

2016-17

Performance Evaluation Report

Based on Reported Data of
National Transmission & Despatch Company (NTDC)
With a comparison to 2011-12 through 2015-16
As per Performance Standards (Transmission) Rules 2005



National Electric Power Regulatory Authority



Contents

0	EXECUTIVE SUMMARY	ES-1
1	INTRODUCTION	1
1.1	REPORTING REQUIREMENT	1
1.2	COMPLIANCE	1
1.2.1	Rule 7 of PSTR 2005 (System Voltage).....	1
1.2.2	Rule 8 of PSTR 2005 (System Frequency)	1
1.3	PERFORMANCE AT A GLANCE.....	2
2	BRIEF ABOUT NTDC.....	3
2.1	LICENCE	3
2.2	TRANSMISSION NETWORK	3
3	ANALYSIS OF ANNUAL PERFORMANCE REPORT (APR)	4
3.1	SYSTEM RELIABILITY	4
3.1.1	System Duration of Interruption.....	4
3.1.2	System Frequency of Interruption	4
3.2	SYSTEM SECURITY	5
3.2.1	System Splitting	7
3.3	QUALITY OF SUPPLY	8
3.3.1	System Voltage.....	8
3.3.2	System Frequency	13
	APPENDICES.....	15

Table of Figures

Figure 2.1: NTDC transmission system (2016-17).....	3
Figure 3.1: Total outages hours recorded at all interconnection points (excluding 132kV line tripping).....	4
Total number of interconnection points	4
Figure 3.2: System Duration of Interruption (Hrs/Point).....	4
Figure 3.3: Total number of outages recorded at all 132kV outgoing circuits (excluding 132kV line tripping)....	4
Total number of 132kV circuits	4
Figure 3.4: System Frequency of Interruption (No. of outages/circuit).....	4
Figure 3.5: Region wise loss of supply incidents	5
Figure 3.6: Month wise loss of supply incidents	5
Figure 3.7: Grid station wise loss of supply incidents (2016-17)	6
Figure 3.8: Other loss of supply incidents	6
Figure 3.9: Number of voltage violations (NTDC)	8
Figure 3.10: Number of voltage violations (NTDC Region wise).....	9
Figure 3.11: Number of voltage violations (NTDC Islamabad Region).....	9
Figure 3.12: Number of voltage violations (NTDC Lahore Region).....	10
Figure 3.13: Number of voltage violations (NTDC Multan Region).....	11
Figure 3.14: Number of voltage violations (NTDC Hyderabad Region).....	12
Figure 3.15: Highest voltage recorded at 500 kV grid stations under Normal condition	12
Figure 3.16: Highest voltage recorded at 220 kV grid stations under Normal condition	12
Figure 3.17: Lowest voltage recorded at 220 kV grid stations under Normal condition	13
Figure 3.18: Highest frequency recorded (Hz)	14
Figure 3.19: Lowest frequency recorded (Hz).....	14

Table of Tables

Table 3.1: Reported ENS.....	5
Table 3.2: Loss of supply incidents, average ENS, duration & financial impact per incident (NTDC)	5
Table 3.3: System splitting/isolation detail (2016-17).....	7
Table 3.4: Number of voltage violations (NTDC Region wise)	8
Table 3.5: Number of voltage violations (NTDC Islamabad Region).....	9
Table 3.6: Number of voltage violations (NTDC Lahore Region)	10
Table 3.7: Number of voltage violations (NTDC Multan Region).....	11
Table 3.8: Number of voltage violations (NTDC Hyderabad Region)	11
Table 3.9: NTDC system frequency statistics (2016-17).....	13
Table 3.10: NTDC system frequency details with comparison	14

PERFORMANCE EVALUATION REPORT 2016-17

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 the 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/Splitting, Voltage and Frequency variation violation limits prescribed in PSTR, and Highest and Lowest voltage recorded at NTDC's 500 kV and 220 kV grid stations under Normal system conditions.

The APR for the year 2016-17, submitted by National Transmission & Despatch Company (NTDC), was reviewed on the basis of these parameters. Highlights of the analysis/findings are given below:-

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 1.08 Hours (1 Hour & 4.8 minutes) which shows an increase of 135% as compared to preceding year's 0.46 Hours (27.6 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. It has been observed that average number of outages per circuit for NTDC is 0.35, showing an increase of 84.2% over the previous year i.e. 0.19.

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 is 74.981 million kWh. Based on the energy transportation charges² of NTDC and average energy sale rate³ of CPPA-G, the financial impact amounts to around **Rs. 415.2 million.**

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 NTDC tariff determination 2015-16 & 2016-17

³ CPPA-G Monthly energy procurement reports 2016-17:- Average energy sale rate = Rs. 5.37/kWh.

Loss of supply incidents: NTDC reported 165 incidents of loss of supply during the year 2016-17 which translates into total duration of 515 hours. Based on this, incident wise average ENS, average duration along with financial impact has been assessed for NTDC. The detail is given below:-

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

System Splitting: As reported by NTDC, these incidents include system splitting a number of times in the year 2016-17. The details are summarized below:-

S. No.	Date	Loading at Interruption time	Duration of Interruption		Remarks
			MW	Min	
1	26-Sep-2016	301	36	0.6	System splitting Tripping of Auto Transformer at 500 kV Dadu caused system splitting into Southern part (NKI – Jamshoro – K-Electric) and Northern part (Shikarpur – Guddu – Peshawar).
2	10-Dec-2016	132	489	8.15	System splitting System got splitted into two islands at Guddu. As a result 220 kV Bahawalpur grid station supply failed.
3	11-Dec-2016	111.45	364	6.06	System splitting System got splitted into two islands at Guddu.
4	01-Jan-2017	1235	348	5.8	System splitting 500 kV Dadu & Guddu - Shikarpur circuit tripped resulting in system splitting into two Islands i.e. (Shikarpur – Sheikh Muhammadi & Dadu – HUBCO – K-Electric).
5	02-Jan-2017	891	363	6.05	System splitting 500 kV Dadu & Guddu - Shikarpur circuit tripped resulting in system splitting into two Islands i.e. (Shikarpur – Sheikh Muhammadi & Dadu – HUBCO – K-Electric).
6	03-Jan-2017	130	473	7.88	System splitting 500 kV Dadu & Guddu - Shikarpur circuit tripped resulting in system splitting into two Islands i.e. (Shikarpur – Sheikh Muhammadi & Dadu – HUBCO – K-Electric).
7	04-Jan-2017	249	264	4.4	System splitting All 500 & 220 kV circuits emanating from 500 kV Dadu & Jamshoro tripped resulting in power failure to these grids and splitting the system into two Islands i.e. (Guddu – Sheikh Muhammadi & NKI – HUBCO – K-Electric).

S. No.	Date	Loading at Interruption time	Duration of Interruption		Remarks
			MW	Min	
8	21-May-2017	0	0	0	System splitting 500 kV Guddu-Dadu Circuit went under fault resulting in splitting of system into two regions i.e. (Shikarpur – Sheikh Muhammadi & Dadu – Jamshoro – HUBCO – K-Electric). No area was affected and the system kept on operating in two regions.
9	28-May-2017	1547	1523	25.38	Isolation of K-Electric from NTDC 500 kV circuits NKI-Jamshoro, NKI-HUB, Hub-Jamshoro, Dadu-Jamshoro and 220 kV circuits Jamshoro-KDA, Jamshoro-T. M. Khan and Jamshoro-Hala Road tripped which resulted in isolation of K-Electric from main NTDC network.
10	30-May-2017	1087	1033	17.22	Isolation of K-Electric from NTDC 500kV Guddu –Dadu & Dadu-Shikarpur T/Lines already under fault due to tower collapse. 500 kV circuits HUB-Jamshoro and NKI-Jamshoro along with 220 kV circuit Jamshoro-KDA tripped, resulting in isolation of K-Electric from main NTDC network.

Voltage variations violating prescribed limits: NEPRA has prescribed limits for voltage variations in the PSTR. During year 2016-17, number of voltage violations for NTDC remained 104,924 and indicates a 16.5% reduction as compared to 125,233 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 564 kV for time duration of 60 minutes, recorded at D. G. Khan. The voltage of 564 kV shows approximately 7.4% variation with respect to allowed limit ($\pm 5\% = 525/475 \text{ kV}$).

Similarly, at 220 kV level, it has been observed that highest voltage was 256 kV recorded at Bannu for time duration of 60 minutes. Voltage of 256 kV indicates approximately 10.8% variation with respect to allowed limit ($\pm 5\% = 231/209 \text{ kV}$). Some of the grid stations with highest 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	256	60	10.8%
2	220 kV Khuzdar	255	35	10.4%
3	220 kV Daudkhel	246	60	6.5%
4	220 kV Ludewala	245	90	6.1%
5	220 kV Chishtian	244	60	5.6%
6	220 kV Jaranwala	244	38	5.6%
7	220 kV Toba Tekh Singh	244	390	5.6%
8	220 kV T. M Khan	244	60	5.6%

On the lower side, the voltage remained as low as 171 kV which is quite alarming. Some of the grid stations with lowest voltage incidents are given hereunder:-

S.No.	Name of Grid Station	Lowest Voltage Recorded (kV)	Duration of Variation (min)	Variation w.r.t Allowed Limit (%)
1	220 kV Shahibagh	171	120	18.2%
2	220 kV Sialkot	175	150	16.3%
3	220 kV New Kot Lakhpat	177	90	15.3%
4	220 kV Bannu	178	120	14.8%
5	220 kV Ravi	178	90	14.8%
6	220 kV Sibbi	180	60	13.9%
7	220 kV Kala Shah Kaku	182	60	12.9%
8	220 kV Gakkhar	185	60	11.5%
9	220 kV Shalamar	185	90	11.5%
10	220 kV Khuzdar	185	45	11.5%
11	220 kV Bund Road	186	120	11.0%
12	220 kV WAPDA Town	187	150	10.5%
13	220 kV Toba Tekh Singh	189	150	9.6%
14	220 kV Sarfaraznagar	190	90	9.1%

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 PSTR. During the reported period, NTDC system frequency varied from 49.32 Hertz to 50.72 Hertz and has violated the prescribed limits 35 times, however, it has shown improvement in comparison to the preceding year. The detail is given below:-

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

PERFORMANCE EVALUATION REPORT 2016-17

INTRODUCTION

1 Introduction

This Performance Evaluation Report (PER) provides information on the performance of the transmission licensee, National Transmission & Despatch Company (NTDC) as per National Electric Power Regulatory Authority (NEPRA) Performance Standards (Transmission) Rules (PSTR) 2005⁴, based on their reported data for the year 2016-17.

The document, moreover, takes account of system reliability, security of supply and quality of supply of the transmission network of the licensee during the reported period. Comparison over the last six years has also been provided in this regard.

1.1 Reporting Requirement

In accordance with Rule 9 of PSTR 2005, 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.

Available at: [http://www.nepra.org.pk/Legislation/Rules/Performance%20Standards%20\(Transmission\)%20Rules%202005.pdf](http://www.nepra.org.pk/Legislation/Rules/Performance%20Standards%20(Transmission)%20Rules%202005.pdf)

1.3 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) = **515 Hrs**
2. Total number of interconnection points = **476**
3. System duration of interruption = $515 \div 76 = 1.08 \text{ Hrs}/\text{point}$ i.e. **1 Hr & 4.8 min.**

*Indicates a 2.35 times increase over the previous year i.e. **0.46 Hrs/point (27.6 min)***

Average Frequency of Interruption

1. Total number of outages recorded at all 132 kV outgoing circuits (excluding 132 kV line tripping) = **165**
2. Total number of 132 kV circuits = **476**
3. System frequency of interruption = $165 \div 476 = 0.35 \text{ Nos./circuit}$

*Indicates a 1.84 times increase over the previous year i.e. **0.19 Nos./circuit***

System Security

Energy Not Served (ENS)

1. Total ENS = **74.981 Million kWh**
2. Number of incidents, where there has been a loss of supply = **165**
3. Average ENS per incident = **0.454 million kWh**
4. Average duration per incident = $515 \div 165 = 3 \text{ Hrs} \& 7 \text{ min}$
5. Financial impact of ENS = **Rs. 415.2 Million**
6. Financial impact per incident = $415.2 \div 165 = \text{Rs. 2.5 Million}$

Quality of Supply

Voltage

1. Total number of violations under normal conditions = **103,818**
2. Total number of violations under N-1 conditions = **1,106**
3. Total number of violations under Normal & N-1 conditions = **104,924**
4. Highest voltage recorded under normal conditions; **564 kV at D.G Khan and 256 kV at Bannu**
5. Lowest voltage recorded under normal conditions = **171 kV at Shahibagh Peshawar**

Frequency

1. Number of times frequency remained outside the limits in a year = **35**
2. Time duration the frequency remained outside the limits in a year = **4 Hrs & 12 min.**
3. %age time of the year the frequency remained outside the limits = **0.048% time of the year**

4. Maximum continuous period of deviation = **15 min**
5. Highest frequency recorded = **50.72 Hz**
6. Lowest frequency recorded = **49.32 Hz**

Allowable limits: 49.5 Hz – 50.5 Hz

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 March 1st, 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.

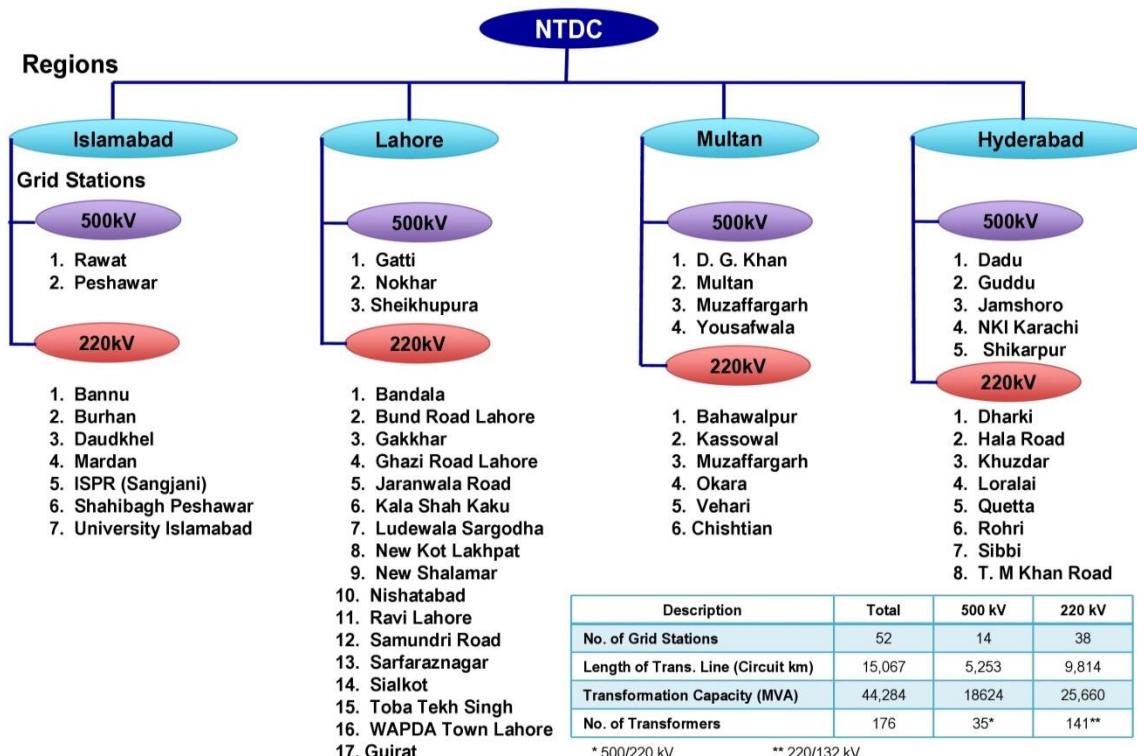
2.1 Licence

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 serves four regions⁵, and it operates & maintains fourteen (14) 500 kV and thirty eight (38) 220 kV Grid Stations with 5,253 km of 500 kV and 9,814 km of 220 kV transmission lines as of June, 2017. Figure 2.1 shows detail of its region wise 500 kV & 220 kV grid stations.

Figure 2.1: NTDC system details



⁵ NTDC Regions: - Islamabad, Lahore, Multan & Hyderabad.

PERFORMANCE EVALUATION REPORT 2016-17

ANALYSIS OF
ANNUAL PERFORMANCE REPORT

3 Analysis of Annual Performance Report (APR)

The APR submitted by NTDC has been evaluated in light of the PSTR 2005. The detail of which is as under;

3.1 System Reliability

3.1.1 System Duration of Interruption

The total outages hours recorded at all interconnection points are 515 indicating a 2.49 times (148.8%) increase in comparison to the preceding year's 207 hours. Similarly, 22 number of interconnection points have been added to the system resulting into 476 in total.

The average duration of interruption per interconnection point during the reported period remained 1.08 hours (1 hour & 4.8 minutes). This indicates a 2.35 times (135%) increase over the previous year's 0.46 hours (27.6 minutes).

All these system parameters are shown in figures 3.1, 3.2 and 3.3 respectively.

Figure 3.1

A. Total outages hours recorded at all interconnection points (excluding 132 kV line tripping)

B. Total number of interconnection points

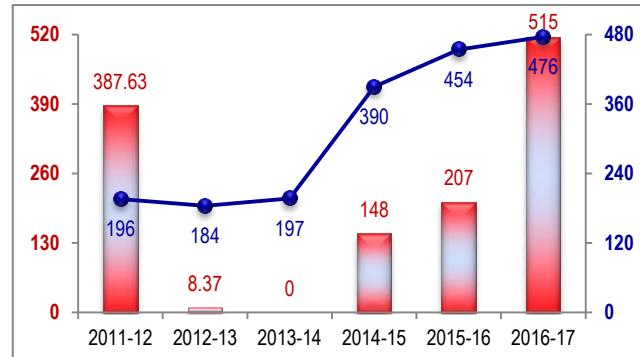
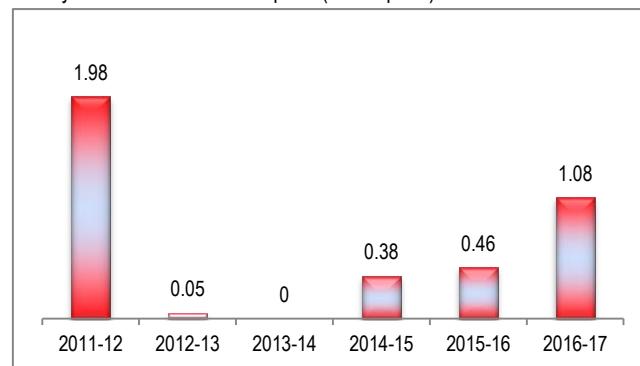


Figure 3.2

C. System duration of interruption (Hours/point) = A ÷ B



3.1.2 System Frequency of Interruption

An increase of 1.89 times (89.6%) has been observed in total number of outages over the previous year i.e. from 87 to 165, as shown in figure 3.3.

Moreover, the number of 132 kV outgoing circuits has been increased by 22 numbers as compared to preceding year.

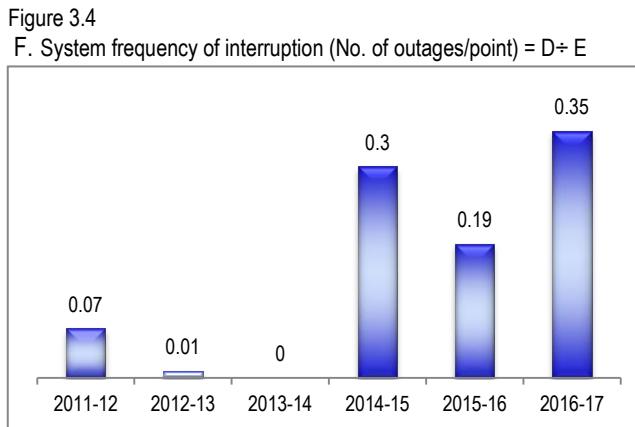
Figure 3.3

D. Total number of outages recorded at all 132 kV outgoing circuits (excluding 132 kV line tripping)

E. Total number of 132 kV circuits



The average number of interruptions per circuit during the reported period is 0.35 that indicates 1.84 times (84.2%) increase in comparison to the preceding year's 0.19 as shown in figure 3.4.



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 74.981 million kWh. Based on the energy transportation charges⁶ of NTDC and average energy sale rate of CPPA-G⁷, the financial impact of 74.981 million kWh, amounts to approximately Rs. 415.2 million. Reported ENS is given hereunder;

Table 3.1: Reported ENS

▼ Unit / Year ►	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Million kWh	0.4	0.1	0	533	143	74.981

Number of incidents, where there has been a loss of supply, average ENS per incident, average duration per incident and financial impact per incident assessed is given in table 3.2 below.

Table 3.2: Loss of supply incidents, average ENS, duration & financial impact per incident

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

The region wise and month wise breakup of loss of supply incidents has been shown in the following figures;

Figure 3.5: Region wise loss of supply incidents

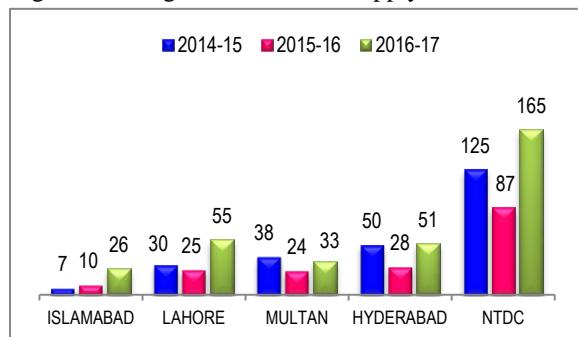
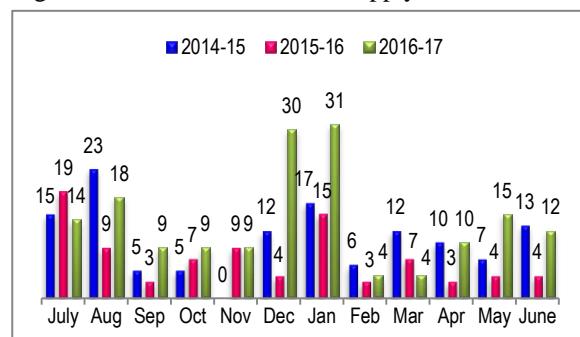


Figure 3.6: Month wise loss of supply incidents



⁶ NTDC tariff determination 2015-16 & 2016-17

⁷ CPPA-G Monthly energy procurement reports 2016-17:- Average energy sale rate = Rs. 5.37/kWh

Figure 3.7: Grid Station wise loss of supply incidents (2016-17)

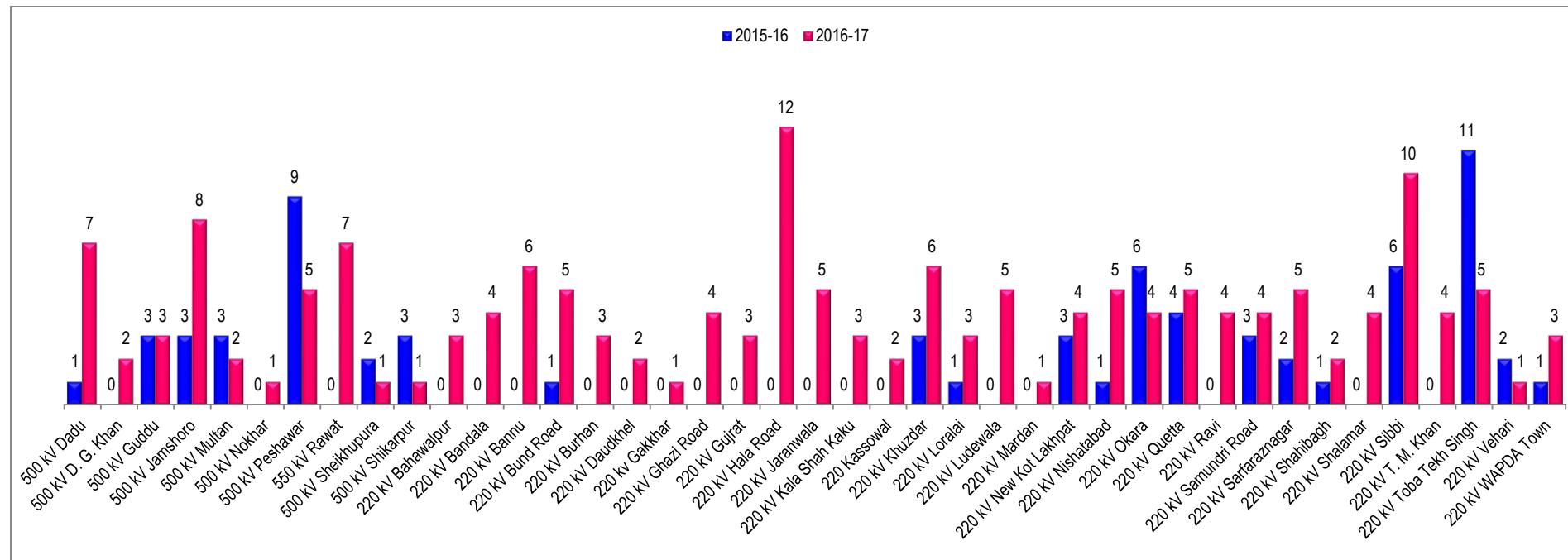
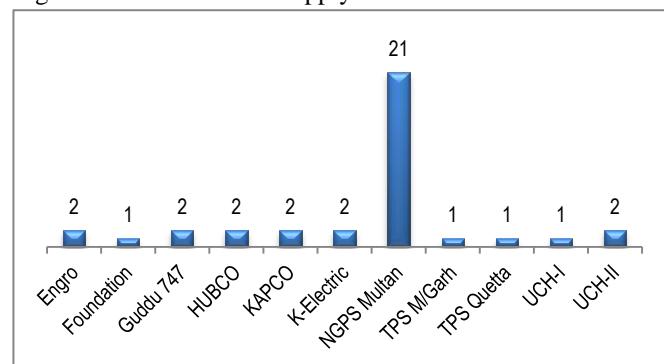


Figure 3.8: Other loss of supply incidents



Note: As reported by NTDC, these loss of supply incidents (outages) include transmission circuits outages, transformers outages and outages occurred at power plant's switchyards.

3.2.1 System Splitting

As reported, these outages also include network splitting/isolation a number of times in the year 2016-17. The detail is given hereunder;

Table 3.3: System splitting/isolation details (2016-17)

S. No.	Date	Loading at Interruption time	Duration of Interruption		Remarks
			MW	Min	
1	26-Sep-2016	301	36	0.6	System splitting Tripping of Auto Transformer at 500 kV Dadu caused system splitting into Southern part (NKI – Jamshoro – K-Electric) and Northern part (Shikarpur – Guddu – Peshawar).
2	10-Dec-2016	132	489	8.15	System splitting System got splitted into two islands at Guddu. As a result 220 kV Bahawalpur grid station supply failed.
3	11-Dec-2016	111.45	364	6.06	System splitting System got splitted into two islands at Guddu.
4	01-Jan-2017	1235	348	5.8	System splitting 500 kV Dadu & Guddu - Shikarpur circuit tripped resulting in system splitting into two Islands i.e. (Shikarpur – Sheikh Muhammadi & Dadu – HUBCO – K-Electric).
5	02-Jan-2017	891	363	6.05	System splitting 500 kV Dadu & Guddu - Shikarpur circuit tripped resulting in system splitting into two Islands i.e. (Shikarpur – Sheikh Muhammadi & Dadu – HUBCO – K-Electric).
6	03-Jan-2017	130	473	7.88	System splitting 500 kV Dadu & Guddu - Shikarpur circuit tripped resulting in system splitting into two Islands i.e. (Shikarpur – Sheikh Muhammadi & Dadu – HUBCO – K-Electric).
7	04-Jan-2017	249	264	4.4	System splitting All 500 & 220 kV circuits emanating from 500 kV Dadu & Jamshoro tripped resulting in power failure to these grids and splitting the system into two Islands i.e. (Guddu – Sheikh Muhammadi & NKI – HUBCO – K-Electric).
8	21-May-2017	0	0	0	System splitting 500 kV Guddu-Dadu Circuit went under fault resulting in splitting of system into two regions i.e. (Shikarpur – Sheikh Muhammadi & Dadu – Jamshoro – HUBCO – K-Electric). No area was affected and the system kept on operating in two regions.
9	28-May-2017	1547	1523	25.38	Isolation of K-Electric form NTDC 500 kV circuits NKI-Jamshoro, NKI-HUB, Hub-Jamshoro, Dadu-Jamshoro and 220 kV circuits Jamshoro-KDA, Jamshoro-T. M. Khan and Jamshoro-Hala Road tripped which resulted in isolation of K-Electric from main NTDC network.

10	30-May-2017	1087	1033	17.22	Isolation of K-Electric from NTDC 500kV Guddu –Dadu & Dadu-Shikarpur T/Lines already under fault due to tower collapse. 500 kV circuits HUB-Jamshoro and NKI-Jamshoro along with 220 kV circuit Jamshoro-KDA tripped, resulting in isolation of K-Electric from main NTDC network.
----	-------------	------	------	-------	---

It has been observed that system disturbances have been increased from 2 to 10 times in the year 2015-17 as compared to preceding year which indicates an alarming situation for NTDC's network. 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 has shown 16.2% improvement in the year 2016-17 as compared to preceding year. Overall and region wise detail of voltage violations is as under:

Figure 3.8 shows the trend over the six years period. From year 2011-12 to year 2014-15, the number of voltage violations is increasing by 33%, 10% and 11% respectively with respect to preceding years. However, 2014-15 onwards it has fallen by 16% & 16.5% respectively.

Figure 3.9: Number of voltage violations (NTDC)

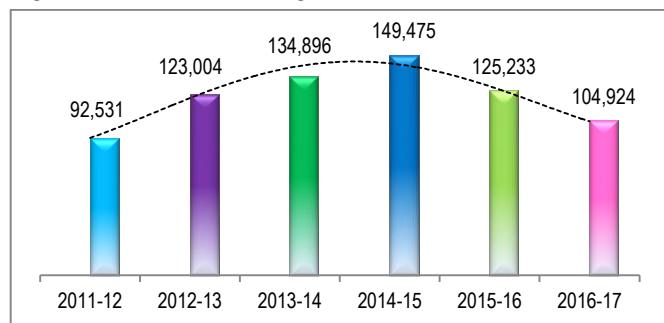
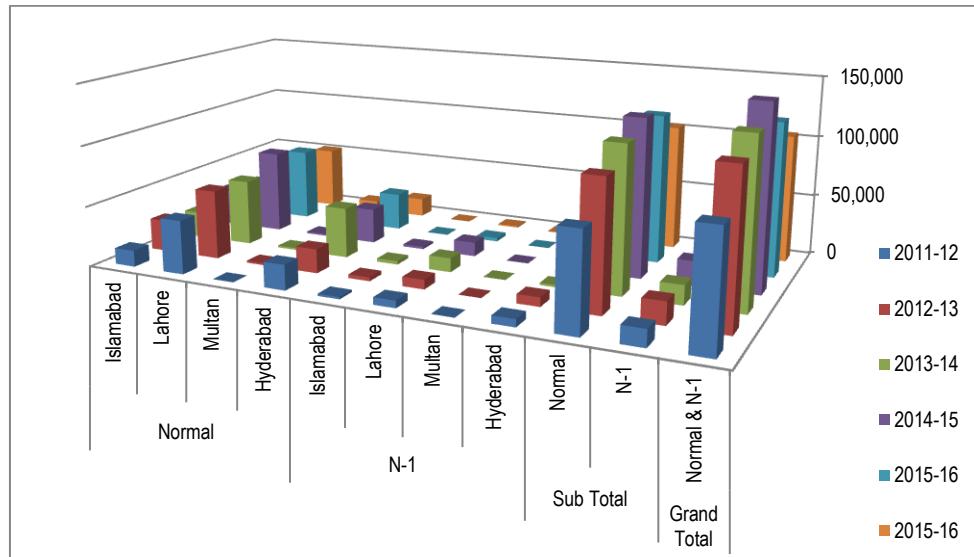


Table 3.4: Number of voltage violations (NTDC Region wise)

System Condition	NTDC Region	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Normal	Islamabad	13,413	26,142	21,386	30,165	27,192	27,776
	Lahore	44,172	56,937	54,262	68,552	60,285	52,005
	Multan	183	1,663	1,557	1,533	3,453	8,455
	Hyderabad	20,754	19,839	41,585	28,958	31,072	15,582
Total (Normal)		78,522	104,581	118,790	129,208	122,002	103,818
N-1	Islamabad	1,788	3,142	2,793	1,914	277	–
	Lahore	5,980	7,782	11,565	11,684	2,951	1,029
	Multan	–	–	12	–	–	75
	Hyderabad	6,241	7,499	1736	6,669	3	2
Total (N-1)		14,009	18,423	16,106	20,267	3,231	1,106
Total (Normal & N-1)		92,531	123,004	134,896	149,475	125,233	104,924

Figure 3.10: Number of voltage violations (NTDC Region wise)



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

Table 3.5: Number of voltage violations

NTDC Islamabad Region

S. No.	Grid Station	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
1	500 kV Rawat	3,749	7,473	7,242	9,376	5,190	6,611
2	500 kV Peshawar	1,521	3,808	335	2,538	3,613	4,239
3	220 kV Bannu	473	502	3,381	3,413	2,733	3,394
4	220 kV Burhan	8	30	73	422	1,754	1,184
5	220 kV Daudkhel	3,132	6,582	4,968	8,714	9,456	5,631
6	220 kV ISPR	77	13	19	9	36	269
7	220 kV Mardan	4,535	5,244	5,328	4,653	2,220	4,008
8	220 kV Shahibagh	1,288	4,955	2,469	1,991	943	806
9	220 kV University	418	677	364	963	1,210	1,634
10	Total	15,201	29,284	24,179	32,079	27,155	27,776

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

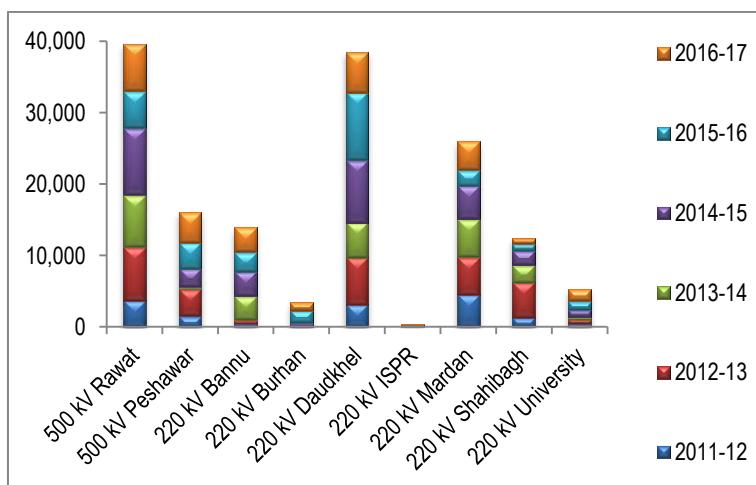


Table 3.6: Number of voltage violations

NA: Not applicable; * Date commissioned/energized

NTDC Lahore Region

S. No.	Grid Station	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
1	500 kV Gatti	416	789	335	1,189	1,285	3,223
2	500 kV Nokhar	—	—	—	—	—	318
3	500 kV Sheikhupura	621	125	120	4,837	4,137	15,365
4	220 kV Bund Road	325	3,278	4,592	4,031	3,607	2,045
5	220 kV Gakkhar	1,445	1,658	902	997	1,582	6,569
6	220 kV Jaranwala	19	222	303	278	208	372
7	220 kV Kala Shah Kaku	5,014	8,798	9,120	10,410	20,704	4,690
8	220 kV Ludewala	468	642	491	442	303	486
9	220 kV New Kot Lakhpat	26,528	27,430	24,575	22,707	5,327	3,140
10	220 kV Nishatabad	0	0	0	20	96	NA
11	220 kV Ravi	7,070	13,749	14,693	19,209	7,604	6,857
12	220 kV Samundri Road	24	204	556	1,160	2,536	324
13	220 kV Sarfaraznagar	3,752	3,778	4,572	3,531	5,898	3,548
14	220 kV Sialkot	1,533	1,198	1,031	982	1,363	2,252
15	220 kV WAPDA Town	2,937	2,848	3,216	1,267	4,976	
16	220 kV Bandala	26-June-2014*			NA	—	441
17	220 kV Ghazi Road	05-Mar-2014*			61	—	—
18	220 kV Gujrat	Apr-2017					51
19	220 kV Shalamar	05-Mar-2014*			5,165	6,309	1,236
20	220 kV Toba Tekh Singh	28-June-2015*			241	896	850
21	Total	50,152	64,719	64,506	80,236	63,236	53,034

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

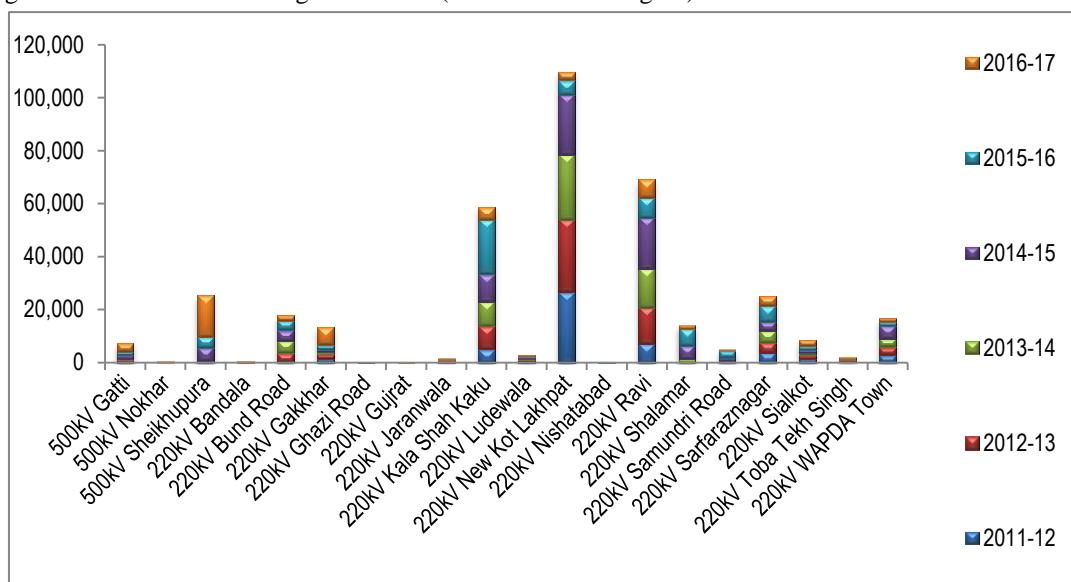


Table 3.7: Number of voltage violations
 * Date commissioned/energized

NTDC Multan Region

S. No.	Grid Station	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
1	500kV Multan	1	-	10	20	8	3
2	500kV Muzaffargarh	-	-	-	-	-	-
3	500kV Yousafwala	-	2	6	351	-	126
4	220kV Bahawalpur	135	15	421	305	506	20
5	220kV Muzaffargarh	1	184	-	4	-	-
6	220kV Vehari	46	1,462	1,132	764	593	2,519
7	500kV D.G. Khan	*05-Oct-2014			14	-	722
8	220kV Kassowal	*15-July-2015			2,008	3,822	
9	220kV Okara	*30-June-2014			75	338	526
10	220 kV Chishtian	*24-Oct-2016				792	
11	Total	183	1,663	1,569	1,533	3,453	8,530

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

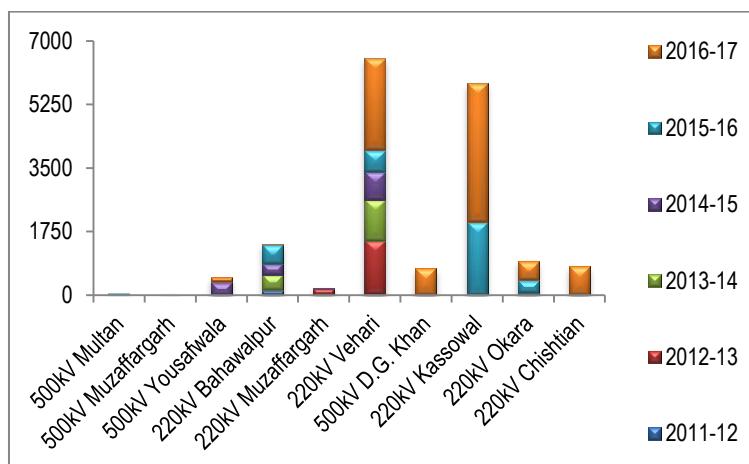
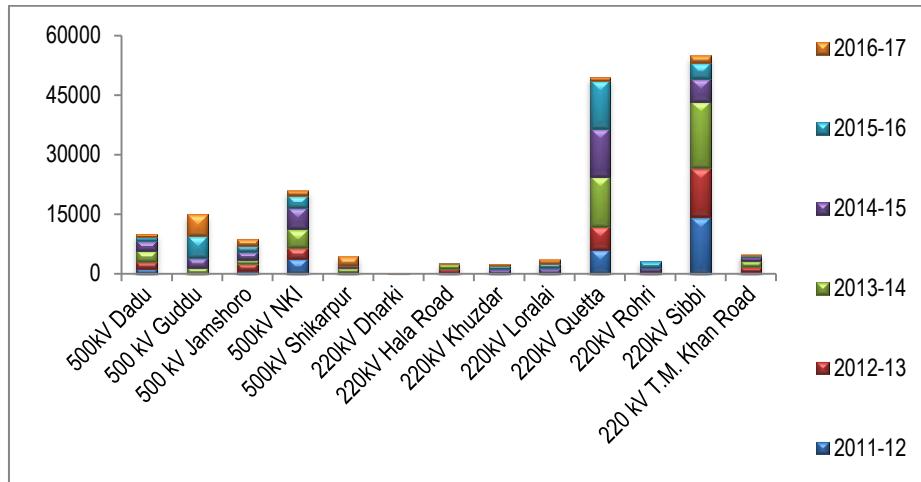


Table 3.8: Number of voltage violations
 * Date commissioned/energized

NTDC Hyderabad Region

S. No.	Grid Station	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
1	500kV Dadu	1,315	1,651	2,864	2,525	835	733
2	500 kV Guddu	-	-	1,584	2,538	5,433	5,433
3	500 kV Jamshoro	673	1,924	890	2,112	1,456	1,688
4	500 kV NKI	3,884	2,738	4,596	5,389	3,188	1,106
5	500 kV Shikarpur	106	202	1,108	572	45	2,242
6	220kV Dharki	11	21	-	-	24	2
7	220kV Hala Road	206	1,086	1,086	162	6	10
8	220kV Quetta	6,032	5,872	12,636	12,020	12,106	890
9	220kV Rohri	14	330	182	1,060	1,642	-
10	220kV Sibbi	14,302	12,282	16,841	5,841	3,924	1,768
11	220 kV T. M. Khan Road	452	1,232	1,534	946	374	244
12	220kV Khuzdar	*09-June-2014 & 24-Aug-2014			1,140	796	458
13	220kV Loralai	*05-Aug-2014 & 29-Aug-2014			1,322	1,246	1,010
14	Total	26,995	27,338	43,321	35,627	31,075	15,584

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



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

Figure 3.15: Highest voltage recorded at 500 kV grid stations under Normal condition

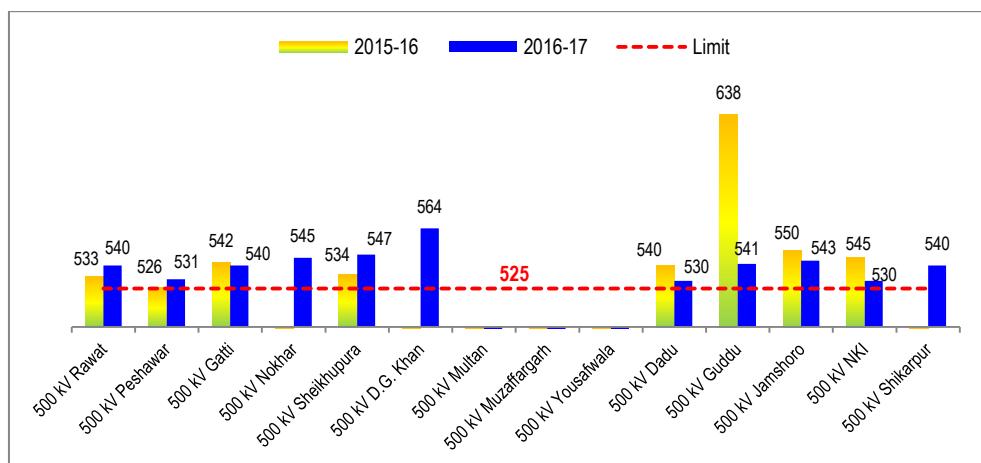
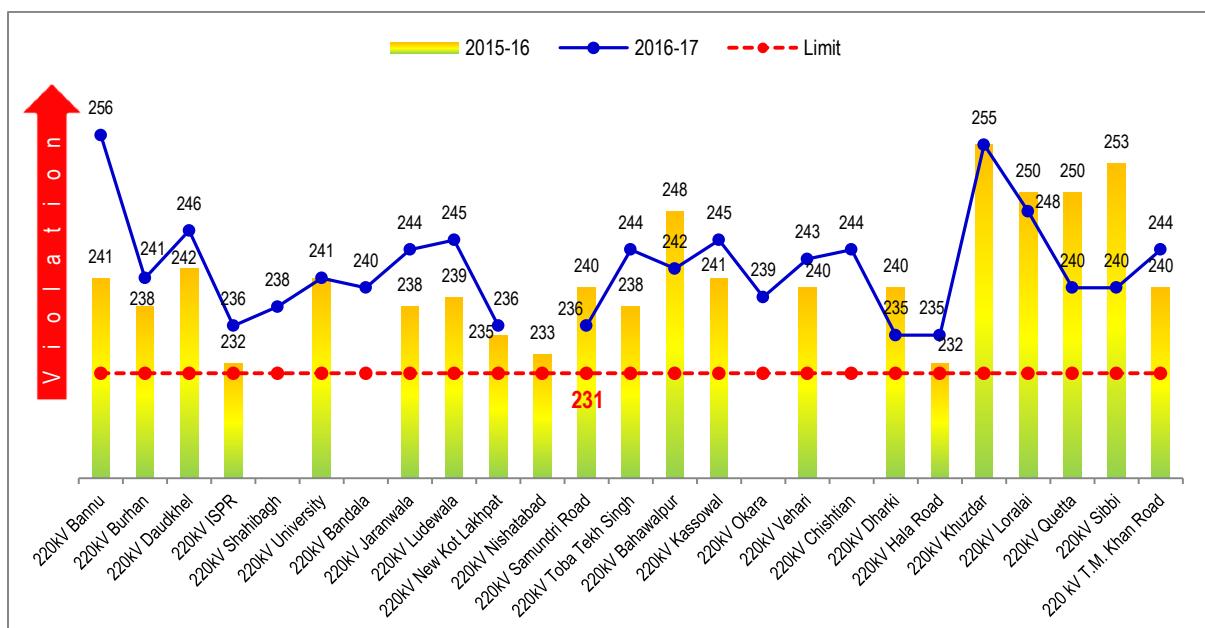
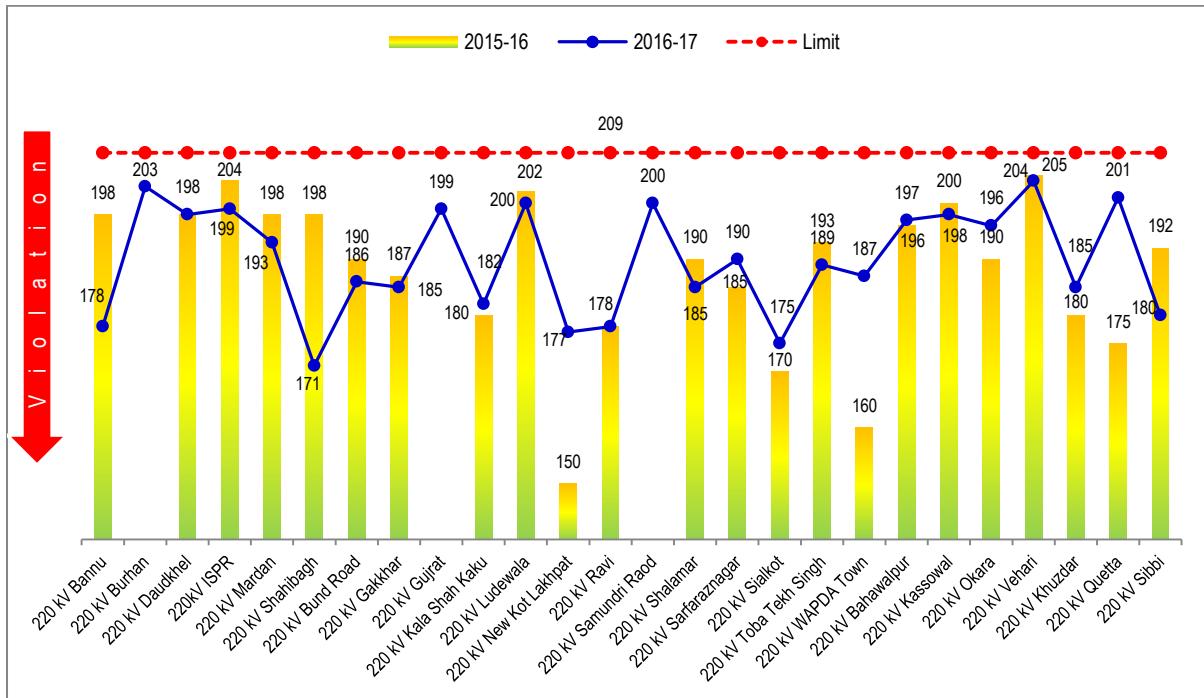


Figure 3.16: Highest voltage recorded at 220 kV grid stations under Normal condition



Note: Break in the plot shows no violation

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



Note: Break in the plot shows no violation

3.3.2 System Frequency

The data as submitted by NTDC was analyzed and revealed that a total of 35 times frequency remained outside the prescribed limits and that comes out to be approximately 0.048% 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 3.9: System frequency stats (2016-17)

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	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Aug	31	744	50.72	49.36	40	0.67	1.44	-1.28	0.090	6
Sep	30	720	50.60	50.51*	12	0.20	1.2	1.02*	0.028	2
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	50.63	49.44	42	0.70	1.26	-1.12	0.094	7
Jan	31	744	51.68	49.37	55	0.92	1.36	-1.26	0.123	8
Feb	28	672	50.65	50.53*	7	0.12	1.30	1.06*	0.017	1
Mar	31	744	50.61	50.51*	15	0.25	1.22	1.02*	0.34	2
Apr	30	720	50.63	49.32	31	0.52	1.26	-1.36	0.072	4
May	31	744	50.65	50.52*	7	0.12	1.30	1.04*	0.016	1
June	30	720	50.64	50.51*	43	0.72	1.28	1.02*	0.100	4
Year	365	8760	50.72	49.32	252	4.2	1.44	-1.36	0.048	35

Note: Shaded figures show highest & lowest frequency recorded and %age variation

* Cannot be validated

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

Table 3.10: System frequency details with comparison

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

The reasons for the frequency fluctuations as reported by NTDC are short fall in generation, violation by DISCOs in load drawl, frequency control through operational margin/ and or emergency (forced) load shedding. It can be noted from table 3.9 that frequency variation has remained maximum in the month of August, December and January which indicates potential for the loss of supply incidents as discussed earlier in section 3.2 (fig 3.6: pg-5).

The figure below shows NTDC month wise reported highest & lowest frequency for the year 2016-17. 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 3.18: Highest frequency recorded (Hz)

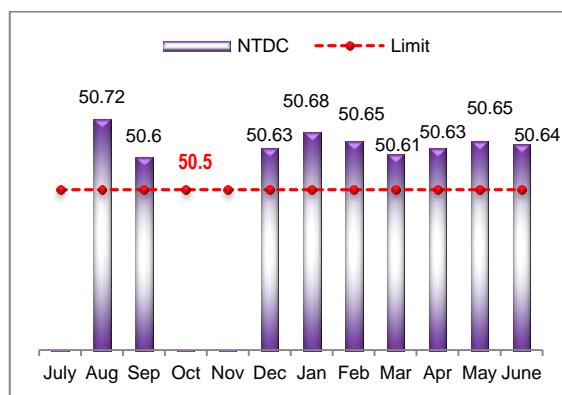
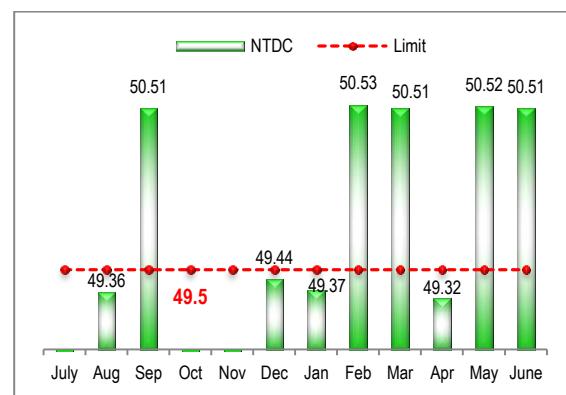
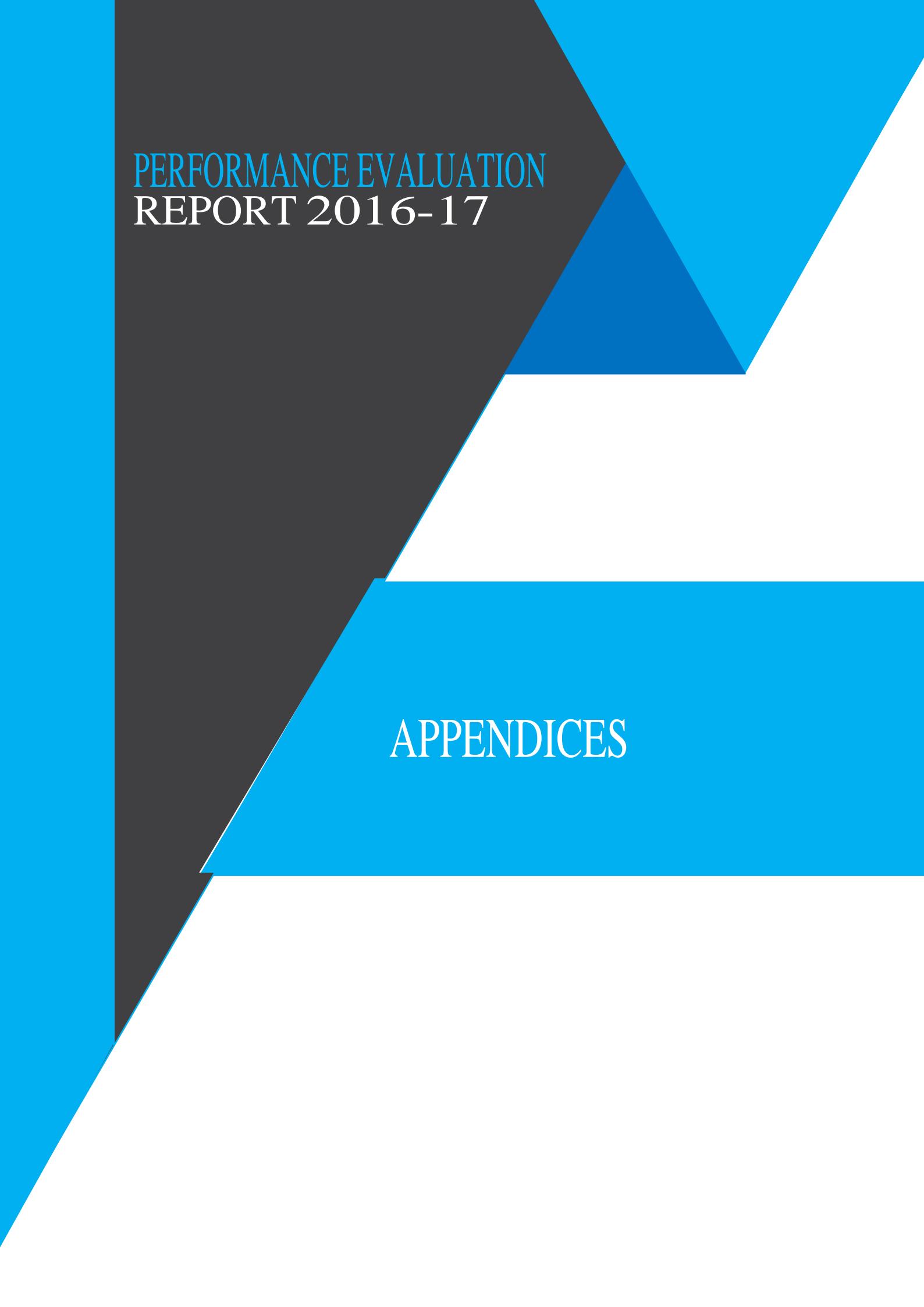


Figure 3.19: Lowest frequency recorded (Hz)





PERFORMANCE EVALUATION REPORT 2016-17

APPENDICES

Appendix 1

QoS data - detailed circuit wise analysis

NTDC Islamabad Region

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

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)											
		2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	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	3	19	22	196	83	494	530	60	538	60	530	60	537	30	533	60	540	120	-	-	-	-	-	-	-	-	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Normal	500 kV Rawat - Gakkhar Ckt I & II	3	19	22	196	83	494	530	60	538	60	530	60	537	30	533	60	540	120	-	-	-	-	-	-	-	-	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Normal	500 kV Rawat - Tarbela	3	19	22	148	83	494	533	60	538	60	530	60	537	30	533	60	540	120	-	-	-	-	-	-	-	-	-	-
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Normal	220 kV Rawat - ISPR Ckt I & II	935	1850	1794	2211	1245	1105	239	60	241	120	240	60	241	120	240	60	241	90	-	-	-	-	-	-	-	-	-	-
N-1		-	4	-	-	-	-	-	-	245	60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Normal	220 kV Rawat - Mangla Ckt I & II	935	1850	1794	2206	1198	1156	-	-	241	120	240	60	241	120	240	60	241	90	-	-	-	-	-	-	-	-	-	-
N-1		-	4	-	-	-	-	-	-	245	60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Normal	220 kV Rawat - Bahria Town Ckt I & II	935	1850	1794	2211	1249	1171	-	-	-	240	60	241	120	240	60	241	90	-	-	-	-	-	-	-	-	-	-	
N-1		-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Normal	220 kV Rawat - University Ckt I & II	935	1850	1794	2208	1249	1697	-	-	241	120	240	60	241	120	240	60	241	150	-	-	-	-	-	-	-	-	-	-
N-1		-	4	-	-	-	-	-	-	245	60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Total No. of Variations (Normal)		3,749	7,457	7,242	9,376	5,190	6,611											Highest Voltage Under Normal Condition @500kV level											
Total No. of Variations (N-1)		-	16	-	-	-	-											Highest Voltage Under Normal Condition @220kV level											
Total of Normal & N-1		3,749	7,473	7,242	9,376	5,190	6,611																						

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)											
		2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	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	5	12	NP	1	17	-	-	531	60	NP	NP	526	60	531	60	470	60	-	-	NP	NP	-	-	473	60			
N-1		-	-		-	-	-	-	-	-			-	-	-	-	-	-	-	-			-	-	-	-			
Normal	220 kV Barotha - Peshawar	607	1337	116	818	1211	1428	241	60	241	120	235	60	240	60	239	60	242	60	198	120	199	60	200	180	200	60	200	60
N-1		10	27	5	95	-	-	-	-	246	60	-	-	-	-	-	-	-	-	180	120	174	60	190	60	180	60	-	-
Normal	220 kV Peshawar - Daudkhel Ckt I & II	445	1271	89	711	1190	1415	240	60	241	120	238	60	241	60	239	60	242	60	198	60	199	60	200	60	-	-	200	60
N-1		12	30	6	2	-	-	-	-	246	60	-	-	243	60	-	-	-	-	180	120	172	60	190	120	195	60	-	-
Normal	220 kV Peshawar - Shahibagh	425	1105	114	817	1211	1379	239	60	241	60	235	60	240	60	239	60	242	60	198	120	200	60	200	60	200	60	200	60
N-1		17	26	5	95	-	-	-	-	245	60	-	-	-	-	-	-	-	-	179	120	23	60	190	60	180	60	-	-

NP: Not Provided

Total No. of Variations (Normal)	1,482	3,725	319	2,346	3,613	4,239
Total No. of Variations (N-1)	39	83	16	192	-	-
Total of Normal & N-1	1,521	3,808	335	2,538	3,613	4,239

 Highest Voltage Under Normal Condition @500kV level

 Lowest Voltage Under Normal Condition @500kV 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)																																							
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17																					
		2011-12	Voltage	2012-13	Voltage	2013-14	Voltage	2014-15	Voltage	2015-16	Voltage	2016-17	Voltage	2011-12	Voltage	2012-13	Voltage	2013-14	Voltage	2014-15	Voltage	2015-16	Voltage	2016-17	2011-12	Voltage	2012-13	Voltage	2013-14	Voltage	2014-15	Voltage	2015-16	Voltage	2016-17																						
Normal	220 kV Daudkhel - Bannu Ckt I & II	366	348	1755	2424	2652	1859	243	60	241	600	242	60	241	60	241	60	256	60	260	300	298	60	195	60	199	60	198	60	178	120																										
N-1		107	154	1626	989	81	-	250	60	250	180	248	60	243	60	-	-	-	-	178	540	180	900	172	60	170	60	180	60	-	-																										
Normal	220 kV Chashma - Bannu Ckt I & II	Added in 2016-17						1535	Added in 2016-17										246	60	Added in 2016-17										202	60																									
N-1		-							-																			-																													
Total No. of Variations (Normal)		366	348	1,755	2,424	2,652	3,394																																																		
Total No. of Variations (N-1)		107	154	1,626	989	81	-																																																		
Total of Normal & N-1		473	502	3,381	3,413	2,733	3,394																																																		

Highest Voltage Under Normal Condition

Lowest Voltage Under Normal Condition

NTDC Islamabad Region

4. 220kV Grid Station BURHAN

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit						Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)											
		2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	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 Burhan - ISPR Ckt I & II	4	30	38	211	877	590	-	-	240	60	236	60	237	60	238	60	241	240	203	60	204	60	-	-	-	-	203	60
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Normal	220 kV Burhan - Tarbela Ckt I, II & III *Ckt III reported in 2015-16	4	NP	35	211	877	594	-	-	NP	236	60	237	60	238	60	241	240	203	60	NP	-	-	-	-	-	-	203	60
N-1		-		-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		

NP : Not Provided

Total No. of Variations (Normal)	8	30	73	422	1,754	1,184
Total No. of Variations (N-1)	-	-	-	-	-	-
Total of Normal & N-1	8	30	73	422	1,754	1,184

 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)															
		2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	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	923	2176	1569	3445	3099	1877	242	60	240	60	241	60	242	60	242	240	246	60	198	120	202	60	200	120	198	60	198	60	198	60
N-1		121	92	87	59	53	-	243	60	244	60	246	60	248	60	248	60	-	-	175	60	-	-	184	60	186	60	190	60	-	-
Normal	220 kV Daudkhel - Chashma Ckt I & II	898	1834	1569	1664	3099	1877	242	60	241	180	241	60	242	60	242	240	246	60	198	120	199	60	200	120	198	60	198	60	198	60
N-1		143	91	87	47	53	-	244	60	250	60	246	60	248	60	248	60	-	-	175	60	184	60	184	60	186	60	190	60	-	-
Normal	220 kV Daudkhel - Bannu Ckt I & II	926	2294	1569	3440	3099	1877	242	60	241	180	241	60	237	60	242	240	246	60	198	120	199	60	200	120	198	60	198	60	198	60
N-1		121	95	87	59	53	-	244	60	250	60	246	60	248	60	248	60	-	-	175	60	184	60	184	60	186	60	190	60	-	-
Total No. of Variations (Normal)		2,747	6,304	4,707	8,549	9,297	5,631																								
Total No. of Variations (N-1)		385	278	261	165	159	-																								
Total of Normal & N-1		3,132	6,582	4,968	8,714	9,456	5,631																								

 Highest Voltage Under Normal Condition

 Lowest Voltage Under Normal Condition

NTDC Islamabad Region

6. 220kV Grid Station ISPR (SANGJANI)

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit						Highest Voltage Recorded (kV) / Time (Min)								Lowest Voltage Recorded (kV) / Time (Min)																	
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2015-17									
		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						
Normal	220 kV ISPR - Mansehra Ckt I	-	2	1	3	+		-	-	233	120	232	120	232	120	+		-	-	-	-	-	-	-	-	+							
N-1		-	-	-	-			-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-								
Normal	220 kV ISPR - Burhan	-	1	1	2	13	8	-	-	231	60	232	60	232	150	232	300	232	120	-	-	205	120	-	-	-	-	205	60				
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
Normal	220 kV ISPR - Tarbela	21	4	6	-	5	169	-	-	-	-	-	-	-	-	-	236	180	204	120	201	480	205	60	209	60	204	120	199	60			
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
Normal	220 kV ISPR - Bahria Town	14	3	6	2	5	30	-	-	-	-	-	-	-	232	60	232	360	-	-	204	120	200	180	205	180	205	180	205	120	199	60	
N-1		14	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	204	120	-	-	-	-	-	-	-	-				
Normal	220 kV ISPR - Rawat	14	3	5	2	5	30	-	-	-	-	-	-	-	232	60	232	360	-	-	204	120	200	180	205	180	205	180	205	120	199	60	
N-1		14	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	204	120	-	-	-	-	-	-	-	-				
Normal	220 kV ISPR - Allai Khwar Ckt I	† Reported earlier as ISPR - Mansehra Ckt I				4	16	† Reported earlier as ISPR - Mansehra Ckt I								232	240	232	60	† Reported earlier as ISPR - Mansehra Ckt I								206	60	201	60		
N-1						-	-									-	-	-	-	-	-	-	-										
Normal	220 kV ISPR - Allai Khwar Ckt II	Did not report				4	16	Did not report								232	240	232	60	Did not report								206	60	201	60		
N-1						-	-									-	-	-	-	-	-	-	-										
Total No. of Variations (Normal)		49	13	19	9	36	269																										
Total No. of Variations (N-1)		28	-	-	-	-	-																										
Total of Normal & N-1		77	13	19	9	36	269																										

 Highest Voltage Under Normal Condition

 Lowest Voltage Under Normal Condition

NTDC Islamabad Region

7. 220kV Grid Station MARDAN

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit						Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)																			
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		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	Voltage	Time	Voltage	Time				
Normal	220 kV Tarbela - Mardan Ckt I & II	3401	1925	1600	1356	740	2004	290	60	-	-	-	-	-	-	-	-	-	-	-	-	-	188	120	199	240	200	540	199	120	198	180	193	60			
N-1		1134	1267	176	139	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	170	60	170	120	182	60	180	240	-	-	-	-			
Normal	220 kV Mardan - Barotha Ckt I & II	-	899	1600	1358	740	1002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	200	540	199	120	198	180	193	60						
N-1		-	128	176	137	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	182	60	180	240	-	-	-	-	-	-	-			
Normal	220 kV Mardan - Shahibagh Ckt I & II	-	896	1600	1520	740	1002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	200	540	199	60	198	180	193	60						
N-1		-	129	176	143	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	182	60	181	60	-	-	-	-	-	-	-			
Total No. of Variations (Normal)		3,401	3,720	4,800	4,234	2,220	4,008																														
Total No. of Variations (N-1)		1,134	1,524	528	419	-	-																														
Total of Normal & N-1		4,535	5,244	5,328	4,653	2,220	4,008																														

■ 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)														
		2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	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	571	40	†				242	60	241	180	†										199	60	199	60	†						
N-1		7	5					-	-	-	-											190	60	180	60							
Normal	220 kV Shahibagh - Peshawar Ckt I	311	968	†				-	-	-	-	†										199	60	199	300	†						
N-1		44	341					-	-	-	-											185	60	178	60							
Normal	220 kV Shahibagh - Peshawar Ckt II	311	968	1331	1637	777	656	-	-	-	-	-	-	-	-	-	-	-	-	-	199	60	199	300	200	420	199	60	198	60	171	120
N-1		44	341	130	52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	185	60	178	60	170	120	181	60	-	-	-	-
Normal	220 kV Shahibagh - Mardan Ckt I	NP	946	395	206	166	150	NP		-	-	-	-	238	240	235	120	238	60	NP		-	-	-	-	199	60	198	60	195	60	
N-1			200	109	96	-	-			-	-	-	-	-	-	-	-	-	-			-	-	175	60	180	60	-	-	-	-	
Normal	220 kV Shahibagh - Mardan Ckt II	NP	946	395	††				NP		-	-	-	-	238	240	††				NP		-	-	-	-	††					
N-1			200	109							-	-	-	-	-	-	-	-	-	-			-	-	175	60						

NP: Not Provided

Total No. of Variations (Normal)	1,193	3,868	2,121	1,843	943	806
Total No. of Variations (N-1)	95	1,087	348	148	-	-
Total of Normal & N-1	1,288	4,955	2,469	1,991	943	806

Highest Voltage Under Normal Condition

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)																			
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17	
		2011-12	Voltage	2012-13	Time	2013-14	Voltage	2014-15	Time	2015-16	Voltage	2016-17	Time	2011-12	Voltage	2012-13	Time	2013-14	Voltage	2014-15	Time	2015-16	Voltage	2016-17	2011-12	Voltage	2012-13	Time	2013-14	Voltage	2014-15	Time	2015-16	Voltage	2016-17		
Normal	220 kV University - Rawat Ckt I & II	418	676	362	962	1210	1634	240	60	241	60	240	60	241	60	241	60	241	60	241	60	-	-	-	-	232	120	-	-	-	-	-	-				
N-1		-	1	2	1	-	-	-	-	245	60	242	60	243	60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
Total No. of Variations (Normal)		418	676	362	962	1,210	1,634																														
Total No. of Variations (N-1)		-	1	2	1	-	-																														
Total of Normal & N-1		418	677	364	963	1,210	1,634																														

 Highest Voltage Under Normal Condition

Appendix 2

QoS data - detailed circuit wise analysis

NTDC Lahore Region

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

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)																													
		2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2011-12	Voltage	Time	2012-13	Voltage	Time	2013-14	Voltage	Time	2014-15	Voltage	Time	2015-16	Voltage	Time	2016-17	Voltage	Time	2011-12	Voltage	Time	2012-13	Voltage	Time	2013-14	Voltage	Time	2014-15	Voltage	Time	2015-16	Voltage	Time	2016-17	Voltage	Time		
Normal	500 kV Gatti - Barotha Ckt I	-	3	-		NP	NA	NA	-	-	530	120	-	-			NP		NA		NA		-	-	-	-	-	-			NP	NA		NA											
N-1		-	-	-					-	-	-	-	-	-										-	-	-	-	-	-																
Normal	500 kV Gatti - Barotha Ckt II	1	12	4	2		NA	NA	530	90	535	60	530	90	528	60			NA		NA		-	-	-	-	-	-			NA			NA											
N-1		-	-	-	-				-	-	-	-	-	-	-	-							-	-	-	-	-	-																	
Normal	500 kV Gatti - Muzaffargarh	286	169	140	358	679	708	542	120	540	120	535	90	545	60	542	90	540	150			-	-	-	-	-	-			-	-	-	-	-	-										
N-1		-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-											
Normal	500 kV Gatti - Rousch	22	83	17	137	154	171	540	60	540	120	538	60	540	60	540	60	540	60	540	60	-	-	-	-	-	-		-	-	-	-	-	-											
N-1		-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-											
Normal	500 kV Gatti - Multan	88	447	155	621	310	232	540	90	545	60	540	300	547	60	540	90	540	150	-	-	-	-	-	-	-		-	-	-	-	-	-												
N-1		-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-											
Normal	500 kV Gatti - Lahore	19	75	19	71	142	NP	540	60	540	60	532	90	540	60	538	60			NP		-	-	-	-	-	-		-	-	-	-	-	-	NP										
N-1		-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-											
Normal	220 kV Gatti - Nishatabad 1			NP			390										240	90																											
N-1							-										-	-																											
Normal	220 kV Gatti - Nishatabad 2			NP			384										240	90																											
N-1							-										-	-																											
Normal	220 kV Gatti - Jaranwala Road 1			NP			287										240	60																											
N-1							-										-	-																											
Normal	220 kV Gatti - Jaranwala Road 2			NP			7										238	60																											
N-1							-										-	-																											
Normal	220 kV Gatti - Yousafwala 1			NP			NA										NA																												
N-1																																													
Normal	220 kV Gatti - Yousafwala 2			NP			NA										NA																												
N-1																																													
Normal	220 kV Gatti - Ludewala 1			NP			NA										NA																												
N-1																																													
Normal	220 kV Gatti - Ludewala 2			NP			NA										NA																												
N-1																																													
Normal	220 kV Gatti - Bandala 1			NP			577										244	150																											
N-1							-										-	-																											
Normal	220 kV Gatti - Bandala 2			NP			467										247	60																											
N-1							-										-	-																											

NP: Not Provided NA: Not Applicable

Total No. of Variations (Normal)	416	789	335	1,189	1,285	3,223
Total No. of Variations (N-1)	-	-	-	-	-	-
Total of Normal & N-1	416	789	335	1,189	1,285	3,223

 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)									
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		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
Normal	500 kV Gakkhar - Rawat 1	Not applicable		77		Not applicable								545	150	Not applicable								453	60
N-1														-	-									-	-
Normal	500 kV Gakkhar - Rawat 2	Not applicable		77		Not applicable								545	150	Not applicable								453	60
N-1														-	-									-	-
Normal	500 kV Gakkhar - Lahore 1	Not applicable		77		Not applicable								545	150	Not applicable								453	60
N-1														-	-									-	-
Normal	500 kV Gakkhar - Lahore 2	Not applicable		77		Not applicable								545	150	Not applicable								453	60
N-1														-	-									-	-
Normal	220 kV Nokhar - Mangla	Not applicable		5		Not applicable								232	120	Not applicable								205	120
N-1														-	-									-	-
Normal	220 kV Nokhar - Gakkhar	Not applicable		5		Not applicable								232	120	Not applicable								205	120
N-1														-	-									-	-
Total No. of Variations (Normal)		Not applicable		318										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																					

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)																			
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		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	Voltage	Time						
Normal	500 kV Sheikhupura - Yousafwala	2	-	-	-	129	24	NP	530	30	-	-	-	-	536	60	534	30	NP	472	30	-	-	-	-	-	-	-	-	NP							
N-1		-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-									
Normal	500 kV Sheikhupura - Gatti	2	-	-	-	129	24	NP	530	30	-	-	-	-	536	60	534	30	NP	472	30	-	-	-	-	-	-	-	-	NP							
N-1		-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-									
Normal	500 kV Sheikhupura - Nokhar Ckt I & II	2	-	-	-	129	24	900	530	30	-	-	-	-	536	60	534	30	547	30	472	30	-	-	-	-	-	-	-	-	462	60					
N-1		-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-							
Normal	220 kV Sheikhupura - WTN	NP	25	23	887	813	2833	NP	-	-	-	-	-	-	-	-	-	-	NP	198	120	200	90	198	30	193	30	192	30								
N-1			-	1	3	-	60		-	-	-	-	-	-	-	-	-	-		-	-	197	90	195	60	-	-	190	30								
Normal	220 kV Sheikhupura - NKLP Ckt I & II	205	25	23	887	813	2833	236	30	233	60	-	-	-	-	-	-	-	198	30	198	120	200	90	198	30	193	30	192	30							
N-1		-	-	1	3	-	60	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	197	90	195	60	-	-	190	30						
Normal	220 kV Sheikhupura - Bund Road Ckt I, II, III & IV	205	25	23	887	813	2833	236	30	233	60	-	-	-	-	-	-	-	198	30	198	120	200	90	198	30	193	30	192	30							
N-1		-	-	1	3	-	60	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	197	90	195	60	-	-	190	30						
Normal	220 kV Sheikhupura - Ravi Ckt I & II	205	25	23	887	813	2833	236	30	233	60	-	-	-	-	-	-	-	198	30	198	120	200	90	198	30	193	30	192	30							
N-1		-	-	1	3	-	60	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	197	90	195	60	-	-	190	30						
Normal	220 kV Sheikhupura - ATLAS P/H	NP	25	23	887	813	2833	NP	-	-	-	-	-	-	-	-	-	NP	198	120	200	90	198	30	-	-	-	192	30								
N-1			-	1	3	-	60		-	-	-	-	-	-	-	-	-		-	-	197	90	195	60	-	-	190	30									

NP: Not Provided

NKLP: New Kot Lakhpat

 Highest Voltage Under Normal Condition @500kV level

 Lowest 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. 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)									
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		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
Normal	220 kV Bandala - KSK 1	Commissioned/ Energized on 26-06-2014			NA	146	Commissioned/Energized on 26-06-2014			NA	240		60	Commissioned/Energized on 26-06-2014			NA	-		-			NA	-	
N-1		-				-	-				-		-	-				-		-			NA	-	
Normal	220 kV Bandala - KSK 2	Commissioned/ Energized on 26-06-2014			NA	146	Commissioned/Energized on 26-06-2014			NA	240		60	Commissioned/Energized on 26-06-2014			NA	-		-			NA	-	
N-1		-				-	-				-		-	-				-		-			NA	-	
Normal	220 kV Bandala - Gatti 1	Commissioned/ Energized on 26-06-2014			NA	149	Commissioned/Energized on 26-06-2014			NA	240		60	Commissioned/Energized on 26-06-2014			NA	-		-			NA	-	
N-1		-				-	-				-		-	-				-		-			NA	-	
Normal	220 kV Bandala - Gatti 2	Commissioned/ Energized on 26-06-2014			NA	-	Commissioned/Energized on 26-06-2014			NA	-		-	Commissioned/Energized on 26-06-2014			NA	-		-			NA	-	
N-1		-				-	-				-		-	-				-		-			NA	-	

NA: Not Applicable

 Highest Voltage Under Normal Condition

Total No. of Variations (Normal)	Commissioned/ Energized on 26-06-2014	NA	441
Total No. of Variations (N-1)		NA	-
Total of Normal & N-1		NA	441

NTDC Lahore Region

5. 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)																			
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		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	Voltage	Time	Voltage	Time				
Normal	220 kV Bus Bar No. 1 & 2	325	3228	4,438	3,844	3,598	1,916	234	30	-	-	-	-	-	-	-	-	-	-	-	-	196	60	196	60	195	150	182	30	190	60	186	120				
N-1		-	50	154	187	9	129	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	195	90	195	120	191	60	190	-	185	90					
Total No. of Variations (Normal)		325	3,228	4,438	3,844	3,598	1,916																														
Total No. of Variations (N-1)		-	50	154	187	9	129																														
Total of Normal & N-1		325	3,278	4,592	4,031	3,607	2,045																														

 Lowest Voltage Under Normal Condition

 Lowest Voltage Under N-1 Condition

NTDC Lahore Region

6. 220kV Grid Station GAKKHar

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit						Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)													
		2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	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	357	393	148	183	791	2495	-	-	-	-	-	-	-	-	-	-	-	-	198	180	199	60	204	280	198	60	187	60	188	60
N-1		28	7	25	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	182	30	193	60	185	60	193	60	-	-	-	-
Normal	220 kV Gakkhar - Mangla Ckt II	266	390	224	288	NP	1580	-	-	260	120	280	60	-	-	NP	-	-	198	360	107	120	198	120	198	60	NP	185	60		
N-1		70	39	52	24		-	-	-	-	-	-	-	-	-	-	-	-	85	120	182	30	186	60	190	60	-	-			
Normal	220 kV Gakkhar - Mangla Ckt III	NP						NP										NP													
N-1		NP						NP										NP													
Normal	220 kV Gakkhar - Sialkot	358	390	148	182	791	914	-	-	-	-	-	-	-	-	-	-	-	-	191	60	199	60	198	60	193	60	187	60	188	60
N-1		30	9	25	5	-	0	-	-	-	-	-	-	-	-	-	-	-	-	182	30	193	60	185	60	190	60	-	-	-	-
Normal	220 kV Gakkhar - Nokhar	-	391	-	NP	NP	-	-	-	-	-	-	-	-	-	NP	-	-	107	120	-	-	NP	NP	NP	NP	NP	NP	NP	NP	
N-1		-	39	-			-	-	-	-	-	-	-	-	-		-	-	182	30	-	-									
Normal	220 kV Old Gakkhar - New Gakkhar	266	NP	226	285	NA	1580	-	-	NP	-	-	-	-	-	NA	-	-	198	360	NP	NP	198	120	198	60	NA	185	60		
N-1		70		54	24		-	-	-		-	-	-	-	-		-	-	85	120			186	60	190	60		-	-		

NP: Not Provided

NA: Not Applicable

 Lowest Voltage Under Normal Condition

Total No. of Variations (Normal)	1,247	1,564	746	938	1,582	6,569
Total No. of Variations (N-1)	198	94	156	59	-	-
Total of Normal & N-1	1,445	1,658	902	997	1,582	6,569

NTDC Lahore Region

7. 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)									
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		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
Normal	220 kV KSK - Shalamar Via Ghazi	Comm./Energized Mar 2014	61	NA	Comm./Energized Mar 2014	–	–	–	NA	Comm./Energized Mar 2014	–	–	NA	Comm./Energized Mar 2014	–	–	NA	Comm./Energized Mar 2014	–	–	NA	Comm./Energized Mar 2014	–	–	
N-1			–			–																			

NA: Not Applicable

Total No. of Variations (Normal)	Comm./Energized in 2014-15	61	NA	NA
Total No. of Variations (N-1)		–	NA	NA
Total of Normal & N-1	Comm./Energized in 2014-15	61	NA	NA

NTDC Lahore Region

8. 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)																			
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		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												
Normal	220 kV Gujrat - Old Gakkhar	Comm./Energized Apr 2017						51	Comm./Energized Apr 2017										—	—	Comm./Energized Apr 2017										199	60					
N-1								—											—	—	—	—															
Normal	220 kV Gujrat - New Gakkhar	Comm./Energized Apr 2017						—	Comm./Energized Apr 2017										—	—	Comm./Energized Apr 2017										—	—					
N-1								—											—	—	—	—															
Normal	220 kV Gujrat - Mangla 1 & 2	Comm./Energized Apr 2017						—	Comm./Energized Apr 2017										—	—	Comm./Energized Apr 2017										—	—					
N-1								—											—	—	—	—															
NA: Not Applicable																																					
Total No. of Variations (Normal)							Comm./Energized Apr 2017						51																			Lowest Voltage Under Normal Condition					
Total No. of Variations (N-1)													—																								
Total of Normal & N-1							Comm./Energized Apr 2017						51																								

NTDC Lahore Region

9. 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)																			
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		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	Voltage	Time						
Normal	220 kV Jarawala - Gatti Ckt I & II	19	222	303	278	208	372	236	45	240	40	237	60	238	34	238	40	244	38	-	-	-	-	-	-	-	-	-	-	-	-	-					
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
Total No. of Variations (Normal)		19	222	303	278	208	372																					Highest Voltage Under Normal Condition									
Total No. of Variations (N-1)		-	-	-	-	-	-																														
Total of Normal & N-1		19	222	303	278	208	372																														

NTDC Lahore Region

10. 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)																
		2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	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	678	2041	2040	NP		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NP						
N-1		45	17	19			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
Normal	220 kV Kala Shah Kaku - Mangla Ckt I, II & III	1195	1634	1632	1048	2940	1016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	198	150	198	60	197	60	196	60	184	60	182	60
N-1		43	7	6	46	17	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	182	30	193	60	193	60	187	60	188	90	185	60
Normal	220 kV Kala Shah Kaku - Bund Road Ckt I & II	1336	1536	1535	1287	3425	486	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	198	150	198	180	198	60	189	60	180	60	190	90
N-1		51	6	6	78	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	188	120	195	60	195	60	190	60	188	90	-	-
Normal	220 kV Kala Shah Kaku - Ravi Ckt I & II	437	1809	1819	1752	3592	570	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	198	120	198	180	198	420	195	60	180	60	184	90
N-1		23	116	117	288	53	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	182	30	188	60	190	240	188	60	187	90	180	120
Normal	220 kV Kala Shah Kaku - Sialkot	1140	1592	1830	1809	3563	1038	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	198	120	196	90	195	60	198	210	182	60	189	90
N-1		66	40	116	172	58	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	188	120	192	60	190	60	184	60	189	60	191	90
Normal	220 kV Kala Shah Kaku - Shalamar	Comm./Energized Mar 2014			1731	3442	592	Comm./Energized Mar 2014				-	-	-	-	-	-	-	-	-	-	-	Comm./Energized Mar 2014				197	60	180	60	60	150		
N-1		294	56	12	-	-	-					-	-	-	-	-	-	-	-	188	60	187					90	182	60					
Normal	220 kV Kala Shah Kaku - Bandala Ckt I & II	Comm./Energized June 2014			1786	3456	950	Comm./Energized June 2014				-	-	-	-	-	-	-	-	-	-	-	Comm./Energized June 2014				190	60	183	60	183	60		
N-1		119	54	4	-	-	-					-	-	-	-	-	-	-	-	185	60	189					60	192	90					

NP: Not Provided

Total No. of Variations - Normal	4,786	8,612	8,856	9,413	20,418	4,652
Total No. of Variations - N-1	228	186	264	997	286	38
Total of Normal & N-1	5,014	8,798	9,120	10,410	20,704	4,690

 Lowest Voltage Under Normal Condition

 Lowest Voltage Under N-1 Condition

NTDC Lahore Region

11. 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)																					
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17	
		2011-12	Voltage	2012-13	Time	2013-14	Voltage	2014-15	Time	2015-16	Voltage	2016-17	Time	2011-12	Voltage	2012-13	Time	2013-14	Voltage	2014-15	Time	2015-16	Voltage	2016-17	2011-12	Voltage	2012-13	Time	2013-14	Voltage	2014-15	Time	2015-16	Voltage	2016-17		
Normal	220 kV Gatti - Ludewala Ckt I & II	414	639	435	351	258	334	233	90	242	210	244	60	239	90	239	270	245	90	198	90	150	150	208	60	208	150	207	150	206	60						
N-1		54	3	4	-	-	-	-	-	248	90	-	-	-	-	-	-	-	-	186	60	190	60	-	-	-	-	-	-	-	-	-					
Normal	220 kV Chashma - Ludewala Ckt I & II	-	-	52	91	45	152	-	-	-	-	237	150	238	120	238	270	236	60	-	-	-	-	202	60	199	60	202	60	200	90						
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
Total No. of Variations (Normal)		414	639	487	442	303	486	Lowest Voltage Under Normal Condition								Lowest Voltage Under Normal Condition								Lowest Voltage Under Normal Condition													
Total No. of Variations (N-1)		54	3	4	-	-	-																														
Total of Normal & N-1		468	642	491	442	303	486																														

NTDC Lahore Region

12. 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)																			
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		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	Voltage	Time						
Normal	220 kV Nishatabad - Gatti Ckt I	-	-	-	5	24	NA	-	-	-	-	-	-	234	90	235	60	NA	-	-	-	-	-	-	-	-	-	-	-	NA							
N-1		-	-	-	-	-		-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-								
Normal	220 kV Nishatabad - Gatti Ckt II	-	-	-	5	24	NA	-	-	-	-	-	-	234	90	235	60	NA	-	-	-	-	-	-	-	-	-	-	-	NA							
N-1		-	-	-	-	-		-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-								
Normal	220 kV Nishatabad - Samundri Road Ckt I	-	-	-	5	24	NA	-	-	-	-	-	-	234	90	235	60	NA	-	-	-	-	-	-	-	-	-	-	-	NA							
N-1		-	-	-	-	-		-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-								
Normal	220 kV Nishatabad - Samundri Road Ckt II	-	-	-	5	24	NA	-	-	-	-	-	-	234	90	235	60	NA	-	-	-	-	-	-	-	-	-	-	-	NA							
N-1		-	-	-	-	-		-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-								
Total No. of Variations (Normal)		-	-	-	20	96	NA																														
Total No. of Variations (N-1)		-	-	-	-	-																															
Total of Normal & N-1		-	-	-	20	96	NA																														

NTDC Lahore Region

13. 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)																			
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17	
		2011-12	Voltage	2012-13	Time	2013-14	Voltage	2014-15	Time	2015-16	Voltage	2016-17	Time	2011-12	Voltage	2012-13	Time	2013-14	Voltage	2014-15	Time	2015-16	Voltage	2016-17	2011-12	Voltage	2012-13	Time	2013-14	Voltage	2014-15	Time	2015-16	Voltage	2016-17		
Normal	220 kV NKLP - BDR - 1	5297	5743	3424	3728	1408	800	-	-	-	-	-	-	233	30	-	-	198	240	198	180	198	300	198	120	150	90	177	90								
N-1		1741	1854	2422	2217	-	7	-	-	-	-	-	-	-	-	-	-	175	60	183	60	179	30	182	30	-	-	185	90								
Normal	220 kV NKLP - BDR - 2	5297	5743	3424	3728	1408	800	-	-	-	-	-	-	233	30	-	-	198	240	198	180	198	300	198	120	150	90	177	90								
N-1		1741	1854	2422	2217	-	7	-	-	-	-	-	-	-	-	-	-	175	60	183	60	179	30	182	30	-	-	185	90								
Normal	220 kV NKLP - SKP Ckt I & II	2606	2484	3078	2652	593	407	-	-	234	30	240	30	235	30	-	-	198	90	198	60	198	120	198	120	160	330	182	60								
N-1		60	164	341	222	-	-	-	-	-	-	-	-	-	-	-	-	185	60	188	30	185	30	190	60	-	-	-	-								
Normal	220 kV NKLP - SNR Ckt I & II	4660	4227	3690	3254	942	539	-	-	-	-	233	60	-	-	-	-	236	90	198	210	195	30	198	180	190	120	160	210	182	90						
N-1		461	732	1046	759	-	9	-	-	-	-	-	-	-	-	-	-	180	60	185	60	183	60	187	30	-	-	195	90								
Normal	220 kV NKLP - WTN	4338	3971	3671	3215	886	569	-	-	-	-	233	60	-	-	-	-	236	90	198	180	198	180	198	180	160	330	180	90								
N-1		327	658	1057	715	-	2	-	-	-	-	-	-	-	-	-	-	181	60	184	60	181	30	186	30	-	-	195	90								

NKLP: New Kot Lakhpat

BDR: Bund Road

SKP: Sheikhupura

WTN: WAPDA Town

 Highest Voltage Under Normal Condition

 Lowest Voltage Under Normal Condition

 Lowest Voltage Under Normal Condition

Total No. of Variations (Normal)	22,198	22,168	17,287	16,577	5,237	3,115
Total No. of Variations (N-1)	4,330	5,262	7,288	6,130	-	25
Total of Normal & N-1	26,528	27,430	24,575	22,707	5,327	3,140

NTDC Lahore Region

14. 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)																			
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		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	Voltage	Time	Voltage	Time				
Normal	220 kV Shalamar - KSK	Comm./Energized Mar 2014	655	2337	2120	386	Comm./Energized Mar 2014		-	-	-	-	-	-	-	-	-	-	-	-	-	Comm./Energized Mar 2014		196	30	188	30	190	60	185	90						
N-1			1	246	1036	-			-	-	-	-	-	-	-	-	-	-	-	-	-			203	30	188	30	178	60	-	-						
Normal	220 kV Shalamar - Ravi	Comm./Energized Mar 2014	664	2313	2122	700	Comm./Energized Mar 2014		-	-	-	-	-	-	-	-	-	-	-	-	-	Comm./Energized Mar 2014		196	30	194	90	190	60	185	90						
N-1			1	269	1031	150			-	-	-	-	-	-	-	-	-	-	-	-	-			203	30	188	30	178	60	184	90						
Total No. of Variations (Normal)		Comm./Energized in 2013-14	1,319	4,650	4,242	1,086																															
Total No. of Variations (N-1)																																					
Total of Normal & N-1		Comm./Energized in 2013-14	1,321	5,165	6,309	1,236																															

 Lowest Voltage Under Normal Condition

 Lowest Voltage Under N-1 Condition

NTDC Lahore Region

15. 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)																			
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17	
		2011-12	Voltage	2012-13	Time	2013-14	Voltage	2014-15	Time	2015-16	Voltage	2016-17	Time	2011-12	Voltage	2012-13	Time	2013-14	Voltage	2014-15	Time	2015-16	Voltage	2016-17	2011-12	Voltage	2012-13	Time	2013-14	Voltage	2014-15	Time	2015-16	Voltage	2016-17		
Normal	220 kV Ravi - Atlas	1889	2027	3140	3391	1243	1310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	198	270	198	450	188	270	198	270	180	90	180	150	
N-1		184	483	769	567	2	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	188	120	175	30	180	30	190	30	191	90	190	450	
Normal	220 kV Ravi - KSK I	1229	3313	2553	3196	1619	1367	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	198	510	194	30	198	150	198	570	180	270	180	570	
N-1		171	107	370	561	8	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	180	60	185	30	182	30	188	30	182	90	190	180	
Normal	220 kV Ravi - KSK II	1927	3871	1673	3196	1619	1367	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	198	270	192	30	185	30	198	570	180	270	180	570	
N-1		106	378	950	561	8	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	188	120	185	30	182	30	188	30	182	90	190	180	
Normal	220 kV Ravi - SKP	1332	2930	3314	3120	1298	1320	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	198	270	198	270	198	270	198	450	180	90	178	90	
N-1		232	640	775	534	7	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	182	60	182	30	188	30	188	30	190	150	191	150	
Normal	220 kV Ravi - SMR	-	-	834	3262	1789	1467	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	198	270	198	390	178	90	178	90		
N-1		-	-	315	821	11	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	188	30	185	30	180	120	188	90		

KSK: Kala Shah Kaku

SMR: Shalamar

Total No. of Variations (Normal)	6,377	12,141	11,514	16,165	7,568	6,831
Total No. of Variations (N-1)	693	1,608	3,179	3,044	36	26
Total of Normal & N-1	7,070	13,749	14,693	19,209	7,604	6,857

 Lowest Voltage Under Normal Condition

 Lowest Voltage Under N-1 Condition

NTDC Lahore Region

16. 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)																			
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		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	Voltage	Time						
Normal	220 kV Samundri Road - Multan Ckt I	5	51	139	289	633	48	-	-	240	60	236	390	240	90	240	150	236	60	196	30	202	150	200	90	-	-	-	-	200	330						
N-1		1	-	-	1	1	33	-	-	-	-	-	-	-	-	-	-	-	-	195	120	-	-	-	-	195	60	190	150	180	150						
Normal	220 kV Samundri Road - Multan Ckt II	5	51	139	289	633	48	-	-	240	60	236	390	240	90	240	150	236	60	196	30	202	150	200	90	-	-	-	-	200	330						
N-1		1	-	-	1	1	33	-	-	-	-	-	-	-	-	-	-	-	-	195	120	-	-	-	-	195	60	190	150	180	150						
Normal	220 kV Samundri Road - Nishatabad Ckt I	5	51	139	289	633	48	-	-	240	60	236	390	240	90	240	150	236	60	196	30	202	150	200	90	-	-	-	-	200	330						
N-1		1	-	-	1	1	33	-	-	-	-	-	-	-	-	-	-	-	-	195	120	-	-	-	-	195	60	190	150	180	150						
Normal	220 kV Samundri Road - Nishatabad Ckt II	5	51	139	289	633	48	-	-	240	60	236	390	240	90	240	150	236	60	196	30	202	150	200	90	-	-	-	-	200	330						
N-1		1	-	-	1	1	33	-	-	-	-	-	-	-	-	-	-	-	-	195	120	-	-	-	-	195	60	190	150	180	150						
Total No. of Variations (Normal)		20	204	556	1156	2532	192	Highest Voltage Under Normal Condition										Lowest Voltage Under Normal Condition										Lowest Voltage Under N-1 Condition									
Total No. of Variations (N-1)		4	-	-	4	4	132																														
Total of Normal & N-1		24	204	556	1160	2536	324																														

NTDC Lahore Region

17. 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)																			
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		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	Voltage	Time						
Normal	220 kV SNR - YSW Ckt I	954	900	1081	672	1068	701	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	198	300	198	840	198	660	190	240	185	60	190	90			
N-1		34	63	68	33	110	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	190	120	190	120	185	30	190	240	180	30	184	90			
Normal	220 kV SNR - YSW Ckt II	894	900	1081	672	1068	701	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	198	300	198	840	198	660	190	240	185	60	190	90			
N-1		30	63	68	33	110	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	190	120	190	120	185	30	190	240	180	30	184	90			
Normal	220 kV SNR - NKLP Ckt I	868	862	1064	673	1073	694	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	198	300	198	420	198	660	169	240	185	60	190	90			
N-1		25	64	73	35	109	46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	190	120	190	120	185	30	169	240	185	150	180	60			
Normal	220 kV SNR - NKLP Ckt II	922	862	1064	673	1073	694	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	198	300	198	420	198	660	169	240	185	60	190	90			
N-1		25	64	73	35	109	46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	190	120	190	120	185	30	169	240	185	150	180	60			
Normal	220 kV SNR - Okara Ckt	Not existing			672	1068	531	Not existing						250	30	-	-	-	-	-	Not existing						195	240	185	60	190	90					
N-1					33	110	39							-	-	-	-	-	-	-							190	120	180	30	180	60					

SNR: Sarfaraznagar

NKLP: New Kot Lakhpat

Total No. of Variations (Normal)	3,638	3,524	4,290	3362	5350	3321
Total No. of Variations (N-1)	114	254	282	169	548	227
Total of Normal & N-1	3752	3,778	4,572	3531	5898	3548

 Lowest Voltage Under Normal Condition

 Lowest Voltage Under N-1 Condition

NTDC Lahore Region

18. 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)																			
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17	
		2011-12	Voltage	2012-13	Voltage	2013-14	Voltage	2014-15	Voltage	2015-16	Voltage	2016-17	Voltage	2011-12	Voltage	2012-13	Voltage	2013-14	Voltage	2014-15	Voltage	2015-16	Voltage	2016-17	Voltage	2011-12	Voltage	2012-13	Voltage	2013-14	Voltage	2014-15	Voltage	2015-16	Voltage	2016-17	
Normal	220 kV Sialkot - Gakkhar	601	494	402	430	681	1123	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	198	420	198	1700	198	180	190	360	170	240	180	210	
N-1		184	104	113	76	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	170	60	175	60	180	120	180	120	195	60	195	90	
Normal	220 kV Sialkot - KSK	597	478	403	401	681	1127	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	195	420	198	180	198	300	190	360	170	240	175	150	
N-1		151	122	113	75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	175	60	175	60	180	120	180	120	-	-	-	-	

KSK: Kala Shah Kaku

Total No. of Variations (Normal)	1,198	972	805	831	1,362	2,250
Total No. of Variations (N-1)	335	226	226	151	1	2
Total of Normal & N-1	1,533	1,198	1,031	982	1,363	2,252

 Lowest Voltage Under Normal Condition

 Lowest Voltage Under N-1 Condition

NTDC Lahore Region

19. 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)																											
		2010-11		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2010-11		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2010-11		2011-12		2012-13		2013-14		2014-15		2015-16		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	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time						
Normal	220 kV Multan - T.T. Singh - Samundri Road Ckt I	240		†		Comm./Energized June 2015							240		660		†		Comm./Energized June 2015							-		-		†		186		90		†							
N-1	T-OFF 220 kV G/S T.T.Singh	1																																									

Table 1: †: Reported as given in relevant column of table 2

Normal	220 kV T.T. Singh - Multan Ckt I & II	Comm./Energized June 2015	‡	448	425	Comm./Energized June 2015							‡	238	600	244	390	Comm./Energized June 2015							‡	193	60	189	150
N-1	T.T. Singh - Samundri Road Ckt I & II	Comm./Energized June 2015	‡	448	425	Comm./Energized June 2015							‡	238	600	244	390	Comm./Energized June 2015							‡	193	60	189	150
Normal	220 kV T.T. Singh - Multan Ckt I & II	Comm./Energized June 2015	‡	448	425	Comm./Energized June 2015							‡	238	600	244	390	Comm./Energized June 2015							‡	193	60	189	150
N-1	T.T. Singh - Samundri Road Ckt I & II	Comm./Energized June 2015	‡	448	425	Comm./Energized June 2015							‡	238	600	244	390	Comm./Energized June 2015							‡	193	60	189	150

Table 2: T.T. Singh: Toba Tek Singh

‡: Collectively reported as given in relevant column of table 1

Total No. of Variations (Normal)	Comm./Energized in 2014-15	240	896	850
Total No. of Variations (N-1)		1	-	-
Total of Normal & N-1	Comm./Energized in 2014-15	241	896	850

 Highest Voltage Under Normal Condition

 Lowest Voltage Under Normal Condition

NTDC Lahore Region

20. 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)																			
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17	
		2011-12	Voltage	2012-13	Voltage	2013-14	Voltage	2014-15	Voltage	2015-16	Voltage	2016-17	Voltage	2011-12	Voltage	2012-13	Voltage	2013-14	Voltage	2014-15	Voltage	2015-16	Voltage	2016-17	Voltage	Time	2011-12	Voltage	2012-13	Voltage	2013-14	Voltage	2014-15	Voltage	2015-16	Voltage	2016-17
Normal	220 kV WTN - NKLP	1575	1157	1610	2331	690	710	-	-	-	-	-	-	194	120	190	240	192	120	190	180	185	90	188	150												
		14	14	-	288	-	-	-	-	-	-	-	-	196	30	194	60	-	-	187	60	-	-	-	-												
Normal	220 kV WTN - Sheikhupura	1338	1592	1601	2233	691	557	-	-	-	-	-	-	198	90	197	60	190	120	197	90	160	120	187	150												
		10	85	5	124	-	-	-	-	-	-	-	-	195	30	190	120	195	160	188	60	-	-	-	-												
WTN: WAPDA Town																																					
Total No. of Variations - Normal		2,913	2,749	3,211	4,564	1,381	1,267																														
Total No. of Variations - N-1		24	99	5	412	-	-																														
Total of Normal & N-1		2,937	2,848	3,216	4,976	1,381	1,267																														

 Lowest Voltage Under Normal Condition

Appendix 3

QoS data - detailed circuit wise analysis

NTDC Multan Region

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



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)																					
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		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	Voltage	Time						
Normal	500 kV Multan - D.G. Khan - Guddu	NIL	14	NIL	15	NIL						569	60	NIL	564	60	NIL						569	60	NIL	569	60	NIL	—	—							
N-1			—	NIL	—	NIL						—	—	NIL	—	—	NIL						—	—	NIL	—	—	NIL	—	—							
Normal	220 kV D.G. Khan - Loralai I	Comm./Energized Aug 2014	NIL	150	—	Comm./Energized Aug 2014						250	60	NIL	250	60	Comm./Energized Aug 2014						250	60	Comm./Energized Aug 2014	250	60	Comm./Energized Aug 2014	—	—							
N-1			Comm./Energized Aug 2014	NIL	150	Comm./Energized Aug 2014						250	60	NIL	250	60	Comm./Energized Aug 2014						250	60	Comm./Energized Aug 2014	250	60	Comm./Energized Aug 2014	—	—							
Normal	220 kV D.G. Khan - Loralai II	Comm./Energized Aug 2014	NIL	150	—	Comm./Energized Aug 2014						250	60	NIL	250	60	Comm./Energized Aug 2014						250	60	Comm./Energized Aug 2014	250	60	Comm./Energized Aug 2014	—	—							
N-1			Comm./Energized Aug 2014	NIL	—	Comm./Energized Aug 2014						250	60	NIL	250	60	Comm./Energized Aug 2014						250	60	Comm./Energized Aug 2014	250	60	Comm./Energized Aug 2014	—	—							
Total No. of Variations (Normal)		NIL		14	NIL	315																															
Total No. of Variations (N-1)		NIL		—	NIL	—																															
Total of Normal & N-1		NIL		14	NIL	315																															

 Highest Voltage Under Normal Condition @500kV level

 Highest Voltage Under Normal Condition @220kV level

NTDC Multan Region

2. 500kV Grid Station MULTAN

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit						Highest Voltage Recorded (kV) / Time (Min)								Lowest Voltage Recorded (kV) / Time (Min)																	
		2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	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						NIL								NIL																	
Normal	500 kV Multan - Guddu 747	NIL						NIL								NIL																	
Normal	500 kV Multan - Muzaffargarh	NIL						NIL								NIL																	
Normal	500 kV Multan - Yousafwala	NIL						NIL								NIL																	
Normal	500 kV Multan - Gatti	NIL						NIL								NIL																	
Normal	500 kV Multan - Rousch	NIL						NIL								NIL																	
Normal	500 kV Multan - D.G. Khan - Guddu	NIL						NIL								NIL																	
Normal	220 kV Multan - Muzaffargarh 1	NIL						NIL								NIL																	
Normal	220 kV Multan - Muzaffargarh 2	NIL	3	5	7	2		NIL	266	120	246	60	247	60	254	60	NIL	-	-	-	-	-	-	-									
Normal	220 kV Multan - Muzaffargarh 3	NIL	2	1	NIL	1		NIL	250	60	244	240	NIL	245	90		NIL	-	-	-	-	NIL	-	-									
Normal	220 kV Multan - Muzaffargarh 4	NIL						NIL								NIL																	
Normal	220 kV Multan - Kapco 3	NIL	1	NIL				NIL	245	240	NIL					NIL	-	-	NIL														
Normal	220 kV Multan - Kafco 4	NIL	3	14	1			NIL	246	330	249	60	246	120			NIL	-	-	-	-	-	-	-									
Normal	220 kV Multan - Kafco 5 & 6	NIL	1	NIL				NIL	246	180	NIL					NIL	-	-	NIL														
Normal	220 kV Multan - NGPS 1 & 2	NIL						NIL								NIL																	
Normal	220 kV Multan - Vehari 1 & 2	NIL						NIL								NIL																	
Normal	220 kV Multan - Samundri Road	NIL						NIL								NIL																	
Normal	220 kV Multan - T.T. Singh 1 & 2	Comm./Energized June 2015			NIL			Comm./Energized June 2015				NIL				Comm./Energized June 2015				NIL													

NP: Not Provided

NA: Not Applicable

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

 Highest Voltage Under Normal Condition @220kV level

NTDC Multan Region

3. 500kV Grid Station MUZAFFARGARH

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit						Highest Voltage Recorded (kV) / Time (Min)						Lowest Voltage Recorded (kV) / Time (Min)											
		2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500 kV Muzaffargarh - Gatti	NIL						NIL						NIL						NIL					
Normal	500 kV Muzaffargarh - Guddu	NIL						NIL						NIL						NIL					
Normal	500 kV Muzaffargarh - Multan	NIL						NIL						NIL						NIL					
Normal	220 kV 500kV Grid Station TPS Phase-I - Muzaffargarh	NIL						NIL						NIL						NIL					
Normal	220 kV 500kV Grid Station TPS Phase-II - Muzaffargarh	NIL						NIL						NIL						NIL					

TPS: Thermal Power Station

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)										
		2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	
Normal	500 kV Yousafwala - Lahore	-	1	-	33	NA	-	-	-	-	-	538	120	NA	-	-	465	60	-	-	-	-	NA	-		
N-1		-	-	-	-		-	-	-	-	-	-	-		-	-	-	-	-	-	-	-		-		
Normal	500 kV Yousafwala - Multan	-	1	-	33	NA	-	-	-	-	-	538	120	NA	-	-	465	60	-	-	-	-	NA	-		
N-1		-	-	-	-		-	-	-	-	-	-	-		-	-	-	-	-	-	-	-		-		
Normal	220 kV Yousafwala - SNR	-	-	2	95	NA	42	-	-	-	-	-	235	60	NA	-	-	-	-	205	120	203	60	NA	208	180
N-1		-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Normal	220 kV Yousafwala - Gatti	-	-	2	95	NA	42	-	-	-	-	-	235	60	NA	-	-	-	-	205	120	203	60	NA	208	180
N-1		-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Normal	220 kV Yousafwala - Kassowal	-	-	2	95	NA	42	-	-	-	-	-	235	60	NA	-	-	-	-	205	120	203	60	NA	208	180
N-1		-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			

SNR: Sarfaraznagar

NA: Not Applicable

Total No. of Variations (Normal)	-	2	6	351	NA	126
Total No. of Variations (N-1)	-	-	-	-	NA	-
Total of Normal & N-1	-	2	6	351	NA	126

 Lowest Voltage Under Normal Condition @220kV level

NTDC Multan Region

5. 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)																			
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17	
		2011-12	Voltage	2012-13	Time	2013-14	Voltage	2014-15	Time	2015-16	Voltage	2016-17	Time	2011-12	Voltage	2012-13	Time	2013-14	Voltage	2014-15	Time	2015-16	Voltage	2016-17	2011-12	Voltage	2012-13	Time	2013-14	Voltage	2014-15	Time	2015-16	Voltage	2016-17		
Normal	220 kV Bahawalpur - TPS Muzaffargarh Ckt I & II	135	15	421	305	506	15	236	60	242	30	248	90	236	180	248	30	242	60	200	120	203	30	200	60	205	120	196	30	197	30						
N-1		-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	246	30	-	-	-	-	-	-	-	-	-	194	30						
Total No. of Variations (Normal)		135	15	421	305	506	15																														
Total No. of Variations (N-1)		-	-	-	-	-	5																														
Total of Normal & N-1		135	15	421	305	506	20																														

 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

6. 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)																					
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		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	Voltage	Time						
Normal	Kassowal - Vehari 1	Comm./Energized July 2015		NIL	502	980	Comm./Energized July 2015						NIL	241	30	245	30	Comm./Energized July 2015						NIL	200	60	198	60									
N-1					-	-								-	-	-	-	-	-	-	-																
Normal	Kassowal - Vehari 2	Comm./Energized July 2015		NIL	502	980	Comm./Energized July 2015						NIL	241	30	245	30	Comm./Energized July 2015						NIL	200	60	198	60									
N-1					-	-								-	-	-	-	-	-	-	-																
Normal	Kassowal - Yousafwala 1	Comm./Energized July 2015		NIL	502	931	Comm./Energized July 2015						NIL	241	30	245	30	Comm./Energized July 2015						NIL	200	60	198	60									
N-1					-	-								-	-	-	-	-	-	-	-																
Normal	Kassowal - Yousafwala 2	Comm./Energized July 2015		NIL	502	931	Comm./Energized July 2015						NIL	241	30	245	30	Comm./Energized July 2015						NIL	200	60	198	60									
N-1					-	-								-	-	-	-	-	-	-	-																
Total No. of Variations (Normal)		Comm./Energized July 2015		NIL	2,008	3,822																															
Total No. of Variations (N-1)		Comm./Energized July 2015		NIL	-	-																															
Total of Normal & N-1		Comm./Energized July 2015		NIL	2,008	3,822																															

 Highest Voltage Under Normal Condition

 Lowest Voltage Under Normal Condition

NTDC Multan Region

7. 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)																			
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		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	Voltage	Time						
Normal	220 kV Muzaffargarh - Multan	1	92	-	4	NIL		232	60	239	90	-	-	236	90	NIL		-	-	-	-	-	-	-	-	-	-	NIL									
N-1		-	-	-	-			-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-											
Normal	220 kV Muzaffargarh - TPS	-	92	-	NP	NIL		232	60	239	90	-	-	NP		NIL		-	-	-	-	-	-	-	-	-	NP										
N-1		-	-	-	NP			-	-	-	-	-	-					-	-	-	-	-	-														

NP : Not Provided

Total No. of Variations (Normal)	1	184	-	4	NIL	
Total No. of Variations (N-1)	-	-	-	-	NIL	
Total of Normal & N-1	1	184	-	4	NIL	

NTDC Multan Region

8. 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)																						
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		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	Voltage	Time							
Normal	220 kV Okara - Sarfaraznagar	Comm./Energized June 2015		75	338	321	Comm./Energized June 2015				234	60	-	-	239	360	Comm./Energized June 2015				202	60	190	90	196	900												
				-	-	-					-	-	-	-	-	-					-	-	-	-	-	-	-	-										
Normal	220 kV Okara - Yousafwala	Comm./Energized June 2015		-	338	205	Comm./Energized June 2015				-	-	-	-	239	360	Comm./Energized June 2015				-	-	190	90	196	900												
N-1				-	-	-					-	-	-	-	-	-					-	-	-	-	-	-	-	-										
Total No. of Variations (Normal)	Comm./Energized June 2015		75	338	526																																	
Total No. of Variations (N-1)			-	-	-																																	
Total of Normal & N-1			75	338	526																																	

 Highest Voltage Under Normal Condition

 Lowest Voltage Under Normal Condition

NTDC Multan Region

9. 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)																			
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		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	Voltage	Time	Voltage	Time				
Normal	220 kV Vehari - Multan Ckt I & II	23	744	559	764	297	837	235	30	240	90	240	150	240	120	240	90	242	270	208	30	-	-	200	150	-	-	205	30	204	30						
N-1		-	-	6	-	-	2	-	-	-	-	246	30	-	-	-	-	243	90	-	-	-	-	180	30	-	-	-	-	-	-						
Normal	220 kV Vehari - Yousafwala Ckt I & II	23	718	561	NP	-	NP	235	30	240	90	238	210	NP	-	-	NP	-	208	30	-	-	200	150	NP	-	-	NP	-	-	-						
N-1		-	-	6		-		-	-	-	-	246	30		-	-		-	-	-	-	-	-	180	30	-	-	-	-	-							
Normal	220 kV Vehari - Kassowal Ckt I & II	Comm./Energized July 2015			296	852	Comm./Energized July 2015						240	90	243	30	Comm./Energized July 2015						205	30	204	30	Comm./Energized July 2015			-		-					
N-1					-	2							-	-	243	90																					
Normal	220 kV Vehari - Chishtian Ckt I & II	Commissioned/Energized Oct, 2016				824	Commissioned/Energized Oct, 2016						242	270	Commissioned/Energized Oct, 2016						Commissioned/Energized Oct, 2016						205	30	Commissioned/Energized Oct, 2016			-					
N-1						2							243	90																							

NP: Not Provided

Total No. of Variations - Normal	46	1,462	1,120	764	593	2,513
Total No. of Variations - N-1	-	-	12	-	-	6
Total of Normal & N-1	46	1,462	1,132	764	593	2,519

 Highest Voltage Under Normal Condition

 Lowest Voltage Under Normal Condition

 Highest Voltage Under N-1 Condition

NTDC Multan Region

10. 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)											
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		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
Normal	220 kV Vehari - Chishhtian Ckt I & II	75	338	722										244	60									-	-
N-1		-	-	70										247	60									-	-
Total No. of Variations (Normal)		Comm./Energized Oct 2016						722																	
Total No. of Variations (N-1)								70																	
Total of Normal & N-1		Comm./Energized Oct 2016						792																	

 Highest Voltage Under Normal Condition

 Highest Voltage Under N-1 Condition

Appendix 4

QoS data - detailed circuit wise analysis

NTDC Hyderabad Region

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

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)																			
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17	
		2011-12	Voltage	2012-13	Time	2013-14	Voltage	2014-15	Time	2015-16	Voltage	2016-17	Voltage	2011-12	Voltage	2012-13	Time	2013-14	Voltage	2014-15	Time	2015-16	Voltage	2016-17	2011-12	Voltage	2012-13	Time	2013-14	Voltage	2014-15	Time	2015-16	Voltage	2016-17		
Normal	500 kV Dadu - Jamshoro I	461	384	829	162	9	1	547	180	540	660	540	560	541	60	539	1350	526	180	-	-	-	-	-	-	-	-	-	-	-	-	-					
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
Normal	500 kV Dadu - Jamshoro II	759	1075	1510	565	99	3	545	120	545	60	544	120	542	300	540	180	530	240	-	-	-	-	-	-	-	-	-	-	-	-	-					
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
Normal	500 kV Dadu - Guddu I	84	177	472	149	7	NP	540	120	540	300	540	120	542	120	535	420	NP		-	-	-	-	-	-	-	-	-	-	-	-	-					
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-						
Normal	500 kV Dadu - Guddu II	11	15	53	24	NIL	2	542	60	538	60	540	180	540	180	NIL		528	60	-	-	-	-	-	-	-	-	-	-	-	-	-					
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
	500 kV Dadu - Shikarpur	does not exist						3	does not exist										530	60	does not exist										-	-					
								-											-	-	-	-															
Normal	220 kV Dadu - Khuzdar I	Comm./Energized Aug 2014		1484	531	344	Comm./Energized Aug 2014						246	120	240	360	240	120	Comm./Energized Aug 2014						-	-	-	-	-	-	-	-					
N-1				-	-	-							-	-	-	-	-	-							-	-	-	-	-	-	-	-					
Normal	220 kV Dadu - Khuzdar II	Comm./Energized June 2014		141	189	380	Comm./Energized June 2014						242	240	240	360	240	240	Comm./Energized June 2014						-	-	-	-	-	-	-	-	-				
N-1				-	-	-							-	-	-	-	-	-							-	-	-	-	-	-	-	-	-				
Total No. of Variations (Normal)		1,315	1,651	2,864	2,525	835	733																														
Total No. of Variations (N-1)		-	-	-	-	-	-																														
Total of Normal & N-1		1,315	1,651	2,864	2,525	835	733																														

 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)																			
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		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	Voltage	Time						
Normal	500 kV Guddu - Dadu I	-		NA	39	NA		NP	-	-		NA	535	120	NA		NP	-	-	NA	-	-	NA		-	-	NA		NP	-							
N-1		-							-	-																											
Normal	500 kV Guddu - Dadu II	-		NA	1545	1449	1268	1183	-	-		NA	540	60	540	180	540	90	540	420	-	-	NA		-	-	NA	-	-	-	-	-	-				
N-1		-							-	-																											
Normal	500 kV Guddu - Multan (T-Off D.G. Khan)	-		NA	-	-	-	1382	NP	-	-	NA		-	-	-	-	638	60	NP		-	-	NA		-	-	-	-	-	-	NP	-				
N-1		-																																			
Normal	500 kV Guddu - 747 MW CCPP Guddu	-	-	-	1089	1378	642	-	-	-	-	-	-	-	540	120	541	90	541	90	-	-	-	-	-	-	-	-	-	-	-						
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
Normal	500 kV Guddu - Muzaffargarh	-	-	-	-	-	1405	-	NP	-	-	-	-	-	-	-	-	638	60	NP		-	-	-	-	-	-	-	-	-	-	NP	-				
N-1		-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
Normal	220 kV Guddu - Sibbi (D/Ckt)	-	-	-	-	-	-	-	NP	-	-	-	-	-	-	-	-	-	-	NP		-	-	-	-	-	-	-	-	-	-	NP	-				
N-1		-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
Normal	220 kV Guddu - Uch (P/H)	-	-	-	-	-	-	-	NP	-	-	-	-	-	-	-	-	-	-	NP		-	-	-	-	-	-	-	-	-	-	NP	-				
N-1		-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
Normal	220 kV Guddu - Shikarpur	-	-	-	-	-	-	-	NP	-	-	-	-	-	-	-	-	-	-	NP		-	-	-	-	-	-	-	-	-	-	NP	-				
N-1		-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							

NA: Not applicable.

Highest Voltage Under Normal Condition @500kV level

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

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)														
								2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17				
		2011-12	2012-13	2013-14	2014-15	2015-16	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	
Normal	500 kV Jamshoro - Dadu I	16	47	17	188	76	224	535	60	538	180	544	60	542	60	550	60	543	60	-	-	245	60	-	-	-	-	-	-	-	-	-		
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Normal	500 kV Jamshoro - Dadu II	16	47	17	188	76	228	535	60	538	180	544	60	542	60	550	60	543	60	-	-	245	60	-	-	-	-	-	-	-	-	-		
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Normal	500 kV Jamshoro - NKL	62	55	17	177	77	218	538	120	538	180	544	60	542	60	538	60	541	60	-	-	-	-	-	-	-	-	-	-	-	-	-		
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Normal	500 kV Hub - Jamshoro (D/Ckt)	53	55	17	180	70	235	536	120	538	60	544	60	542	60	536	120	543	60	-	-	-	-	-	-	-	-	-	-	-	-	-		
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Normal	220 kV Jamshoro - KDA33 - I	107	297	138	230	193	135	239	120	242	60	247	60	239	60	245	60	242	60	-	-	-	-	-	-	-	-	-	-	-	-	-		
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Normal	220 kV Jamshoro - KDA33 - II	107	297	138	230	192	134	239	120	242	60	247	60	239	60	241	60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Normal	220 kV Jamshoro - Hala Road I	66	277	136	229	193	135	239	180	240	120	247	60	239	60	245	60	242	60	-	-	-	-	-	-	-	-	-	-	-	-	-		
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Normal	220 kV Jamshoro - Hala Road II	66	277	136	230	193	130	239	180	240	120	247	60	239	60	245	60	242	60	-	-	-	-	-	-	-	-	-	-	-	-	-		
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Normal	220 kV Jamshoro - T.M. Khan - I	90	286	138	230	193	127	240	120	241	60	247	60	239	60	245	60	242	60	-	-	-	-	-	-	-	-	-	-	-	-	-		
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Normal	220 kV Jamshoro - T.M. Khan - II	90	286	136	230	193	122	240	120	241	60	247	60	239	60	245	60	242	60	-	-	-	-	-	-	-	-	-	-	-	-	-		
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Total No. of Variations (Normal)		673	1,924	890	2,112	1,456	1,688																											
Total No. of Variations (N-1)		-	-	-	-	-	-																											
Total of Normal & N-1		673	1,924	890	2,112	1,456	1,688																											

 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)																			
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		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	Voltage	Time	Voltage	Time				
Normal	500 kV NKI - Hub	53	200	201	175	61	91	531	60	542	30	539	30	537	30	545	60	530	60	468	30	472	30	-	-	463	30	-	-	-	-						
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
Normal	500 kV NKI - Jamshoro	54	200	201	175	61	NP	531	60	542	30	539	30	537	30	545	60	NP	NP	468	30	472	30	-	-	463	30	-	-	NP	NP						
N-1		-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
Normal	220 kV NKI - Baldia	1854	1169	2097	2516	1533	614	245	60	247	30	248	30	243	30	250	60	238	180	-	-	208	60	-	-	-	-	-	-	-	-	-					
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
Normal	220 kV NKI - KDA33	1923	1169	2097	2523	1533	401	245	60	247	30	242	60	243	30	250	60	239	120	198	60	208	60	-	-	-	-	-	-	-	-	-					
N-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
Total No. of Variations (Normal)		3,884	2,738	4,596	5,389	3,188	1,106																														
Total No. of Variations (N-1)		-	-	-	-	-	-																														
Total of Normal & N-1		3,884	2,738	4,596	5,389	3,188	1,106																														

 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)																			
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		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	Voltage	Time						
Normal	500 kV Shikarpur - Guddu Ckt I	does not exist						841	does not exist										540	1080	does not exist										-	-					
N-1								-											-	-											-	-					
Normal	500 kV Shikarpur - Dadu Ckt I	does not exist						862	does not exist										540	1080	does not exist										-	-					
N-1								-											-	-											-	-					
Normal	220 kV Shikarpur - Guddu	35	87	276	182	18	258	-	-	-	-	-	-	-	-	-	-	235	180	240	180	-	-	-	-	-	-	-	-	-	-	-					
N-1		18	14	1	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
Normal	220 kV Shikarpur - Uch	35	87	276	167	7	255	-	-	-	-	-	-	-	-	-	-	235	180	236	120	200	240	200	1440	200	1440	200	780	-	-	-	-				
N-1		18	14	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	180	180	180	1440	198	300	196	480	-	-	-	-					
Normal	220 kV Shikarpur - Rohri I	-	-	276	111	19	13	-	-	-	-	-	-	-	-	-	-	250	120	234	240	-	-	-	-	200	1440	198	480	205	300	-	-				
N-1		-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	198	300	-	-	-	-	-					
Normal	220 kV Shikarpur - Rohri II	-	-	276	107	19	13	-	-	-	-	-	-	-	-	-	-	250	120	234	240	-	-	-	-	200	1440	198	480	205	300	-	-				
N-1		-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	198	300	-	-	-	-	-					
Total No. of Variations (Normal)		70	174	1,104	567	45	2,242											Highest Voltage Under Normal Condition @500kV level																			
Total No. of Variations (N-1)		36	28	4	5	-	-											Highest Voltage Under Normal Condition @220kV level																			
Total of Normal & N-1		106	202	1,108	572	45	2,242																														

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)																			
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		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	Voltage	Time						
Normal	220 kV Bus Bar	11	19	—	Reported as Dharki-Engro & Dharki FPCDL given below						236	480	235	150	—	—	Reported as Dharki-Engro & Dharki FPCDL given below						208	120	207	30	—	—	Reported as Dharki-Engro & Dharki FPCDL given below								
N-1		—	2	—							—	—	—	—	—	—							—	—	197	60	—	—									
Normal	220 kV Dharki - Engro	Reported as 220 kV Bus Bar given above			NA	12	1	Reported as 220 kV Bus Bar given above						NA	240 120 235 180				Reported as 220 kV Bus Bar given above						NA	206 60 — —				— — — —							
N-1						—	—								—	—	—	—																			
Normal	220 kV Dharki - FPCDL	Reported as 220 kV Bus Bar given above			NA	12	1	Reported as 220 kV Bus Bar given above						NA	240 120 235 180				Reported as 220 kV Bus Bar given above						NA	206 60 — —				— — — —							
N-1						—	—								—	—	—	—																			

Na: Not Applicable

Total No. of Variations (Normal)	11	19	—	NA	24	2
Total No. of Variations (N-1)	—	2	—	—	—	—
Total of Normal & N-1	11	21	—	NA	24	2

 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)																			
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		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	Voltage	Time						
Normal	220 kV	103	543	543	81	3	5	237	420	239	300	239	300	238	120	232	90	235	180	-	-	-	-	-	-	-	-	-	-	-							
N-1	Hala Road - Jamshoro I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
Normal	220 kV	103	543	543	81	3	5	237	420	239	300	239	300	238	120	232	90	235	180	-	-	-	-	-	-	-	-	-	-	-							
N-1	Hala Road - Jamshoro II	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
Total No. of Variations (Normal)		206	1,086	1,086	162	6	10																														
Total No. of Variations (N-1)		-	-	-	-	-	-																														
Total of Normal & N-1		206	1,086	1,086	162	6	10																														

 Highest Voltage Under Normal Condition

NTDC Hyderabad Region

8. 220kV Grid Station KHUZDAR

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit						Highest Voltage Recorded (kV) / Time (Min)								Lowest Voltage Recorded (kV) / Time (Min)																					
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		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	Voltage	Time						
Normal	220 kV Dadu - Khuzdar I	Comm./Energized Aug 2014		567	398	229							240	540	255	90	255	35							185	120	180	60	185	45							
N-1				3	-	-							-	-	-	-	-	-							194	60	-	-	-	-							
Normal	220 kV Dadu - Khuzdar II	Comm./Energized Aug 2014		567	398	229							240	540	255	90	255	35							185	120	180	60	185	45							
N-1				3	-	-							-	-	-	-	-	-							194	60	-	-	-	-							
Total No. of Variations (Normal)		Comm./Energized Aug 2014		1,134	796	458																															
Total No. of Variations (N-1)				6	-	-																															
Total of Normal & N-1		Comm./Energized Aug 2014		1,140	796	458																															

 Highest Voltage Under Normal Condition

 Lowest Voltage Under Normal Condition

NTDC Hyderabad Region

9. 220kV Grid Station LORALAI

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit						Highest Voltage Recorded (kV) / Time (Min)								Lowest Voltage Recorded (kV) / Time (Min)																					
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		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	Voltage	Time						
Normal	220 kV Loralai - D.G. Khan I	Comm./Energized Aug 2014		584	623	505	Comm./Energized Aug 2014		242	600	250	60	248	600	Comm./Energized Aug 2014		200	60	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
N-1				77	—	—			252	60	—	—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—					
Normal	220 kV Loralai - D.G. Khan II	Comm./Energized Aug 2014		584	623	505	Comm./Energized Aug 2014		242	600	250	60	248	600	Comm./Energized Aug 2014		200	60	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
N-1				77	—	—			252	60	—	—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
Total No. of Variations (Normal)		Comm./Energized Aug 2014		1,168	1,246	1,010																															
Total No. of Variations (N-1)		Aug 2014		154	—	—																															
Total of Normal & N-1		Comm./Energized Aug 2014		1,322	1,246	1,010																															

 Highest Voltage Under Normal Condition

NTDC Hyderabad Region

10. 220kV Grid Station QUETTA INDUSTRIAL-II

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit						Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)																			
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		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	Voltage	Time	Voltage	Time				
Normal	220 kV Sibbi - Quetta Ckt I	522	641	6157	2865	6053	444	-	-	-	-	-	-	240	120	250	60	240	60	199	120	199	120	170	60	199	180	175	60	201	60						
N-1		2494	2295	40	3145	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	174	60	170	120	-	-	199	60					
Normal	220 kV Sibbi - Quetta Ckt II	522	641	6387	2865	6053	444	-	-	-	-	-	-	240	120	250	60	240	60	155	60	180	60	170	60	199	180	175	60	201	60						
N-1		2494	2295	52	3145	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	174	60	170	120	-	-	199	60					
Total No. of Variations (Normal)		1,044	1,282	12,544	5,730	12,106	888																														
Total No. of Variations (N-1)		4,988	4,590	92	6,290	-	2																														
Total of Normal & N-1		6,032	5,872	12,636	12,020	12,106	890																														

 Highest Voltage Under Normal Condition

 Lowest Voltage Under Normal Condition

 Lowest Voltage Under N-1 Condition

NTDC Hyderabad Region

11. 220kV Grid Station ROHRI

Condition	Name of Transmission Circuit(s) violating the voltage criteria	Total Number / Times violating the limit						Highest Voltage Recorded (kV) / Time (Min)										Lowest Voltage Recorded (kV) / Time (Min)																			
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		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	Voltage	Time	Voltage	Time				
Normal	220 kV Shikarpur - Rohri I	Comm./Energized June 2012	165	84	111	411	Nil	Comm./Energized June 2012	240	30	239	30	242	60	252	60	Nil	Comm./Energized June 2012	190	30	200	30	198	480	208	60	Nil	Nil									
N-1			-	7	-	-			-	-	264	30	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-	-						
Normal	220 kV Shikarpur - Rohri II	Comm./Energized Oct 2014	111	411	Nil	Comm./Energized Oct 2014	-	-	252	60	Nil	Comm./Energized Oct 2014	198	480	208	60	Nil	Comm./Energized Oct 2014	-	-	-	-	-	-	-	-	Nil	Nil									
N-1			-	-			-	-	-	-			-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-							
Normal	220 kV Rohri - Engro I	Comm./Energized Oct 2014	13	165	84	419	410	Nil	239 30 240 30 239 30	242	60	252	60	Nil	200 30 190 30 200 30	-	-	208	60	Nil	Nil	-	-	-	-	-	-	-	Nil	Nil							
N-1			1	-	7	-	-			245	60	-	-	264	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
Normal	220 kV Rohri - Engro II	Comm./Energized Oct 2014	419	410	Nil	Comm./Energized Oct 2014	-	-	242	60	252	60	Nil	Comm./Energized Oct 2014	-	-	208	60	Nil	Nil	-	-	-	-	-	-	-	Nil	Nil								
N-1			-	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-											
Total No. of Variations (Normal)	13	330	168	1,060	1,642	Nil																															
Total No. of Variations (N-1)	1	-	14	-	-																																
Total of Normal & N-1	14	330	182	1,060	1,642	Nil																															

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)																			
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		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	Voltage	Time	Voltage	Time				
Normal	220 kV Sibbi - Quetta Ckt I	2742	1681	3754	851	1145	588	-	-	240	120	-	-	240	60	-	-	240	60	200	180	199	60	199	90	180	60	192	60	180	60						
N-1		299	558	426	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	180	60	130	30	180	30	-	-	-	-	-	-						
Normal	220 kV Sibbi - Quetta Ckt II	2742	1681	3754	781	1149	588	-	-	240	120	-	-	-	-	237	60	240	60	200	180	199	60	199	90	180	60	192	60	180	60						
N-1		299	558	426	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	180	60	130	30	180	30	195	60	-	-	-	-						
Normal	220 kV Sibbi - Uch Ckt I	2412	1483	2606	604	545	182	-	-	235	30	238	60	240	540	253	60	240	60	190	60	199	240	199	60	185	60	192	60	200	60						
N-1		200	450	280	4	1	-	-	-	-	-	-	-	-	-	-	-	-	-	180	60	180	240	180	30	194	60	196	60	-	-						
Normal	220 kV Sibbi - Uch Ckt II	2412	1483	2606	722	543	182	-	-	235	30	238	60	240	540	253	60	240	60	190	60	199	240	199	60	185	120	192	60	200	60						
N-1		200	450	280	4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	180	60	180	240	180	30	194	60	196	60	-	-						
Normal	220 kV Sibbi - Guddu DC Ckt	2778	3075	2495	2669	539	228	-	-	241	210	240	30	240	30	253	60	240	60	20	30	199	270	192	90	195	60	192	60	200	60						
N-1		218	863	214	205	-	-	-	-	-	-	-	-	-	-	-	-	-	-	180	60	180	120	180	60	180	30	-	-	-							
Total No. of Variations (Normal)		13,086	9,403	15,215	5,627	3,921	1,768	Highest Voltage Under Normal Condition										Lowest Voltage Under Normal Condition																			
Total No. of Variations (N-1)		1,216	2,879	1,626	214	3	-																														
		14,302	12,282	16,841	5,841	3,924	1,768																														

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)																			
		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2011-12		2012-13		2013-14		2014-15		2015-16		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	Voltage	Time						
Normal	220 kV	226	616	767	473	187	122	242	60	240	540	241	60	242	60	240	60	244	60	-	-	-	-	-	-	-	-	-	-	-							
N-1	T.M.Khan - Jamshoro I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
Normal	220 kV	226	616	767	473	187	122	242	60	240	540	241	60	242	60	240	60	244	60	-	-	-	-	-	-	-	-	-	-	-							
N-1	T.M.Khan - Jamshoro II	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
Total No. of Variations (Normal)		452	1,232	1,534	946	374	244																														
Total No. of Variations (N-1)		-	-	-	-	-	-																														
Total of Normal & N-1		452	1,232	1,534	946	374	244																														

 Highest Voltage Under Normal Condition

Appendix 6

System Frequency - Historical Data as Reported by NTDC



Performance Evaluation Report of NTDC for the year 2016-17

Historical System Frequency Data as Reported by NTDC

Month	Highest System Frequency Recorded Violating the prescribed Upper Limit¹ (Hz)					
	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
July	50.56	50.48	50.2	50.71	50.75	Nil
Aug	50.48	50.52	50.31	50.68	50.69	50.72
Sep	50.44	50.56	50.22	50.55	50.69	50.60
Oct	50.44	50.45	50.35	50.69	50.53	Nil
Nov	50.56	50.4	50.3	50.62	50.62	Nil
Dec	50.48	50.4	50.28	58.63	50.71	50.63
Jan	50.44	50.21	50.7	54.69	51.47	50.68
Feb	50.36	50.1	50.63	49.49*	Nil	50.65
Mar	50.48	50.34	50.63	50.65	50.64	50.61
Apr	50.4	50.3	50.68	50.66	Nil	50.63
May	50.44	50.26	50.6	50.69	Nil	50.65
June	50.48	50.23	50.57	50.68	49.49*	50.64

* Cannot be validated

Month	Lowest System Frequency Recorded Violating the prescribed Lower Limit² (Hz)					
	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
July	48.72	48.76	49.05	48.74	49.07	Nil
Aug	48.72	48.80	49.15	48.91	49.15	49.36
Sep	48.72	48.72	49.35	48.93	49.19	50.51*
Oct	48.80	48.80	49.50	48.99	49.21	Nil
Nov	48.92	48.72	49.31	48.83	49.22	Nil
Dec	48.76	48.72	49.15	45	49.32	49.44
Jan	48.72	49.10	48.67	45	45	49.37
Feb	48.80	48.66	48.87	49.06	Nil	50.53*
Mar	48.76	49.40	48.92	49.11	50.52*	50.51*
Apr	48.76	49.32	48.89	49.02	Nil	49.32
May	48.76	49.48	49.20	49.2	Nil	50.52*
June	48.76	49.20	49.19	50.51*	49.32	50.51*

* Cannot be validated

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

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

