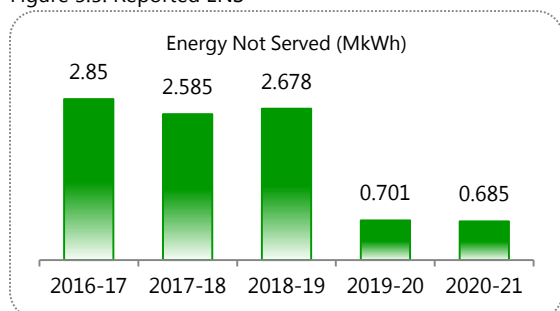


Figure 5.6: Loss of supply incidents & duration per incident

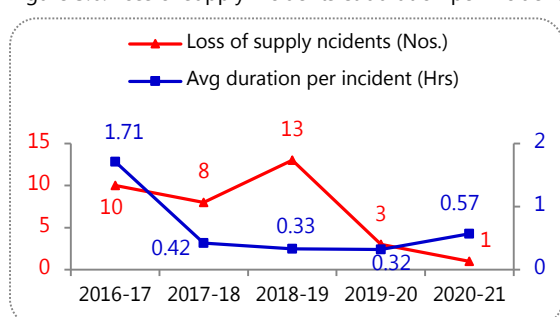


Figure 5.7: Loss of supply incidents along with average

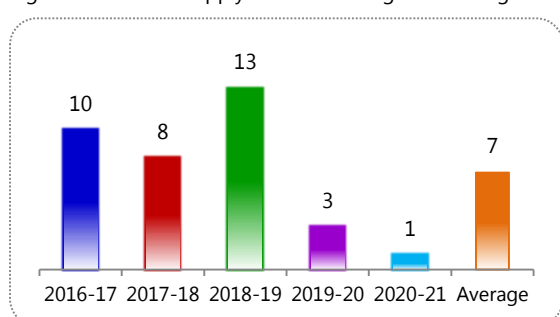


Table 5.1: Loss of supply incidents, average ENS, duration & financial impact per incident

Description	2016-17	2017-18	2018-19	2019-20	2020-21
Loss of Supply Incidents (Nos.)	10	8	13	3	1
Average ENS per Incident (Million kWh)	0.285	0.323	0.206	0.234	0.685
Average Duration per Incident (Hrs : Min)	00 : 43	00 : 25	00 : 20	00 : 19	0.57
Financial Impact per Incident Rs. (Million)	3.65	4.1	2.6	2.2	6.85

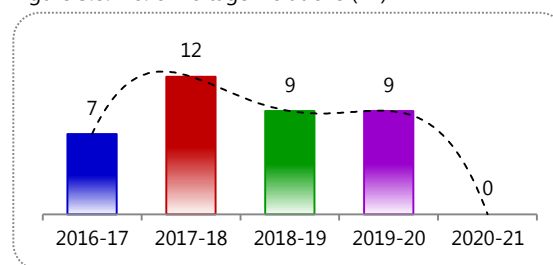
5.3 Quality of Supply

Quality of supply (QoS) is measured with reference to system voltage and system frequency. The analysis of QoS data as reported by KE is given hereunder: -

5.3.1 System Voltage

KE has reported none voltage violations under both normal and N-1 contingency conditions. The following figure shows the trend, whereas detailed circuit wise analysis is given at appendix 5.

Figure 5.8: No. of voltage violations (KE)



5.3.2 System Frequency

During 2020-21, there was no reportable frequency violation by KE.

⁶ KE's average energy sale rate = Rs. 10/kWh.



APPENDIX 1

Voltage violations data - detailed circuit wise analysis

NTDC Islamabad Region

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

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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							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	494	552	482	223	195	540	120	541	60	553	60	537	150	539	120	-	-	-	-	-	-	-	-	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	500 kV Rawat - Gakkhar Ckt I & II	494	548	481	223	195	540	120	544	180	553	60	537	150	539	120	-	-	-	-	-	-	-	-	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	500 kV Rawat - Tarbela	494	276	481	223	195	540	120	541	60	553	60	537	150	539	120	-	-	-	-	-	-	-	-	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	500 kV Rawat - Neelum Jehlum	*	53	479	223	195	*		544	180	553	60	537	150	539	120	*		-	-	-	-	-	-	-	-
N-1		-	-	-	-	-			-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-
Normal	220 kV Rawat - ISPR Ckt I & II	1105	798	534	1469	879	241	90	241	60	246	60	245	180	245	240	-	-	-	-	-	-	-	-	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Rawat - Mangla Ckt I & II	1156	1604	1068	1469	879	241	90	243	90	246	60	245	180	245	240	-	-	-	-	-	-	-	-	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Rawat - Bahria Town Ckt I & II	1171	793	589	1469	881	241	90	241	90	246	60	245	180	245	240	-	-	-	-	-	-	-	-	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Rawat - University Ckt I & II	1697	1578	1051	1469	879	241	150	243	60	246	60	245	180	245	240	-	-	-	-	-	-	-	-	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Energized in May 2018

Total No. of Variations (Normal)	6,611	6,202	5,165	6,768	4,298
Total No. of Variations (N-1)	-	-	-	-	-
Total of Normal & N-1	6,611	6,202	5,165	6,768	4,298

 Highest Voltage Under Normal Condition @500kV level

 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500 kV	17	58	19	432	172	531	60	527	60	538	60	541	60	536	60	473	60	-	-	-	-	468	60	473	60
N-1	Tarbela - Peshawar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Normal	220 kV	1428	549	209	NP	242	60	236	60	238	60	NP				-	-	180	60	198	60	NP				
N-1	Barotha - Peshawar	-	-	-		-	-	-	-	-	-	-	NP				-	-	-	-	-	-	NP			
Normal	220 kV	1415	1062	251	587	415	242	60	236	60	238	60	238	60	234	60	-	-	180	60	180	60	185	60	199	60
N-1	Peshawar - Daudkhel Ckt I & II	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Normal	220 kV	1379	543	251	621	415	242	60	236	60	238	60	238	60	234	60	-	-	175	60	180	60	185	60	199	60
N-1	Peshawar - Shahibagh	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Normal	220 kV	Added in 2018-19		42	635	415	Added in 2018-19				-	-	238	60	234	60	Added in 2018-19				180	60	186	60	199	60
N-1	Peshawar - Nowshera			-	-	-					-	-	-	-	-	-					-					

NP: Not Provided

Total No. of Variations (Normal)	4,239	2,212	772	2,275	1,417
Total No. of Variations (N-1)	-	-	-	-	-
Total of Normal & N-1	4,239	2,212	772	2,275	1,417

 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. 220kV 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							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	1859	651	586	358	332	256	60	241	60	241	60	240	60	241	60	178	120	174	60	198	60	200	60	203	60
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Chashma - Bannu Ckt I & II	1535	605	609	358	332	246	60	241	60	241	60	240	60	241	60	202	60	180	60	196	60	200	60	203	60
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Total No. of Variations (Normal)	3,394	1,256	1,195	716	664
Total No. of Variations (N-1)	-	-	-	-	-
Total of Normal & N-1	3,394	1,256	1,195	716	664



Highest Voltage Under Normal Condition



Lowest Voltage Under Normal Condition

NTDC Islamabad Region

4. 220kV 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							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	590	51	130	516	322	241	240	–	–	241	60	235	120	238	180	203	60	200	120	–	–	194	60	204	60
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220 kV Burhan - Tarbela Ckt I, II & III	594	168	135	516	322	241	240	232	60	241	60	235	120	238	180	203	60	200	120	206	60	194	60	204	60
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Total No. of Variations (Normal)	1,184	219	265	1,032	644
Total No. of Variations (N-1)	–	–	–	–	–
Total of Normal & N-1	1,184	219	265	1,032	644

 Highest Voltage Under Normal Condition

 Lowest Voltage Under Normal Condition

NTDC Islamabad Region

5. 220kV 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							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 & II	1877	566	302	228	81	246	60	240	90	244	60	242	240	238	540	198	60	194	60	204	60	204	60	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Daudkhel - Chashma Ckt I & II	1877	276	302	228	81	246	60	241	180	244	60	242	240	238	540	198	60	193	90	204	60	204	60	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Daudkhel - Bannu Ckt I & II	1877	579	302	228	81	246	60	241	180	244	60	242	240	238	540	198	60	194	60	204	60	204	60	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Total No. of Variations (Normal)	5,631	1,421	906	684	243
Total No. of Variations (N-1)	-	-	-	-	-
Total of Normal & N-1	5,631	1,421	906	684	243

 Highest Voltage Under Normal Condition

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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							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	8	25	43	259	102	232	120	-	-	235	120	232	30	-	-	205	60	200	60	204	60	190	60	196	60
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV ISPR - Tarbela	169	139	54	322	168	236	180	-	-	240	60	238	90	240	240	199	60	195	60	204	60	195	60	196	60
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV ISPR - Bahria Town	30	181	98	269	84	-	-	-	-	235	180	235	90	234	120	199	60	195	60	203	60	190	60	195	60
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV ISPR - Rawat	30	192	101	268	84	-	-	-	-	235	180	235	90	232	120	199	60	198	60	200	60	190	60	195	60
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV ISPR - Mansehra Ckt I	16	118	116	124	72	232	60	-	-	238	60	235	60	236	180	201	60	195	60	205	120	196	60	198	60
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV ISPR - Mansehra Ckt II	16	118	58	122	72	232	60	-	-	238	60	235	60	236	180	201	60	195	60	205	120	196	60	198	60
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Total No. of Variations (Normal)	269	773	470	1,364	582
Total No. of Variations (N-1)	-	-	-	-	-
Total of Normal & N-1	269	773	470	1,364	582

 Highest Voltage Under Normal Condition

 Lowest Voltage Under Normal Condition

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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							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	2004	5730	6875	1820	1333	-	-	-	-	-	-	-	-	-	-	193	60	180	60	188	60	181	60	185	60
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Mardan - Barotha Ckt I & II	1002	2845	3345	-	-	-	-	-	-	-	-	-	-	-	-	193	60	180	60	185	120	-	-	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Mardan - Shahibagh Ckt I & II	1002	2784	747	-	-	-	-	-	-	-	-	-	-	-	-	193	60	180	60	185	150	-	-	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Mardan - Nowshera Ckt I & II	-	-	-	1820	1333	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	181	60	185	60
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Mardan - Chakdara Ckt	Energized 16-Sep-2018		2546	1820	1333	Energized 16-Sep-2018				-	-	-	-	-	-	Energized 16-Sep-2018				190	60	181	60	185	60
N-1		Energized 16-Sep-2018		-	-	-	Energized 16-Sep-2018				-	-	-	-	-	-	Energized 16-Sep-2018				-	-	-	-	-	-

Total No. of Variations (Normal)	4,008	11,359	13,513	5,460	3,999
Total No. of Variations (N-1)	-	-	-	-	-
Total of Normal & N-1	4,008	11,359	13,513	5,460	3,999

 Lowest Voltage Under Normal Condition

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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							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	Energized 19-Apr-2019	Nil	338	215	Energized 19-Apr-2019	Nil	240	60	238	60	Energized 19-Apr-2019	Nil	199	30	200	60	Energized 19-Apr-2019	Nil	199	30	200	60	Energized 19-Apr-2019	Nil	
N-1				-	-			-	-	-	-			-	-	-	-			-	-	-	-			-
Normal	220 kV Nowshera - Barotha 1 & 2	Energized 19-Apr-2019	Nil	689	215	Energized on 19-Apr-2019	Nil	240	60	238	60	Energized on 19-Apr-2019	Nil	199	30	200	60	Energized on 19-Apr-2019	Nil	199	30	200	60	Energized on 19-Apr-2019	Nil	
N-1				-	-			-	-	-	-			-	-	-	-			-	-	-	-			-
Normal	220 kV Nowshera - S. M Peshawar	Energized 19-Apr-2019	Nil	330	198	Energized on 19-Apr-2019	Nil	240	60	238	60	Energized on 19-Apr-2019	Nil	199	30	200	60	Energized on 19-Apr-2019	Nil	199	30	200	60	Energized on 19-Apr-2019	Nil	
N-1				-	-			-	-	-	-			-	-	-	-			-	-	-	-			-

Total No. of Variations (Normal)	Energized 19-Apr-2019	Nil	1,357	628
Total No. of Variations (N-1)			-	-
Total of Normal & N-1			1,357	628

 Highest Voltage Under Normal Condition

 Lowest Voltage Under Normal Condition

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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2016-17		2018-19		2019-20		2020-21	
							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	656	1612	1878	2103	2954	-	-	-	-	-	-	-	-	-	-	171	120	190	180	190	120	182	60	184	120
N-1	Shahibagh - Peshawar Ckt II	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Shahibagh - Mardan Ckt I	150	1091	601	NP		238	60	-	-	-	-	NP				195	60	182	60	192	120	NP			
N-1	Shahibagh - Mardan Ckt I	-	-	-			-	-	-	-	-	-					-	-	-	-	-	-				
Normal	220 kV Shahibagh - Chakdara	Energized 16-Sep-2018		337	1517	1396	Energized 16-Sep-2018				-	-	-	-	-	-	Energized 16-Sep-2018				170	60	182	60	185	60
N-1	Shahibagh - Chakdara			-	-	-					-	-	-	-	-	-					-	-	-	-	-	-

Total No. of Variations (Normal)	806	2,703	2,816	3,620	4,350
Total No. of Variations (N-1)	-	-	-	-	-
Total of Normal & N-1	806	2,703	2,816	3,620	4,350

 Lowest Voltage Under Normal Condition

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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							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	1634	2832	2812	2541	2363	241	60	242	60	250	60	246	240	249	120	-	-	-	-	202	60	202	120	-	-
N-1	University - Rawat Ckt I & II	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Total No. of Variations (Normal)	1,634	2,832	2,812	2,541	2,363
Total No. of Variations (N-1)	-	-	-	-	-
Total of Normal & N-1	1,634	2,832	2,812	2,541	2,363

249 Highest Voltage Under Normal Condition

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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV	*	1	31	14	78	*		232	150	241	60	235	120	238	180	*		-	-	-	-	194	60	198	50
N-1	Mansehra - Allai Khwar 1		-	-	-	-			-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-
Normal	220 kV	*	1	31	14	78	*		232	150	241	60	235	120	238	180	*		-	-	-	-	194	60	198	50
N-1	Mansehra - Allai Khwar 2		-	-	-	-			-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-
Normal	220 kV	**		31	14	78	**				241	60	235	120	238	180	**				-	-	194	60	198	50
N-1	Mansehra - ISPR 1			-	-	-					-	-	-	-	-	-					-	-	-	-	-	-
Normal	220 kV	**		31	14	78	**				241	60	235	120	238	180	**				-	-	194	60	198	50
N-1	Mansehra - ISPR 2			-	-	-					-	-	-	-	-	-					-	-	-	-	-	-

* Energized Apr, 2018

** Energized Nov, 2018

Total No. of Variations (Normal)	*	2	124	56	312
Total No. of Variations (N-1)		-	-	-	-
Total of Normal & N-1		2	124	56	312

Highest Voltage Under Normal Condition

Lowest Voltage Under Normal Condition

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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							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	Energized 16-Sep-2018	115	289	169	Energized 16-Sep-2018		-	-	-	-	-	-	Energized 16-Sep-2018		196	60	190	90	190	90					
N-1			-	-	-			-	-	-	-	-	-			-	-	-	-	-						
Normal	220 kV Chakdara - Mardan	Energized 16-Sep-2018	202	289	199	Energized 16-Sep-2018		-	-	-	-	-	-	Energized 16-Sep-2018		193	60	190	90	190	90					
N-1			-	-	-			-	-	-	-	-	-			-	-	-	-							

Total No. of Variations (Normal)	Energized 16-Sep-2018	317	578	368
Total No. of Variations (N-1)		-	-	-
Total of Normal & N-1		317	578	368

 Lowest Voltage Under Normal Condition

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)											
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21			
							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	Energized 18-Feb-2019		915	1563	921	Energized 18-Feb-2019					246	60	242	120	240	180	Energized 18-Feb-2019					-	-	-	-	-	-
N-1	D. I. Khan - Chashma 1			-	-	-						-	-	-	-	-	-						-	-	-	-	-	-
Normal	220 kV	Energized 18-Feb-2019		915	1563	921	Energized 18-Feb-2019					246	60	242	120	240	180	Energized 18-Feb-2019					-	-	-	-	-	-
N-1	D. I. Khan - Chashma 2			-	-	-						-	-	-	-	-	-						-	-	-	-	-	-

Total No. of Variations (Normal)	Energized 18-Feb-2019	1,830	3,126	1,842
Total No. of Variations (N-1)		-	-	-
Total of Normal & N-1		1,830	3,126	1,842

 Highest Voltage Under Normal Condition



APPENDIX 2

Voltage violations data - detailed circuit wise analysis

NTDC Lahore Region

1.	500 kV Gatti	1 of 21
2.	500 kV Nokhar	2 of 21
3.	500 kV Sheikhupura	3 of 21
4.	500 kV New Lahore	4 of 21
5.	220 kV Bandala	5 of 21
6.	220 kV Bund Road Lahore	6 of 21
7.	220 kV Gakkhar	7 of 21
8.	220 kV Ghazi Road	8 of 21
9.	220 kV Gujrat	9 of 21
10.	220 kV Jaranwala	10 of 21
11.	220 kV Kala Shah Kaku	11 of 21
12.	220 kV Ludewala	12 of 21
13.	220 kV Nishatabad	13 of 21
14.	220 kV New Kot Lakhpat	14 of 21
15.	220 kV New Shalamar	15 of 21
16.	220 kV Ravi	16 of 21
17.	220 kV Samundri Road	17 of 21
18.	220 kV Sarfaraznagar	18 of 21
19.	220 kV Sialkot	19 of 21
20.	220 kV Toba Tek Singh	20 of 21
21.	220 kV WAPDA Town	21 of 21

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)										
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17	2017-18	2018-19	2019-20	2020-21						
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time						Voltage	Time				
Normal	500 kV Gatti - Barotha Ckt I	NP	NA			NA	NP		NA						NP		NA										
N-1																											
Normal	500 kV Gatti - Barotha Ckt II	NA					NA										NA										
N-1																											
Normal	500 kV Gatti - Muzaffargarh	708	NP		—	NP	540	150	NP				—	—	NP		—	—	NP				—	—	NP		
N-1		—	NP		—	NP	—	—	NP				—	—	NP		—	—	NP				—	—	NP		
Normal	500 kV Gatti - Rousch	171	120	22	26	30	540	60	540	60	538	150	540	330	540	360	—	—	—	—	—	—	—	—	—	—	
N-1		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
Normal	500 kV Gatti - H. B. Shah 1*	232	618	155	23	7	540	150	540	60	535	90	543	390	535	90	—	—	—	—	—	—	—	—	—	—	
N-1		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
Normal	500 kV Gatti - H. B. Shah 2	**	252	155	232	18	**		540	90	545	30	540	690	540	390	**		—	—	—	—	—	—	—	—	
N-1		—	—	—	—	—	**		—	—	—	—	—	—	—	—	**		—	—	—	—	—	—	—	—	
Normal	500 kV Gatti - QATPL Bhikhi Ckt	208	340	8	1	1	540	120	540	90	530	180	533	100	530	150	540	60	—	—	—	—	—	—	—	—	
N-1		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
Normal	500 kV Gatti - Lahore	NP			—	NP	NP						—	—	NP		NP				—	—	NP				
N-1					—	NP																					
Normal	220 kV Gatti - Nishatabad 1	390	312	72	42	9	240	90	240	150	243	90	234	120	236	240	—	—	—	—	—	—	—	203	330	207	60
N-1		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Normal	220 kV Gatti - Nishatabad 2	384	313	72	42	9	240	90	240	60	243	90	234	120	236	240	—	—	—	—	—	—	—	203	330	207	60
N-1		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Normal	220 kV Gatti - Jaranwala Road 1	287	208	45	45	28	240	60	242	90	242	90	232	120	235	240	—	—	—	—	—	—	—	200	240	204	60
N-1		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Normal	220 kV Gatti - Jaranwala Road 2	7	208	45	45	28	238	60	241	90	242	90	232	120	235	240	—	—	—	—	—	—	—	200	240	204	60
N-1		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Normal	220 kV Gatti - Yousafwala 1	NA			67	NP	NA						231	90	NP		NA				200	60	NP				
N-1					—	NP							—	—									—	—			
Normal	220 kV Gatti - Yousafwala 2	NA			67	NP	NA						231	90	NP		NA				200	60	NP				
N-1					—	NP							—	—									—	—			
Normal	220 kV Gatti - Ludewala 1	NA			91	41	NA						—	—	—		NA				201	330	203	120	—	—	
N-1					—	—	NA						—	—	—		NA				—	—	—	—	—	—	
Normal	220 kV Gatti - Ludewala 2	NA			91	41	NA						—	—	—		NA				201	330	203	120	—	—	
N-1					—	—	NA						—	—	—		NA				—	—	—	—	—	—	
Normal	220 kV Gatti - Bandala 1	577	392	111	38	21	244	150	242	90	245	90	236	240	232	300	—	—	—	—	—	—	—	206	90	204	120
N-1		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Normal	220 kV Gatti - Bandala 2	467	392	111	38	21	247	60	242	90	245	90	236	240			—	—	—	—	—	—	—	206	90	204	120
N-1		—	—	—	—	—	—	—	—	—	—	—	—	—			—	—	—	—	—	—	—	—	—	—	

NP: Not Provided

* Previously Gatti - Multan

** Added in 2017-18

Total No. of Variations (Normal)	3,223	3,155	796	848	254
Total No. of Variations (N-1)	—	—	—	—	—
Total of Normal & N-1	3,223	3,155	796	848	254

 Highest Voltage Under Normal Condition @500kV level

 Lowest Voltage Under Normal Condition @220kV Level

 Highest Voltage Under Normal Condition @220kV level

NTDC Lahore Region

2. 500kV 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2019-20	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500 kV	77	117	77	32	28	545	150	535	60	535	150	537	90	536	120	453	60	450	90	465	90	472	180	–	–
N-1	Gakkhar - Rawat 1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500 kV	77	117	77	32	28	545	150	535	60	535	150	537	90	536	120	453	60	450	90	465	90	472	180	–	–
N-1	Gakkhar - Rawat 2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500 kV	77	117	77	32	28	545	150	535	60	535	150	537	90	536	120	453	60	450	90	465	90	472	180	–	–
N-1	Gakkhar - Lahore 1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500 kV	77	117	77	32	28	545	150	535	60	535	150	537	90	536	120	453	60	450	90	465	90	472	180	–	–
N-1	Gakkhar - Lahore 2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220 kV	5	121	215	449	245	232	120	232	360	236	90	241	150	240	120	205	120	200	270	200	210	197	90	202	270
N-1	Nokhar - Mangla	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220 kV	5	121	215	449	245	232	120	232	360	236	90	241	150	240	120	205	120	200	270	200	210	197	90	202	270
N-1	Nokhar - Gakkhar	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Total No. of Variations (Normal)	318	710	738	1,026	602
Total No. of Variations (N-1)	–	–	–	–	–
Total of Normal & N-1	318	710	738	1,026	602

 Highest Voltage Under Normal Condition @500kV level

 Lowest Voltage Under Normal Condition @220kV level

 Highest Voltage Under Normal Condition @220kV level

NTDC Lahore Region

3. 500kV Grid Station SHEIKHUPURA

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)												
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17			2017-18			2018-19			2019-20		2020-21	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time		Voltage	Time		Voltage	Time		Voltage	Time	Voltage	Time
Normal	500 kV Sheikhpura - Nokhar Ckt I & II	900	476	30	8	7	547	30	539	30	532	90	528	90	528	90	462	60	–	–	–	–	–	–	–	–	–	–	
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		
Normal	500 kV Sheikhpura - CCPP Sahiwal	900	NP			NP	547	30	NP						NP		–	–	NP						NP				
N-1		–					–	–	–	–	–	–					–	–			–	–					–	–	
Normal	500 kV Sheikhpura - CCPP Bhikhi	900	156	26	26	5	547	30	538	30	535	60	540	60	526	120	–	–	–	–	–	–	–	–	–	–	–	–	
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		
Normal	500 kV Sheikhpura - New Lahore	*	476	52	5	NP	*		541	60	535	60	528	60	NP		*		–	–	–	–	–	–	–	–	NP		
N-1		–	–	–	–				–	–	–	–	–	–	–	–			–	–	–	–	–	–	–	–	–	–	–
Normal	500 kV Sheikhpura - HVDC 1	Added in 2020-21				7	Added in 2020-21								526	90	Added in 2020-21								–	–			
N-1						–									–	–									–	–			
Normal	500 kV Sheikhpura - HVDC 2	Added in 2020-21				5	Added in 2020-21								526	90	Added in 2020-21								–	–			
N-1						–									–	–									–	–			
Normal	220 kV Sheikhpura - WTN	2833	3846	986	283	17	–	–	–	–	–	–	–	–	–	–	192	30	198	30	198	60	197	90	202	60			
N-1		60	392	30	–	–	–	–	–	–	–	–	–	–	–	–	190	30	189	30	192	60	–	–	–	–			
Normal	220 kV Sheikhpura - NKLP Ckt I & II	2833	2983	780	686	6	–	–	–	–	–	–	–	–	–	–	192	30	198	30	198	60	194	60	202	60			
N-1		60	1175	2	–	–	–	–	–	–	–	–	–	–	–	–	190	30	190	30	196	60	–	–	–	–			
Normal	220 kV Sheikhpura - Bund Road Ckt I, II, III & IV	2833	12587	4509	582	57	–	–	–	–	–	–	–	–	–	–	192	30	194	30	198	60	197	60	202	90			
N-1		60	4165	89	–	–	–	–	–	–	–	–	–	–	–	–	190	30	190	60	192	60	–	–	–	–			
Normal	220 kV Sheikhpura - Ravi Ckt I & II	2833	2845	472	436	42	–	–	–	–	–	–	–	–	–	–	192	30	198	30	198	60	197	60	204	90			
N-1		60	596	2	–	–	–	–	–	–	–	–	–	–	–	–	190	30	189	30	197	90	–	–	–	–			
Normal	220 kV Sheikhpura - ATLAS P/H	2833	3252	1662	986	27	–	–	–	–	–	–	–	–	237	120	192	30	198	30	198	60	184	60	204	120			
N-1		60	655	66	–	–	–	–	–	–	–	–	–	–	–	–	190	30	190	30	192	120	–	–	–	–			

NP: Not Provided

* Energized November, 2017

Total No. of Variations (Normal)	15,065	26,621	8,517	3,012	173
Total No. of Variations (N-1)	300	6,983	189	–	–
Total of Normal & N-1	15,365	33,604	8,706	3,012	173

 Highest Voltage Under Normal Condition @500kV level

 Lowest Voltage Under Normal Condition @220kV level

 Highest Voltage Under Normal Condition @220kV level

NTDC Lahore Region

4. 500kV Grid Station NEW LAHORE

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500 kV	*	674	214	110	94	*		542	60	542	60	534	60	534	120	*		—	—	—	—	464	60	473	60
N-1	New Lahore - Balloki		—	—	—	—			—	—	—	—	—	—	—	—			—	—	—	—	—	—	—	—
Normal	500 kV	*	667	291	111	NP	*		544	120	542	60	534	60	NP		*		—	—	—	—	464	60	NP	
N-1	New Lahore - SKP		—	—	—				—	—	—	—	—	—					—	—	—	—	—	—		
Normal	500 kV	**		191	106	94	**				542	60	534	60	534	120	**				—	—	464	60	472	60
N-1	New Lahore - GAKKHAR			—	—	—					—	—	—	—	—	—					—	—	—	—	—	—
Normal	500 kV	***			111	93	***					534	60	534	120	***					464	60	473	60		
N-1	New Lahore - CEPP Sahiwal				—	—						—	—	—	—						—	—	—	—	—	—
Normal	500 kV	Added in 2020-21				93	Added in 2020-21							534	120	Added in 2020-21						473	60			
N-1	New Lahore - HVDC Conv 1 & 2					—								—	—							—	—	—	—	—
Normal	220 kV	***			11	202	***					234	150	235	60	***					207	20	202	60		
N-1	New Lahore - Ghazi Road				—	—						—	—	—	—						—	—	—	—	—	—
Normal	220 kV	*	67	643	83	201	*		—	—	240	60	235	180	235	60	*		203	60	198	60	203	60	202	60
N-1	New Lahore - NKLP		—	—	—	—			—	—	—	—	—	—	—	—			—	—	—	—	—	—	—	—
Normal	220 kV	*	66	627	71	NP	*		—	—	242	60	235	180	NP		*		203	60	198	60	203	60	NP	
N-1	New Lahore - SNR		—	—	—				—	—	—	—	—	—					—	—	—	—	—	—		
Normal	220 kV	***			90	202	***					235	180	235	60	***					203	60	202	60		
N-1	New Lahore - Wapda Town				—	—						—	—	—	—						—	—	—	—	—	—

* Energized 01-Nov-2017

** Added in 2018-19

*** Added in 019-20

Total No. of Variations (Normal)	*	1,474	1,966	693	886
Total No. of Variations (N-1)		–	–	–	–
Total of Normal & N-1		1,474	1,966	693	886

 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 Lahore Region

5. 220kV Grid Station BANDALA

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Bandala - KSK 1	146	416	298	450	260	240	60	240	60	–	–	241	90	240	120	–	–	–	–	199	60	202	60	201	180
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
Normal	220 kV Bandala - KSK 2	146	416	298	450	260	240	60	236	70	–	–	241	90	240	120	–	–	–	–	199	60	202	60	201	180
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
Normal	220 kV Bandala - Gatti 1	149	432	298	450	68	240	60	240	60	–	–	241	90	–	–	–	–	–	–	199	60	202	60	201	180
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
Normal	220 kV Bandala - Gatti 2	–	419	298	450	68	–	–	240	60	–	–	241	90	–	–	–	–	–	–	199	60	202	60	201	180
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	

Total No. of Variations (Normal)	441	1,683	1,192	1,800	656
Total No. of Variations (N-1)	–	–	–	–	–
Total of Normal & N-1	441	1,683	1,192	1,800	656

 Highest Voltage Under Normal Condition

 Lowest Voltage Under Normal Condition

NTDC Lahore Region

6. 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV	1916	*				—	—	*								186	120	*							
N-1	Bus Bar No. 1 & 2	129					—	—									185	90								
Normal	220 kV	**	1202	1147	875	841	**		—	—	—	—	—	—	—	—	**		182	90	184	90	188	90	198	90
N-1	Bund Road - NKLP I & II		97	17	10	—			—	—	—	—	—	—	—	180			90	186	270	190	150	—	—	
Normal	220 kV	**	1287	1196	1052	904	**		—	—	—	—	—	—	—	—	**		180	240	183	210	190	210	197	90
N-1	Bund Road - KSK I & II		135	29	9	—			—	—	—	—	—	—	—	180			90	187	90	190	210	—	—	
Normal	220 kV	**	1268	1119	852	833	**		—	—	—	—	—	—	—	—	**		182	90	183	90	188	90	198	90
N-1	Bund Road - SKP I & II		115	21	11	—			—	—	—	—	—	—	—	180			90	187	90	192	150	—	—	
Normal	220 kV	**	1270	1119	874	842	**		—	—	—	—	—	—	—	—	**		182	120	184	90	188	90	198	90
N-1	Bund Road - SKP III & IV		128	16	11	—			—	—	—	—	—	—	—	184			90	188	90	192	150	—	—	

* Reported as separate circuits

** Reported as Bus Bar No. 1 & 2

Total No. of Variations (Normal)	1,916	5,027	4,581	3,653	3,420
Total No. of Variations (N-1)	129	475	83	41	–
Total of Normal & N-1	2,045	5,502	4,664	3,694	3,420

 Lowest Voltage Under Normal Condition

NTDC Lahore Region

7. 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							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 I	2495	1335	1606	1133	990	—	—	—	—	—	—	—	—	—	—	188	60	189	60	188	60	189	60	187	60
N-1		—	4	12	19	—	—	—	—	—	—	—	—	—	—	—	—	—	190	60	190	60	188	60	—	—
Normal	220 kV Gakkhar - Mangla Ckt II	1580	NP	1606	1133	990	—	—	NP	—	—	—	—	—	—	—	185	60	NP	188	60	189	60	187	60	
N-1		—		12	19	—	—	—		—	—	—	—	—	—	—	—	—		190	60	188	60	—	—	
Normal	220 kV Gakkhar - Mangla Ckt III	NP	1606	1133	990	NP	—	—	—	—	—	—	—	NP	188	60	189	60	187	60						
N-1			12	19	—		—	—	—	—	—	—	—		190	60	188	60	—	—						
Normal	220 kV Gakkhar - Sialkot	914	1360	1626	1147	1016	—	—	—	—	—	—	—	—	—	188	60	191	60	183	60	189	60	187	60	
N-1		—	11	19	19	—	—	—	—	—	—	—	—	—	—	—	—	190	60	186	60	186	60	—	—	
Normal	220 kV Old Gakkhar - New Gakkhar (Nokhar)	1580	1917	1898	895	1299	—	—	—	—	—	—	—	—	—	185	60	191	60	181	60	188	60	185	60	
N-1		—	—	31	19	—	—	—	—	—	—	—	—	—	—	—	—	190	60	184	60	184	60	—	—	
Normal	220 kV Gakkhar - Gujrat	*	1917	1898	895	1299	*	—	—	—	—	—	—	—	—	*	191	60	181	60	188	60	185	60		
N-1		—	31	19	—	—		—	—	—	—	—	—	190	60		184	60	184	60	—	—				

NP: Not Provided

* Energized Apr, 2017

Total No. of Variations (Normal)	4,989	6,529	10,240	6,336	6,584
Total No. of Variations (N-1)	–	15	117	114	–
Total of Normal & N-1	6,569	6,544	10,357	6,450	6,584

Lowest Voltage Under Normal Condition

NTDC Lahore Region

8. 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							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	NA	2539	2505	1745	3225	NA	-	-	-	-	-	-	-	-	NA	178	60	170	60	195	60	180	120		
N-1			39	672	1765	-		-	-	-	-	-	-	-	-		190	50	174	60	168	60	-	-		
Normal	220 kV Ghazi - KSK	NA	2539	2229	1745	3225	NA	-	-	-	-	-	-	-	-	NA	178	60	170	60	195	180	180	120		
N-1			39	1484	1765	-		-	-	-	-	-	-	-	-		190	50	173	60	168	60	-	-		
Normal	220 kV KSK - New Lahore	Added in 2019-20			771	3201	Added in 2019-20						-	-	-	-	Added in 2019-20						198	180	180	120
N-1					185	-							-	-	-	-							-	184	60	-
Normal	220 kV Ghazi - Sarfaraznagar	Reported in 2020-21				3211	Added in 2019-20							-	-	Added in 2019-20							180	120		
N-1						-								-	-								-	-	-	-

NA: Not Applicable

Total No. of Variations (Normal)	NA	2,539	4,734	4,261	12,862
Total No. of Variations (N-1)		39	2,156	3,715	-
Total of Normal & N-1		2,578	6,940	7,976	12,862

 Lowest Voltage Under Normal Condition

NTDC Lahore Region

9. 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV	51	1211	2815	876	1087	–	–	234	60	238	60	241	60	239	60	199	60	190	60	189	60	193	60	191	150
N-1	Gujrat - Old Gakkhar	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220 kV	–	1199	777	880	1084	–	–	234	60	238	120	241	60	239	60	–	–	190	60	191	60	193	60	191	150
N-1	Gujrat - New Gakkhar	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220 kV	–	1201	1809	876	1123	–	–	234	60	238	60	241	60	239	60	–	–	190	60	189	60	193	60	189	60
N-1	Gujrat - Mangla 1 & 2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Total No. of Variations (Normal)	51	3,611	5,401	2,632	3,294
Total No. of Variations (N-1)	–	–	–	–	–
Total of Normal & N-1	51	3,611	5,401	2,632	3,294

 Highest Voltage Under Normal Condition

 Lowest Voltage Under Normal Condition

NTDC Lahore Region

10. 220kV Grid Station JARANWALA ROAD 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Jaranwala - Gatti	372	836	340	661	52	244	38	246	38	238	90	242	62	234	35	-	-	-	-	-	-	-	-	206	159
N-1	Jaranwala - Gatti Ckt I & II	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Total No. of Variations (Normal)	372	836	340	661	52
Total No. of Variations (N-1)	-	-	-	-	-
Total of Normal & N-1	372	836	340	661	52

 Highest Voltage Under Normal Condition

 Lowest Voltage Under Normal Condition

NTDC Lahore Region

11. 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							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 Ckt I, II & III	1016	702	680	639	859	–	–	–	–	–	–	–	–	–	–	182	60	185	90	180	120	–	–	184	150
N-1		1	48	66	101	–	–	–	–	–	–	–	–	–	–	–	185	60	180	90	180	60	–	–	–	–
Normal	220 kV Kala Shah Kaku - Bund Road Ckt I & II	486	777	768	560	622	–	–	–	–	–	–	–	–	–	–	190	90	185	90	184	90	184	90	188	60
N-1		–	52	88	117	–	–	–	–	–	–	–	–	–	–	–	–	–	180	60	187	90	180	90	–	–
Normal	220 kV Kala Shah Kaku - Ravi Ckt I & II	570	737	756	639	972	–	–	–	–	–	–	–	–	–	–	184	90	184	120	184	90	184	90	173	90
N-1		15	56	86	115	–	–	–	–	–	–	–	–	–	–	–	180	120	185	90	180	90	181	90	–	–
Normal	220 kV Kala Shah Kaku - Sialkot	1038	710	735	596	628	–	–	–	–	–	–	–	–	–	–	189	90	184	90	183	60	187	90	188	90
N-1		6	56	78	117	–	–	–	–	–	–	–	–	–	–	–	191	90	185	60	181	90	180	90	–	–
Normal	220 kV Kala Shah Kaku - Shalamar	592	383	NP	–	NP	–	–	–	–	NP		–	–	NP		60	150	184	90	NP		–	–	NP	
N-1		12	57		–		–	–	–	–			–	–			182	60	184	90			–	–		
Normal	220 kV Kala Shah Kaku - Bandala Ckt I & II	950	592	566	457	600	–	–	–	–	–	–	–	–	–	–	183	60	184	60	187	120	189	120	189	150
N-1		4	45	77	73	–	–	–	–	–	–	–	–	–	–	–	192	90	185	60	187	90	188	120	–	–
Normal	220 kV Kala Shah Kaku - Ghazi Rd	*	407	766	672	773	*		–	–	–	–	–	–	–	–	*		188	60	180	60	185	150	180	60
N-1			7	88	133	–			–	–	–	–	–	–	–	–			190	90	180	90	181	90	–	–

NP: Not Provided

*Energized 18-Oct-2017

Total No. of Variations - Normal	4,652	4,308	4,271	3,563	4,454
Total No. of Variations - N-1	38	321	483	656	–
Total of Normal & N-1	4,690	4,629	4,754	4,219	4,454

 Lowest Voltage Under Normal Condition

NTDC Lahore Region

12. 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Gatti - Ludewala Ckt I & II	334	282	243	210	75	245	90	242	60	240	240	240	120	240	240	206	60	–	–	198	60	198	60	204	120
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220 kV Chashma - Ludewala Ckt I & II	152	307	133	201	82	236	60	236	60	238	120	238	120	240	210	200	90	198	60	–	–	198	90	202	60
N-1		–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	197	120	–	–	–	–	–	–

Total No. of Variations (Normal)	486	589	376	411	157
Total No. of Variations (N-1)	–	1	–	–	–
Total of Normal & N-1	486	590	376	411	157



Highest Voltage Under Normal Condition



Lowest Voltage Under Normal Condition

NTDC Lahore Region

13. 220kV Grid Station NISHATABAD 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Nishatabad - Gatti Ckt I	NA	22	12	67	14	NA		238	120	234	120	–	–	235	90	NA		–	–	–	–	203	60	–	–
N-1			10	–	–	–			–	–	–	–	–	–	–	–			183	30	–	–	–	–	–	–
Normal	220 kV Nishatabad - Gatti Ckt II	NA	22	12	67	14	NA		238	120	234	120	–	–	235	90	NA		–	–	–	–	203	60	–	–
N-1			10	–	–	–			–	–	–	–	–	–	–	–			183	30	–	–	–	–	–	–
Normal	220 kV Nishatabad - Samundri Road Ckt I	NA	22	12	67	–	NA		238	120	234	120	–	–	–	–	NA		–	–	–	–	203	60	–	–
N-1			10	–	–	–			–	–	–	–	–	–	–	–			183	30	–	–	–	–	–	–
Normal	220 kV Nishatabad - Samundri Road Ckt II	NA	22	12	67	–	NA		238	120	234	120	–	–	–	–	NA		–	–	–	–	203	60	–	–
N-1			10	–	–	–			–	–	–	–	–	–	–	–			183	30	–	–	–	–	–	–

NA: Not Applicable

Total No. of Variations (Normal)	NA	88	48	268	28
Total No. of Variations (N-1)		40	–	–	–
Total of Normal & N-1	NA	128	48	268	28

 Highest Voltage Under Normal Condition

NTDC Lahore Region

14. 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							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	800	933	610	1042	1147	–	–	–	–	–	–	–	–	–	–	177	90	180	150	185	150	185	90	185	90
N-1	NKLP - BDR - 1	7	49	28	–	–	–	–	–	–	–	–	–	–	–	–	185	90	187	90	185	90	–	–	–	–
Normal	220 kV NKLP - BDR - 2	800	933	610	1042	1147	–	–	–	–	–	–	–	–	–	–	177	90	180	150	185	150	185	90	185	90
N-1	NKLP - BDR - 2	7	49	28	–	–	–	–	–	–	–	–	–	–	–	–	185	90	187	90	185	90	–	–	–	–
Normal	220 kV NKLP - SKP Ckt I & II	407	563	442	479	1059	–	–	–	–	236	190	235	90	–	–	182	60	184	150	191	90	190	90	186	90
N-1	NKLP - SKP Ckt I & II	–	15	8	–	–	–	–	–	–	–	–	–	–	–	–	–	–	192	90	195	90	–	–	–	–
Normal	220 kV NKLP - SNR Ckt I & II	539	731	539	474	691	236	90	–	–	–	–	–	–	–	–	182	90	184	90	187	90	195	150	187	150
N-1	NKLP - SNR Ckt I & II	9	16	15	–	–	–	–	–	–	–	–	–	–	–	–	195	90	189	150	190	90	–	–	–	–
Normal	220 kV NKLP - WTN	569	714	528	–	–	236	90	–	–	–	–	–	–	–	–	180	90	185	180	187	90	–	–	–	–
N-1	NKLP - WTN	2	33	13	–	–	–	–	–	–	–	–	–	–	–	–	195	90	187	90	191	150	–	–	–	–
Normal	220 kV NKLP - New Lahore	–	220	813	785	691	–	–	–	–	–	–	–	–	–	–	–	–	192	150	187	90	191	90	188	90
N-1	NKLP - New Lahore	–	29	12	–	–	–	–	–	–	–	–	–	–	–	–	–	–	190	90	191	90	–	–	–	–

Total No. of Variations (Normal)	3,115	4,094	3,542	3,822	4,735
Total No. of Variations (N-1)	25	191	104	–	–
Total of Normal & N-1	3,140	4,285	3,646	3,822	4,735

 Lowest Voltage Under Normal Condition

NTDC Lahore Region

15. 220kV Grid Station NEW 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Shalamar - KSK	386	193	NP	–	–	–	–	NP	–	–	–	–	–	–	185	90	180	60	NP	–	–	–	–		
N-1		–	4		–	–	–	–		–	–	–	–	–	–	–	–	180	150		–	–	–	–		
Normal	220 kV Shalamar - Ravi	700	827	728	718	949	–	–	–	–	–	–	–	–	–	185	90	182	60	183	90	186	90	182	120	
N-1		150	155	175	278	–	–	–	–	–	–	–	–	–	–	184	90	178	60	180	90	183	90	–	–	
Normal	220 kV Shalamar - Ghazi Rd		598	619	563	953			–	–	–	–	–	–	–			184	90	183	90	186	90	182	120	
N-1			–	–	–	–			–	–	–	–	–	–	–			–	–	–	–	–	–	–	–	–

NP: Not Provided

Total No. of Variations (Normal)	1,086	1,618	1,347	1,281	1,902
Total No. of Variations (N-1)	150	159	175	278	–
Total of Normal & N-1	1,236	1,777	1,522	1,559	1,902

 Lowest Voltage Under Normal Condition

NTDC Lahore Region

16. 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time			Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Ravi - Atlas	1310	426	587	558	492	–	–	232	90	–	–	–	–	–	–	180	150	191	90	188	90	188	90	194	90
N-1		6	45	4	4	–	–	–	–	–	–	–	–	–	–	–	190	450	188	90	190	90	190	90	–	–
Normal	220 kV Ravi - KSK I	1367	856	1181	1258	697	–	–	–	–	–	–	–	–	–	–	180	570	190	270	190	90	180	90	193	90
N-1		4	49	–	–	–	–	–	–	–	–	–	–	–	–	–	190	180	191	180	–	–	–	–	–	–
Normal	220 kV Ravi - KSK II	1367	856	1181	1258	697	–	–	–	–	–	–	–	–	–	–	180	570	190	270	190	90	180	90	193	90
N-1		4	49	–	–	–	–	–	–	–	–	–	–	–	–	–	190	180	191	180	–	–	–	–	–	–
Normal	220 kV Ravi - SKP	1320	553	527	500	406	–	–	–	–	–	–	–	–	–	–	178	90	187	60	183	90	190	90	192	210
N-1		3	25	4	–	–	–	–	–	–	–	–	–	–	–	–	191	150	190	90	192	90	–	–	–	–
Normal	220 kV Ravi - SMR	1467	800	974	1161	620	–	–	–	–	–	–	–	–	–	–	178	90	190	90	180	60	180	60	195	90
N-1		9	54	4	7	–	–	–	–	–	–	–	–	–	–	–	188	90	190	60	190	60	190	60	–	–

Total No. of Variations (Normal)	6,831	3,471	4,450	4,735	2,912
Total No. of Variations (N-1)	26	222	12	11	–
Total of Normal & N-1	6,857	3,693	4,462	4,746	2,912

Lowest Voltage Under Normal Condition

NTDC Lahore Region

17. 220kV Grid Station SAMUNDRI ROAD FAISALABAD

Condition	Name of Transmission Circuits violating the Voltage Criteria	Total Number / Times violating the limit					Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Samundri Road - Multan Ckt I	48	36	7	–	–	236	60	241	150	241	150	–	–	–	–	200	330	200	330	–	–	–	–	–	–
N-1		33	3	6	–	–	–	–	–	–	–	–	–	–	–	–	180	150	190	120	180	90	–	–	–	–
Normal	220 kV Samundri Road - Multan Ckt II	48	36	7	–	–	236	60	241	150	241	150	–	–	–	–	200	330	200	330	–	–	–	–	–	–
N-1		33	3	6	–	–	–	–	–	–	–	–	–	–	–	–	180	150	190	120	180	90	–	–	–	–
Normal	220 kV Samundri Road - Nishatabad Ckt I	48	36	7	201	100	236	60	241	150	241	150	239	90	241	210	200	330	200	330	–	–	205	210	204	90
N-1		33	3	6	1	–	–	–	–	–	–	–	–	–	–	–	180	150	190	120	180	90	179	90	–	–
Normal	220 kV Samundri Road - Nishatabad Ckt II	48	36	7	201	100	236	60	241	150	241	150	239	90	241	120	200	330	200	330	–	–	205	210	204	90
N-1		33	3	6	1	–	–	–	–	–	–	–	–	–	–	–	180	150	190	120	180	90	179	90	–	–
Normal	220 kV Samundri Road - T.T Singh Ckt I&II	48	36	7	201	24	236	60	241	150	241	150	239	90	238	120	200	330	200	330	–	–	205	210	204	90
N-1		33	3	6	1	–	–	–	–	–	–	–	–	–	–	–	180	150	190	120	180	90	179	90	–	–

Total No. of Variations (Normal)	192	144	28	603	224
Total No. of Variations (N-1)	132	12	24	3	–
Total of Normal & N-1	324	156	52	606	224

Highest Voltage Under Normal Condition

Lowest Voltage Under Normal Condition

NTDC Lahore Region

18. 220kV Grid Station SARFARAZNAGAR

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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV SNR - YSW Ckt I	701	472	NP	–	NP	–	–	–	–	NP		–	–	–	–	190	90	185	90	NP		–	–	NP	
N-1		48	2		–		–	–	–	–			–	–	–	–	–	–	–	–			–	–		
Normal	220 kV SNR - YSW Ckt II	701	472	NP	–	NP	–	–	–	–	NP		–	–	–	–	190	90	185	90	NP		–	–	NP	
N-1		48	2		–		–	–	–	–			–	–	–	–	–	–	–	–			–	–		
Normal	220 kV SNR - NKLP Ckt I	694	667	630	814	1556	–	–	–	–	–	–	–	–	–	–	190	90	195	90	190	510	178	270	176	210
N-1		46	6	–	–	–	–	–	–	–	–	–	–	–	–	–	–	180	60	185	90	–	–	–	–	–
Normal	220 kV SNR - NKLP Ckt II	694	667	630	814	1556	–	–	–	–	–	–	–	–	–	–	190	90	195	90	190	510	178	270	176	210
N-1		46	6	–	–	–	–	–	–	–	–	–	–	–	–	–	–	180	60	185	90	–	–	–	–	–
Normal	220 kV SNR - Okara Ckt	531	670	643	818	1518	–	–	–	–	–	–	–	–	–	–	190	90	185	90	190	510	178	270	176	210
N-1		39	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	180	60	190	510	–	–	–	–	–
Normal	220 kV SNR - New Lahore	Added in 2018-19		643	475	NP	Added in 2018-19				–	–	–	–	–	–	Added in 2018-19				190	510	195	570	NP	
N-1				–	–						–	–	–	–	–	–					–	–	–			
Normal	220 kV SNR - Ghazi Road	Added in 2019-20			345	1532	Added in 2019-20						–	–	–	–	Added in 2019-20					178	270	176	210	
N-1					–	–							–	–	–	–						–	–	–		

NP: Not Provided

Total No. of Variations (Normal)	3,321	2,948	2,948	2,546	6,162
Total No. of Variations (N-1)	227	20	20	–	–
Total of Normal & N-1	3,548	2,968	2,968	2,546	6,162

 Lowest Voltage Under Normal Condition

NTDC Lahore Region

19. 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2019-20	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Sialkot - Gakkhar	1123	1183	1219	1224	1174	–	–	–	–	–	–	–	–	–	–	180	210	180	390	170	150	180	90	180	330
N-1		2	4	–	–	–	–	–	–	–	–	–	–	–	–	–	195	90	188	90	–	–	–	–	–	–
Normal	220 kV Sialkot - KSK	1127	1163	1200	1195	1176	–	–	–	–	–	–	–	–	–	–	175	150	180	210	170	150	180	150	180	210
N-1		–	2	6	1	–	–	–	–	–	–	–	–	–	–	–	–	–	180	90	160	90	190	90	–	–

Total No. of Variations (Normal)	2,250	2,346	2,421	2,419	2,350
Total No. of Variations (N-1)	2	6	4	1	–
Total of Normal & N-1	2,252	2,352	2,425	2,420	2,350

 Lowest Voltage Under Normal Condition

NTDC Lahore Region

20. 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV T.T. Singh - Multan Ckt I & II	425	455	707	468	224	244	390	243	450	248	570	245	660	247	1110	189	150	180	870	170	480	171	1410	182	540
N-1		–	–	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	177	1290	172	1410	–	–
Normal	220 kV T.T. Singh - Samundri Road Ckt I & II	425	455	707	468	224	244	390	243	450	248	570	245	660	247	1110	189	150	180	870	170	480	171	1410	182	540
N-1		–	–	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	177	1290	172	1410	–	–

Total No. of Variations (Normal)	850	910	1414	936	448
Total No. of Variations (N-1)	–	–	4	4	–
Total of Normal & N-1	850	910	1418	940	448

 Highest Voltage Under Normal Condition

 Lowest Voltage Under Normal Condition

NTDC Lahore Region

21. 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV WTN - NKLP	710	1054	707	–	NP	–	–	–	–	–	–	–	–	NP		188	150	175	90	184	90	–	–	NP	
N-1	WTN - NKLP	–	13	2	–		–	–	–	–	–	–	–	–			–	–	175	90	196	90	–	–		
Normal	220 kV WTN - Sheikhupura	557	963	681	518	639	–	–	–	–	–	–	–	–	–	–	187	150	180	90	180	90	193	90	190	90
N-1	WTN - Sheikhupura	–	9	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	191	150	194	150	–	–	–	–
Normal	220 kV WTN - New Lahore	Added in 2019			441	599	Added in 2019							–	–	–	–	Added in 2019					193	90	190	90
N-1	WTN - New Lahore				1	–								–	–	–	–						207	90	–	–

NP: Not provided

Total No. of Variations - Normal	1,267	2,017	1,388	959	1,238
Total No. of Variations - N-1	–	22	4	1	–
Total of Normal & N-1	1,267	2,039	1,392	960	1,238

 Lowest Voltage Under Normal Condition



APPENDIX 3

Voltage violations data - detailed circuit wise analysis

NTDC Multan Region

1.	500 kV D. G. Khan	1 of 12
2.	500 kV Multan	2 of 12
3.	500 kV Muzaffargarh	3 of 12
4.	500 kV Yousafwala	4 of 12
5.	500 kV Rahim Yar Khan	5 of 12
6.	220 kV Bahawalpur	6 of 12
7.	220 kV Kassowal	7 of 12
8.	220 kV Muzaffargarh	8 of 12
9.	220 kV Okara	9 of 12
10.	220 kV Vehari	10 of 12
11.	220 kV Chishtian	11 of 12
12.	220 kV Lal Sohanra	12 of 12

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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							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	15	26	20	39	21	564	60	575	60	561	60	565	60	560	60	—	—	—	—	—	—	494	60	—	—
N-1		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Normal	500 kV D.G. Khan - Multan	*	1	20	38	8	*		554	30	561	60	565	60	560	60	*		—	—	—	—	494	60	—	—
N-1			—	—	—	—			—	—	—	—	—	—	—	—			—	—	—	—	—	—	—	—
Normal	220 kV D.G. Khan - Loralai I	150	NP	77	74	78	250	60	NP		251	60	252	60	250	60	—	—	NP		NP		—	—	—	—
N-1		—	—	—	—	—	—	—			—	—	—	—	—	—	—	—					—	—	—	—
Normal	220 kV D.G. Khan - Loralai II	150	NP	77	74	78	250	60	NP		251	60	252	60	250	60	—	—	NP		NP		—	—	—	—
N-1		—	—	—	—	—	—	—			—	—	—	—	—	—	—	—					—	—	—	—

NP: Not Provided

* Provided as 500kV Multan-D.G. Khan-Guddu

Total No. of Variations (Normal)	315	27	194	225	185
Total No. of Variations (N-1)	—	—	—	—	—
Total of Normal & N-1	315	27	194	225	185

 Highest Voltage Under Normal Condition @500kV level

 Highest Voltage Under Normal Condition @220kV level

NTDC Multan Region

2. 500kV Grid Station MULTAN

Multan Region
2 of 12

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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500 kV	NIL	NP	—	NP	NIL	NP				—	—	NP		NIL	NP				—	—	NP				
N-1	Multan - Guddu I			—			—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—
Normal	500 kV	NIL	3	—	NP	NIL				547	30	—	—	NP	NIL				—	—	—	—	NP			
N-1	Multan - Guddu 747			—		—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—		—	—	—
Normal	500 kV	NIL	3	NIL	NA	NIL				560	30	NIL	NA	NIL				—	—	NIL	NA					
N-1	Multan - Muzaffargarh					—	—	—	—	—	—			—	—	—	—	—	—			—	—	—	—	—
Normal	500 kV	NIL	NP	—	NP	NIL	NP				—	—	NP	NIL	NP				—	—	NP					
N-1	Multan - Yousafwala			—			—	—	—	—	—	—			—	—	—	—	—	—		—	—	—	—	—
Normal	500 kV	NIL	NP	—	NP	NIL	NP				—	—	NP	NIL	NP				—	—	NP					
N-1	Multan - Gatti			—			—	—	—	—	—	—			—	—	—	—	—	—		—	—	—	—	—
Normal	500 kV	NIL	NP	3	NP	NIL	NP	550	30	—	—	NP	NIL	NIL	NP	NIL	NP	—	—	—	—	NP				
N-1	Multan - Rousch			—				—	—	—	—							—	—	—	—		—	—	—	—
Normal	500 kV	NIL	NP	3	NIL	NP	NIL	NP	547	30	NIL	NP	NIL	NP	NIL	NP	NIL	NP	—	—	NIL	NP				
N-1	Multan - D.G. Khan - Guddu			—					—	—									—	—			—	—	—	—
Normal	500 kV	*	3	NIL	NA	*	NIL	565	30	NIL	NA	*	*	*	*	*	*	—	—	NA	NA					
N-1	Multan - R Y Khan							—	—									—	—			—	—	—	—	—
Normal	500 kV	**	2	—	NP	**	546	30	—	—	NP	**	**	**	**	**	**	—	—	—	—	NP				
N-1	Multan - Sahiwal																	—	—	—	—		—	—	—	—
Normal	500 kV	**	3	—	NP	**	560	30	—	—	NP	**	**	**	**	**	**	—	—	—	—	NP				
N-1	Multan - HBS																	—	—	—	—		—	—	—	—
Normal	220 kV	NIL	NP	2	NA	NIL	NP				—	—	NA	NIL	NP				207	570	NA					
N-1	Multan - Muzaffargarh 1			—			—	—	—	—	—	—			—	—	—	—	—	—		—	—	—	—	—
Normal	220 kV	2	NP	—	6	254	60	NP				—	—	252	180	—	—	NP	—	—	—	—				
N-1	Multan - Muzaffargarh 2	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—		
Normal	220 kV	1	NP	1	3	245	90	NP				—	—	NA		—	—	NP	207	240	NA					
N-1	Multan - Muzaffargarh 3	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—		
Normal	220 kV	NIL	NP	2	NA	NIL	NP				—	—	NA	NIL	NP				207	570	NA					
N-1	Multan - Muzaffargarh 4			—			—	—	—	—	—	—			—	—	—	—	—	—		—	—	—	—	—
Normal	220 kV	***	6	NP	***	250	300	NP				251	90	252	150	NIL	NP	—	—	NP						
N-1	Multan - New M-Garh							—	—	—	—							—	—	—	—	—	—	—	—	—
Normal	220 kV	NIL	NP	3	14	NIL	NP				251	90	252	150	NIL	NP	—	—	—	—						
N-1	Multan - Kapco 3			—	—		—	—	—	—	—	—	—	—			—	—	—	—	—	—	—	—	—	—
Normal	220 kV	NIL	NP	3	14	NIL	NP				251	90	—	—	NIL	NP	—	—	—	—						
N-1	Multan - Kapco 4			—	—		—	—	—	—	—	—	—	—			—	—	—	—	—	—	—	—	—	—
Normal	220 kV	NIL	NP	NIL	NA	NIL	NP				NIL		NA		NIL	NP	NIL		NA							
N-1	Multan - Kapco 5 & 6			—	—		—	—	—	—	—	—	—	—			—	—	—	—	—	—	—	—	—	—
Normal	220 kV	NIL	NP	1	2	NIL	NP				—	—	246	90	NIL	NP	208	120	—	—						
N-1	Multan - NGPS 1 & 2			—	—		—	—	—	—	—	—	—	—			—	—	—	—	—	—	—	—	—	—
Normal	220 kV	NIL	NP	9	12	NIL	NP				250	210	250	290	NIL	NP	208	60	—	—						
N-1	Multan - Vehari 1 & 2			—	—		—	—	—	—	—	—	—	—			—	—	—	—	—	—	—	—	—	—
Normal	220 kV	NIL	NP	—	NP	NIL	NP				—	—	NP		NIL	NP	—	—	NP							
N-1	Multan - Samundri Road			—			—	—	—	—	—	—	—	—			—	—	—	—	—	—	—	—	—	—
Normal	220 kV	NIL	NP	1	4	NIL	NP				—	—	246	90	NIL	NP	208	60	—	—						
N-1	Multan - T.T. Singh 1 & 2			—	—		—	—	—	—	—	—	—	—			—	—	—	—	—	—	—	—	—	—

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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							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	NIL		NP	NA		NIL		NP		NA		NIL		NP		NA		NIL		NP		NA			
N-1																										
Normal	500 kV Muzaffargarh - Guddu	NIL					NIL										NIL									
N-1																										
Normal	500 kV Muzaffargarh - Multan	NIL		NP	NA		NIL		NP		NA		NIL		NP		NA		NIL		NP		NA			
N-1																										
Normal	220 kV 500kV Grid Station TPS Phase-I - Muzaffargarh	NIL		NP	NA		NIL		NP		NA		NIL		NP		NA		NIL		NP		NA			
N-1																										
Normal	220 kV 500kV Grid Station TPS Phase-II - Muzaffargarh	NIL		NP	NA		NIL		NP		NA		NIL		NP		NA		NIL		NP		NA			
N-1																										
Normal	500 kV Muzaffargarh - Guddu 747	NIL		NP	NA		NIL		NP		NA		NIL		NP		NA		NIL		NP		NA			
N-1																										
Normal	220 kV Muzaffargarh- D.G Khan	Added in 2019			NA		Added in 2019					NA			Added in 2019					NA						
N-1																										

NP: Not Provided

NA: Not Applicable

Total No. of Variations (Normal)	NIL/NP	NA
Total No. of Variations (N-1)		
Total of Normal & N-1		

NTDC Multan Region

4. 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500 kV Yousafwala - Lahore	NA	NP	–	NP	NA	NP		NP		–	–	NP	NA	NP				–	–	NP					
N-1				–															–	–		–	–			
Normal	500 kV Yousafwala - Multan	NA	207	500	693	NP	NA	544	120	541	180	552	120	NP	NA	–	–	–	–	–	–	–	–	–	NP	
N-1			–	–	–			–	–	–	–	–	–			–	–	–	–	–	–	–	–	–		–
Normal	500 kV Yousafwala - CFPP		204	554	184	NP	–	–	543	180	542	180	–	–	NP	–	–	–	–	–	–	–	–	–	NP	
N-1		–	–	–	–		–	–	–	–	–	–	–	–		–	–	–	–	–	–	–	–	–		–
Normal	220 kV Yousafwala - SNR	42	NP	–	NP	–	–	NP				–	–	NP	208	180	NP				–	–	NP			
N-1		–		–		–	–					–	–		–	–					–	–		–	–	–
Normal	220 kV Yousafwala - Gatti	42	49	156	167	NP	–	–	238	180	239	120	238	120	NP	208	180	–	–	–	–	200	120	NP		
N-1		–	–	–	–		–	–	–	–	–	–	–	–		–	–	–	–	–	–	–	–		–	
Normal	220 kV Yousafwala - Kassowal	42	40	94	158	NP	–	–	236	180	237	120	236	120	NP	208	180	–	–	198	120	198	120	NP		
N-1		–	–	–	–		–	–	–	–	–	–	–	–		–	–	–	–	–	–	–	–		–	
Normal	220 kV Yousafwala - CFPP	NP	43	NP	–	NP	NP	543	180	NP		–	–	NP	NP	–	–	NP		–	–	NP				
N-1			–		–			–	–			–	–			–	–			–	–		–	–	–	–
Normal	220 kV Yousafwala - Okara			297	118	NP					236	180	237	120	NP					198	120	199	120	NP		
N-1				–	–						–	–	–	–						–	–	–	–		–	–

NP: Not Provided NA: Not Applicable

Total No. of Variations (Normal)	126	543	1,601	1320	NP
Total No. of Variations (N-1)	–	–	–	–	
Total of Normal & N-1	126	543	1,601	1320	

NTDC Hyderabad 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							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	*	NIL	3	NIL	NA	*	NIL	565	30	NIL	NA	*	NIL	565	30	NIL	NA								
N-1				–					–	–					–											
Normal	500 kV Multan - RY Khan	*	NIL	3	NIL	NA	*	NIL	565	30	NIL	NA	*	NIL	565	30	NIL	NA								
N-1				–					–	–					–											

* Energized Feb, 2018

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

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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							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	15	21	657	806	660	242	60	242	180	242	30	242	180	252	30	197	30	197	30	–	–	197	30	–	–
N-1		5	–	179	226	108	246	30	–	–	251	60	252	90	247	60	194	30	–	–	–	–	190	30	192	30
Normal	220 kV Bahawalpur - Lal Sohanra Ckt I & II	15	21	657	505	59	242	60	242	180	242	30	242	30	240	60	197	30	197	30	–	–	197	30	201	60
N-1		5	–	179	136	6	246	30	–	–	251	60	250	90	245	30	194	30	–	–	–	–	190	30	195	30
Total No. of Variations (Normal)		15	21	657	1311	719																				
Total No. of Variations (N-1)		5	–	179	362	114																				
Total of Normal & N-1		20	21	836	1673	833																				

 Highest Voltage Under Normal Condition

 Lowest Voltage Under Normal Condition

 Highest Voltage Under N-1 Condition

 Lowest Voltage Under N-1 Condition

NTDC Multan Region

7. 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	Kassowal - Vehari 1	980	248	318	273	36	245	30	243	120	250	60	242	60	239	60	198	60	197	60	–	–	197	60	197	60
N-1		–	1	12	2	–	–	–	243	150	–	–	–	–	–	–	–	–	–	–	192	60	193	60	–	–
Normal	Kassowal - Vehari 2	980	248	318	273	36	245	30	243	120	250	60	242	60	239	60	198	60	197	60	–	–	197	60	197	60
N-1		–	1	12	2	–	–	–	243	150	–	–	–	–	–	–	–	–	–	–	192	60	193	60	–	–
Normal	Kassowal - Yousafwala 1	931	248	299	273	36	245	30	243	150	250	60	242	60	239	60	198	60	197	60	197	60	197	60	197	60
N-1		–	2	8	2	–	–	–	–	–	–	–	–	–	–	–	–	–	189	90	192	60	193	60	–	–
Normal	Kassowal - Yousafwala 2	931	248	299	273	36	245	30	243	150	250	60	242	60	239	60	198	60	197	60	197	60	197	60	197	60
N-1		–	2	8	2	–	–	–	–	–	–	–	–	–	–	–	–	–	189	90	192	60	193	60	–	–

Total No. of Variations (Normal)	3,822	998	1,234	1,092	144
Total No. of Variations (N-1)	–	–	40	8	–
Total of Normal & N-1	3,822	998	1,274	1,100	144

 Highest Voltage Under Normal Condition

 Lowest Voltage Under Normal Condition

NTDC Multan Region

8. 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)										
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21		
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage
Normal	220 kV Muzaffargarh - Multan	NIL	276	207	179	164	NIL		244	120	244	60	242	210	248	60	NIL	-	-	-	-	-	-	-	-	-	-
N-1			-	28	29	-		-	-	250	270	247	120	-	-	-		-	-	-	-	-	-	-	-	-	-
Normal	220 kV Muzaffargarh - TPS	NIL	374	199	179	165	NIL		245	180	244	60	245	60	248	60	NIL	-	-	-	-	-	-	-	-	-	-
N-1			-	29	29	-		-	-	250	270	247	120	-	-	-		-	-	-	-	-	-	-	-	-	-

Total No. of Variations (Normal)	NIL	650	406	358	329
Total No. of Variations (N-1)		-	57	58	-
Total of Normal & N-1		650	463	416	329

Highest Voltage Under Normal Condition

NTDC Multan Region

9. 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							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	*	44	221	204	100	*		237	240	-	-	241	390	-	-			-	-	195	1380	195	1440	195	1440
N-1			-	-	-	-			-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-
Normal	220 kV Okara - Yousafwala Ckt I & II	*	44	221	204	104	*		237	240	-	-	241	390	-	-			-	-	195	1380	195	1440	195	1440
N-1			-	-	-	-			-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-

* Proper in out energized on 19.12.2017

Total No. of Variations (Normal)	526	364	884	408	204
Total No. of Variations (N-1)	-	1	-	-	-
Total of Normal & N-1	526	365	884	408	204

 Lowest Voltage Under Normal Condition

NTDC Multan Region

10. 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							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	837	1640	2074	900	639	242	270	242	270	–	–	243	210	249	270	204	30	196	30	135	90	195	60	–	–
N-1		2	140	228	99	3	243	90	248	150	–	–	245	270	241	270	–	–	190	30	191	30	190	90	–	–
Normal	220 kV Vehari - Kassowal Ckt I & II	852	1638	2081	900	633	243	30	242	150	–	–	243	210	249	270	204	30	196	30	198	30	195	60	–	–
N-1		2	140	228	101	5	243	90	248	150	–	–	245	270	241	270	–	–	190	30	191	30	190	90	–	–
Normal	220 kV Vehari - Chishtian Ckt I & II	824	1637	1821	772	377	242	270	243	90	–	–	–	–	249	270	205	30	194	30	198	30	–	–	–	–
N-1		2	140	228	98	2	243	90	247	150	–	–	–	–	241	41	–	–	191	30	190	30	–	–	–	–

NP: Not Provided

Total No. of Variations - Normal	2,513	4,915	5,975	2,572	1,649
Total No. of Variations - N-1	6	420	684	298	10
Total of Normal & N-1	2,519	5,335	6,659	2,870	1,659

 Highest Voltage Under Normal Condition

 Highest Voltage Under N-1 Condition

NTDC Multan Region

11. 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							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	720	3282	3944	3923	2389	244	60	241	90	-	-	242	90	249	150	-	-	199	120	198	60	197	30	194	120
N-1		70	505	817	944	83	247	60	249	30	-	-	250	30	247	30	-	-	173	30	189	30	190	60	-	-

Total No. of Variations (Normal)	722	3,282	3,944	3,923	2,389
Total No. of Variations (N-1)	70	505	817	944	38
Total of Normal & N-1	792	3,787	4,761	4,867	2,427

 Highest Voltage Under Normal Condition

 Lowest Voltage Under Normal Condition

 Highest Voltage Under N-1 Condition

NTDC Multan Region

12. 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							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			631	167	Added in 2019						242	90	250	60	Added in 2019						197	30	-	-
N-1					100	41							250	30	250	30							190	60	194	60

Total No. of Variations (Normal)	Added in 2019	631	167
Total No. of Variations (N-1)		100	41
Total of Normal & N-1		731	208

 Highest Voltage Under Normal Condition

 Lowest Voltage Under N-1 Condition

 Highest Voltage Under N-1 Condition



APPENDIX 4

Voltage violations data - detailed circuit wise analysis

NTDC Hyderabad Region

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

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)										
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21		
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage
Normal	500 kV	1	15	7	6	3	526	180	535	60	542	60	535	60	535	60	–	–	–	–	–	–	–	–	–	–	
N-1	Dadu - Jamshoro I	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		
Normal	500 kV	3	15	7	NA	NP	530	240	535	60	542	60	NA		NP		–	–	–	–			NA		NP		
N-1	Dadu - Jamshoro II	–	–	–			–	–	–	–	–	–					–	–	–	–	–	–					–
Normal	500 kV	NP			–	NP	NP					–	–	NP		NP					–	–	NP				
N-1	Dadu - Guddu I				–							–	–								–	–		–	–	–	–
Normal	500 kV	2	5	*			528	60	535	60	*					–	–	–	–	*							
N-1	Dadu - Guddu II	–	–				–	–	–	–						–	–	–	–							–	–
Normal	500 kV	3	15	10	6	3	530	60	535	120	542	60	535	60	535	60	–	–	–	–	–	–	–	–	–	–	
N-1	Dadu - Shikarpur I	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
Normal	500 kV	*	10	10	6	3	*		535	120	542	60	535	60	535	60	*		–	–	–	–	–	–	–	–	–
N-1	Dadu - Shikarpur II		–	–	–	–			–	–	–	–	–	–	–	–			–	–	–	–	–	–	–	–	–
Normal	500 kV	Energized in Apr, 2019		NA	6	2	Energized in Apr, 2019				NA		535	60	530	60	Energized in Apr, 2019				NA		–	–	–	–	
N-1	Dadu - Port Qasim				–	–							–	–	–	–							–	–	–	–	–
Normal	500 kV	Energized in Apr, 2019		34	6	3	Energized in Apr, 2019				535	60	535	60	535	60	Energized in Apr, 2019				–	–	–	–	–	–	
N-1	Dadu - Moro			–	–	–					–	–	–	–	–	–					–	–	–	–	–	–	–
Normal	220 kV	344	106	42	50	19	240	120	238	360	240	240	240	60	240	240	–	–	–	–	–	–	–	–	–	–	
N-1	Dadu - Khuzdar I	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
Normal	220 kV	380	99	42	33	19	240	240	238	360	240	240	240	60	240	240	–	–	–	–	–	–	–	–	–	–	
N-1	Dadu - Khuzdar II	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
Normal	220 kV	Added in 2020-21				1	Added in 2020-21							535	60	Added in 2020-21							–	–			
N-1	Dadu - Matiari					–								–	–								–	–	–	–	–

* 500 kV Dadu - Guddu II line bifurcated into Dadu - Shikarpur II & Guddu - Shikarpur II since March 2018 and does not exist anymore

NA: Not applicable

NP: Not provided

Total No. of Variations (Normal)	733	265	152	113	53
Total No. of Variations (N-1)	–	–	–	–	–
Total of Normal & N-1	733	265	152	113	53

 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							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	
N-1					-								-	-									-	-		
Normal	500 kV Guddu - Dadu II	1183	521	*			540	420	540	420	*						-	-	-	-	*					
N-1		-	-				-	-	-	-							-	-	-	-						
Normal	500 kV Guddu - D.G. Khan (Old Multan)	NP	504	10	48	33	NP		540	300	535	300	538	420	538	360	NP		-	-	-	-	-	-	-	-
N-1			-	-	-	-			-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-
Normal	500 kV Guddu - 747 MW CCPP Guddu	642	NA		20	9	541	90	NA				538	360	538	180	-	-	NA				-	-	-	-
N-1		-			-	-	-	-					-	-	-	-	-	-					-	-	-	-
Normal	500 kV Guddu - Muzaffargarh	NP	456	13	101	23	NP		540	300	535	120	540	240	538	360	NP		-	-	-	-	-	-	-	-
N-1			-	-	-	-			-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-
Normal	500 kV Guddu - Shikarpur I	NA			29	20	NA						539	60	538	120	NA						-	-	-	-
N-1					-	-							-	-	-	-							-	-	-	-
Normal	500 kV Guddu - Shikarpur II	*	13	23	62	29	*		536	120	535	120	538	420	538	120	*		-	-	-	-	-	-	-	-
N-1			-	-	-	-			-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-
Normal	220 kV Guddu - Sibbi (D/Ckt)	NP			-	NP	NP						-	-	NP		NP						-	-	NP	
N-1					-								-	-									-	-		
Normal	220 kV Guddu - Uch (P/H)	NP			-	NP	NP						-	-	NP		NP						-	-	NP	
N-1					-								-	-									-	-		

NA: Not applicable.

NP: Not provided

* 500 kV Dadu - Guddu II line bifurcated into Dadu - Shikarpur II & Guddu - Shikarpur II in March 2018 and does not exist anymore

Total No. of Variations (Normal)	1,825	1,494	46	260	114
Total No. of Variations (N-1)	-	-	-	-	-
Total of Normal & N-1	1,825	1,494	46	260	114

 Highest Voltage Under Normal Condition @500kV level

NTDC Hyderabad Region

3. 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500 kV Jamshoro - Dadu I	224	473	27	69	8	543	60	540	60	543	60	535	60	530	60	-	-	-	-	-	-	-	-	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Normal	500 kV Jamshoro - Dadu II	228	473	27	69	NP	543	60	540	60	543	60	535	60	NP		-	-	-	-	-	-	-	-	NP	
N-1		-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Normal	500 KV Jamshoro-NKI	-	-	-	-	3	-	-	-	-	-	-	-	-	531	60	-	-	-	-	-	-	-	-	-	
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Normal	500 kV Jamshoro - Hub (D/Ckt)	235	473	**	69	3	543	60	540	60	543	60	535	60	525	60	-	-	-	-	-	-	-	-	-	
N-1		-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Normal	500 kV Jamshoro - Port Qasim	*	242	26	69	6	*	540		60	543	60	535	60	534	60	*	-	-	-	-	-	-	-	-	
N-1		-	-	-	-	-		-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	
Normal	500 kV Jamshoro - Thar Engro	***		6	1	NP	***			535	60	528	30	NP		***			-	-	-	-	-	NP		
N-1		-		-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Normal	500 kV Jamshoro - K2K3	Added in 2020-21				1	Added in 2020-21								529	60	Added in 2020-21						-	-		
N-1		-				-	-								-	-	-						-	-		
Normal	500 kV Jamshoro - CPHGC	Added in 2020-21				3	Added in 2020-21								530	60	Added in 2020-21						-	-		
N-1		-				-	-								-	-	-						-	-		
Normal	220 kV Jamshoro - KDA33 - I	135	497	378	702	928	242	60	244	60	241	60	244	60	242	60	-	-	-	-	-	-	-	-	-	
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Normal	220 kV Jamshoro - KDA33 - II	134	497	378	702	928	-	-	244	60	241	60	244	60	242	60	-	-	-	-	-	-	-	-	-	
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Normal	220 kV Jamshoro - Hala Road I	135	497	409	747	1,134	242	60	244	60	241	60	244	60	244	60	-	-	-	-	-	-	-	-	-	
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Normal	220 kV Jamshoro - Hala Road II	130	497	409	747	1,134	242	60	244	60	241	60	244	60	244	60	-	-	-	-	-	-	-	-	-	
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Normal	220 kV Jamshoro - T.M. Khan - I	127	497	408	704	963	242	60	244	60	242	60	241	60	244	60	-	-	-	-	-	-	-	-	-	
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Normal	220 kV Jamshoro - T.M. Khan - II	122	497	408	704	963	242	60	244	60	242	60	241	60	244	60	-	-	-	-	-	-	-	-	-	
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Normal	220 kV Jamshoro - Matiari - I	Added in 2020-21				3	Added in 2020-21								528	60	Added in 2020-21						-	-		
N-1		-				-	-								-	-	-						-	-		
Normal	220 kV Jamshoro - Matiari - II	Added in 2020-21				9	Added in 2020-21								532	60	Added in 2020-21						-	-		
N-1		-				-	-								-	-	-						-	-		

* 500 kV Jamshoro - NKI line bifurcated into Jamshoro - Port Qasim & Port Qasim - NKI on 01-Nov-2017

** Only comparison reported

*** Commissioned in Dec, 2018

Total No. of Variations (Normal)	1,470	4,874	5,755	3,879	6,086
Total No. of Variations (N-1)	-	-	-	-	-
Total of Normal & N-1	1,470	4,874	5,755	3,879	6,086

 Highest Voltage Under Normal Condition @500kV level

 Highest Voltage Under Normal Condition @220kV level

4. 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							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	91	139	6	1	NP	530	60	535	30	–	–	528	30	NP	–	–	–	–	472	30	–	–	NP		
N-1		–	–	–	–		–	–			–	–	–	–		–	–	–	–	–	–	–	–			
Normal	500 kV NKI - Port Qasim	*	138	6	–	NA	*		535	30	–	–	–	–	NA			–	–	472	30	–	–	NA		
N-1			–	–	–				–	–	–	–	–	–				–	–	–	–	–	–			
Normal	500 kV NKI - Jamshoro	Added in 2020-21				NA	Added in 2020-21							NA	Added in 2020-21								–	–		
N-1																							–	–		
Normal	220 kV NKI - Baldia	614	419	8	21	NA	238	180	241	120	240	30	234	150	NA	–	–	–	–	–	–	–	208	30	NA	
N-1		–	–	–	–		–	–	–	–	–	–	–	–		–	–	–	–	–	–	–	–			
Normal	220 kV NKI - KDA33	401	419	9	21	NA	239	120	241	120	240	30	234	150	NA	–	–	–	–	–	–	–	208	30	NA	
N-1		–	–	–	–		–	–	–	–	–	–	–	–		–	–	–	–	–	–	–	–	–		
Normal	500 kV NKI - K2/K3	Added in 2019			31	NA	Added in 2019					535	30	NA	Added in 2019					–	–	NA				
N-1					–							–	–							–	–					

* 500 kV NKI - Jamshoro line bifurcated into Jamshoro - Port Qasim & NKI - Port Qasim - NKI on 01-Nov-2017 and does not exist anymore

Total No. of Variations (Normal)	1,106	1,118	29	74	NA
Total No. of Variations (N-1)	–	–	–	–	–
Total of Normal & N-1	1,106	1,118	29	74	NA

NTDC Hyderabad Region

5. 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							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	841	1176	1120	970	827	540	1080	546	90	544	90	545	120	550	180	-	-	-	-	-	-	-	-	-	-
N-1	Shikarpur - Guddu Ckt I	-	544	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	500 kV Shikarpur - Guddu Ckt II	*	320	1177	973	828	*		545	180	542	210	545	120	550	180	*		-	-	-	-	-	-	-	-
N-1	Shikarpur - Guddu Ckt II	-	-	-	-	-			-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-
Normal	500 kV Shikarpur - Dadu Ckt I	862	1193	82	965	832	540	1080	546	90	540	450	548	120	550	180	-	-	-	-	-	-	-	-	-	-
N-1	Shikarpur - Dadu Ckt I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	500 kV Shikarpur - Dadu Ckt II	*	318	1133	905	829	*		545	180	541	270	548	120	550	180	*		-	-	-	-	-	-	-	-
N-1	Shikarpur - Dadu Ckt II	-	-	-	-	-			-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-
Normal	220 kV Shikarpur - Guddu Ckt I	258	482	548	869	1249	240	180	240	180	240	150	242	120	245	180	-	-	-	-	-	-	-	-	-	-
N-1	Shikarpur - Guddu Ckt I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Shikarpur - Guddu Ckt II	**	50	660	1031	1099	**		238	120	241	180	245	120	248	120	**		-	-	-	-	-	-	-	-
N-1	Shikarpur - Guddu Ckt II	-	-	-	-	-			-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-
Normal	220 kV Shikarpur - Uch Ckt I	255	480	506	831	1278	236	120	240	180	240	150	242	120	245	180	-	-	-	-	-	-	-	-	-	-
N-1	Shikarpur - Uch Ckt I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Shikarpur - Uch Ckt II	**	48	657	1029	1131	**		238	120	241	180	241	240	248	120	**		-	-	-	-	-	-	-	-
N-1	Shikarpur - Uch Ckt II	-	-	-	-	-			-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-
Normal	220 kV Shikarpur - Rohri I	13	37	687	1016	1107	234	240	238	120	241	180	242	120	247	120	-	-	-	-	-	-	-	-	-	-
N-1	Shikarpur - Rohri I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Shikarpur - Rohri II	13	38	688	1013	1131	234	240	238	120	241	180	242	330	248	120	-	-	-	-	-	-	-	-	-	-
N-1	Shikarpur - Rohri II	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

* Bifurcated from Dadu - Guddu II in March 2018

** Reported as Shikarpur - Uch collectively

Total No. of Variations (Normal)	2,242	4,142	7,258	9,602	10,311
Total No. of Variations (N-1)	-	-	-	-	-
Total of Normal & N-1	2,242	4,142	7,258	9,602	10,311

 Highest Voltage Under Normal Condition @500kV level

 Highest Voltage Under Normal Condition @220kV level

NTDC Hyderabad Region

6. 220kV Grid Station DHARKI

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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							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	1	NA		948	582	235	180	NA				250	120	251	60	–	–	NA				200	120	–	–
N-1		–			–	–	–	–					–	–	–	–	–	–					–	–	–	–
Normal	220 kV Ddharki - FPCDL	1	NA		964	583	235	180	NA				250	120	252	120	–	–	NA				200	120	–	–
N-1		–			–	–	–	–					–	–	–	–	–	–					–	–	–	–

Na: Not Applicable

Total No. of Variations (Normal)	2	NA	1912	1165
Total No. of Variations (N-1)	–			–
Total of Normal & N-1	2		1912	1165

 Highest Voltage Under Normal Condition

 Lowest Voltage Under Normal Condition

NTDC Hyderabad Region
7. 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV	5	28	10	5	1	235	180	240	60	240	30	238	270	240	30	–	–	–	–	–	–	–	–	–	–
N-1	Hala Road - Jamshoro I	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220 kV	5	28	10	5	1	235	180	240	60	240	30	238	270	240	30	–	–	–	–	–	–	–	–	–	–
N-1	Hala Road - Jamshoro II	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Total No. of Variations (Normal)	10	56	20	10	2
Total No. of Variations (N-1)	–	–	–	–	–
Total of Normal & N-1	10	56	20	10	2

 Highest Voltage Under Normal Condition

NTDC Hyderabad Region

8. 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV	229	141	123	983	1386	255	35	248	30	250	35	248	60	250	60	185	45	190	35	180	30	180	60	-	-
N-1	Dadu - Khuzdar I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV	229	141	123	983	1386	255	35	248	30	250	35	248	60	250	60	185	45	190	35	180	30	180	60	-	-
N-1	Dadu - Khuzdar II	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Total No. of Variations (Normal)	458	282	246	1,966	2,772
Total No. of Variations (N-1)	-	-	-	-	-
Total of Normal & N-1	458	282	246	1,966	2,772

 Highest Voltage Under Normal Condition

NTDC Hyderabad Region

9. 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV	505	1570	991	1094	965	248	600	254	300	242	240	250	120	245	60	–	–	180	180	143	180	195	60	–	–
N-1	Loralai - D.G. Khan I	–	–	154	126	67	–	–	–	–	255	60	255	60	250	60	–	–	–	–	190	60	190	180	–	–
Normal	220 kV	505	1570	991	1094	965	248	600	254	300	242	240	250	120	245	60	–	–	180	180	143	180	195	60	–	–
N-1	Loralai - D.G. Khan II	–	–	154	126	67	–	–	–	–	255	60	255	60	250	60	–	–	–	–	190	60	190	180	–	–

Total No. of Variations (Normal)	1,010	3,140	1,982	2,188	1,930
Total No. of Variations (N-1)	–	–	308	252	134
Total of Normal & N-1	1,010	3,140	2,290	2,440	2,064

 Highest Voltage Under Normal Condition
 Highest Voltage Under N-1 Normal Condition

NTDC Hyderabad Region

10. 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							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	444	3022	4379	5468	2851	240	60	-	-	280	60	-	-	239	60	201	60	180	60	178	60	176	60	180	60
N-1		1	-	-	-	2424	-	-	-	-	-	-	-	-	245	60	199	60	-	-	-	-	-	-	170	60
Normal	220 kV Sibbi - Quetta Ckt II	444	3022	4379	5468	2851	240	60	-	-	280	60	-	-	239	60	201	60	180	60	178	60	176	60	180	60
N-1		1	-	-	-	2424	-	-	-	-	-	-	-	-	245	60	199	60	-	-	-	-	-	-	170	60

Total No. of Variations (Normal)	888	6,044	8,758	10,936	5,702
Total No. of Variations (N-1)	2	-	-	-	-
Total of Normal & N-1	890	6,044	8,758	10,936	5,702

 Highest Voltage Under Normal Condition

 Lowest Voltage Under Normal Condition

 Highest Voltage Under N-1 Condition

 Lowest Voltage Under N-1 Condition

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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Shikarpur - Rohri I	Nil	20	83	460	544	Nil		236	60	232	60	246	60	247	60	Nil		-	-	-	-	-	-	-	-
N-1			-	-	-	-			-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-
Normal	220 kV Shikarpur - Rohri II	Nil	20	83	460	544	Nil		236	60	232	60	246	60	247	60	Nil		-	-	-	-	-	-	-	-
N-1			-	-	-	-			-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-
Normal	220 kV Rohri - Engro I	Nil	15	17	24	206	Nil		238	180	232	60	244	60	247	120	Nil		-	-	-	-	-	-	-	-
N-1			-	-	-	-			-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-
Normal	220 kV Rohri - Engro II	Nil	15	17	24	206	Nil		238	180	232	60	244	60	247	120	Nil		-	-	-	-	-	-	-	-
N-1			-	-	-	-			-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-

Total No. of Variations (Normal)	Nil	70	200	968	1,500
Total No. of Variations (N-1)		-	-	-	
Total of Normal & N-1	Nil	70	200	968	1,500

 Highest Voltage Under Normal Condition

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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							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	588	534	410	777	700	240	60	238	60	246	60	241	60	243	60	180	60	196	60	207	60	205	60	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Sibbi - Quetta Ckt II	588	534	410	777	700	240	60	238	60	246	60	241	60	243	60	180	60	196	60	207	60	205	60	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Sibbi - Uch Ckt I	182	289	943	1554	1160	240	60	240	60	246	60	250	60	245	60	200	60	200	120	-	-	207	60	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Sibbi - Uch Ckt II	182	289	943	1554	1160	240	60	240	60	246	60	250	60	245	60	200	60	200	120	-	-	207	60	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Sibbi - Guddu DC Ckt	228	258	931	1514	1160	240	60	240	60	246	60	250	60	245	60	200	60	200	60	-	-	207	60	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Sibbi - Uch DC Ckt	*	258	971	1505	1160	*		240	60	246	60	250	60	245	60	*		200	120	-	-	206	60	-	-
N-1		-	-	-	-	-			-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-
	220 kV Sibbi - D. M Jamali Ckt	*	77	902	1505	1160	*		240	60	246	60	250	60	245	60	*		-	-	-	-	207	60	-	-
N-1		-	-	-	-	-			-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-

* Energized on 05-05-2018

Total No. of Variations (Normal)	1,768	2,239	4,579	9,186	7,200
Total No. of Variations (N-1)	-	-	-	-	-
Total of Normal & N-1	1,768	2,239	4,579	9,186	7,200

 Highest Voltage Under Normal Condition

 Lowest Voltage Under Normal Condition

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)										Highest Voltage Recorded (kV) / Time (Min)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV	122	287	671	1284	456	244	60	242	60	247	60	243	60	245	60	-	-	-	-	-	-	-	-	-	-
N-1	T.M.Khan - Jamshoro I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV	122	287	671	1284	456	244	60	242	60	247	60	243	60	245	60	-	-	-	-	-	-	-	-	-	-
N-1	T.M.Khan - Jamshoro II	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV	Energized Aug 2017	240	738	1320	456	Energized Aug 2017	242	60	247	60	243	60	245	60	Energized Aug 2017	-	-	-	-	-	-	-	-	-	-
N-1	T.M.Khan - Jhampir I		-	-	-	-		-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-
Normal	220 kV	Energized Aug 2017	240	738	1320	456	Energized Aug 2017	242	60	247	60	243	60	245	60	Energized Aug 2017	-	-	-	-	-	-	-	-	-	-
N-1	T.M.Khan - Jhampir II		-	-	-	-		-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-

Total No. of Variations (Normal)	244	1,054	2,818	5,208	1,824
Total No. of Variations (N-1)	-	-	-	-	-
Total of Normal & N-1	244	1,054	2,818	5,208	1,824

 Highest Voltage Under Normal Condition

NTDC Hyderabad Region

14. 220kV Grid Station JHIMPIR

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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV	Energized in Aug 2017	174	444	415	101	Energized in Aug 2017		245	60	247	60	245	120	249	60	Energized in Aug 2017		-	-	190	60	-	-	-	-
N-1	Jhimpir - T.M.Khan I		-	-	-	-			-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-
Normal	220 kV	Energized in Aug 2017	174	444	415	101	Energized in Aug 2017		245	60	247	60	245	120	249	60	Energized in Aug 2017		-	-	190	60	-	-	-	-
N-1	Jhimpir - T.M.Khan II		-	-	-	-			-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-

Total No. of Variations (Normal)	Energized in Aug 2017	348	888	830	202
Total No. of Variations (N-1)		-	-	-	-
Total of Normal & N-1		348	888	830	202

 Highest Voltage Under Normal Condition

NTDC Hyderabad Region

15. 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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							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	Added in 2018-19		1119	2205	NP	Added in 2018-19				241	60	241	120	NP		Added in 2018-19				-	-	-	-	NP	
N-1				-	-						-	-	-	-							-	-	-	-		
Normal	220 kV D. M. Jamali - Sibbi	Added in 2018-19		*	2625	NP	Added in 2018-19				241	60	241	120	NP		Added in 2018-19				-	-	-	-	NP	
N-1				-	-						-	-	-	-							-	-	-	-		

* Only comparison reported

Total No. of Variations (Normal)	Added in 2018-19	1,119	4,830	NP
Total No. of Variations (N-1)		-	-	
Total of Normal & N-1		1,119	4,830	



APPENDIX 5

Voltage violations data – KE's detailed circuit wise analysis

K-Electric System

Circuit Wise Number of Voltage Variations Violating Criteria

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)									
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21	
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	132 kV	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N-1	Surjani - Maymar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	132 kV	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N-1	Surjani - Valika	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	132 kV	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N-1	KDA - Federal B	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	117.4	147	-	-	118.6	33	-	-	-	-
Normal	132 kV	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N-1	Qayyumabad - K. East	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	117.1	280	114	48	117.3	47	118.3	54	-	-
Normal	132 kV	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N-1	KDA - Johar	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	117.4	147	-	-	118.6	33	118.6	33	-	-
Normal	132 kV	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N-1	KDA - Gulshan	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	117.4	147	-	-	118.6	33	-	-	-	-
Normal	132 kV	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N-1	KDA - Maymar	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	117.4	147	-	-	118.6	33	-	-	-	-
Normal	132 kV	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N-1	Mauripur - Haroonabad	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	117.4	331	116.8	56	116.8	34	118.2	250	-	-
Normal	132 kV	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N-1	Korangi West - Defence	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	117.1	280	114	48	117.3	47	118.2	250	-	-

K-Electric System**Circuit Wise Number of Voltage Variations Violating Criteria**

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)										
		2016-17	2017-18	2018-19	2019-20	2020-21	2016-17		2017-18		2018-19		2019-20		2020-21		2016-17		2017-18		2018-19		2019-20		2020-21		
							Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage
Normal	132 kV Queen's Road - Clifton	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	118.68	36	-	-	
N-1		1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	114	48	117.3	47	118.3	54	-	-	-	-	
Normal	132 kV Queen's Road - Gizri	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	118.68	36	-	-	
N-1		1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	114	48	117.3	47	118.3	54	-	-	-	-	
Normal	132 kV Queen's Road - Elander Road	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	118.68	36	-	-	
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Normal	132 kV Queen's Road - Old Town	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	118.68	36	-	-	
N-1		1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	114	48	117.3	47	118.3	54	-	-	-	-	
Normal	132 kV KDA / Memon Goth /Malir	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
N-1		-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	118.6	33	-	-	-	-	-	-	
Normal	132 kV Korangi West / Baloch / Gizri	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
N-1		-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	117.3	47	118.3	54	-	-	-	-	
Normal	132 kV Mauripur - Old Golimar	-			-	1	-	-					-	-	-	-	-	-				-	-	124.74	32	-	-
N-1					1	-	-						-	-	-	-	118.2					250	-	-	-	-	
Normal	132 kV Mauripur - Lyari	-			-	1	-	-					-	-	-	-	-	-				-	-	124.74	32	-	-
N-1					1	-	-						-	-	-	-	118.2					250	-	-	-	-	
Normal	132 kV Mauripur - Labour Square	-			1	-	-					-	-	-	-	-	-				1247.7	32	-	-			
N-1					-	-						-	-	-	-	-					-	-					

NP: Not Provided

Total No. of Variations (Normal)	Nil	Nil	Nil	9	-
Total No. of Variations (N-1)	7	12	9	Nil	-
Total of Normal & N-1	7	12	9	9	-



APPENDIX 6

System Frequency - Historical Data as Reported by the Licensees

1.	NTDC	A6-1
2.	K-Electric	A6-3

Month	Highest System Frequency Recorded Violating the Prescribed Upper Limit ¹ (Hz)				
	2016-17	2017-18	2018-19	2019-20	2020-21
July	NIL	50.5	50.66	50.62	50.72
Aug	50.72	50.56	50.54	50.55	NIL
Sep	50.6	50.56	50.6	NIL	50.54
Oct	NIL	NIL	50.58	50.59	NIL
Nov	NIL	NIL	NIL	NIL	NIL
Dec	50.63	NIL	50.64	NIL	NIL
Jan	50.68	50.64	50.67	50.58	NIL
Feb	50.65	NIL	NIL	NIL	NIL
Mar	50.61	50.54	50.59	NIL	NIL
Apr	50.63	50.56	50.68	NIL	NIL
May	50.65	50.62	NIL	50.6	NIL
June	50.64	50.6	50.79	50.54	NIL

Month	Lowest System Frequency Recorded Violating the prescribed Lower Limit ² (Hz)				
	2016-17	2017-18	2018-19	2019-20	2020-21
July	NIL	50.51	50.51	NIL	NIL
Aug	49.36	50.51	50.51	NIL	NIL
Sep	50.51	50.51	50.51	NIL	NIL
Oct	NIL	NIL	50.51	NIL	NIL
Nov	NIL	NIL	NIL	NIL	NIL
Dec	49.44	NIL	50.51	NIL	NIL
Jan	49.37	NIL	49.44	NIL	NIL
Feb	50.53*	NIL	NIL	NIL	NIL
Mar	50.51*	NIL	50.51	NIL	NIL
Apr	49.32	NIL	50.52	NIL	NIL
May	50.52*	NIL	NIL	NIL	NIL
June	50.51*	NIL	50.51	NIL	NIL

* Cannot be validated

¹ Upper Limit: 50.50 Hz, Rule 8(1) of PSTR 2005

² Lower Limit: 49.50 Hz, Rule 8(1) of PSTR 2005

K-Electric

Month	Highest System Frequency Recorded Violating the Prescribed Upper Limit ³ (Hz)				
	2016-17	2017-18	2018-19	2019-20	2020-21
July	Nil	NA	–	Nil	Nil
Aug	Nil	NA	–	Nil	Nil
Sep	Nil	NA	51.5	Nil	Nil
Oct	Nil	NA	–	Nil	Nil
Nov	Nil	NA	–	Nil	Nil
Dec	Nil	NA	–	Nil	Nil
Jan	50.6	50.9	50.8	Nil	Nil
Feb	Nil	NA	–	Nil	Nil
Mar	Nil	NA	–	Nil	Nil
Apr	Nil	50.6	–	Nil	Nil
May	50.6	50.6	–	Nil	Nil
June	Nil	NA	–	Nil	Nil

Month	Lowest System Frequency Recorded Violating the prescribed Lower Limit ⁴ (Hz)				
	2016-17	2017-18	2018-19	2019-20	2020-21
July	Nil	NA	–	–	–
Aug	Nil	NA	–	–	–
Sep	Nil	NA	–	–	–
Oct	Nil	NA	–	–	–
Nov	Nil	NA	–	–	–
Dec	Nil	NA	–	–	–
Jan	Nil	NA	–	–	–
Feb	Nil	NA	–	–	–
Mar	Nil	NA	–	–	–
Apr	49.3	NA	–	–	–
May	Nil	NA	–	–	–
June	Nil	NA	–	–	–

³ Upper Limit: 50.50 Hz, Rule 8(1) of PSTR 2005

⁴ Lower Limit: 49.50 Hz, Rule 8(1) of PSTR 2005



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