Performance Evaluation Report

National Transmission & Despatch Company (NTDC)

K-Electric Ltd. (KEL)

Based on Reported Data for

FY 2010-11 | FY 2011-12 | FY 2012-13 | FY 2013-14

Through Annual Performance Reports

As per

PERFORMANCE STANDARDS TRANSMISSION RULES - 2005

STANDARDS DEPARTMENT

National Electric Power Regulatory Authority

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Introduction

to

Performance Evaluation Report as per Performance Standards Transmission Rules (PSTR) 2005

1 Introduction

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.

1.1 Reporting Requirement

1.1.1 Rule 9 of PSTR-2005

As per Rule 9 of Performance Standards (Transmission) Rules (PSTR) 2005, the licensee shall submit to the Authority every year, before the 31st of August of the succeeding year, an Annual Performance Report. The Annual Performance Report shall contain all relevant information with respect to compliance with these rules during the year, including a statement of comparison with the compliance reporting achieved during the preceding year.

1.2 Standards to be Complied

1.2.1 Rule 6 of PSTR-2005

As per Rule 6 of PSTR the quality of supply shall be measured with reference to system voltage and system frequency.

1.2.2 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 minutes.

1.2.3 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 minutes.

1.2.4 Rule 10 of PSTR-2005
Reporting Guidelines

All transmission licensees shall be required to report to the Authority the performance of their transmission system. The following guidance notes are provided to assist licensees on the presentation of system performance.

a) System Reliability
   i. System Duration of interruption
   ii. System Frequency of Interruption
b) Tie Line Reliability
c) System Security (Energy Not Served)
d) Quality of Supply
   i. System Voltage
   ii. System Frequency

1.3 Setting up of Benchmarks

As per Rule 12 Monitoring, fines and penalties of Performance Standards Transmission Rules (PSTR) 2005;

1) Two years data after the notification of these rules will be used to set benchmarks which would be monitored for the purposes of fines and penalties.

2) For the purpose of reporting system reliability, the following shall be excluded from calculations of indices.
   a) Planned outages:
   b) Outages caused under force majeure (conditions); and
   c) Outages due to generation deficits or interconnection of a Generation facility.

1.4 Working/Analysis of Standards Department

Through efficient and effective coordination, Standards Department remained successful in obtaining the data related to Annual Performance Reports from National Transmission & Despatch Company (NTDC) for the FY 2010-11, FY 2011-12, FY 2012-13 and FY 2013-14. For this purpose, regular interactive meetings with NTDC professionals were held at NEPRA HQ.

Standards Department conducted full day workshops for better understanding and awareness of NEPRA Rules and Regulations including Performance Standards (Transmission) Rules (PSTR) 2005, at all four regions of National Transmission & Despatch Company (NTDC) i.e. Islamabad Region, Lahore Region, Multan Region and Hyderabad Region.

Through performance of National Transmission & Despatch Company (NTDC) the transmission network has been depicted in the evaluation/analysis report. It covers the analysis of data submitted by NTDC as per requirement of Form-1, Form-2, Form-3, Form-4 and Form-5 of PSTR-2005 for the FY 2010-11, FY 2011-12, FY 2012-13 and FY 2013-14 with tabular and graphical representation.

1.5 Evaluation/Analysis Parameters

System Description		Parameters
Reliability	Form – 1	• Total outages hours recorded at all interconnection points (excluding 132 kV line tripping); • Total number of interconnection points; • System duration of interruption.
	From – 2	• Total number of outages recorded at all 132 kV circuits (excluding 132 kV line tripping); • Total number of 132 kV circuits; • System frequency of interruption.
Security	From – 3	• Total Energy Not Served (MWh).
Quality of Supply	Form – 4	• List of transmission circuits violating the voltage criteria; • Total number of violations under normal conditions; • Total number of violations under N-1 conditions; • Highest/Lowest voltage recorded and time duration under normal conditions; • Highest/Lowest voltage recorded and time duration under N-1 conditions.
	From – 5	• Month wise Highest/Lowest frequency recorded; • Percentage variation of frequency.

Table 1.1: Evaluation Parameters

National Transmission & Despatch Company (NTDC)

2 National Transmission and Despatch Company (NTDC)

2.1 Brief about NTDC

National Transmission & Despatch Company (NTDC) Limited was incorporated on 6th November 1998, out of Pakistan Water and Power Development Authority (WAPDA), to build, operate and maintain extra-high voltage electric transmission system in Pakistan, and commenced commercial operation on 24th December 1998.

2.2 Licence

NTDC was granted transmission licence No. TL/01/2002 on 31st December 2002 by National Electric Power Regulatory Authority (NEPRA) to engage in the exclusive 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.

2.3 Grid Stations

As per reported data, NTDC has four regions & it operates and maintains twelve (12) 500 kV and thirty (30) 220 kV Grid Stations, 5,183 km of 500 kV transmission line and 9,104 km of 220 kV transmission line in Pakistan. The detail of region wise grid stations is as under:

2.3.1 500 kV Grid Stations

Islamabad Region

- 500 kV RAWAT
- 500 kV PESHAWAR

Multan Region

- 500 kV YOUSAFWALA
- 500 kV MUZAFFARGARH
- 500 kV NEW MULTAN

Lahore Region

- 500 kV GATTI (FAISALABAD)
- 500 kV SHEIKHUPURA
- 500 kV NOKHAR

Hyderabad Region

- 500 kV GUDDU
- 500 kV DADU
- 500 kV JAMSHORO
- 500 kV NKI (KARACHI)

2.3.2 220 kV Grid Stations

Islamabad Region

- 220 kV BANNU
- 220 kV DAUDKHEL
- 220 kV ISPR (SANGJANI)
- 220 kV UNIVERSITY
- 220 kV BURHAN
- 220 kV MARDAN
- 220 kV SHAHIBAGH

Lahore Region

- 220 kV BUND ROAD
- 220 JARANWALA
- 220 kV LUDEWALA
- 220 kV NEW SHALAMAR
- 220 kV RAVI
- 220 kV SIALKOT
- 220 kV WAPDA TOWN
- 220 kV GAKKHAR
- 220 kV KALA SHAH KAKU
- 220 kV NEW KOT LAKHPAT
- 220 kV NISHATABAD
- 220 kV SARFARAZ NAGAR
- 220 kV SAMMUNDRI ROAD

Multan Region

- 220 kV BAHAWALPUR
- 220 kV NEW MUZAFFARGARH
- 220 kV VEHARI

Hyderabad Region

- 220 kV DHARKI
- 220 kV HALA ROAD
- 220 kV QUETTA INDUSTRIAL-II
- 220 kV ROHRI
- 220 kV SHIKARPUR
- 220 kV SIBBI
- 220 kV T.M. KHAN ROAD

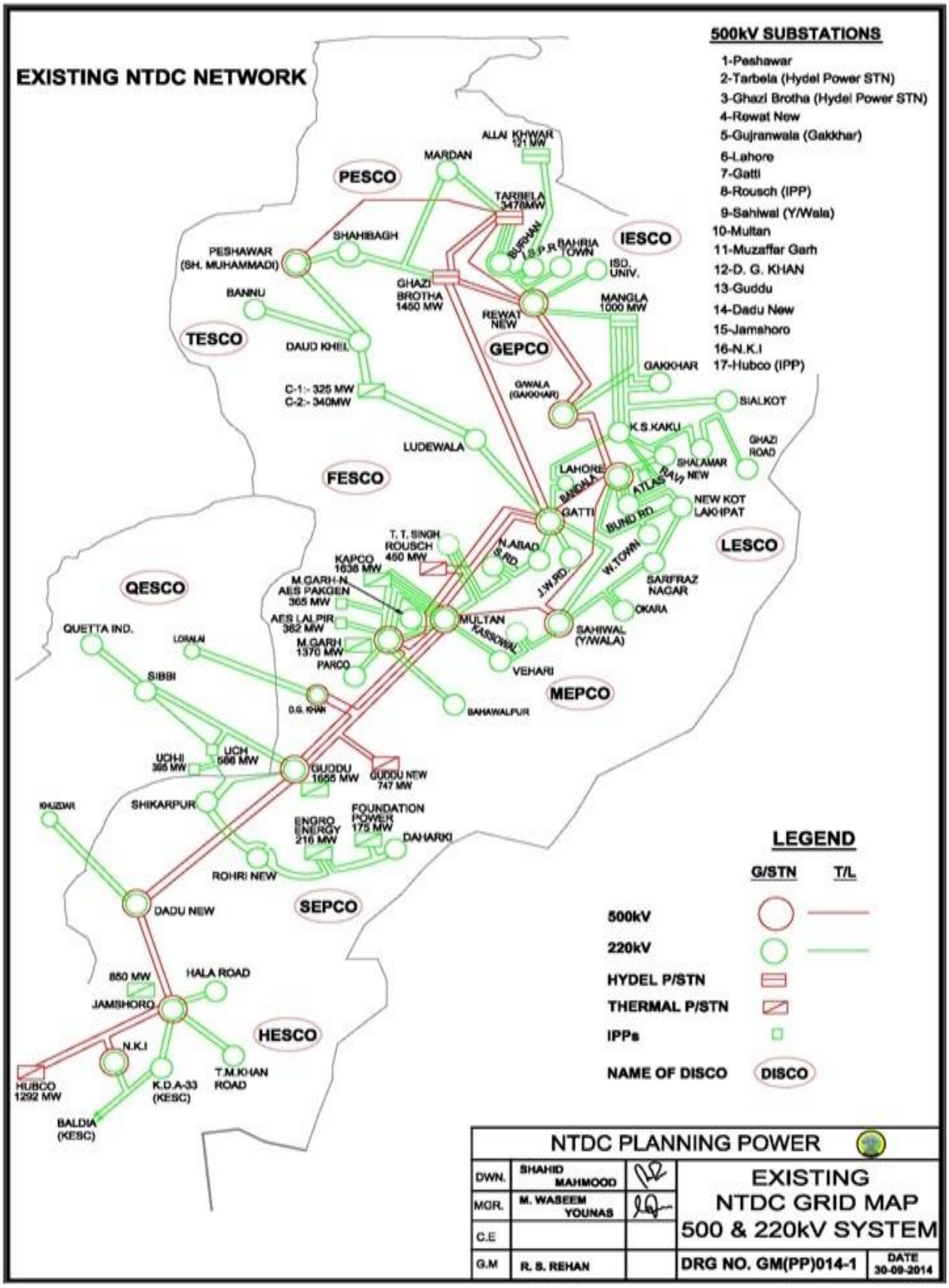

Figure 2.1: Existing NTDC Network

NTDC's Data Analysis

3 Analysis of NTDC's Annual Performance Reports (APRs)

The reports submitted by NTDC as per requirement of Performance Standards (Transmission) Rules (PSTR) 2005 for the FY 2010-11, FY 2011-12, FY 2012-13 and FY 2013-14 have been evaluated and the detail is as under:

3.1 System Reliability

3.1.1 System Duration of Interruption

3.1.1.1 Analysis of Form-1 as per PSTR-2005

S.No.	Parameters of Form-1	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14
1	Total outages hours recorded at all interconnection points (excluding 132 kV line tripping). **1**	47.66	387.63	8.37	0
2	Total number of interconnection points **2**	193	196	184	197
3	System duration of interruption (Hrs) **(3 = 1/2)**	0.25	1.98	0.05	0

Table 3.1: Yearly System Duration of Interruption

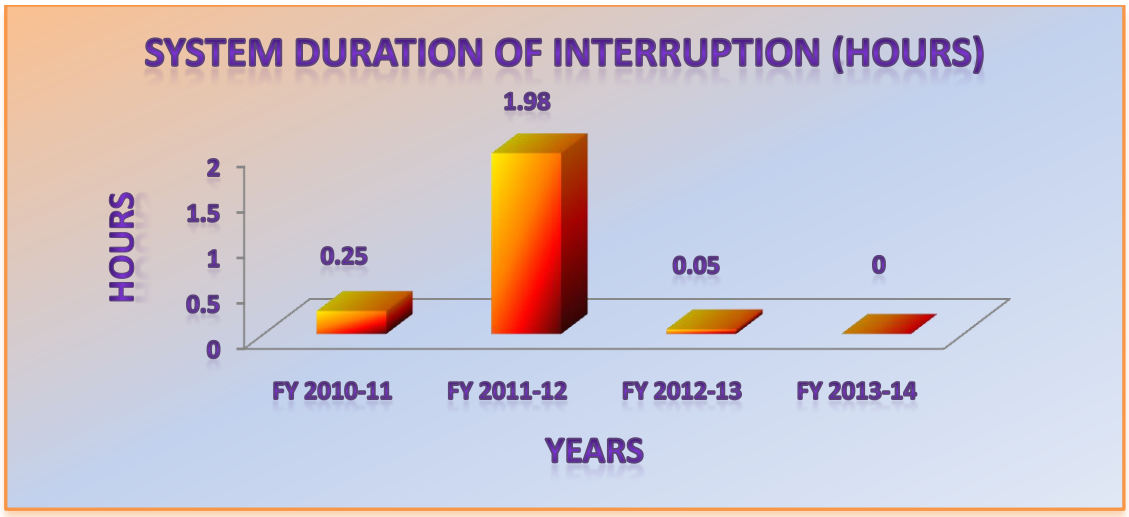

Figure 3.1: Yearly System Duration of Interruption

Observations

- There is a sudden rise (from 47 to 387) of almost 700% in the total outages hours for the FY 2011-12 as compared to FY 2010-11. It has an adverse effect on the power crisis of Pakistan.
- Similarly total outages hours have fallen abruptly from 387 to 8 and 0 for the FY 2012-13 and FY 2013-14 respectively. Although it is a good sign but this sudden rise and fall shows that the data provided is unrealistic.
- Total number of interconnection points reduced from 196 to 184 for the FY 2012-13 which is unfathomable.
- Even a small duration of voltage interruption can cause relay tripping and stopping a process which results in many hours of supply failure.
- High percentage of system duration of outages indicates the improper operation of the protective relays.

3.1.2 System Frequency of Interruption

3.1.2.1 Analysis of Form-2 as per PSTR-2005

S.No.	Parameters of Form-2	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14
1	Total number of outages recorded at all 132 kV circuits (excluding 132 kV line tripping). **1**	5	17	3	0
2	Total number of 132 kV circuits **2**	251	254	258	264
3	System frequency of interruption (Nos.) **(3 = 1/2)**	0.02	0.07	0.01	0

Table 3.2: Yearly System Frequency of Interruption

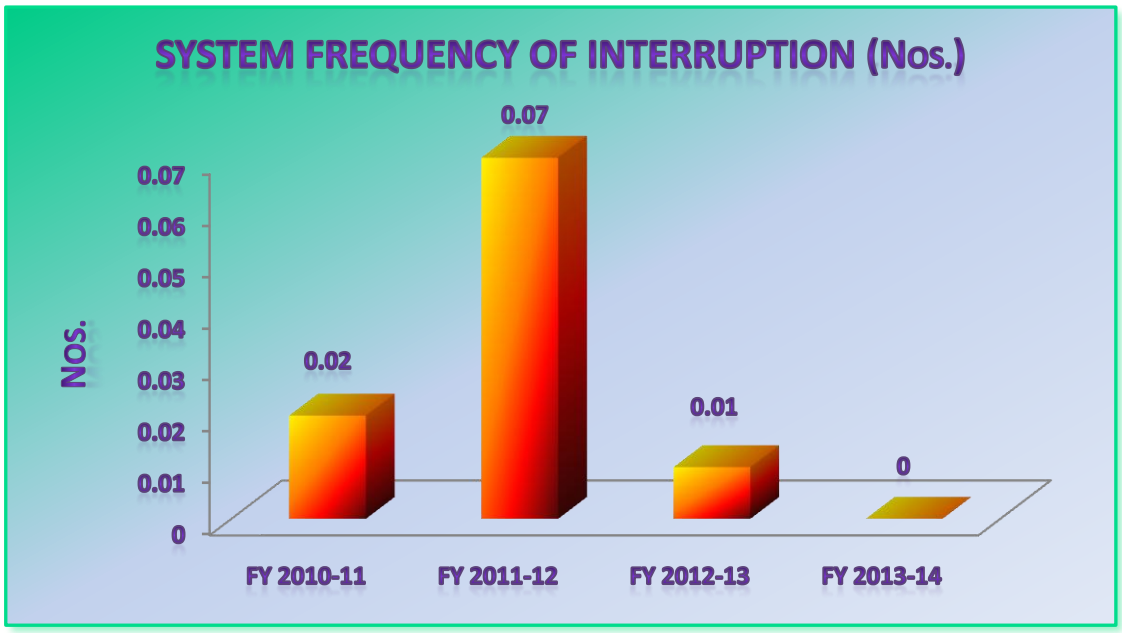

Figure 3.2: Yearly System Frequency of Interruption

Observations

- In comparison with the FY 2010-11 the total number of outages for the FY 2011-12 have increased by 240% indicting poor performance of NTDC to improve system outages.
- A dramatic decrease is observed in total number of outages i.e. 3 for the FY 2012-13 and 0 for FY 2013-14. Although it's a sign of improvement but at the same time it also shows that the data has been provided on unrealistic basis.
- As the number of outages in system increase, system reliability decreased which has an adverse effect on the consumers power supply.
- Major reason of outages in transmission system is the poor maintenance activities of the Grid System and transmission lines equipments, specially the protective relays.
- There are many other causes for power outages such as weather conditions, faults in interconnected networks, etc.

3.2 System Security

3.2.1 Energy Not Served

3.2.1.1 Analysis of Form-3 as per PSTR-2005

S.No.	Grid Station	Energy Not Served (MWh)			
		FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14
ISLAMABAD REGION					
1	500 kV RAWAT	0	0	0	0
2	500 kV PESHAWAR	0	0	0	0
3	220 kV BANNU	0	0	0	0
4	220 kV BURHAN	0	0	0	0
5	220 kV DAUDKHEL	0	0	0	0
6	220 kV MARDAN	0	0	0	0
7	220 kV ISPR	0	0	0	0
8	220 kV SHAHIBAGH	0	0	0	0
9	220 kV UNIVERSITY	0	0	0	0
10	**TOTAL**	**0**	**0**	**0**	**0**
LAHORE REGION					
1	500 kV GATTI (FAISALABAD)	Not Provided	Not Provided	Not Provided	Not Provided
2	500 kV SHEIKHUPURA	0	0	-	-
3	550 kV NOKHAR	0	0	-	-
4	220 kV BUND ROAD	0	0	-	-
5	220 kV GAKKHAR	0	0	-	-
6	220 kV JARANWALA	0	0	-	-
7	220 kV KALA SHAH KAKU	0	0	-	-
8	220 kV LUDEWALA	0	0	-	-
9	220 kV NEW KOT LAKHPAT	0	0	-	-
10	220 kV NEW SHALAMAR	Not Existing	Not Existing	Not Existing	0
11	220 kV NISHATABAD	0	0	-	-
12	220 kV RAVI	0	0	-	-
13	220 kV SARFARAZ NAGAR	0	0	-	-
14	220 kV SIALKOT	0	0	-	-
15	220 kV SAMMUNDRI ROAD	0	183.68	-	-
16	220 kV WAPDA TOWN	Not Existing	0	-	-
17	**TOTAL**	**0**	**183.68**	**-**	**-**

S.No.	Grid Station	Energy Not Served (MWh)			
		FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14
MULTAN REGION					
1	500 kV YOUSAFWALA	0	0	0	0
2	500 kV NEW MULTAN	Not Existing	Not Existing	0	0
3	500 kV MUZAFFARGARH	Not Provided	Not Provided	Not Provided	Not Provided
4	220 kV BAHAWALPUR	1508.99	0	0	0
5	220 kV NEW MUZAFFARGARH	171	132.66	0	0
6	220 kV VEHARI	0	0	0	0
7	**TOTAL**	**1,679.99**	**132.66**	**0**	**0**
HYDERABAD REGION					
1	500 kV GUDDU	Not Provided	Not Provided	Not Provided	Not Provided
2	500 kV DADU	293.44	36.99	0	0
3	500 kV JAMSHORO	0	24.95	35.2	0
4	500 kV NKI (KARACHI)	Not Provided	Not Provided	Not Provided	Not Provided
5	220 kV DHARKI	0	0	0	0
6	220 kV HALA ROAD	32.8	0	0	0
7	220 kV QUETTA INDUSTRIAL-II	0	0	0	0
8	220 kV SHIKARPUR	16.8	12.7	0	0
9	220 kV SIBBI	0	44.7	15.5	0
10	220 kV T.M. KHAN ROAD	0	0	0	0
11	220 kV ROHRI	0	0	0	0
12	**TOTAL**	**343.04**	**119.34**	**50.7**	**0**

Table 3.3: Region Wise Yearly Energy Not Served

S.No.	Region	Energy Not Served (MWh)			
		FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14
Overall NTDC System					
1	ISLAMABAD REGION	0	0	0	0
2	LAHORE REGION	0	183.68	-	-
3	MULTAN REGION	1,679.99	132.66	0	0
4	HYDERABAD REGION	343.04	119.34	50.7	0
5	**TOTAL**	**2,023.03**	**435.68**	**50.7**	**0**

Table 3.4: Year Wise Overall System Energy Not Served

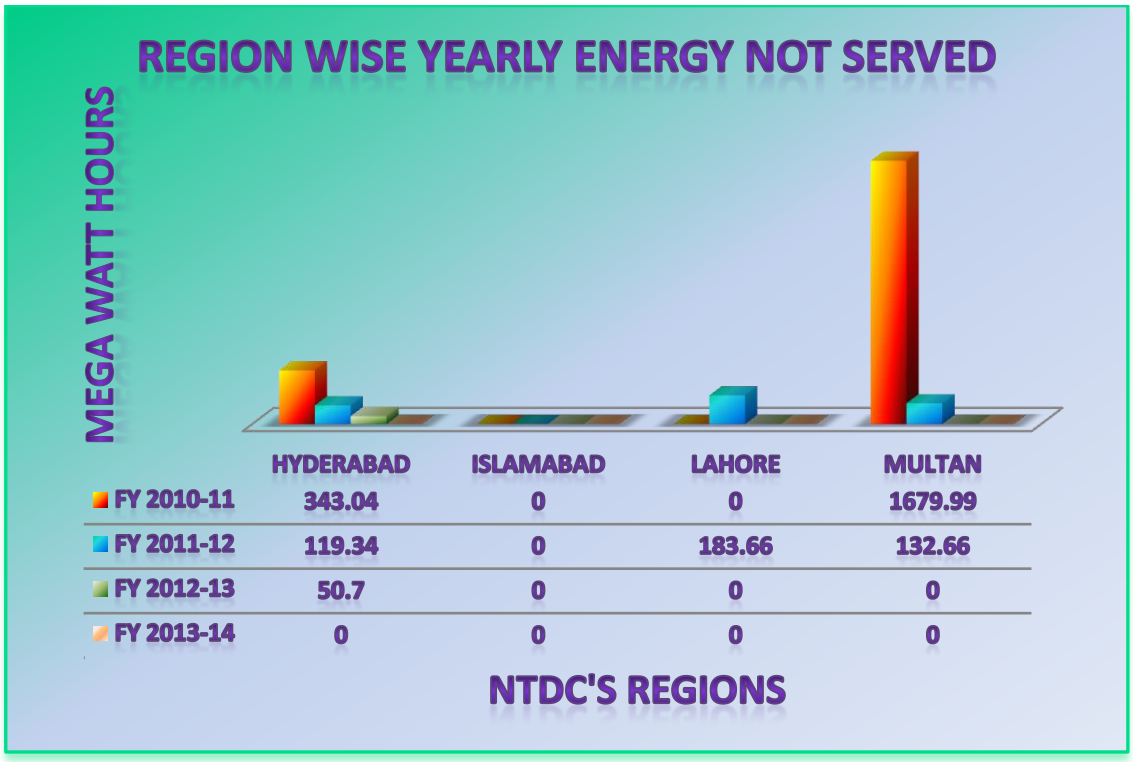

Figure 3.3: Region Wise Yearly Energy Not Served

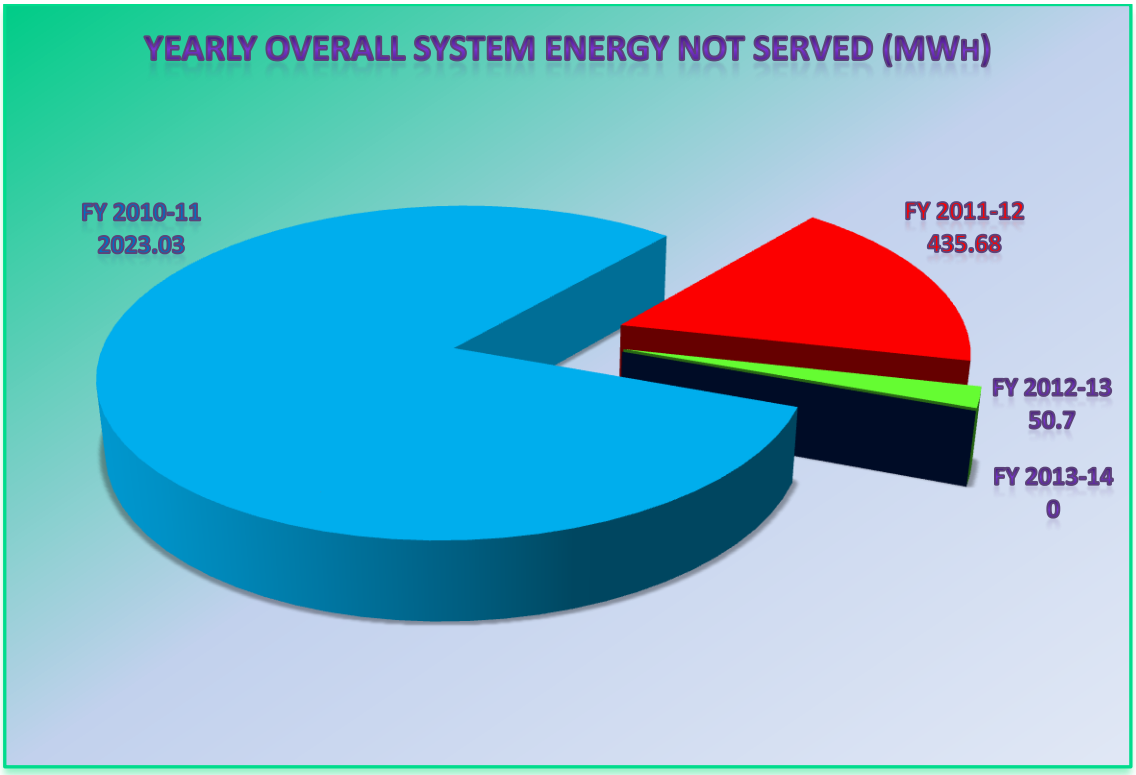

Figure 3.4: Yearly Overall System Energy Not Served

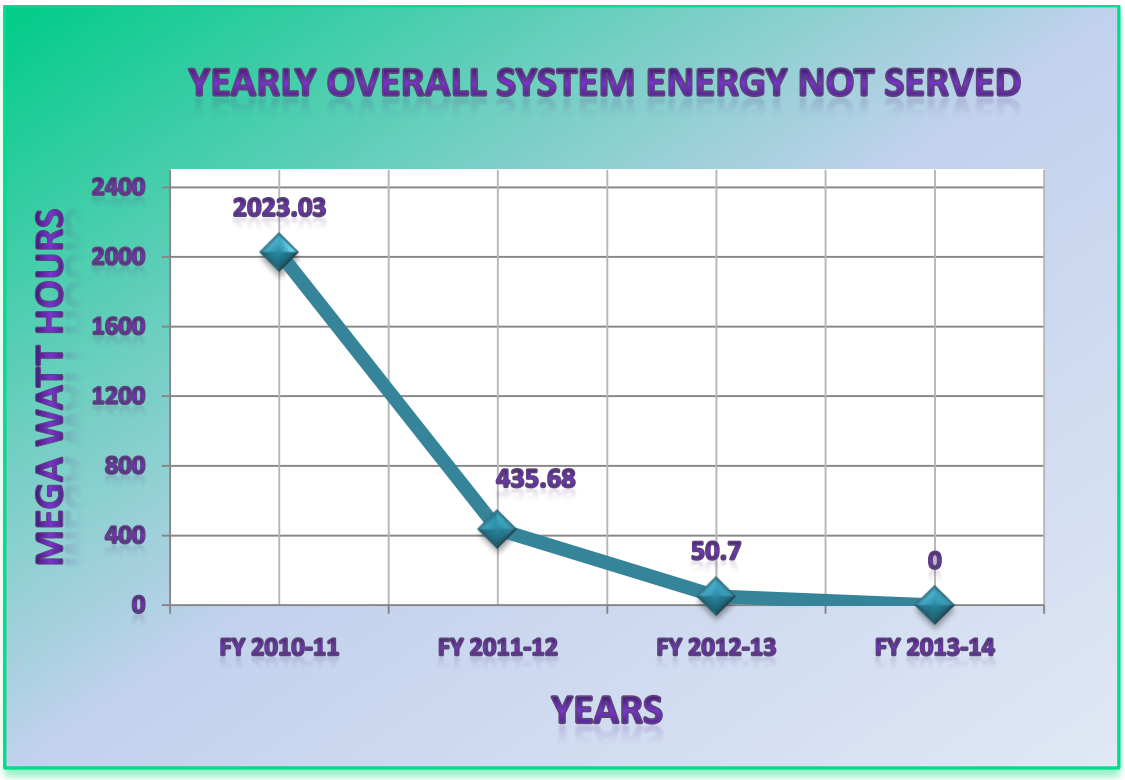

Figure 3.5: Yearly Overall System Energy Not Served [Trend Line]

Observations

- Hyderabad and Multan regions have worst performance for the FY 2010-11 and FY 2011-12 as compared to Islamabad and Lahore regions. However both of them improved for the FY 2012-13 and FY 2013-14 as shown in Figure 3.3.
- Figure 3.4 shows the improved percentage performance of NTDC system as the energy not served for the FY 2013-14 is 0% as compared to the preceding years.
- Figure 3.5 shows the year wise improvement but for the FY 2013-14 there is a sudden drop to zero which is unfathomable and shows that the data is not based on reality.

3.3 Quality of Supply

3.3.1 SYSTEM VOLTAGE

3.3.1.1 Analysis of Form-4 as per PSTR-2005 ISLAMABAD REGION

S. No.	Grid Station	Total Number of Violations			
		FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14
1	500 kV RAWAT	611	3,749	7,473	7,242
2	500 kV PESHAWAR	1,108	1,521	3,807	335
3	220 kV BANNU	5,388	473	502	3,381
4	220 kV BURHAN	76	8	30	73
5	220 kV DAUDKHEL	4,725	3,132	6,581	4,863
6	220 kV MARDAN	4,189	4,535	5,161	5,312
7	220 kV ISPR	27	77	13	19
8	220 kV SHAHIBAGH	1,246	933	3,656	1,920
9	220 kV UNIVERSITY	534	418	677	364
10	**TOTAL**	**17,904**	**14,846**	**27,900**	**23,509**

Table 3.5: Total Number of Violations [Islamabad Region]

S. No.	Grid Station	FY 2011-12 Vs FY 2010-11	FY 2012-13 Vs FY 2011-12	FY 2013-14 Vs FY 2012-13
1	500 kV RAWAT	▲ 514%	▲ 99%	▼ 3%
2	500 kV PESHAWAR	▲ 37%	▲ 150%	▼ 91%
3	220 kV BANNU	▼ 91%	▲ 6%	▲ 574%
4	220 kV BURHAN	▼ 89%	▲ 275%	▲ 143%
5	220 kV DAUDKHEL	▼ 34%	▲ 110%	▼ 26%
6	220 kV MARDAN	▲ 8%	▲ 13%	▲ 3%
7	220 kV ISPR	▲ 185%	▼ 83%	▼ 46%
8	220 kV SHAHIBAGH	▼ 25%	▲ 292%	▼ 47%
9	220 kV UNIVERSITY	▼ 22%	▲ 62%	▼ 46%
10	**TOTAL**	**▼ 17%**	**▲ 88%**	**▼ 16%**

Table 3.6: %age Variation in Year Wise Total Number of Violations [Islamabad Region]

▲ Increase
▼ Decrease

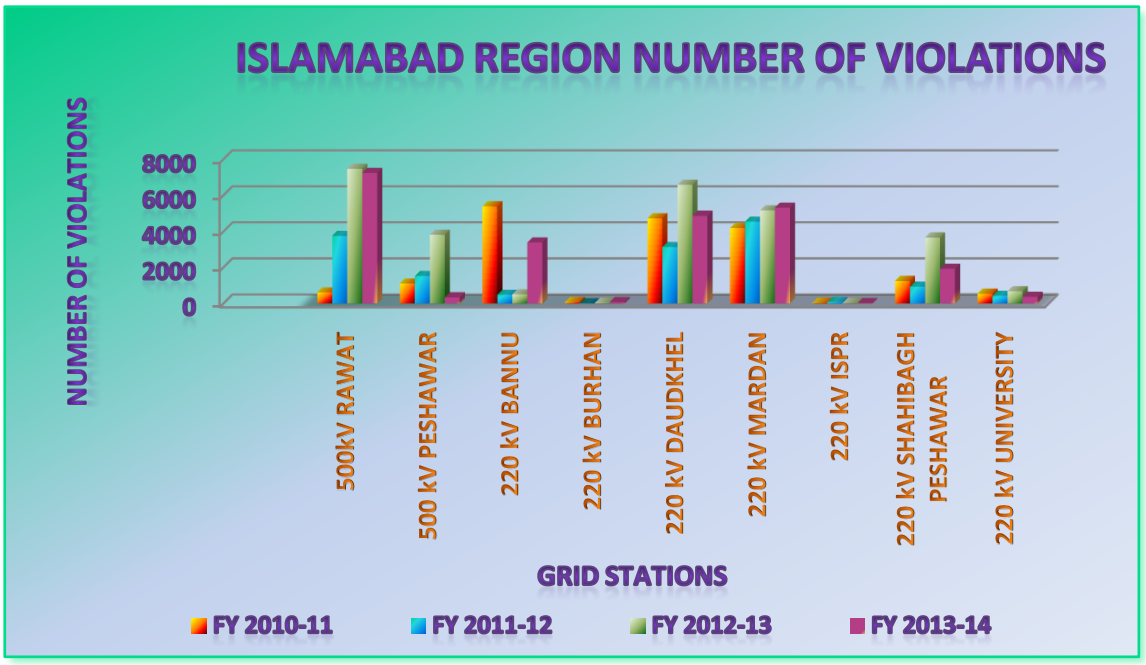

Figure 3.6: Year Wise Total Number of Violations [Islamabad Region]

Observations (Detailed analysis of all Grid Stations circuits is attached at **Annex-I**)

- The 500 kV circuits, Rawat-Barotha, Rawat-Gakkhar and Rawat Tarbela have exactly similar voltage limits violations for the FY 2010-11, FY 2011-12, FY 2012-13 and FY 2013-14. Similarly 220 kV circuits, Rawat-ISPR, Rawat-Mangla, Rawat-Bahria Town, and Rawat- University violations of voltage limits are mirror images, which indicate that data reported by NTDC is unrealistic.
- An increase of almost 100% in voltage limits violations was noted at Rawat Grid Station for the FY 2012-13 as compared to the preceding year. On the other hand violations of voltage limits were decreased by only 3% for the FY 2013-14 which indicates the poor maintenance activities at Rawat Grid Station.
- Voltage limits violations at 500 kV Peshawar were increased by 37% and 150% for the FY 2011-12 and FY 2012-13 respectively. Whereas, a sudden decrease of 91% for the FY 2013-14 as compared to preceding year shows the non-serious behavior of NTDC towards performance improvement.
- 220 kV circuits, Burhan-ISPR, Tarbela-Burhan have exactly the same number of voltage limits violations for the FY 2010-11 and FY 2011-12, indicating that data is not based on reality.
- Voltage limits violations at 220 kV Shahibagh Grid Station has been decreased by 47% for the FY 2013-14 as compared to preceding year.
- Data for 500 kV Tarbela-Peshawar circuit and 220 kV Tarbela-Burhan circuit has not been provided by NTDC for the FY 2010-11 and FY 2012-13 respectively.
- Voltage limits violations at 220 kV Bannu Grid Station has been increased by 574% for the FY 2013-14 as compared to preceding year.
- Overall voltage limits violations of Islamabad Region decreased by 16% for the FY 2013-14 as compared to preceding year which is a sign of performance improvement.

3.3.1.2 Analysis of Form-4 as per PSTR-2005 LAHORE REGION

S. No.	Grid Station	Total Number of Violations			
		FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14
1	500 kV Gatti Faisalabad	294	416	789	335
2	500 kV Sheikhupura	26	207	25	26
3	220 kV Bund Road	707	325	3,035	4,574
4	220 kV Gakkhar	2,946	1,445	1,639	902
5	220 kV Jaranwala	70	19	222	303
6	220 kV Kala Shah Kaku	3,995	5,014	8,863	9114
7	220 kV Ludewala	1,441	468	646	543
8	220 kV New Kot Lakhpat	4,658	19,490	20,355	19,685
9	220 kV New Shalamar	Not Existing	Not Existing	Not Existing	1,312
10	220 kV Nishatabad	37	-	-	-
11	220 kV Ravi	2,276	7,070	13,756	15,470
12	220 kV Sarfaraz Nagar	1,317	3,752	3,806	4,636
13	220 kV Sialkot	1,323	1,533	1,207	1,022
14	220 kV Sammundri Road	-	6	51	139
15	220 kV WAPDA Town	-	5,170	2,814	3,216
16	**TOTAL**	**19,090**	**44,915**	**57,208**	**61,277**

Table 3.7: Total Number of Violations [Lahore Region]

S. No.	Grid Station	FY 2011-12 Vs FY 2010-11	FY 2012-13 Vs FY 2011-12	FY 2013-14 Vs FY 2012-13
1	500 kV Gatti Faisalabad	▲ 41%	▲ 90%	▼ 57%
2	500 kV Sheikhupura	▲ 696%	▼ 88%	▲ 4%
3	220 kV Bund Road	▼ 54%	▲ 834%	▲ 51%
4	220 kV Gakkhar	▼ 51%	▲ 13%	▼ 45%
5	220 kV Jaranwala	▼ 72%	▲ 1,068%	▲ 36%
6	220 kV Kala Shah Kaku	▲ 26%	▲ 77%	▲ 3%
7	220 kV Ludewala	▼ 68%	▲ 38%	▼ 16%
8	220 kV New Kot Lakhpat	▼ 318%	▲ 4%	▼ 3%
9	220 kV New Shalamar	-	-	-
10	220 kV Nishatabad	▼ 100%	-	-

11	220 kV Ravi	▲ 210%	▲ 95%	▲ 12%
12	220 kV Sarfaraz Nagar	▲ 185%	▲ 1%	▲ 22%
13	220 kV Sialkot	▲ 16%	▼ 21%	▼ 15%
14	220 kV Sammundri Road	-	▲ 750%	▲ 173%
15	220 kV WAPDA Town	-	▼ 46%	▲ 14%
16	**TOTAL**	▲ **135%**	▲ **27%**	▲ **7%**

Table 3.8: %age Variation in Year Wise Total Number of Violations [Lahore Region]

▲ Increase
▼ Decrease

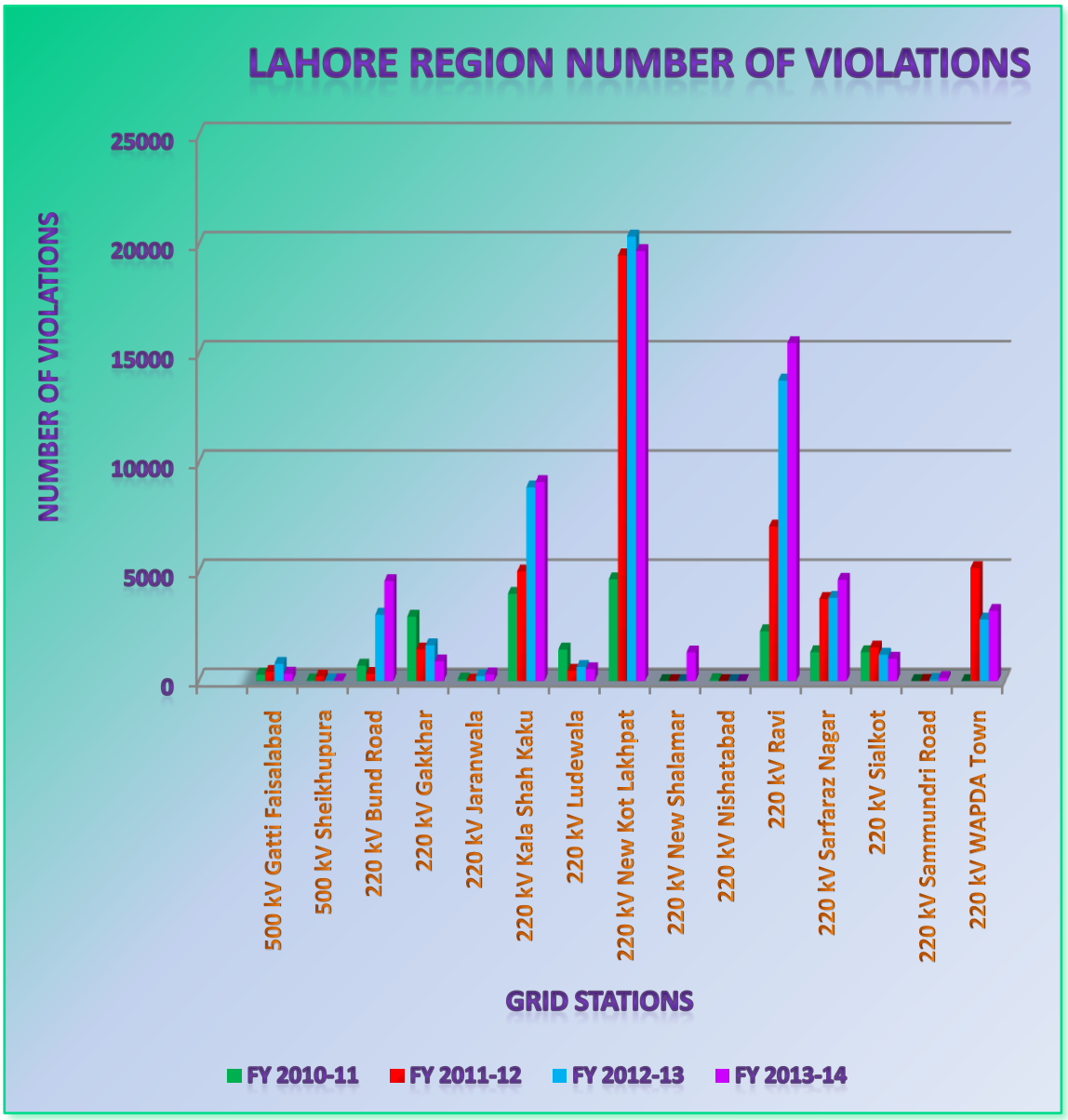

Figure 3.7: Year Wise Total Number of Violations [Lahore Region]

Observations (Detailed analysis of all Grid Stations circuits is attached at **Annex-II**)

- Voltage limits violations of all the circuits at 500 kV Gatti (Faisalabad) Grid Station are decreased for the FY 2013-14 as compared to the FY 2012-13, which is a sign of performance improvement. However, data for 500 kV Barotha-Gatti Circuit has not been provided for the FY 2013-14.

- Data for 220 kV New Shalamar Grid Station has been provided by NTDC for the FY 2013-14, which indicates that this Grid Station has been added in 2013-14.

- Voltage limits violations at 220 kV Gakkhar and 220 kV Ludewala Grid Stations decreased by 45% and 16% respectively for the FY 2013-14 as compared to FY 2012-13 indicating a slight improvement.

- Voltage limits violations at 220 kV Bund Road, and 220 kV Jaranwala Grid Stations increased by 51% and 36% respectively for the FY 2013-14 as compared to preceding year. For 220 kV Bund Road Grid Station it abruptly increased from hundreds to thousands for succeeding years. This indicates the poor maintenance activities at this Grid Station.

- For 220 kV Kala Shah Kaku Grid Station a consistent increase was noted in voltage limits violations for each year as compared to its respective preceding year indicating non-serious behavior of NTDC towards performance improvement.

- The worst possible condition of voltage limits violation was noted at 220 kV New Kot Lakhpat Grid Station.

- Data for circuits, Gakkhar-Mangla III for the FY 2011-12 to FY 2013-14 and Old Gakkhar-New Gakkhar for the FY 2012-13 has not been provided by NTDC.

- Data for different circuits at 500 kV Sheikhupura, 220 kV Nishatabad and 220 kV Sammundri Road Grid Stations should be reported by NTDC on individual basis.

- Overall voltage limits violations of Lahore Region increased by 135% for the FY 2011-12, 23% for the FY 2012-13 and 11% for the FY 2013-14 as compared to their respective preceding years.

3.3.1.3 Analysis of Form-4 as per PSTR-2005 MULTAN REGION

S. No.	Grid Station	Total Number of Violations			
		FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14
1	500 kV Yousafwala	-	-	1	6
2	500 kV New Multan	9	-	-	10
3	500 kV Muzaffargarh	-	-	-	-
4	220 kV Bahawalpur	31	131	15	421
5	220 kV New Muzaffargarh	100	2	184	-
6	220 kV Vehari	572	48	1,459	1,132
7	**TOTAL**	**712**	**181**	**1,659**	**1,569**

Table 3.9: Total Number of Violations [Multan Region]

S. No.	Grid Station	FY 2011-12 Vs FY 2010-11	FY 2012-13 Vs FY 2011-12	FY 2013-14 Vs FY 2012-13
1	500 kV Yousafwala	-	-	▲ 500%
2	500 kV New Multan	-	-	-
3	5000 kV Muzaffargarh	-	-	-
4	220 kV Bahawalpur	▲ 323%	▼ 89%	▲ 2,707%
5	220 kV New Muzaffargarh	▼ 98%	▲ 9,100%	-
6	220 kV Vehari	▼ 92%	▲ 2,940%	▼ 22%
7	**TOTAL**	**▼ 75%**	**▲ 817%**	**▼ 5%**

Table 3.10: %age Variation in Year Wise Total Number of Violations [Multan Region]

▲ Increase
▼ Decrease

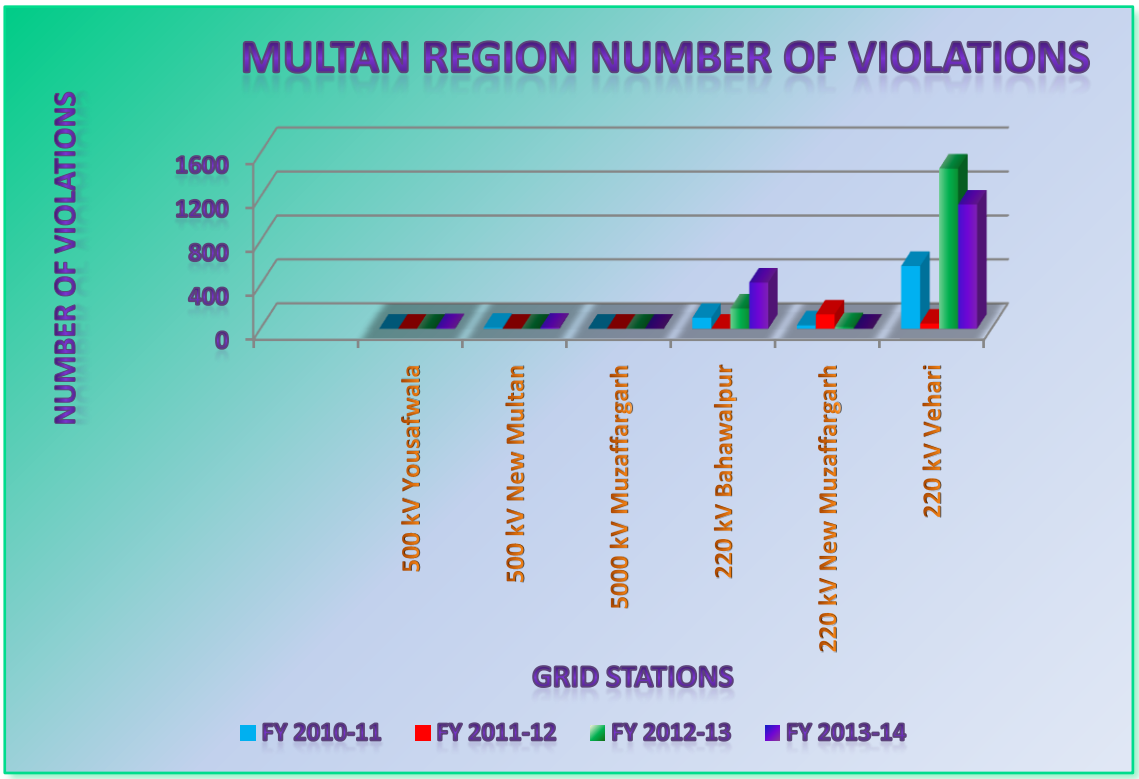

Figure 3.8: Year Wise Total Number of Violations [Multan Region]

Observations (Detailed analysis of all Grid Stations circuits is attached at **Annex-III**)

- The voltage limits violations at 500 kV Yousafwala Gird Station were increased by 500% for the FY 2013-14 as compared to FY 2012-13 indicating the non-serious behavior of NTDC towards performance improvement.
- A sudden fall from 100 to 2 numbers of violations for the FY 2011-12 as compared to FY 2010-11 at 220 kV Bahawalpur Gird Station was noted. Similarly an abrupt rise from 2 to 184 numbers of violations for the FY 2012-13 as compared to FY 2011-12 was also noted. This indicates that data has been provided by NTDC on un-realistic basis.
- No voltage limits violation has been seen for 500 kV Muzaffargarh Grid Station for the FY 2010-11, FY 2011-12, FY 2012-13 and FY 2013-14, which shows performance improvement by NTDC at this Grid Station.
- No voltage limits violation was noted at 500 kV New Multan Grid Station for the FY 2011-12 and FY 2012-13.
- No voltage violation has been seen for the FY 2013-14 at 220 kV Muzaffargarh Grid Station as compared to the preceding year. This is a sign of performance improvement at this particular Grid Station.
- Voltage limits violations at 220 kV Vehari have a high Rise and fall over the period of four years i.e. from FY 2010-11 to FY 2013-14, however it decreased for the FY 2013-14 as compared to FY 2012-13.
- Overall voltage limits violations of Multan Region were decreased by 31% for the FY 2013-14 as compared to FY 2012-13, indicating performance improvement by NTDC.

3.3.1.4 Analysis of Form-4 as per PSTR-2005 HYDERABAD REGION

S. No.	Grid Station	Total Number of Violations			
		FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14
1	500 kV GUDDU	-	95	-	6,105
2	500 kV DADU	112	1,315	1,641	2,863
3	500 kV JAMSHORO	844	394	1,017	889
4	500 kV NKI (KARACHI)	2,337	3,884	2,738	4,596
5	220 kV SHIKARPUR	214	106	200	1,108
6	220 kV T.M. KHAN ROAD	133	226	616	767
7	220 kV DHARKI	50	11	21	-
8	220 kV HALA ROAD	1,312	103	543	1285
9	220 kV SIBBI	6,249	8,649	12,338	9,922
10	220 kV QUETTA INDUSTRIAL-II	5,376	6,032	6,058	12,636
11	220 kV ROHRI	15	14	165	90
12	**TOTAL**	**16,742**	**20,829**	**29,642**	**40,261**

Table 3.11: Total Number of Violations [Hyderabad Region]

S. No.	Grid Station	FY 2011-12 Vs FY 2010-11	FY 2012-13 Vs FY 2011-12	FY 2013-14 Vs FY 2012-13
1	500 kV GUDDU	-	-	-
2	500 kV DADU	▲ 1074%	▲ 367%	▲ 74%
3	500 kV JAMSHORO	▼ 53%	▲ 158%	▼ 13%
4	500 kV NKI (KARACHI)	▲ 66%	▼ 30%	▲ 68%
5	220 kV SHIKARPUR	▼ 50%	▲ 89%	▲ 454%
6	220 kV T.M. KHAN ROAD	▲ 70%	▲ 173%	▼ 25%
7	220 kV DHARKI	▼ 78%	▲ 91%	-
8	220 kV HALA ROAD	▼ 92%	▲ 427%	▲ 137%
9	220 kV SIBBI	▲ 38%	▲ 43%	20%
10	220 kV QUETTA INDUSTRIAL-II	▲ 9%	▼ 2%	▲ 116%
11	220 kV ROHRI	▼ 7%	▲ 1,079%	▼ 45%
12	**TOTAL**	**▲ 24%**	**▲ 43%**	**▲ 36%**

Table 3.12: %age Variation in Year Wise Total Number of Violations [Hyderabad Region]

▲ Increase
▼ Decrease

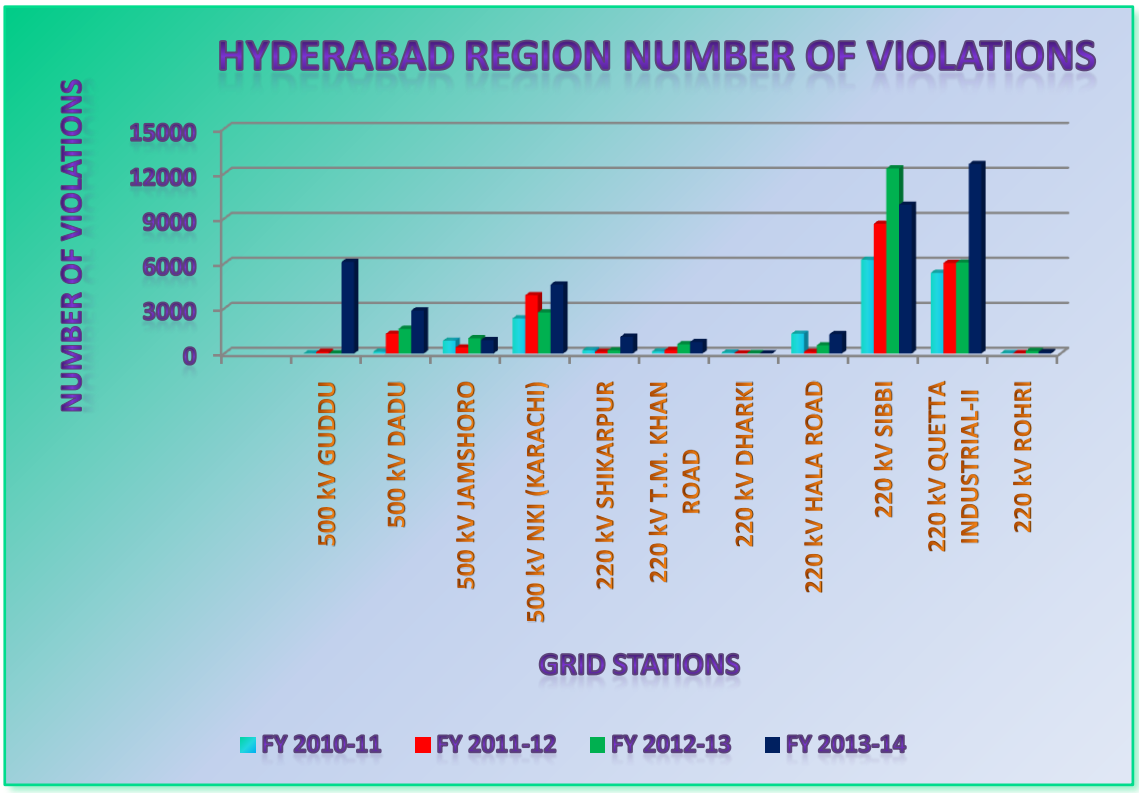

Figure 3.9: Year Wise Total Number of Violations [Hyderabad Region]

Observations **(**Detailed analysis of all Grid Stations circuits is attached at **Annex-IV**)

- Data for 500 kV circuits NKI-HUB & NKI-Jamshoro and 220 kV circuits NKI-Baldia & NKI-KDA has the same numbers and values; this indicates that the data has been provided by NTDC on un-realistic basis.

- Similarly data for all the circuits at 220 kV Shikarpur Grid Station has the same values for the FY 2013-14. NTDC should report data for all the circuits individually.

- Voltage limits violations for 500 kV Jamshoro and 220 kV Dharki, Sibbi and Rohri Grid Stations has been decreased for the FY 2013-14 as compared to preceding year, which shows performance improvement by NTDC at these Grid Stations.

- Voltage limits violations for 500 kV Dadu, 500 kV NKI (Karachi), 220 kV Quetta Industrial-II and 220 kV Shikarpur Grid Stations increased for the FY 2013-14 as compared to FY 2012-13.

- Voltage limits violations for 220 kV Hala Road Grid Station increased by 137% for the FY 2013-14 as compared to preceding year. Whereas, 500 kV Guddu has no violation for the FY 2012-13 but an abrupt rise of 6,105 numbers of violations were noted for the FY 2013-14, which is surprising and needs to be monitored.

- Overall voltage limits violations of Hyderabad Region increased by 56% for the FY 2013-14 as compared to the FY 2012-13 and by 21% for the FY 2012-13 as compared to the FY 2011-12. Although, under the head of O&M 63.36% amount was allowed by NEPRA to NTDC in the tariff determination for the FY 2012-13.

3.3.2 SYSTEM FREQUENCY

3.3.2.1 Analysis of Form-5 as per PSTR-2005 FY 2010-11

Month	Highest/Lowest Frequency Recorded/Measured (Hz)		%age Variation (%)		Remarks
	Max	Min	Max	Min	
July	50.54	48.99	1.08	-3.18	• NTDC has violated the lower frequency limit repeatedly which may subject the system to undesirable effects like degrading load performance, reducing the speed of generators connected to power grid and ultimately leading to instability on the power system. • Upper frequency limit has also been violated three times but needs to improve and keep within limits.
Aug	50.53	48.84	1.06	-2.32	
Sep	50.56	48.91	1.12	-2.18	
Oct	50.43	48.81	0.86	-2.38	
Nov	50.44	49.02	0.88	-1.96	
Dec	50.39	48.80	0.78	-3.60	
Jan	50.40	48.80	0.80	-2.40	
Feb	50.40	48.78	0.80	-2.44	
Mar	50.48	48.81	0.96	-2.38	
Apr	50.44	48.75	0.88	-2.06	
May	50.50	48.62	1.00	-2.76	
June	50.48	48.68	0.96	-2.64	

Table 3.13: Month Wise Frequency Maxima and Minima [FY 2010-11]

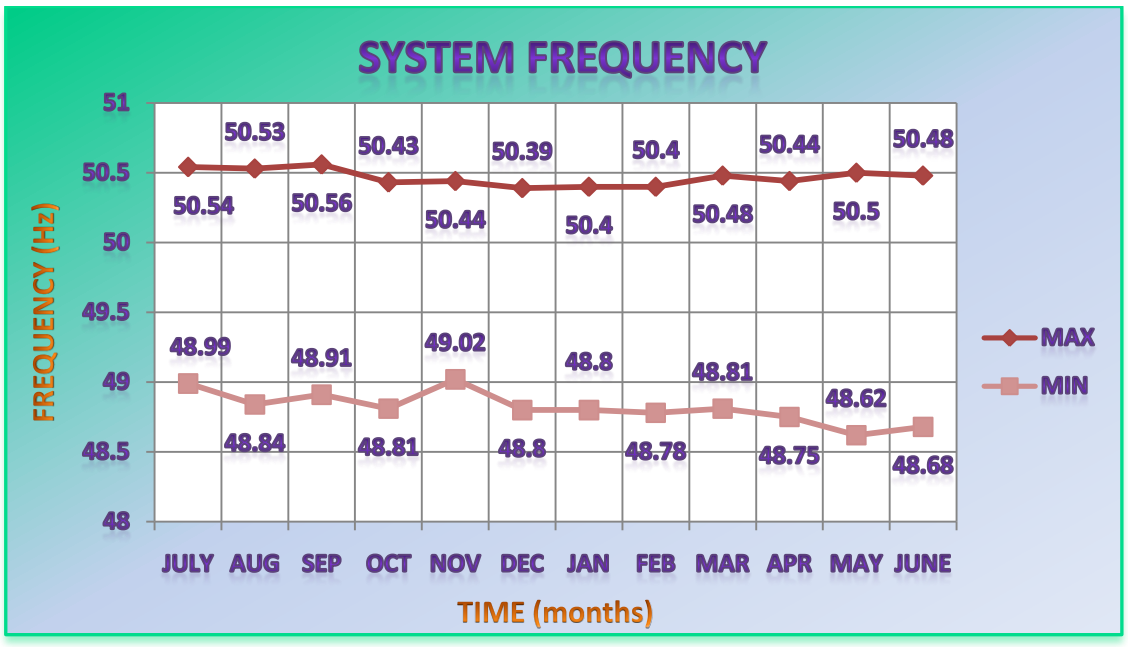

Figure 3.10: System Frequency [FY 2010-11]

3.3.2.2 Analysis of Form-5 as per PSTR-2005 FY 2011-12

Month	Highest/Lowest Frequency Recorded/Measured (Hz)		%age Variation (%)		Remarks
	Max	Min	Max	Min	
July	50.56	48.72	1.12	-2.56	• NTDC has violated the lower frequency limit multiple times; this condition is very miserable keeping in view the power crisis of Pakistan. • At lower frequencies the magnetizing currents to transformers and motors increases as their inductive impedance fall ($Z_L = 2 \bullet \pi \bullet f \bullet \ell$). This results in overheating of the machines, especially since the speeds of any motor shaft driven cooling fans are reducing so that the equipment has more heating and less cooling, thereby, reducing the life span of equipment and increasing maintenance expenses.
Aug	50.48	48.72	0.96	-2.56	
Sep	50.44	48.72	0.88	-2.56	
Oct	50.44	48.80	0.88	-2.04	
Nov	50.56	48.92	1.12	-2.16	
Dec	50.48	48.76	0.96	-2.48	
Jan	50.44	48.72	0.88	-2.56	
Feb	50.36	48.80	0.72	-2.40	
Mar	50.48	48.76	0.96	-2.48	
Apr	50.40	48.76	0.80	-2.48	
May	50.44	48.76	1.00	-2.48	
June	50.48	48.76	0.96	-2.48	

Table 3.14: Month Wise Frequency Maxima and Minima [FY 2011-12]

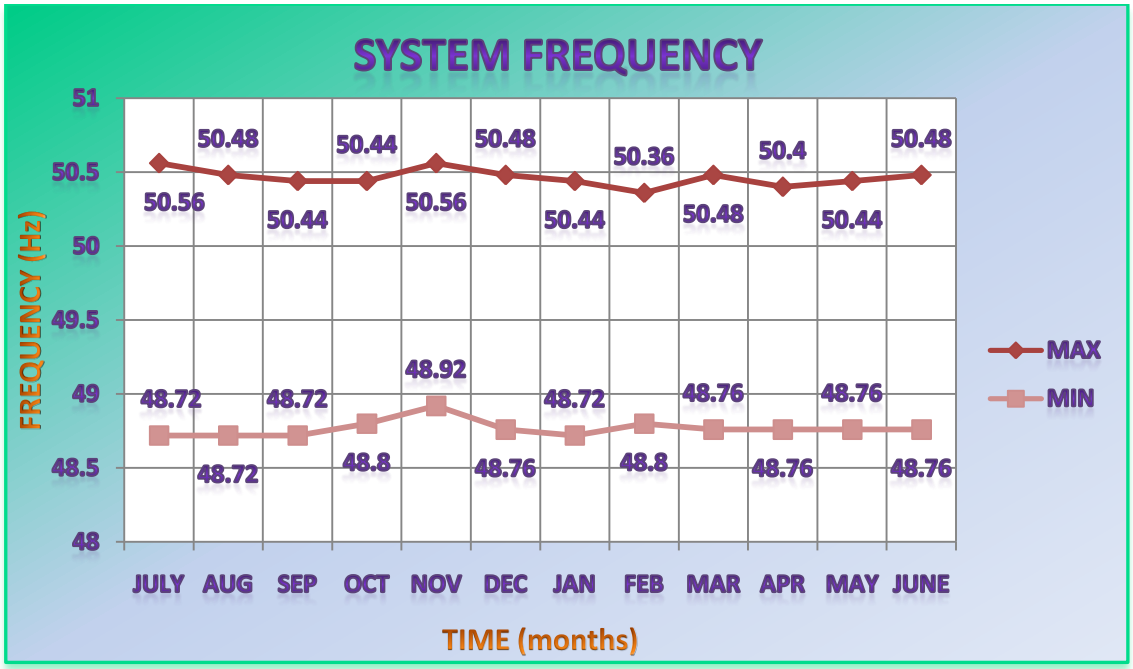

Figure 3.11: System Frequency [FY 2011-12]

3.3.2.3 Analysis of Form-5 as per PSTR-2005 FY 2012-13

Month	Highest/Lowest Frequency Recorded/Measured (Hz)		%age Variation (%)		Remarks
	Max	Min	Max	Min	
July	50.48	48.76	0.96	-2.48	• Higher frequency limit has fewer violations which is a sign of improvement, however the lower frequency limit has been violated a number of times which may have an adverse effect on the system.
Aug	50.52	48.80	1.04	-2.40	
Sep	50.56	48.72	1.12	-2.56	
Oct	50.45	48.80	0.90	-2.4	
Nov	50.40	48.72	0.80	-2.56	
Dec	50.40	48.72	0.80	-2.56	
Jan	50.21	49.10	0.42	-1.80	
Feb	50.10	48.66	0.20	-2.68	
Mar	50.34	49.40	0.68	-1.20	
Apr	50.30	49.32	0.60	-1.36	
May	50.26	49.48	0.52	-1.04	
June	50.23	49.20	0.46	-1.60	

Table 3.15: Month Wise Frequency Maxima and Minima [FY 2012-13]

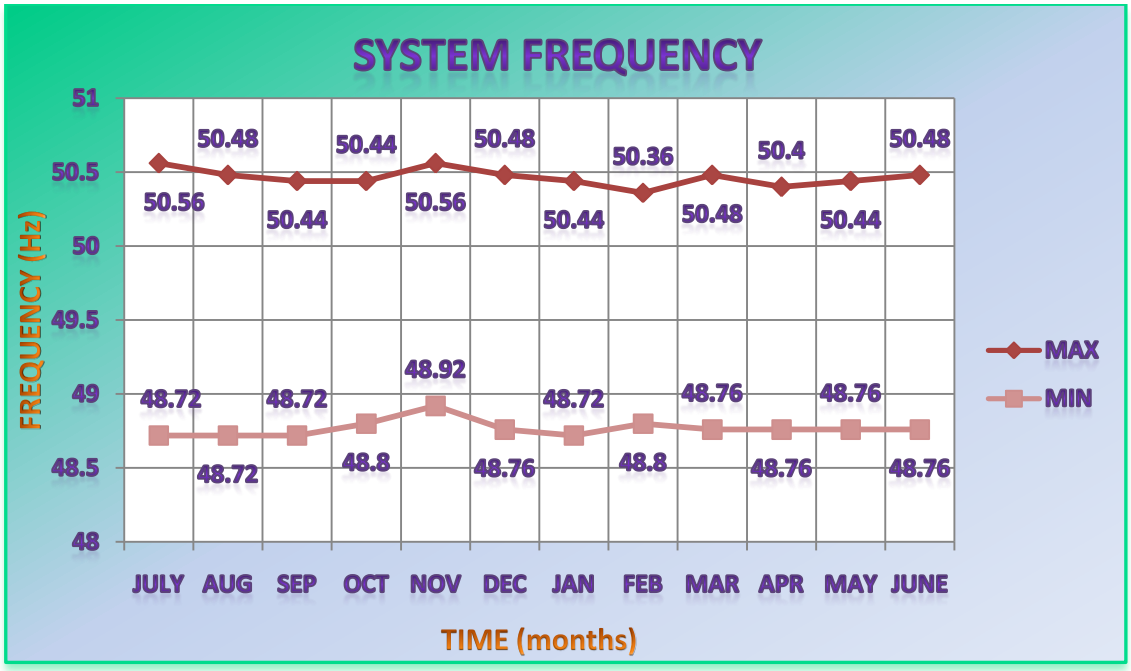

Figure 3.12: System Frequency [FY 2012-13]

3.3.2.4 Analysis of Form-5 as per PSTR-2005 FY 2013-14

Month	Highest/Lowest Frequency Recorded/Measured (Hz)		%age Variation (%)		Remarks
	Max	Min	Max	Min	
July	50.20	49.05	0.40	-1.90	• The lower limit is repeatedly violated by NTDC. • Transformers are sensitive to frequency and may be overloaded if the frequency drifts substantially from the nominal value. • As long as frequency variations are small the interconnected system remains synchronized. The system will continue to operate in a stable manner unless the variations continue to gain in magnitude and oscillate at low frequencies. These oscillations can lead to more threatening voltage and frequency problems that may lead to instability and potentially to cascading outages.
Aug	50.31	49.15	0.62	-1.70	
Sep	50.22	49.35	0.44	-1.30	
Oct	50.35	49.50	0.70	-1.00	
Nov	50.30	49.31	0.60	-1.38	
Dec	50.28	49.15	0.56	-1.70	
Jan	50.70	48.67	1.40	-2.66	
Feb	50.63	48.87	1.26	-2.26	
Mar	50.63	48.92	1.26	-2.16	
Apr	50.68	48.89	1.36	-2.22	
May	50.60	49.20	1.20	-1.60	
June	50.57	49.19	1.14	-1.62	

Table 3.16: Month Wise Frequency Maxima and Minima [FY 2013-14]

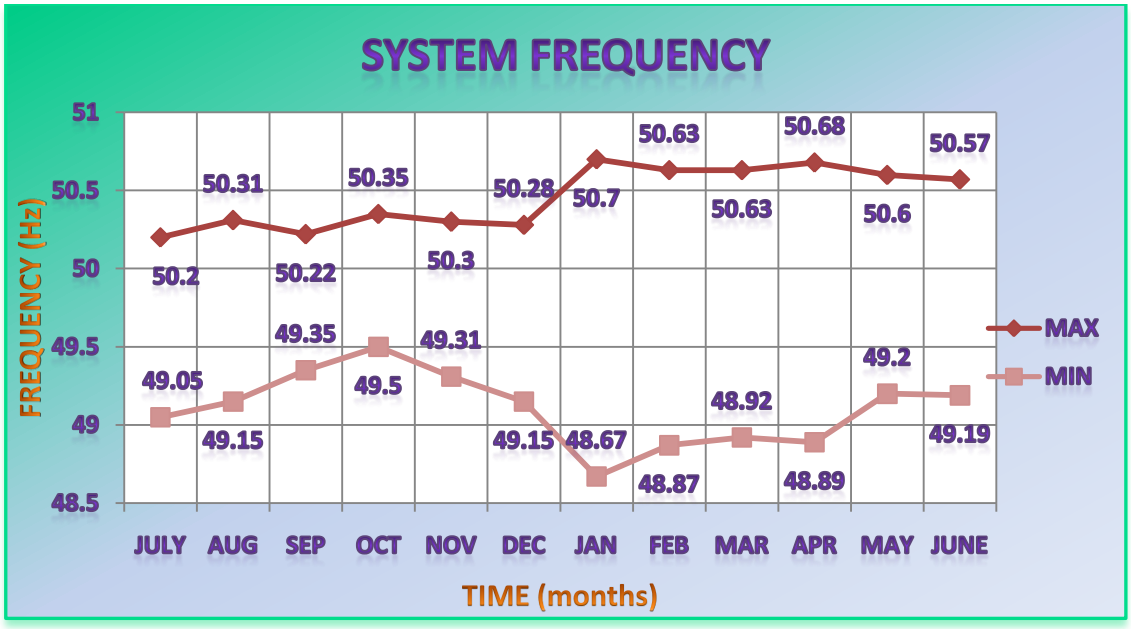

Figure 3.13: System Frequency [FY 2013-14]

3.4 System Frequency Comparison

3.4.1 System Frequency Maxima

Month	Highest Frequency Recorded/Measured (Hz)			
	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14
July	50.54	50.56	50.48	50.20
Aug	50.53	50.48	50.52	50.31
Sep	50.56	50.44	50.56	50.22
Oct	50.43	50.44	50.45	50.35
Nov	50.44	50.56	50.40	50.30
Dec	50.39	50.48	50.40	50.28
Jan	50.40	50.44	50.21	50.70
Feb	50.40	50.36	50.10	50.63
Mar	50.48	50.48	50.34	50.63
Apr	50.44	50.40	50.30	50.68
May	50.50	50.44	50.26	50.60
June	50.48	50.48	50.23	50.57

Table 3.17: System Frequency Maxima

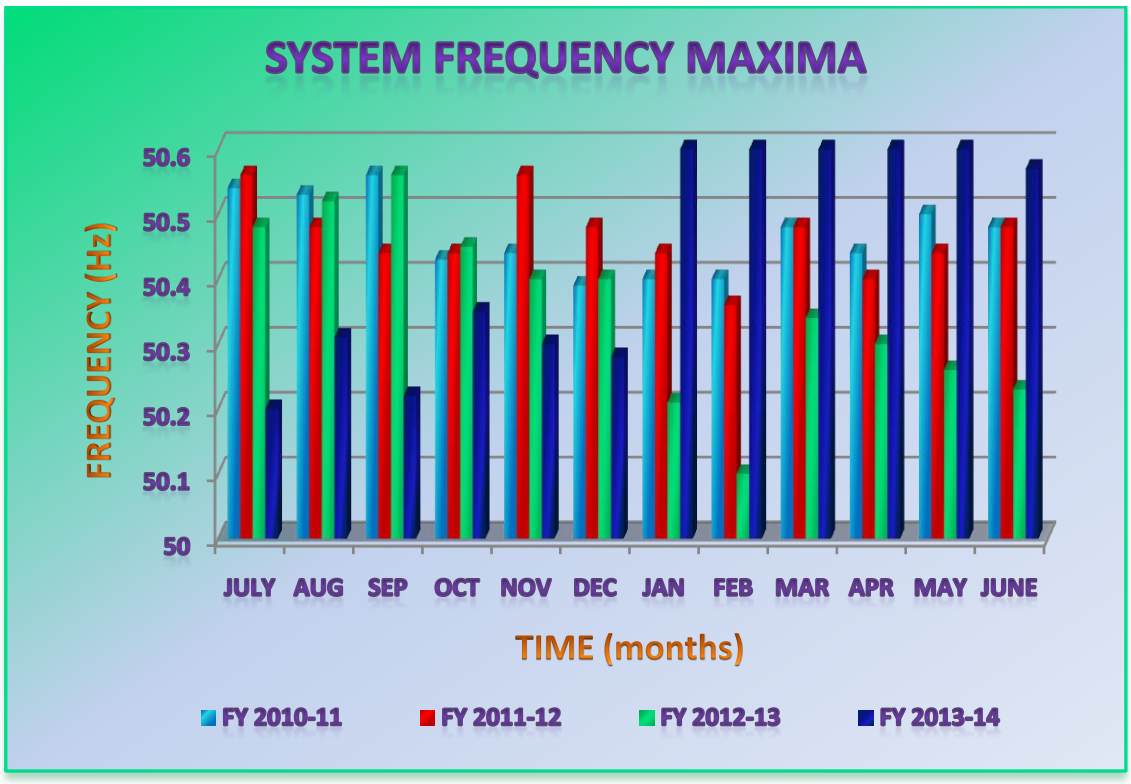

Figure 3.14: System Frequency Maxima

3.4.2 System Frequency Minima

Month	Lowest Frequency Recorded/Measured (Hz)			
	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14
July	48.99	48.72	48.76	49.05
Aug	48.84	48.72	48.8	49.15
Sep	48.91	48.72	48.72	49.35
Oct	48.81	48.8	48.80	49.50
Nov	49.02	48.92	48.72	49.31
Dec	48.8	48.76	48.72	49.15
Jan	48.8	48.72	49.10	48.67
Feb	48.78	48.8	48.66	48.87
Mar	48.81	48.76	49.40	48.92
Apr	48.75	48.76	49.32	48.89
May	48.62	48.76	49.48	49.20
June	48.68	48.76	49.20	49.19

Table 3.18: System Frequency Minima

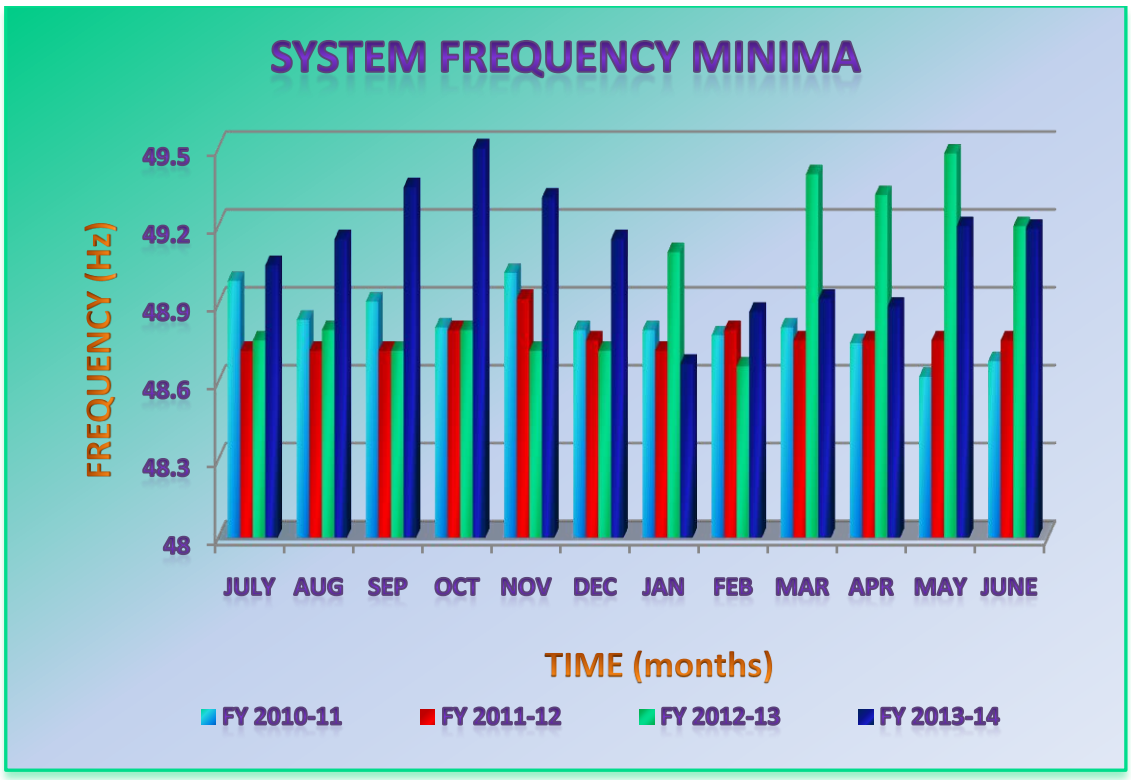

Figure 3.15: System Frequency Minima

K-Electric

4 K-ELECTRIC (KE)

4.1 Brief about KE

K-Electric formerly known as Karachi Electric Supply Company was established on September 13, 1913 under the Indian Companies Act of 1882 as the Karachi Electric Supply Corporation – KESC. The entity was nationalized in 1952 and re-privatized on November 29, 2005.

4.2 Licence

KE was granted transmission licence No. TL/02/2010 on 11th June 2010 by National Electric Power Regulatory Authority (NEPRA) to engage in the exclusive transmission business for a term of twenty (20) years, pursuant to section 17 of the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997.

4.3 Transmission Network

K-Electric's transmission system comprises a total of 1,249 km of 220 kV, 132 kV and 66 kV transmission lines with 62 grid stations, 14 Auto Transformers and 128 power transformers. K-Electric grid is interconnected with the NTDC grid system through two double circuit 220 kV transmission lines.

K-Electric's Data Analysis

5 Analysis of KE's Annual Performance Reports (APRs)

The reports submitted by KE as per requirement of Performance Standards (Transmission) Rules (PSTR) 2005 for the FY 2010-11, FY 2011-12, FY 2012-13 and FY 2013-14 have been evaluated and the detail is as under:

5.1 System Reliability

5.1.1 System Duration of Interruption

5.1.1.1 Analysis of Form-1 as per PSTR-2005

S.No.	Parameters of Form-1	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14
1	Total outages hours recorded at all interconnection points (excluding 132 kV line tripping). **1**	21	13	19	24.31
2	Total number of interconnection points **2**	7	7	7	7
3	System duration of interruption (Hrs) **(3 = 1/2)**	3	1.86	2.71	3.47

Table 5.1: Yearly System Duration of Interruption

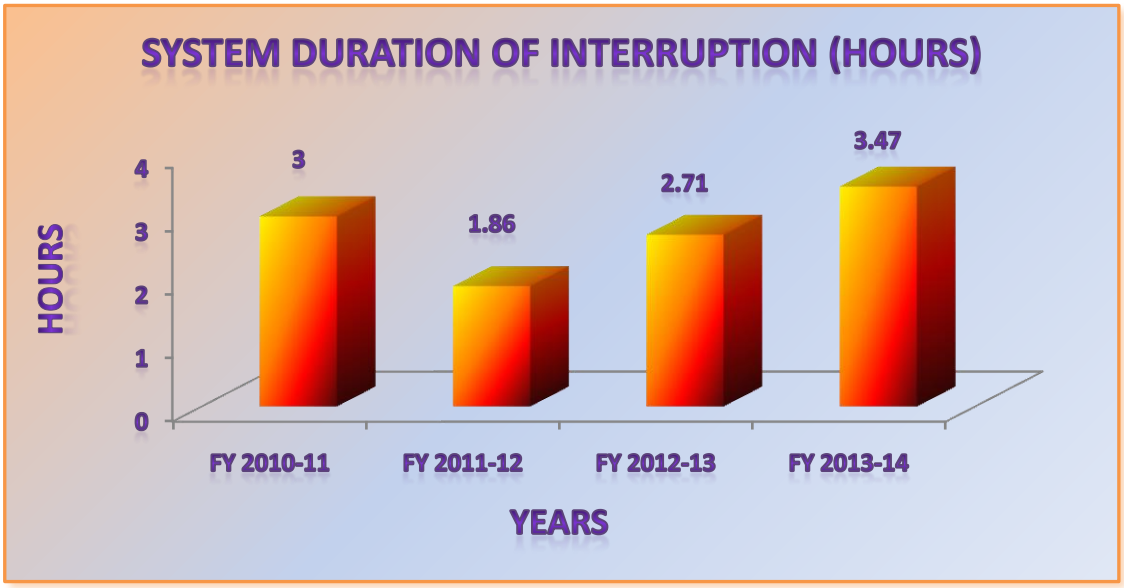

Figure 5.1: Yearly System Duration of Interruption

Observations

- System Duration of Interruption increased by 28% for the FY 2013-14 as compared to preceding year.
- Similarly an increase of 28% in total outages hours was noted for the FY 2013-14 as compared to FY 2012-13.

5.1.2 System Frequency of Interruption

5.1.2.1 Analysis of Form-2 as per PSTR-2005

S.No.	Parameters of Form-2	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14
1	Total number of outages recorded at all 132 kV circuits (excluding 132 kV line tripping). **1**	12	28	9	12
2	Total number of 132 kV circuits **2**	31	31	31	31
3	System frequency of interruption (Nos.) **(3 = 1/2)**	0.39	0.9	0.29	0.39

Table 5.2: Yearly System Frequency of Interruption

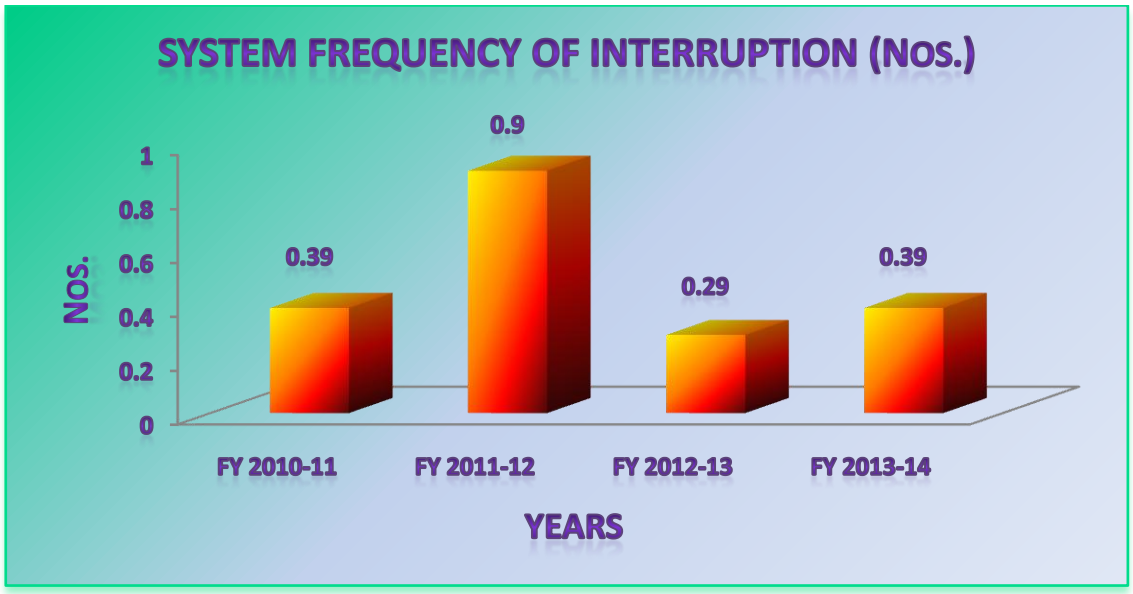

Figure 5.2: Yearly System Frequency of Interruption

Observations

- System Frequency of Interruption increased for the FY 2013-14 as compared to preceding year.
- System Frequency of Interruption for the FY 2013-14 is a mirror image of Interruptions for the FY 2010-11 indicating that the data is not based on reality.
- A sudden rise of about three times was noted for the FY 2011-12 as compared to FY 2010-11.

5.2 System Security

5.2.1 Energy Not Served

5.2.1.1 Analysis of Form-3 as per PSTR-2005

S.No.	Name of Circuit	Energy Not Served (MWh)			
		FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14
1	KDA – Federal B	0	218	0	172
2	KDA – Maymar	0	227	0	178
3	KDA – Gulshan	0	131	0	103
4	KDA – Johar	0	113	0	89
5	KDA – Memon Goth	0	183	0	144
6	Pipri – RECP	0	52	35	0
7	Pipri – BOC	0	39	26	0
8	Pipri – Port Qasim	0	96	64	0
9	Pipri – KEPZ	0	78	52	0
10	Pipri – Landhi	0	74	49	0
11	Pipri – Korangi Town	0	65	44	0
12	Pipri – Steel 1	0	15	10	0
13	Pipri – Steel 2	0	15	10	0
14	Korangi West – Defence	8	182	361	144
15	Korangi West – PRL	0	48	95	38
16	Korangi West – Gizri / Baloch	17	334	664	264
17	Korangi West – Korangi East	0	373	740	295
18	Korangi West – DHA 1	0	19	38	15
19	Queens Road – Elander Road 1	16	96	190	110
20	Queens Road – Elander Road 2	16	96	190	110
21	Queens Road – Gizri	145	497	987	574
22	Queens Road – Clifton	41	707	1,405	817
23	Queens Road – Old Town	97	516	1,025	597
24	Mauripur – Haroonabad 1	468	704	49	631
25	Mauripur – Haroonabad 2	468	815	49	631
26	Baldia – Hub Chowki	7	51	30	56
27	Baldia – SGT 1	16	204	120	222
28	Baldia SGT – SITE	16	204	120	222
29	Baldia – Orangi	52	663	389	723
30	Baldia – Valika	43	578	339	630
31	ICI – PTA	0	-	-	-
32	**TOTAL**	**1,410**	**7,393**	**7,081**	**6,765**

Table 5.3: Year Wise Overall System Energy Not Served

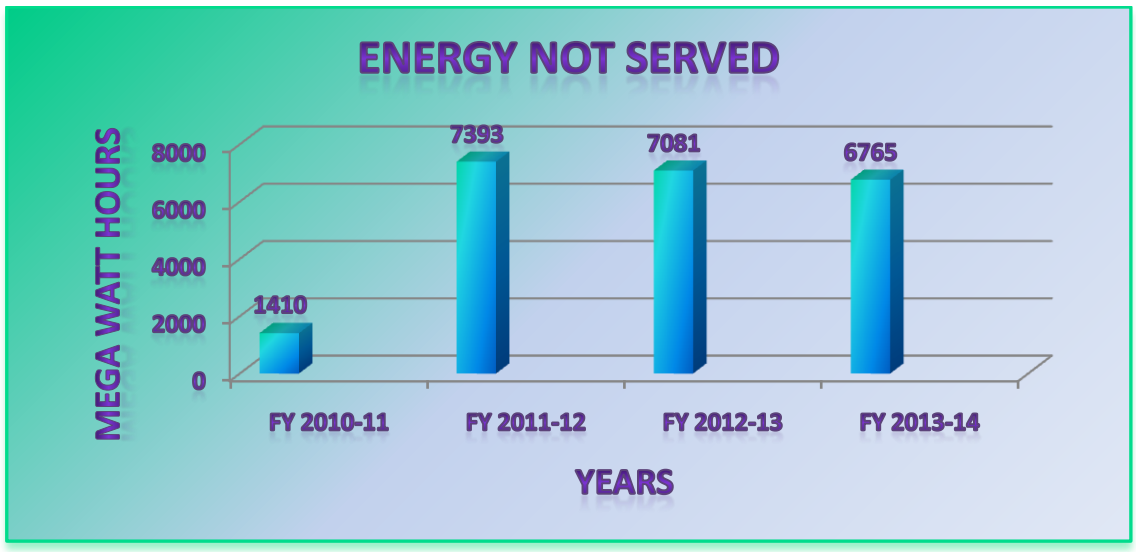

Figure 5.3: Yearly Energy Not Served

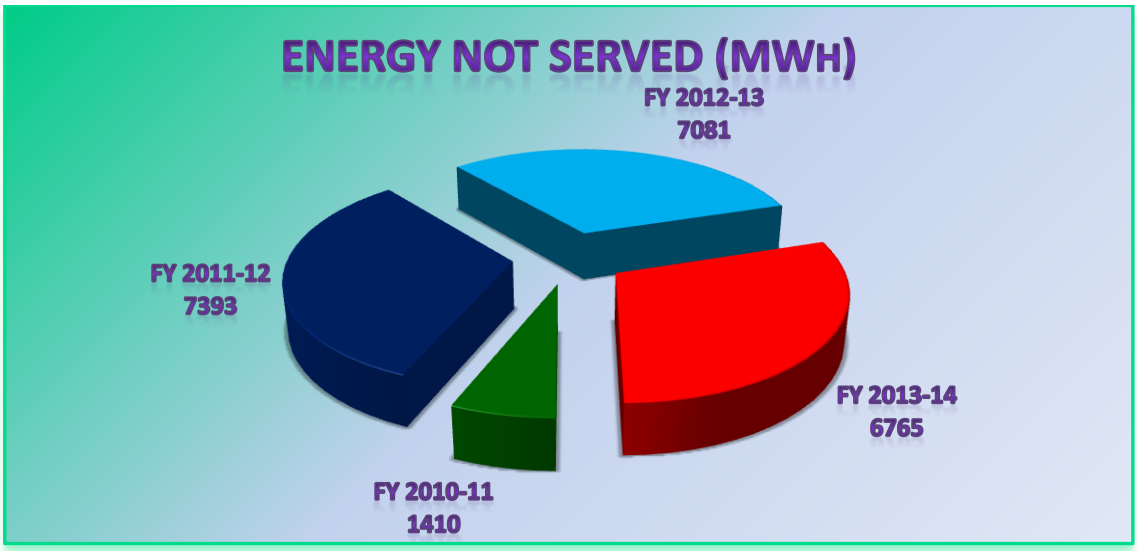

Figure 5.4: Yearly Energy Not Served

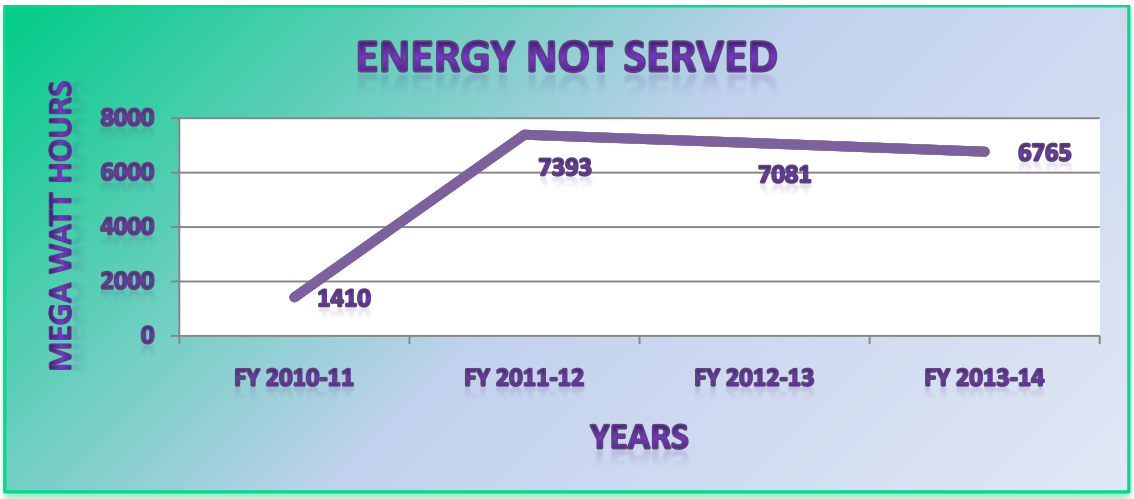

Figure 5.5: Yearly Energy Not Served [Trend Line]

5.3 Quality of Supply

5.3.1 SYSTEM VOLTAGE

5.3.1.1 Analysis of Form-4 as per PSTR-2005

S. No.	Voltage Class	Name of Circuit	Total Number of Violations			
			FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14
1	132 kV	Surjani / Maymar	2	1	1	2
2		Surjani / Valika	1	1	2	2
3		SITE / SGT 1	1	-	-	-
4		SITE / SGT 2	2	-	-	-
5		KDA / Federal B	1	1	2	2
6		Valika / N. Karachi	1	-	-	-
7		Gulshan / Civic	1	-	1	2
8		West wharf / Lyari	-	1	-	-
9		Qayyumabad /K.East	-	1	1	2
10		Memon Goth / Malir	-	2	2	2
11		Malir / CAA	-	2	2	2
12		Gulshan / Hospital	-	2	1	2
13		Gharo / RECP	-	1	1	1
14		BOC / Dhabeji	-	-	1	1
15		Dhabeji /Gharo	-	-	1	1
16		KDA / Memon Goth	-	-	1	1
17		KDA / Johar	-	-	2	2
18		Johar / Hospital	-	-	2	2
19		KDA / Gulshan	-	-	2	2
20		KDA / Maymar	-	-	2	2
21		Federal B / Valika	-	-	1	2
22		Haroonabad/Liaquatabad	-	-	-	1
23		Valika / Nazimabad	-	-	1	1
24		Gulshan / Jalil Road	-	-	2	2
25		Gulshan / Azizabad	-	-	2	2
26		Mauripur / Haroonabad	-	-	2	2
27		Haroonabad / Nazimabad	-	-	2	1
28		Korangi West / Defence	-	-	1	1

29	132 kV	Pipri West / Port Qasim	-	-	-	1
30		Pipri West / KEPZ	-	-	-	1
31		KEPZ / Landhi	-	-	-	1
32		Gul Ahmed /Airport 1&2	-	-	-	1
33		KTPS / PRL	-	-	1	1
34		K.East / K.South	-	-	1	1
35		Valika/ North Nazimabad	-	-	-	1
36		Orangi / Valika	-	-	-	1
37		Port Qasim / Landhi	-	-	-	1
38		Liaquatabad / Azizabad	-	-	2	2
38	220 kV	Baldia / Mauripur 2	1	Nil	Nil	Nil
39	500 kV	NA	NA	NA	NA	NA
40	**TOTAL**		**10**	**12**	**38**	**51**

Table 5.4: Total Number of Violations

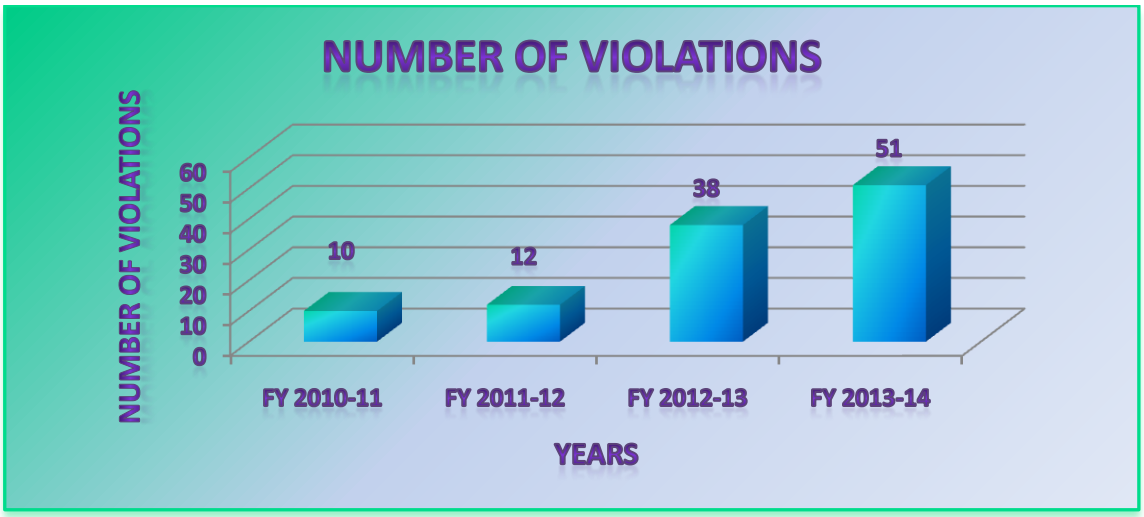

Figure 5.6: Total Number of Violations

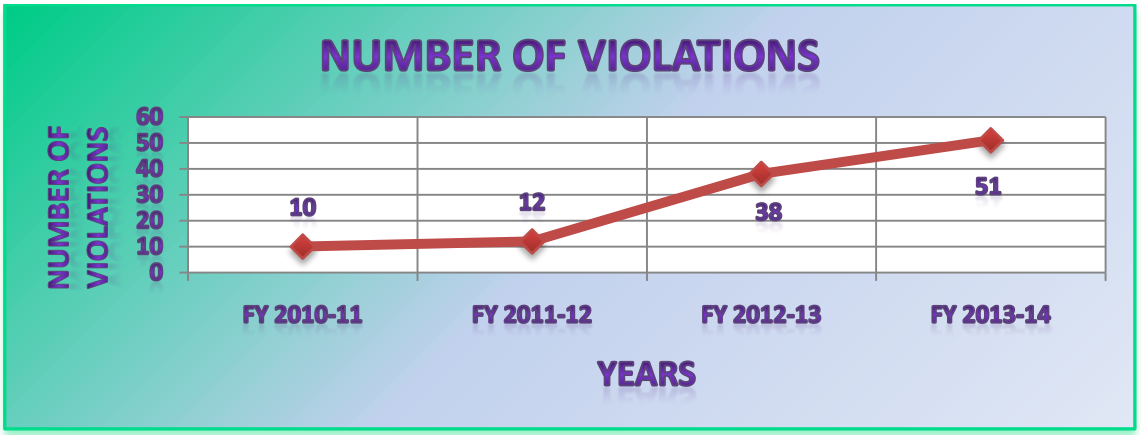

Figure 5.7: Total Number of Violations [Trend Line]

5.3.2 SYSTEM FREQUENCY

5.3.2.1 Analysis of Form-5 as per PSTR-2005 FY 2010-11

Month	Highest/Lowest Frequency Recorded/Measured (Hz)		%age Variation (%)		Remarks
	Max	Min	Max	Min	
July	50.92	48.80	1.84	-2.40	• K-Electric has violated a number of times the upper and lower frequency limit. As long as frequency variations are small the interconnected system remains synchronized. The system will continue to operate in a stable manner unless the variations continue to gain in magnitude and oscillate at low frequencies. These oscillations can lead to more threatening voltage and frequency problems that may lead to instability and potentially to cascading outages.
Aug	50.97	48.80	1.94	-2.40	
Sep	50.61	48.80	1.22	-2.40	
Oct	50.81	48.80	1.62	-2.40	
Nov	50.52	48.80	1.04	-2.40	
Dec	50.73	48.80	1.46	-2.40	
Jan	50.54	48.79	1.08	-2.42	
Feb	50.58	48.80	1.16	-2.40	
Mar	50.77	48.88	1.54	-2.24	
Apr	50.47	48.40	0.94	-3.20	
May	50.65	46.64	1.30	-6.72	
June	50.73	46.38	1.46	-7.24	

Table 5.5: Month Wise Frequency Maxima and Minima [FY 2010-11]

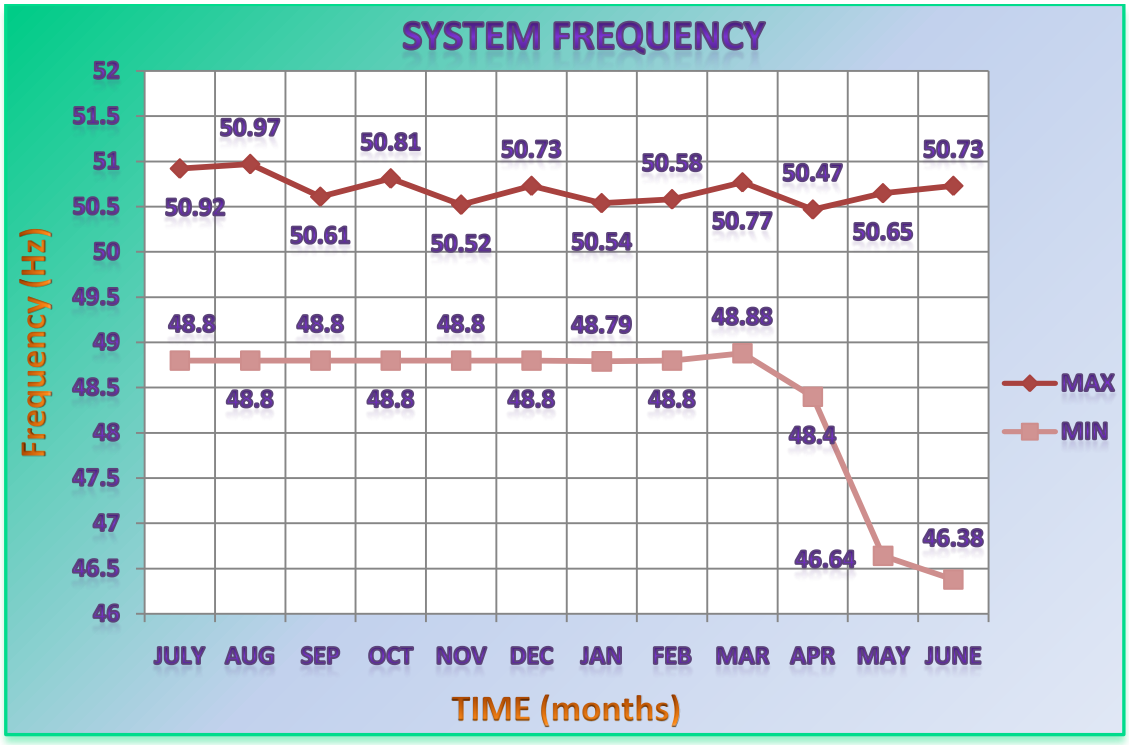

Figure 5.8: System Frequency [FY 2010-11]

5.3.2.2 Analysis of Form-5 as per PSTR-2005 FY 2011-12

Month	Highest/Lowest Frequency Recorded/Measured (Hz)		%age Variation (%)		Remarks
	Max	Min	Max	Min	
July	50.61	48.51	1.22	-2.98	• Transformers are sensitive to frequency and may be overloaded if the frequency drifts substantially from the nominal value. • At lower frequencies the magnetizing currents to transformers and motors increases as their inductive impedance fall ($Z_L = 2 \bullet \pi \bullet f \bullet \ell$). These results in overheating of the machines, especially since the speeds of any motor shaft driven cooling fans are reducing so that the equipment has more heating and less cooling thereby, reducing the life span of equipment and increasing maintenance expenses.
Aug	50.96	48.60	1.92	-2.80	
Sep	50.90	48.60	1.80	-2.80	
Oct	50.46	48.51	0.92	-2.98	
Nov	50.55	48.67	1.10	-2.66	
Dec	50.57	48.60	1.14	-2.80	
Jan	50.61	48.60	1.22	-2.80	
Feb	50.56	48.52	1.12	-2.96	
Mar	50.90	48.60	1.80	-2.80	
Apr	50.28	48.60	0.56	-2.80	
May	51.25	48.54	2.50	-2.92	
June	50.78	48.59	1.56	-2.82	

Table 5.6: Month Wise Frequency Maxima and Minima [FY 2011-12]

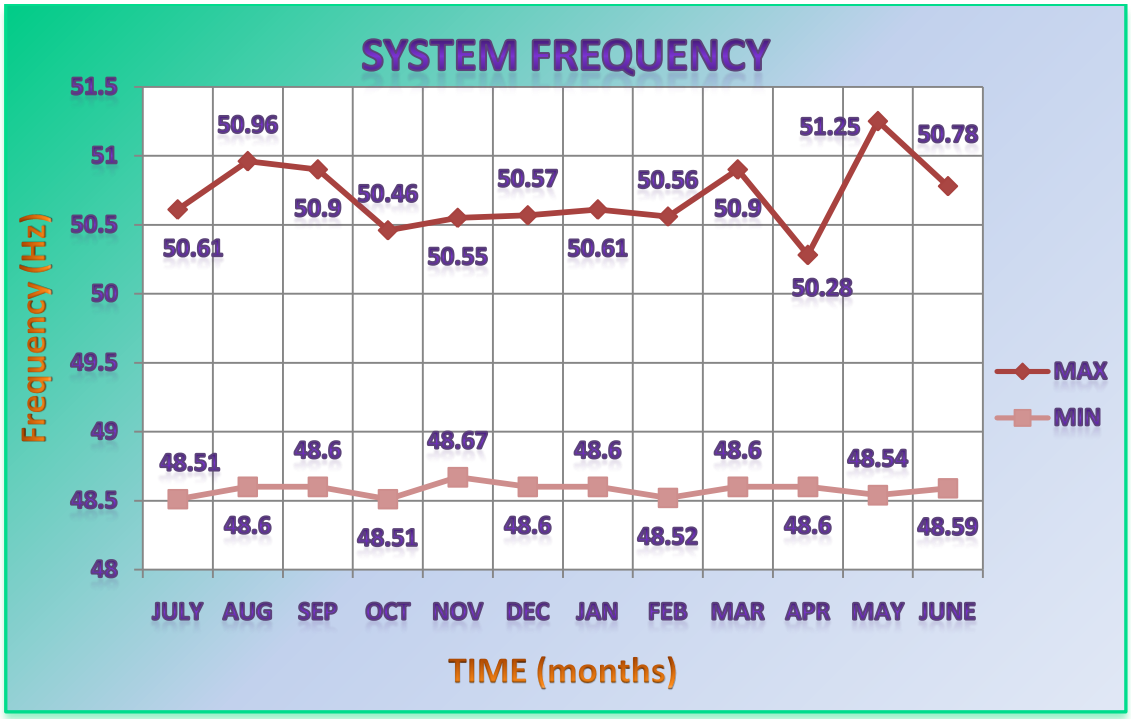

Figure 5.9: System Frequency [FY 2011-12]

5.3.2.3 Analysis of Form-5 as per PSTR-2005 FY 2012-13

Month	Highest/Lowest Frequency Recorded/Measured (Hz)		%age Variation (%)		Remarks
	Max	Min	Max	Min	
July	50.60	48.56	1.20	-2.88	• K-Electric has violated the upper & lower frequency limit repeatedly which may subject the system to undesirable effects like degrading load performance, reducing the speed of generators connected to power grid and ultimately leading to instability on the power system.
Aug	51.05	48.60	2.10	-2.80	
Sep	50.65	48.59	1.30	-2.82	
Oct	50.65	48.60	1.30	-2.80	
Nov	50.57	48.60	1.14	-2.80	
Dec	50.76	48.59	1.52	-2.82	
Jan	50.80	48.50	1.60	-3.00	
Feb	50.59	47.12	1.18	-5.76	
Mar	50.72	48.80	1.44	-2.40	
Apr	51.08	48.74	2.16	-2.52	
May	51.49	48.63	2.98	-2.74	
June	51.55	48.62	3.10	-2.76	

Table 5.7: Month Wise Frequency Maxima and Minima [FY 2012-13]

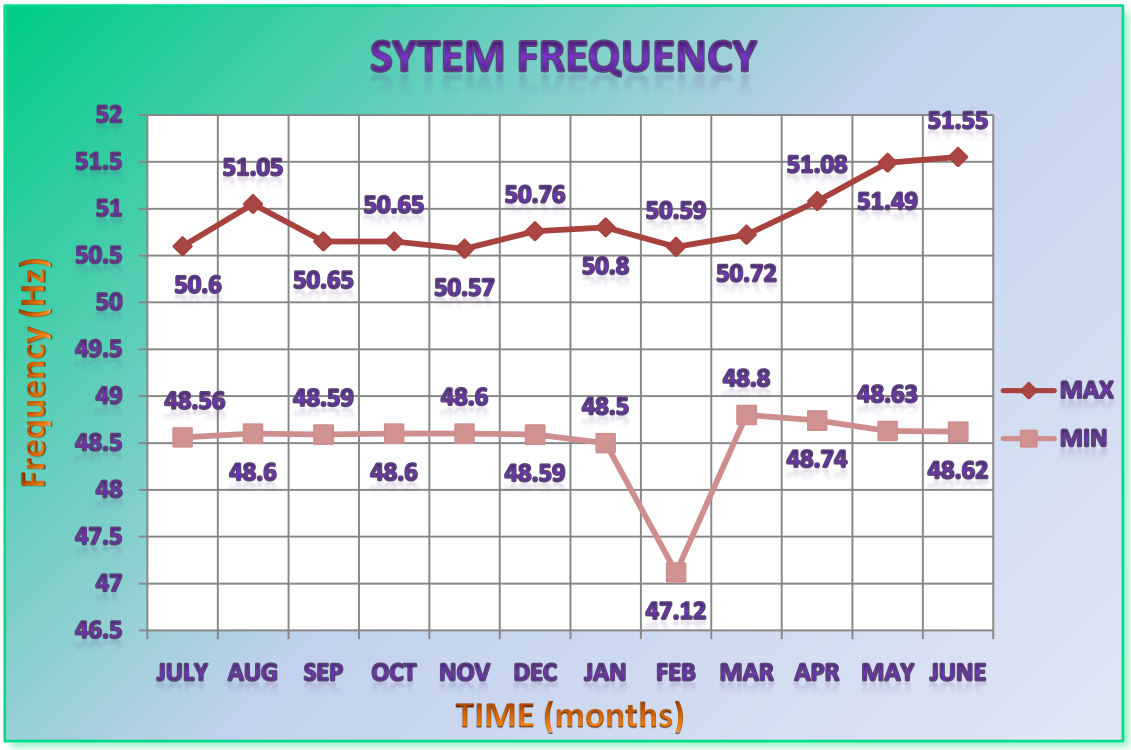

Figure 5.10: System Frequency [FY 2012-13]

5.3.2.4 Analysis of Form-5 as per PSTR-2005 FY 2013-14

Month	Highest/Lowest Frequency Recorded/Measured (Hz)		%age Variation (%)		Remarks
	Max	Min	Max	Min	
July	51.15	48.61	2.30	-2.78	• K-Electric has violated the upper and lower frequency limits a number of times which can adversely affect the system performance and may lead to instability and cascading outages which is undesirable keeping in view the current power crisis of the country.
Aug	51.70	48.68	3.40	-2.64	
Sep	51.70	48.73	3.40	-2.54	
Oct	51.69	48.80	3.38	-2.40	
Nov	51.93	48.74	3.86	-2.52	
Dec	51.68	48.76	3.36	-2.48	
Jan	51.15	48.61	2.30	-2.78	
Feb	51.10	48.80	2.20	-2.40	
Mar	51.91	48.59	3.82	-2.82	
Apr	51.28	48.63	2.56	-2.74	
May	51.06	48.66	2.12	-2.68	
June	51.72	48.80	3.44	-2.40	

Table 5.8: Month Wise Frequency Maxima and Minima [FY 2013-14]

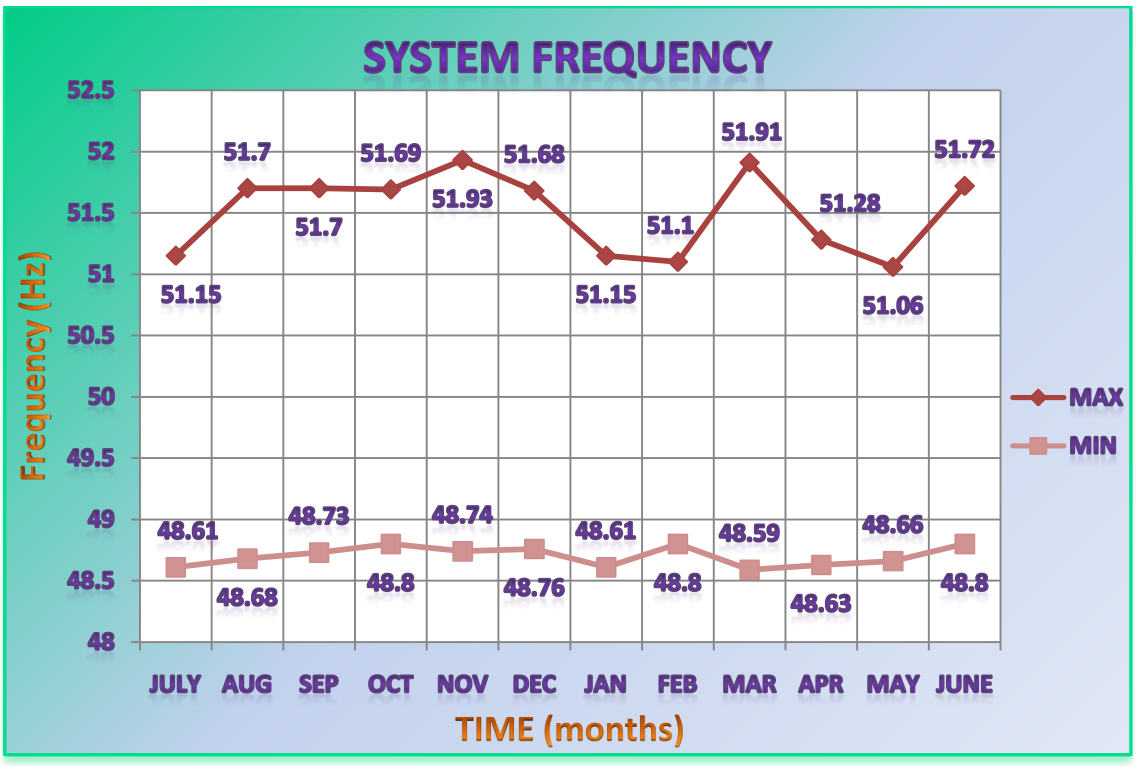

Figure 5.11: System Frequency [FY 2013-14]

5.4 System Frequency Comparison

5.4.1 System Frequency Maxima

Month	Highest Frequency Recorded/Measured (Hz)			
	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14
July	50.92	50.61	50.60	51.15
Aug	50.97	50.96	51.05	51.70
Sep	50.61	50.90	51.65	51.70
Oct	50.81	50.46	50.65	51.69
Nov	50.52	50.55	50.57	51.93
Dec	50.73	50.57	50.76	51.68
Jan	50.54	50.61	50.80	51.15
Feb	50.58	50.56	50.59	51.10
Mar	50.77	50.90	50.72	51.91
Apr	50.47	50.28	51.08	51.28
May	50.65	51.25	51.49	51.06
June	50.73	50.78	51.55	51.72

Table 5.9: System Frequency Maxima

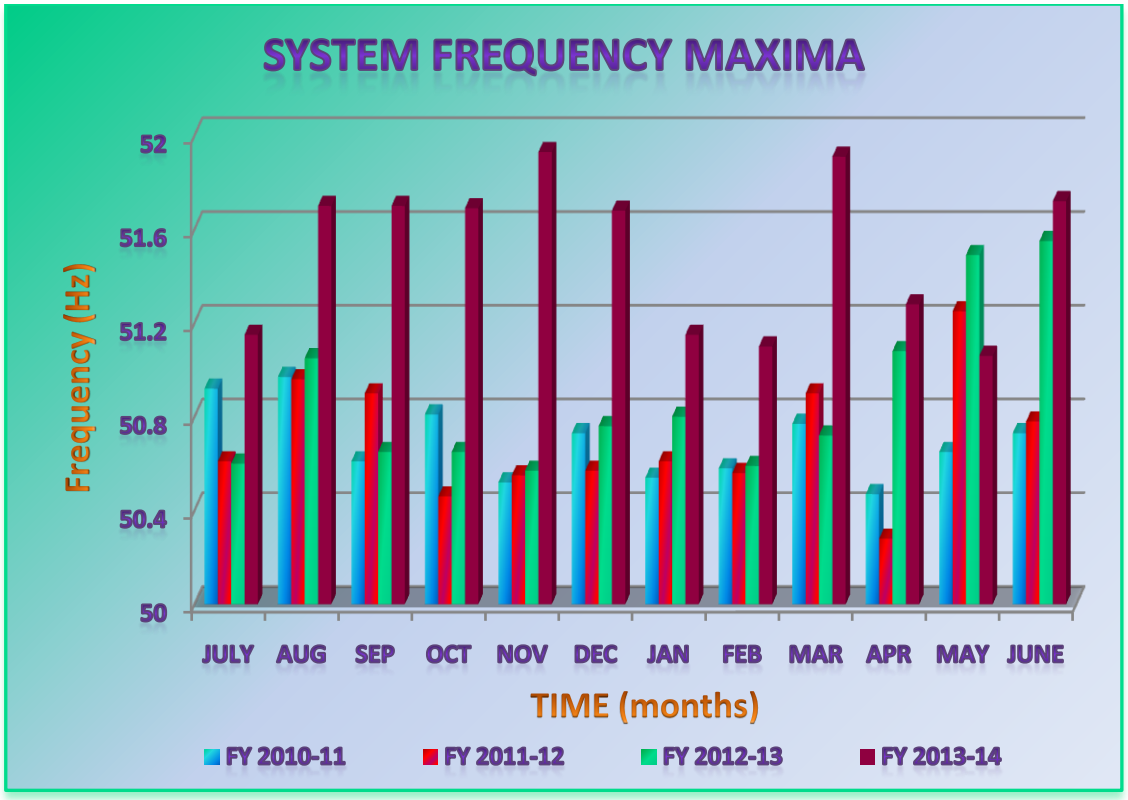

Figure 5.12: System Frequency Maxima

5.4.2 System Frequency Minima

Month	Lowest Frequency Recorded/Measured (Hz)			
	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14
July	48.80	48.51	48.56	48.61
Aug	48.80	48.60	48.60	48.68
Sep	48.80	48.60	48.59	48.73
Oct	48.80	48.51	48.60	48.80
Nov	48.80	48.67	48.60	48.74
Dec	48.80	48.60	48.59	48.76
Jan	48.79	48.60	48.50	48.61
Feb	48.80	48.52	47.12	48.80
Mar	48.88	48.60	48.80	48.59
Apr	48.40	48.60	48.74	48.63
May	46.64	48.54	48.63	48.66
June	46.38	48.59	48.62	48.80

Table 5.10: System Frequency Minima

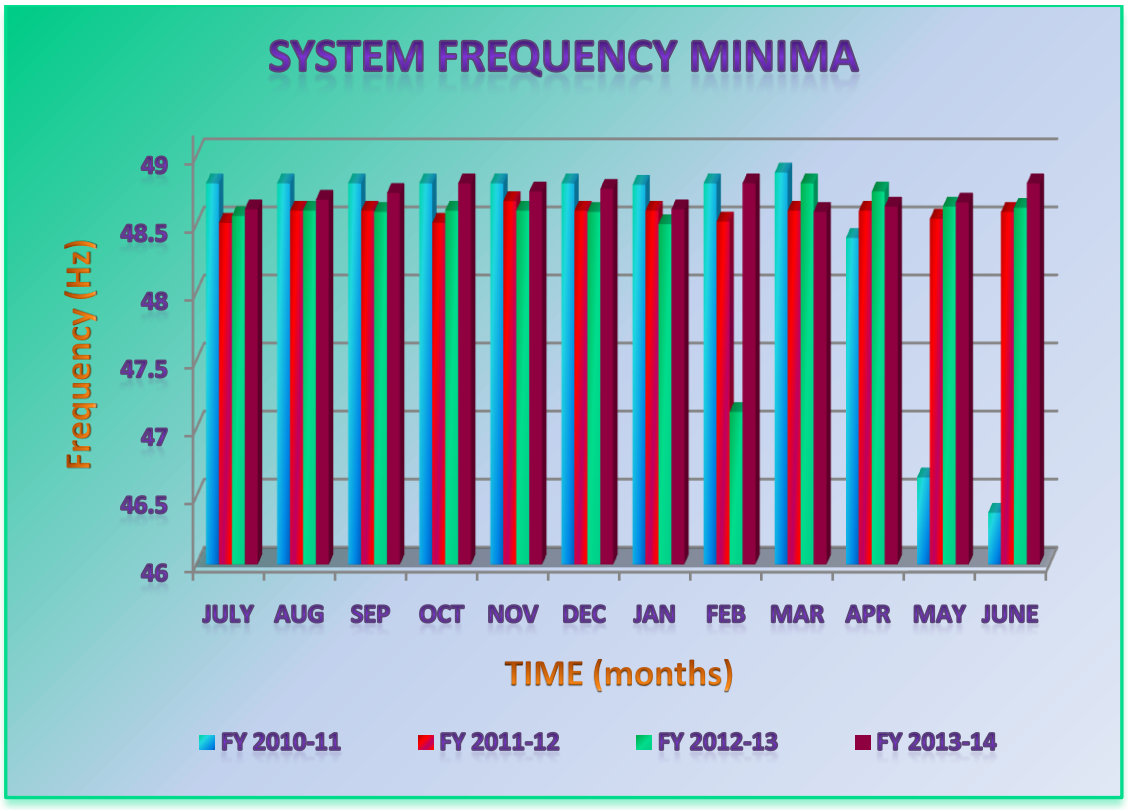

Figure 5.13: System Frequency Minima

Inter TRANSCOs Data Comparison

6 Inter TERANSCOs Data Comparison

6.1 System's Reliability

6.1.1 System's Duration of Interruption

Transmission Licensee	Total outages hours recorded at all interconnection points (excluding 132 kV line tripping). 1				Total number of interconnection points 2				System duration of interruption Hours (3 = 1/2)			
	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14
NTDC	47.66	387.63	8.37	0	193	196	184	197	**0.25**	**1.98**	**0.05**	**0**
KE	21	13	19	24.31	7	7	7	7	**3**	**1.86**	**2.71**	**3.47**

Table 6.1: System's Duration of Interruption

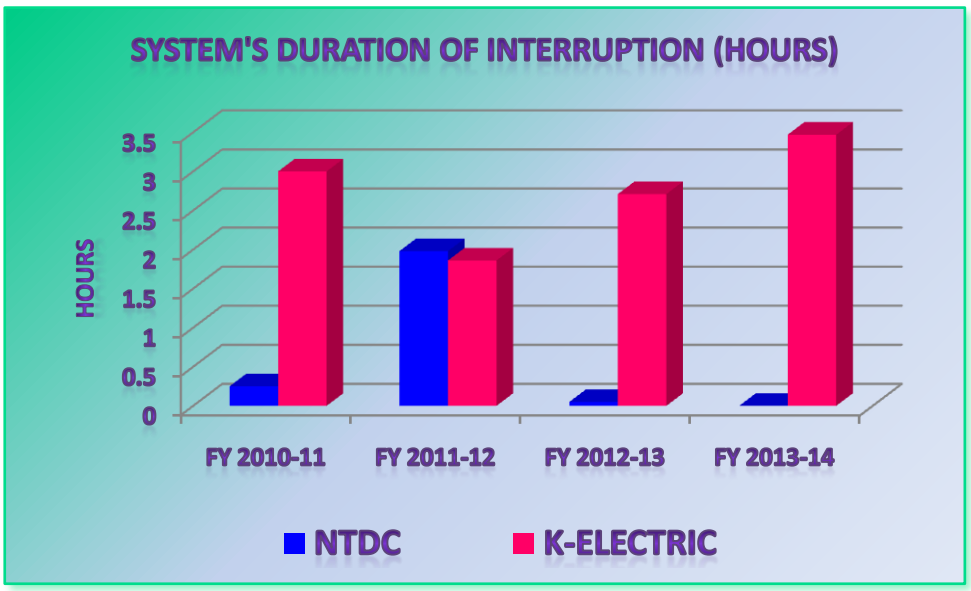

Figure 6.1: System's Duration of Interruption

6.1.2 System's Frequency of Interruption

Transmission Licensee	Total number of outages recorded at all 132 kV circuits (excluding 132 kV line tripping). 1				Total number of 132 kV circuits 2				System frequency of interruption Nos. (3 = 1/2)			
	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14
NTDC	5	17	3	0	251	254	258	264	**0.02**	**0.07**	**0.01**	**0**
KE	12	28	9	12	31	31	31	31	**0.39**	**0.9**	**0.29**	**0.39**

Table 6.2: System's Frequency of Interruption

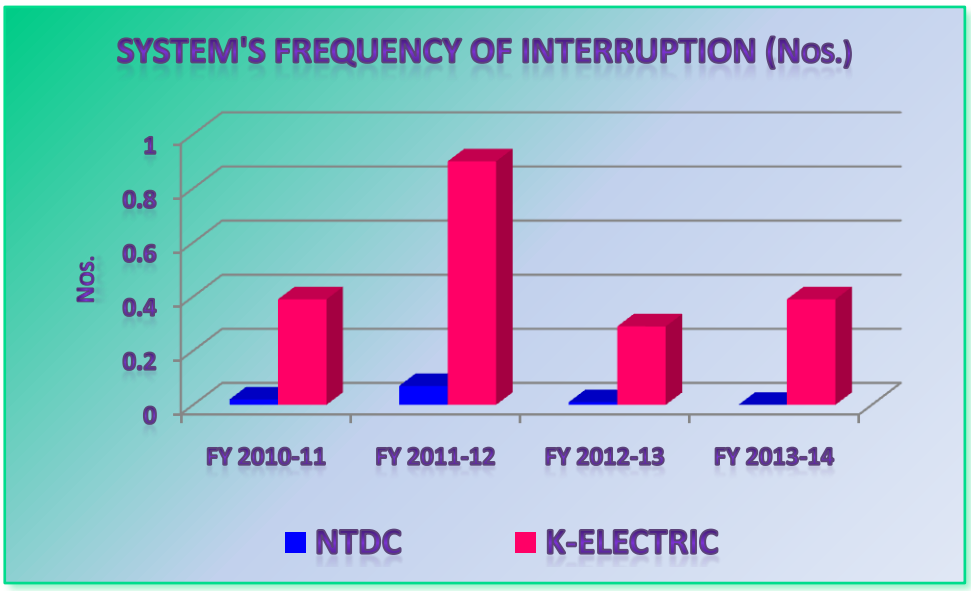

Figure 6.2: System's Frequency of Interruption

6.2 System's Security

6.2.1 Energy Not Served

Transmission Licensee	Energy Not Served (MWh)			
	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14
NTDC	2,023.03	435.68	50.7	0
K-Electric	1,410	7,393	7,081	6,765

Table 6.3: Energy Not Served

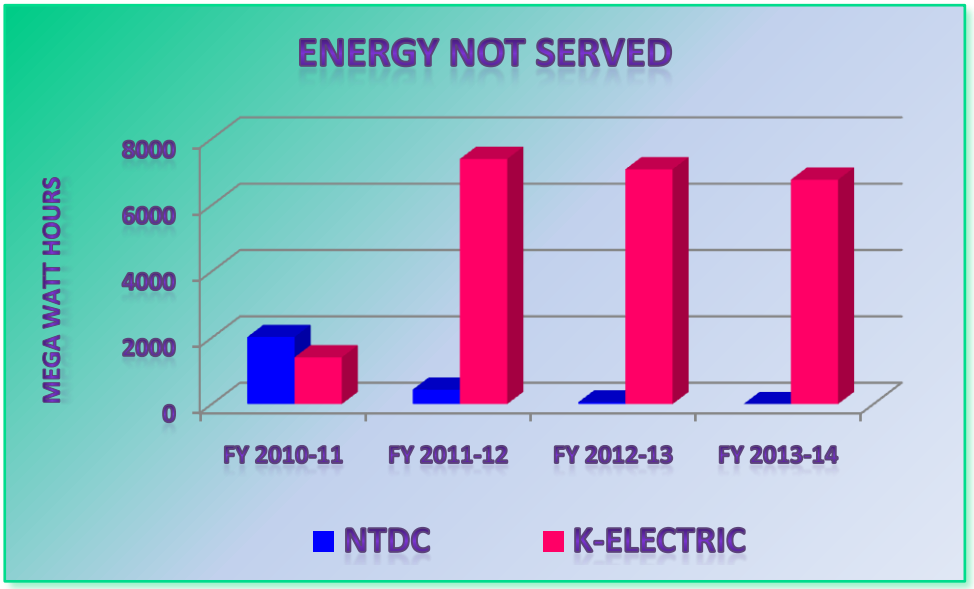

Figure 6.3: Energy Not Served

6.3 Quality of Supply

6.3.1 System's Voltage

Transmission Licensee	No. of Voltage Limits Violations			
	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14
NTDC	54447	80722	116409	126616
K-Electric	10	12	39	51

Table 6.4: No. of Voltage Limits Violations

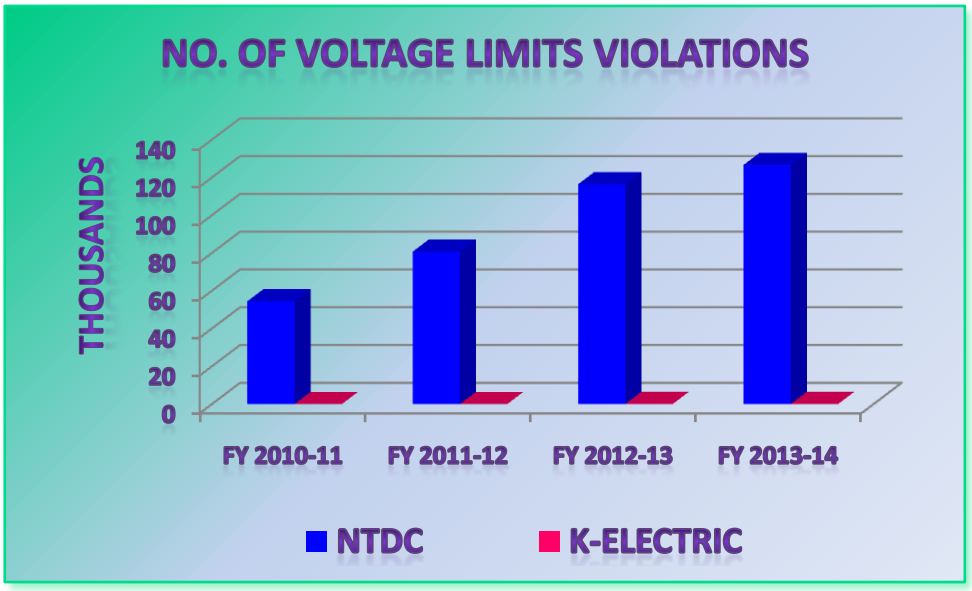

Figure 6.4: No. of Voltage Limits Violations

6.3.2 System's Frequency

6.3.2.1 Maximum Frequency with year wise comparison

Month	Highest Frequency Recorded/Measured (Hz)							
	NTDC				K-Electric			
	2010-11	2011-12	2012-13	2013-14	2010-11	2011-12	2012-13	2013-14
July	50.54	50.56	50.48	50.2	50.92	50.61	50.60	51.15
Aug	50.53	50.48	50.52	50.31	50.97	50.96	51.05	51.70
Sep	50.56	50.44	50.56	50.22	50.61	50.90	50.65	51.70
Oct	50.43	50.44	50.45	50.35	50.81	50.46	50.65	51.69
Nov	50.44	50.56	50.4	50.3	50.52	50.55	50.57	51.93
Dec	50.39	50.48	50.4	50.28	50.73	50.57	50.76	51.68
Jan	50.4	50.44	50.21	50.7	50.54	50.61	50.80	51.15
Feb	50.4	50.36	50.1	50.63	50.58	50.56	50.59	51.10
Mar	50.48	50.48	50.34	50.63	50.77	50.90	50.72	51.91
Apr	50.44	50.4	50.3	50.68	50.47	50.28	51.08	51.28
May	50.5	50.44	50.26	50.6	50.65	51.25	51.49	51.06
June	50.48	50.48	50.23	50.57	50.73	50.78	51.55	51.72

Table 6.5: System's Max Frequency Comparison

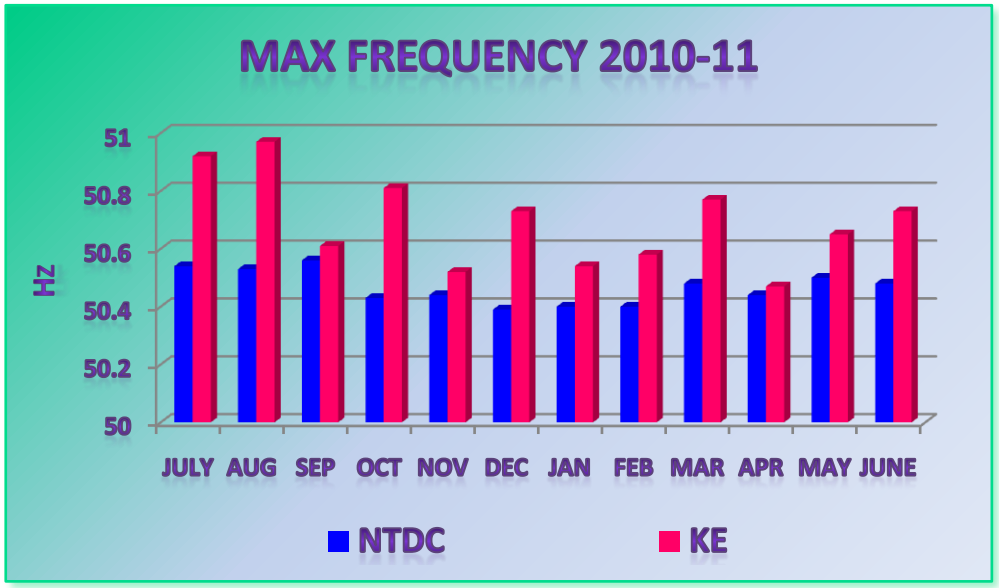

Figure 6.5: Max Frequency [2010-11]

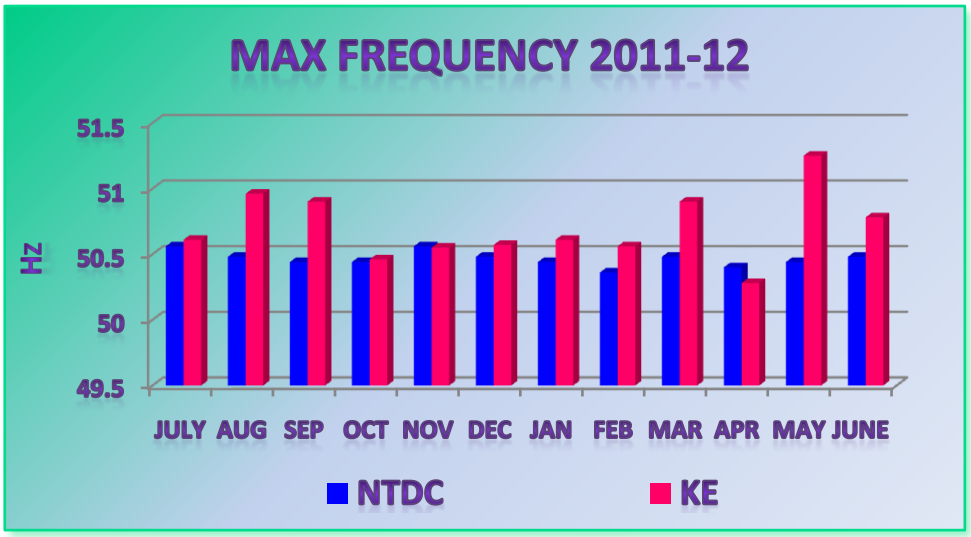

Figure 6.6: Max Frequency [2011-12]

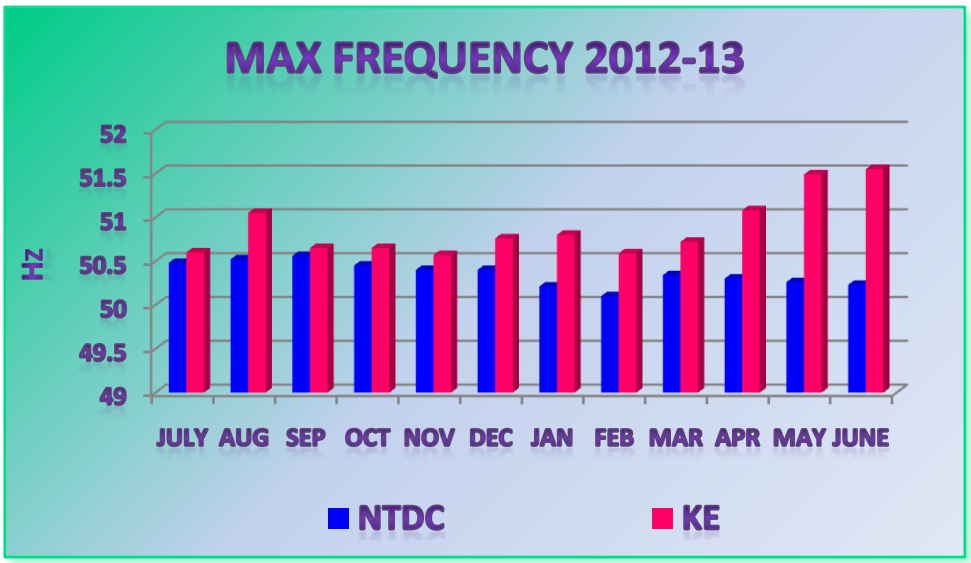

Figure 6.7: Max Frequency [2012-13]

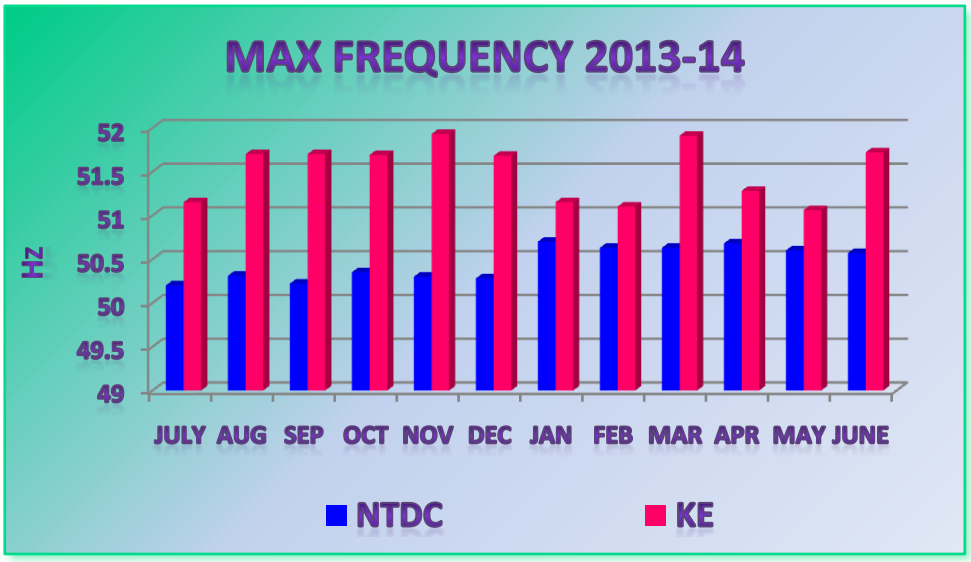

Figure 6.8: Max Frequency [2013-14]

6.3.2.2 Minimum Frequency with year wise comparison

Month	Lowest Frequency Recorded/Measured (Hz)							
	NTDC				K-Electric			
	2010-11	2011-12	2012-13	2013-14	2010-11	2011-12	2012-13	2013-14
July	48.99	48.72	48.76	49.05	48.80	48.51	48.56	48.61
Aug	48.84	48.72	48.80	49.15	48.80	48.60	48.60	48.68
Sep	48.91	48.72	48.72	49.35	48.80	48.60	48.59	48.73
Oct	48.81	48.80	48.80	49.50	48.80	48.51	48.60	48.80
Nov	49.02	48.92	48.72	49.31	48.80	48.67	48.60	48.74
Dec	48.80	48.76	48.72	49.15	48.80	48.60	48.59	48.76
Jan	48.80	48.72	49.10	48.67	48.79	48.60	48.50	48.61
Feb	48.78	48.80	48.66	48.87	48.80	48.52	47.12	48.80
Mar	48.81	48.76	49.40	48.92	48.88	48.60	48.80	48.59
Apr	48.75	48.76	49.32	48.89	48.40	48.60	48.74	48.63
May	48.62	48.76	49.48	49.20	46.64	48.54	48.63	48.66
June	48.68	48.76	49.20	49.19	46.38	48.59	48.62	48.80

Table 6.6: System's Min Frequency Comparison

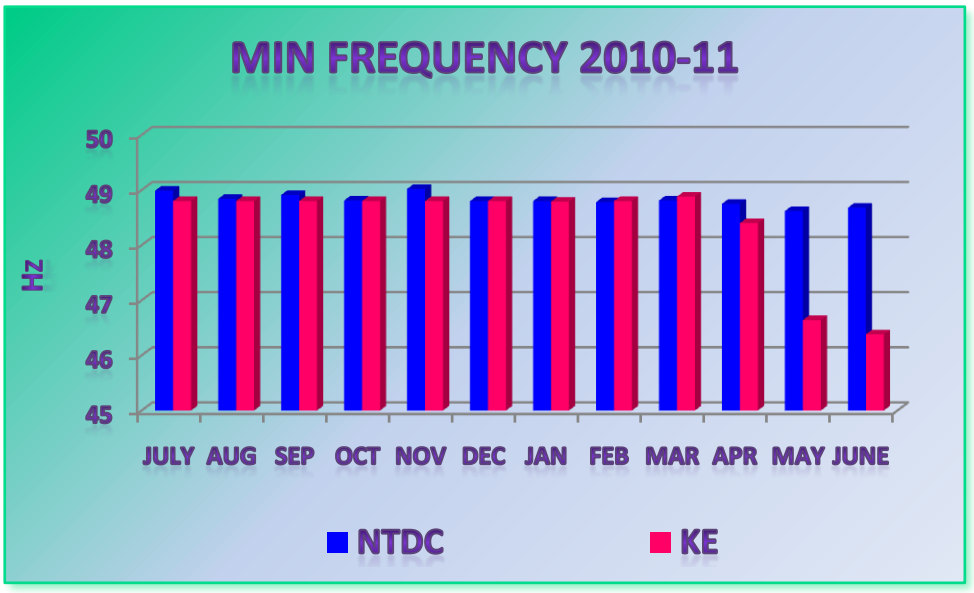

Figure 6.9: Min Frequency [2010-11]

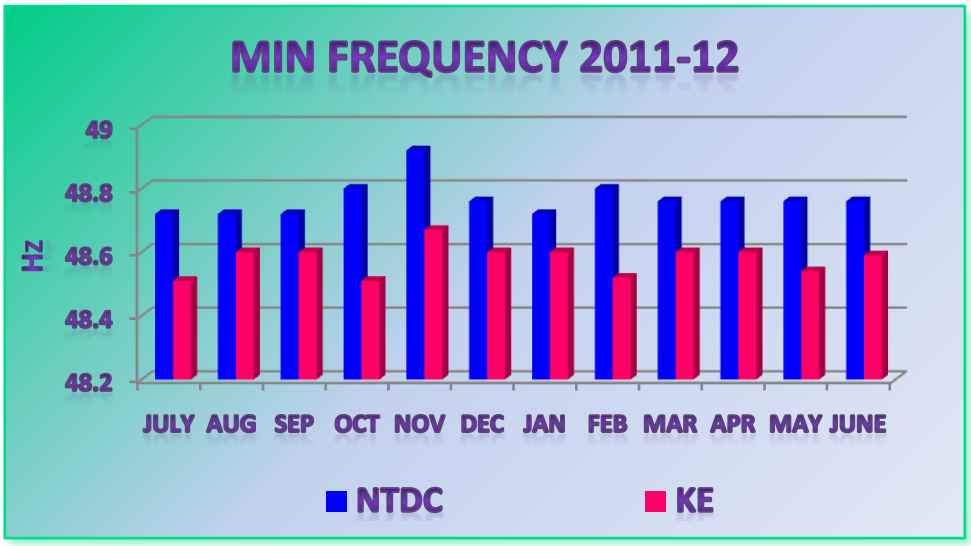

Figure 6.10: Min Frequency [2011-12]

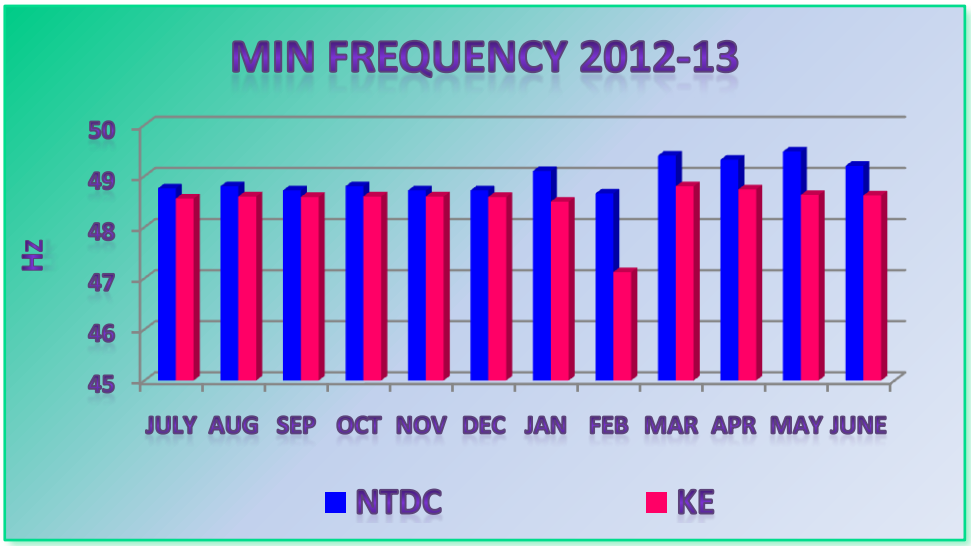

Figure 6.11: Min Frequency [2012-13]

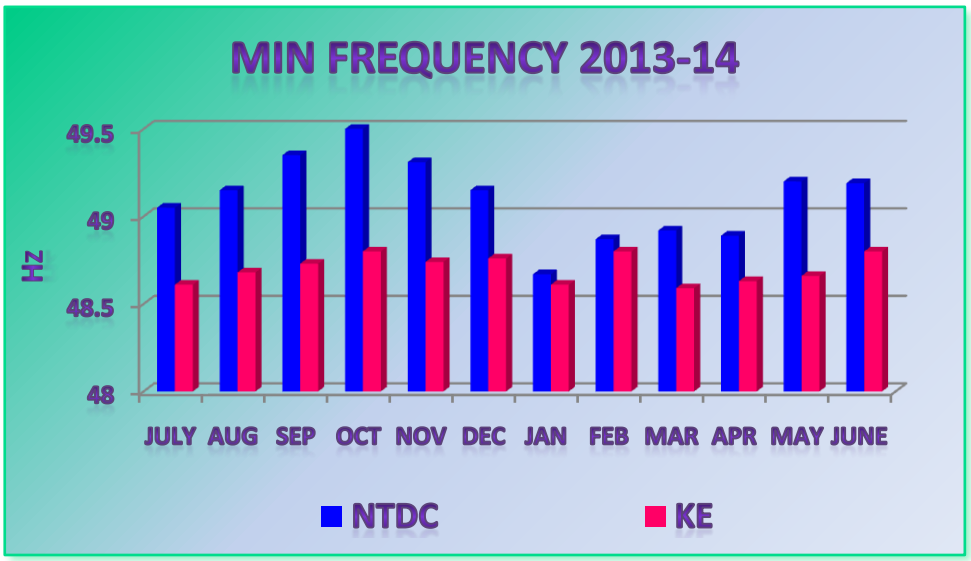

Figure 6.12: Min Frequency [2013-14]

Observations/Findings & Recommendation

7 Observations/Findings:

During review the following major observations were noted:

Violations against specified voltage limits in NTDC Transmission System

Islamabad Region:

i. For Islamabad Region, the voltage limits as specified in PSTR-2005 were violated and decreased by 16% for the FY 2013-14 as compared to preceding year, which indicates performance improvement by NTDC for this region.

ii. For Rawat 500 kV Grid Station, it was noted

iii. with concern that 220 kV Rawat-ISPR, 220 kV Rawat-Mangla, 220 kV Rawat-Bahria Town and 220 kV Rawat-University transmission lines have violated the voltage limits, 1794 times, under normal conditions for the FY 2013-14.

iv. For Sheikh Muhammadi 500 kV Grid Station at Peshawar, the 220 kV Barotha-Peshawar, 220 kV Peshawar-Daudkhel and 220 kV Peshawar-Shahibagh transmission lines, have violated the voltage limits, 1337, 1271 and 1105 times respectively under normal conditions for the FY 2012-13.

v. For 220 kV Bannu Grid Station, the 220 kV Daudkhel-Bannu transmission line has violated the voltage limits, for 1755 times, under normal conditions, whereas, 1626 times under contingency (N-1) conditions for the FY 2013-14.

vi. For 220 kV Daudkhel Grid Station, it has been noted that 220 kV Peshawar-Daudkhel, 220 kV Chashma-Daudkhel and 220 kV Bannu-Daudkhel transmission lines have violated the voltage limits, for 1535 times, under normal conditions for the FY 2013-14.

vii. For 220 kV Mardan Grid Station, all the transmission lines have violated the voltage limits, for 1600 times, under normal conditions for the FY 2013-14.

viii. For 220 kV Shahibagh Grid Station at Peshawar, it was observed that 220 kV Peshawar-Shahibagh transmission line has violated the voltage limits, for 1331 times, under normal conditions for the FY 2013-14.

Lahore Region:

ix. For Lahore Region, the limits of voltage as specified in PSTR-2005 were violated and increased by 7% for the FY 2013-14 as compared to preceding year, which clearly indicates that SOP of NTDC for the maintenance of Transmission Lines & Grid-Stations is not being implemented properly for this region.

x. For 220 kV Bund Road Grid Station Lahore, the voltage at Bus Bar No. 1 & 2 has violated the limits, for **4413** times, under normal conditions for the FY 2013-14.

xi. For 220 kV Kala Shah Kaku Grid Station, it has been noted that 220 kV KSK-Gatti, 220 kV KSK-Mangla, 220 kV KSK-Bund Road, 220 kV KSK-Ravi and 220 kV KSK-Sialkot transmission lines have violated the voltage limits, for **2019**, 1651, 1535, 1828, and 1817 times, respectively under normal conditions for the FY 2013-14.

xii. For 220 kV New Kot Lkhpat Grid Station, 220 kV NKLP-BDR, 220 kV NKLP-SKP, 220 kV NKLP-SNR and 220 kV NKLP-WTN transmission lines have violated the voltage limits, for **4157, 3082, 3825** & **3768** times, respectively under normal conditions and for **2409,** 343, **1044 & 1057** times, respectively under contingency (N-1) conditions for the FY 2013-14.

xiii. For 220 kV Grid Station Ravi Lahore, 220 kV Ravi-KSK I, 220 kV Ravi-KSK II, 220 kV Ravi-Atlas and 220 kV Ravi-SKP transmission lines have violated the voltage limits for **2553**, 1673, **3140** and **3314** times respectively under normal conditions for the FY 2013-14.

xiv. For 220 kV Sarfaraznagar Grid Station, 220 kV SNR-YSW and 220 kV SNR-NKLP transmission lines have violated the voltage limits, for 1097 and 1072 times, respectively under normal conditions for the FY 2013-14.

xv. For 220 kV Wapda Town Grid Station at Lahore, 220 kV WTN-NKLP and 220 kV WTN-SKP transmission lines have violated the voltage limits, for 1610 and 1601 times, respectively under normal conditions for the FY 2013-14.

Multan Region:

xvi. For Multan Region, the voltage limits as specified in PSTR-2005 were violated and decreased by 5% for the FY 2013-14 as compared to preceding year, which indicates slight improvement by NTDC for this region.

Hyderabad Region:

xvii. For Hyderabad Region, the limits of voltage as specified in PSTR-2005 were violated and increased by 36% for the FY 2013-14 as compared to preceding year, which clearly indicates that the SOP of NTDC for the maintenance of Transmission Lines & Grid-Stations is not being implemented properly by NTDC and as a result of all these, major disturbances are occurring in the system.

xviii. The voltage profile for 220 kV Sibbi and 220 kV Quetta Industrial-II, Grid Stations remained below the allowed limit i.e. ±5% of the nominal voltage, almost throughout the year.

xix. For 500 kV Guddu Grid Station at Hyderabad, 500 kV Guddu-Multan-I, 500 kV Guddu-Multan-II, 500 kV Guddu-Multan-III and 500 kV Guddu-Dadu-II transmission circuits have violated the voltage limits, for 1422, 1536, 1563 and 1545 times, respectively under normal conditions for the FY 2013-14.

xx. For 500 kV Dadu Grid Station, 500 kV Dadu-Jamshoro II transmission circuit has violated the voltage limits, for 1510 times, under normal conditions for the FY 2013-14.

xxi. For 500 kV NKI Grid Station at Hyderabad, the transmission lines 220 kV NKI-Baldia and 220 kV NKI-KDA have violated the voltage limits, for **2097** times, under normal conditions for the FY 2013-14.

xxii. For 220 kV Sibbi Grid Station, 220 kV Sibbi-Quetta, 220 kV Sibbi-Guddu DC and 220 kV Sibbi-Uch I & II transmission lines have violated the voltage limits, **3784, 2418** and **2640** times, respectively for the FY 2013-14 under normal conditions.

xxiii. The worst possible condition of voltage limits violations was noted at 220 kV Quetta Industrial-II Grid Station. The transmission lines 220 kV Sibbi-Quetta I and 220 kV Sibbi-Quetta II violated the limits, for **6157** and **6387** times, for the FY 2013-14 under normal conditions. Moreover it has been noted with concern that the lowest voltage under normal and N-1 conditions was 170 kV and 174 kV respectively for time duration of sixty (60) minutes.

xxiv. In addition to above, it is also pertinent to mention that at some of the Grid Stations, data is not being maintained properly i.e. as per requirements of Rule-7(3) of PSTR-

2005, the criteria for reporting voltage variations outside the limits specified only apply when the duration of variation exceeds a continuous period of thirty minutes.

Violations against specified frequency limits in NTDC Transmission System

xxv. NTDC has violated the upper and lower frequency limits, a number of times which can adversely affect the system performance and may lead to instability and cascaded outages which is undesirable. Moreover, the data provided by NPCC/NTDC does not indicate the times the violations have been occurred, which needs further clarification

xxvi. As per Rule 8 (2) of PSTR-2005, the criteria for reporting frequency variations outside the limits specified only apply when the duration of the variation exceeds a continuous period of five minutes, whereas, the data reported by NPCC/NTDC indicates the measurement intervals of fifteen (15) minutes instead of five (5) minutes.

Violations against specified voltage limits in K-Electric Transmission System

i. The Form-4 (Quality of Supply), data reported by K-Electric is mostly related to 132 kV lines. The detail for the 220 kV transmission system is also required.

ii. The data of Form-4 (Quality of Supply), reported by K-Electric is incomplete as the time duration for voltage limits violations has not been provided.

Violations against specified frequency limits in K-Electric Transmission System

iii. K-Electric has violated the upper and lower frequency limits a number of times, for the months of May & June 2011; the system frequency decreased by 6.72% and 7.24% respectively. Similarly for the month of February 2013 the frequency decreased by 5.76% and in March 2014 it increased by 3.82%, whereas, as per Rule 8(1) of PSTR-2005 "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 the times". The above mentioned severe violations of frequency limits can adversely affect the system performance and may lead to instability and cascaded outages which is undesirable. Moreover, the data provided by K-Electric does not indicate the times the violations have been occurred, which needs further clarification.

iv. As per Rule 8(2) of PSTR-2005, the criteria for reporting frequency variations outside the limits specified only apply when the duration of the variation exceeds a continuous period of five minutes, whereas the data reported by K-Electric indicates the measurement intervals of fifteen (15) minutes instead of five (5) minutes.

8 Recommendation:

The Authority approved the "Performance Evaluation Report" of NTDC & K-Electric and directed to upload it on NEPRA website (www.nepra.org.pk) for comments of all concerned stakeholders.

Annexes

Circuit Wise Details of NTDC & K-Electric

Annex – I

NTDC ISLAMABAD REGION

NTDC Islamabad Region

1. 500kV Grid Station RAWAT

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500kV Rawat-Barotha 1&2 T/Line	1	3	19	22	530	60	530	60	538	60	530	60	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500kV Rawat-Gakkhar 1&2 T/Line	1	3	19	22	530	60	530	60	538	60	530	60	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500kV Rawat-Tarbela 1&2 T/Line	1	3	19	22	530	60	533	60	538	60	530	60	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220kV Rawat-ISPR 1&2 T/Line	–	935	1850	1794	–	–	239	60	241	120	240	60	–	–	–	–	–	–	–	–
N-1		–	–	4	–	–	–	–	–	245	60	–	–	–	–	–	–	–	–	–	–
Normal	220kV Rawat-Mangla 1&2 T/Line	608	935	1850	1794	239	60	–	–	241	120	240	60	–	–	–	–	–	–	–	–
N-1		–	–	4	–	–	–	–	–	245	60	–	–	–	–	–	–	–	–	–	–
Normal	220kV Rawat-Bahria Town 1&2 T/Line	–	935	1850	1794	–	–	–	–	–	–	240	60	–	–	–	–	–	–	–	–
N-1		–	–	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220kV Rawat-University 1&2 T/Line	–	935	1850	1794	–	–	–	–	241	120	240	60	–	–	–	–	–	–	–	–
N-1		–	–	4	–	–	–	–	–	245	60	–	–	–	–	–	–	–	–	–	–

NTDC Islamabad Region

2. 500kV Grid Station SHEIKH MUHAMMADI PESHAWAR

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500kV Tarbela-Peshawar T/Line	–	5	12	NP	–	–	–	–	531	60	–	–	–	–	470	60	–	–	–	–
N-1		–	–	–	NP	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220kV Barotha-Peshawar T/Line	352	607	1337	116	240	60	241	60	241	120	235	60	198	240	198	120	199	60	200	180
N-1		104	10	26	5	–	–	–	–	246	60	–	–	178	60	180	120	174	60	190	60
Normal	220kV Peshawar-Daudkhel T/Line	162	445	1271	89	238	60	240	60	241	120	238	60	198	60	198	60	199	60	200	60
N-1		197	12	30	6	–	–	–	–	246	60	–	–	176	60	180	120	172	60	190	120
Normal	220kV Peshawar-Shahibagh T/Line	168	425	1105	114	237	180	239	60	241	60	235	60	198	120	198	120	200	60	200	60
N-1		125	17	26	5	–	–	–	–	245	60	–	–	176	60	179	120	23	60	190	60

NP: Not Provided

NTDC Islamabad Region

3. 220kV Grid Station BANNU

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV Daudkhel-Bannu 1&2 T/Line	3528	366	348	1755	240	60	243	60	241	600	242	60	298	60	260	300	298	60	195	60
N-1		1860	107	154	1626	199	60	250	60	250	180	248	60	155	60	178	540	180	900	172	60

NTDC Islamabad Region

4. 220kV Grid Station BURHAN

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV Burhan-ISPR T/Line	38	4	30	38	–	–	–	–	240	60	236	60	202	180	203	60	204	60	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220kV Tarbela-Burhan T/Line	38	4	NP	35	–	–	–	–	–	–	236	60	202	180	203	60	–	–	–	–
N-1		–	–	NP	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

NP: Not Provided

NTDC Islamabad Region

5. 220kV Grid Station DAUDKHEL

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV Peshawar-Daudkhel Ckt I &II	1412	923	325	1535	244	60	242	60	240	60	241	60	198	120	198	120	202	60	200	120
N-1		323	121	1	86	248	60	243	60	244	60	246	60	171	60	175	60	–	–	184	60
Normal	220kV Chashma-Daudkhel Ckt I &II	1097	898	1829	1535	244	60	242	60	241	180	241	60	198	120	198		199	60	200	120
N-1		162	143	91	86	248	60	244	60	250	60	246	60	171	60	175		184	60	184	60
Normal	220kV Bannu-Daudkhel Ckt I &II	1412	926	2300	1535	248	60	242	60	241	180	241	60	198	120	198		199	60	200	120
N-1		319	121	96	86	246	60	244	60	250	60	246	60	171	60	175		184	60	184	60
Normal	220kV Peshawar-Daudkhel Ckt I &II	–	–	1848	–	–	–	–	–	241	180	–	–	–	–	–	–	199	60	–	–
N-1		–	–	91	–	–	–	–	–	250	60	–	–	–	–	–	–	184	60	–	–

NTDC Islamabad Region

6. 220kV Grid Station MARDAN

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV Tarbela-Mardan Ckt 1&2	3451	3401	1667	1600	–	–	290	60	–	–	–	–	192	60	188	120	199	240	200	540
N-1		738	1134	1438	176	–	–	–	–	–	–	–	–	182	60	170	60	170	120	182	60
Normal	220kv Barotha-Mardan Ckt	–	–	897	1600	–	–	–	–	–	–	–	–	–	–	–	–	–	–	200	540
N-1		–	–	129	176	–	–	–	–	–	–	–	–	–	–	–	–	–	–	182	60
Normal	220kV Shahibagh-Mardan	–	–	910	1600	–	–	–	–	–	–	–	–	–	–	–	–	–	–	200	540
N-1		–	–	120	176	–	–	–	–	–	–	–	–	–	–	–	–	–	–	182	60

NTDC Islamabad Region

7. 220kV Grid Station ISPR (SANGJANI)

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV ISPR -Mansehra Ckt-1	–	–	2	1	–	–	–	–	233	120	232	120	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220kV ISPR - Burhan	8	–	1	1	–	–	–	–	231	60	232	60	202	420	–	–	205	120	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220kV ISPR-Tarbela	13	21	4	6	–	–	–	–	–	–	–	–	202	240	204	120	201	480	205	60
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220kV ISPR-Bahria Town	–	14	3	6	–	–	–	–	–	–	_	_	–	–	204	120	200	180	205	180
N-1		–	14	0	–	–	–	–	–	–	–	–	–	–	–	204	120	–	–	–	–
Normal	220kV ISPR-Rawat	6	14	3	5	–	–	–	–	–	–	–	–	202	60	204	120	200	180	205	180
N-1		–	14	0	–	–	–	–	–	–	–	–	–	–	–	204	120	–	–	–	–

NTDC Islamabad Region

8. 220kV Grid Station NEW SHAHIBAGH PESHAWAR

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV Barotha-Shahibagh T/Line	335	571	40	NP	241	60	242	60	241	180	–	–	200	300	199	60	199	60	–	–
N-1		57	7	5	NP	_	_	_	_	248	60	_	_	181	60	190	60	180	60	_	_
Normal	220kV Peshawar-Shahibagh T/Line	458	311	978	1331	–	–	–	–	–	–	–	–	200	180	199	60	199	300	200	420
N-1		396	44	341	130	–	–	–	–	–	–	–	–	180	240	185	60	178	60	170	120
Normal	220kV Shahibagh-Mardan T/Line	NP	NP	946	351	_	_	_	_	_	_	238	240	_	_	_	_	_	_	_	_
N-1		NP	NP	200	108	–	–	–	–	–	–	–	–	–	–	–	–	–	–	175	60

NP: Not Provided

NTDC Islamabad Region

9. 220kV Grid Station UNIVERSITY

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV University-Rawat 1&2 T/Line	534	418	676	362	240	60	240	60	241	60	240	60	–	–	–	–	–	–	232	120
N-1		–	–	1	2	–	–	–	–	245	60	242	60	–	–	–	–	–	–	–	–

Annex – II

NTDC LAHORE REGION

NTDC Lahore Region

1. 500kV Grid Station GATTI FAISALABAD

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500kV Barotha-Gatti Ckt I	–	–	3	NP	–	–	–	–	530	120	–	–	–	–	–	–	–	–	–	–
N-1		–	–	–	NP	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500kV Barotha-Gatti Ckt II	2	1	12	4	530	90	530	90	535	60	530	90	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500kV M/Garh-Gatti Ckt	180	286	169	140	540	300	542	120	540	120	535	90	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500kV Rousch-Gatti Ckt	30	22	83	17	540	90	540	60	540	120	538	60	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500kV Multan-Gatti Line	58	88	447	155	540	300	540	90	545	60	540	300	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500kV Gatti-Lahore Ckt	24	19	75	19	538	360	540	60	540	60	532	90	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

NP: Not Provided

NTDC Lahore Region

2. 500kV Grid Station SHEIKHUPURA

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500kV Yousafwala Gatti Gakhar-I & Gakhar-II Note: Voltages are recorded at Bus Bar I & II	_	2	_	_	_	_	530	30	_	_	_	_	_	_	472	30	_	_	_	_
N-1		_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Normal	220kV Kotlakhpat I & II, BandRoad I, II, III & IV Ravi I & II Note: Voltages are recorded at Bus Bar I & II	26	205	25	25	237	1020	236	30	233	60	_	_	205	480	198	30	198	120	200	60
N-1		_	_	_	1	_	_	_	_	_	_	_	_	_	_	_	_	_	_	197	90

NTDC Lahore Region

3. 220kV Grid Station BUND ROAD LAHORE

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV Bus Bar No. 1 & 2	707	325	2991	4413	242	90	234	30	–	–	–	–	203	60	196	60	196	60	195	150
N-1		–	–	44	161	–	–	–	–	–	–	–	–	–	–	–	–	195	90	195	120

NTDC Lahore Region

4. 220kV Grid Station GAKKHAR

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV Gakkhar-Mangla I	649	357	384	148	–	–	–	–	–	–	–	–	190	60	198	180	199	60	204	280
N-1		166	28	9	25	–	–	–	–	–	–	–	–	176	60	182	30	193	60	185	60
Normal	220kV Gakkhar-Mangla II	514	266	388	224	–	–	–	–	260	120	280	60	198	180	198	360	107	120	198	120
N-1		159	70	38	52	–	–	–	–	–	–	–	–	172	30	85	120	182	30	186	60
Normal	220kV Gakkhar-Mangla III	294	NP	NP	NP	294	60	–	–	–	–	–	–	191	30	–	–	–	–	–	–
N-1		135	NP	NP	NP	–	–	–	–	–	–	–	–	172	30	–	–	–	–	–	–
Normal	220kV Gakkhar-Sialkot	628	358	384	148	–	–	–	–	–	–	–	–	198	120	191	60	199	60	198	60
N-1		159	30	9	25	–	–	–	–	–	–	–	–	176	60	182	30	193	60	185	60
Normal	220kV Gakkhar-Nokhar	–	–	389	–	–	–	–	–	–	–	–	–	–	–	–	–	107	120	–	–
N-1		–	–	38	–	–	–	–	–	–	–	–	–	–	–	–	–	182	30	–	–
Normal	220kV Old Gakkhar-New Gakkhar	218	266	NP	226	–	–	–	–	–	–	–	–	198	180	198	360	–	–	198	120
N-1		24	70	NP	54	–	–	–	–	–	–	–	–	190	60	85	120	–	–	186	60

NP: Not Provided

NTDC Lahore Region

5. 220kV Grid Station JARANWALA ROAD FAISALABAD

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV JWR-Gatti Ckt I & II Note: Voltages are Recorded at Bus Bar I & II	70	19	222	303	235	90	236	45	240	40	237	60	_	_	_	_	_	_	_	_
N-1		_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_

NTDC Lahore Region

6. 220kV Grid Station KALA SHAH KAKU

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV KSK-Gatti 1&2	836	678	2039	2019	–	–	–	–	–	–	–	–	196	60	198	120	198	120	198	120
N-1		42	45	20	20	–	–	–	–	–	–	–	–	193	120	188	60	194	60	194	60
Normal	220kV KSK-Mangla 1, 2, & 3	541	1195	1631	1651	232	30	–	–	–	–	–	–	197	60	198	150	198	60	197	60
N-1		10	43	7	7	232	30	–	–	–	–	–	–	196	30	182	30	193	60	193	60
Normal	220kV KSK-Band Road 1 & 2	465	1336	1539	1535	–	–	–	–	–	–	–	–	196	30	198	150	198	180	198	60
N-1		14	51	6	6	232	120	–	–	–	–	–	–	196	120	188	120	195	60	195	60
Normal	220kV KSK-Ravi 1 & 2	1113	437	1813	1828	–	–	–	–	–	–	–	–	198	150	198	120	198	180	198	420
N-1		154	23	116	116	–	–	–	–	–	–	–	–	190	90	182	30	188	60	190	240
Normal	220kV KSK-Sialkot	787	1140	1646	1817	–	–	–	–	–	–	–	–	198	90	198	120	196	90	195	60
N-1		33	66	46	115	–	–	–	–	–	–	–	–	192	30	188	120	192	60	190	60

NTDC Lahore Region

7. 220kV Grid Station LUDEWALA SARGODHA

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV Gatti-Ludewala Ckt I & II	1214	414	641	491	234	30	233	90	242	210	244	60	190	60	198	90	150	150	208	60
N-1		227	54	5	–	–	–	–	–	248	90	–	–	175	30	186	60	190	60	–	–
Normal	220kV Chashma-Ludewala Ckt I & II	–	–	–	52	–	–	–	–	–	–	237	150	–	–	–	–	–	–	202	60
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

NTDC Lahore Region

8. 220kV Grid Station NEW KOT LAKHPAT

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-134		2010-11		2011-12		2012-13		2013-134	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV NKLP-BDR 1& 2	2209	5297	5850	4157	–	–	–	–	–	–	–	–	198	180	198	240	198	180	198	300
N-1		70	1741	1832	2409	–	–	–	–	–	–	–	–	190	120	175	60	183	60	179	30
Normal	220kV NKLP-SKP 1& 2	999	2606	2746	3082	–	–	–	–	234	30	240	30	195	30	198	90	198	60	198	120
N-1		50	60	211	343	240	60	–	–	–	–	–	–	190	30	185	60	188	30	185	30
Normal	220kV NKLP-SNR 1& 2	1251	4660	4238	3825	–	–	–	–	–	–	233	60	197	60	198	210	195	30	198	180
N-1		79	461	700	1044	233	60	–	–	–	–	–	–	191	60	180	60	185	60	183	60
Normal	220kV NKLP-WTN	–	4338	4122	3768	–	–	–	–	–	–	233	60	–	–	198	180	198	180	198	240
N-1		–	327	656	1057	–	–	–	–	–	–	–	–	–	–	181	60	184	60	181	30

Note:
Data for NKLP-WTN circuit has been submitted by NTDC in year 2011-12, 2012-13 & 2013-14 which indicates that this circuit has been added in 2011-12

NTDC Lahore Region

9. 220kV Grid Station NEW SHALAMAR LAHORE

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV New Shalamar-KSK T/L	NE	NE	NE	655	–	–	–	–	–	–	–	–	–	–	–	–	–	–	196	30
N-1		NE	NE	NE	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	203	30
Normal	220kV New Shalamar-Ravi T/L	NE	NE	NE	655	–	–	–	–	–	–	–	–	–	–	–	–	–	–	196	30
N-1		NE	NE	NE	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	203	30

NE: Not Existing

NTDC Lahore Region

10. 220kV Grid Station NISHATABAD FAISALABAD

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV NBD-Gatti Ckt I & II 220kV NBD-SRD Ckt I & II Note: Voltages are recorded at Bus Bar I & II	37	–	–	–	235	120	–	–	–	–	–	–	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

NTDC Lahore Region

11. 220kV Grid Station RAVI LAHORE

Condition	Name of Transmission Circuit violating the Voltage	Total Number / Times violating the limit				Highest Voltage Recorded (kV) / Time (Min)								Lowest Voltage Recorded (kV) / Time							
		2010-11	2011-12	2012-13	2013-14	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV Ravi-KSK I+II	857	–	–	610	235	30	–	–	–	–	–	–	195	30	–	–	–	–	198	390
N-1		59	–	–	167	–	–	–	–	–	–	–	–	188	90	–	–	–	–	190	150
Normal	220kV Ravi-KSK I	–	1229	3261	2553	–	–	–	–	–	–	–	–	–	–	198	510	194	30	198	150
N-1		–	171	105	370	–	–	–	–	–	–	–	–	–	–	180	60	185	30	182	30
Normal	220kV Ravi-KSK II	–	1927	3963	1673	–	–	–	–	–	–	–	–	–	–	198	270	192	30	185	30
N-1		–	106	358	950	–	–	–	–	–	–	–	–	–	–	188	120	185	30	182	30
Normal	220kV Ravi-Atlas	826	1889	2031	3140	236	240	–	–	–	–	–	–	198	240	198	270	198	450	188	270
N-1		31	184	476	769	–	–	–	–	–	–	–	–	190	60	188	120	175	30	180	30
Normal	220kV Ravi-SKP	477	1332	2930	3314	236	240	–	–	–	–	–	–	198	300	198	270	198	270	198	270
N-1		26	232	632	775	–	–	–	–	–	–	–	–	190	60	182	60	182	30	188	30
Normal	220kV Ravi-SMR	–	–	–	834	–	–	–	–	–	–	–	–	–	–	–	–	–	–	198	270
N-1		–	–	–	315	–	–	–	–	–	–	–	–	–	–	–	–	–	–	188	30

NTDC Lahore Region

12. 220kV Grid Station SARFRAZNAGAR

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV SNR-YSW Ckt-I	333	954	912	1097	–	–	–	–	–	–	–	–	196	60	198	300	198	840	198	660
N-1		–	34	65	74	–	–	–	–	–	–	–	–	–	–	190	120	190	120	185	30
Normal	220kV SNR-YSW Ckt-II	337	894	912	1097	–	–	–	–	–	–	–	–	198	180	198	300	198	840	198	660
N-1		1	30	65	74	–	–	–	–	–	–	–	–	196	60	190	120	190	120	185	30
Normal	220kV SNR-NKLP Ckt-I	307	868	862	1072	–	–	–	–	–	–	–	–	198	300	198	300	198	420	198	660
N-1		1	25	64	75	–	–	–	–	–	–	–	–	196	60	190	120	190	120	185	30
Normal	220kV SNR-NKLP Ckt-II	337	922	862	1072	–	–	–	–	–	–	–	–	194	120	198	300	198	420	198	660
N-1		1	25	64	75	–	–	–	–	–	–	–	–	190	30	190	120	190	120	185	30

NTDC Lahore Region

13. 220kV Grid Station SIALKOT

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV Sialkot-Ghakhar	517	601	503	402	–	–	–	–	–	–	–	–	198	360	198	420	198	1700	198	180
N-1		171	184	104	104	–	–	–	–	–	–	–	–	160	120	170	60	175	60	180	120
Normal	220kV Sialkot-KSK	498	597	478	405	–	–	–	–	–	–	–	–	198	420	195	420	198	180	198	300
N-1		137	151	122	111	–	–	–	–	–	–	–	–	120	60	175	60	175	60	180	120

NTDC Lahore Region

14. 220kV Grid Station SAMUNDARI ROAD FAISALABAD

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV Samundri Road-Nishat Abad Ckt I & II 220kV Samundri Road-Multan Ckt I & II Note: Voltages are recorded at Bus Bar I & II	_	5	51	139	_	_	_	_	240	60	236	390	_	_	196	30	202	150	200	90
N-1		_	1	_	_	_	_	_	_	_	_			_	_	195	120	_	_	_	_

NTDC Lahore Region

15. 220kV Grid Station WAPDA TOWN LAHORE

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV Bus Bar No. 1 & 2	–	1958	NP	NP	–	–	–	–	–	–	–	–	–	–	192	60	–	–	–	–
N-1		–	275	NP	NP	–	–	–	–	–	–	–	–	–	–	188	60	–	–	–	–
Normal	220 kV WTN - NKLP	–	1575	1105	1610	–	–	–	–	–	–	–	–	–	–	194	120	190	240	192	120
N-1		–	14	14	–	–	–	–	–	–	–	–	–	–	–	196	30	194	60	–	–
Normal	220 kV WTN - Shiekhupura	–	1338	1603	1601	–	–	–	–	–	–	–	–	–	–	198	90	197	60	190	120
N-1		–	10	92	5	–	–	–	–	–	–	–	–	–	–	195	30	190	120	195	160

NP: Not Provided

Annex – III

NTDC MULTAN REGION

NTDC Multan Region

1. 500kV Grid Station YOUSAF WALA

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500kV Y/Wala-Lahore & 500kV Y/Wala-Multan	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	465	60	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220kV Y/Wala-Sarfaraz Nagar	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	205	120
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220kV Y/Wala-Gatti	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	205	120
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220kV Y/Wala-Vehari Ckt I&II	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	205	120
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

NTDC Multan Region

2. 500kV Grid Station NEW MULTAN

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-14		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV Multan S/Road Ckt I & II	1	–	–	–	244	60	–	–	–	–	–	–	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220kV Multan M/Garh 1&2	1	–	–	3	244	60	–	–	–	–	266	120	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220kV Multan M/Garh-3	1	–	–	2	244	60	–	–	–	–	250	60	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220kV Multan M/Garh-4	1	–	–	–	244	60	–	–	–	–	–	–	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220kV Multan Kapco-3	1	–	–	1	244	60	–	–	–	–	245	240	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220kV Multan Kapco-4	1	–	–	3	244	60	–	–	–	–	246	330	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220kV Multan Kapco-5&6	1	–	–	1	244	60	–	–	–	–	246	180	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220kV Multan NGPS I & II	1	–	–	–	244	60	–	–	–	–	–	–	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220kV Multan VehRI I & II	1	–	–	–	244	60	–	–	–	–	–	–	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

NTDC Multan Region

3. 500kV Grid Station MUZAFFARGARH

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV T/L 500kV G/S TPS Phase-I M/Garh	NO Violation																			
N-1																					
Normal	220kV T/L 500kV G/S TPS Phase-II M/Garh																				
N-1																					
Normal	500kV M/Garh-Multan																				
N-1																					
Normal	500kV M/Garh-Gatti																				
N-1																					
Normal	500kV M/Garh-Guddu																				
N-1																					

NTDC Multan Region

4. 220kV Grid Station NEW MUZAFFARGARH

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV M/Garh-Multan	50	1	92	–	–	–	232	60	239	90	–	–	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220kV M/Garh-TPS	50	1	92	–	236	60	232	60	239	90	–	–	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

NTDC Multan Region

5. 220kV Grid Station BAHAWALPUR

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV BWP-M/Garh Ckt I & II	31	131	15	421	240	120	236	60	242	30	248	90	194	60	200	120	203	30	200	60
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

NTDC Multan Region

6. 220kV Grid Station VEHARI

Condition	Name of Transmission Circuit violating the Voltage	Total Number/Times violating the limit				Highest Voltage Recorded/Time								Lowest Voltage Recorded/Time							
		2010-11	2011-12	2012-13	2013-14	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV Vehari-Multan Ckt I & II	286	24	745	559	240	90	235	30	240	90	240	150	207	150	208	30	–	–	200	150
N-1		–	–	–	6	–	–	–	–	–	–	246	30	–	–	–	–	–	–	180	30
Normal	220kV Vehari-Y/Wala Ckt I & II	286	24	714	561	241	60	235	30	240	90	238	210	207	150	208	30	–	–	200	150
N-1		–	–	–	6	–	–	–	–	–	–	246	30	–	–	–	–	–	–	180	30

Annex – IV

NTDC HYDERABAD REGION

NTDC Hyderabad Region

1. 500kV Grid Station GUDDU HYDERABAD

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500 kV Guddu-Multan I	–	–	–	1422	–	–	–	–	–	–	539	720	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500 kV Guddu-Multan II	–	–	–	1536	–	–	–	–	–	–	539	420	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500 kV Guddu-Multan III	–	–	–	1563	–	–	–	–	–	–	540	120	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500 kV Guddu-Dadu I	–	84	–	39	–	–	540	120	–	–	535	120	–	–	–	–	–	–	–	–
N-1		–	11	–	–	–	–	542	60	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500 kV Guddu-Dadu II	–	–	–	1545	–	–	–	–	–	–	540	60	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

NTDC Hyderabad Region

2. 500kV Grid Station DADU

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500 kV Dadu-Jamshoro-I	41	461	384	828	539	60	547	180	540	660	540	560	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500 kV Dadu-Jamshoro-II	57	759	1075	1510	540	60	545	120	545	60	544	120	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500 kV Dadu-Guddu-I	9	84	167	472	535	60	540	120	540	300	540	120	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500 kV Dadu-Guddu-II	5	11	15	53	536	60	542	60	538	60	540	180	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

NTDC Hyderabad Region

3. 500kV Grid Station JAMSHORO

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500 kV Jamshoro-Dadu Ckt I & II	75	16	48	34	540	360	535	60	538	180	544	60	–	–	–	–	245	60	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500 kV Jamshoro-NKI	134	62	55	17	538	60	538	120	538	180	544	60	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500 kV Hub-Jamshoro (Direct Circuit)	179	53	54	17	538	120	536	120	538	60	544	60	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220 kV Jamshoro-Hala road Ckt I & II	113	66	277	271	239	120	239	180	240	120	247	60	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220kV Jamshoro-TMK Ckt I & II	167	90	286	274	249	120	240	120	241	60	247	60	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220kV Jamshoro-KDA33 Ckt I & II	176	107	297	276	241	60	239	120	242	60	247	60	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

NTDC Hyderabad Region

4. 500kV Grid Station NKI KARACHI

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	500 kV NKI-HUB	64	53	200	201	531	60	531	60	542	30	539	30	_	_	468	30	472	30	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	500 kV NKI-Jamshoro	64	54	200	201	531	60	531	60	542	30	539	30	–	–	468	30	472	30	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220 kV NKI-Baldia	1105	1854	1169	2097	244	120	245	60	247	30	248	30	200	60	_	_	208	60	_	_
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220 kV NKI-KDA	1104	1923	1169	2097	244	120	245	60	247	30	242	60	200	60	198	60	208	60	_	_
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

NTDC Hyderabad Region

5. 220kV Grid Station SHIKARPUR

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV Shikarpur-Guddu Ckt	83	35	86	276	240	660	–	–	–	–	–	–	200	480	200	240	200	1440	199	1440
N-1		24	18	14	1	–	–	–	–	–	–	–	–	180	240	180	180	180	1440	196	300
Normal	220kV Shikarpur-Uch Ckt	83	35	86	276	240	660	–	–	–	–	–	–	200	480	200	240	200	1440	200	1440
N-1		24	18	14	1	–	–	–	–	–	–	–	–	180	240	180	180	180	1440	198	300
Normal	220k Engro-Shikarpur Ckt	–	–	–	276	–	–	–	–	–	–	–	–	–	–	–	–	–	–	200	1440
N-1		–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	198	300
Normal	220kV Rohri-Shikarpur Ckt	–	–	–	276	–	–	–	–	–	–	–	–	–	–	–	–	–	–	201	1440
N-1		–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	198	300

NTDC Hyderabad Region

6. 220kV Grid Station T.M.ROAD HYDERABAD

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV TMK-JMS 1&2	133	226	616	767	240	180	242	60	240	540	241	60	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

NTDC Hyderabad Region

7. 220kV Grid Station DHARKI

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV Bus Bar	28	11	19	–	240	60	236	480	235	150	–	–	–	–	208	120	207	30	–	–
N-1		22	–	2	–	–	–	–	–	–	–	–	–	204	60	–	–	197	60	–	–

NTDC Hyderabad Region

8. 220kV Grid Station HALA ROAD HYDERABAD

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2012-13		2010-11		2011-12		2012-13		2012-13	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV Hala Road-Jamshoro I & II	1312	103	543	1285	241	540	237	420	239	300	239	300	–	–	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

NTDC Hyderabad Region

9. 220kV Grid Station SIBBI

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Sibbi-Quetta I & II	1828	2742	3398	3784	240	240	–	–	240	120	–	–	192	60	200	180	199	60	199	90
N-1		255	299	1130	427	245	60	–	–	–	–	–	–	170	60	180	60	130	30	180	30
Normal	220 kV Sibbi-Guddu D/C	1828	2778	3036	2418	240	240	–	–	241	210	240	30	192	60	20	30	199	270	192	90
N-1		255	218	858	183	245	60	–	–	–	–	–	–	170	60	180	60	180	120	180	60
Normal	220 kV Sibbi-Uch I & II	1828	2412	3017	2640	240	240	–	–	235	30	238	60	192	60	190	60	199	240	199	60
N-1		255	200	899	470	245	60	–	–	–	–	–	–	170	60	180	60	180	240	180	30

NTDC Hyderabad Region

10. 220kV Grid Station QUETTA-INDUSTRIAL-II

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220kV Sibbi-Quetta I T/L	477	522	669	6157	–	–	–	–	–	–	–	–	188	60	199	120	199	120	170	60
N-1		2211	2494	2360	40	–	–	–	–	–	–	–	–	–	–	–	–	–	–	174	60
Normal	220kV Sibbi-Quetta II T/L	477	522	669	6387	–	–	–	–	–	–	–	–	170	300	155	60	180	60	170	60
N-1		2211	2494	2360	52	–	–	–	–	–	–	–	–	–	–	–	–	–	–	174	60

NTDC Hyderabad Region

11. 220kV Grid Station ROHRI

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	220 kV Engro-Rohri Ckt	12	13	165	84	240	180	239	30	240	30	239	30	203	60	200	30	190	30	200	30
N-1		3	1	–	6	245	60	245	60	–	–	264	30	–	–	–	–	–	–	–	–

Annex – V

K-Electric System

Circuit Wise Number of Violations

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	132 kV Surjani-Maymar	1	1	1	1	–	–	–	–	–	–	–	–	118	–	122	–	117	–	116	–
N-1		1	–	–	1	–	–	–	–	–	–	–	–	111	–	–	–	–	–	114	–
Normal	132 kV Surjani-Valika	1	1	1	1	–	–	–	–	–	–	–	–	122	–	122	–	117	–	114	–
N-1		–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	118	–	112	–
Normal	132 kV SITE-SGT 1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
N-1		1	–	–	–	–	–	–	–	–	–	–	–	117	–	–	–	–	–	–	–
Normal	132 kV SITE-SGT 2	1	–	–	–	–	–	–	–	–	–	–	–	122	–	–	–	–	–	–	–
N-1		1	–	–	–	–	–	–	–	–	–	–	–	117	–	–	–	–	–	–	–
Normal	132 kV KDA-Federal B	–	1	1	1	–	–	–	–	–	–	–	–	–	–	119	–	119	–	116	–
N-1		1	–	1	1	–	–	–	–	–	–	–	–	114	–	–	–	118	–	113	–
Normal	132 kV Valika-N.Karachi	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
N-1		1	–	–	–	–	–	–	–	–	–	–	–	112	–	–	–	–	–	–	–
Normal	132 kV Gulshan-Civic	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	119	–	113	–
N-1		1	–	–	1	–	–	–	–	–	–	–	–	119	–	–	–	–	–	113	–
Normal	132 kV West Wharf-Lyari	–	1	–	–	–	–	–	–	–	–	–	–	–	119	–	–	–	–	–	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

K-Electric System

Circuit Wise Number of Violations

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	132 kV Qayyumabad-K.East	–	1	1	1	–	–	–	–	–	–	–	–	–	–	118	–	116	–	122	–
N-1		–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	114	–
Normal	132 kV Memon Goth-Malir	–	1	1	1	–	–	–	–	–	–	–	–	–	–	120	–	114	–	114	–
N-1		–	1	1	1	–	–	–	–	–	–	–	–	–	–	116	–	118	–	116	–
Normal	132 kV Malir-CAA	–	1	1	1	–	–	–	–	–	–	–	–	–	–	120	–	114	–	114	–
N-1		–	1	1	1	–	–	–	–	–	–	–	–	–	–	118	–	115	–	115	–
Normal	132 kV Gulshan-Hospital	–	1	1	1	–	–	–	–	–	–	–	–	–	–	122	–	116	–	113	–
N-1		–	1	–	1	–	–	–	–	–	–	–	–	–	–	118	–	–	–	113	–
Normal	132 kV Gharo-RECP	–	1	1	1	–	–	–	–	–	–			–	–	123	–	120	–	118	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	132 kV BOC-Dhabeji	–	_	1	1	_	_	_	_	_	_	_	_	_	_	–	–	122	–	118	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	132 kV Dhabeji-Gharo	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	120	–	118	–
N-1		1	–	–	–	–	–	–	–	–	–	_	_	119	–	–	–	–	–	–	–
Normal	132 kV KDA-Memon Goth	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	119	–	116	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

K-Electric System

Circuit Wise Number of Violations

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	132 kV KDA-Johar	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	113	–	116	–
N-1		–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	118	–	113	–
Normal	132 kV Johar-Hospital	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	113	–	111	–
N-1		–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	116	–	111	–
Normal	132 kV KDA-Gulshan	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	116	–	116	–
N-1		–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	118	–	113	–
Normal	132 kV KDA-Maymar	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	117	–	116	–
N-1		–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	118	–	113	–
Normal	132 kV Federal B-Valika	–	–	1	1	–	–	–	–	–	–			–	–	–	–	119	–	122	–
N-1		–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	112	–
Normal	132 kV Haroonabad-Liaquatabad	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	114	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	132 kV Valika-Nazimabad	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	116	–	111	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	132 kV Gulshan-Jalil Road	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	117	–	113	–
N-1		–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	118	–	113	–

K-Electric System

Circuit Wise Number of Violations

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	132 kV Gulshan-Azizabad	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	116	–	113	–
N-1		–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	117	–	113	–
Normal	132 kV Mauripur-Haroonabad	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	116	–	117	–
N-1		–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	118	–	116	–
Normal	132 kV Haroonabad-Nazimabad	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	116	–	114	–
N-1		–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	114	–	–	–
Normal	132 kV Korangi-West Defence	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	118	–	122	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	132 kV Pipri West-Port Qasim	–	–	–	1	–	–	–	–	–	–			–	–	–	–	–	–	121	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	132 kV Pipri West-KEPZ	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	121	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	132 kV KEPZ-Lnadhi	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	120	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	132 kV Gul Ahmed-Airport 1 & 2	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	122	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

K-Electric System

Circuit Wise Number of Violations

Condition	Name of Transmission Circuit violating the Voltage	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	2010-11		2011-12		2012-13		2013-14		2010-11		2011-12		2012-13		2013-14	
						Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time	Voltage	Time
Normal	132 kV KTPS-PRL	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	120	–	121	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	132 kV K.East-K.South	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	114	–	121	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	132 kV Valika-North Nazimabad	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	116	–	–	–
N-1		–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	112	–
Normal	132 kV Orangi-Valika	–	–	–	1	–	–	–	–	–	–			–	–	–	–	–	–	119	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	132 kV Liaquatabad-Azizabad	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	114	–	115	–
N-1		–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	116	–	117	–
Normal	132 kV Port Qasim-Landhi	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	120	–
N-1		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Normal	220 kV Baldia-Mauripur	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
N-1		1	–	–	–	–	–	–	–	–	–	–	–	207	–	–	–	–	–	–	–