



NATIONAL ELECTRIC POWER
REGULATORY AUTHORITY



2017-18

**Performance
Evaluation Report**

NTDC & K-Electric

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EXECUTIVE SUMMARY

0 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.

In order to encourage safe, efficient and reliable transmission service, NEPRA has framed the Performance Standards (Transmission) Rules 2005 (PSTR)¹. Under PSTR, each transmission licensee is required to submit to NEPRA an Annual Performance Report (APR) in a manner as prescribed in PSTR. These performance reports are analyzed by NEPRA in light of the performance parameters such as System Duration of Interruption, System Frequency of Interruption, Energy Not Served (ENS), Loss of Supply Incidents and its financial impact, System Collapses (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 rid stations under Normal system conditions.

The APRs for the year 2017-18, submitted by NTDC and K-Electric were reviewed on the basis of these parameters. Highlights of the analysis/findings are given below:-

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 0.6 hours (36 minutes) on average that indicates a decrease of 44.4% as compared to preceding year's average of 1.08 hours (1 hour & 5 minutes).

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 2017-18 the average number of outages per circuit for NTDC turn out to be 0.29, showing a decrease of 17% over the previous year i.e. 0.35.

Energy Not Served (ENS): In order to gauge system security, the estimates of total ENS during the year as reported by the licensee has been analyzed. The total ENS as reported by NTDC in 2017-18 is **469 million kWh** that is 525.5% higher over the previous year i.e. 74.981 million kWh. Based on the average energy sale rate of DISCOs², the financial impact amounts to around **Rs. 2,486 million**.

Loss of Supply Incidents: NTDC reported 142 loss of supply incidents during the year 2017-18 which translates into total duration of 293 hours. The average ENS per incident along with duration and subsequent financial impact has been assessed. The detail is given below:-

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.

² Monthly adjustment in DISCOs approved tariff on account of variation in fuel charges 2017-18:- Average energy sale rate = Rs. 5.3/kWh.

| ▼ Description / Unit / Year ► | Unit | 2014-15 | 2015-16 | 2016-17 | 2017-18 |
|--------------------------------------|---------------|----------------|----------------|----------------|----------------|
| Loss of Supply Incidents | Nos. | 125 | 87 | 165 | 142 |
| Average ENS per Incident | Million kWh | 4.264 | 1.644 | 0.454 | 3.3 |
| Average Duration per Incident | Hrs : Min | 01 : 12 | 02 : 24 | 03 : 07 | 02 : 06 |
| Financial Impact per Incident | Rs. (Million) | 42.6 | 8.322 | 2.5 | 17.5 |

System Collapses/Major Disturbances:- As reported by NTDC, these outages also include a partial system collapse and other major disturbances in the year 2017-18. The details are summarized below:-

| S. No. | Date | Loading at Interruption time | Duration of Interruption | Remarks |
|---------------|--------------|-------------------------------------|---------------------------------|---|
| 1 | 26-July-2017 | 515 MW | 2 Hrs & 53 min | 220 kV Sibbi & 220 kV Quetta Industrial grid stations affected. |
| 2 | 03-Aug-2017 | 2108 MW | 42 min | 220 kV Sibbi & 220 kV Quetta Industrial grid stations affected. |
| 3 | 11-Aug-2017 | 2000 MW | 1 Hr & 1 min | 220 kV Sarfaraznagar grid station affected. |
| 4 | 22-Aug-2017 | 1320 MW | 3 Hrs & 5 min | 220 kV ISPR grid station affected. |
| 5 | 27-Sep-2017 | 1030 MW | 10 min | 220 kV Gakkhar grid station affected. |
| 6 | 29-Sep-2017 | 1020 MW | 22 min | 220 kV Gakkhar grid station affected. |
| 7 | 06-Oct-2017 | 1200 MW | 1 Hr & 3 min | Complete Chashnupp Complex Outage |
| 8 | 03-Nov-2017 | 1495 MW | 7 Hrs & 1 min | 500 kV Lahore & 500 kV Multan grid stations affected |
| 9 | 06-Nov-2017 | 876 MW | 16 Hrs & 23 min | 220 kV Dharki, 220 kV Bahawalpur, Guddu 747 & 220 kV NGPS Multan affected |
| 10 | 25-Jan-2018 | 753 MW | 4 Hrs & 13 min | 220 kV Dharki, 220 kV Bahawalpur, Guddu 747 & 220 kV NGPS Multan affected |
| 11 | 26-Jan-2018 | 875 MW | 3 Hrs & 37 min | Outage at UCH-I, UCH-II, Guddu 747, Sapphire, Halmore, Saba, and HUBCO. |
| 12 | 27-Jan-2018 | 1196 MW | 4 Hrs & 5 min | Outage at UCH-I, UCH-II, Foundation, Guddu 747, Guddu, and HUBCO. |
| 13 | 09-Mar-2018 | 1200 MW | 1 Hr & 12 min | Complete Chashnupp Complex Outage |
| 14 | 01-May-2018 | 1240 MW | 2 Hrs & 19 min | Complete Chashnupp Complex Outage |
| 15 | 03-May-2018 | 1240 MW | 17 Hrs & 38 min | Complete Port Qasim Outage 500kV Circuits affected; Port Qasim – NKI, Port Qasim – Jamshoro, HUBCO – Jamshoro. 220kV Circuits affected; Jhimpir – T. M. Khan circuit # 1, Jhimpir – T. M. Khan circuit # 2, Jamshoro – T. M. Khan circuit # 2, Jamshoro – KDA circuit # 1, Jamshoro – KDA circuit # 2. |
| 16 | 16-May-2018 | 12840 MW | 5 Hrs & 22 min | Partial System Collapse The region from Guddu to Sheikh Muhammadi Peshawar went under dark. |
| 17 | 21-May-2019 | 1854 MW | 9 Hrs & 55 min | Outages at Allai Khwar, Khan Khwar, Dubair Khwar, Mangla, HUBCO, Attock Gen Ltd, and Chashnupp (C1). |
| 18 | 27-June-2018 | 1240 MW | 8 Hrs & 53 min | Complete Port Qasim Outage 500kV Circuits affected; Port Qasim – NKI, Port Qasim – Jamshoro. |

Voltage Variations Violating Prescribed Limits: NEPRA has prescribed limits for voltage variations in the Rules. During year 2017-18, number of voltage violations for NTDC remained 149,754 that indicate 42.7% increase as compared to 104,924 violations in preceding year.

Highest and Lowest Voltage Recorded Under Normal System Condition: The highest voltage recorded due to voltage variations at 500 kV voltage class was 575 kV for time duration of 60 minutes, recorded at D. G. Khan. The voltage of 575 kV shows approximately 9.5% variation with respect to allowed limit ($\pm 5\% = 525/475 \text{ kV}$). Detail is given in section 3.3.1 (figure 3.16).

Similarly, at 220 kV level, highest voltage was 254 kV recorded at Loralai for time duration of 300 minutes. Voltage of 254 kV indicates approximately 10% variation with respect to allowed limit ($\pm 5\% = 231/209 \text{ kV}$). Detail of highest voltage incidents is given in section 3.3.1 (figure 3.17). Some of the 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 Loralai | 254 | 300 | 10% |
| 2 | 220 kV Khuzdar | 248 | 30 | 7.4% |
| 3 | 220 kV Jaranwala | 246 | 38 | 6.5% |
| 4 | 220 kV Jhimpir | 245 | 60 | 6.1% |
| 5 | 220 kV Kassowal | 243 | 120 | 5.2% |
| 6 | 220 kV T. M. Khan Road | 242 | 60 | 4.8% |
| 7 | 220 kV Daudkhel | 241 | 180 | 4.3% |
| 8 | 220 kV Sibbi | 240 | 60 | 3.9% |

On the lower side, the voltage remained as low as 174 kV which is quite alarming. Some of the 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 Bannu | 174 | 60 | 16.7% |
| 2 | 220 kV WAPDA Town | 175 | 90 | 16.3% |
| 3 | 220 kV Ghazi Road | 178 | 60 | 14.8% |
| 4 | 220 kV Bund Road | 180 | 240 | 13.9% |
| 5 | 220 kV Nishatabad | 183 | 30 | 12.4% |
| 6 | 220 kV Kala Shah Kaku | 184 | 120 | 12.0% |
| 7 | 220 kV Sarfaraznagar | 185 | 90 | 11.5% |
| 8 | 220 kV Ravi | 187 | 60 | 10.5% |
| 9 | 220 kV Gakkhar | 189 | 60 | 9.6% |
| 10 | 220 kV Khuzdar | 190 | 35 | 9.1% |
| 11 | 220 kV Daudkhel | 193 | 90 | 7.7% |
| 12 | 220 kV Vehari | 194 | 30 | 7.2% |
| 13 | 220 kV ISPR (Sangjani) | 195 | 195 | 6.7% |
| 14 | 220 kV Sibbi | 196 | 60 | 6.2% |
| 15 | 220 kV Bahawalpur | 197 | 30 | 5.7% |
| 16 | 220 kV Ludewala | 198 | 60 | 5.3% |
| 17 | 220 kV Chishtian | 199 | 120 | 4.8% |
| 18 | 220 kV Samundri Road | 200 | 330 | 4.3% |

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

Frequency Variations Violating Prescribed Limits: NEPRA has prescribed limits for frequency variations under the Rules. During the reported period, NTDC system frequency varied from 50.51 Hertz to 50.62 Hertz and has violated the prescribed limits 25 times, however, it has shown improvement in comparison to the preceding year. Detail is given below:-

| ▼ Description / Unit / Year ► | Unit | 2014-15 | 2015-16 | 2016-17 | 2017-18 |
|--|---------------|---------|---------|---------|---------|
| Number of times Frequency remained outside the Limits in a Year | In a year | 1264 | 248 | 35 | 25 |
| | Average/month | 105 | 21 | 2.9 | 2.1 |
| | Average/day | 3.5 | 0.7 | 0.096 | 0.068 |
| Time duration the Frequency remained outside the Limits in a Year | Days | 10.43 | 1.6 | 0.18 | 0.17 |
| | Hours | 250.33 | 37.9 | 4.2 | 4.1 |
| | %age of year | 2.86 | 0.43 | 0.048 | 0.047 |
| Maximum Continuous period of Deviation | Hours | 2.48 | 1.5 | 0.25 | 0.18 |
| | Minutes | 149 | 89 | 15 | 11 |

Loading Position of Power Transformers: Out of 189, a total of 103 power transformers remained loaded more than the prescribed limit of 80% in the month of June, 2018. These include nineteen (19) 500/220 kV transformers and eighty four (84) 220/132 kV transformers. The detail is given in section 4.

PERFORMANCE OF K-ELECTRIC

System Duration of Interruption: System duration of interruption was witnessed on average around 0.48 Hours (29 minutes) which shows a decrease of 52.5% as compared to preceding year's average of 1.01 Hours.

System Frequency of Interruption: Regarding system frequency of interruption it was observed that average number of outages per circuit for KE remained 0.24, showing a decrease of 20% over the previous year i.e. 0.30.

Energy Not Served (ENS): In order to gauge system security, the estimates of total ENS during the year as reported by the licensee has been analyzed. The total ENS as reported by KE is **2.585 million kWh** that is 9.3% lower than the previous year i.e. 2.850 million kWh. Based on the average energy sale rate³ of KE, the financial impact amounts to around **Rs. 33.1 million**.

Loss of Supply Incidents: KE has reported 8 incidents of loss of supply during the year 2017-18 which translates into total duration of 3.37 hours. The average ENS per incident along with duration and subsequent financial impact has been assessed. The detail is given below:-

| ► Description / Unit / Year ► | Unit | 2014-15 | 2015-16 | 2016-17 | 2017-18 |
|-------------------------------|---------------|---------|---------|---------|---------|
| Loss of Supply Incidents | Nos. | 10 | 10 | 10 | 8 |
| Average ENS per Incident | Million kWh | 0.546 | 0.481 | 0.285 | 0.323 |
| Average Duration per Incident | Hrs : Min | 01 : 06 | 01 : 24 | 00 : 43 | 00 : 25 |
| Financial Impact per Incident | Rs. (Million) | 8.2 | 6.24 | 3.65 | 4.1 |

³ KE's Average energy sale rate = Rs. 12.8172/kWh, subject to adjustment & indexation by NEPRA.

INTRODUCTION

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 2017-18.

The document, moreover, takes account of system reliability, security of supply and quality of supply of the transmission network of the licensees during the reported period. 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

In pursuance of Rule 6 of PSTR 2005, the quality of supply shall be measured with reference to system voltage and system frequency.

1.2.1 Rule 7 of PSTR 2005 (System Voltage)

- 1) *Under normal conditions the voltage variations of plus or minus ±5% of the nominal voltage for voltages of 132kV (where applicable) and above shall be permitted.*
- 2) *Under (N-1) contingency conditions voltage variations of plus or minus ±10% of the nominal voltage for voltages of 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.*

1.2.2 Rule 8 of PSTR 2005 (System Frequency)

- 1) *The frequency variations of plus or minus ±1% of the nominal frequency of 50 Hertz shall be permitted, i.e. frequency to remain within the frequency limits of 49.50 to 50.50 Hertz at all times.*
- 2) *The criteria for reporting frequency variations outside the limits specified in sub-rule (1) only apply when the duration of the variation exceeds a continuous period of five (5) minutes.*

⁴ In exercise of the powers conferred by section 46 of the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997 (XL of 1997), read with clause (c) of sub section (2) of section 7 and section 34 thereof, the National Electric Power Regulatory Authority, with the approval of Federal Government, has made the Performance Standards (Transmission) Rules (PSTR) notified vide S.R.O. 1138(I)/2005 dated 15th November, 2005.

The logo consists of a white rectangular box containing the letters "NTDC" in a bold, black, serif font. This white box is positioned on the tip of a large, solid dark green wedge that tapers to a point at the bottom left.

NTDC

2 Brief about NTDC

National Transmission & Despatch Company (NTDC) Limited 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 500 kV and 220 kV 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.

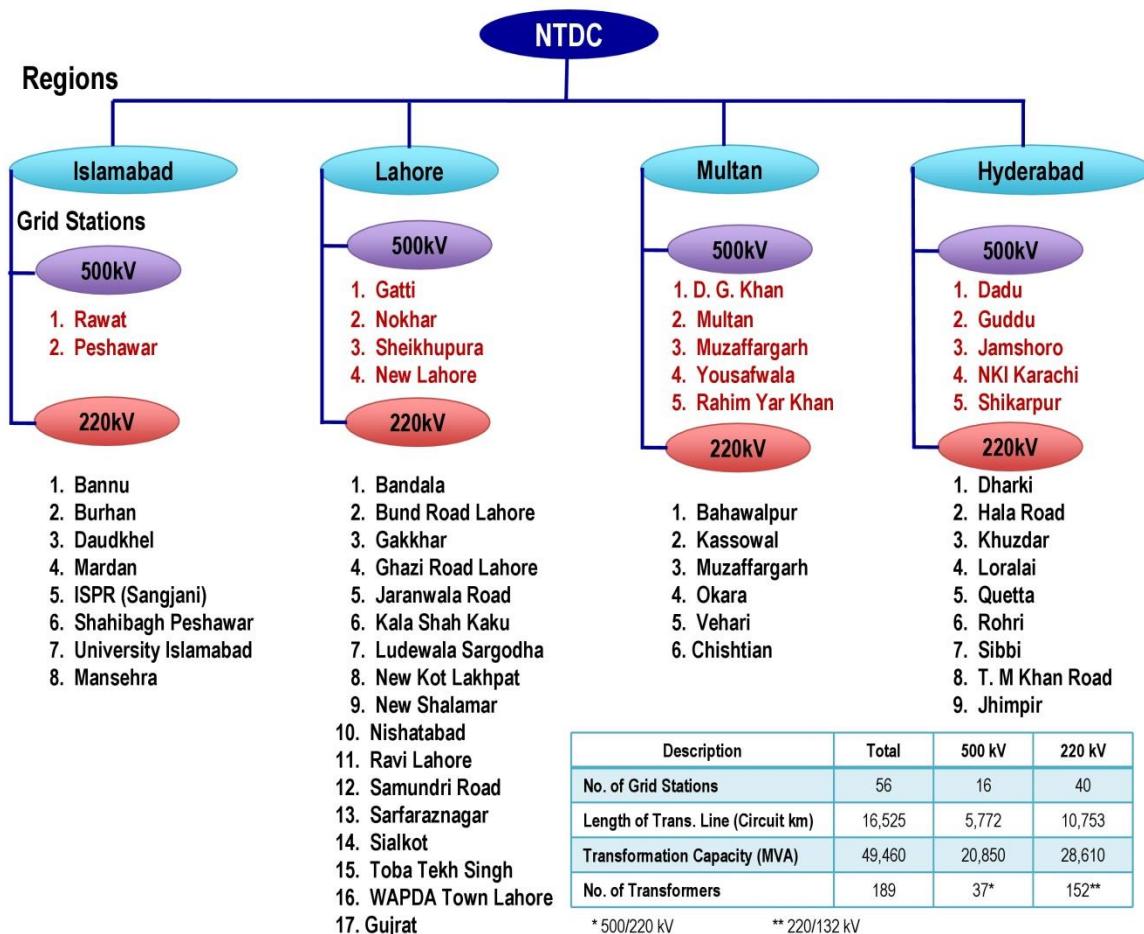
2.1 Licence

NTDC was granted Transmission Licence No. TL/01/2002 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 (40) 220 kV Grid Stations with 5,772 km of 500 kV and 10,753 km of 220 kV transmission lines as of June, 2018. Figure 2.1 shows detail of NTDC transmission system.

Figure 2.1: NTDC transmission system



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) = **293 Hrs**
2. Total number of interconnection points = **490**
3. System duration of interruption = $293 \div 490 = 0.6 \text{ Hrs}/\text{point}$ i.e. **36 min.**

*Indicates a 44.4% decrease over the previous year i.e. **1.08 Hrs/point (1 Hour & 5 min)***

Average Frequency of Interruption

1. Total number of outages recorded at all 132 kV outgoing circuits (excluding 132 kV line tripping) = **142**
2. Total number of 132 kV circuits = **490**
3. System frequency of interruption = $142 \div 490 = 0.29 \text{ Nos./circuit}$.

*Indicates a 17% decrease over the previous year i.e. **0.35 Nos./circuit***

System Security

Energy Not Served (ENS)

1. Total ENS = **469 million kWh**
2. Number of incidents, where there has been a loss of supply = **142**
3. Average ENS per incident = **3.3 million kWh**
4. Average duration per incident = $293 \div 142 = 2.1 \text{ Hrs (2 Hr & 6 min)}$
5. Financial impact of ENS = **Rs. 2,486 Million**
6. Financial impact per incident = $2486 \div 142 = \text{Rs. 17.5 Million.}$

Rs. 2486 Million indicates 498.8% increase than the previous year's impact of Rs. 415.2 Million.

Quality of Supply

Voltage

1. Total number of violations under normal conditions = **140,322**
2. Total number of violations under N-1 conditions = **9,432**
3. Total number of violations under Normal & N-1 conditions = **149,754.**
4. Highest voltage recorded under normal conditions; @550 kV level: **575 kV** for 60 min. at D.G Khan; @220kV level: **254 kV** for 300 min. at Loralai.
5. Lowest voltage recorded under normal conditions; @500kv level: **450 kV** for 90 min. at Nokhar; @220kV level: **174 kV** for 30 min. at Bannu.

Violations of 149,754, indicates 42.7% increase over the previous year's 104,924.

Frequency

1. Number of times frequency remained outside the limits in a year = **25**
2. Time duration the frequency remained outside the limits in a year = **4 Hrs & 6 min.**
3. %age time of the year the frequency remained outside the limits = **0.047% time of the year.**

4. Maximum continuous period of deviation = **11 min**
5. Highest frequency recorded = **50.64 Hz**
6. Lowest frequency recorded = **50.51* Hz.**

Allowable limits: 49.5 Hz – 50.5 Hz

* cannot be validated.

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

The Annual Performance Report submitted by NTDC has been evaluated 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 293 during the reported period, indicating a 43% decrease in comparison to the preceding year's 515 hours. Similarly, 14 number of interconnection points have been added to the system resulting into 490 in total. The same has been shown in figure 3.1.

The average duration of interruption per interconnection point during the reported period remained 0.6 hours (36 minutes). This indicates a 44.4% decrease over the previous year's 1.08 hours (1 hour & 5 minutes).

NTDC has shown improvement with respect to preceding year that has been shown in figure 3.2

3.1.2 System Frequency of Interruption

A total of 142 number of outages have been recorded during the year 2017-18 that indicates 14% decrease over the previous year i.e. 165, as shown in figure 3.3.

The average number of interruptions per circuit during the reported period remained 0.29 indicating 17% improvement in comparison to the preceding year's 0.35 as shown in figure 3.4.

Figure 3.1: Outages hours & No. of interconnection points

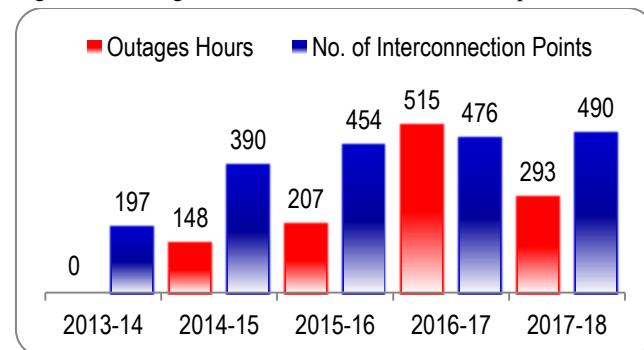


Figure 3.2: System duration of interruption (Hours/Point)

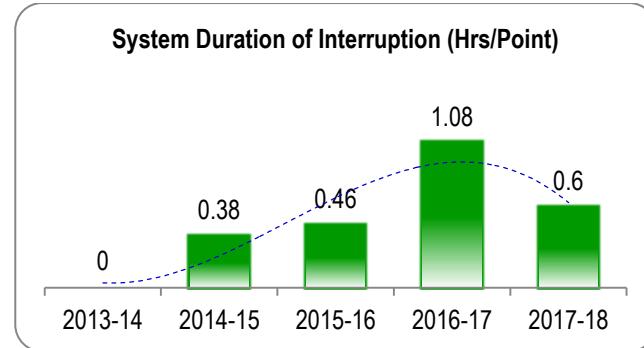


Figure 3.3: No. of outages & No. of 132kV outgoing circuits

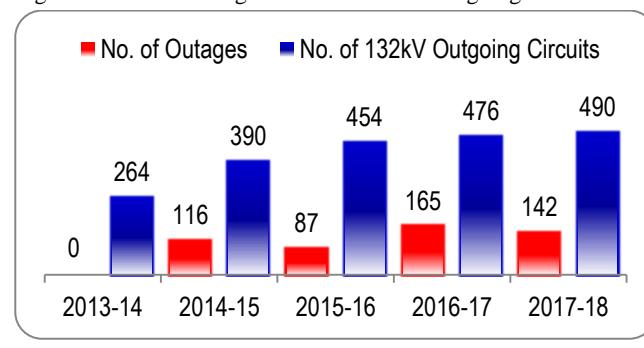
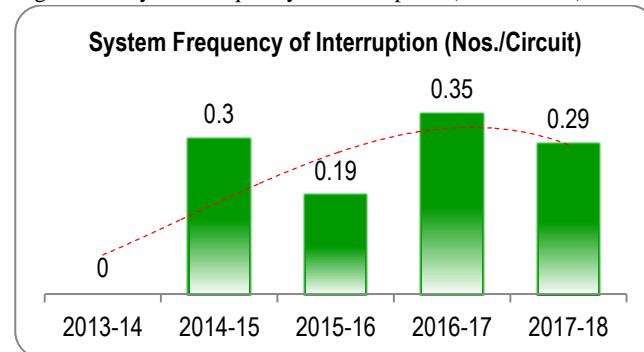


Figure 3.4: System frequency of interruption (Nos./Circuit)



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 469 million kWh. Based on the average energy sale rate of DISCOs⁵, the financial impact of 469 million kWh, amounts to approximately Rs. 2486 million. The details are given below;

Figure 3.5: Reported ENS

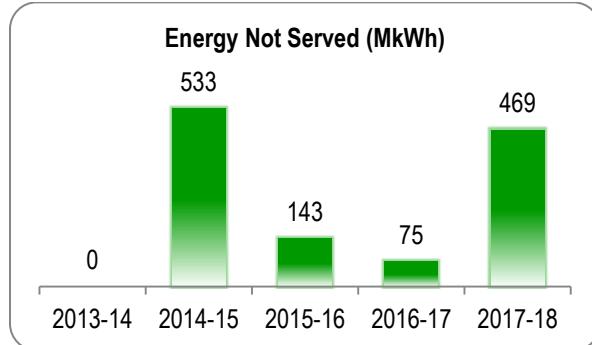


Figure 3.6: Loss of supply incidents & duration per incident

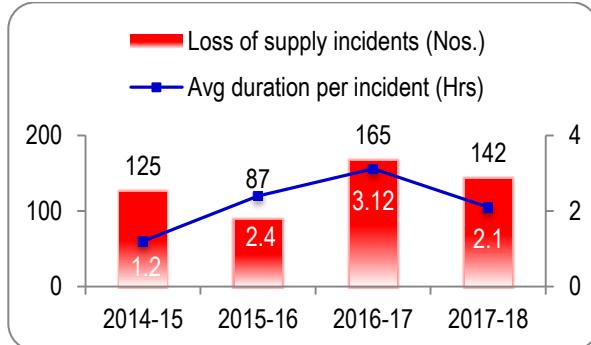


Table 3.1: Loss of supply incidents, average ENS, duration & financial impact per incident

| ▼ Description / Unit / Year ► | Unit | 2014-15 | 2015-16 | 2016-17 | 2017-18 |
|-------------------------------|---------------|---------|---------|---------|---------|
| Loss of Supply Incidents | Nos. | 125 | 87 | 165 | 142 |
| Average ENS per Incident | Million kWh | 4.264 | 1.644 | 0.454 | 3.3 |
| Average Duration per Incident | Hrs : Min | 01 : 12 | 02 : 24 | 03 : 07 | 02 : 06 |
| Financial Impact per Incident | Rs. (Million) | 42.6 | 8.322 | 2.5 | 17.5 |

Figure 3.7: Total number of loss of supply incidents with average

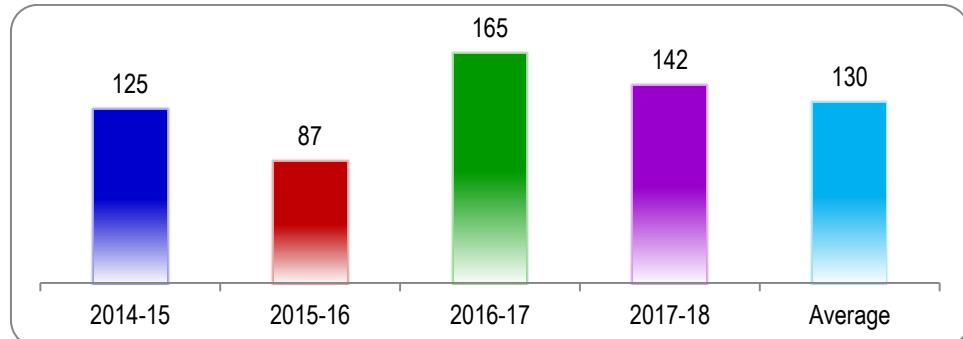
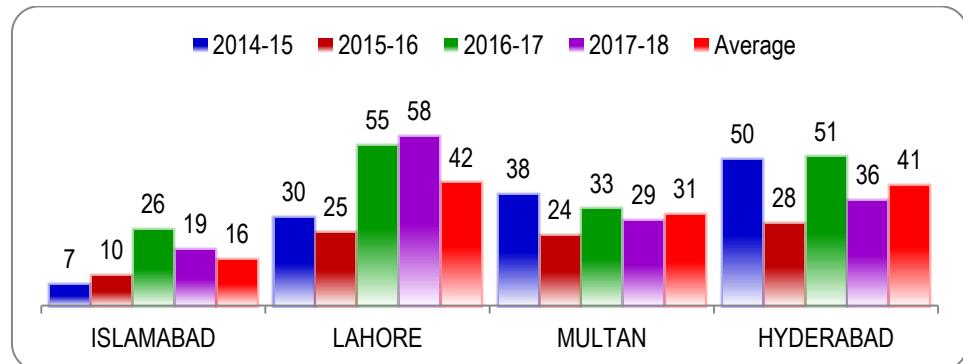
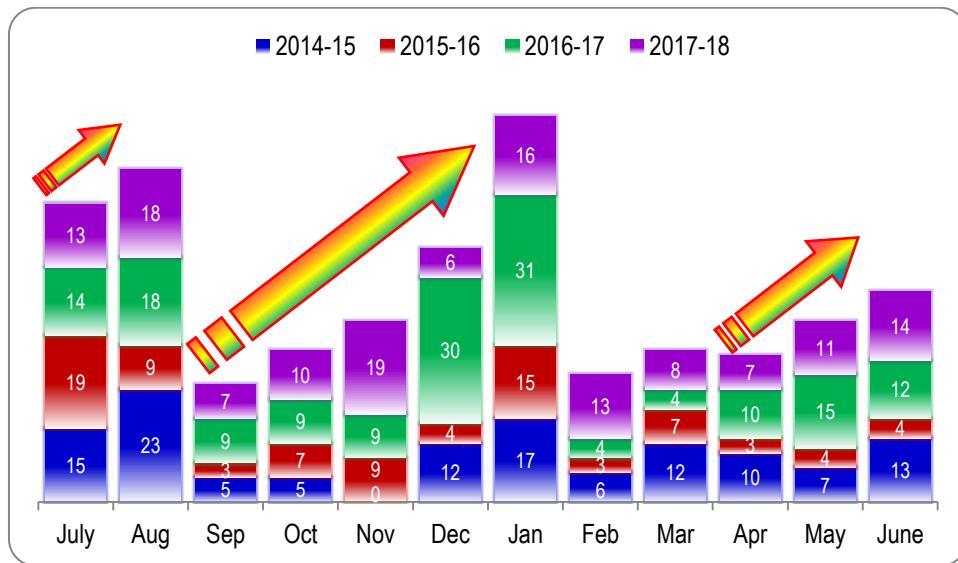


Figure 3.8: Region wise loss of supply incidents



⁵ Monthly adjustment in DISCOs approved tariff on account of variation in fuel charges 2017-18:- Average energy sale rate = Rs. 5.3/kWh

Figure 3.9: Seasonal trend of loss of supply incidents



3.2.1 System Collapses/Major Disturbances

As reported, these outages also include a partial system collapse and other major disturbances in the year 2017-18. The detail is given hereunder;

Table 3.2: System collapses/major disturbances

| S. No. | Date | Loading at Interruption time | Duration of Interruption | Remarks |
|--------|--------------|------------------------------|--------------------------|---|
| 1 | 26-July-2017 | 515 MW | 2 Hrs & 53 min | 220 kV Sibbi & 220 kV Quetta Industrial grid stations affected. |
| 2 | 03-Aug-2017 | 2108 MW | 42 min | 220 kV Sibbi & 220 kV Quetta Industrial grid stations affected. |
| 3 | 11-Aug-2017 | 2000 MW | 1 Hr & 1 min | 220 kV Sarfaraznagar grid station affected. |
| 4 | 22-Aug-2017 | 1320 MW | 3 Hrs & 5 min | 220 kV ISPR grid station affected. |
| 5 | 27-Sep-2017 | 1030 MW | 10 min | 220 kV Gakkhar grid station affected. |
| 6 | 29-Sep-2017 | 1020 MW | 22 min | 220 kV Gakkhar grid station affected. |
| 7 | 06-Oct-2017 | 1200 MW | 1 Hr & 3 min | Complete Chashnapp Complex Outage |
| 8 | 03-Nov-2017 | 1495 MW | 7 Hrs & 1 min | 500 kV Lahore & 500 kV Multan grid stations affected |
| 9 | 06-Nov-2017 | 876 MW | 16 Hrs & 23 min | 220 kV Dharki, 220 kV Bahawalpur, Guddu 747 & 220 kV NGPS Multan affected |
| 10 | 25-Jan-2018 | 753 MW | 4 Hrs & 13 min | 220 kV Dharki, 220 kV Bahawalpur, Guddu 747 & 220 kV NGPS Multan affected |
| 11 | 26-Jan-2018 | 875 MW | 3 Hrs & 37 min | Outage at UCH-I, UCH-II, Guddu 747, Sapphire, Halmore, Saba, and HUBCO. |
| 12 | 27-Jan-2018 | 1196 MW | 4 Hrs & 5 min | Outage at UCH-I, UCH-II, Foundation, Guddu 747, Guddu, and HUBCO. |
| 13 | 09-Mar-2018 | 1200 MW | 1 Hr & 12 min | Complete Chashnapp Complex Outage |
| 14 | 01-May-2018 | 1240 MW | 2 Hrs & 19 min | Complete Chashnapp Complex Outage |

| S. No. | Date | Loading at Interruption time | Duration of Interruption | Remarks |
|--------|--------------|------------------------------|--------------------------|--|
| 15 | 03-May-2018 | 1240 MW | 17 Hrs & 38 min | Complete Port Qasim Outage 500kV Circuits affected; Port Qasim – NKI, Port Qasim – Jamshoro, HUBCO – Jamshoro. 220kV Circuits affected; Jhimpur – T. M. Khan circuit # 1, Jhimpur – T. M. Khan circuit # 2, Jamshoro – T. M. Khan circuit # 2, Jamshoro – KDA circuit # 1, Jamshoro – KDA circuit # 2. |
| 16 | 16-May-2018 | 12840 MW | 5 Hrs & 22 min | Partial System Collapse The region from Guddu to Sheikh Muhammadi Peshawar went under dark. |
| 17 | 21-May-2019 | 1854 MW | 9 Hrs & 55 min | Outages at Allai Khwar, Khan Khwar, Dubair Khwar, Mangla, HUBCO, Attock Gen Ltd, and Chashnupp (C1). |
| 18 | 27-June-2018 | 1240 MW | 8 Hrs & 53 min | Complete Port Qasim Outage 500kV Circuits affected; Port Qasim – NKI, Port Qasim – Jamshoro. |

It has been observed that system disturbances have occurred 9 times including a partial system collapse in the year 2017-18 that indicates an alarming situation. NTDC shall follow the day-to-day and long term principles, standards, procedures and guidelines for Planning, Operation, Dispatch and Connection purposes for normal and abnormal transmission system conditions to avoid loss of supply to the consumers and hence financial loss to the national exchequer.

3.3 Quality of Supply

Quality of supply (QoS) is measured with reference to system voltage and system frequency (see section 1.2.1). The analysis of QoS data as reported by the licensee is given hereunder:

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 declined by 42.7% in the year 2017-18 as compared to preceding year as shown in figure 3.10. Region wise detail of voltage violations is as under;

Figure 3.10: Number of voltage violations (NTDC)

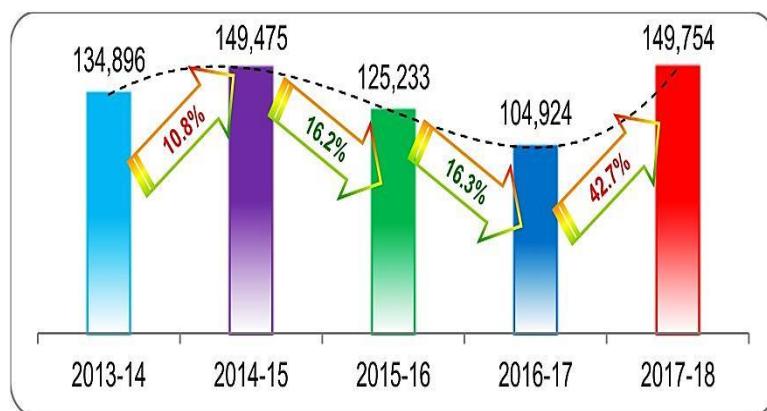
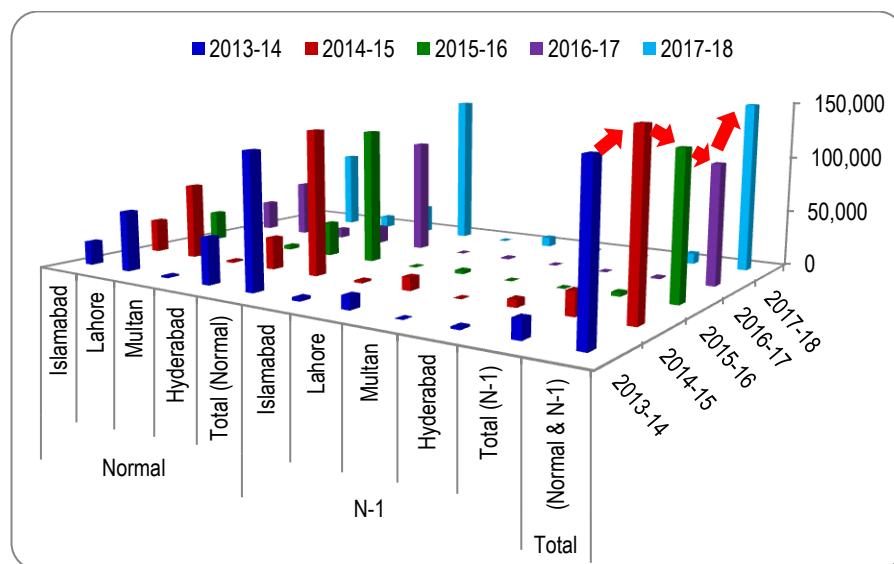


Table 3.3: Number of voltage violations (NTDC Region wise)

| System Condition | NTDC Region | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 |
|---------------------------------|-------------|----------------|----------------|----------------|----------------|----------------|
| Normal | Islamabad | 21,386 | 30,165 | 27,192 | 27,776 | 28,978 |
| | Lahore | 54,262 | 68,552 | 60,285 | 52,005 | 74,718 |
| | Multan | 1,557 | 1,533 | 3,453 | 8,455 | 10,800 |
| | Hyderabad | 41,585 | 28,958 | 31,072 | 15,582 | 25,826 |
| Total (Normal) | | 118,790 | 129,208 | 122,002 | 103,818 | 140,322 |
| N-1 | Islamabad | 2,793 | 1,914 | 277 | — | — |
| | Lahore | 11,565 | 11,684 | 2,951 | 1,029 | 8,506 |
| | Multan | 12 | — | — | 75 | 926 |
| | Hyderabad | 1,736 | 6,669 | 3 | 2 | — |
| Total (N-1) | | 16,106 | 20,267 | 3,231 | 1,106 | 9,432 |
| Total (Normal & N-1) | | 134,896 | 149,475 | 125,233 | 104,924 | 149,754 |

Figure 3.11: Number of voltage violations (NTDC Region wise)



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

Table 3.4: Number of voltage violations | NTDC Islamabad Region

| S. No. | Grid Station | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 |
|-----------|-------------------|---------------|---------------|---------------|---------------|---------------|
| 1 | 500 kV Rawat | 7,242 | 9,376 | 5,190 | 6,611 | 6,202 |
| 2 | 500 kV Peshawar | 335 | 2,538 | 3,613 | 4,239 | 2,212 |
| 3 | 220 kV Bannu | 3,381 | 3,413 | 2,733 | 3,394 | 1,256 |
| 4 | 220 kV Burhan | 73 | 422 | 1,754 | 1,184 | 219 |
| 5 | 220 kV Daudkhel | 4,968 | 8,714 | 9,456 | 5,631 | 1,421 |
| 6 | 220 kV ISPR | 19 | 9 | 36 | 269 | 773 |
| 7 | 220 kV Mardan | 5,328 | 4,653 | 2,220 | 4,008 | 11,359 |
| 8 | 220 kV Shahibagh | 2,469 | 1,991 | 943 | 806 | 2,703 |
| 9 | 220 kV University | 364 | 963 | 1,210 | 1,634 | 2,832 |
| 10 | 220 kV Mansehra | 04-Apr-2018* | | | | 1 |
| 11 | Total | 24,179 | 32,079 | 27,155 | 27,776 | 28,978 |

* Date commissioned/energized

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

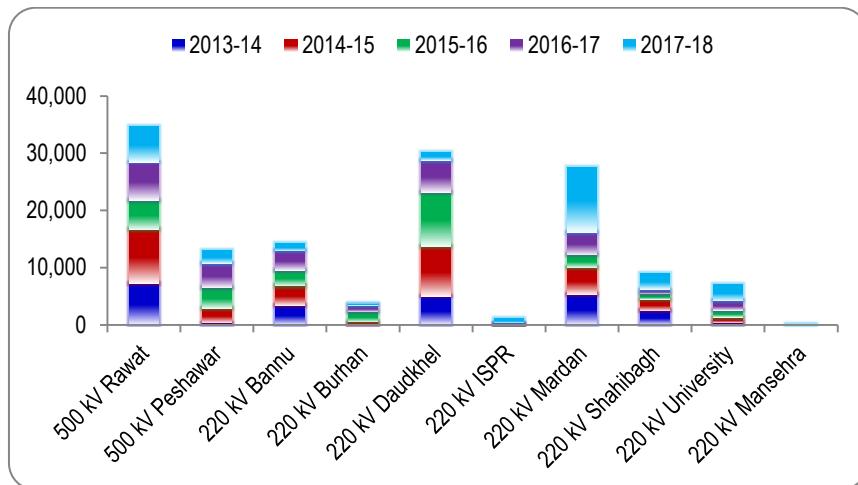


Table 3.5: Number of voltage violations

NTDC Lahore Region

| S. No. | Grid Station | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 |
|--------|------------------------|---------------|---------------|---------------|---------------|---------------|
| 1 | 500 kV Gatti | 335 | 1,189 | 1,285 | 3,223 | 3,155 |
| 2 | 500 kV Nokhar | — | — | — | 318 | 710 |
| 3 | 500 kV Sheikhupura | 120 | 4,837 | 4,137 | 15,365 | 33,604 |
| 4 | 220 kV Bund Road | 4,592 | 4,031 | 3,607 | 2,045 | 5,502 |
| 5 | 220 kV Gakkhar | 902 | 997 | 1,582 | 6,569 | 6,544 |
| 6 | 220 kV Jaranwala | 303 | 278 | 208 | 372 | 836 |
| 7 | 220 kV Kala Shah Kaku | 9,120 | 10,410 | 20,704 | 4,690 | 4,629 |
| 8 | 220 kV Ludewala | 491 | 442 | 303 | 486 | 590 |
| 9 | 220 kV New Kot Lakhpat | 24,575 | 22,707 | 5,327 | 3,140 | 4,285 |
| 10 | 220 kV New Shalamar | 1,321 | 5,165 | 6,309 | 1,236 | 1,777 |
| 11 | 220 kV Nishatabad | 0 | 20 | 96 | NA | 128 |
| 12 | 220 kV Ravi | 14,693 | 19,209 | 7,604 | 6,857 | 3,693 |
| 13 | 220 kV Samundri Road | 556 | 1,160 | 2,536 | 324 | 156 |
| 14 | 220 kV Sarfaraznagar | 4,572 | 3,531 | 5,898 | 3,548 | 2,968 |
| 15 | 220 kV Sialkot | 1,031 | 982 | 1,363 | 2,252 | 2,352 |
| 16 | 220 kV WAPDA Town | 3,216 | 4,976 | 1,381 | 1,267 | 2,039 |
| 17 | 500 kV New Lahore | 01-Nov-2017* | | | | 1,474 |
| 18 | 220 kV Ghazi Road | 05-Mar-2014* | 61 | — | — | 2,578 |
| 19 | 220 kV Bandala | 26-June-2014* | NA | — | 441 | 1,683 |
| 20 | 220 kV Toba Tekh Singh | 28-June-2015* | 241 | 896 | 850 | 910 |
| 21 | 220 kV Gujrat | Apr, 2017* | | | 51 | 3,611 |
| 22 | Total | 65,827 | 80,236 | 63,236 | 53,034 | 83,224 |

* Date commissioned/energized NA: Not applicable

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

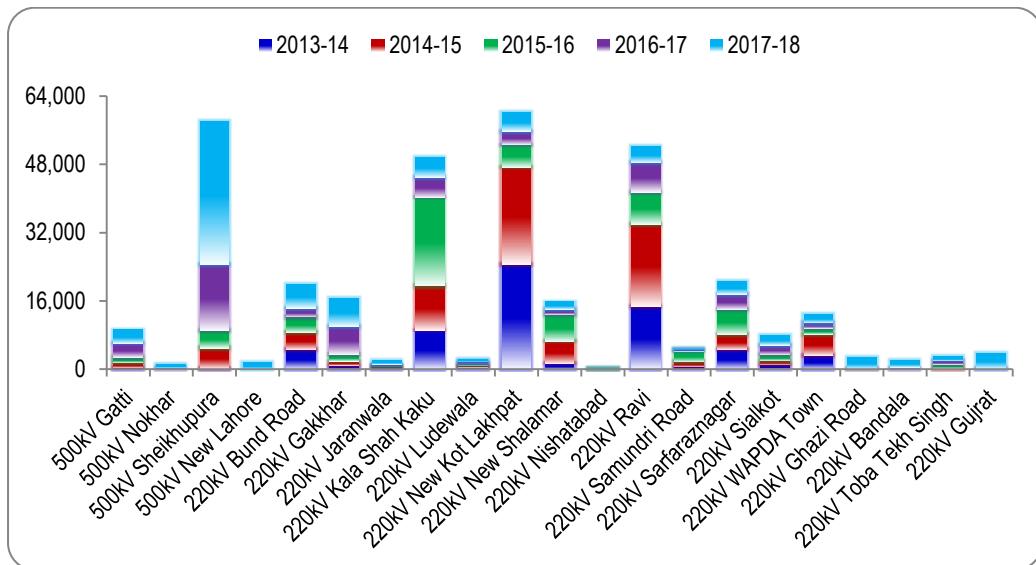


Table 3.6: Number of voltage violations

NTDC Multan Region

| S. No. | Grid Station | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 |
|-----------|-----------------------|---------------|--------------|--------------|--------------|---------------|
| 1 | 500kV Multan | 10 | 20 | 8 | 3 | - |
| 2 | 500kV Muzaffargarh | - | - | - | - | - |
| 3 | 500kV Yousafwala | 6 | 351 | - | 126 | 543 |
| 4 | 220kV Bahawalpur | 421 | 305 | 506 | 20 | 21 |
| 5 | 220kV Muzaffargarh | - | 4 | - | - | 650 |
| 6 | 220kV Vehari | 1,132 | 764 | 593 | 2,519 | 5,335 |
| 7 | 500kV D.G. Khan | *05-Oct-2014 | 14 | - | 722 | 27 |
| 8 | 550 kV Rahim Yar Khan | Feb, 2018* | | | | NIL |
| 9 | 220kV Okara | 30-June-2014* | 75 | 338 | 526 | 365 |
| 10 | 220kV Kassowal | 15-July-2015* | | 2,008 | 3,822 | 998 |
| 11 | 220 kV Chishtian | 24-Oct-2016* | | | 792 | 3,787 |
| 12 | Total | 1,569 | 1,458 | 3,453 | 8,530 | 11,726 |

* Date commissioned/energized

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

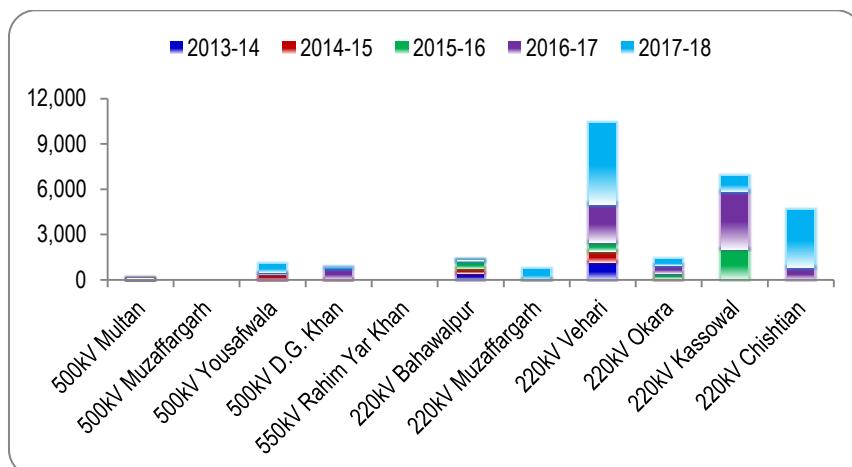


Table 3.7: Number of voltage violations

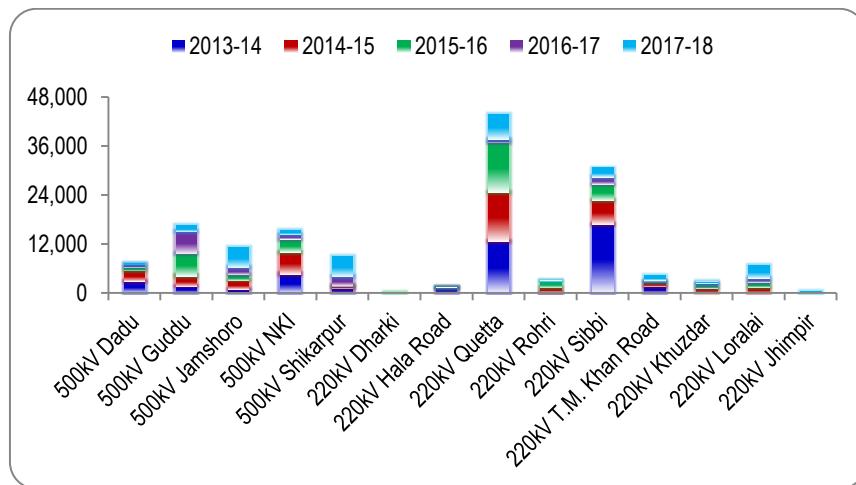
| NTDC Hyderabad Region

| S. No. | Grid Station | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 |
|--------|------------------------|---------------|---------------|---------------|---------------|---------------|
| 1 | 500kV Dadu | 2,864 | 2,525 | 835 | 733 | 265 |
| 2 | 500 kV Guddu | 1,584 | 2,538 | 5,433 | 5,433 | 1,494 |
| 3 | 500 kV Jamshoro | 890 | 2,112 | 1,456 | 1,688 | 4,874 |
| 4 | 500 kV NKI | 4,596 | 5,389 | 3,188 | 1,106 | 1,118 |
| 5 | 500 kV Shikarpur | 1,108 | 572 | 45 | 2,242 | 4,842 |
| 6 | 220kV Dharki | - | - | 24 | 2 | NA |
| 7 | 220kV Hala Road | 1,086 | 162 | 6 | 10 | 56 |
| 8 | 220kV Quetta | 12,636 | 12,020 | 12,106 | 890 | 6,044 |
| 9 | 220kV Rohri | 182 | 1,060 | 1,642 | - | 70 |
| 10 | 220kV Sibbi | 16,841 | 5,841 | 3,924 | 1,768 | 2,239 |
| 11 | 220 kV T. M. Khan Road | 1,534 | 946 | 374 | 244 | 1,054 |
| 12 | 220kV Khuzdar | June, 2014* | 1,140 | 796 | 458 | 282 |
| 13 | 220kV Loralai | Aug, 2014* | 1,322 | 1,246 | 1,010 | 3140 |
| 14 | 220 kV Jhimpir | Aug, 2017* | | | | 348 |
| 15 | Total | 43,321 | 35,627 | 31,075 | 15,584 | 25,826 |

* 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 recorded at 500 kV grid stations under Normal condition

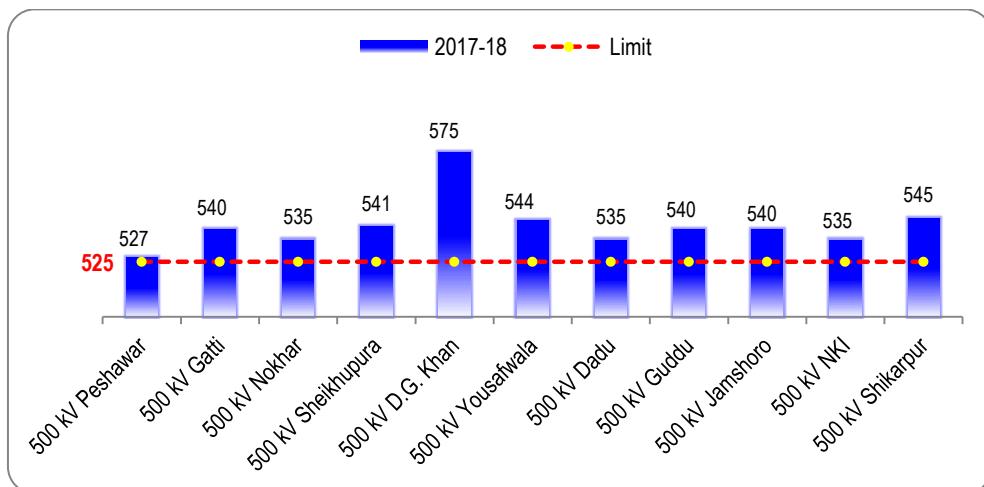


Figure 3.17: Highest voltage recorded at 220 kV grid stations under Normal condition

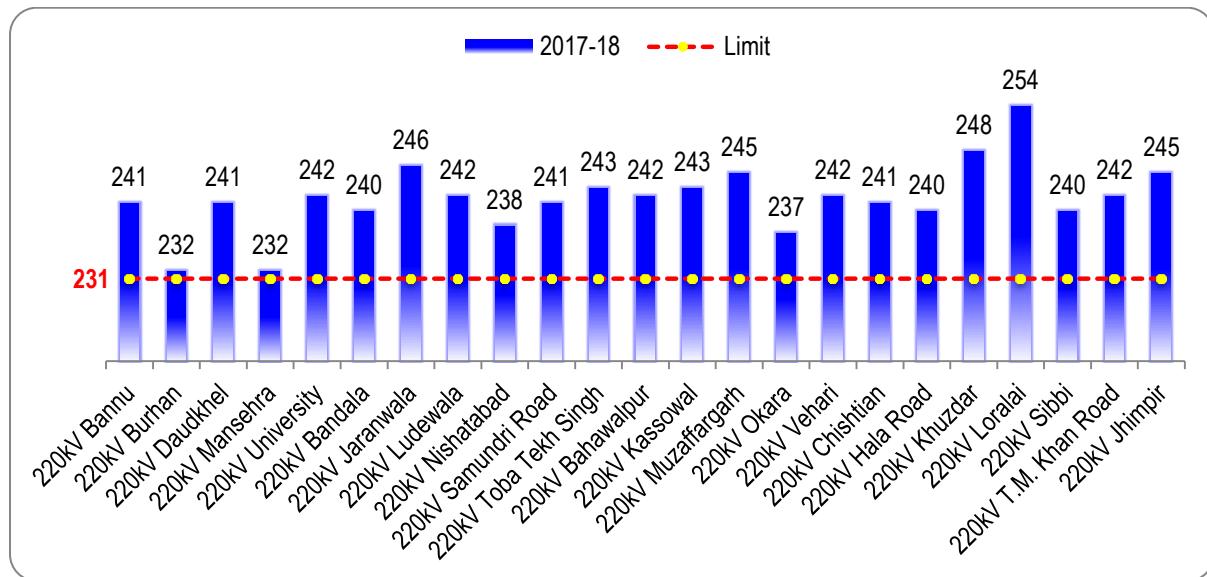
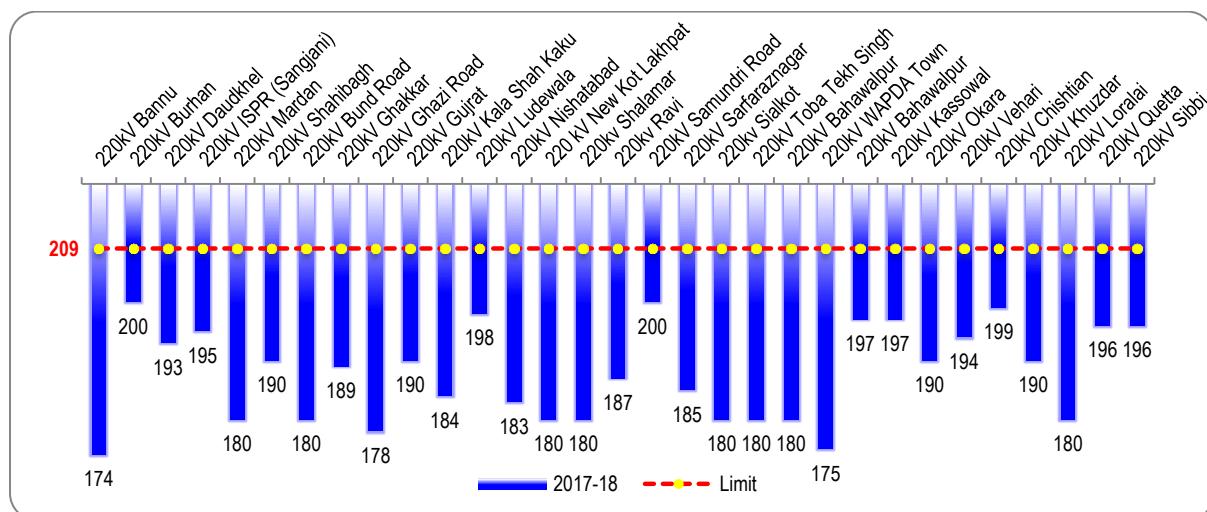


Figure 3.18: Lowest voltage recorded at 220 kV grid stations under Normal condition



3.3.2 System Frequency

The data submitted by NTDC was analyzed and it revealed that a total of 25 times frequency remained outside the prescribed limits and that comes out to be approximately 0.047% of the reported period. NTDC has shown improvement as compared to preceding year. The following table shows statistics of system frequency over the reported period.

Table 3.8: System frequency stats (2017-18)

| 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 | Minutes | Hours | Highest | Lowest | Period | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8=(4-50)/50*100 | 9=(5-50)/50*100 | 10=7/3*100 | 11 |
| July | 31 | 744 | 50.55 | 50.51* | Nil | Nil | Nil | Nil | Nil | 1 |
| Aug | 31 | 744 | 50.56 | 50.51* | 40 | 0.67 | 1.44 | -1.28 | 0.090 | 2 |
| Sep | 30 | 720 | 50.56 | 50.51* | 12 | 0.20 | 1.2 | 1.02* | 0.028 | 3 |
| 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 | 42 | 0.70 | 1.26 | -1.12 | 0.094 | Nil |
| Jan | 31 | 744 | 50.64 | Nil | 55 | 0.92 | 1.36 | -1.26 | 0.123 | 9 |
| Feb | 28 | 672 | Nil | Nil | 7 | 0.12 | 1.30 | 1.06* | 0.017 | Nil |
| Mar | 31 | 744 | 50.54 | Nil | 15 | 0.25 | 1.22 | 1.02* | 0.34 | 1 |
| Apr | 30 | 720 | 50.56 | Nil | 31 | 0.52 | 1.26 | -1.36 | 0.072 | 2 |
| May | 31 | 744 | 50.62 | Nil | 7 | 0.12 | 1.30 | 1.04* | 0.016 | 3 |
| June | 30 | 720 | 50.60 | Nil | 43 | 0.72 | 1.28 | 1.02* | 0.100 | 4 |
| Year | 365 | 8760 | 50.64 | 50.51* | 246 | 4.1 | 1.28 | -1.02 | 0.047 | 25 |

* Cannot be validated

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

Table 3.9: System frequency details with comparison

| ▼ Description / Unit / Year ► | Unit | 2014-15 | 2015-16 | 2016-17 | 2017-18 |
|--|---------------|---------|---------|---------|---------|
| Number of times Frequency remained outside the Limits in a Year | In a year | 1264 | 248 | 35 | 25 |
| | Average/month | 105 | 21 | 2.9 | 2.1 |
| | Average/day | 3.5 | 0.7 | 0.096 | 0.068 |
| Time duration the Frequency remained outside the Limits in a Year | Days | 10.43 | 1.6 | 0.18 | 0.17 |
| | Hours | 250.33 | 37.9 | 4.2 | 4.1 |
| | %age of year | 2.86 | 0.43 | 0.048 | 0.047 |
| Maximum Continuous period of Deviation | Hours | 2.48 | 1.5 | 0.25 | 0.18 |
| | Minutes | 149 | 89 | 15 | 11 |

The reasons for the frequency fluctuations as reported by NTDC are loss of load due to tripping event at 220 kV Gakkhar, due to fixation of hydel generation as regulation of sudden load drop in demand could not be achieved through thermal generation, sudden load drop by DISCOs and tripping of network associated with Port Qasim. The following figures show the NTDC's month wise highest & lowest frequency for the year 2017-18. The dotted red line shows the prescribed limits (upper 50.5 Hz & lower 49.5 Hz) as per PSTR 2005. Historical data as reported by NTDC is given at appendix 6.

Figure 3.19: Highest frequency recorded (Hz)

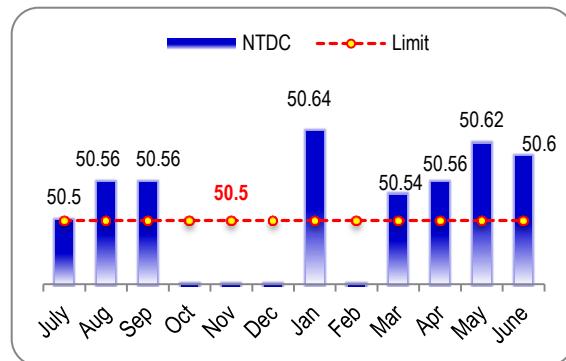
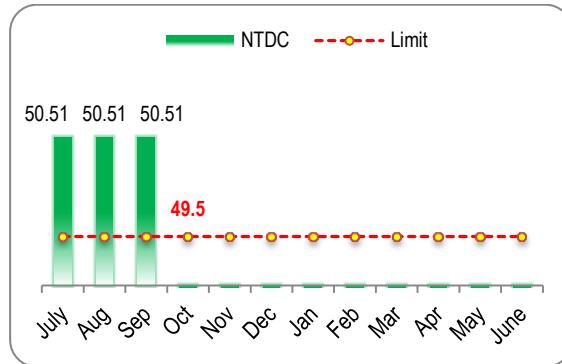


Figure 3.20: Lowest frequency recorded (Hz)



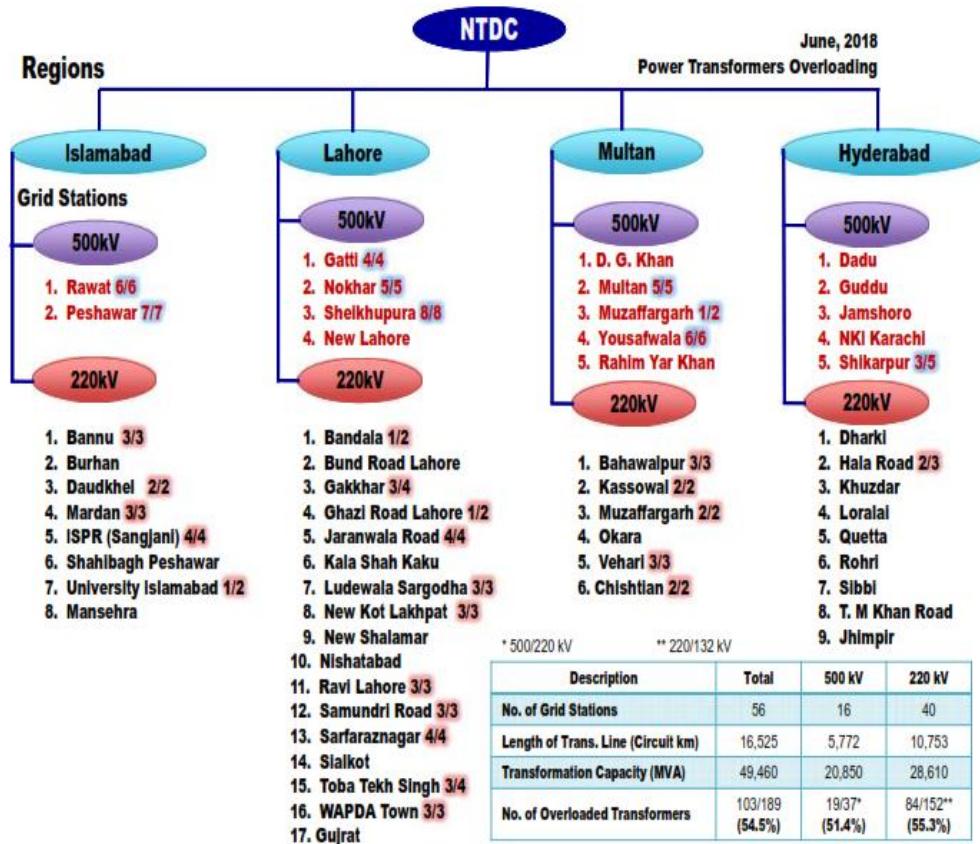
4 Miscellaneous

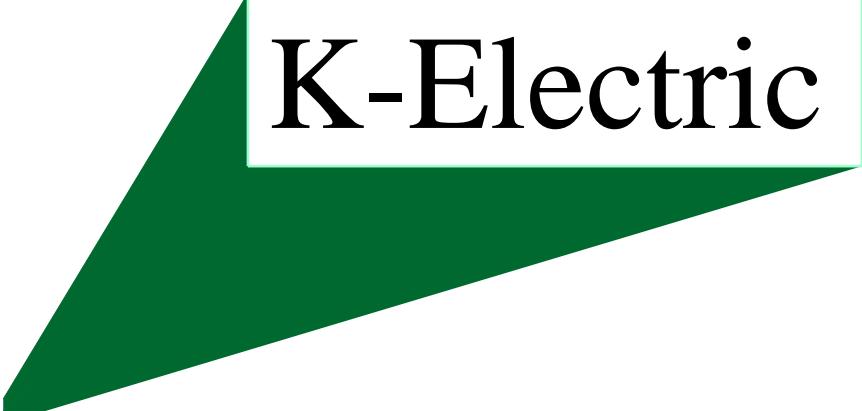
4.1 Loading Position of Power Transformers

A total of 103 power transformers out of 189 remained loaded more than 80% in the month of June, 2018 that comes out to be approximately 54% overloading. These include nineteen (19) 500/220 kV transformers and eighty four (84) 220/132 kV transformers. The following figure shows grid station wise power transformers loading position.

Figure 4.1: Loading position of power transformers (June, 2018)

Hint: Rawat 6/6 means that 500 kV Rawat grid station has 6 overloaded transformers out of 6.





K-Electric

5 Brief about K-Electric

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.

5.1 Licence

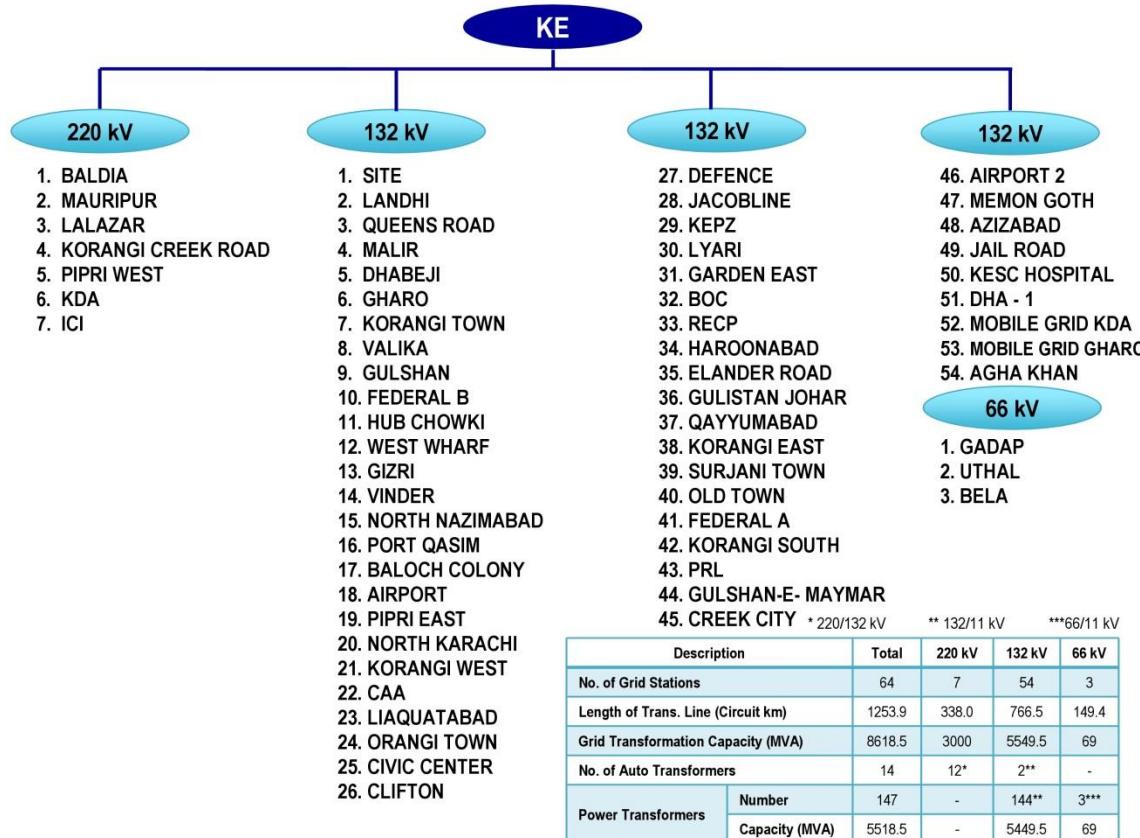
KE was granted Transmission Licence on 10th June 2010 by NEPRA to engage exclusively in the transmission business for a term of thirty (30) years, pursuant to Section 17 of the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997.

5.2 Transmission Network

KE's transmission system comprises a total of 1,254 km of 220 kV, 132 kV and 66 kV transmission lines, 64 grid stations, 14 Auto Transformers and 147 power transformers, as of June 2018. 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 5.1: KE transmission system



5.3 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) = **3.37 Hrs**
2. Total number of interconnection points = **7**
3. System duration of interruption = $3.37 \div 7 = 0.48 \text{ Hrs}/\text{point}$ i.e. **29 min.**

*Indicates a 52.5% decrease over the previous year i.e. **1.01 Hrs/point***

Average Frequency of Interruption

1. Total number of outages recorded at all 132 kV outgoing circuits (excluding 132 kV line tripping) = **8**
2. Total number of 132 kV circuits = **33**
3. System frequency of interruption = $8 \div 33 = 0.24 \text{ Nos./circuit}$

*Indicates a 20% decrease over the previous year i.e. **0.30 Nos./circuit***

System Security

Energy Not Served (ENS)

1. Total ENS = **2.585 million kWh**
2. Number of incidents, where there has been a loss of supply = **8**
3. Average ENS per incident = **0.323 million kWh**
4. Average duration per incident = $3.37 \div 8 = 0.42 \text{ Hrs (25 min)}$
5. Financial impact of ENS = **Rs. 33.1 Million**
6. Financial impact per incident = $33.1 \div 8 = \text{Rs. 4.1 Million.}$

Rs. 33.1 Million indicates 9.3% decrease than the previous year's impact of Rs. 36.5 Million.

Quality of Supply

Voltage

1. Total number of violations under Normal conditions = **Nil**
2. Total number of violations under N-1 conditions = **12**
3. Total number of violations under Normal & N-1 conditions = **12**
4. Lowest voltage recorded under N-1 conditions; @ 132kV level: 116.8 kV for 34 min. at Mauripur-Haroonabad circuit.
5. As reported, no highest voltage violation recorded for 220kV & 132kV.

Voltage violations have increased by 71.4% over the previous year.

Frequency

1. Number of times frequency remained outside the limits in a year = **5**
2. Time duration the frequency remained outside the limits in a year = **41 min**
3. %age time of the year the frequency remained outside the limits = **0.0078% time of the year.**

4. Maximum continuous period of deviation = **12 min**
5. Highest frequency recorded = **50.90 Hz**
6. No violation at lower end.

Allowable limits: 49.5 Hz – 50.5 Hz

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

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

6.1 System Reliability

6.1.1 System Duration of Interruption

The total outages hours recorded at all interconnection points are 3.37 during the reported period, indicating a 52.5% decrease in comparison to the preceding year's 7.10 hours. Number of interconnection points remained the same. The same has been shown in figure 3.1.

The average duration of interruption per interconnection point during the reported period remained 0.48 hours (29 minutes). This indicates a 52.5% decrease over the previous year's 1.01 hours.

KE has shown improvement with respect to preceding year that has been shown in figure 3.2

Figure 6.1: Outages hours & No. of interconnection points

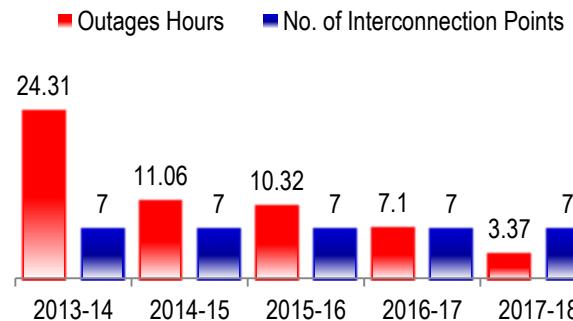
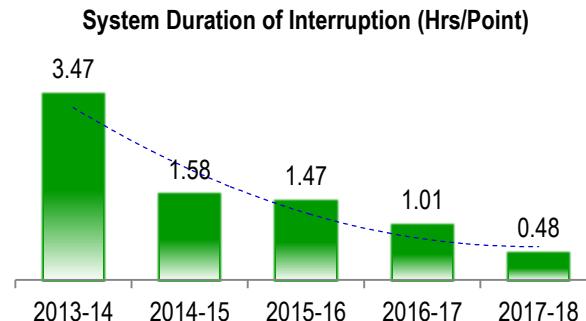


Figure 6.2: System duration of interruption (Hours/Point)



6.1.2 System Frequency of Interruption

A total of 8 number of outages have been recorded during the year 2017-18 that indicates 20% decrease over the previous year i.e. 10, as shown in figure 3.3.

Moreover, the number of 132 kV outgoing circuits remained the same as compared to preceding year.

The average number of interruptions per circuit during the reported period remained 0.24 indicating 20% decrease in comparison to the preceding year's 0.30 as shown in figure 3.4.

Figure 6.3: No. of outages & No. of 132kV outgoing circuits

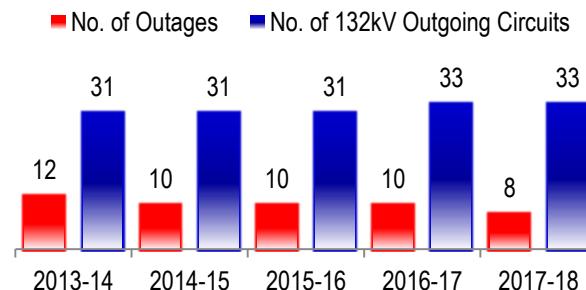
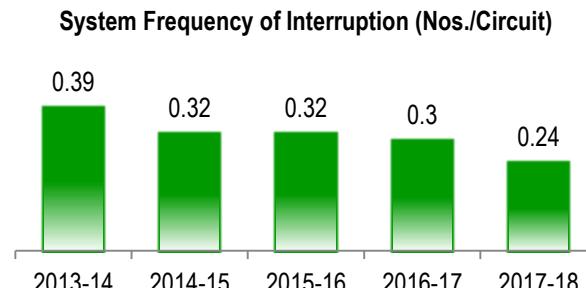


Figure 6.4: System frequency of interruption (Nos./Circuit)



6.2 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 2.585 million kWh. Based on the average energy sale rate of KE⁶, the financial impact of 2.585 million kWh, amounts to approximately Rs. 33.1 million. The detail is given below;

Figure 6.5: Reported ENS

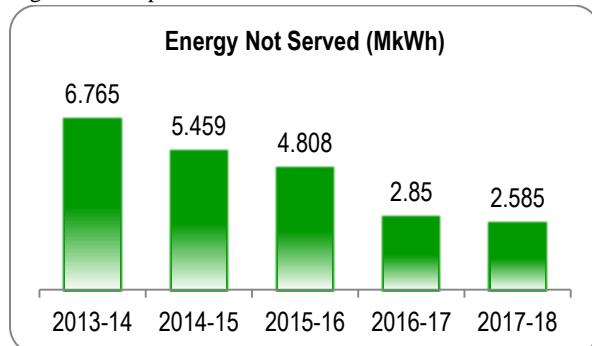


Figure 6.6: Loss of supply incidents & duration per incident

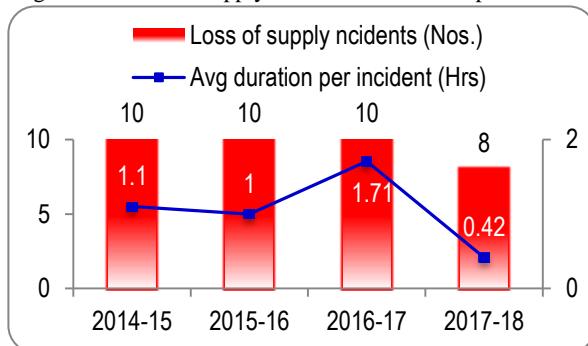
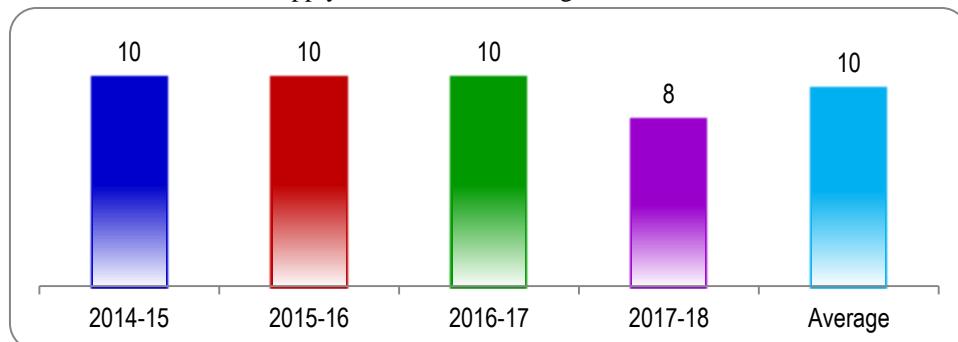


Table 6.1: Loss of supply incidents, average ENS, duration & financial impact per incident

| ▼ Description / Unit / Year ► | Unit | 2014-15 | 2015-16 | 2016-17 | 2017-18 |
|-------------------------------|---------------|---------|---------|---------|---------|
| Loss of Supply Incidents | Nos. | 10 | 10 | 10 | 8 |
| Average ENS per Incident | Million kWh | 0.546 | 0.481 | 0.285 | 0.323 |
| Average Duration per Incident | Hrs : Min | 01 : 06 | 01 : 24 | 00 : 43 | 00 : 25 |
| Financial Impact per Incident | Rs. (Million) | 8.2 | 6.24 | 3.65 | 4.1 |

Figure 6.7: Total number of loss of supply incidents with average



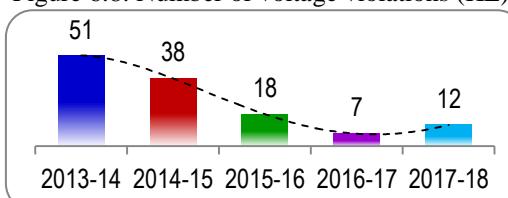
6.3 Quality of Supply

Quality of supply (QoS) is measured with reference to system voltage and system frequency (see section 1.2.1). The analysis of QoS data as reported by KE is given hereunder:

6.3.1 System Voltage

The voltage violations have increased by 71.4% in 2017-18 as compared to preceding year. Further, no violation has occurred at 220 kV level both under normal and N-1 conditions and at 132 kV level, limits were violated under N-1 condition only.

Figure 6.8: Number of voltage violations (KE)



⁶ KE's Average energy sale rate = Rs. 12.8172/kWh, subject to adjustment & indexation by NEPRA.

Figure 6.8 shows historical trend over the five years period. Detailed circuit wise analysis is given at appendix 5.

6.3.2 System Frequency

The data submitted by KE was analyzed and it was revealed that a total of 5 times frequency remained outside the prescribed limits and that comes out to be approximately 0.0078% of the reported period. The number of violations remained the same as that of preceding year. The following table shows statistics of system frequency over the reported period.

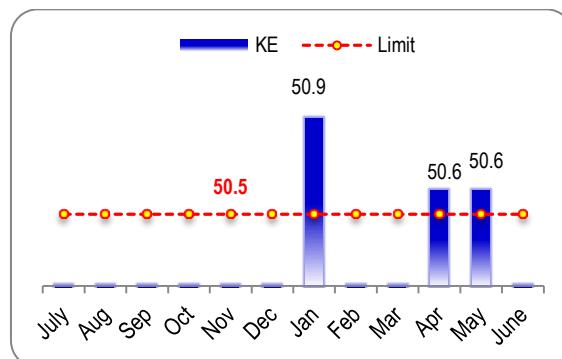
Table 6.2: System frequency stats (2017-18)

| 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 | Minutes | Hours | Highest | Lowest | | |
| 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 | NA | NA | NA | NA | NA | NA | NA | Nil |
| Aug | 31 | 744 | NA | NA | NA | NA | NA | NA | NA | Nil |
| Sep | 30 | 720 | NA | NA | NA | NA | NA | NA | NA | Nil |
| Oct | 31 | 744 | NA | NA | NA | NA | NA | NA | NA | Nil |
| Nov | 30 | 720 | NA | NA | NA | NA | NA | NA | NA | Nil |
| Dec | 31 | 744 | NA | NA | NA | NA | NA | NA | NA | Nil |
| Jan | 31 | 744 | 50.90 | NA | 25 | 0.42 | 1.8% | NA | 0.0565 | 3 |
| Feb | 28 | 672 | NA | NA | NA | NA | NA | NA | NA | Nil |
| Mar | 31 | 744 | NA | NA | NA | NA | NA | NA | NA | Nil |
| Apr | 30 | 720 | 50.60 | NA | 10 | 0.16 | 1.2% | NA | 0.0222 | 1 |
| May | 31 | 744 | 50.60 | NA | 6 | 0.1 | 1.2% | NA | 0.0134 | 1 |
| June | 30 | 720 | NA | NA | NA | NA | NA | NA | NA | Nil |
| Year | 365 | 8760 | 50.90 | NA | 41 | 0.68 | 1.8 | NA | 0.0078 | 5 |

NA: Not applicable

The upper and lower limits as prescribed in PSTR are 50.5 Hz & 49.5 Hz respectively. The figure below shows KE's month wise highest frequency for the year 2017-18. The dotted red line shows the prescribed limit (upper 50.5 Hz). The lower limit has not been violated as reported by KE. Historical data as reported by KE is given at appendix 6.

Figure 6.9: Highest frequency recorded (Hz)



APPENDIX 1

Voltage violations data - detailed circuit wise analysis

NTDC Islamabad Region

| | | |
|-----|------------------------------|----------|
| 1. | 500 kV Rawat | 1 of 10 |
| 2. | 500 kV Peshawar | 2 of 10 |
| 3. | 220 kV Bannu | 3 of 10 |
| 4. | 220 kV Burhan..... | 4 of 10 |
| 5. | 220 kV Daudkhel..... | 5 of 10 |
| 6. | 220 kV ISPR (Sangjani) | 6 of 10 |
| 7. | 220 kV Mardan..... | 7 of 10 |
| 8. | 220 kV Shahibagh..... | 8 of 10 |
| 9. | 220 kV University..... | 9 of 10 |
| 10. | 220 kV Mansehra..... | 10 of 10 |

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) | | | | | | | | | | | | | | |
|-----------|--|--|------|---------|------|---------|--|---------|------|---------|------|---------|------|---------|------|---------|---|---------|-----------------------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | |
| Normal | 500 kV Rawat - Barotha Ckt I & II | 22 | 196 | 83 | 494 | 552 | 530 | 60 | 537 | 30 | 533 | 60 | 540 | 120 | 541 | 60 | - | - | - | - | - | - | - | - | - | - | - | - | - | | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| Normal | 500 kV Rawat - Gakkhar Ckt I & II | 22 | 196 | 83 | 494 | 548 | 530 | 60 | 537 | 30 | 533 | 60 | 540 | 120 | 544 | 180 | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| Normal | 500 kV Rawat - Tarbela | 22 | 148 | 83 | 494 | 276 | 530 | 60 | 537 | 30 | 533 | 60 | 540 | 120 | 541 | 60 | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| Normal | 500 kV Rawat - Neelum Jehlum | Energized in May 2018 | | | | 53 | Energized in May 2018 | | | | | | | | | | 544 | 180 | Energized in May 2018 | | | | | | | | | | | | |
| N-1 | | | | | | - | | | | | | | | | | | - | - | | | | | | | | | | | | | |
| Normal | 220 kV Rawat - ISPR Ckt I & II | 1794 | 2211 | 1245 | 1105 | 798 | 240 | 60 | 241 | 120 | 240 | 60 | 241 | 90 | 241 | 60 | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| Normal | 220 kV Rawat - Mangla Ckt I & II | 1794 | 2206 | 1198 | 1156 | 1604 | 240 | 60 | 241 | 120 | 240 | 60 | 241 | 90 | 243 | 90 | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| Normal | 220 kV Rawat - Bahria Town Ckt I & II | 1794 | 2211 | 1249 | 1171 | 793 | 240 | 60 | 241 | 120 | 240 | 60 | 241 | 90 | 241 | 90 | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| Normal | 220 kV Rawat - University Ckt I & II | 1794 | 2208 | 1249 | 1697 | 1578 | 240 | 60 | 241 | 120 | 240 | 60 | 241 | 150 | 243 | 60 | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | | |

Total No. of Variations (Normal)

7,242 9,376 5,190 6,611 6,202

 Highest Voltage Under Normal Condition @500kV level

Total No. of Variations (N-1)

- - - - -

 Highest Voltage Under Normal Condition @220kV level

Total of Normal & N-1

7,242 9,376 5,190 6,611 6,202

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) | | | | | | | | | | | | | | |
|-----------|--|--|------|---------|------|---------|--|---------|------|---------|------|---------|------|---------|------|---------|---|---------|------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | |
| Normal | 500 kV Tarbela - Peshawar | NP | 1 | 17 | 58 | NP | NP | 526 | 60 | 531 | 60 | 527 | 60 | NP | NP | - | - | 473 | 60 | - | - | - | - | - | - | - | - | - | | | |
| N-1 | | | - | - | - | | | - | - | - | - | - | - | | | - | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| Normal | | | 116 | 818 | 1211 | 1428 | 549 | 235 | 60 | 240 | 60 | 239 | 60 | 242 | 60 | 236 | 60 | 200 | 180 | 200 | 60 | 200 | 60 | - | - | 180 | 60 | | | | |
| N-1 | 220 kV Barotha - Peshawar | 5 | 95 | - | - | - | - | - | - | - | - | - | - | - | - | - | 190 | 60 | 180 | 60 | - | - | - | - | - | - | - | - | | | |
| Normal | | 89 | 711 | 1190 | 1415 | 1062 | 238 | 60 | 241 | 60 | 239 | 60 | 242 | 60 | 236 | 60 | 200 | 60 | - | - | 200 | 60 | - | - | - | - | 180 | 60 | | | |
| N-1 | 220 kV Peshawar - Daudkhel Ckt I & II | 6 | 2 | - | - | - | - | - | - | 243 | 60 | - | - | - | - | - | 190 | 120 | 195 | 60 | - | - | - | - | - | - | - | - | | | |
| Normal | 220 kV Peshawar - Shahibagh | 114 | 817 | 1211 | 1379 | 543 | 235 | 60 | 240 | 60 | 239 | 60 | 242 | 60 | 236 | 60 | 200 | 60 | 200 | 60 | 200 | 60 | - | - | - | - | 175 | 60 | | | |
| N-1 | | 5 | 95 | - | - | - | - | - | - | - | - | - | - | - | - | - | 190 | 60 | 180 | 60 | - | - | - | - | - | - | - | - | | | |

NP: Not Provided

| | | | | | |
|----------------------------------|-----|-------|-------|-------|-------|
| Total No. of Variations (Normal) | 319 | 2,346 | 3,613 | 4,239 | 2,212 |
| Total No. of Variations (N-1) | 16 | 192 | - | - | - |
| Total of Normal & N-1 | 335 | 2,538 | 3,613 | 4,239 | 2,212 |

 Highest Voltage Under Normal Condition @500kV level

 Lowest Voltage Under Normal Condition @220kV level

 Highest 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) | | | | | | | | | |
|----------------------------------|--|--|-------|---------|-------|------------------|---|---------|------|---------|------|---------|------|---------|---|---------|------|---------|--|---------|------|---------|------|-----|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | | | |
| | | 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 Daudkhel - Bannu Ckt I & II | 1755 | 2424 | 2652 | 1859 | 651 | 242 | 60 | 241 | 60 | 241 | 60 | 256 | 60 | 241 | 60 | 195 | 60 | 199 | 60 | 198 | 60 | 178 | 120 |
| N-1 | | 1626 | 989 | 81 | - | - | 248 | 60 | 243 | 60 | - | - | - | - | - | - | 172 | 60 | 170 | 60 | 180 | 60 | - | - |
| Normal | 220 kV Chashma - Bannu Ckt I & II | Added in 2016-17 | | 1535 | 605 | Added in 2016-17 | | | | | 246 | 60 | 241 | 60 | Added in 2016-17 | | | | | 202 | 60 | 180 | 60 | |
| N-1 | | | | - | - | | | | | | - | - | - | - | | | | | | - | - | - | - | |
| Total No. of Variations (Normal) | | 1,755 | 2,424 | 2,652 | 3,394 | 1,256 | Highest Voltage Under Normal Condition | | | | | | | | | | | | Lowest Voltage Under Normal Condition | | | | | |
| Total No. of Variations (N-1) | | 1,626 | 989 | 81 | - | - | | | | | | | | | | | | | | | | | | |
| Total of Normal & N-1 | | 3,381 | 3,413 | 2,733 | 3,394 | 1,256 | | | | | | | | | | | | | | | | | | |

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) | | | | | | | | | |
|-----------|--|--|---------|---------|---------|---------|--|------|---------|------|---------|------|---------|------|---------|------|---|------|---------|------|---------|------|---------|------|---------|-----|
| | | | | | | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2016-17 | |
| | | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | 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 | 38 | 211 | 877 | 590 | 51 | 236 | 60 | 237 | 60 | 238 | 60 | 241 | 240 | - | - | - | - | - | - | - | 203 | 60 | 200 | 120 | |
| | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | |
| Normal | 220 kV Burhan - Tarbela Ckt I, II & III* | 35 | 211 | 877 | 594 | 168 | 236 | 60 | 237 | 60 | 238 | 60 | 241 | 240 | 232 | 60 | - | - | - | - | - | - | 203 | 60 | 200 | 120 |
| | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | |

NP : Not Provided

*Ckt III reported in 2015-16

| | | | | | |
|----------------------------------|----|-----|-------|-------|-----|
| Total No. of Variations (Normal) | 73 | 422 | 1,754 | 1,184 | 219 |
| Total No. of Variations (N-1) | - | - | - | - | - |
| Total of Normal & N-1 | 73 | 422 | 1,754 | 1,184 | 219 |

 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) | | | | | | | | | | | | | | | | | | | | |
|----------------------------------|--|--|-------|---------|-------|---------|--|---------|---------|---------|---------|---------|---------|---------|---------|---------|---|---------|---------|---------|---------|---------|---------|---------|---------|----|--|--|--|--|--|--|--|--|--|--|--|
| | | | | | | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | | | | | | | | | | | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | | | | | | | | | | | |
| Normal | 220 kV Daudkhel - Peshawar Ckt I & II | 1569 | 3445 | 3099 | 1877 | 566 | 241 | 60 | 242 | 60 | 242 | 240 | 246 | 60 | 240 | 90 | 200 | 120 | 198 | 60 | 198 | 60 | 198 | 60 | 194 | 60 | | | | | | | | | | | |
| N-1 | | 87 | 59 | 53 | - | - | 246 | 60 | 248 | 60 | 248 | 60 | - | - | - | - | 184 | 60 | 186 | 60 | 190 | 60 | - | - | - | - | | | | | | | | | | | |
| Normal | 220 kV Daudkhel - Chashma Ckt I & II | 1569 | 1664 | 3099 | 1877 | 276 | 241 | 60 | 242 | 60 | 242 | 240 | 246 | 60 | 241 | 180 | 200 | 120 | 198 | 60 | 198 | 60 | 198 | 60 | 193 | 90 | | | | | | | | | | | |
| N-1 | | 87 | 47 | 53 | - | - | 246 | 60 | 248 | 60 | 248 | 60 | - | - | - | - | 184 | 60 | 186 | 60 | 190 | 60 | - | - | - | - | | | | | | | | | | | |
| Normal | 220 kV Daudkhel - Bannu Ckt I & II | 1569 | 3440 | 3099 | 1877 | 579 | 241 | 60 | 237 | 60 | 242 | 240 | 246 | 60 | 241 | 180 | 200 | 120 | 198 | 60 | 198 | 60 | 198 | 60 | 194 | 60 | | | | | | | | | | | |
| N-1 | | 87 | 59 | 53 | - | - | 246 | 60 | 248 | 60 | 248 | 60 | - | - | - | - | 184 | 60 | 186 | 60 | 190 | 60 | - | - | - | - | | | | | | | | | | | |
| Total No. of Variations (Normal) | | 4,707 | 8,549 | 9,297 | 5,631 | 1,421 | Highest Voltage Under Normal Condition | | | | | | | | | | Lowest Voltage Under Normal Condition | | | | | | | | | | | | | | | | | | | | |
| Total No. of Variations (N-1) | | 261 | 165 | 159 | - | - | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total of Normal & N-1 | | 4,968 | 8,714 | 9,456 | 5,631 | 1,421 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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) | | | | | | | | | | | | | | |
|----------------------------------|--|---|------|---------|------|---------|---|---------|------|---------|------|---------|------|---------|------|---------|---|---------|------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | |
| Normal | 220 kV ISPR - Mansehra Ckt I | 1 | 3 | † | | 232 | 120 | 232 | 120 | † | | - | | - | | - | | - | | - | | - | | - | | - | | | | | |
| N-1 | | - | - | | | - | - | - | - | | | | | | | | | | | | | | | | | | | | | | |
| Normal | 220 kV ISPR - Burhan | 1 | 2 | 13 | 8 | 25 | 232 | 60 | 232 | 150 | 232 | 300 | 232 | 120 | - | - | - | - | - | - | - | - | - | - | 205 | 60 | 200 | 60 | | | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| Normal | 220 kV ISPR - Tarbela | 6 | - | 5 | 169 | 139 | - | - | - | - | - | - | - | - | - | 236 | 180 | - | - | 205 | 60 | 209 | 60 | 204 | 120 | 199 | 60 | 195 | 60 | | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| Normal | 220 kV ISPR - Bahria Town | 6 | 2 | 5 | 30 | 181 | - | - | 232 | 60 | 232 | 360 | - | - | - | - | - | - | 205 | 180 | 205 | 180 | 205 | 120 | 199 | 60 | 195 | 60 | | | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| Normal | 220 kV ISPR - Rawat | 5 | 2 | 5 | 30 | 192 | - | - | 232 | 60 | 232 | 360 | - | - | - | - | - | - | 205 | 180 | 205 | 180 | 205 | 120 | 199 | 60 | 198 | 60 | | | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| Normal | 220 kV ISPR - Allai Khwar Ckt I | † Reported earlier as ISPR - Mansehra Ckt I | | 4 | 16 | 118 | † Reported earlier as ISPR - Mansehra Ckt I | | | | 232 | 240 | 232 | 60 | - | - | † Reported earlier as ISPR - Mansehra Ckt I | | | | 206 | 60 | 201 | 60 | 195 | 60 | | | | | |
| N-1 | | - | - | - | - | - | | | | | - | - | - | - | - | - | | | | | - | - | - | - | - | - | - | - | | | |
| Normal | 220 kV ISPR - Allai Khwar Ckt II | Did not report | | 4 | 16 | 118 | Did not report | | | | 232 | 240 | 232 | 60 | - | - | Did not report | | | | 206 | 60 | 201 | 60 | 195 | 60 | | | | | |
| N-1 | | | | - | - | - | | | | | - | - | - | - | - | - | | | | | - | - | - | - | - | - | - | - | | | |
| Total No. of Variations (Normal) | | 19 | 9 | 36 | 269 | 773 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total No. of Variations (N-1) | | - | - | - | - | - | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total of Normal & N-1 | | 19 | 9 | 36 | 269 | 773 | | | | | | | | | | | | | | | | | | | | | | | | | |

 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) | | | | | | | | | |
|----------------------------------|--|--|---------|---------|---------|---------|--|------|---------|------|---------|------|---------|------|---------|------|---|------|---------|------|---------|------|---------|------|---------|----|
| | | | | | | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
| | | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | 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 | 1600 | 1356 | 740 | 2004 | 5730 | - | - | - | - | - | - | - | - | - | - | 200 | 540 | 199 | 120 | 198 | 180 | 193 | 60 | 180 | 60 |
| N-1 | | 176 | 139 | - | - | - | - | - | - | - | - | - | - | - | - | - | 182 | 60 | 180 | 240 | - | - | - | - | - | - |
| Normal | 220 kV Mardan - Barotha Ckt I & II | 1600 | 1358 | 740 | 1002 | 2845 | - | - | - | - | - | - | - | - | - | - | 200 | 540 | 199 | 120 | 198 | 180 | 193 | 60 | 180 | 60 |
| N-1 | | 176 | 137 | - | - | - | - | - | - | - | - | - | - | - | - | - | 182 | 60 | 180 | 240 | - | - | - | - | - | - |
| Normal | 220 kV Mardan - Shahibagh Ckt I & II | 1600 | 1520 | 740 | 1002 | 2784 | - | - | - | - | - | - | - | - | - | - | 200 | 540 | 199 | 60 | 198 | 180 | 193 | 60 | 180 | 60 |
| N-1 | | 176 | 143 | - | - | - | - | - | - | - | - | - | - | - | - | - | 182 | 60 | 181 | 60 | - | - | - | - | - | - |
| Total No. of Variations (Normal) | | 4,800 | 4,234 | 2,220 | 4,008 | 11,359 | | | | | | | | | | | | | | | | | | | | |
| Total No. of Variations (N-1) | | 528 | 419 | - | - | - | | | | | | | | | | | | | | | | | | | | |
| Total of Normal & N-1 | | 5,328 | 4,653 | 2,220 | 4,008 | 11,359 | | | | | | | | | | | | | | | | | | | | |

 Lowest Voltage Under Normal Condition

NTDC Islamabad Region

8. 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) | | | | | | | | | | | | | | |
|-----------|--|--|------|---------|------|---------|--|---------|------|---------|------|---------|------|---------|------|---------|---|---------|------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2016-17 | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | |
| Normal | 220 kV Shahibagh - Barotha | † | | | | | | | | | | | | | | | | | | | | | | | | | | | † | | |
| N-1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Normal | 220 kV Shahibagh - Peshawar Ckt I | † | | | | | | | | | | | | | | | | | | | | | | | | | | | † | | |
| N-1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Normal | 220 kV Shahibagh - Peshawar Ckt II | 1331 | 1637 | 777 | 656 | 1612 | — | — | — | — | — | — | — | — | — | — | — | — | — | 200 | 420 | 199 | 60 | 198 | 60 | 171 | 120 | 190 | 180 | | |
| N-1 | | 130 | 52 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 170 | 120 | 181 | 60 | — | — | — | — | — | — | | |
| Normal | 220 kV Shahibagh - Mardan Ckt I | 395 | 206 | 166 | 150 | 1091 | — | — | 238 | 240 | 235 | 120 | 238 | 60 | — | — | — | — | — | — | — | 199 | 60 | 198 | 60 | 195 | 60 | 182 | 60 | — | |
| N-1 | | 109 | 96 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 175 | 60 | 180 | 60 | — | — | — | — | — | — | | |
| Normal | 220 kV Shahibagh - Mardan Ckt II | 395 | †† | | | | — | — | 238 | 240 | †† | | | | | | — | — | †† | | | | | | | | | | | | |
| N-1 | | 109 | | | | | — | — | — | — | | | | | | | | | 175 | 60 | | | | | | | | | | | |

NP: Not Provided

| | | | | | |
|----------------------------------|-------|-------|-----|-----|-------|
| Total No. of Variations (Normal) | 2,121 | 1,843 | 943 | 806 | 2,703 |
| Total No. of Variations (N-1) | 348 | 148 | — | — | — |
| Total of Normal & N-1 | 2,469 | 1,991 | 943 | 806 | 2,703 |

Lowest Voltage Under Normal Condition

[†] 220 kV Shahibagh-Barotha at tower (Loc # 260 -261) bundled with Peshawar-Shahibagh-I at tower (Loc # 119-120) circuit, due to that reason 220 kV Shahibagh-Barotha & Peshawar-Shahibagh-I readings are missing in year 2013-14 and onwards.

†† Shahibagh-Mardan circuit -II does not exist

NTDC Islamabad Region

9. 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) | | | | | | | | | |
|----------------------------------|--|--|---------|---------|---------|---------|--|------|---------|------|---------|------|---------|------|---------|------|---|------|---------|------|---------|------|---------|------|---------|----|
| | | | | | | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
| | | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | |
| Normal | 220 kV University - Rawat Ckt I & II | 362 | 962 | 1210 | 1634 | 2832 | 240 | 60 | 241 | 60 | 241 | 60 | 241 | 60 | 242 | 60 | 232 | 120 | - | - | - | - | - | - | 202 | 60 |
| N-1 | | 2 | 1 | - | - | - | 242 | 60 | 243 | 60 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | |
| Total No. of Variations (Normal) | | 362 | 962 | 1,210 | 1,634 | 2,832 | Highest Voltage Under Normal Condition | | | | | | | | | | | | | | | | | | | |
| Total No. of Variations (N-1) | | 2 | 1 | - | - | - | | | | | | | | | | | | | | | | | | | | |
| Total of Normal & N-1 | | 364 | 963 | 1,210 | 1,634 | 2,832 | | | | | | | | | | | | | | | | | | | | |

NTDC Islamabad Region

10. 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) | | | | | | | | | |
|----------------------------------|--|--|---------|--|---------|---------|--|------|---------|------|---------|------|---------|------|---------|--------------------|---|------|---------|------|---------|------|---------|------|---------|--|
| | | | | | | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
| | | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | |
| Normal | 220 kV Mansehra - Allai Khwar | Energized May 2018 | 1 | Energized May 2018 | | | | | | | | | | 232 | 150 | Energized May 2018 | | | | | | | | | | |
| N-1 | | | - | | | | | | | | | | | - | - | | | | | | | | | | | |
| Total No. of Variations (Normal) | | 1 | | Highest Voltage Under Normal Condition | | | | | | | | | | | | | | | | | | - | - | | | |
| Total No. of Variations (N-1) | | - | | | | | | | | | | | | | | | | | | | | - | - | | | |
| Total of Normal & N-1 | | 1 | | | | | | | | | | | | | | | | | | | | | | | | |

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 New Kot Lakhpat..... | 13 of 21 |
| 14. 220 kV New Shalamar..... | 14 of 21 |
| 15. 220 kV Nishatabad | 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) | | | | | | | | | |
|-----------|--|--|---------|---------|---------|---------|--|------|---------|------|---------|------|---------|------|---------|------|---|------|---------|------|---------|------|---------|------|---------|------|
| | | | | | | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
| | | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time |
| Normal | 500 kV Gatti - Barotha Ckt I | - | | | | | - | - | | | | | | | | - | - | | | | | | | | | |
| N-1 | | - | | | | | - | - | | | | | | | | - | - | | | | | | | | | |
| Normal | 500 kV Gatti - Barotha Ckt II | 4 | 2 | | | | 530 | 90 | 528 | 60 | | | | | | - | - | | | | | | | | | |
| N-1 | | - | - | | | | - | - | - | - | | | | | | - | - | | | | | | | | | |
| Normal | 500 kV Gatti - Muzaffargarh | 140 | 358 | 679 | 708 | | 535 | 90 | 545 | 60 | 542 | 90 | 540 | 150 | | - | - | | | | | | | | | |
| N-1 | | - | - | - | - | | - | - | - | - | - | - | - | - | | - | - | | | | | | | | | |
| Normal | 500 kV Gatti - Rousch | 17 | 137 | 154 | 171 | 120 | 538 | 60 | 540 | 60 | 540 | 60 | 540 | 60 | 540 | - | - | - | - | - | - | - | - | - | - | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | |
| Normal | 500 kV Gatti - H. B. Shah 1* | 155 | 621 | 310 | 232 | 618 | 540 | 300 | 547 | 60 | 540 | 90 | 540 | 150 | 540 | 60 | - | - | - | - | - | - | - | - | - | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | |
| Normal | 500 kV Gatti - H. B. Shah 2 | | | | | 252 | | | | | | | | | 540 | 90 | | | | | | | | | | |
| N-1 | | | | | | - | | | | | | | | | - | - | | | | | | | | | | |
| Normal | 500 kV Gatti - QATPL Bhikhi Ckt | | | | 208 | 340 | | | | | 540 | 120 | 540 | 90 | | | | | | | 540 | 60 | - | - | - | |
| N-1 | | | | | - | - | | | | | - | - | - | - | - | | | | | - | - | - | - | - | - | |
| Normal | 500 kV Gatti - Lahore | 19 | 71 | 142 | | | 532 | 90 | 540 | 60 | 538 | 60 | | | | - | - | - | - | - | | | | | | |
| N-1 | | - | - | - | | | - | - | - | - | - | - | | | - | - | - | - | - | - | | | | | | |
| Normal | 220 kV Gatti - Nishatabad 1 | | | | 390 | 312 | | | | | 240 | 90 | 240 | 150 | | | | | | | NP | - | - | - | - | |
| N-1 | | | | | - | - | | | | | - | - | - | - | | | | | | | | - | - | - | - | |
| Normal | 220 kV Gatti - Nishatabad 2 | | | | NP | | 384 | 313 | | | 240 | 90 | 240 | 60 | | | | | | | NP | - | - | - | - | |
| N-1 | | | | | - | - | | | | | - | - | - | - | | | | | | | | - | - | - | - | |
| Normal | 220 kV Gatti - Jaranwala Road 1 | | | | NP | | 287 | 208 | | | 240 | 60 | 242 | 90 | | | | | | | NP | - | - | - | - | |
| N-1 | | | | | - | - | | | | | - | - | - | - | | | | | | | | - | - | - | - | |
| Normal | 220 kV Gatti - Jaranwala Road 2 | | | | NP | | 7 | 208 | | | 238 | 60 | 241 | 90 | | | | | | | NP | - | - | - | - | |
| N-1 | | | | | - | - | | | | | - | - | - | - | | | | | | | | - | - | - | - | |
| Normal | 220 kV Gatti - Yousafwala 1 | | | | NP | | NA | | | | | | | | | | | | | NP | | | | | | |
| N-1 | | | | | - | - | | | | | | | | | | | | | | | | | | | | |
| Normal | 220 kV Gatti - Yousafwala 2 | | | | NP | | NA | | | | | | | | | | | | | NP | | | | | | |
| N-1 | | | | | - | - | | | | | | | | | | | | | | | | | | | | |
| Normal | 220 kV Gatti - Ludewala 1 | | | | NP | | NA | | | | | | | | | | | | | NP | | | | | | |
| N-1 | | | | | - | - | | | | | | | | | | | | | | | | | | | | |
| Normal | 220 kV Gatti - Ludewala 2 | | | | NP | | NA | | | | | | | | | | | | | NP | | | | | | |
| N-1 | | | | | - | - | | | | | | | | | | | | | | | | | | | | |
| Normal | 220 kV Gatti - Bandala 1 | | | | NP | | 577 | 392 | | | 244 | 150 | 242 | 90 | | | | | | | NP | - | - | - | - | - |
| N-1 | | | | | - | - | | | | | - | - | - | - | | | | | | | | - | - | - | - | |
| Normal | 220 kV Gatti - Bandala 2 | | | | NP | | 467 | 392 | | | 247 | 60 | 242 | 90 | | | | | | | NP | - | - | - | - | - |
| N-1 | | | | | - | - | | | | | - | - | - | - | | | | | | | | - | - | - | - | |

NP: Not Provided

NA: Not Applicable

* Previously Gatti - Multan

 Highest Voltage Under Normal Condition @500kV 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) | | | | | | | | | | | | | | | | |
|----------------------------------|--|--|------|---------|----------------|---------|--|---------|------|---------|------|---------|---|---------|---|---------|------|---------|------|---------|------|---------|------|---------|--|---------|------|---------|--|----------|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 20117-18 | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | | | |
| Normal | 500 kV Gakkhar - Rawat 1 | Not applicable | 77 | 117 | Not applicable | | | | 545 | 150 | 535 | 60 | Not applicable | | | | 453 | 60 | 450 | 90 | | | | | 453 | 60 | 450 | 90 | | | |
| N-1 | | | - | - | | | | | - | - | - | - | | | | | - | - | - | - | | | | | - | - | - | - | | | |
| Normal | 500 kV Gakkhar - Rawat 2 | Not applicable | 77 | 117 | Not applicable | | | | 545 | 150 | 535 | 60 | Not applicable | | | | 453 | 60 | 450 | 90 | | | | | - | - | - | - | | | |
| N-1 | | | - | - | | | | | - | - | - | - | | | | | - | - | - | - | | | | | - | - | - | - | | | |
| Normal | 500 kV Gakkhar - Lahore 1 | Not applicable | 77 | 117 | Not applicable | | | | 545 | 150 | 535 | 60 | Not applicable | | | | 453 | 60 | 450 | 90 | | | | | - | - | - | - | | | |
| N-1 | | | - | - | | | | | - | - | - | - | | | | | - | - | - | - | | | | | - | - | - | - | | | |
| Normal | 500 kV Gakkhar - Lahore 2 | Not applicable | 77 | 117 | Not applicable | | | | 545 | 150 | 535 | 60 | Not applicable | | | | 453 | 60 | 450 | 90 | | | | | - | - | - | - | | | |
| N-1 | | | - | - | | | | | - | - | - | - | | | | | - | - | - | - | | | | | - | - | - | - | | | |
| Normal | 220 kV Nokhar - Mangla | Not applicable | 5 | 121 | Not applicable | | | | 232 | 120 | 232 | 360 | Not applicable | | | | 205 | 120 | 200 | 270 | | | | | - | - | - | - | | | |
| N-1 | | | - | - | | | | | - | - | - | - | | | | | - | - | - | - | | | | | - | - | - | - | | | |
| Normal | 220 kV Nokhar - Gakkhar | Not applicable | 5 | 121 | Not applicable | | | | 232 | 120 | 232 | 360 | Not applicable | | | | 205 | 120 | 200 | 270 | | | | | - | - | - | - | | | |
| N-1 | | | - | - | | | | | - | - | - | - | | | | | - | - | - | - | | | | | - | - | - | - | | | |
| Total No. of Variations (Normal) | Not applicable | | 318 | 710 | | | | | | | | | Highest Voltage Under Normal Condition @500kV level | | | | | | | | | | | | Lowest Voltage Under Normal Condition @500kV level | | | | | | |
| Total No. of Variations (N-1) | Not applicable | | - | - | | | | | | | | | Highest Voltage Under Normal Condition @220kV level | | | | | | | | | | | | Lowest Voltage Under Normal Condition @220kV level | | | | | | |
| Total of Normal & N-1 | Not applicable | | 318 | 710 | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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) | | | | | | | | | | | | | | | | | |
|-----------|--|--|------|---------|------|---------|--|---------|------|---------|------|---------|--------------------------|---------|---|---------|--------------------------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|--|---------|--|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | | | | |
| Normal | 500 kV Sheikhpura - Yousafwala | - | 129 | 24 | NP | - | - | 536 | 60 | 534 | 30 | NP | - | - | - | - | - | - | - | - | NP | NP | NP | NP | NP | NP | | | | | | |
| N-1 | | - | - | - | | - | - | - | - | - | - | | - | - | - | - | - | - | - | - | | | | | | | | | | | | |
| Normal | 500 kV Sheikhpura - Gatti | - | 129 | 24 | NP | - | - | 536 | 60 | 534 | 30 | NP | - | - | - | - | - | - | - | - | NP | NP | NP | NP | NP | NP | | | | | | |
| N-1 | | - | - | - | | - | - | - | - | - | - | | - | - | - | - | - | - | - | - | | | | | | | | | | | | |
| Normal | 500 kV Sheikhpura - Nokhar Ckt I & II | - | 129 | 24 | 900 | 476 | - | - | 536 | 60 | 534 | 30 | 547 | 30 | 539 | 30 | - | - | - | - | - | - | 462 | 60 | - | - | - | - | | | | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | | | |
| Normal | 500 kV Sheikhpura - CCPP Sahiwal | | | 900 | | NP | | | | | | | 547 | 30 | NP | | | | | | | | | | | | | | | | | |
| N-1 | | | | - | | | | | | | | | - | - | - | | | | | | | | | | | | | | | | | |
| Normal | 500 kV Sheikhpura - CCPP Bhikhi | | | 900 | | 156 | | | | | | | 547 | 30 | 538 | 30 | | | | | | | | | | | | | | | | |
| N-1 | | | | - | | | | | | | | | - | - | - | - | | | | | | | | | | | | | | | | |
| Normal | 500 kV Sheikhpura - New Lahore | Energized November, 2017 | | | | 476 | Energized November, 2017 | | | | 541 | 60 | Energized November, 2017 | | | | Energized November, 2017 | | | | - | | | | - | | | | | | | |
| N-1 | | - | | | | - | | | | | - | - | | | | | | | | | - | | | | - | | | | | | | |
| Normal | 220 kV Sheikhpura - WTN | 23 | 887 | 813 | 2833 | 3846 | - | - | - | - | - | - | - | - | - | - | 200 | 90 | 198 | 30 | 193 | 30 | 192 | 30 | 198 | 30 | | | | | | |
| N-1 | | 1 | 3 | - | 60 | 392 | - | - | - | - | - | - | - | - | - | - | 197 | 90 | 195 | 60 | - | - | 190 | 30 | 189 | 30 | | | | | | |
| Normal | 220 kV Sheikhpura - NKL P Ckt I & II | 23 | 887 | 813 | 2833 | 2983 | - | - | - | - | - | - | - | - | - | - | 200 | 90 | 198 | 30 | 193 | 30 | 192 | 30 | 198 | 30 | | | | | | |
| N-1 | | 1 | 3 | - | 60 | 1175 | - | - | - | - | - | - | - | - | - | - | 197 | 90 | 195 | 60 | - | - | 190 | 30 | 190 | 30 | | | | | | |
| Normal | 220 kV Sheikhpura - Bund Road Ckt I, II, III & IV | 23 | 887 | 813 | 2833 | 12587 | - | - | - | - | - | - | - | - | - | - | 200 | 90 | 198 | 30 | 193 | 30 | 192 | 30 | 194 | 30 | | | | | | |
| N-1 | | 1 | 3 | - | 60 | 4165 | - | - | - | - | - | - | - | - | - | - | 197 | 90 | 195 | 60 | - | - | 190 | 30 | 190 | 60 | | | | | | |
| Normal | 220 kV Sheikhpura - Ravi Ckt I & II | 23 | 887 | 813 | 2833 | 2845 | - | - | - | - | - | - | - | - | - | - | 200 | 90 | 198 | 30 | 193 | 30 | 192 | 30 | 198 | 30 | | | | | | |
| N-1 | | 1 | 3 | - | 60 | 596 | - | - | - | - | - | - | - | - | - | - | 197 | 90 | 195 | 60 | - | - | 190 | 30 | 189 | 30 | | | | | | |
| Normal | 220 kV Sheikhpura - ATLAS P/H | 23 | 887 | 813 | 2833 | 3252 | - | - | - | - | - | - | - | - | - | - | 200 | 90 | 198 | 30 | 193 | 30 | 192 | 30 | 198 | 30 | | | | | | |
| N-1 | | 1 | 3 | - | 60 | 655 | - | - | - | - | - | - | - | - | - | - | 197 | 90 | 195 | 60 | - | - | 190 | 30 | 190 | 30 | | | | | | |

NP: Not Provided

| | | | | | |
|----------------------------------|-----|-------|-------|--------|--------|
| Total No. of Variations (Normal) | 115 | 4,822 | 4,137 | 15,065 | 26,621 |
| Total No. of Variations (N-1) | 5 | 15 | - | 300 | 6,983 |
| Total of Normal & N-1 | 120 | 4,837 | 4,137 | 15,365 | 33,604 |

 Highest Voltage Under Normal Condition @500kV level

 Lowest Voltage Under Normal Condition @220kV level

 Lowest Voltage Under N-1 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 violating the limit | | | | | Highest Voltage Recorded (kV) / Time (Min) | | | | | | | | | | Lowest Voltage Recorded (kV) / Time (Min) | | | | | | | | | | | | | | | | | | | | | | | | | | |
|----------------------------------|--|--|-------|---------|-----------------------|---------|--|---------|------|---------|------|---------|------|---------|------|---------|---|---------|------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|--|--|--|--|--|--|--|--|--|--|--|--|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | | | | | | | | | | | | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | | | | | | | | | | | | | |
| Normal | 500 kV New Lahore - Balloki | Energized 01-Nov-2017 | 674 | - | Energized 01-Nov-2017 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | | | | | | | | | | | | | | | |
| N-1 | | | - | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Normal | 500 kV New Lahore - SKP | Energized 01-Nov-2017 | 667 | - | Energized 01-Nov-2017 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | | | | | | | | | | | | | | | |
| N-1 | | | - | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Normal | 220 kV New Lahore - NKLP | Energized 01-Nov-2017 | 67 | - | Energized 01-Nov-2017 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | | | | | | | | | | | | | | | |
| N-1 | | | - | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Normal | 220 kV New Lahore - SNR | Energized 01-Nov-2017 | 66 | - | Energized 01-Nov-2017 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | | | | | | | | | | | | | | | |
| N-1 | | | - | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total No. of Variations (Normal) | | Energized 01-Nov-2017 | 1,474 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total No. of Variations (N-1) | | | - | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total of Normal & N-1 | | | 1,474 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Highest Voltage Under N-1 Condition

Lowest Voltage Under Normal Condition

NTDC Lahore Region

5. 220kV Grid Station BANDALA

| Condition | Name of Transmission Circuit(s) violating the voltage criteria | Total Number / Times violating the limit | | | | | Highest Voltage Recorded (kV) / Time (Min) | | | | | | | | Lowest Voltage Recorded (kV) / Time (Min) | | | | | | | | | | | | | | | | |
|-----------|--|--|------|---------|------|------------------------|--|---------|------|---------|------|------------------------|------|---------|---|---------|------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | |
| Normal | 220 kV Bandala - KSK 1 | Energized 26-June-2014 | NA | 146 | 416 | Energized 26-June-2014 | NA | 240 | 60 | 240 | 60 | Energized 26-June-2014 | NA | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | |
| N-1 | | | | - | - | | | - | - | - | - | | | | | | | | | | | | | | | | | | | | |
| Normal | 220 kV Bandala - KSK 2 | Energized 26-June-2014 | NA | 146 | 416 | Energized 26-June-2014 | NA | 240 | 60 | 236 | 70 | Energized 26-June-2014 | NA | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | |
| N-1 | | | | - | - | | | - | - | - | - | | | | | | | | | | | | | | | | | | | | |
| Normal | 220 kV Bandala - Gatti 1 | Energized 26-June-2014 | NA | 149 | 432 | Energized 26-June-2014 | NA | 240 | 60 | 240 | 60 | Energized 26-June-2014 | NA | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | |
| N-1 | | | | - | - | | | - | - | - | - | | | | | | | | | | | | | | | | | | | | |
| Normal | 220 kV Bandala - Gatti 2 | Energized 26-June-2014 | NA | - | 419 | Energized 26-June-2014 | NA | - | - | 240 | 60 | Energized 26-June-2014 | NA | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | |
| N-1 | | | | - | - | | | - | - | - | - | | | | | | | | | | | | | | | | | | | | |

NA: Not Applicable

 Highest Voltage Under Normal Condition

| | | | | |
|----------------------------------|------------------------|----|-----|------|
| Total No. of Variations (Normal) | Energized 26-June-2014 | NA | 441 | 1683 |
| Total No. of Variations (N-1) | | | - | - |
| Total of Normal & N-1 | | | 441 | 1683 |

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) | | | | | | | | | | | | | | |
|-----------|--|--|------|---------|------|---------|--|---------|------|---------|------|---------|------|---------|------|---------|---|---------|------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | |
| Normal | 220 kV Bus Bar No. 1 & 2 | 4438 | 3844 | 3598 | 1916 | * | - | - | - | - | - | - | - | - | * | - | - | 195 | 150 | 182 | 30 | 190 | 60 | 186 | 120 | * | | | | | |
| N-1 | | 154 | 187 | 9 | 129 | | - | - | - | - | - | - | - | - | | - | - | 195 | 120 | 191 | 60 | 190 | - | 185 | 90 | | | | | | |
| Normal | 220 kV Bund Road - NKLPI & II | Reported as Bus Bar No. 1 & 2 | | | | 1202 | Reported as Bus Bar No. 1 & 2 | | | | | | | | - | - | Reported as Bus Bar No. 1 & 2 | | | | | | | | | | 182 | 90 | | | |
| N-1 | | | | | | 97 | | | | | | | | | - | - | 180 | 90 | | | | | | | | | | | | | |
| Normal | 220 kV Bund Road - KSK I & II | Reported as Bus Bar No. 1 & 2 | | | | 1287 | Reported as Bus Bar No. 1 & 2 | | | | | | | | - | - | Reported as Bus Bar No. 1 & 2 | | | | | | | | | | 180 | 240 | | | |
| N-1 | | | | | | 135 | | | | | | | | | - | - | 180 | 90 | | | | | | | | | | | | | |
| Normal | 220 kV Bund Road - SKP I & II | Reported as Bus Bar No. 1 & 2 | | | | 1268 | Reported as Bus Bar No. 1 & 2 | | | | | | | | - | - | Reported as Bus Bar No. 1 & 2 | | | | | | | | | | 182 | 90 | | | |
| N-1 | | | | | | 115 | | | | | | | | | - | - | 180 | 90 | | | | | | | | | | | | | |
| Normal | 220 kV Bund Road - SKP III & IV | Reported as Bus Bar No. 1 & 2 | | | | 1270 | Reported as Bus Bar No. 1 & 2 | | | | | | | | - | - | Reported as Bus Bar No. 1 & 2 | | | | | | | | | | 182 | 120 | | | |
| N-1 | | | | | | 128 | | | | | | | | | - | - | 184 | 90 | | | | | | | | | | | | | |

* Reported as separate circuits

| | | | | | |
|----------------------------------|-------|-------|-------|-------|-------|
| Total No. of Variations (Normal) | 4,438 | 3,844 | 3,598 | 1,916 | 5,027 |
| Total No. of Variations (N-1) | 154 | 187 | 9 | 129 | 475 |
| Total of Normal & N-1 | 4,592 | 4,031 | 3,607 | 2,045 | 5,502 |

 Lowest Voltage Under Normal Condition

 Lowest Voltage Under N-1 Condition

NTDC Lahore Region

7. 220kV Grid Station GAKKHER

| 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) | | | | | | | | | | | | | | | | | | | | | |
|-----------|--|--|------|---------|------|---------|--|---------------------|------|---------|------|---------|------|---------|---|---------|------|---------------------|------|---------|------|---------|------|---------|------|---------|------|---------|--|---------|--|--|--|--|--|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | | | | | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | | | | | | | | |
| Normal | 220 kV Gakkhar - Mangla Ckt I | 148 | 183 | 791 | 2495 | 1335 | - | - | - | - | - | - | - | - | - | - | - | - | 204 | 280 | 198 | 60 | 187 | 60 | 188 | 60 | 189 | 60 | | | | | | | | |
| N-1 | | 25 | 6 | - | - | 4 | - | - | - | - | - | - | - | - | - | - | - | 185 | 60 | 193 | 60 | - | - | - | - | 190 | 60 | | | | | | | | | |
| Normal | 220 kV Gakkhar - Mangla Ckt II | 224 | 288 | NP | NP | 1580 | NP | 280 | 60 | - | - | NP | NP | - | - | NP | NP | 198 | 120 | 198 | 60 | NP | NP | 185 | 60 | NP | NP | | | | | | | | | |
| N-1 | | 52 | 24 | | | - | | - | - | - | - | | | - | - | | | 186 | 60 | 190 | 60 | | | - | - | | | | | | | | | | | |
| Normal | 220 kV Gakkhar - Mangla Ckt III | NP | | | | | NP | | | | | | | | NP | | | | | | | | NP | | | | | | | | | | | | | |
| N-1 | | NP | | | | | NP | | | | | | | | NP | | | | | | | | NP | | | | | | | | | | | | | |
| Normal | 220 kV Gakkhar - Sialkot | 148 | 182 | 791 | 914 | 1360 | - | - | - | - | - | - | - | - | - | - | - | - | 198 | 60 | 193 | 60 | 187 | 60 | 188 | 60 | 191 | 60 | | | | | | | | |
| N-1 | | 25 | 5 | - | - | 11 | - | - | - | - | - | - | - | - | - | - | - | - | 185 | 60 | 190 | 60 | - | - | - | - | 190 | 60 | | | | | | | | |
| Normal | 220 kV Old Gakkhar - New Gakkhar (Nokhar) | 226 | 285 | NA | NA | 1580 | NA | 1917 | - | - | - | NA | NA | - | - | NA | NA | 198 | 120 | 198 | 60 | NA | NA | 185 | 60 | 191 | 60 | | | | | | | | | |
| N-1 | | 54 | 24 | | | - | | - | - | - | - | | | - | - | | | 186 | 60 | 190 | 60 | | | - | - | 190 | 60 | | | | | | | | | |
| Normal | 220 kV Gakkhar - Gujrat | Energized Apr, 2017 | | | | | 1917 | Energized Apr, 2017 | | | | | | | | - | - | Energized Apr, 2017 | | | | | | | | 191 | 60 | | | | | | | | | |
| N-1 | | - | | | | | - | - | | | | | | | | - | - | Energized Apr, 2017 | | | | | | | | 190 | 60 | | | | | | | | | |

NP: Not Provided

| | | | | | |
|----------------------------------|-----|-----|-------|-------|-------|
| Total No. of Variations (Normal) | 746 | 938 | 1,582 | 4,989 | 6,529 |
| Total No. of Variations (N-1) | 156 | 59 | - | - | 15 |
| Total of Normal & N-1 | 902 | 997 | 1,582 | 6,569 | 6,544 |

 Lowest Voltage Under Normal Condition

 Lowest Voltage Under N-1 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) | | | | | | | | | |
|-----------|--|--|---------|---------|---------|---------------------|--|------|---------|------|---------|------|---------|------|---------|------|---|------|---------|------|---------|------|---------|------|---------|------|
| | | | | | | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
| | | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time |
| Normal | 220 kV KSK - Shalamar Via Ghazi | Energized Mar, 2014 | 61 | NA | 2539 | Energized Mar, 2014 | - | - | NA | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| N-1 | | | - | | 39 | | - | - | | | | | | | | | | | | | | | | | | |

NA: Not Applicable

| | | | | |
|----------------------------------|---------------------|----|----|-------|
| Total No. of Variations (Normal) | Energized Mar, 2014 | 61 | NA | 2539 |
| Total No. of Variations (N-1) | | - | | 39 |
| Total of Normal & N-1 | | 61 | | 2,578 |

 Lowest Voltage Under Normal Condition

 Lowest Voltage Under N-1 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) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|----------------------------------|--|--|------|---------|--|---------|--|---------|------|---------|------|---------|---------------------------------------|---------|---|---------------------|------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|--|---------|--|--|--|--|--|--|--|--|--|--|--|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | | | | | | | | | | | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | | | | | | | | | | | | | | |
| Normal | 220 kV Gujrat - Old Gakkhar | Energized Apr, 2017 | 51 | 1211 | Energized Apr, 2017 | | | | | | | - | - | 234 | 60 | Energized Apr, 2017 | | | | | | | 199 | 60 | 190 | 60 | | | | | | | | | | | | | | | | |
| N-1 | | | - | - | | | | | | | | | | | | | | | | | | | - | - | - | - | | | | | | | | | | | | | | | | |
| Normal | 220 kV Gujrat - New Gakkhar | Energized Apr, 2017 | - | 1199 | Energized Apr, 2017 | | | | | | | - | - | 234 | 60 | Energized Apr, 2017 | | | | | | | - | - | 190 | 60 | | | | | | | | | | | | | | | | |
| N-1 | | | - | - | | | | | | | | | | | | | | | | | | | - | - | - | - | | | | | | | | | | | | | | | | |
| Normal | 220 kV Gujrat - Mangla 1 & 2 | Energized Apr, 2017 | - | 1201 | Energized Apr, 2017 | | | | | | | - | - | 234 | 60 | Energized Apr, 2017 | | | | | | | - | - | 190 | 60 | | | | | | | | | | | | | | | | |
| N-1 | | | - | - | | | | | | | | | | | | | | | | | | | - | - | - | - | | | | | | | | | | | | | | | | |
| Total No. of Variations (Normal) | | Energized Apr 2017 | 51 | 3611 | Highest Voltage Under Normal Condition | | | | | | | | Lowest Voltage Under Normal Condition | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total No. of Variations (N-1) | | | - | - | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total of Normal & N-1 | | | 51 | 3,611 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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) | | | | | | | | | | | | | |
|----------------------------------|--|--|---------|---------|---------|---------|--|------|---------|------|---------|------|---------|------|---|------|---------|------|---------|------|---------|------|---------|------|---------|--|--|--|
| | | | | | | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | | |
| | | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | | | |
| Normal | 220 kV Jaranwala - Gatti Ckt I & II | 303 | 278 | 208 | 372 | 836 | 237 | 60 | 238 | 34 | 238 | 40 | 244 | 38 | 246 | 38 | - | - | - | - | - | - | - | - | | | | |
| N-1 | 220 kV Jaranwala - Gatti Ckt I & II | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | | | | |
| Total No. of Variations (Normal) | | 303 | 278 | 208 | 372 | 836 | Highest Voltage Under Normal Condition | | | | | | | | | | | | | | | | | | | | | |
| Total No. of Variations (N-1) | | - | - | - | - | - | | | | | | | | | | | | | | | | | | | | | | |
| Total of Normal & N-1 | | 303 | 278 | 208 | 372 | 836 | | | | | | | | | | | | | | | | | | | | | | |

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) | | | | | | | | | | | | | | |
|-----------|--|--|------|---------|------|---------|--|-----------------------|------|---------|------|---------|------|---------|------|---------|---|---------|-----------------------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | |
| Normal | 220 kV Kala Shah Kaku - Gatti Ckt I & II | 2040 | NP | | | | | - | - | NP | | | | | | | | | | 198 | 120 | NP | | | | | | | | | |
| N-1 | | 19 | - | - | 194 | 60 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Normal | 220 kV Kala Shah Kaku - Mangla Ckt I, II & III | 1632 | 1048 | 2940 | 1016 | 702 | - | - | - | - | - | - | - | - | - | - | - | - | - | 197 | 60 | 196 | 60 | 184 | 60 | 182 | 60 | 185 | 90 | | |
| N-1 | | 6 | 46 | 17 | 1 | 48 | - | - | - | - | - | - | - | - | - | - | - | - | - | 193 | 60 | 187 | 60 | 188 | 90 | 185 | 60 | 180 | 90 | | |
| Normal | 220 kV Kala Shah Kaku - Bund Road Ckt I & II | 1535 | 1287 | 3425 | 486 | 777 | - | - | - | - | - | - | - | - | - | - | - | - | - | 198 | 60 | 189 | 60 | 180 | 60 | 190 | 90 | 185 | 90 | | |
| N-1 | | 6 | 78 | 48 | - | 52 | - | - | - | - | - | - | - | - | - | - | - | - | - | 195 | 60 | 190 | 60 | 188 | 90 | - | - | 180 | 60 | | |
| Normal | 220 kV Kala Shah Kaku - Ravi Ckt I & II | 1819 | 1752 | 3592 | 570 | 737 | - | - | - | - | - | - | - | - | - | - | - | - | - | 198 | 420 | 195 | 60 | 180 | 60 | 184 | 90 | 184 | 120 | | |
| N-1 | | 117 | 288 | 53 | 15 | 56 | - | - | - | - | - | - | - | - | - | - | - | - | - | 190 | 240 | 188 | 60 | 187 | 90 | 180 | 120 | 185 | 90 | | |
| Normal | 220 kV Kala Shah Kaku - Sialkot | 1830 | 1809 | 3563 | 1038 | 710 | - | - | - | - | - | - | - | - | - | - | - | - | - | 195 | 60 | 198 | 210 | 182 | 60 | 189 | 90 | 184 | 90 | | |
| N-1 | | 116 | 172 | 58 | 6 | 56 | - | - | - | - | - | - | - | - | - | - | - | - | - | 190 | 60 | 184 | 60 | 189 | 60 | 191 | 90 | 185 | 60 | | |
| Normal | 220 kV Kala Shah Kaku - Shalamar | Energized Mar 2014 | 1731 | 3442 | 592 | 383 | Energized Mar 2014 | | - | - | - | - | - | - | - | - | - | - | Energized Mar 2014 | 197 | | 60 | 180 | 60 | 60 | 150 | 184 | 90 | | | |
| N-1 | | | 294 | 56 | 12 | 57 | | | - | - | - | - | - | - | - | - | - | - | | 188 | | 60 | 187 | 90 | 182 | 60 | 184 | 90 | | | |
| Normal | 220 kV Kala Shah Kaku - Bandala Ckt I & II | Energized Mar 2014 | 1786 | 3456 | 950 | 592 | Energized Mar 2014 | | - | - | - | - | - | - | - | - | - | - | Energized Mar 2014 | 190 | | 60 | 183 | 60 | 183 | 60 | 184 | 60 | | | |
| N-1 | | | 119 | 54 | 4 | 45 | | | - | - | - | - | - | - | - | - | - | - | | 185 | | 60 | 189 | 60 | 192 | 90 | 185 | 60 | | | |
| Normal | 220 kV Kala Shah Kaku - Ghazi Rd | Energized 18-Oct-2017 | | | | | 407 | Energized 18-Oct-2017 | | | | | | | | | | | Energized 18-Oct-2017 | | | | | 188 | 60 | | | | | | |
| N-1 | | | | | | | 7 | | | | | | | | | | | | | | | | | 190 | 90 | | | | | | |

| | | | | | |
|----------------------------------|-------|--------|--------|-------|-------|
| Total No. of Variations - Normal | 8,856 | 9,413 | 20,418 | 4,652 | 4,308 |
| Total No. of Variations - N-1 | 264 | 997 | 286 | 38 | 321 |
| Total of Normal & N-1 | 9,120 | 10,410 | 20,704 | 4,690 | 4,629 |

 Lowest Voltage Under Normal Condition

 Lowest Voltage Under N-1 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) | | | | | | | | | | | | | | |
|----------------------------------|--|--|------|---------|------|---------|--|---------|------|---------|------|---------|------|---------|------|---------|---|---------|------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | |
| Normal | 220 kV Gatti - Ludewala Ckt I & II | 435 | 351 | 258 | 334 | 282 | 244 | 60 | 239 | 90 | 239 | 270 | 245 | 90 | 242 | 60 | 208 | 60 | 208 | 150 | 207 | 150 | 206 | 60 | - | - | - | - | | | |
| N-1 | | 4 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| Normal | 220 kV Chashma - Ludewala Ckt I & II | 52 | 91 | 45 | 152 | 307 | 237 | 150 | 238 | 120 | 238 | 270 | 236 | 60 | 236 | 60 | 202 | 60 | 199 | 60 | 202 | 60 | 200 | 90 | 198 | 60 | - | - | | | |
| N-1 | | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 197 | 120 | | | |
| Total No. of Variations (Normal) | | 487 | 442 | 303 | 486 | 589 | Highest Voltage Under Normal Condition | | | | | | | | | | Lowest Voltage Under Normal Condition | | | | | | | | | | | | | | |
| Total No. of Variations (N-1) | | 4 | - | - | - | 1 | Lowest Voltage Under N-1 Condition | | | | | | | | | | | | | | | | | | | | | | | | |
| Total of Normal & N-1 | | 491 | 442 | 303 | 486 | 590 | | | | | | | | | | | | | | | | | | | | | | | | | |

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) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|----------------------------------|--|--|------|---------|------|---------|--|---------|------|---------|------|---------|------|---------|---|---------|------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|--|---------|--|--|--|--|--|--|--|--|--|--|--|--|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | | | | | | | | | | | | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | | | | | | | | | | | | | | | |
| Normal | 220 kV Nishatabad - Gatti Ckt I | - | 5 | 24 | NA | 22 | - | - | 234 | 90 | 235 | 60 | NA | 238 | 120 | - | - | - | - | - | - | NA | - | - | NA | - | - | | | | | | | | | | | | | | | | |
| N-1 | | - | - | - | | 10 | - | - | - | - | - | - | | - | - | - | - | - | - | - | - | | - | - | | 183 | 30 | | | | | | | | | | | | | | | | |
| Normal | 220 kV Nishatabad - Gatti Ckt II | - | 5 | 24 | NA | 22 | - | - | 234 | 90 | 235 | 60 | NA | 238 | 120 | - | - | - | - | - | - | NA | - | - | NA | - | - | | | | | | | | | | | | | | | | |
| N-1 | | - | - | - | | 10 | - | - | - | - | - | - | | - | - | - | - | - | - | - | - | | - | - | | 183 | 30 | | | | | | | | | | | | | | | | |
| Normal | 220 kV Nishatabad - Samundri Road Ckt I | - | 5 | 24 | NA | 22 | - | - | 234 | 90 | 235 | 60 | NA | 238 | 120 | - | - | - | - | - | - | NA | - | - | NA | - | - | | | | | | | | | | | | | | | | |
| N-1 | | - | - | - | | 10 | - | - | - | - | - | - | | - | - | - | - | - | - | - | - | - | 183 | 30 | | | | | | | | | | | | | | | | | | | |
| Normal | 220 kV Nishatabad - Samundri Road Ckt II | - | 5 | 24 | NA | 22 | - | - | 234 | 90 | 235 | 60 | NA | 238 | 120 | - | - | - | - | - | - | NA | - | - | NA | - | - | | | | | | | | | | | | | | | | |
| N-1 | | - | - | - | | 10 | - | - | - | - | - | - | | - | - | - | - | - | - | - | - | - | 183 | 30 | | | | | | | | | | | | | | | | | | | |
| Total No. of Variations (Normal) | | - | 20 | 96 | NA | 88 | Highest Voltage Under Normal Condition | | | | | | | | Lowest Voltage Under N-1 Condition | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total No. of Variations (N-1) | | - | - | - | NA | 40 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total of Normal & N-1 | | - | 20 | 96 | NA | 128 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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) | | | | | | | | | | | | | | | | | | | |
|-----------|--|--|---------|---------|---------|---------|--|---------------------|---------|------|---------|------|---------|------|---------|------|---|------|---------|---------------------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|--|---------|--|
| | | | | | | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
| | | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | | | |
| Normal | 220 kV NKLP - BDR - 1 | 3424 | 3728 | 1408 | 800 | 933 | - | - | - | - | 233 | 30 | - | - | - | - | 198 | 300 | 198 | 120 | 150 | 90 | 177 | 90 | 180 | 150 | - | - | - | - | | | | | | |
| N-1 | | 2422 | 2217 | - | 7 | 49 | - | - | - | - | - | - | - | - | - | - | 179 | 30 | 182 | 30 | - | - | 185 | 90 | 187 | 90 | - | - | - | - | | | | | | |
| Normal | 220 kV NKLP - BDR - 2 | 3424 | 3728 | 1408 | 800 | 933 | - | - | - | - | 233 | 30 | - | - | - | - | 198 | 300 | 198 | 120 | 150 | 90 | 177 | 90 | 180 | 150 | - | - | - | - | | | | | | |
| N-1 | | 2422 | 2217 | - | 7 | 49 | - | - | - | - | - | - | - | - | - | - | 179 | 30 | 182 | 30 | - | - | 185 | 90 | 187 | 90 | - | - | - | - | | | | | | |
| Normal | 220 kV NKLP - SKP Ckt I & II | 3078 | 2652 | 593 | 407 | 563 | 240 | 30 | 235 | 30 | - | - | - | - | - | - | 198 | 120 | 198 | 120 | 160 | 330 | 182 | 60 | 184 | 150 | - | - | - | - | | | | | | |
| N-1 | | 341 | 222 | - | - | 15 | - | - | - | - | - | - | - | - | - | - | 185 | 30 | 190 | 60 | - | - | - | - | - | - | - | - | - | - | - | | | | | |
| Normal | 220 kV NKLP - SNR Ckt I & II | 3690 | 3254 | 942 | 539 | 731 | 233 | 60 | - | - | - | - | 236 | 90 | - | - | 198 | 180 | 190 | 120 | 160 | 210 | 182 | 90 | 184 | 90 | - | - | - | - | | | | | | |
| N-1 | | 1046 | 759 | - | 9 | 16 | - | - | - | - | - | - | - | - | - | - | 183 | 60 | 187 | 30 | - | - | 195 | 90 | 189 | 150 | - | - | - | - | | | | | | |
| Normal | 220 kV NKLP - WTN | 3671 | 3215 | 886 | 569 | 714 | 233 | 60 | - | - | - | - | 236 | 90 | - | - | 198 | 240 | 198 | 180 | 160 | 330 | 180 | 90 | 185 | 180 | - | - | - | - | | | | | | |
| N-1 | | 1057 | 715 | - | 2 | 33 | - | - | - | - | - | - | - | - | - | - | 181 | 30 | 186 | 30 | - | - | 195 | 90 | 187 | 90 | - | - | - | - | | | | | | |
| Normal | 220 kV NKLP - New Lahore | Energized Apr, 2018 | | | | | 220 | Energized Apr, 2018 | | | | | | | | | | - | - | Energized Apr, 2018 | | | | | | | | | | 192 | 150 | | | | | |
| N-1 | | | | | | | 29 | | | | | | | | | | | 190 | 90 | | | | | | | | | | | | | | | | | |

| | | | | | |
|----------------------------------|--------|--------|-------|-------|-------|
| Total No. of Variations (Normal) | 17,287 | 16,577 | 5,237 | 3,115 | 4,094 |
| Total No. of Variations (N-1) | 7,288 | 6,130 | - | 25 | 191 |
| Total of Normal & N-1 | 24,575 | 22,707 | 5,327 | 3,140 | 4,285 |

 Lowest Voltage Under Normal Condition
 Lowest Voltage Under N-1 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) | | | | | | | | | | | |
|----------------------------------|--|--|---------|---------|---------|---------|--|-----------------------|---------|------|---------|------|---------|------|---------|------|---|------|---------|-----------------------|---------|------|---------|------|---------|-----|----|--|
| | | | | | | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | | |
| | | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | | | |
| Normal | 220 kV Shalamar - KSK | 655 | 2337 | 2120 | 386 | 193 | - | - | - | - | - | - | - | - | - | - | 196 | 30 | 188 | 30 | 190 | 60 | 185 | 90 | 180 | 60 | | |
| N-1 | | 1 | 246 | 1036 | - | 4 | - | - | - | - | - | - | - | - | - | - | 203 | 30 | 188 | 30 | 178 | 60 | - | - | 180 | 150 | | |
| Normal | 220 kV Shalamar - Ravi | 664 | 2313 | 2122 | 700 | 827 | - | - | - | - | - | - | - | - | - | - | 196 | 30 | 194 | 90 | 190 | 60 | 185 | 90 | 182 | 60 | | |
| N-1 | | 1 | 269 | 1031 | 150 | 155 | - | - | - | - | - | - | - | - | - | - | 203 | 30 | 188 | 30 | 178 | 60 | 184 | 90 | 178 | 60 | | |
| Normal | 220 kV Shalamar - Ghazi Rd | Energized 18-Oct-2017 | | | | | 598 | Energized 18-Oct-2017 | | | | | | | | | | - | - | Energized 18-Oct-2017 | | | | | | 184 | 90 | |
| N-1 | | | | | | | - | | | | | | | | | | | - | - | | | | | | | | | |
| Total No. of Variations (Normal) | | 1,319 | 4,650 | 4,242 | 1,086 | 1,618 | | | | | | | | | | | | | | | | | | | | | | |
| Total No. of Variations (N-1) | | 2 | 515 | 2,067 | 150 | 159 | | | | | | | | | | | | | | | | | | | | | | |
| Total of Normal & N-1 | | 1,321 | 5,165 | 6,309 | 1,236 | 1,777 | | | | | | | | | | | | | | | | | | | | | | |

Lowest Voltage Under Normal Condition

Lowest Voltage Under N-1 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) | | | | | | | | | | | | |
|----------------------------------|--|--|---------|---------|---------|---------|--|------|---------|------|---------|------|---------|------|---------|------|---|------|---------|------|---------|------|---------|------|---------|------|---------|------|--|
| | | | | | | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | | | |
| | | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | 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 Ravi - Atlas | 3140 | 3391 | 1243 | 1310 | 426 | - | - | - | - | - | - | - | - | 232 | 90 | 188 | 270 | 198 | 270 | 180 | 90 | 180 | 150 | 191 | 90 | | | |
| N-1 | | 769 | 567 | 2 | 6 | 45 | - | - | - | - | - | - | - | - | - | - | 180 | 30 | 190 | 30 | 191 | 90 | 190 | 450 | 188 | 90 | | | |
| Normal | 220 kV Ravi - KSK I | 2553 | 3196 | 1619 | 1367 | 856 | - | - | - | - | - | - | - | - | - | - | 198 | 150 | 198 | 570 | 180 | 270 | 180 | 570 | 190 | 270 | | | |
| N-1 | | 370 | 561 | 8 | 4 | 49 | - | - | - | - | - | - | - | - | - | - | 182 | 30 | 188 | 30 | 182 | 90 | 190 | 180 | 191 | 180 | | | |
| Normal | 220 kV Ravi - KSK II | 1673 | 3196 | 1619 | 1367 | 856 | - | - | - | - | - | - | - | - | - | - | 185 | 30 | 198 | 570 | 180 | 270 | 180 | 570 | 190 | 270 | | | |
| N-1 | | 950 | 561 | 8 | 4 | 49 | - | - | - | - | - | - | - | - | - | - | 182 | 30 | 188 | 30 | 182 | 90 | 190 | 180 | 191 | 180 | | | |
| Normal | 220 kV Ravi - SKP | 3314 | 3120 | 1298 | 1320 | 553 | - | - | - | - | - | - | - | - | - | - | 198 | 270 | 198 | 450 | 180 | 90 | 178 | 90 | 187 | 60 | | | |
| N-1 | | 775 | 534 | 7 | 3 | 25 | - | - | - | - | - | - | - | - | - | - | 188 | 30 | 188 | 30 | 190 | 150 | 191 | 150 | 190 | 90 | | | |
| Normal | 220 kV Ravi - SMR | 834 | 3262 | 1789 | 1467 | 800 | - | - | - | - | - | - | - | - | - | - | 198 | 270 | 198 | 390 | 178 | 90 | 178 | 90 | 190 | 90 | | | |
| N-1 | | 315 | 821 | 11 | 9 | 54 | - | - | - | - | - | - | - | - | - | - | 188 | 30 | 185 | 30 | 180 | 120 | 188 | 90 | 190 | 60 | | | |
| Total No. of Variations (Normal) | | 11,514 | 16,165 | 7,568 | 6,831 | 3,471 | Highest Voltage Under Normal Condition | | | | | | | | | | Lowest Voltage Under Normal Condition | | | | | | | | | | | | |
| Total No. of Variations (N-1) | | 3,179 | 3,044 | 36 | 26 | 222 | | | | | | | | | | | Lowest Voltage Under N-1 Condition | | | | | | | | | | | | |
| Total of Normal & N-1 | | 14,693 | 19,209 | 7,604 | 6,857 | 3,693 | | | | | | | | | | | | | | | | | | | | | | | |

NTDC Lahore Region

17. 220kV Grid Station SAMUNDRI 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) | | | | | | | | | | | | | | |
|----------------------------------|--|--|------|---------|------|---------|--|---------|------|---------|------|---------|------|---------|------|---------|---|---------|------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | |
| Normal | 220 kV Samundri Road - Multan Ckt I | 139 | 289 | 633 | 48 | 36 | 236 | 390 | 240 | 90 | 240 | 150 | 236 | 60 | 241 | 150 | 200 | 90 | - | - | - | - | 200 | 330 | 200 | 330 | | | | | |
| N-1 | | - | 1 | 1 | 33 | 3 | - | - | - | - | - | - | - | - | - | - | - | - | 195 | 60 | 190 | 150 | 180 | 150 | 190 | 120 | | | | | |
| Normal | 220 kV Samundri Road - Multan Ckt II | 139 | 289 | 633 | 48 | 36 | 236 | 390 | 240 | 90 | 240 | 150 | 236 | 60 | 241 | 150 | 200 | 90 | - | - | - | - | 200 | 330 | 200 | 330 | | | | | |
| N-1 | | - | 1 | 1 | 33 | 3 | - | - | - | - | - | - | - | - | - | - | - | - | 195 | 60 | 190 | 150 | 180 | 150 | 190 | 120 | | | | | |
| Normal | 220 kV Samundri Road - Nishatabad Ckt I | 139 | 289 | 633 | 48 | 36 | 236 | 390 | 240 | 90 | 240 | 150 | 236 | 60 | 241 | 150 | 200 | 90 | - | - | - | - | 200 | 330 | 200 | 330 | | | | | |
| N-1 | | - | 1 | 1 | 33 | 3 | - | - | - | - | - | - | - | - | - | - | - | - | 195 | 60 | 190 | 150 | 180 | 150 | 190 | 120 | | | | | |
| Normal | 220 kV Samundri Road - Nishatabad Ckt II | 139 | 289 | 633 | 48 | 36 | 236 | 390 | 240 | 90 | 240 | 150 | 236 | 60 | 241 | 150 | 200 | 90 | - | - | - | - | 200 | 330 | 200 | 330 | | | | | |
| N-1 | | - | 1 | 1 | 33 | 3 | - | - | - | - | - | - | - | - | - | - | - | - | 195 | 60 | 190 | 150 | 180 | 150 | 190 | 120 | | | | | |
| Total No. of Variations (Normal) | | 556 | 1156 | 2532 | 192 | 144 | Highest Voltage Under Normal Condition | | | | | | | | | | Lowest Voltage Under Normal Condition | | | | | | | | | | | | | | |
| Total No. of Variations (N-1) | | - | 4 | 4 | 132 | 12 | | | | | | | | | | | Lowest Voltage Under N-1 Condition | | | | | | | | | | | | | | |
| Total of Normal & N-1 | | 556 | 1160 | 2536 | 324 | 156 | | | | | | | | | | | | | | | | | | | | | | | | | |

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) | | | | | | | | | | | |
|-----------|--|--|---------|---------|---------|---------|--|------|---------|------|---------|------|---------|------|---------|------|---|------|---------|------|---------|------|---------|------|---------|------|---------|------|
| | | | | | | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | | |
| | | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | 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 SNR - YSW Ckt I | 1081 | 672 | 1068 | 701 | 472 | - | - | - | - | - | - | - | - | - | - | - | - | 198 | 660 | 190 | 240 | 185 | 60 | 190 | 90 | 185 | 90 |
| N-1 | | 68 | 33 | 110 | 48 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | 185 | 30 | 190 | 240 | 180 | 30 | 184 | 90 | 195 | 150 |
| Normal | 220 kV SNR - YSW Ckt II | 1081 | 672 | 1068 | 701 | 472 | - | - | - | - | - | - | - | - | - | - | - | - | 198 | 660 | 190 | 240 | 185 | 60 | 190 | 90 | 185 | 90 |
| N-1 | | 68 | 33 | 110 | 48 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | 185 | 30 | 190 | 240 | 180 | 30 | 184 | 90 | 195 | 150 |
| Normal | 220 kV SNR - NKLP Ckt I | 1064 | 673 | 1073 | 694 | 667 | - | - | - | - | - | - | - | - | - | - | - | - | 198 | 660 | 169 | 240 | 185 | 60 | 190 | 90 | 195 | 90 |
| N-1 | | 73 | 35 | 109 | 46 | 6 | - | - | - | - | - | - | - | - | - | - | - | - | 185 | 30 | 169 | 240 | 185 | 150 | 180 | 60 | 185 | 90 |
| Normal | 220 kV SNR - NKLP Ckt II | 1064 | 673 | 1073 | 694 | 667 | - | - | - | - | - | - | - | - | - | - | - | - | 198 | 660 | 169 | 240 | 185 | 60 | 190 | 90 | 195 | 90 |
| N-1 | | 73 | 35 | 109 | 46 | 6 | - | - | - | - | - | - | - | - | - | - | - | - | 185 | 30 | 169 | 240 | 185 | 150 | 180 | 60 | 185 | 90 |
| Normal | 220 kV SNR - Okara Ckt | Not existing | 672 | 1068 | 531 | 670 | Not existing | 250 | 30 | 250 | 30 | 250 | 30 | 250 | 30 | 250 | 30 | 250 | 30 | 195 | 240 | 185 | 60 | 190 | 90 | 185 | 90 | |
| N-1 | | | 33 | 110 | 39 | 4 | | - | - | - | - | - | - | - | - | - | - | - | 190 | 120 | 180 | 30 | 180 | 60 | 190 | 510 | | |

| | | | | | |
|----------------------------------|-------|-------|-------|-------|-------|
| Total No. of Variations (Normal) | 4,290 | 3,362 | 5,350 | 3,321 | 2,948 |
| Total No. of Variations (N-1) | 282 | 169 | 548 | 227 | 20 |
| Total of Normal & N-1 | 4,572 | 3,531 | 5,898 | 3,548 | 2,968 |

 Lowest Voltage Under Normal Condition

 Lowest Voltage Under N-1 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) | | | | | | | | | |
|-----------|--|--|---------|---------|---------|---------|--|------|---------|------|---------|------|---------|------|---------|------|---|------|---------|------|---------|------|---------|------|---------|-----|
| | | | | | | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
| | | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | |
| Normal | 220 kV Sialkot - Gakkhar | 402 | 430 | 681 | 1123 | 1183 | - | - | - | - | - | - | - | - | - | - | 198 | 180 | 190 | 360 | 170 | 240 | 180 | 210 | 180 | 390 |
| N-1 | | 113 | 76 | 1 | 2 | 4 | - | - | - | - | - | - | - | - | - | - | 180 | 120 | 180 | 120 | 195 | 60 | 195 | 90 | 188 | 90 |
| Normal | 220 kV Sialkot - KSK | 403 | 401 | 681 | 1127 | 1163 | - | - | - | - | - | - | - | - | - | - | 198 | 300 | 190 | 360 | 170 | 240 | 175 | 150 | 180 | 210 |
| N-1 | | 113 | 75 | - | - | 2 | - | - | - | - | - | - | - | - | - | - | 180 | 120 | 180 | 120 | - | - | - | - | 180 | 90 |

KSK: Kala Shah Kaku

| | | | | | |
|----------------------------------|-------|-----|-------|-------|-------|
| Total No. of Variations (Normal) | 805 | 831 | 1,362 | 2,250 | 2,346 |
| Total No. of Variations (N-1) | 226 | 151 | 1 | 2 | 6 |
| Total of Normal & N-1 | 1,031 | 982 | 1,363 | 2,252 | 2,352 |

 Lowest Voltage Under Normal Condition

 Lowest Voltage Under N-1 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) | | | | | | | | | |
|-----------|---|--|---------|---------------|---------|---------|--|------|---------------------|------|---------|---------------|---------|------|---|------|---------------------|------|---------|---------------|---------|------|--|--|
| | | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | |
| Normal | 220 kV Multan - T.T. Singh - Samundri Road Ckt I T-OFF 220 kV G/S T.T.Singh | Energized June 2015 | 240 | Refer Table 2 | | | | | Energized June 2015 | 240 | 660 | Refer Table 2 | | | | | Energized June 2015 | - | - | Refer Table 2 | | | | |
| N-1 | | | 1 | | | | | | | - | - | | | | | | | 186 | 90 | | | | | |

Table 1

| | | | | | | | | | | | | | | | | | | | | | | |
|--------|--|---------------------|---------------|-----|-----|-----|---------------------|---------------|-----|-----|-----|-----|-----|-----|---------------------|---------------|-----|----|-----|-----|-----|-----|
| Normal | 220 kV T.T. Singh - Multan Ckt I & II | Energized June 2015 | Refer table 1 | 448 | 425 | 455 | Energized June 2015 | Refer table 1 | 238 | 600 | 244 | 390 | 243 | 450 | Energized June 2015 | Refer table 1 | 193 | 60 | 189 | 150 | 180 | 870 |
| N-1 | | | | - | - | - | | | - | - | - | - | - | - | | | - | - | - | - | - | - |
| Normal | 220 kV T.T. Singh - Samundri Road Ckt I & II | Energized June 2015 | Refer table 1 | 448 | 425 | 455 | Energized June 2015 | Refer table 1 | 238 | 600 | 244 | 390 | 243 | 450 | Energized June 2015 | Refer table 1 | 193 | 60 | 189 | 150 | 180 | 870 |
| N-1 | | | | - | - | - | | | - | - | - | - | - | - | | | - | - | - | - | - | - |

Table 2

| | | | | | | | | | |
|----------------------------------|---------------------|-----|-----|-----|-----|--|--|--|---------------------------------------|
| Total No. of Variations (Normal) | Energized June 2015 | 240 | 896 | 850 | 910 | | Highest Voltage Under Normal Condition | | Lowest Voltage Under Normal Condition |
| Total No. of Variations (N-1) | | 1 | - | - | - | | | | |
| Total of Normal & N-1 | | 241 | 896 | 850 | 910 | | | | |

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) | | | | | | | | | | | | |
|----------------------------------|--|--|-------|---------|-------|---------|--|---------|---------|---------|---------|---------|---------|---------|---------|---------|---|---------|---------|---------|---------|---------|---------|-----|---------|-----|--|--|--|
| | | | | | | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | | | |
| | | 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 WTN - NKLP | 1610 | 2331 | 690 | 710 | 1054 | - | - | - | - | - | - | - | - | - | - | 192 | 120 | 190 | 180 | 185 | 90 | 188 | 150 | 175 | 90 | | | |
| N-1 | | - | 288 | - | - | 13 | - | - | - | - | - | - | - | - | - | - | - | 187 | 60 | - | - | - | - | 175 | 90 | | | | |
| Normal | 220 kV WTN - Sheikhupura | 1601 | 2233 | 691 | 557 | 963 | - | - | - | - | - | - | - | - | - | - | 190 | 120 | 197 | 90 | 160 | 120 | 187 | 150 | 180 | 90 | | | |
| N-1 | | 5 | 124 | - | - | 9 | - | - | - | - | - | - | - | - | - | - | 195 | 160 | 188 | 60 | - | - | - | - | 191 | 150 | | | |
| Total No. of Variations - Normal | | 3,211 | 4,564 | 1,381 | 1,267 | 2,017 | | | | | | | | | | | Lowest Voltage Under Normal Condition | | | | | | | | | | | | |
| Total No. of Variations - N-1 | | 5 | 412 | - | - | 22 | | | | | | | | | | | Lowest Voltage Under N-1 Condition | | | | | | | | | | | | |
| Total of Normal & N-1 | | 3,216 | 4,976 | 1,381 | 1,267 | 2,039 | | | | | | | | | | | | | | | | | | | | | | | |

APPENDIX 3

Voltage violations data - detailed circuit wise analysis

NTDC Multan Region

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

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) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|----------------------------------|--|---|------|---------|------|--------------------|---|---------|------|---------|------|---------|------|--------------------|---|---------|---|---------|------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Normal | 500 kV D.G. Khan - Guddu | NIL | 14 | NIL | 15 | 26 | NIL | 569 | 60 | NIL | 564 | 60 | 575 | 60 | NIL | 569 | 60 | NIL | — | — | — | — | NIL | — | — | — | — | — | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| N-1 | | | — | | — | — | | — | — | | — | — | — | — | | — | — | | — | — | — | — | | — | — | — | — | — | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Normal | 500 kV D.G. Khan - Multan | Provided as 500kV Multan-D.G. Khan-Guddu | | | | 1 | Provided as 500kV Multan-D.G. Khan-Guddu | | | | | | 554 | 30 | Provided as 500kV Multan-D.G. Khan-Guddu | | | | | | | | | | — | — | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| N-1 | | | | | | — | | | | | | | — | — | | | | | | | | | | | — | — | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Normal | 220 kV D.G. Khan - Loralai I | Energized Aug 2014 | NIL | 150 | NP | Energized Aug 2014 | NIL | | | NP | 250 | 60 | NP | Energized Aug 2014 | | NIL | | — | | — | | NP | | — | | NP | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| N-1 | | | | | | | | | | | — | — | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Normal | 220 kV D.G. Khan - Loralai II | Energized Aug 2014 | NIL | 150 | NP | Energized Aug 2014 | NIL | | | NP | 250 | 60 | NP | Energized Aug 2014 | | NIL | | — | | — | | NP | | — | | NP | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| N-1 | | | | | | | | | | | — | — | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total No. of Variations (Normal) | | Energized Aug 2014 | 14 | NIL | 315 | 27 | Highest Voltage Under Normal Condition @500kV level | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total No. of Variations (N-1) | | | — | | — | — | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total of Normal & N-1 | | | 14 | | 315 | 27 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

NTDC Multan Region

2. 500kV Grid Station MULTAN

Multan Region
2 of 11

| 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) | | | | | | | | | | | | | | | | | | | | | |
|-----------|--|--|------|---------|------|---------------------|--|---------|------|---------|------|---------|------|---------|---|--------------------------|---------------------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|--|--|--|--|--|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | | | | | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | | | | | | |
| Normal | 500 kV Multan - Guddu I | NIL | | | | NP | NIL | | | | | | | | NP | NIL | | | | | | | | NP | | | | | | | | | | | | |
| Normal | 500 kV Multan - Guddu 747 | NIL | | | | | NIL | | | | | | | | | NIL | | | | | | | | NIL | | | | | | | | | | | | |
| Normal | 500 kV Multan - Muzaffargarh | NIL | | | | | NIL | | | | | | | | | NIL | | | | | | | | NIL | | | | | | | | | | | | |
| Normal | 500 kV Multan - Yousafwala | NIL | | | | NP | NIL | | | | | | | | NP | NIL | | | | | | | | NP | | | | | | | | | | | | |
| Normal | 500 kV Multan - Gatti | NIL | | | | NP | NIL | | | | | | | | NP | NIL | | | | | | | | NP | | | | | | | | | | | | |
| Normal | 500 kV Multan - Rousch | NIL | | | | NP | NIL | | | | | | | | NP | NIL | | | | | | | | NP | | | | | | | | | | | | |
| Normal | 500 kV Multan - D.G. Khan - Guddu | NIL | | | | NP | NIL | | | | | | | | NP | NIL | | | | | | | | NP | | | | | | | | | | | | |
| Normal | 500 kV Multan - R Y Khan | Commissioned in Feb 2018 | | | | NIL | Commissioned in Feb 2018 | | | | | | | | NIL | Commissioned in Feb 2018 | | | | | | | | NIL | | | | | | | | | | | | |
| Normal | 220 kV Multan - Muzaffargarh 1 | NIL | | | | NP | NIL | | | | | | | | NP | NIL | | | | | | | | NP | | | | | | | | | | | | |
| Normal | 220 kV Multan - Muzaffargarh 2 | 3 | 5 | 7 | 2 | NP | 266 | 120 | 246 | 60 | 247 | 60 | 254 | 60 | NP | - | | | | | | | | NP | | | | | | | | | | | | |
| N-1 | Multan - Muzaffargarh 2 | - | - | - | - | | - | - | - | - | - | - | - | - | | - | | | | | | | | - | | | | | | | | | | | | |
| Normal | 220 kV Multan - Muzaffargarh 3 | 2 | 1 | NIL | 1 | NP | 250 | 60 | 244 | 240 | NIL | | 245 | 90 | NP | - | | | | | | | | NIL | | | | | | | | | | | | |
| N-1 | Multan - Muzaffargarh 3 | - | - | | - | | - | - | - | - | | | - | - | | - | | | | | | | | - | | | | | | | | | | | | |
| Normal | 220 kV Multan - Muzaffargarh 4 | NIL | | | | NP | NIL | | | | | | | | NP | NIL | | | | | | | | NP | | | | | | | | | | | | |
| Normal | 220 kV Multan - Kapco 3 | 1 | NIL | | | NP | 245 | 240 | NIL | | | | | | NP | - | | | | | | | | NIL | | | | | | | | | | | | |
| N-1 | Multan - Kapco 3 | - | | | | | - | - | | | | | | | | - | | | | | | | | - | | | | | | | | | | | | |
| Normal | 220 kV Multan - Kafco 4 | 3 | 14 | 1 | NIL | | NP | 246 | 330 | 249 | 60 | 246 | 120 | | | NP | - | | | | | | | | - | | | | | | | | | | | |
| N-1 | Multan - Kafco 4 | - | - | - | | | - | - | - | - | - | - | - | | | | | | | | - | | | | | | | | | | | | | | | |
| Normal | 220 kV Multan - Kafco 5 & 6 | 1 | NIL | | | NP | 246 | 180 | NIL | | | | | | NP | - | | | | | | | | NIL | | | | | | | | | | | | |
| N-1 | Multan - Kafco 5 & 6 | - | | | | | - | - | | | | | | | | - | | | | | | | | - | | | | | | | | | | | | |
| Normal | 220 kV Multan - NGPS 1 & 2 | NIL | | | | NP | NIL | | | | | | | | NP | NIL | | | | | | | | NP | | | | | | | | | | | | |
| Normal | 220 kV Multan - Vehari 1 & 2 | NIL | | | | NP | NIL | | | | | | | | NP | - | | | | | | | | - | | | | | | | | | | | | |
| N-1 | Multan - Samundri Road | NIL | | | | | NIL | | | | | | | | | | - | | | | | | | | - | | | | | | | | | | | |
| Normal | 220 kV Multan - T.T. Singh 1 & 2 | Energized june 2015 | NIL | | NP | Energized june 2015 | | NIL | | | | | | | | NP | Energized june 2015 | | | | | | | | NP | | | | | | | | | | | |
| N-1 | Multan - T.T. Singh 1 & 2 | NIL | | | | NIL | | NIL | | | | | | | | | NIL | | | | | | | | - | | | | | | | | | | | |

NP: Not Provided

| | | | | | |
|----------------------------------|----|----|---|---|-----|
| Total No. of Variations (Normal) | 10 | 20 | 8 | 3 | NIL |
| Total No. of Variations (N-1) | - | - | - | - | NIL |
| Total of Normal & N-1 | 10 | 20 | 8 | 3 | NIL |

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) | | | | | | | | | | | | | | | | |
|-----------|--|--|------|---------|------|---------|--|---------|------|---------|------|---------|------|---------|---|---------|------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | |
| Normal | 500 kV Muzaffargarh - Gatti | NIL | | NP | | NIL | | | | NP | | NIL | | | | | | | | | | | | | | | | | NP | | |
| N-1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Normal | 500 kV Muzaffargarh - Guddu | NIL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| N-1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Normal | 500 kV Muzaffargarh - Multan | NIL | | NP | | NIL | | | | NP | | NIL | | | | | | | | | | | | | | | | | NP | | |
| N-1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Normal | 220 kV 500kV Grid Station TPS Phase-I - Muzaffargarh | NIL | | NP | | NIL | | | | NP | | NIL | | | | | | | | | | | | | | | | | NP | | |
| N-1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Normal | 220 kV 500kV Grid Station TPS Phase-II - Muzaffargarh | NIL | | NP | | NIL | | | | NP | | NIL | | | | | | | | | | | | | | | | | NP | | |
| N-1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

NP: Not Provided

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

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) | | | | | | | | | | | | | | |
|-----------|--|--|------|---------|------|---------|--|---------|------|---------|------|---------|----------------------|---------|------|---------|---|---------|------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | |
| Normal | 500 kV Yousafwala - Lahore | - | 33 | NA | | NP | - | - | 538 | 120 | NA | | NP | | - | - | - | - | NA | | NP | | NA | | NP | | | | | | |
| N-1 | | - | - | | | | - | - | - | - | | | | | - | - | - | - | | | | | | | | | | | | | |
| Normal | 500 kV Yousafwala - Multan | - | 33 | NA | | 207 | - | - | 538 | 120 | NA | | 544 | 120 | - | - | - | - | NA | | NA | | - | - | NA | | | | | | |
| N-1 | | - | - | | | | - | - | - | - | | | - | - | - | - | - | - | | | | | | | | | | | | | |
| Normal | 500 kV Yousafwala - CFPP | | | | | 204 | - | - | | | | | - | - | 543 | | 180 | | | | | | | | | | | | | | |
| N-1 | | | | | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | | | |
| Normal | 220 kV Yousafwala - SNR | 2 | 95 | NA | 42 | NP | - | - | 235 | 60 | NA | - | - | NP | | 205 | 120 | 203 | 60 | NA | 208 | 180 | NP | | - | - | NA | | | | |
| N-1 | | - | - | | | | - | - | - | - | | - | - | | | - | - | - | - | | | | | | | | | | | | |
| Normal | 220 kV Yousafwala - Gatti | 2 | 95 | NA | 42 | 49 | - | - | 235 | 60 | NA | - | - | 238 | 180 | 205 | 120 | 203 | 60 | NA | 208 | 180 | NA | | - | - | NA | | | | |
| N-1 | | - | - | | | | - | - | - | - | | - | - | - | - | - | - | - | - | | | | | | | | | | | | |
| Normal | 220 kV Yousafwala - Kassowal | 2 | 95 | NA | 42 | 40 | - | - | 235 | 60 | NA | - | - | 236 | 180 | 205 | 120 | 203 | 60 | NA | 208 | 180 | NA | | - | - | NA | | | | |
| N-1 | | - | - | | | | - | - | - | - | | - | - | - | - | - | - | - | - | | | | | | | | | | | | |
| Normal | 220 kV Yousafwala - CFPP | Energized June, 2015 | | NP | | 43 | Energized June, 2015 | | NP | | 543 | 180 | Energized June, 2015 | | 543 | 180 | NP | | NP | | - | - | NP | | - | - | | | | | |
| N-1 | | | | | | - | | | | | - | - | | | - | - | | | | | | | | | | | | | | | |

 Highest Voltage Under Normal Condition @500kV level

 Highest Voltage Under Normal Condition @220kV level

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) | | | | | | | | | | | |
|----------------------------------|--|--|------|---------|------|---------|--|---------------------|---------|---------|---------|---------|---------|---------|---|---------|---------|---------------------|---------|---------|---------|---------|---------|---------|---------|-----|
| | | | | | | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | |
| Normal | 500 kV | Energized Feb, 2018 | | | | | NIL | Energized Feb, 2018 | | | | | | | | NIL | | Energized Feb, 2018 | | | | | | | | NIL |
| N-1 | Guddu 747 - RY Khan | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total No. of Variations (Normal) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total No. of Variations (N-1) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total of Normal & N-1 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |

NTDC Multan Region

6. 220kV Grid Station BAHAWALPUR

| Condition | Name of Transmission Circuit(s) violating the voltage criteria | Total Number / Times violating the limit | | | | | Highest Voltage Recorded (kV) / Time (Min) | | | | | | | | Lowest Voltage Recorded (kV) / Time (Min) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|----------------------------------|--|--|------|---------|------|---------|---|---------|------|---------|------|---------|------|---------|---|---------|------|---------|--|---------|------|---------|------|---------|------|---------|------|---------|------|---------|--|--|--|--|--|--|--|--|--|--|--|--|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | | | | | | | | | | | | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | | | | | | | | | | | | | |
| Normal | 220 kV Bahawalpur - TPS Muzaffargarh Ckt I & II | 421 | 305 | 506 | 15 | 21 | 248 | 90 | 236 | 180 | 248 | 30 | 242 | 60 | 242 | 180 | 200 | 60 | 205 | 120 | 196 | 30 | 197 | 30 | 197 | 30 | 30 | 30 | | | | | | | | | | | | | | | |
| N-1 | | - | - | - | 5 | - | - | - | - | - | - | - | - | 246 | 30 | - | - | - | - | - | - | - | - | - | 194 | 30 | - | - | | | | | | | | | | | | | | | |
| Total No. of Variations (Normal) | | 421 | 305 | 506 | 15 | 21 | Highest Voltage Under Normal Condition | | | | | | | | | | | | Lowest Voltage Under Normal Condition | | | | | | | | | | | | | | | | | | | | | | | | |
| Total No. of Variations (N-1) | | - | - | - | 5 | - | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total of Normal & N-1 | | 421 | 305 | 506 | 20 | 21 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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) | | | | | | | | | | | | | | | | |
|----------------------------------|--|--|------|---------|-------|---------|--|---------|------|---------|------|---------|------|---------|---|---------|------|---------|------|---------|------|---------|---------------------|---------|------|---------|------|---------|------|---------|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | |
| Normal | Kassowal - Vehari 1 | Energized July 2015 | NIL | 502 | 980 | 248 | Energized July 2015 | NIL | 241 | 30 | 245 | 30 | 243 | 120 | Energized July 2015 | NIL | 200 | 60 | 198 | 60 | 197 | 60 | Energized July 2015 | NIL | - | - | - | - | - | - | |
| N-1 | | | | - | - | 1 | | | - | - | - | - | 243 | 150 | | | - | - | - | - | - | - | | | - | - | - | - | - | - | |
| Normal | Kassowal - Vehari 2 | Energized July 2015 | NIL | 502 | 980 | 248 | Energized July 2015 | NIL | 241 | 30 | 245 | 30 | 243 | 120 | Energized July 2015 | NIL | 200 | 60 | 198 | 60 | 197 | 60 | Energized July 2015 | NIL | - | - | - | - | - | - | |
| N-1 | | | | - | - | 1 | | | - | - | - | - | 243 | 150 | | | - | - | - | - | - | - | | | - | - | - | - | - | - | |
| Normal | Kassowal - Yousafwala 1 | Energized July 2015 | NIL | 502 | 931 | 248 | Energized July 2015 | NIL | 241 | 30 | 245 | 30 | 243 | 150 | Energized July 2015 | NIL | 200 | 60 | 198 | 60 | 197 | 60 | Energized July 2015 | NIL | - | - | - | - | 189 | 90 | |
| N-1 | | | | - | - | 2 | | | - | - | - | - | - | - | | | - | - | - | - | - | - | | | - | - | - | - | - | - | |
| Normal | Kassowal - Yousafwala 2 | Energized July 2015 | NIL | 502 | 931 | 248 | Energized July 2015 | NIL | 241 | 30 | 245 | 30 | 243 | 150 | Energized July 2015 | NIL | 200 | 60 | 198 | 60 | 197 | 60 | Energized July 2015 | NIL | - | - | - | - | 189 | 90 | |
| N-1 | | | | - | - | 2 | | | - | - | - | - | - | - | | | - | - | - | - | - | - | | | - | - | - | - | - | - | |
| Total No. of Variations (Normal) | | Energized July 2015 | NIL | 2,008 | 3,822 | 998 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total No. of Variations (N-1) | | | NIL | - | - | - | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total of Normal & N-1 | | | NIL | 2,008 | 3,822 | 998 | | | | | | | | | | | | | | | | | | | | | | | | | |

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

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) | | | | | | | | | | | | | | | | |
|-----------|--|--|------|---------|------|---------|--|---------|------|---------|------|---------|------|---------|---|---------|------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | |
| Normal | 220 kV Muzaffargarh - Multan | - | 4 | NIL | 276 | - | - | 236 | 90 | NIL | 244 | 120 | - | - | - | - | NIL | - | - | - | NIL | - | - | NIL | - | - | - | | | | |
| N-1 | | - | - | | - | - | - | - | - | | - | - | - | - | - | - | | - | - | - | | - | - | | - | - | - | - | | | |
| Normal | 220 kV Muzaffargarh - TPS | - | NP | NIL | 374 | - | - | NP | NIL | 245 | 180 | - | - | NP | NIL | - | - | NP | NIL | - | - | NP | NIL | - | - | NP | NIL | | | | |
| N-1 | | - | | | - | - | - | | | - | - | - | - | | | - | - | | | - | - | | | - | - | | | | | | |

NP : Not Provided

| | | | | | |
|----------------------------------|---|---|--|-----|-----|
| Total No. of Variations (Normal) | - | 4 | | NIL | 650 |
| Total No. of Variations (N-1) | - | - | | - | - |
| Total of Normal & N-1 | - | 4 | | NIL | 650 |

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) | | | | | | | | | | | | | | | | |
|-----------|--|--|------|---------|------|---------|--|---------|------|---------|------|---------|------|---------|------|----------------------|---|---------------------------------------|------|---------|------|---------|------|---------|----------------------|---------|------|---------|------|---------|-----|-----|------|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | | | |
| Normal | 220 kV Okara - Sarfaraznagar | Energized June, 2015 | 75 | 338 | 321 | 139 | Energized June, 2015 | 234 | 60 | - | - | 239 | 360 | 236 | 90 | Energized June, 2015 | 202 | 60 | 190 | 90 | 196 | 900 | 190 | 270 | Energized June, 2015 | 202 | 60 | 190 | 90 | 196 | 900 | 190 | 270 |
| N-1 | | | - | - | - | - | | - | - | - | - | - | - | - | - | | - | - | - | - | - | - | - | - | | - | - | - | - | - | - | - | - |
| Normal | 220 kV Okara - Sarfaraznagar Ckt I & II | Proper in out energized on 19.12.2017 | | | | 44 | Proper in out energized on 19.12.2017 | | | | | | | | | 237 | 240 | Proper in out energized on 19.12.2017 | | | | | | | | | | - | - | | | | |
| N-1 | | | | | | - | | | | | | | | | | - | - | | | | | | | | | | | - | - | | | | |
| Normal | 220 kV Okara - Yousafwala | Energized June, 2015 | - | 338 | 205 | 137 | Energized June, 2015 | - | - | - | - | 239 | 360 | 236 | 90 | Energized June, 2015 | - | - | 190 | 90 | 196 | 900 | 199 | 1410 | Energized June, 2015 | - | - | 190 | 90 | 196 | 900 | 199 | 1410 |
| N-1 | | | - | - | - | 1 | | - | - | - | - | - | - | - | - | | - | - | - | - | - | - | - | - | | - | - | - | - | - | - | 180 | 450 |
| Normal | 220 kV Okara - Yousafwala Ckt I & II | Proper in out energized on 19.12.2017 | | | | 44 | Proper in out energized on 19.12.2017 | | | | | | | | | 237 | 240 | Proper in out energized on 19.12.2017 | | | | | | | | | | - | - | | | | |
| N-1 | | | | | | - | | | | | | | | | | - | - | | | | | | | | | | | - | - | | | | |

| | | | | | |
|----------------------------------|----------------------|----|-----|-----|-----|
| Total No. of Variations (Normal) | Energized June, 2015 | 75 | 338 | 526 | 364 |
| Total No. of Variations (N-1) | | - | - | - | 1 |
| Total of Normal & N-1 | | 75 | 338 | 526 | 365 |

 Highest Voltage Under Normal Condition

 Lowest Voltage Under Normal Condition

 Lowest Voltage Under N-1 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) | | | | | | | | | | | | | | | | |
|-----------|--|--|---------|---------|---------|---------|--|---------------------|---------|------|---------|------|---------|------|---|---------------------|----------------------|------|---------|------|---------|------|---------|------|---------|----|--|--|--|--|--|
| | | | | | | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | | | | | |
| | | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | 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 | 559 | 764 | 297 | 837 | 1640 | 240 | 150 | 240 | 120 | 240 | 90 | 242 | 270 | 242 | 270 | 200 | 150 | - | - | 205 | 30 | 204 | 30 | 196 | 30 | | | | | |
| N-1 | | 6 | - | - | 2 | 140 | 246 | 30 | - | - | - | - | 243 | 90 | 248 | 150 | 180 | 30 | - | - | - | - | - | - | 190 | 30 | | | | | |
| Normal | 220 kV Vehari - Yousafwala Ckt I & II | 561 | NP | - | NP | 238 | 210 | NP | NP | - | - | NP | | | | 200 | 150 | NP | NP | - | - | NP | | | | | | | | | |
| N-1 | | 6 | | - | | 246 | 30 | | | - | - | | | | | 180 | 30 | | | - | - | | | | | | | | | | |
| Normal | 220 kV Vehari - Kassowal Ckt I & II | Energized July, 2015 | | 296 | 852 | 1638 | Energized July, 2015 | | | | 240 | 90 | 243 | 30 | 242 | 150 | Energized July, 2015 | | | | 205 | 30 | 204 | 30 | 196 | 30 | | | | | |
| N-1 | | | | - | 2 | 140 | | | | | - | - | 243 | 90 | 248 | 150 | | | | | - | - | - | - | 190 | 30 | | | | | |
| Normal | 220 kV Vehari - Chishtian Ckt I & II | Energized Oct, 2016 | | 824 | 1637 | 2 | 140 | Energized Oct, 2016 | | | | 242 | 270 | 243 | 90 | Energized Oct, 2016 | | | | 205 | 30 | 194 | 30 | 191 | 30 | | | | | | |
| N-1 | | | | 2 | 140 | | | | | | | 243 | 90 | 247 | 150 | | | | | | | | | | | | | | | | |

NP: Not Provided

| | | | | | |
|----------------------------------|-------|-----|-----|-------|-------|
| Total No. of Variations - Normal | 1,120 | 764 | 593 | 2,513 | 4,915 |
| Total No. of Variations - N-1 | 12 | - | - | 6 | 420 |
| Total of Normal & N-1 | 1,132 | 764 | 593 | 2,519 | 5,335 |

 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

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) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|----------------------------------|--|--|------|---------|------|--|--|-----------------------|------|---------------------------------------|------|-----------------------|------|-------------------------------------|---|-----------------------|------|------------------------------------|------|-----------------------|------|-------------------------------------|------|-----------------------|------|------------------------------------|------|---------|------|---------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | | | | | | | | | | | | | | | | | | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | | | | | | | | | | | | | | | | | | | |
| Normal | 220 kV Chishtian - Vehari Ckt I & II | Energized 24-Oct-2016 | 75 | 338 | 722 | 3282 | Energized 24-Oct-2016 | | | | | 244 | 60 | 241 | 90 | Energized 24-Oct-2016 | | | | | - | - | 199 | 120 | | | | | | | | | | | | | | | | | | | | | | | | | |
| N-1 | | | - | - | 70 | 505 | | | | | | 247 | 60 | 249 | 30 | | | | | | - | - | 173 | 30 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total No. of Variations (Normal) | | Energized 24-Oct-2016 | | 722 | 3282 | Highest Voltage Under Normal Condition | | Energized 24-Oct-2016 | | Lowest Voltage Under Normal Condition | | Energized 24-Oct-2016 | | Highest Voltage Under N-1 Condition | | Energized 24-Oct-2016 | | Lowest Voltage Under N-1 Condition | | Energized 24-Oct-2016 | | Highest Voltage Under N-1 Condition | | Energized 24-Oct-2016 | | Lowest Voltage Under N-1 Condition | | | | | | | | | | | | | | | | | | | | | | | |
| Total No. of Variations (N-1) | | | | 70 | 505 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total of Normal & N-1 | | | | 792 | 3787 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

APPENDIX 4

Voltage violations data - detailed circuit wise analysis

NTDC Hyderabad Region

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

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) | | | | | | | | | | |
|-----------|--|--|---------|---------|---------|--|--|------|---------|------|---------|------|--|------|---------|--------------------|---|------|---------|------|---------|------|---------|------|---------|------|---------|
| | | | | | | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | |
| | | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage |
| Normal | 500 kV Dadu - Jamshoro I | 829 | 162 | 9 | 1 | 15 | 540 | 560 | 541 | 60 | 539 | 1350 | 526 | 180 | 535 | 60 | - | - | - | - | - | - | - | - | - | - | - |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Normal | 500 kV Dadu - Jamshoro II | 1510 | 565 | 99 | 3 | 15 | 544 | 120 | 542 | 300 | 540 | 180 | 530 | 240 | 535 | 60 | - | - | - | - | - | - | - | - | - | - | - |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Normal | 500 kV Dadu - Guddu I | 472 | 149 | 7 | NP | | 540 | 120 | 542 | 120 | 535 | 420 | NP | | - | - | - | - | - | - | - | - | - | NP | | | |
| N-1 | | - | - | - | | | - | - | - | - | - | - | | | - | - | - | - | - | - | - | - | - | | | | |
| Normal | 500 kV Dadu - Guddu II | 53 | 24 | NIL | 2 | 5* | 540 | 180 | 540 | 180 | NIL | | 528 | 60 | 535 | 60 | - | - | - | - | - | - | - | - | - | - | - |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Normal | 500 kV Dadu - Shikarpur I | does not exist | | | 3 | 15 | does not exist | | | | | 530 | 60 | 535 | 120 | does not exist | | | | | - | - | - | - | - | - | - |
| N-1 | | | | | - | - | | | | | | - | - | - | - | | | | | | - | - | - | - | - | - | - |
| Normal | 500 kV Dadu - Shikarpur II | Bifurcated from Dadu - Guddu II since March 2018 | | | 10 | Bifurcated from Dadu - Guddu II since March 2018 | | | | | 535 | 120 | Bifurcated from Dadu - Guddu II since March 2018 | | | | | - | - | - | - | - | - | - | - | - | |
| N-1 | | | | | - | | | | | | - | | | | | | | | | | | | | | | | |
| Normal | 220 kV Dadu - Khuzdar I | Energized Aug 2014 | 1484 | 531 | 344 | 106 | Energized Aug 2014 | 246 | 120 | 240 | 360 | 240 | 120 | 238 | 360 | Energized Aug 2014 | - | - | - | - | - | - | - | - | - | - | |
| N-1 | | | - | - | - | - | | - | - | - | - | - | - | - | - | | - | - | - | - | - | - | - | - | - | - | |
| Normal | 220 kV Dadu - Khuzdar II | Energized Aug 2014 | 141 | 189 | 380 | 99 | Energized Aug 2014 | 242 | 240 | 240 | 360 | 240 | 240 | 238 | 360 | Energized Aug 2014 | - | - | - | - | - | - | - | - | - | - | |
| N-1 | | | - | - | - | - | | - | - | - | - | - | - | - | - | | - | - | - | - | - | - | - | - | - | - | |

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

| | | | | | |
|----------------------------------|-------|-------|-----|-----|-----|
| Total No. of Variations (Normal) | 2,864 | 2,525 | 835 | 733 | 265 |
| Total No. of Variations (N-1) | - | - | - | - | - |
| Total of Normal & N-1 | 2,864 | 2,525 | 835 | 733 | 265 |

 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) | | | | | | | | | | | | | | |
|-----------|--|---|------|---------|------------------------|---------|---|---------|------|---------|------|---------|------------------------|------------------------|---|---------|---|---------|------|---------|------|---------|------|---------|------|------------------------|------------------------|---------|------|---------|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | |
| Normal | 500 kV Guddu - Dadu I | 39 | NA | NP | 535 | 120 | NA | NP | - | - | NA | NP | - | - | NA | NP | - | - | NA | NP | - | - | NA | NP | - | - | | | | | |
| N-1 | | - | | | - | - | | | - | - | | | - | - | | | - | - | | | - | - | | | - | - | | | | | |
| Normal | 500 kV Guddu - Dadu II | 1545 | 1449 | 1268 | 1183 | 521* | 540 | 60 | 540 | 180 | 540 | 90 | 540 | 420 | 540 | 420 | - | - | - | - | - | - | - | - | - | - | - | - | - | | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | |
| Normal | 500 kV Guddu - D.G. Khan (Old Multan) | - | - | 1382 | NP | 504 | - | - | - | - | 638 | 60 | NP | NP | 540 | 300 | - | - | - | - | - | - | NP | NP | - | - | - | - | - | | |
| N-1 | | - | - | - | | - | - | - | - | - | - | - | | | - | - | - | - | - | - | - | - | | | - | - | - | - | - | | |
| Normal | 500 kV Guddu - 747 MW CCPP Guddu | - | 1089 | 1378 | 642 | NA | - | - | 540 | 120 | 541 | 90 | 541 | 90 | NA | NA | - | - | - | - | - | - | - | - | - | - | - | NA | NA | | |
| N-1 | | - | - | - | - | | - | - | - | - | - | - | - | - | - | | - | - | - | - | - | - | - | - | - | | | | | | |
| Normal | 500 kV Guddu - Muzaffargarh | - | - | 1405 | NP | 456 | - | - | - | - | 638 | 60 | NP | NP | 540 | 300 | - | - | - | - | - | - | NP | NP | - | - | - | - | - | | |
| N-1 | | - | - | - | | - | - | - | - | - | - | - | | | - | - | - | - | - | - | - | - | | | - | - | - | - | - | | |
| | 500 kV Guddu - Shikarpur I | does not exist | | | NA | | does not exist | | | | | NA | | | does not exist | | | | | NA | | | | | NA | | | | | | |
| | 500 kV Guddu - Shikarpur II | Bifurcated from Dadu - Guddu II in March 2018 | | | | 13 | Bifurcated from Dadu - Guddu II in March 2018 | | | | | | 536 | 120 | Bifurcated from Dadu - Guddu II in March 2018 | | | | - | | | | | - | | | | | | | |
| Normal | 220 kV Guddu - Sibbi (D/Ckt) | - | - | - | NP | - | - | - | - | - | - | - | NP | NP | - | - | - | - | - | - | - | - | - | - | - | NP | NP | | | | |
| N-1 | | - | - | - | | - | - | - | - | - | - | - | | | - | - | - | - | - | - | - | - | - | - | - | | | | | | |
| Normal | 220 kV Guddu - Uch (P/H) | - | - | - | NP | - | - | - | - | - | - | - | NP | NP | - | - | - | - | - | - | - | - | - | - | - | NP | NP | | | | |
| N-1 | | - | - | - | | - | - | - | - | - | - | - | | | - | - | - | - | - | - | - | - | - | - | - | | | | | | |
| Normal | 220 kV Guddu - Shikarpur | - | - | - | does not exist anymore | - | - | - | - | - | - | - | does not exist anymore | does not exist anymore | - | - | - | - | - | - | - | - | - | - | - | does not exist anymore | does not exist anymore | | | | |
| 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

 Highest Voltage Under Normal Condition @500kV level

| | | | | | |
|----------------------------------|-------|-------|-------|-------|-------|
| Total No. of Variations (Normal) | 1,584 | 2,538 | 5,433 | 1,825 | 1,494 |
| Total No. of Variations (N-1) | - | - | - | - | - |
| Total of Normal & N-1 | 1,584 | 2,538 | 5,433 | 1,825 | 1,494 |

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) | | | | | | | | | | | | |
|-----------|--|---|---------|---------|---------|---------|---|------|---------|------|---------|------|---------|------|---------|------|---|------|---------|------|---------|------|---------|------|---------|------|---------|------|---|
| | | | | | | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | | | |
| | | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | Voltage | Time | 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 | 17 | 188 | 76 | 224 | 473 | 544 | 60 | 542 | 60 | 550 | 60 | 543 | 60 | 540 | 60 | - | - | - | - | - | - | - | - | - | - | - | - | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| Normal | 500 kV Jamshoro - Dadu II | 17 | 188 | 76 | 228 | 473 | 544 | 60 | 542 | 60 | 550 | 60 | 543 | 60 | 540 | 60 | - | - | - | - | - | - | - | - | - | - | - | - | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| Normal | 500 kV Jamshoro - NKI | 17 | 177 | 77 | 218 | 231* | 544 | 60 | 542 | 60 | 538 | 60 | 541 | 60 | 539 | 60 | - | - | - | - | - | - | - | - | - | - | - | - | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| Normal | 500 kV Jamshoro - Hub (D/Ckt) | 17 | 180 | 70 | 235 | 473 | 544 | 60 | 542 | 60 | 536 | 120 | 543 | 60 | 540 | 60 | - | - | - | - | - | - | - | - | - | - | - | - | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| Normal | 500 kV Jamshoro - Port Qasim | Bifurcated from Jamshoro - NKI on 01-Nov-2017 | | | | 242 | Bifurcated from Jamshoro - NKI on 01-Nov-2017 | | | | | | | | 540 | 60 | Bifurcated from Jamshoro - NKI on 01-Nov-2017 | | | | | | | | | | - | - | |
| N-1 | | | | | | - | | | | | | | | | - | - | | | | | | | | | | | | | |
| Normal | 220 kV Jamshoro - KDA33 - I | 138 | 230 | 193 | 135 | 497 | 247 | 60 | 239 | 60 | 245 | 60 | 242 | 60 | 244 | 60 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| Normal | 220 kV Jamshoro - KDA33 - II | 138 | 230 | 192 | 134 | 497 | 247 | 60 | 239 | 60 | 241 | 60 | - | - | 244 | 60 | - | - | - | - | - | - | - | - | - | - | - | - | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| Normal | 220 kV Jamshoro - Hala Road I | 136 | 229 | 193 | 135 | 497 | 247 | 60 | 239 | 60 | 245 | 60 | 242 | 60 | 244 | 60 | - | - | - | - | - | - | - | - | - | - | - | - | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| Normal | 220 kV Jamshoro - Hala Road II | 136 | 230 | 193 | 130 | 497 | 247 | 60 | 239 | 60 | 245 | 60 | 242 | 60 | 244 | 60 | - | - | - | - | - | - | - | - | - | - | - | - | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| Normal | 220 kV Jamshoro - T.M. Khan - I | 138 | 230 | 193 | 127 | 497 | 247 | 60 | 239 | 60 | 245 | 60 | 242 | 60 | 244 | 60 | - | - | - | - | - | - | - | - | - | - | - | - | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| Normal | 220 kV Jamshoro - T.M. Khan - II | 136 | 230 | 193 | 122 | 497 | 247 | 60 | 239 | 60 | 245 | 60 | 242 | 60 | 244 | 60 | - | - | - | - | - | - | - | - | - | - | - | - | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |

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

| | | | | | |
|----------------------------------|-----|-------|-------|-------|-------|
| Total No. of Variations (Normal) | 890 | 2,112 | 1,456 | 1,688 | 4,874 |
| Total No. of Variations (N-1) | - | - | - | - | - |
| Total of Normal & N-1 | 890 | 2,112 | 1,456 | 1,688 | 4,874 |

| |
|---|
|  Highest Voltage Under Normal Condition @500kV level |
|  Highest Voltage Under Normal Condition @220kV level |

NTDC Hyderabad Region

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) | | | | | | | | | | |
|-----------|--|---|---------|---------|---------|---|--|------|---------|------|---------|------|---------|------|---------|---|---|------|---------|------|---------|------|---------|------|---------|---|--|
| | | | | | | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | |
| | | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | | |
| Normal | 500 kV NKI - Hub | 201 | 175 | 61 | 91 | 139 | 539 | 30 | 537 | 30 | 545 | 60 | 530 | 60 | 535 | 30 | - | - | 463 | 30 | - | - | - | - | | | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| Normal | 500 kV NKI - Jamshoro | 201 | 175 | 61 | NP | 3* | 539 | 30 | 537 | 30 | 545 | 60 | NP | NP | 528 | 30 | - | - | 463 | 30 | - | - | NP | - | - | | |
| N-1 | | - | - | - | | - | - | - | - | - | - | - | | | - | - | - | - | - | - | - | - | | - | - | | |
| Normal | 500 kV NKI - Port Qasim | Bifurcated from Jamshoro - NKI on 01-Nov-2017 | | | 138 | Bifurcated from Jamshoro - NKI on 01-Nov-2017 | | | | | | | | 535 | 30 | Bifurcated from Jamshoro - NKI on 01-Nov-2017 | | | | | | | | - | - | | |
| N-1 | | | | | - | | | | | | | | | - | - | - | | | | | | | | | | | |
| Normal | 220 kV NKI - Baldia | 2097 | 2516 | 1533 | 614 | 419 | 248 | 30 | 243 | 30 | 250 | 60 | 238 | 180 | 241 | 120 | - | - | - | - | - | - | - | - | - | - | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | |
| Normal | 220 kV NKI - KDA33 | 2097 | 2523 | 1533 | 401 | 419 | 242 | 60 | 243 | 30 | 250 | 60 | 239 | 120 | 241 | 120 | - | - | - | - | - | - | - | - | - | - | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | |

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

| | | | | | |
|----------------------------------|-------|-------|-------|-------|-------|
| Total No. of Variations (Normal) | 4,596 | 5,389 | 3,188 | 1,106 | 1,118 |
| Total No. of Variations (N-1) | - | - | - | - | - |
| Total of Normal & N-1 | 4,596 | 5,389 | 3,188 | 1,106 | 1,118 |

 Highest Voltage Under Normal Condition @500kV level

 Highest Voltage Under Normal Condition @220kV level

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) | | | | | | | | | | | | | | | | |
|----------------------------------|--|--|------|---------|--|---------|---|---------|------|---------|------|---------|------|---------|---|---------|----------------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | |
| Normal | 500 kV Shikarpur - Guddu Ckt I | does not exist | 841 | 1176 | does not exist | | | | | | | | 540 | 1080 | 546 | 90 | does not exist | | | | | | | | - | - | - | - | - | | |
| N-1 | | | - | - | | | | | | | | | - | - | - | - | - | - | - | - | - | | | | | | | | | | |
| Normal | 500 kV Shikarpur - Guddu Ckt II | Bifurcated from Dadu - Guddu II since March 2018 | 320 | 320 | Bifurcated from Dadu - Guddu II since March 2018 | | | | | | | | 545 | 180 | Bifurcated from Dadu - Guddu II since March 2018 | | | | | | | | - | - | - | - | - | | | | |
| N-1 | | | - | - | | | | | | | | | - | - | - | - | - | - | - | - | - | | | | | | | | | | |
| Normal | 500 kV Shikarpur - Dadu Ckt I | does not exist | 862 | 1193 | does not exist | | | | | | | | 540 | 1080 | 546 | 90 | does not exist | | | | | | | | - | - | - | - | - | | |
| N-1 | | | - | - | | | | | | | | | - | - | - | - | - | - | - | - | - | | | | | | | | | | |
| Normal | 500 kV Shikarpur - Dadu Ckt II | Bifurcated from Dadu - Guddu II in March 2018 | 318 | 318 | Bifurcated from Dadu - Guddu II in March 2018 | | | | | | | | 545 | 180 | Bifurcated from Dadu - Guddu II in March 2018 | | | | | | | | - | - | - | - | - | | | | |
| N-1 | | | - | - | | | | | | | | | - | - | - | - | - | - | - | - | - | | | | | | | | | | |
| Normal | 220 kV Shikarpur - Guddu Ckt I | 276 | 182 | 18 | 258 | 482 | - | - | - | - | 235 | 180 | 240 | 180 | 240 | 180 | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| N-1 | | 1 | 4 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| Normal | 220 kV Shikarpur - Guddu Ckt II | Reported as Shikarpur - Guddu collectively | 50 | 50 | Reported as Shikarpur - Guddu collectively | | | | | | | | 238 | 120 | Reported as Shikarpur - Guddu collectively | | | | | | | | - | - | - | - | - | | | | |
| N-1 | | | - | - | | | | | | | | | - | - | - | - | - | - | - | - | - | | | | | | | | | | |
| Normal | 220 kV Shikarpur - Uch Ckt I | 276 | 167 | 7 | 255 | 480 | - | - | - | - | 235 | 180 | 236 | 120 | 240 | 180 | 200 | 1440 | 200 | 780 | - | - | - | - | - | - | - | - | - | | |
| N-1 | | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | 198 | 300 | 196 | 480 | - | - | - | - | - | - | - | - | - | | |
| Normal | 220 kV Shikarpur - Uch Ckt II | Reported as Shikarpur - Uch collectively | 48 | 48 | Reported as Shikarpur - Uch collectively | | | | | | | | 238 | 120 | Reported as Shikarpur - Uch collectively | | | | | | | | - | - | - | - | - | | | | |
| N-1 | | | - | - | | | | | | | | | - | - | - | - | - | - | - | - | - | | | | | | | | | | |
| Normal | 220 kV Shikarpur - Rohri I | 276 | 111 | 19 | 13 | 37 | - | - | - | - | 250 | 120 | 234 | 240 | 238 | 120 | 200 | 1440 | 198 | 480 | 205 | 300 | - | - | - | - | - | | | | |
| N-1 | | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 198 | 300 | - | - | - | - | - | - | - | - | - | | | | |
| Normal | 220 kV Shikarpur - Rohri II | 276 | 107 | 19 | 13 | 38 | - | - | - | - | 250 | 120 | 234 | 240 | 238 | 120 | 200 | 1440 | 198 | 480 | 205 | 300 | - | - | - | - | - | | | | |
| N-1 | | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 198 | 300 | - | - | - | - | - | - | - | - | - | | | | |
| Total No. of Variations (Normal) | | 1,104 | 567 | 45 | 2,242 | 4,142 | Highest Voltage Under Normal Condition @500kV level | | | | | | | | Highest Voltage Under Normal Condition @220kV level | | | | | | | | | | | | | | | | |
| Total No. of Variations (N-1) | | 4 | 5 | - | - | - | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total of Normal & N-1 | | 1,108 | 572 | 45 | 2,242 | 4,142 | | | | | | | | | | | | | | | | | | | | | | | | | |

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) | | | | | | | | | | | | | | | | |
|-----------|--|--|------|---------|------|---------|--|---------|------|---------|------|---------|----------------------------------|---------|---|---------|------|---------|----------------------------------|---------|------|---------|------|---------|----------------------------------|---------|------|---------|------|---------|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | |
| Normal | 220 kV Dharki - Engro | Reported as 220 kV Bus Bar given above | NA | 12 | 1 | NA | Reported as 220 kV Bus Bar given | 240 | 120 | 235 | 180 | NA | Reported as 220 kV Bus Bar given | 206 | 60 | — | — | NA | Reported as 220 kV Bus Bar given | 206 | 60 | — | — | NA | Reported as 220 kV Bus Bar given | — | — | — | — | | |
| N-1 | | | | — | — | | | — | — | — | — | | | — | — | — | — | | | — | — | — | — | | | — | — | — | — | | |
| Normal | 220 kV Ddharki - FPCDL | Reported as 220 kV Bus Bar given above | NA | 12 | 1 | NA | Reported as 220 kV Bus Bar given | 240 | 120 | 235 | 180 | NA | Reported as 220 kV Bus Bar given | 206 | 60 | — | — | NA | Reported as 220 kV Bus Bar given | 206 | 60 | — | — | NA | Reported as 220 kV Bus Bar given | — | — | — | — | | |
| N-1 | | | | — | — | | | — | — | — | — | | | — | — | — | — | | | — | — | — | — | | | — | — | — | — | | |

Na: Not Applicable

| | | | | | |
|----------------------------------|---|----|----|---|----|
| Total No. of Variations (Normal) | — | NA | 24 | 2 | NA |
| Total No. of Variations (N-1) | — | — | — | — | — |
| Total of Normal & N-1 | — | NA | 24 | 2 | NA |

 Highest 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) | | | | | | | | | | | | | | |
|----------------------------------|--|--|------|---------|------|---------|--|---------|------|---------|------|---------|------|---------|------|---------|---|---------|------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | |
| Normal | 220 kV Hala Road - Jamshoro I | 543 | 81 | 3 | 5 | 28 | 239 | 300 | 238 | 120 | 232 | 90 | 235 | 180 | 240 | 60 | - | - | - | - | - | - | - | - | - | - | - | - | - | | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| Normal | 220 kV Hala Road - Jamshoro II | 543 | 81 | 3 | 5 | 28 | 239 | 300 | 238 | 120 | 232 | 90 | 235 | 180 | 240 | 60 | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| Total No. of Variations (Normal) | | 1,086 | 162 | 6 | 10 | 56 | Highest Voltage Under Normal Condition | | | | | | | | | | | | | | | | | | | | | | | | |
| Total No. of Variations (N-1) | | - | - | - | - | - | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total of Normal & N-1 | | 1,086 | 162 | 6 | 10 | 56 | | | | | | | | | | | | | | | | | | | | | | | | | |

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) | | | | | | | | | | | | | | | | |
|----------------------------------|--|--|-------|---------|------|---------|--|---------|------|---------|------|---------|------|---------|------|--------------------|---|---------|------|---------|------|---------|------|---------|--------------------|---------|------|---------|------|---------|----|-----|----|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | | | |
| Normal | 220 kV Dadu - Khuzdar I | Energized Aug 2014 | 567 | 398 | 229 | 141 | Energized Aug 2014 | 240 | 540 | 255 | 90 | 255 | 35 | 248 | 30 | Energized Aug 2014 | 185 | 120 | 180 | 60 | 185 | 45 | 190 | 35 | Energized Aug 2014 | 185 | 120 | 180 | 60 | 185 | 45 | 190 | 35 |
| N-1 | | | 3 | - | - | - | | - | - | - | - | - | - | - | - | | 194 | 60 | - | - | - | - | - | - | | 194 | 60 | - | - | - | - | - | - |
| Normal | 220 kV Dadu - Khuzdar II | Energized Aug 2014 | 567 | 398 | 229 | 141 | Energized Aug 2014 | 240 | 540 | 255 | 90 | 255 | 35 | 248 | 30 | Energized Aug 2014 | 185 | 120 | 180 | 60 | 185 | 45 | 190 | 35 | Energized Aug 2014 | 185 | 120 | 180 | 60 | 185 | 45 | 190 | 35 |
| N-1 | | | 3 | - | - | - | | - | - | - | - | - | - | - | - | | 194 | 60 | - | - | - | - | - | - | | 194 | 60 | - | - | - | - | - | - |
| Total No. of Variations (Normal) | | Energized Aug 2014 | 1,134 | 796 | 458 | 282 | Highest Voltage Under Normal Condition | | | | | | | | | | Lowest Voltage Under Normal Condition | | | | | | | | | | | | | | | | |
| Total No. of Variations (N-1) | | | 6 | - | - | - | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total of Normal & N-1 | | Energized Aug 2014 | 1,140 | 796 | 458 | 282 | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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) | | | | | | | | | | | | | | |
|----------------------------------|--|--|-------|---------|-------|---------|--|---------|------|---------|------|---------|------|---------|------|--------------------|---|---------|------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | |
| Normal | 220 kV Loralai - D.G. Khan I | Energized Aug 2014 | 584 | 623 | 505 | 1570 | Energized Aug 2014 | 242 | 600 | 250 | 60 | 248 | 600 | 254 | 300 | Energized Aug 2014 | 200 | 60 | - | - | - | - | 180 | 180 | - | - | - | - | - | - | |
| N-1 | | | 77 | - | - | - | | 252 | 60 | - | - | - | - | - | - | | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| Normal | 220 kV Loralai - D.G. Khan II | Energized Aug 2014 | 584 | 623 | 505 | 1570 | Energized Aug 2014 | 242 | 600 | 250 | 60 | 248 | 600 | 254 | 300 | Energized Aug 2014 | 200 | 60 | - | - | - | - | 180 | 180 | - | - | - | - | - | - | |
| N-1 | | | 77 | - | - | - | | 252 | 60 | - | - | - | - | - | - | | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| Total No. of Variations (Normal) | | Energized Aug 2014 | 1,168 | 1,246 | 1,010 | 3,140 | Highest Voltage Under Normal Condition | | | | | | | | | | Lowest Voltage Under Normal Condition | | | | | | | | | | | | | | |
| Total No. of Variations (N-1) | | | 154 | - | - | - | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total of Normal & N-1 | | Energized Aug 2014 | 1,322 | 1,246 | 1,010 | 3,140 | | | | | | | | | | | | | | | | | | | | | | | | | |

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) | | | | | | | | | |
|----------------------------------|--|--|--------|---------|------|---------|--|---------|---------|---------|---------|---------|---------|---------|---------|---------|---|---------|---------|---------|---------|---------|---------|---------|---------|----|
| | | | | | | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | |
| Normal | 220 kV Sibbi - Quetta Ckt I | 6157 | 2865 | 6053 | 444 | 3022 | - | - | 240 | 120 | 250 | 60 | 240 | 60 | - | - | 170 | 60 | 199 | 180 | 175 | 60 | 201 | 60 | 180 | 60 |
| N-1 | | 40 | 3145 | - | 1 | - | - | - | - | - | - | - | - | - | - | - | 174 | 60 | 170 | 120 | - | - | 199 | 60 | - | - |
| Normal | 220 kV Sibbi - Quetta Ckt II | 6387 | 2865 | 6053 | 444 | 3022 | - | - | 240 | 120 | 250 | 60 | 240 | 60 | - | - | 170 | 60 | 199 | 180 | 175 | 60 | 201 | 60 | 180 | 60 |
| N-1 | | 52 | 3145 | - | 1 | - | - | - | - | - | - | - | - | - | - | - | 174 | 60 | 170 | 120 | - | - | 199 | 60 | - | - |
| Total No. of Variations (Normal) | | 12,544 | 5,730 | 12,106 | 888 | 6,044 | | | | | | | | | | | | | | | | | | | | |
| Total No. of Variations (N-1) | | 92 | 6,290 | - | 2 | - | | | | | | | | | | | | | | | | | | | | |
| Total of Normal & N-1 | | 12,636 | 12,020 | 12,106 | 890 | 6,044 | | | | | | | | | | | | | | | | | | | | |

 Lowest Voltage Under Normal 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) | | | | | | | | | | | | | | | | |
|----------------------------------|--|--|-------|---------|------|---------|--|---------|------|---------|------|---------|------|---------|---|---------|--------------------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | |
| Normal | 220 kV Shikarpur - Rohri I | 84 | 111 | 411 | Nil | 20 | 239 | 30 | 242 | 60 | 252 | 60 | Nil | Nil | 236 | 60 | 200 | 30 | 198 | 480 | 208 | 60 | Nil | Nil | - | - | - | - | | | |
| N-1 | | 7 | - | - | | - | 264 | 30 | - | - | - | - | | | - | - | - | - | - | - | - | - | | | - | - | - | - | | | |
| Normal | 220 kV Shikarpur - Rohri II | Energized Aug 2014 | 111 | 411 | Nil | 20 | Energized Aug 2014 | | - | - | 252 | 60 | Nil | Nil | 236 | 60 | Energized Aug 2014 | | 198 | 480 | 208 | 60 | Nil | Nil | - | - | - | - | | | |
| N-1 | | | - | - | | - | | | - | - | - | - | | | - | - | | | - | - | - | - | | | - | - | - | - | | | |
| Normal | 220 kV Rohri - Engro I | 84 | 419 | 410 | Nil | 15 | 239 | 30 | 242 | 60 | 252 | 60 | Nil | Nil | 238 | 180 | 200 | 30 | - | - | 208 | 60 | Nil | Nil | - | - | - | - | | | |
| N-1 | | 7 | - | - | | - | 264 | 30 | - | - | - | - | | | - | - | - | - | - | - | - | - | | | - | - | - | - | | | |
| Normal | 220 kV Rohri - Engro II | Energized Aug 2014 | 419 | 410 | Nil | 15 | Energized Aug 2014 | | 242 | 60 | 252 | 60 | Nil | Nil | 238 | 180 | Energized Aug 2014 | | - | - | 208 | 60 | Nil | Nil | - | - | - | - | | | |
| N-1 | | | - | - | | - | | | - | - | - | - | | | - | - | | | - | - | - | - | | | - | - | - | - | | | |
| Total No. of Variations (Normal) | | 168 | 1,060 | 1,642 | | Nil | 70 | | | | | | | | | | | | | | | | | | | | | | | | |
| Total No. of Variations (N-1) | | 14 | - | - | | - | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Total of Normal & N-1 | | 182 | 1,060 | 1,642 | | Nil | 70 | | | | | | | | | | | | | | | | | | | | | | | | |

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) | | | | | | | | | | | | | |
|----------------------------------|--|--|---------|---------|---------|---------|--|-------------------------|---------|------|---------|------|---------|------|---------|------|---|------|---------|-------------------------|---------|------|---------|------|---------|-----|-----|---------------------------------------|--|--|
| | | | | | | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | | | | |
| | | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | 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 | 3754 | 851 | 1145 | 588 | 534 | - | - | 240 | 60 | - | - | 240 | 60 | 238 | 60 | 199 | 90 | 180 | 60 | 192 | 60 | 180 | 60 | 196 | 60 | | | | |
| N-1 | | 426 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 180 | 30 | - | - | - | - | - | - | - | - | | | | |
| Normal | 220 kV Sibbi - Quetta Ckt II | 3754 | 781 | 1149 | 588 | 534 | - | - | - | - | 237 | 60 | 240 | 60 | 238 | 60 | 199 | 90 | 180 | 60 | 192 | 60 | 180 | 60 | 196 | 60 | | | | |
| N-1 | | 426 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | 180 | 30 | 195 | 60 | - | - | - | - | - | - | | | | |
| Normal | 220 kV Sibbi - Uch Ckt I | 2606 | 604 | 545 | 182 | 289 | 238 | 60 | 240 | 540 | 253 | 60 | 240 | 60 | 240 | 60 | 199 | 60 | 185 | 60 | 192 | 60 | 200 | 60 | 200 | 120 | | | | |
| N-1 | | 280 | 4 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | 180 | 30 | 194 | 60 | 196 | 60 | - | - | - | - | | | | |
| Normal | 220 kV Sibbi - Uch Ckt II | 2606 | 722 | 543 | 182 | 289 | 238 | 60 | 240 | 540 | 253 | 60 | 240 | 60 | 240 | 60 | 199 | 60 | 185 | 120 | 192 | 60 | 200 | 60 | 200 | 120 | | | | |
| N-1 | | 280 | 4 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | 180 | 30 | 194 | 60 | 196 | 60 | - | - | - | - | | | | |
| Normal | 220 kV Sibbi - Guddu DC Ckt | 2495 | 2669 | 539 | 228 | 258 | 240 | 30 | 240 | 30 | 253 | 60 | 240 | 60 | 240 | 60 | 192 | 90 | 195 | 60 | 192 | 60 | 200 | 60 | 200 | 60 | | | | |
| N-1 | | 214 | 205 | - | - | - | - | - | - | - | - | - | - | - | - | - | 180 | 60 | 180 | 30 | - | - | - | - | - | - | | | | |
| Normal | 220 kV Sibbi - Uch DC Ckt | Energized on 05-05-2018 | | | | | 258 | Energized on 05-05-2018 | | | | | | | | | | 240 | 60 | Energized on 05-05-2018 | | | | | | 200 | 120 | | | |
| N-1 | | | | | | | - | | | | | | | | | | | - | - | - | - | | | | | | | | | |
| Normal | 220 kV Sibbi - D. M Jamali Ckt | Energized on 13-05-2018 | | | | | 77 | Energized on 13-05-2018 | | | | | | | | | | 240 | 60 | Energized on 13-05-2018 | | | | | | - | - | | | |
| N-1 | | | | | | | - | | | | | | | | | | | - | - | - | - | | | | | | | | | |
| Total No. of Variations (Normal) | | 15,215 | 5,627 | 3,921 | 1,768 | 2,239 | | | | | | | | | | | Highest Voltage Under Normal Condition | | | | | | | | | | | Lowest Voltage Under Normal Condition | | |
| Total No. of Variations (N-1) | | 1,626 | 214 | 3 | - | - | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 16,841 | 5,841 | 3,924 | 1,768 | 2,239 | | | | | | | | | | | | | | | | | | | | | | | | |

NTDC Hyderabad Region

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

| Condition | Name of Transmission Circuit(s) violating the voltage criteria | Total Number / Times violating the limit | | | | | Highest Voltage Recorded (kV) / Time (Min) | | | | | | | | | | Lowest Voltage Recorded (kV) / Time (Min) | | | | | | | | | | | | | | |
|----------------------------------|--|--|------|---------|------|---------|--|---------|------|---------|------|---------|------|---------|------|---------|---|---------|------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | |
| Normal | 220 kV T.M.Khan - Jamshoro I | 767 | 473 | 187 | 122 | 287 | 241 | 60 | 242 | 60 | 240 | 60 | 244 | 60 | 242 | 60 | - | - | - | - | - | - | - | - | - | - | - | - | - | | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| Normal | 220 kV T.M.Khan - Jamshoro II | 767 | 473 | 187 | 122 | 287 | 241 | 60 | 242 | 60 | 240 | 60 | 244 | 60 | 242 | 60 | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| Normal | 220 kV T.M.Khan - Jhimpur I | Energized Aug 2017 | | | | 240 | Energized Aug 2017 | | | | | | | | 242 | 60 | Energized Aug 2017 | | | | | | | | - | - | - | - | | | |
| N-1 | | | | | | - | | | | | | | | | - | - | - | - | - | - | - | | | | | | | | | | |
| Normal | 220 kV T.M.Khan - Jhimpur I | Energized Aug 2017 | | | | 240 | Energized Aug 2017 | | | | | | | | 242 | 60 | Energized Aug 2017 | | | | | | | | - | - | - | - | | | |
| N-1 | | | | | | - | | | | | | | | | - | - | - | - | - | - | - | | | | | | | | | | |
| Total No. of Variations (Normal) | | 1,534 | 946 | 374 | 244 | 1,054 | Highest Voltage Under Normal Condition | | | | | | | | | | | | | | | | | | | | | | | | |
| Total No. of Variations (N-1) | | - | - | - | - | - | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total of Normal & N-1 | | 1,534 | 946 | 374 | 244 | 1,054 | | | | | | | | | | | | | | | | | | | | | | | | | |

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) | | | | | | | | | | | | | | |
|----------------------------------|--|--|------|---------|------|---------|--|---------|------|---------|------|---------|------|---------|------|---------|---|---------|------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | |
| Normal | 220 kV Jhimpur - T.M.Khan I | Energized in Aug 2017 | 174 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| N-1 | | | - | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Normal | 220 kV Jhimpur - T.M.Khan II | Energized in Aug 2017 | 174 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| N-1 | | | - | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total No. of Variations (Normal) | | Energized in Aug 2017 | 348 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total No. of Variations (N-1) | | | - | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total of Normal & N-1 | | | 348 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

 Highest Voltage Under Normal Condition

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) | | | | | | | | | | | | | | |
|-----------|--|--|------|---------|------|---------|--|---------|------|---------|------|---------|------|---------|------|---------|---|---------|------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|--|
| | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
| | | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | |
| Normal | 220 kV Balidia - Mauripur | - | | Nil | | - | | - | | Nil | | - | | - | | - | | Nil | | - | | - | | - | | | | | | | |
| N-1 | | - | | | | - | | - | | | | - | | - | | - | | | | - | | - | | | | - | | - | | | |
| Normal | 132 kV Surjani - Maymar | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 116 | NP | - | - | - | - | - | - | - | - | - | |
| N-1 | | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 114 | NP | - | - | - | - | - | - | - | - | - | |
| Normal | 132 kV Surjani - Valika | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 114 | NP | - | - | - | - | - | - | - | - | - | |
| N-1 | | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 112 | NP | - | - | - | - | - | - | - | - | - | |
| Normal | 132 kV SITE - SGT 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| Normal | 132 kV SITE - SGT 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| Normal | 132 kV KDA - Federal B | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 116 | NP | 115 | NP | - | - | - | - | - | - | - | |
| N-1 | | 1 | 1 | 1 | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | 113 | NP | 114 | NP | 117.4 | 147 | - | - | 118.6 | 33 | | |
| Normal | 132 kV Valika - N. Karachi | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| Normal | 132 kV Gulshan - Civic | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 113 | NP | - | - | - | - | - | - | - | - | - | |
| N-1 | | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 113 | NP | - | - | - | - | - | - | - | - | - | |
| Normal | 132 kV West Wharf - Lyari | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| Normal | 132 kV Qayyumabad - K. East | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 122 | NP | 112 | NP | - | - | - | - | - | - | - | |
| N-1 | | 1 | 1 | 1 | 1 | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | 114 | NP | 116 | NP | 117.1 | 280 | 114 | 48 | 117.3 | 47 | | |
| Normal | 132 kV Memon Goth - Malir | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 114 | NP | - | - | - | - | - | - | - | - | - | |
| N-1 | | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 116 | NP | - | - | - | - | - | - | - | - | - | |
| Normal | 132 kV Malir - CAA | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 114 | NP | - | - | - | - | - | - | - | - | - | |
| N-1 | | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 115 | NP | - | - | - | - | - | - | - | - | - | |
| Normal | 132 kV Gulshan - Hospital | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 113 | NP | - | - | - | - | - | - | - | - | - | |
| N-1 | | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 113 | NP | - | - | - | - | - | - | - | - | - | |
| Normal | 132 kV Gharo - RECP | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 118 | NP | 121 | NP | - | - | - | - | - | - | - | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| Normal | 132 kV BOC - Dhabeji | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 118 | NP | 121 | NP | - | - | - | - | - | - | - | |
| N-1 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |

NP: Not Provided

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) | | | | | | | | | | | | | | |
|-----------|--|--|---------|---------|---------|---------|--|------|---------|------|---------|---------|---------|------|---------|------|---|------|---------|------|---------|---------|---------|-------|---------|-------|---------|-------|----|--|--|
| | | | | | | | 2013-14 | | | | | 2014-15 | | | | | 2015-16 | | | | | 2016-17 | | | | | 2017-18 | | | | |
| | | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | | | |
| Normal | 132 kV Dhabeji - Gharo | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 118 | NP | - | - | - | - | - | - | - | | |
| N-1 | 132 kV Dhabeji - Gharo | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| Normal | 132 kV KDA - Memon Goth | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 116 | NP | 115 | NP | - | - | - | - | - | | |
| N-1 | 132 kV KDA - Memon Goth | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 114 | - | - | - | - | - | | | |
| Normal | 132 kV KDA - Johar | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 116 | NP | 115 | NP | - | - | - | - | - | | |
| N-1 | 132 kV KDA - Johar | 1 | 1 | 1 | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 113 | NP | 114 | 117.4 | 147 | - | - | 118.6 | 33 | | |
| Normal | 132 kV Johar - Hospital | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 111 | NP | - | - | - | - | - | - | - | | |
| N-1 | 132 kV Johar - Hospital | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 111 | NP | - | - | - | - | - | - | - | | |
| Normal | 132 kV KDA - Gulshan | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 116 | NP | 115 | NP | - | - | - | - | - | | |
| N-1 | 132 kV KDA - Gulshan | 1 | 1 | 1 | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 113 | NP | 114 | 117.4 | 147 | - | - | 118.6 | 33 | | |
| Normal | 132 kV KDA - Maymar | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 116 | NA | 115 | NP | - | - | - | - | - | | |
| N-1 | 132 kV KDA - Maymar | 1 | 1 | 1 | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 113 | NA | 114 | 117.4 | 147 | - | - | 118.6 | 33 | | |
| Normal | 132 kV Federal B - Valika | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 122 | NA | - | - | - | - | - | - | - | | |
| N-1 | 132 kV Federal B - Valika | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 112 | NA | - | - | - | - | - | - | - | | |
| Normal | 132 kV Haroonabad - Liaquatabad | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 114 | NP | - | - | - | - | - | - | - | | |
| N-1 | 132 kV Haroonabad - Liaquatabad | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| Normal | 132 kV Valika - Nazimabad | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 111 | NP | - | - | - | - | - | - | - | | |
| N-1 | 132 kV Valika - Nazimabad | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| Normal | 132 kV Gulshan - Jalil Road | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 113 | NP | - | - | - | - | - | - | - | | |
| N-1 | 132 kV Gulshan - Jalil Road | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 113 | NP | - | - | - | - | - | - | - | | |
| Normal | 132 kV Gulshan - Azizabad | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 113 | NP | - | - | - | - | - | - | - | | |
| N-1 | 132 kV Gulshan - Azizabad | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 113 | NP | - | - | - | - | - | - | - | | |
| Normal | 132 kV Mauripur - Haroonabad | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 117 | NP | 112 | NP | - | - | - | - | - | | |
| N-1 | 132 kV Mauripur - Haroonabad | 1 | 1 | 1 | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 116 | NP | 118 | 117.4 | 331 | 116.8 | 56 | 116.8 | 34 | | |
| Normal | 132 kV Haroonabad - Nazimabad | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 114 | NP | - | - | - | - | - | - | - | | |
| N-1 | 132 kV Haroonabad - Nazimabad | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | | |
| Normal | 132 kV Korangi West - Defence | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 122 | NP | 115 | NP | - | - | - | - | - | | |
| N-1 | 132 kV Korangi West - Defence | - | 1 | 1 | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 115 | NP | 117.1 | 280 | 114 | 48 | 117.3 | 47 | | |
| Normal | 132 kV Pipri West - Port Qasim | 1 | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 121 | NP | - | - | 116.9 | 78 | - | - | - | | |
| N-1 | 132 kV Pipri West - Port Qasim | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | | |

NP: Not Provided

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) | | | | | | | | | | | | |
|-----------|--|--|---------|---------|---------|---------|--|------|---------|------|---------|------|---------|------|---------|------|---|------|---------|------|---------|------|---------|------|---------|------|---------|------|---|
| | | | | | | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | | | |
| | | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | |
| Normal | 132 kV Pipri West - KEPZ | 1 | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 121 | NP | - | - | 116.9 | 78 | - | - | - | - | |
| N-1 | Pipri West - KEPZ | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| Normal | 132 kV KEPZ - Landhi | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 120 | NP | - | - | - | - | - | - | - | - | - |
| N-1 | KEPZ - Landhi | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| Normal | 132 kV Gul Ahmed - Airport 1 & 2 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 122 | NP | - | - | - | - | - | - | - | - | - |
| N-1 | Gul Ahmed - Airport 1 & 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| Normal | 132 kV KTPS - PRL | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 121 | NP | - | - | - | - | - | - | - | - | - |
| N-1 | KTPS - PRL | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| Normal | 132 kV K. East - K. South | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 121 | NP | - | - | - | - | - | - | - | - | - |
| N-1 | K. East - K. South | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| Normal | 132 kV Valika - North Nazimabad | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| N-1 | Valika - North Nazimabad | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 112 | NP | - | - | - | - | - | - | - | - | - |
| Normal | 132 kV Orangi - Valika | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 119 | NP | - | - | - | - | - | - | - | - | - |
| N-1 | Orangi - Valika | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| Normal | 132 kV Liaquatabad - Azizabad | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 115 | NP | - | - | - | - | - | - | - | - | - |
| N-1 | Liaquatabad - Azizabad | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 117 | NP | - | - | - | - | - | - | - | - | - |
| Normal | 132 kV Port Qasim - Landhi | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 120 | NP | - | - | - | - | - | - | - | - | - |
| N-1 | Port Qasim - Landhi | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| Normal | 132 kV Baldia - Orangi | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 124 | NP | - | - | - | - | - | - | - | - | - |
| N-1 | Baldia - Orangi | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 118 | NP | - | - | - | - | - | - | - | - | - |
| Normal | 132 kV Baldia - Valika | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 124 | NP | - | - | - | - | - | - | - | - | - |
| N-1 | Baldia - Valika | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| Normal | 132 kV Baldia - Hub | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 124 | NP | - | - | - | - | - | - | - | - | - |
| N-1 | Baldia - Hub | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 118 | NP | - | - | - | - | - | - | - | - | - |
| Normal | 132 kV Baldia - SGT - SITE | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 124 | NP | - | - | - | - | - | - | - | - | - |
| N-1 | Baldia - SGT - SITE | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 118 | NP | - | - | - | - | - | - | - | - | - |
| Normal | 132 kV K. West - Gizri - Baloch | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 115 | NP | - | - | - | - | - | - | - | - | - |
| N-1 | K. West - Gizri - Baloch | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 114 | 48 | - |
| Normal | 132 kV Pipri - Korangi Town | - | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 121 | NP | 116.9 | 78 | - | - | - | - | - | - | - |
| N-1 | Pipri - Korangi Town | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

NP: Not Provided

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) | | | | | | | | | | |
|-----------|--|--|---------|---------|---------|---------|--|------|---------|------|---------|------|---------|------|---------|------|---|------|---------|------|---------|-------|---------|------|---------|-------|---------|
| | | | | | | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | | |
| | | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage | Time | Voltage |
| Normal | 132 kV Pipri - Landhi | - | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 121 | NP | 116.9 | 78 | - | - | - | - |
| N-1 | Pipri - Landhi | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | NP | - | - | - | - | - | - |
| Normal | 132 kV Qayyumabad - DHA 1 | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 112 | NP | - | - | - | - | - | - |
| N-1 | Qayyumabad - DHA 1 | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 116 | NP | - | - | - | - | - | - |
| Normal | 132 kV Queen's Road - Clifton | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 116 | NP | - | - | - | - | - | - |
| N-1 | Queen's Road - Clifton | - | 1 | 1 | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | 116 | NP | 117.1 | 280 | 114 | 48 | 117.3 | 47 |
| Normal | 132 kV Queen's Road - Gizri | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 116 | NP | - | - | - | - | - | - |
| N-1 | Queen's Road - Gizri | - | 1 | 1 | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | 116 | NP | 117.1 | 280 | 114 | 48 | 117.3 | 47 |
| Normal | 132 kV Queen's Road - Elander Road | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 116 | NP | - | - | - | - | - | - |
| N-1 | Queen's Road - Elander Road | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 116 | NP | - | - | - | - | - | - |
| Normal | 132 kV Queen's Road - Old Town | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 116 | NP | - | - | - | - | - | - |
| N-1 | Queen's Road - Old Town | - | 1 | 1 | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | 116 | NP | 117.1 | 280 | 114 | 48 | 117.3 | 47 |
| Normal | 132 kV Pipri / RECP / Gharo | Nil | | 1 | - | - | Nil | | | | - | - | - | - | - | - | Nil | | | | 116.9 | 78 | - | - | - | - | |
| N-1 | Pipri / RECP / Gharo | | | - | - | - | | | | | - | - | - | - | - | - | | | | | - | - | - | - | - | - | |
| Normal | 132 kV Pipri / BOC / Dhabeji | Nil | | 1 | - | - | Nil | | | | - | - | - | - | - | - | Nil | | | | 116.9 | 78 | - | - | - | - | |
| N-1 | Pipri / BOC / Dhabeji | | | - | - | - | | | | | - | - | - | - | - | - | | | | | - | - | - | - | - | - | |
| Normal | 132 kV KDA / Memon Goth / Malir | Nil | | - | - | - | Nil | | | | - | - | - | - | - | - | Nil | | | | - | - | - | - | - | - | |
| N-1 | KDA / Memon Goth / Malir | | | 1 | - | 1 | | | | | - | - | - | - | - | - | | | | | 117.4 | 280 | - | - | 118.6 | 33 | |
| Normal | 132 kV Korangi West / Baloch / Gizri | Nil | | - | - | - | Nil | | | | - | - | - | - | - | - | Nil | | | | - | - | - | - | - | - | |
| N-1 | Korangi West / Baloch / Gizri | | | 1 | - | 1 | | | | | - | - | - | - | - | - | | | | | 117.1 | 280 | - | - | 117.3 | 47 | |

NP: Not Provided

| | | | | | |
|----------------------------------|----|----|----|-----|-----|
| Total No. of Variations (Normal) | 32 | 22 | 6 | Nil | Nil |
| Total No. of Variations (N-1) | 18 | 16 | 12 | 7 | 12 |
| Total of Normal & N-1 | 50 | 38 | 18 | 7 | 12 |

 Lowest Voltage Under N-1 Condition

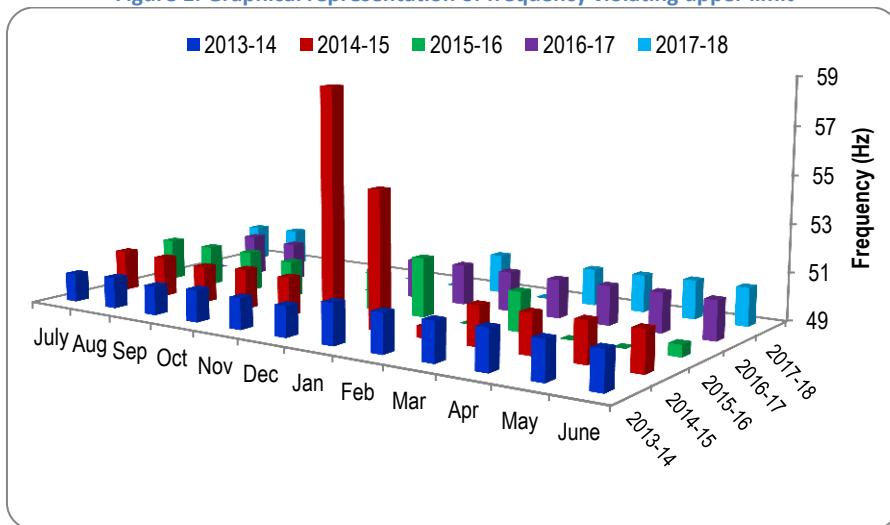
APPENDIX 6

System Frequency - Historical Data as Reported by the Licensees

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

NTDC

| Month | Highest System Frequency Recorded Violating the Prescribed Upper Limit ¹ (Hz) | | | | |
|-------------|--|---------|---------|---------|---------|
| | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 |
| July | 50.2 | 50.71 | 50.75 | NIL | 50.5 |
| Aug | 50.31 | 50.68 | 50.69 | 50.72 | 50.56 |
| Sep | 50.22 | 50.55 | 50.69 | 50.6 | 50.56 |
| Oct | 50.35 | 50.69 | 50.53 | NIL | NIL |
| Nov | 50.3 | 50.62 | 50.62 | NIL | NIL |
| Dec | 50.28 | 58.63 | 50.71 | 50.63 | NIL |
| Jan | 50.7 | 54.69 | 51.47 | 50.68 | 50.64 |
| Feb | 50.63 | 49.49 | NIL | 50.65 | NIL |
| Mar | 50.63 | 50.65 | 50.64 | 50.61 | 50.54 |
| Apr | 50.68 | 50.66 | NIL | 50.63 | 50.56 |
| May | 50.6 | 50.69 | NIL | 50.65 | 50.62 |
| June | 50.57 | 50.68 | 49.49 | 50.64 | 50.6 |

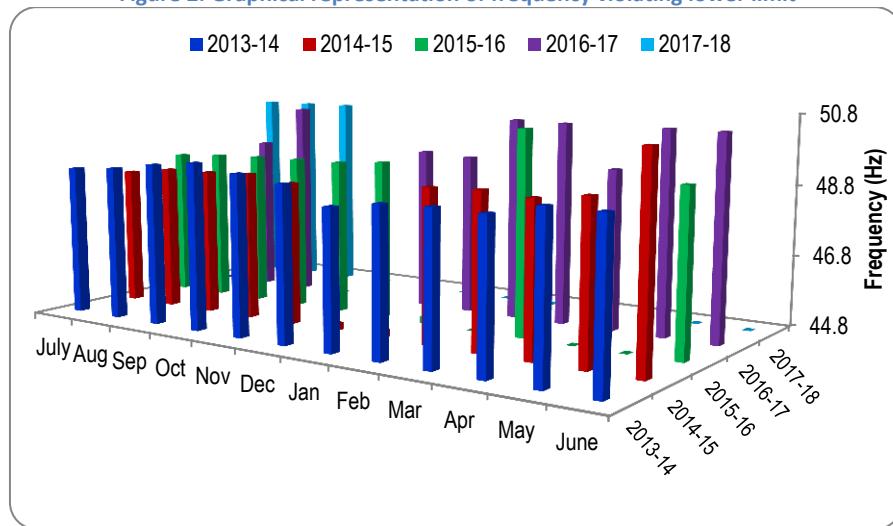
Figure 1: Graphical representation of frequency violating upper limit

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

| Month | Lowest System Frequency Recorded Violating the prescribed Lower Limit ² (Hz) | | | | |
|-------|---|---------|---------|---------|---------|
| | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 |
| July | 49.05 | 48.74 | 49.07 | NIL | 50.51 |
| Aug | 49.15 | 48.91 | 49.15 | 49.36 | 50.51 |
| Sep | 49.35 | 48.93 | 49.19 | 50.51 | 50.51 |
| Oct | 49.5 | 48.99 | 49.21 | NIL | NIL |
| Nov | 49.31 | 48.83 | 49.22 | NIL | NIL |
| Dec | 49.15 | 45 | 49.32 | 49.44 | NIL |
| Jan | 48.67 | 45 | 45 | 49.37 | NIL |
| Feb | 48.87 | 49.06 | NIL | 50.53* | NIL |
| Mar | 48.92 | 49.11 | 50.52 | 50.51* | NIL |
| Apr | 48.89 | 49.02 | NIL | 49.32 | NIL |
| May | 49.2 | 49.2 | NIL | 50.52* | NIL |
| June | 49.19 | 50.51 | 49.35 | 50.51* | NIL |

* Cannot be validated

Figure 2: Graphical representation of frequency violating lower limit

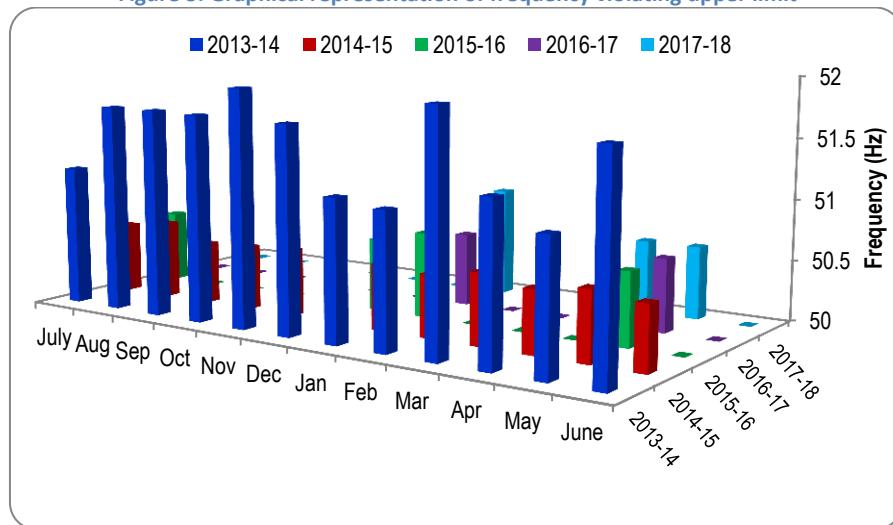


² Lower Limit: 49.50 Hz, Rule 8(1) of PSTR 2005

K-Electric

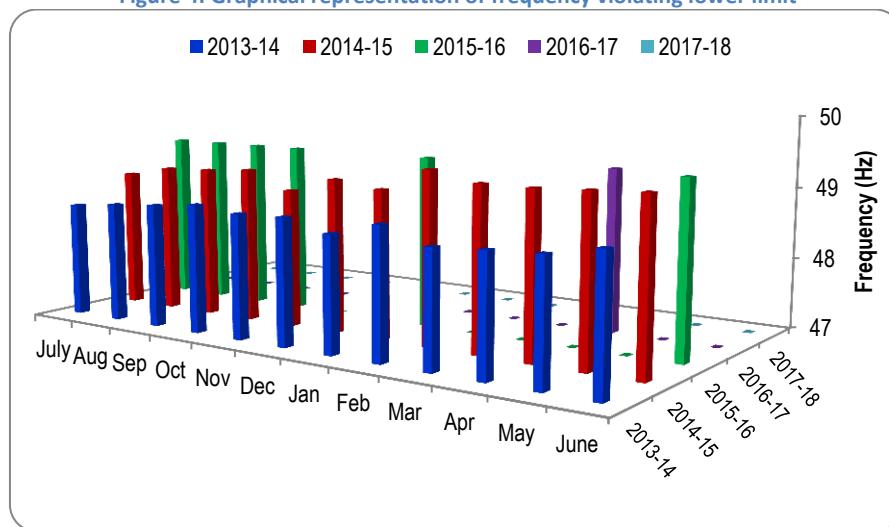
| Month | Highest System Frequency Recorded Violating the Prescribed Upper Limit ³ (Hz) | | | | |
|-------|--|---------|---------|---------|---------|
| | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 |
| July | 51.15 | 50.58 | 50.6 | Nil | NA |
| Aug | 51.7 | 50.64 | Nil | Nil | NA |
| Sep | 51.7 | 50.51 | Nil | Nil | NA |
| Oct | 51.69 | 50.53 | Nil | Nil | NA |
| Nov | 51.93 | 50.55 | 0 | Nil | NA |
| Dec | 51.68 | 50.82 | 50.6 | Nil | NA |
| Jan | 51.15 | 50.54 | 50.7 | 50.6 | 50.9 |
| Feb | 51.1 | 50.51 | Nil | Nil | NA |
| Mar | 51.91 | 50.58 | Nil | Nil | NA |
| Apr | 51.28 | 50.51 | Nil | Nil | 50.6 |
| May | 51.06 | 50.57 | 50.6 | 50.6 | 50.6 |
| June | 51.72 | 50.52 | Nil | Nil | NA |

Figure 3: Graphical representation of frequency violating upper limit



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

| Month | Lowest System Frequency Recorded Violating the prescribed Lower Limit ⁴ (Hz) | | | | |
|-------|---|---------|---------|---------|---------|
| | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 |
| July | 48.61 | 48.97 | 49.4 | Nil | NA |
| Aug | 48.68 | 49.1 | 49.4 | Nil | NA |
| Sep | 48.73 | 49.13 | 49.4 | Nil | NA |
| Oct | 48.8 | 49.18 | 49.4 | Nil | NA |
| Nov | 48.74 | 48.94 | Nil | Nil | NA |
| Dec | 48.76 | 49.15 | Nil | Nil | NA |
| Jan | 48.61 | 49.07 | 49.4 | Nil | NA |
| Feb | 48.8 | 49.39 | Nil | Nil | NA |
| Mar | 48.59 | 49.26 | Nil | Nil | NA |
| Apr | 48.63 | 49.26 | Nil | 49.3 | NA |
| May | 48.66 | 49.29 | Nil | Nil | NA |
| June | 48.8 | 49.32 | 49.4 | Nil | NA |

Figure 4: Graphical representation of frequency violating lower limit⁴ Lower Limit: 49.50 Hz, Rule 8(1) of PSTR 2005



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