दिल्ली ट्रांस्को लिमिटेड
DELHI TRANSCO LIMITED
पंजीकृत कायालय :शि□त सदन, कोटला रोड़, □यू □द□ल□-110002
(Regd. Office Shakti Sadan, Kotla Road, New Delhi-110002)
Office of General Manager (SLDC)
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No. F./DTL/207/16-17/GM(SLDC)/F.3/166 **Dated : 15.03.2016**

Subject : Minutes of meeting held on 09.02.2017 at SLDC, Conference Hall at 03.00PM to discuss about High Voltage problems existing in the Grid.

Sir,

The Minutes of meeting held on 09.02.2017 at SLDC, Conference Hall at 03.00PM to discuss about High Voltage problems existing in the Grid are enclosed for ready reference and further necessary action please.

Thanking you,

Yours faithfully

Encl : As above

(V. VENUGOPAL)
General Manager (SLDC)

To
As per list of the participants through email.

Copy for favour of kind information to :-

1. Secretary (Power), Govt. of NCT of Delhi,
2. Chairperson, NDMC, Palika Kendra, Sansad Marg, New Delhi-110001
3. Secretary, DERC, Viniyamak Bhawan, C-Block, Shivalik, New Delhi-110017
4. Managing Director, DTL
5. Member Secretary, NRPC, Katwaria Sarai, New Delhi-110016
6. M.D., IPGCL / PPCL, Himadri, Rajghat Power House, New Delhi-110002
7. Director (Tech), IPGCL / PPCL
8. Director (Operations), DMRC
9. Director (Electrical), DMRC
10. Executive Director (T), DTL, Planning Department, DTL, Jhandewalan, Delhi.
11. Executive Director (Tariff), DERC, Viniyamak Bhawan, Malviya Nagar, New Delhi.
12. Executive Director (Engg.), DERC, Viniyamak Bhawan, Malviya Nagar, New Delhi.
13. General Manager, NRLDC
14. General Manager, Badarpur Thermal Power Station, NTPC, Badarpur, New Delhi.
15. General Manager (C&RA), DTL
16. General Manager (Electrical), DMRC, 6th Floor, Metro Bhawan, Fire Brigade Bhawan, Barakhamba Road, New Delhi-110001
17. CEO, BRPL, BSES Bhawan, Nehru Place, New Delhi-110019

18. CEO, BYPL, Shakti Kiran Building, Karkardooma, New Delhi-110092
19. CEO, TPDDL, 33kV Grid S/Stn, Hudson Lane, Kingsway Camp, Delhi-110009
20. Chief Engineer (Electrical)-I, NDMC
21. Director (Power), NDMC, Room No. 5016, 5th Floor, Palika Kendra, Sansad Marg, New Delhi.
22. Chief Engineer, Delhi Zone,(CEDZ), MES, Delhi Cantt, New Delhi-110010
23. Addl. Secretary (Power), Govt. of NCT of Delhi, Delhi Secretariat, New Delhi.
24. Dy.G.M.(System Operation), SLDC
25. Dy. G.M. (SCADA), SLDC
26. Manager (System Operation)-Shift, SLDC
27. Manager (System Operation), SLDC
28. Manager (Energy Accounting), SLDC
29. Asstt. Manager (F), SLDC, Delhi.

DELHI TRANSCO LTD.
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Subject : **Summary of record of discussions in the meetings held in SLDC on 09.02.17 at SLDC, Conference Hall at 03.00PM to discuss about High Voltage problems existing in Grid.**

The issue of high voltage in the Grid was discussed in the 16th Grid Coordination Committee meeting held on 18.01.2017. It was decided to convene a separate meeting exclusively for the issue of high voltage. It was also decided to call DMRC in the meeting as MDRC feeders are also found one of the reasons of high voltage problems in the Grid. Accordingly, a meeting was called on 09.02.2017 in SLDC.

2 Director (Operations) Chaired the meeting.

3 The list of participants is annexed.

Gist of discussions and decisions.

4 SLDC representative presented the severity of high voltage problems persisting in the Grid since the beginning of off peak season i.e. second fortnight of October 2016. It was explained that even during peak hours, the voltage remains more than the normal limit. Indian Electricity Grid Code Regulations 2010 stipulates the permissible voltage limits as under:-

5.2 System Security Aspects
(r) All users, STUs and CTU shall make all possible efforts to ensure that the grid voltage always remains within the following operating range

Voltage level	Voltage (rms)	
	Maximum	Minimum
765kV	800	728
400 kV	420	380
220 kV	245	198
132 kV	145	122

5 It was pointed out at that all users including that of STUs and CTUs are required to take steps to ensure stable operation of the system with the voltage profile in the above mentioned limits for secure operation of the Grid.

6 It was explained that that Delhi system is having 9040MVA capacity at 400/220KV level and 11720MVA capacity at 220/66/33kV level. In addition to the above, there are 10 nos 400KV transmission lines and 102 nos. 220KV transmission lines (some of them are cables). These transmission assets are created to cater the present peak load demand of about 6500MW. During the Winter months off peak hours, the demand has been hovering around 1500MW. This huge transmission elements generating reactive power is more than the requirement of load leading to operation of high voltage. Despite taking all possible steps, like opening of around 30-35 nos. of 220KV lines and about 20-25 nos. of 66KV cable lines of DISCOMs, the Reactive Power Injection could not be reduced beyond 400MVAR during night time. A broad analysis of the Reactive Power injection shows that out of 400MVAR Reactive Power injection, the Reactive Power Injection by the Discoms system to the grid is about 100MVAR. The balance 300MVAR Injection is due to the transmission system. The main reason of this Injection is the loading of Transmission lines below Surge Impedance Loading (SIL) and the transmission system itself generates Reactive Power more than the requirement of the load causing Reactive Power Injection to the Grid. For deterring reactive power injection during high voltage regime for the Reactive Power Injection to the grid above 412KV at inter exchange points and 226.6KV at 220KV level the Injecting utility has to pay 13 Paisa per Reactive Unit (the charges being increased by 0.5paisa per year). In this process, the Transmission Co. has to pay about Rs. 6 Crores in a year to NRLDC as Reactive Power charges.

PGCIL(the CTU) has already conducted the study for the reactive power compensation and recommended 125 MVAR Reactor at Mandola. The study has been conducted considering the 125MVAR Reactors at the upcoming ISTSs at Maharani Bagh, Tuglakabad and Dwarka. It is anticipated that by the year 2019-20, with all the ISTS with 125MVAR Reactors along with Reactor at Mandola will reduce the high voltage problem.

6 It was informed that the high voltage issue have been the regular agenda of Northern Regional Power Committee (NRPC) monthly Operational Coordination Committee (OCC) meeting and Delhi OCC meetings.

7 The issue of high voltage in the Grid is explained in the Minutes of Meeting of NRPCôs 131st meeting of Operational Coordination Committee (OCC) held on 13.01.2017 / 17.01.2017. The extracts of the MoM was cited as under:-

22. High Voltage control

22.1 Representative of NRLDC presented the Voltage duration curve of all the 400kV nodes of NR clubbing the nodes state wise. Based on these curves, it was observed that

a. The high voltage (>420 kV) was observed for about 10-20% of time at most of the locations except for some locations such as in Punjab ring etc wherein voltage was above 420 kV for approx. 40-50% of time.

b. This high voltage was observed for extended time during night hours.

c. Some of the 400kV node's voltage duration curve had a vast difference from the nearby interconnected nodes as given below:

400kV Jallandhar (PGCIL): Voltage much higher than nearby nodes. POWERGRID representative stated that Jallandhar and Fatehbad voltages issues have been noticed by them also and are looking into the issue.
400kV Amritsar (PGCIL): Voltage was bit lower than nearby nodes.
400kV Bamnoli (DTL): Voltages was lower in range of ~ 5-10kV in comparison to nearby nodes.
400kV Suratgarh (RRVPNL): Voltage very high. Both Bus voltages at Suratgarh also have difference of ~ 10-15kV.
400kV Jodhpur (RRVPNL): Voltages quite higher than nearby nodes and their bus voltage has difference of ~ 20kV.
Telemetry of new 400kV Chittorgarh (RRVPNL) is inaccurate.
400kV Agra (PG) & Agra (UP) bus voltages has difference of ~ 14- 15kV.
400kV Lucknow(UP): Voltages high than that of nearby nodes.
400 kV Dehar (BBMB): Voltages higher than nearby nodes.

22.2 OCC deliberated on the issue and expressed that following may be the reasons for such difference:
Inaccurate telemetry [transducer issue]
CVT error

22.3 OCC advised all the concerned members to Check the telemetry of such sub-stations
Check the CVTs and correct them if erroneous as wrong CVT output could result in protection mis-operation as well.

22.4 It was decided and agreed that all the concerned utilities would check the telemetry of site and SCADA to remove the discrepancies.

22.5 It was also observed that following sub-stations were having over voltages(voltage>420 kV) for more than 30% of time:
Dhuri, Muktsar, Makhu, Nakodar, Rajpura, Talwandi Saboo, Jallandhar in Punjab ; Dehar BBMB; **CCGT Bawana & Mandola in Delhi;** Agra, Vishnuprayag & Lucknow UP in Uttar Pradesh.

22.6 OCC advised concerned agencies to study the reactive power injection at these nodes in order to control the same. All members agreed for the same.

Tap optimization:

22.7 Previous OCC approved list (based on scatter plots of 400 and 200kV voltages) of suggested tap changes at 400kV and above nodes was presented by NRLDC. POWERGRID and Uttar Pradesh representatives informed that they had changed tap position at some location in line with the suggestion. POWERGRID representative stated that they were looking into the issues in respect of Bahadurgarh tap change and assured that they would correct it soon.

22.8 OCC observed that there had been improvement in voltages after the tap changes. However, OCC expressed concern at non information of status of tap changes at 220 kV and below

transformers. As already agreed in previous OCC meetings, OCC again advised all entities/SLDCs to carry out the tap optimization at 220kV & below transformers based on scatter plots of HV/LV of ICTs and submit the information.

Generator reactive absorption response:

22.9 NRLDC presented the Generator reactive power absorption response especially that of thermal station (since most of the hydro stations normally remain out of bar during high voltage periods) at 400kV level based on SCADA data available at NRLDC.

22.10 Following were the observation based on SCADA data of 25th - 31st Dec 2016:

- Dadri NCR machines were generating MVAr while voltages were above 410kV for most of the time.
- Rihand & Singrauli some machines were generating MVAr.
- Jhajjar MVAr absorption appeared to be similar on one and two machine operation. Enough margins for further absorption had been observed based on its capability curve.
- Rajpura TPS, sign reversal of Unit MVAr has been observed on 26th Dec 2016 as per telemetry. Till then, as per Telemetry data Rajpura TPS was absorbing MVAr to some extent. However, as per capability curve, further absorption margin was available and this margin should be exploited for voltage control.
- Talwandi Saboo TPS, reactive absorption trend was not as per system requirement. Telemetry of Talwandi Saboo units MVAr also needs recheck.
- Telemetry of Khedar TPS was not reliable and therefore, its performance could not be observed.
- CLP Jhajjar was absorbing the MVAr though enough margins were still available as per its capability curve.
- MVAr response of 400kV and 220kV Suratgarh units appeared to be erroneous. Most of the time, it appeared that Suratgarh TPS was generating MVAr in spite of having high voltage. Telemetry of voltage was also not reliable. Therefore, telemetry of Voltages, MVAr of generating units etc. at Suratgarh need to be reviewed by Rajasthan.
- Kalisindh & Kawai TPS were absorbing MVAr though further margin were available as per their capability curves.
- Uttar Pradesh: AnparaC, Bara & Lalitpur TPS graph were shown. All the generating units were absorbing . However, these stations had more margins as per their capability curve.

22.11 NTPC representative stated that they were also checking their machine MVAR response on daily basis. As per their observation, machines were absorbing MVAr based on system requirement. OCC observed that telemetry of sign of MVAr may be an issue which needs a review/recheck. It was also observed that apart from direction, the value of VARs also was very high in some of the cases such as Dadri. NTPC agreed to look into the telemetry issues of units MVAr (Sign and amplitude) and would take up the corrective action in this regard

22.12 Based on above observations and discussions, OCC advised following action:

a. All users shall ensure that their generating stations/units are generating/absorbing MVAR as per their capability curves based on system requirement (voltages).
b. Monitoring of Units MVAr response through SCADA data by all SLDCs
c. Telemetry of VARs of generating units (Signs and amplitude) shall be checked and corrected.
d. All utilities shall share the discrepancies observed and corrective action taken to rectify the above issues during next OCC meeting.

22.13 Reactive Power injection at ISTS:
NRLDC presented data based on NRPC reactive energy account. The nodes which were injecting reactive power to ISTS during high voltage were as under:

State control area	MVAr Injection into ISTS during High voltage as per NRPC RE account for week of 12th -18th Dec 2016
Punjab	Barnala, Gobindgarh,Jamsher, Ropar, Amritsar, Ludhiana, MogaPG, Patiala & Sarna
Haryana	Bahadurgarh, Deepalpur, Gurgaon,Kaithal
Rajasthan	Hissar, Bhinmal,Heerapura, Jaipur South, Kankroli & Sikar
Delhi	**BTPS, Narela,Bamnoli, Bawana, Maharanibagh, Mandola & Mundka**
Uttar Pradesh	Anpara, Rosa and Mainpur
Uttrakhand	--
Himmachal Pradesh	Jessore
Jammu & Kashmir	--
Chandigarh	--

22.14 It was also observed that Delhi & Punjab state control areas were net payable in reactive power accounts due to reactive power injection during high voltages.

22.15 NRLDC also presented SCADA data of ICTs wherein reactive power injection was seen from 220 kV to 400 kV. Some of these nodes are as given below

S. N	States	400/220kV ICT nodes
1	Punjab	Amritsar, Moga, Patiala & Ludhiana
2	Haryana	Bahadurgarh,Gurgaon,Kaithal & Dhanoda
3	Rajasthan	Bhinmal, Jaipur South, Kankroli & Sikar
4	**Delhi**	**MaharaniBagh,Mandola, Bamnoli & Bawana**

22.16 As per SCADA plots of MVAr of ICTs of Delhi, reactive injection at Bawana and Bamnauli had reduced considerably. However, at Bamnauli, it has again increased. SLDC, Delhi representative stated that they had taken numbers of preventive measures to

control the high voltage and MVAr injection into the grid by opening of many 220kV cables during night hours or lean period. OCC requested SLDC, Delhi to submit action taken report, in this regard, within a week's time.

Synchronous condenser Operation:

22.17 NRLDC representative stated that to contain the high voltage during winter, it was suggested that the machines having synchronous condenser capability should operate in condenser mode to absorb the MVAr especially during night hours. For this purpose, mock testing schedule of such machines was discussed and agreed in previous OCC meetings.

22.18 It was informed that testing of two machines at Tehri HEP had been done. Himachal Pradesh stated that Larji HEP mock test had been done on 27th & 28th Dec 2016 for uni#3.

22.19 SLDC, HP stated that unit#3 generated ~ 14 MVAr during the testing. However, it had been taken under shutdown for further checking. OCC advised them to check the absorption capability of units also during condenser operation.

22.20 OCC advised to run Tehri & larji HEP units in synchronous condenser mode as per system requirement.

22.21 NHPC representative stated that Chamera-II Power Station was ready to operate one machine on condenser mode. NRLDC/NRPC may provide the appropriate date for this. In response, NRLDC stated that, in such cases the suitable date is provided by Power Station. Hence, NHPC was requested to send a suitable date to operate the machine of Chamera-II Power Station on condenser mode and accordingly NRLDC would monitor the requisite data during operation.

22.22 OCC also advised Punjab and Uttrakhand to update the forum about testing of synchronous capability at RSD, and Gas units of Uttarakhand at the earliest.

22.23 Representative of SLDC, Delhi informed that it was not techno-economically viable to modify GTs of IPGTPS for synchronous condenser mode.

EHV Line opening:

22.24 NRLDC representative stated that due to high voltages in the system, on an average about 33 nos. of EHV lines (400kV and above) were being opened daily. 400kV Agra-Bhiwadi-2, 400kV Bhiwadi-Neemrana-1, 400kV BallabhgarhMainpuri-1 and 400kV Nalagarh-Parbati Pool had been open more than 25 times during Dec'16.

22.25 NTPC representative expressed concern over daily switching operation of 400 kV Auraiya-Agra line to control high voltage problem as such frequent operation has detrimental effect on life of equipment. PGCIL was advised to ensure that their line reactors at Agra end are kept in service to control high voltage.

22.26 OCC advised to give priority to reliability and also advised all utilities to ensure usage of line reactors as bus reactor when lines are being opened on high voltage. It was also suggested that for reliability purpose, substation personnel at respective substations shall ensure closer (connection) of dia after opening of the lines.

23. Hydro generation during winter

23.1 NRLDC representative stated that Hydro generation in NR is mostly snow fed and therefore during winter, their generation reduces due to less water in winter. In addition, most of the hydro plants in NR are Run of river (RoR) or small Pondage type. Since, hydro generation is limited during winter; it is mainly used for peaking requirement. Hence, Hydro generation optimization become important during winter to meet peak demand.

23.2 Considering the importance of hydro generation, NRLDC presented the generation patterns, ratio of peak to IC and off peak to IC of most of the hydro generators for the month of Dec 2016. Following was observed from these patterns:

- NHPC station e.g. Bairasuil, Chamera-I,II,III, Dulhasti, Dhauliganga, SewaII, NJPC & Rampur, Tehri, Karcham HEP etc. were generating during peak hours only.

- NHPC's Uri-I & II, Salal, Tanakpur, Koteshwar HEP were generating other than peak hours also.

- Some of NHPC stations were not giving full peaking capacity as per their installed capacities. NHPC informed that it was due to shutdown of units for maintenance. SJVN representative informed about shut down of one unit at Rampur for maintenance.

- Bhakra, Dehar, Pong has also increased the generation during day hours. No fixed pattern for States hydro stations was observed and these stations are also generating during night hours.

- Vishnuprayang and Alaknanda HEP in Uttar Pradesh were generating throughout the time. Uttar Pradesh representative stated that they would try to minimize the generation of Vishnuprayag and Alaknanda during night hours. In case of Rihand Hydro, Uttar Pradesh representative stated that out of six units, only three units were running and also there were other constraints for water usage.

- Regarding RPS generation, the representative of Rajasthan stated that there were constraints due to barrage level as well as for irrigation usage.

23 Punjab hydro e.g. RSD, UBDC, Mukerian, Shanan were generating throughout the day & night. 23.3 NHPC representative stated that since Uri-I, Uri-II, Salal and Tanakpur Power Stations are purely ROR Plants hence peaking generation from these Power

plants is not possible. It was also added that in up-stream of Salal there is Baglihar Power Station which is operated by J&K State and in up-stream of Uri-I & Uri-II Power Station there is Lower Jhelum Power Station which is also operated by J&K State. Hence the generation of these NHPC Power Stations are regulated as per the discharge received from their up-stream Power Projects during lean season. It was further informed that Generation at Uri-I and Uri-II Power Station was considerably high during 2014-15 due to high flooding in Kashmir region and during 2015-16 due to heavy rains. The inflow data at Uri-1 Power Station for the last 6-7 years had been analyzed and it was been observed that the actual inflow in lean period during 2016-17 was near about the average inflow during 2010 to 2013. However, the inflow during 2014-15 and 2015-16 had abnormally high due to flooding & heavy rain, respectively. 23.4 OCC advised all the concerned utilities to Minimize the Hydro generation during night hours and Maximize during peak hours. It was also suggested that Machine maintenance, co-ordination with associated barrage/dam/reservoirs /irrigation facility should be done so as to maximize the generation during peak hrs as well as during other day hours of high demand period. Representatives of Uttar Pradesh, Punjab, and Rajasthan agreed to explore all possibilities of optimization by coordinating with respective downstream dam/reservoir or irrigation authorities to minimize the generation during night hours 23.5 OCC advised BBMB to further explore possibility of reducing the generation during night hours in both quantum [at Bhakra complex] as well as time [at Pong and Dehar]. This saving of water during night hour can be utilized during high demand hours of day time. Representative of BBMB also agreed to take appropriate action to minimize the generation at Bhakra & Pong during night hours. 23.6 OCC advised, all SLDCs to apprise the outcome in next OCC meeting.

8 It was explained that on every day, number of transmission and distribution lies got opened particularly during nigh time to control high voltages putting the reliability of power supply at very risky stage. For example, in Northern Region on 08.02.2017, total 60 nos. of Bulk Transmission Lines including that of 765kV and 400kV lines got opened. The details are as under:-

Sr. No	Name of the transmission line	Voltage level	Owner	From		To	
				Date	Time	Date	Time
1	Meerut - Moga	765 kV	PGCIL	7/2/17	21:32	8/2/17	6:27
2	Bhiwani -Meerut	765 kV	PGCIL	7/2/17	23:45	8/2/17	6:28
3	Agra-Fatehpur	765 kV	PGCIL	7/2/17	23:53	8/2/17	7:11
4	Jatikala-Kanpur New	765 kV	PGCIL	8/2/17	1:23	8/2/17	7:59
5	Meerut - Moga	765 kV	PGCIL	8/2/17	20:27	10/2/17	8:59
6	Mainpuri(PG)-Paricha(UPPTCL) -2	400 kV	UPPTCL	26/1/17	20:48	9/2/17	12:52
7	Bhiwani-Jind 1	400 kV	PGCIL	27/1/17	21:15	8/2/17	21:00
8	Chamera pool-Jalandhar 2	400 kV	PGCIL	30/1/17	13:30	8/2/17	8:18
9	Bhiwani-Jind 2	400 kV	PGCIL	4/2/17	0:24	**	**
10	Ajmer II-Didwana	400 kV	RRVPNL	6/2/17	14:06	12/2/17	7:37
11	Abdullapur-Kurukshetra(PG) 2	400 kV	PGCIL	6/2/17	20:10	10/2/17	5:56

Sr. No	Name of the transmission line	Voltage level	Owner	From		To	
				Date	Time	Date	Time
12	Dhuri(400kv) -Talwandi Sabo 1	400 kV	PSEB	6/2/17	23:55	**	**
13	Khedar-Nuhiyawali 2	400 kV	HVPNL	7/2/17	0:27	11/2/17	9:05
14	Bikaner-Didwana 1	400 kV	RRVPNL	7/2/17	18:07	8/2/17	6:12
15	Jodhpur II-Merta 1	400 kV	RRVPNL	7/2/17	18:09	8/2/17	10:25
16	Ratangarh (RVPNL) - Sikar (PG) ï 1	400 kV	PGCIL	7/2/17	19:50	8/2/17	6:23
17	Abdullapur-Kurukshetra(PG) 1	400 kV	PGCIL	7/2/17	20:14	8/2/17	6:03
18	Jhakri(SJVNL)-Karchamwangtoo(JP) 1	400 kV	JPHYDRO	7/2/17	20:17	8/2/17	5:25
19	Abdullapur-Panchkula 2	400 kV	PGCIL	7/2/17	20:17	8/2/17	5:44
20	Jhakri-Panchkula 2	400 kV	PGCIL	7/2/17	20:18	8/2/17	5:36
21	Amritsar-Parb-pol 1	400 kV	PGCIL	7/2/17	20:34	8/2/17	5:45
22	Koldam(NTPC)-Ludhiana(PG) -1	400 kV	PKTCL	7/2/17	20:42	8/2/17	6:04
23	Jalandhar-Kurukshetra(PG) 1	400 kV	PGCIL	7/2/17	20:47	8/2/17	7:26
24	Neemrana-Sikar 2	400 kV	PGCIL	7/2/17	21:34	8/2/17	7:26
25	Bhiwadi-Neemrana 1	400 kV	PGCIL	7/2/17	21:37	8/2/17	7:09
26	Makhu -Mukatsar -1	400 kV	PSEB	7/2/17	21:37	8/2/17	7:27
27	Agra-Jaipur South-1	400 kV	PGCIL	7/2/17	21:38	8/2/17	7:24
28	Agra-Bhiwadi 2	400 kV	PGCIL	7/2/17	21:39	8/2/17	7:06
29	Mukatsar -Talwandi Sabo - 1	400 kV	PSEB	7/2/17	21:43	8/2/17	7:46
30	Nallagarh(PG)-Rampur(SJVNL)-2	400 kV	PGCIL	7/2/17	21:59	8/2/17	5:38
31	Fatehabad-Hisar	400 kV	PGCIL	7/2/17	22:00	8/2/17	8:10
32	Nallagarh(PG)-Parbati Pool(PG)	400 kV	PKTCL	7/2/17	22:00	8/2/17	7:23
33	Heerapura-Hindaun II	400 kV	RRVPNL	7/2/17	22:02	8/2/17	5:55
34	Chamera I(NHPC)-Jalandhar(PG) 1	400 kV	PGCIL	7/2/17	22:04	8/2/17	6:09
35	Kurukshetra(PG)-Nakodar(PSEB)	400 kV	PGCIL	7/2/17	22:05	8/2/17	8:19
36	Panchkula-Patiala 1	400 kV	PGCIL	7/2/17	22:07	8/2/17	8:23
37	Patiala(PG)-Patran(PTCL) 2	400 kV	PGCIL	7/2/17	22:08	8/2/17	8:19
38	Akal-Jodhpur II	400 kV	RRVPNL	7/2/17	22:11	9/2/17	23:14
39	Kaithal(PG)-Patran(PTCL) 2	400 kV	PGCIL	7/2/17	22:33	8/2/17	9:32
40	Ballabgarh(PG)-Bamnauli(DTL) 2	400 kV	DTL	7/2/17	22:56	8/2/17	7:07
41	Abdullapur(PG)-Dipalpur(HVPNL)	400 kV	PGCIL	7/2/17	23:18	8/2/17	7:19
42	Bhiwadi-Hisar	400 kV	PGCIL	8/2/17	0:08	8/2/17	9:04
43	Ballabgarh-Mainpuri 1	400 kV	PGCIL	8/2/17	1:14	8/2/17	7:18
44	Kurukshetra(PG)-Sonipat 1	400 kV	PGCIL	8/2/17	1:22	8/2/17	8:25
45	Bahadurgarh-Sonepat 1	400 kV	PGCIL	8/2/17	1:23	10/2/17	10:44
46	Merta-Ratangarh	400 kV	RRVPNL	8/2/17	4:03	8/2/17	5:50
47	Jhakri(SJVNL)-Karchamwangtoo(JP) 2	400 kV	JPHYDRO	8/2/17	20:04	9/2/17	5:33
48	Koldam(NTPC)-Ludhiana(PG) -1	400 kV	PKTCL	8/2/17	22:04	9/2/17	11:22
49	Chamera I(NHPC)-Jalandhar(PG) 1	400 kV	PGCIL	8/2/17	22:10	9/2/17	5:06
50	Nallagarh(PG)-Rampur(SJVNL)-2	400 kV	PGCIL	8/2/17	22:14	9/2/17	5:44
51	Nallagarh-Patiala 2	400 kV	PGCIL	8/2/17	22:15	9/2/17	6:18
52	Agra-Bassi 1	400 kV	PGCIL	8/2/17	22:16	9/2/17	6:37
53	Fatehabad-Hisar	400 kV	PGCIL	8/2/17	22:16	9/2/17	11:25
54	Abdullapur-Kurukshetra(PG) 1	400 kV	PGCIL	8/2/17	22:27	9/2/17	10:28
55	Mukatsar -Talwandi Sabo - 2	400 kV	PSEB	8/2/17	22:50	9/2/17	9:20
56	Makhu -Mukatsar -2	400 kV	PSEB	8/2/17	22:50	9/2/17	9:16
57	Panchkula-Patiala 1	400 kV	PGCIL	8/2/17	23:22	9/2/17	6:17
58	Baspa(HP)-Karchamwangtoo(JP) 2	400 kV	JP HYDRO	8/2/17	23:38	9/2/17	5:40
59	Bawana(DTL)-Mandola(PG) 2	400 kV	DTL	8/2/17	23:52	9/2/17	6:59
60	Dadri(NTPC)-Harsh Vihar(DTL) -1	400 kV	NTPC	8/2/17	23:52	9/2/17	7:00

Source : NRLDC website reports.

9 In Delhi System, about 33 nos. 220kV, 26 nos.66kV and 26 nos. 33kV lines got opened daily in night time to control high voltage. The details are as under:-

Sr. No	Name of Stn.	Name of the circuit	Remarks
1	Bamnauli	Dial ckts	Both ckts. at both ends
2		Naraina Ckt.	Single ckt. at both ends
3		Papankalan ï I Ckt.	Single ckt. at both ends
4		Papankalan ï II Ckt.	Single ckt. at both ends
5	Mehrauli	Vasant Kunj ckts.	Single ckt. at both ends
6	Maharani Bagh	Trauma Centre ckts	Both ckts. at both ends
7	Trauma Centre	Ridge Valley Ckt.	Single ckt. at both ends
8	Bawana	DSIDC Bawana Ckt.	Both ckts. at both ends
9	DSIDC Bawana	Narela ckt.	Single ckt. at both ends
10	Bawana	Rohini ï II	Single ckt. at both ends
11		Rohini ï I	Single ckt. at both ends
12		Shalimarbagh	Single ckt. at both ends
13	Rohini-I	Shalimarbagh	Both ckts. at both ends
14	Mundka	Peeragarhi	Both ckts. at both ends
15	Peeragarhi	Wazirpur	Single ckt. at both ends
16	Shalimarbagh	Wazirpur	Single ckt. at both ends
17	Bawana	Khanjawala	Both ckts. at both ends
18	Pragati	Park street	Single ckt. at both ends
19	Maharani Bagh	Masjid moth ckts.	Both ckts. at both ends
20		Electric Lane	Both ckts. at both ends
21		Lodhi Road	Single ckt. at both ends
22	Wazirabad	Gopalpur	Both ckts. at both ends
23		Mandola	Single ckt. at both ends
24		Kashmiri Gate	Single ckt. at both ends
25	Gopalpur	Subzi Mandi	Single ckt. at both ends
26	Bamnauli	400kV Ballabgarh	Single ckt. at both ends
27	Gazipur	Noida-Btps ckt	Single ckt. at both ends
28	Vasant Kunj	220kV R.K.Puram ckt. charged at 66kV	To be made off at Vasant Kunj
29	Kashmiri Gate	DMRC Ckt.	Ckt. which is on no load to be made off
30	Shalimarbagh	DMRC Ckt.	To be made off
31	Harsh Vihar	Preet Vihar	Both ckts. at both ends
32	Patparganj	Preet Vihar	Both ckts. at both ends
33	Patparganj	Gazipur	Single ckt. at both ends

1. Switching OFF lines to be initiated by 20.00hrs positively.
2. While charging the lines during normalization, it should be ensured that line be charged from low voltage end .

BYPL

Sr. No.	Name of Stn.	Name of Ckt.
1	220kV Park Street	33kV Faiz Road Ckt-I
2		33kV Motia Khan Ckt-II
3	220kV Subzi Mandi	33kV BG Road Ckt-II
4	220kV IP	33kV Bay-17 ï Delhi Gate
5		33kV Bay-18 ï DDU
6	220kV RPH	33kV Bay-13 ï GB Pant
7		33kV Bay-12 ï IG Stadium
8		33kV Bay-5 ï Jama Masjid
9		33kV Bay-6 ï Jama Masjid
10		33kV Bay-2 ï Lahori Gate
11		33kV Bay-17 ï Minto Road
12		33kV Bay-18 ï Town Hall
13	220kV Patparganj	66kV GH-I Ckt-II
14		66kV Vivek Vihar Ckt-II
15		66kV Khichripur Ckt
16		66kV Akshardham Ckt.
17		33kV Karkardooma Ckt-II
18		33kV Geeta Colony Ckt.
19		33kV Scope Tower Ckt.
20		33kV Guru Angad Nagar Ckt-II
21	220kV Gazipur	66kV Kondli Ckt-I
22	220kV Wazirabad	66kV Shastri Park Ckt-I
23		66kV Yamuna Vihar Ckt-I
24	220kV Geeta Colony	33kV Kailash Nagar Ckt-II
25		33kV Kanti Nagar CKt-II
26		33kV Shakarpur Ckt.
27	400kV Harsh Vihar	66kV Nand Nagari Ckt-II

TPDDL

Sr. No.	Name of Stn.	Name of Ckt.
1	66kV Rohini-II	66kV Mangolpuri Ckt-I
2	66kV Rohini-II	66kV Mangolpuri Ckt-II
3	66kV Rohini-I	66kV Pitampura-II Ckt-II
4	66kV Rohini-I	66kV Rithala Ckt-I
5	66kV Mangopuri-II	66kV Pitampura-II Ckt-II

BRPL

Sr. No.	Name of Stn.	Name of Ckt.	Remarks
1	220kV Sarita Vihar	66kV Mathura Road Ckt-I	
2	220kV Vasant Kunj	66kV Vasant Kunj `CôBlock Ckt-I & II	
3	220kV Okhla	66kV Okhla Phase-I Ckt-I	
4		33kV Okhla Phase-II Ckt-I	
5		33kV Balaji Ckt-I	
6		33kV Nehru Place Ckt-II	
7		33kV Alaknanda Ckt-I	
8	220kV DIAL	66kV DIAL (Aerocity) Ckt-I	
9	220kV Peera Garhi	33kV Udyog Nagar Ckt	
10		33kV Paschim Puri Ckt-II	
11	220kV Pappankalan-I	66kV Bindapur Ckt-I	
12		66kV GH-II Ckt-I	Load of Sagarpur and Hari Nagar can be managed through 66kV Pankha Road ï Sagarpur link
13	220kV Pappankalan-II	66kV GGS Ckt-I	
14		66kV G-15 Ckt-I	
15		66kV G-6 Ckt-I	
16	220kV IP	33kV Bay-7 (Exh Ground-I)	
17		33kV Bay-37 ï Kilokari	
18	220kV Najafgarh	66kV Jafarpur Ckt-I	
19		66kV Nangloi Ckt.	
20	220kV Mehrauli	66kV Malviya Nagar (Two Ckts)	Load can be managed through 66kV Okhla ï Malviya Nagar Ckts.

10 From the above, it is evident that in case of outage of existing circuit (since the other circuit is kept opened to control high voltage), the reliability of power supply including essential services of Delhi Metro, Railways, Hospitals etc would definitely be affected. It was brought out that during July 2012 incident, number of 765kV, 400kV and 220kV and below lines were kept opened to control high voltage. This was also one of the reasons of massive collapse of the system.

11 Despite doing all the efforts, it has been observed that reactive power injection to the tune of 400MVAR and high voltage profile exists during off peak hours as evident from following table :-

Load profile on the day maximum peak demand met occurred during this winter - 4168MW on 20.01.2017 at 10:00:08hrs.

TIME HRs.	Demand Met IN MW	Reactive Power Drawal In MVAR	VOLTAGE PROFILE AT VARIOUS POWER EXCHANGE POINTS OF DELHI(kV)								
			Mandola		Bamnauli		Mundka			Maharani Bagh	
			400kV	220kV	400kV	220kV	400kV	220kV	66kV	400kV	220kV
01:00	1714	-327	426	240	421	236	424	224	70	NA	234
02:00	1601	-350	428	241	423	237	426	224	71	NA	235
03:00	1554	-380	428	241	423	237	427	224	71	NA	235
04:00	1562	-383	429	242	424	238	428	224	71	NA	236
05:00	1736	-413	422	238	417	234	420	224	70	NA	232
06:00	2423	-306	416	234	410	231	414	224	68	NA	228
07:00	3327	-55	412	231	407	227	412	224	68	NA	226
08:00	3710	-94	416	232	410	229	415	224	69	NA	227
09:00	3782	-165	409	229	402	225	409	224	68	NA	223
10:00	4142	-42	408	226	401	224	407	224	67	NA	222
11:00	3976	8	407	226	400	224	406	224	67	NA	222
12:00	3762	-64	409	228	404	226	409	224	67	NA	224
13.00	3344	-242	410	229	406	228	410	224	68	NA	225
14.00	3065	-216	410	229	406	228	410	224	68	NA	225
15.00	3058	-163	410	229	406	228	411	224	68	NA	225
16.00	2988	-134	412	230	408	229	413	224	68	NA	226
17.00	3031	-127	412	230	408	229	412	224	68	NA	226
18:00	3377	-11	414	230	410	229	414	224	68	NA	227
19:00	3482	15	411	229	408	228	411	224	67	NA	226
20.00	3350	-84	419	234	416	233	420	224	69	NA	229
21.00	3029	-214	420	235	416	233	420	224	69	NA	230
22.00	2811	-283	422	236	419	235	422	224	70	NA	231
23.00	2382	-282	417	234	414	233	418	224	69	NA	230
24:00	1977	-310	424	239	421	237	424	224	70	NA	234

TIME HRs.	Demand Met IN MW	Reactive Power Drawal In MVAR	VOLTAGE PROFILE AT VARIOUS POWER EXCHANGE POINTS OF DELHI(kV)									
			Bawana			Narela			BTPS	GAZIPUR		
			400kV	220kV	66kV	220kV	66kV	11kV	220kV	220kV	66kV	11kV
01:00	**1714**	-327	424	232	67.6	240	68	11.4	238	242	69	11.9
02:00	**1601**	-350	426	233	68.1	241	69	11.4	239	242	69	11.9
03:00	**1554**	-380	427	234	68	243	69	11.3	240	242	69	11.9
04:00	**1562**	-383	427	234	67.7	244	69	11.3	240	242	69	11.9
05:00	**1736**	-413	420	230	66.8	239	67	11	236	240	69	11.8
06:00	**2423**	-306	414	227	66.1	237	67	10.9	227	230	66	11.3
07:00	**3327**	-55	412	226	65.4	234	66	10.8	222	228	65	11.1
08:00	**3710**	-94	414	227	65.7	232	66	10.9	214	228	65	11.1
09:00	**3782**	-165	409	224	64.6	229	65	10.8	212	225	65	11
10:00	**4142**	-42	408	223	63.3	226	64	10.8	202	220	65	11
11:00	**3976**	8	406	223	63.2	227	64	10.8	208	217	64	10.9
12:00	**3762**	-64	408	223	63.6	216	65	10.9	215	220	65	11
13.00	**3344**	-242	408	224	64.8	231	65	10.9	212	222	65	11.1
14.00	**3065**	-216	408	224	64.4	229	65	11	206	222	65	11.1
15.00	**3058**	-163	409	224	64.3	232	65	11	204	222	66	11.1
16.00	**2988**	-134	411	225	64.3	232	65	11	219	223	66	11.2
17.00	**3031**	-127	411	225	64.6	230	65	11	221	223	66	11.2
18:00	**3377**	-11	412	226	64.8	231	65	11	224	223	66	11.2
19:00	**3482**	15	411	225	64.7	230	65	10.9	222	222	66	11.2
20.00	**3350**	-84	419	230	65.8	236	66	11.2	229	226	67	11.4
21.00	**3029**	-214	420	231	66.4	238	67	11	231	227	67	11.4
22.00	**2811**	-283	422	232	66.7	238	67	11	233	229	68	11.5
23.00	**2382**	-282	417	229	66.4	237	67	11	230	230	68	11.6
24:00	**1977**	-310	424	233	67.4	240	68	11.2	234	234	69	11.8

12 It has been observed that the reactive power flow at 400kV Bamnauli could not be controlled so far despite taking all possible steps.. The reactive power injection through 220kV lines and 400/220kV ICTs at Bamnauli 400kV S/Stn. during a day (23.01.2017) is as under:-

Hrs.	400/220 kv Total ICTs Loading		400	220	220 KV PAPANKALAN-1-I		220 KV PAPANKALAN-1-II		220 KV PAPANKALAN-2-I	
					MW	MVAR	MW	MVAR	MW	MVAR
01:00	286	-57	417	236	51	-12	1	1	60	-19
02:00	269	-61	420	238	47	-14	1	1	56	-20
03:00	263	-64	421	239	45	-14	1	1	54	-20
04:00	270	-63	421	239	46	-15	1	1	55	-19
05:00	314	-57	415	235	56	-15	1	1	66	-19
06:00	678	-149	403	230	108	-4	1	1	109	-10
07:00	922	-139	397	226	165	-6	0	-1	58	-12
08:00	937	-162	404	231	72	-14	91	3	59	-14
09:00	983	-151	408	233	77	-12	90	1	62	-12
10:00	1011	-90	404	229	88	3	85	6	59	-10
11:00	954	-91	405	230	88	2	79	5	61	-10
12:00	882	-93	407	231	76	2	70	7	49	-13
13:00	797	-142	410	234	62	-3	60	3	50	-15
14:00	740	-138	408	232	65	-2	52	0	47	-15
15:00	705	-134	410	233	63	-2	49	4	34	-15
16:00	699	-139	412	235	62	-1	47	4	47	-14
17:00	735	-120	412	234	53	-3	48	3	42	-15
18:00	815	-102	414	235	78	5	61	6	51	-14
19:00	873	-93	408	231	79	4	66	7	56	-12
20:00	817	-126	416	237	72	0	65	5	56	-13
21:00	786	-148	415	237	-1	-2	127	5	0	-2
22:00	718	-150	416	237	-1	-2	117	-3	0	-2
23:00	607	-158	414	236	0	0	96	-2	0	0
24:00	333	-47	417	236	0	0	69	-8	0	0

Hrs.	220 KV PAPANKALAN-2-II		220 KV NARAINA-I		220 KV NARAINA-II		220 KV DIAL-I		220 KV DIAL-II	
	MW	MVAR	MW	MVAR	MW	MVAR	MW	MVAR	MW	MVAR
01:00	0	0	128	-34	0	0	1	-5	0	0
02:00	0	0	122	-35	0	0	1	-5	0	0
03:00	0	0	117	-37	0	0	1	-5	0	0
04:00	0	0	118	-38	0	0	1	-5	0	0
05:00	0	0	133	-35	0	0	1	-5	0	0
06:00	0	0	186	-28	0	0	99	-70	97	-66
07:00	103	-10	121	-14	123	-12	120	-62	118	-59
08:00	102	-12	130	-14	131	-12	112	-60	111	-57
09:00	100	-12	137	-11	137	-9	126	-56	125	-54
10:00	100	5	141	-8	142	-6	135	-51	134	-49
11:00	93	3	136	-9	137	-8	125	-48	124	-46
12:00	82	0	130	-9	131	-7	121	-45	119	-42
13:00	70	-4	117	-14	117	-12	120	-55	119	-53
14:00	60	-2	109	-14	110	-12	116	-53	115	-50
15:00	61	0	107	-13	108	-11	110	-53	109	-50
16:00	62	0	105	-12	106	-11	101	-60	100	-57
17:00	61	0	107	-12	107	-10	120	-51	119	-49
18:00	81	8	117	-7	117	-5	113	-57	112	-54
19:00	81	7	120	-9	121	-7	123	-53	122	-50
20:00	76	4	116	-10	116	-8	122	-57	122	-55
21:00	123	-11	110	-14	111	-12	111	-64	110	-62
22:00	111	-15	100	-16	101	-14	104	-64	103	-62
23:00	92	-19	0	0	171	-31	95	-63	94	-61
24:00	68	-18	0	0	144	-27	1	-5	0	0

Observations :-

i) **220kV DIAL Ckts having about 1.5Kms 1000mm^2 cable and very less load at DIAL S/Stn might be one of the reasons of high injection of reactive power through these circuits.**

ii) Injection of reactive power through Pappankalan-I and Pappankalan-II is presumably due to the fact that DMRC is fed through the circuits having 800mm^2 66kV double cable circuit and capacitance offered by cable is predominant.

13 To provide stable range of voltage as mandated in IEGC the transformerôs tap positions have also been reduced to the extent possible. The details were cited as under**:**

Present Tap position of ICTs as on 17.02.2017

400kV Sub-Stations.

Note: TT-Total No. of Taps, NT-Nominal Tap, PT- Present Tap (Tap position as on 17.02.2017)

Sl No.	Sub station	Voltage Ratio (kV)	Transmission Element	Rating (MVA)	ICT details (MVA)	Configuration	TT	NT	PT
1	BAMNAULI	400/220	ICT 01	315	1*315	Y-Y	17	9	7B
2	BAMNAULI	400/220	ICT 02	315	1*315	Y-Y	17	9	7B
3	BAMNAULI	400/220	ICT 03	500	1*500	Y-Y	17	9	7B
4	BAMNAULI	400/220	ICT 04	500	1*500	Y-Y	17	9	7B
5	BAWANA	400/220	ICT 01	315	1*315	Y-Y	17	9	9B
6	BAWANA	400/220	ICT 02	315	1*315	Y-Y	17	9	9B
7	BAWANA	400/220	ICT 03	315	1*315	Y-Y	17	9	9B
8	BAWANA(CCGT)	400/220	ICT 04	315	1*315	Y-Y	17	9	9B
9	BAWANA(CCGT)	400/220	ICT 05	315	1*315	Y-Y	17	9	9B
10	BAWANA(CCGT)	400/220	ICT 06	315	1*315	Y-Y	17	9	9B
11	MUNDKA	400/220	ICT 02	315	1*315	Y-Y	17	9	9B
12	MUNDKA	400/220	ICT 03	315	1*315	Y-Y	17	9	9B
13	MUNDKA	400/220	ICT 04	315	1*315	Y-Y	17	9	9B
14	HARSH VIHAR	400/220	ICT 01	315	1*315	Y-Y	17	9	5
15	HARSH VIHAR	400/220	ICT 02	315	1*315	Y-Y	17	9	5
16	HARSH VIHAR	400/220	ICT 03	315	1*315	Y-Y	17	9	5

220kV Sub-Stations.

Tap Position as on 17.02.2017.

S. N	Name of the Element	MVA rating of ICT	Total tap no	Normal tap no.	Present tap position no.
	400kV Bawana S/S				
1	220/66kV 100MVA Tx	100	17	5	5B
	400kV Mundka S/S				
2	220/66kV 160MVA Tx-II	160	17	5	5
3	220/66kV 160MVA Tx-III	160	17	5	5
	220kV Narela S/S				
4	220/66kV 100MVA Tx-I	100	12	5	3
5	220/66kV 100MVA Tx-II	100	12	5	3
6	220/66kV 100MVA Tx-III	100	12	5	3
	220kV Rohini S/S				
7	220/66kV 100MVA Tx-I	100	17	5	5
8	220/66kV 100MVA Tx-II	100	17	5	5
9	220/66kV 100MVA Tx-III	100	17	5	5
10	220/66kV 100MVA Tx-IV	100	17	5	5
	220kV Patparganj S/S				
11	220/66kV 100MVA Tx-I	100	17	5	3
12	220/66kV 100MVA Tx-II	100	17	5	3
13	220/33kV 100MVA Tx-I	100	17	5	3
14	220/33kV 100MVA Tx-IV	100	17	5	3
15	220/33kV 100MVA Tx-V	100	17	5	3
	220kV Pragati S/S				
16	220/66kV 160MVA Tx-I	160	17	5	3
17	220/66kV 160MVA Tx-II	160	17	5	3
	220kV Gazipur S/S				
18	220/66kV 100MVA Tx-I	100	17	5	3
19	220/66kV 100MVA Tx-II	100	17	5	3
20	220/66kV 160MVA Tx	160	17	5	3
	220kV Wazirabad S/S				
21	220/66kV 100MVA Tx-I	100	17	5	3
22	220/66kV 100MVA Tx-II	100	17	5	3
23	220/66kV 100MVA Tx-III	100	17	5	3
24	220/66kV 160MVA Tx-I	160	17	5	3
	220kV Okhla S/S				
25	220/66kV 100MVA Tx-I	100	17	5	3
26	220/66kV 100MVA Tx-II	100	17	5	3
27	220/33kV 100MVA Tx-III	100	17	5	3
28	220/33kV 100MVA Tx-IV	100	17	5	3
29	220/33kV 100MVA Tx-V	100	17	5	3
	220kV Sarita Vihar S/S				
30	220/66kV 100MVA Tx-I	100	17	5	3
31	220/66kV 100MVA Tx-II	100	17	5	3
32	220/66kV 100MVA Tx-III	100			

S. N	Name of the Element	MVA rating of ICT	Total tap no	Normal tap no.	Present tap position no.
	220kV Vasant Kunj S/S				
33	220/66kV 160MVA Tx-I	160	17	5	3
34	220/66kV 100MVA Tx-II	100	17	5	3
35	220/66kV 100MVA Tx-III	100	17	5	3
	220kV Najafgarh S/S				
36	220/66kV 100MVA Tx-I	100	17	5	3
37	220/66kV 100MVA Tx-II	100	17	5	3
38	220/66kV 100MVA Tx-III	100	17	5	3
39	220/66kV 100MVA Tx-IV	100	17	5	3
	220kV Park Street S/S				
40	220/66kV 100MVA Tx-I	100	17	5	2
41	220/66kV 100MVA Tx-II	100	17	5	2
42	220/33kV 100MVA Tx-I	100	17	5	3
43	220/33kV 100MVA Tx-II	100	17	5	Under B/D
	220kV Kanjhawala S/S				
44	220/66kV 100MVA Tx-I	100	17	5	3
45	220/66kV 100MVA Tx-II	100	17	5	3
46	220/66kV 160MVA Tx-III	160	17	5	3
	220kV Pappankalan-II S/S				
47	220/66kV 100MVA Tx-I	100	17	5	3
48	220/66kV 100MVA Tx-II	100	17	5	3
49	220/66kV 160MVA Tx-III	160	17	5	3
50	220/66kV 160MVA Tx-IV	160	17	5	3
	220kV Pappankalan-I S/S				
51	220/66kV 100MVA Tx-I	100	17	5	3
52	220/66kV 100MVA Tx-II	100	17	5	3
53	220/66kV 100MVA Tx-III	100	-	-	Under B/D
54	220/66kV 100MVA Tx-IV	100	17	5	3
55	220/66kV 160MVA Tx-V	160	17	5	3
	220kV Mehrauli S/S				
56	220/66kV 100MVA Tx-I	100	17	5	3
57	220/66kV 100MVA Tx-II	100	17	5	3
58	220/66kV 100MVA Tx-III	100	17	5	3
59	220/66kV 160MVA Tx	160	17	5	3
	220kV Gopalpur S/S				
60	220/66kV 100MVA Tx-II	100	17	5	3
61	220/33kV 100MVA Tx-I	100	17	5	4
62	220/33kV 100MVA Tx-III	100	17	5	4
	220kV DSIIDC Bawana S/S				
63	220/66kV 100MVA Tx-II	100	17	5	3
64	220/66kV 100MVA Tx-III	100	17	5	3
65	220/66kV 160MVA Tx	160	17	5	3
	220kV DIAL S/S				
66	220/66kV 160MVA Tx-I	160	17	4	1
67	220/66kV 160MVA Tx-II	160	17	4	1
	220kV Ridge Valley S/S				
68	220/66kV 160MVA Tx-I	160	17	3	3
69	220/66kV 160MVA Tx-II	160	17	3	3

S. N	Name of the Element	MVA rating of ICT	Total tap no	Normal tap no.	Present tap position no.
	220kV Rohini-II S/S				
70	220/66kV 160MVA Tx-I	160	17	5	3
71	220/66kV 160MVA Tx-II	160	17	5	3
	HARSH VIHAR 400kV S/S				
72	220/66kV 160MVA Tx-I	160	17	5	3
73	220/66kV 160MVA Tx-III	160	17	5	3
74	220/66kV 160MVA Tx-II	160	17	5	3
	220kV Subzi Mandi S/S				
75	220/33kV 100MVA Tx-I	100	1-17	5	3
76	220/33kV 100MVA Tx-II	100	1-17	5	3
	220kV Kasmere Gate S/S				
77	220/33kV 100MVA Tx-I	100	17	5	3
78	220/33kV 100MVA Tx-II	100	17	5	3
	220kV Lodhi Road S/S				
79	220/33kV 100MVA Tx-I	100	17	5	3
80	220/33kV 100MVA Tx-II	100	17	5	3
	220kV Naraina S/S				
81	220/33kV 100MVA Tx-I	100	17	5	3
82	220/33kV 100MVA Tx-II	100	17	5	3
83	220/33kV 100MVA Tx-III	100	17	5	3
	220kV Geeta Colony S/S				
84	220/33kV 100MVA Tx-I	100	17	5	3
85	220/33kV 100MVA Tx-II	100	17	5	Under B/D
	220kV Shalimarbagh S/S				
86	220/33kV 100MVA Tx-I	100	17	5	5
87	220/33kV 100MVA Tx-II	100	17	5	5
88	220/33kV 100MVA Tx-III	100	17	5	5
	220kV I.P. S/S				
89	220/33kV 100MVA Tx-I	100	21	9	5
90	220/33kV 100MVA Tx-II	100	21	9	5
91	220/33kV 100MVA Tx-III	100	17	5	1
	220kV Masjid Moth S/S				
92	220/33kV 100MVA Tx-I	100	17	5	2
93	220/33kV 100MVA Tx-II	100	17	5	2
	220kV Trauma Center S/S				
94	220/33kV 100MVA Tx-I	100	17	5	5
95	220/33kV 100MVA Tx-II	100	17	5	5
	220kV Electric Lane S/S				
96	220/33kV 100MVA Tx-I	100	17	5	5
97	220/33kV 100MVA Tx-II	100	17	5	5
	220kV Wazirpur S/S				
98	220/33kV 100MVA Tx-I	100	17	5	Under B/D
99	220/33kV 100MVA Tx-II	100	17	5	5
	220kV Peeragarhi S/S				
100	220/33kV 100MVA Tx-II	100	17	5	5
101	220/33kV 100MVA Tx-III	100	17	5	5

14 It was found that due to very less demand during night time and high capacity cables (for each circuit 66kV 800mm^2 double XLPE cables are used) high voltages are found induced in the Grid particularly from where Delhi Metro is fed. It was explained that the drawal of Delhi Metro from the System now-a-days during off peak hours is about 43MW whereas during peak hours, it is about 143MW. The details of voltage, active and reactive power flows from Delhi System to Delhi Metro feeders from the 220kV Sub-Stations of Delhi were cited as under:-

DETAILS OF DMRC SUPPLY AND THEIR LOADING ON 23.01.2017 .

S. NO	NAME OF DMRC FEEDER	FEEDING 220kV SUB STATION	MVAR INJ/ DRAWL BY DISCOMS AT 03.00HRS	MVAR INJ / DRAWL BY DISCOMS AT 10.00HRS	VOLTAGES PROFILE (KV)				TX TAPS ON 100/160 MVA	LOAD ON DMRC FEEDER AT 03.00Hrs		LOAD ON DMRC FEEDER AT 10.00Hrs	
					220	66	33	11		MW	MVAR	MW	MVAR
1	220 kV DMRC ckt-I	Kashmiri Gate	4	7.2	240	é	35.4	11.7	3	7	-7	12	1
2	220 kV DMRC ckt-II	Kashmiri Gate			240	é	35.4	11.7	3	0	$	0	-5
3	66kV DMRC-I	Rohini-I	0	25	236	69	é	11.9	5	0.5	$	1	-4
4	66kV DMRC-II	Rohini-I			236	69	é	11.9	5	0.5	$	1	-1
5	220kV DMRC-I	Shalimar bagh	8	16	235	é	35.6	11.6	5	5	$	7	-20
6	66kV DMRC-I	GTPS	-8	-5	238	66	é	é	4	3	-8	33	-3
7	66kV DMRC-II	GTPS			238	66	é	é	4	3	-8	16	-5
8	66kV DMRC-I	Mehrauli	1	4.6	240	69	é	11.8	3	2	-6	39	-4
9	66kV DMRC-II	Mehrauli			240	69	é	11.8	3	0	-2	0	-1
10	66kV DMRC-I	PPK-I	-16	-16	232	68	é	11	3	4	$	6	$
11	66kV DMRC-II	PPK-I			232	68	é	11	3	3.5	$	3.4	$
12	66kV DMRC-I	PPK-II	-19	-11	235	67	é	é	3	0	0	0	0
13	66kV DMRC-II	PPK-II			235	67	é	é	3	4	$	6	4
14	66kV DMRC-I	Dial	-4	-8	240	70	é	é	2	0	0	0	-4
15	66kV DMRC-II	Dial			240	70	é	é	2	2	-2	3	0
16	66kV DMRC-I	Sarita Vihar	-19	-8	245	71	é	11.9	3	3.2	-15	5	-16
17	66kV DMRC-II	Sarita Vihar			245	71	é	11.9	3	0	-2	0	-2
18	66Kv DAMPEL	Parkstreet	-15	-15	237	70.6	34.6	é	3	0	$	0	-1
19	66kV DMRC-II	Parkstreet			237	70.6	34.6		3	4	$	11	-8
20	220kV R.K.Puram	Vasantkunj	-4	-2	237	69	é	11.6	3	Under Shutdown		Under Shutdown	

15 The details indicating the reactive power flow at various grids substations from where power is injected to Delhi system at the off peak time during this winter were shown as under

(Active and Reactive Power status on 23.01.2017 at 03.00hrs)

Sr. No	Name of the station	Ckt. / Tx	MW	MVAR	Voltage		Remarks
					400kV	220kV	
1	400kV Bamnauli	Pappankalan-I	44	-16	417	239	Metro is fed from Pappankalan-I
2		Pappankalan-II	45	-21			
3		Najafgarh	49	9			
4		DIAL	0	0			
5		Naraina	27	-3			
6	400kV Bawana	DSIDC Bawana	74	-18			
7		Rohini-I	69	0	427	232	
8		Rohini-II	15	0			
9		Shalimar Bagh	34	8			
10		Kanjhawala	39	-8			
11		220/66kV Tx.	24	-4			
12	Maharani Bagh	Masjid Moth	0	0	NA	236	
13		Trauma Centre	40	9			
14		Electric Lane	0	0			
15		Lodhi Road	47	1			
16	Harsh Vihar	220/66kV 160MVA	50	1	429	236	
17	Mundka	Peera Garhi	15	-2	426	233	
18		Najafgarh	79	6			
19		Kanjhawala	--	-			
20		220/66kV 160MVA Tx.	33	-13			
21	Mandola	Wazirabad	210	-46	428	238	
22		Gopalpur	80	-11			
23		Narela	128	-38			
24	BTPS	Okhla	72	-7	--	240	
25		Sarita Vihar	-89	-35			Delhi Metro is fed from Sarita Vihar
26		Ballabhgarh	-190	60			
27		Alwar	50	11			
28		Mehrauli	141	-46			

TOTAL MVAR INJECTION BY DELHI SYSTEM ON 23.01.17
AT 03.00HRS : (-281MVAR)
A 10.00HRS : (-44MVAR)

TOTAL MVAR INJECTION BY DISCOM SYSTEM ON 23.01.17
AT 03.00HRS : (-148MVAR)
AT 10.00HRS : (+94 MVAR)

DELHI DEMAND
AT 03.00HRS : 1412MW
AT 10.00HRS : 3777MW

16 It was also pointed out that reactive energy injection by Delhi Metro during high voltage regime at some of the 220kV sub stations during the year 2016 is as under:-

Energy in Million Reactive Units

Months	220 KV DMRC - Shalimar Bagh Ckt		220KV DMRC- Kashmere Gate Ckt-I		220KV DMRC- Kashmere Gate Ckt-II		66KV DMRC- Park Street Ckt-I	
	Energy Above 103%	Energy Below 97 %	Energy Above 103%	Energy Below 97 %	Energy Above 103%	Energy Below 97 %	Energy Above 103%	Energy Below 97 %
Jan-16	-4.33	0.00	0.00	0.00	-2.49	0.00	-0.43	0.00
Feb-16	-4.29	0.00	0.00	0.00	-3.16	0.00	-0.52	0.00
Mar-16	-4.55	0.00	0.00	0.00	-1.39	0.00	-0.36	0.00
Apr-16	0.13	0.00	-0.17	-0.02	-0.65	0.00	-0.08	-0.03
May-16	-1.71	-0.01	-0.05	-0.26	-0.07	-0.31	-0.02	-0.22
Jun-16	-0.85	-0.01	0.00	-0.48	-0.01	-0.42	0.00	-0.32
Jul-16	-1.56	0.00	-0.04	-0.12	-0.11	-0.08	0.00	-0.23
Aug-16	-2.51	0.00	-0.07	-0.02	-0.02	-0.07	0.00	-0.16
Sep-16	-1.97	0.00	-0.09	-0.06	-0.01	-0.09	0.00	-0.16
Oct-16	-3.66	0.00	-0.40	-0.03	-0.92	-0.01	-0.22	-0.07
Nov-16	-7.60	0.00	-1.57	0.00	-0.97	0.00	-0.55	0.00
Dec-16	-5.71	0.00	-1.20	0.00	-2.08	0.00	-0.44	0.00
Total	-38.61	-0.02	-3.58	-0.99	-11.86	-0.98	-2.63	-1.20
Amount paid by Discoms as Penalty in Rs. Lacs due to reactive power injection	**52.12**	**(-)0.02**	**4.83**	**(-)1.33**	**16.01**	**(-)1.33**	**3.55**	**(-)1.62**

Note : Reactive Energy (-) indicates injection.

Months	66KV DMRC- Park Street Ckt-II		66KV DMRC- Kanjhawala Ckt.		66KV DMRC - Mundka Ckt	
	Energy Above 103%	Energy Below 97 %	Energy Above 103%	Energy Below 97 %	Energy Above 103%	Energy Below 97 %
Jan-16	-1.67	-0.02	-1.22	0.00	-0.35	-0.01
Feb-16	-1.15	0.00	-2.12	0.00	-0.40	0.00
Mar-16	0.00	0.00	-0.75	0.00	-0.99	0.00
Apr-16	-0.36	-0.11	-0.69	-0.01	-0.05	-0.01
May-16	-0.07	-0.90	-0.85	-0.01	-0.01	-0.28
Jun-16	0.00	-1.37	-0.45	-0.01	0.00	-1.10
Jul-16	-0.01	-0.99	-0.90	0.00	0.00	-0.24
Aug-16	-0.01	-0.66	-1.39	0.00	0.00	-0.12
Sep-16	-0.01	-0.59	-0.64	0.00	0.00	-0.17
Oct-16	-0.93	-0.30	-1.01	0.00	-0.15	-0.01
Nov-16	-2.48	0.00	-2.48	-0.01	-0.62	0.00
Dec-16	-2.00	0.00	-0.45	-0.07	-1.39	0.00
Total	-8.69	-4.93	-12.95	-0.11	-3.96	-1.94
Amount paid by Discoms as Penalty in Rs. Lacs due to reactive power injection	11.73	(-)6.66	17.48	(-)0.15	5.35	(-)2.62
Net penalty given by Discoms due to injection of reactive power by DMRC for the year 2016 = Rs. 97.33 Lacs.						

17 Distribution utilities further mentioned that as per the DERCôs óStandard of Performanceô Regulations 2007, they have to maintain the voltage profiles of the consumer level within range specified as detailed in this Regulations. They cited various aspects in this regard from the Regulations as under:-

63. Procedure for lodging complaint:

Voltage Complaints

x. In the case of Low / High voltage, the complaint should be lodged at the Centralised Call Center/Complaint Center giving name, address, telephone no., if any, of the complainant along with brief nature of the problem faced. The operator on duty shall register the complaint and intimate the complaint number in every case.

xi The Centralized Call Center/Complaint Center shall communicate the complaint to the mobile service groups at the concerned Service Centres. The mobile service group would then proceed to the address provided by the complainant, investigate the cause of complaint and resolve the problem.

xii In case problem is local e.g. due to loose connection of service line, the mobile group shall rectify the fault themselves. In case the voltage problem is due to some other reason(s), such as, deficiency in the system, the mobile group shall bring this to the notice of the Area Assistant Manager/Designated Officer.

xiii The Area Assistant Manager/Designated Officer shall ascertain if the problem can be rectified by changing the Tap position of the transformer or proper control of the capacitors installed in the system and if possible, he shall do so. However, in case the Assistant Manager finds that problem is due to deficiency in the distribution system requiring up-gradation of distribution lines, transformers, capacitors etc., he shall inform the District Manager for taking further necessary action.

xiv. The consumer shall also be informed of the need to switching on or switching off of the capacitors installed in his premises when the connected load is not in operation which shall also help the consumer to extend the life of the capacitors besides avoiding over voltage problems, if the capacitors are not controlled automatically.

Schedule-I

2. Quality of Power Supply Voltage variations:

(i) The Licensee shall maintain the voltages at the point of commencement of supply to a consumer within the limits stipulated hereunder, with reference to declared voltage:

(a) In the case of Low Voltage, +6% and -6%;

(b) In the case of High Voltage, +6% and -9%; and,

(c) In the case of Extra High Voltage, +10% and -12.5%.

Schedule-II

1.7 Voltage Unbalance:

The Licensee shall ensure that the voltage unbalance does not exceed 3% at the point of commencement of supply. Voltage Unbalance shall be computed in a manner to be specified by the Commission separately or as part of the Distribution Code or Distribution Operating Standards. The Licensee shall submit an exception report to the Commission giving details of the instances when the voltage was beyond the permissible band at the distribution transformer level.

18 They have also submitted that even though the supply of normal voltage to the consumer is stipulated in the supply end there is no penalty for leading power factor drawal by the users. TPDDL representative intimated that DERC vide their letter dated 27.04.2004 directed that th**e meters may be programmed so that kVARh consumption in the leading power factor is not taken into account into consumption.** They cited the full text of the letter as under:-

No.F.3'(49)/Tariff/2003-041...5283 27-Aug-04

To,
The Chief Executive Officer
M/s North Delhi Power Ltd.
Grid Sub-station Building,
Tata Power Hudson Lane,
Kingsway Camp, Delhi

Sir,

This is with reference to your letter no. ND-CCO/R04/1815 of 23rd August, 2004 in connection with the imposition of Low Power Factor surcharge.

2. The matter has been considered in the Commission. It is noticed that Commission's Order, as indicated at Clause 4.9.2.14 of the Tariff Order for the years 2002-03 and 2003-04, has not been adhered to in entirety. Accordingly, the Commission directs that NDPL shall immediately withdraw LPF surcharge from the bills. Further, LPS charge which has been levied for non-payment of LPF surcharge shall also be withdrawn.

3. Another issue on which the Commission is receiving representations is of KVAh billing. Some bills have been produced by NDPL before the Commission showing high KVAh billing" disproportionate to KWH consumption. This apparently is on account of leading power factor. This is not to be accounted for. Accordingly, the Commission directs that the meters may be programmed so that KVARh consumption in the leading power factor mode is not taken into account as consumption. NDPL is also directed to reprogramme the meters and the time frame for this task may be submitted to the Commission for consideration. In the meantime and pending further consideration, payments of such bills may be realised accordingly to KWh consumption in terms of clause 6.8.12 of the Tariff Order dated 9thJune, 2004.

16 For clarity, clause 4.9.2.14 of the Tariff order of DERC applicable for 2002-03 and 2003-04 which was mentioned in the above letters was cited as under:-

4.9.2.14 Low Power Factor (LPF) Surcharge

Large number of stakeholders have opposed the levy of LPF surcharge by the petitioner stating that as per provisions of Conditions of Supply of the petitioner the petitioner is required to install the required capacitors if the consumer fails to provide the same and the cost of which may be recovered from the consumers. The petitioner should, therefore, first install the required equipment and thereafter the maintenance/replacement may be done by the consumer. They have

also complained about the harassment by utility staff on this account. Some stakeholders have suggested that the provision of LPF surcharge may be removed if all consumers are billed on kVAh basis, which has inbuilt penalty/incentive for low/high power factor. At present most of the SIP / NDLT consumers are having electro-mechanical meters. The petitioner has submitted that it has plans to install electronic meters for all consumers in the SIP/NDLT categories. The Commission has already discussed the application of this provision on LIP / MLHT consumers through its Order dated 16.01.01, who are being billed on kVAh basis. However, as long as all the consumers in the SIP/NDLT category are metered (with electronic meters capable of recording kVAh consumption), kVAh based tariff cannot be introduced in these categories and hence this provision shall be required to be maintained till all the electronic meters are installed by the petitioner. The Commission, hereby, directs the petitioner to complete installation of electronic meters for all the consumers, except those upto 10kW being supplied on single phase, of SIP/NDLT categories by 31st March 2004 so that kVAh (or kWh and kVARh) system of billing energy could be appropriately considered for introduction next year. However, the petitioner shall not replace the electronic meters provided by the erstwhile DVB unless there are compelling reasons to do so. The Commission opines that LPF penalty should be levied only when it is established by measurements with equipment/meters that the average power factor of the installation is less than the required value and the power factor correction equipment provided is either non-functional or inadequate. Before imposing LPF penalty, the consumer should be given a chance to bring his power factor within acceptable limits. The petitioner should, therefore, advise the consumer to bring his power factor within specified limits and also suggest measures, including specifications of equipment required, in such advice. If the consumer fails to comply with the power factor requirement within one month from the receipt of advice, the petitioner should install the requisite equipment at the cost of the consumer to be included in his subsequent bill. Thereafter, it shall be the responsibility of the consumer to maintain and enhance/reduce the capacity of correction equipment as per his load requirement so as to be within specified limits of power factor. For consumers getting electronic meters installed, the levy on account of such low power factor shall not be done unless the consumer has been advised for equipment installation and till a period of 4 months has elapsed from the date of receipt of such advice by the consumer or installation of electronic meter, whichever is later.

19 Discoms further informed that as per Tariff order of DERC issued on 29.09.2015the rates applicable for DMRC from 01.10.2015 are
Fixed charges Rs. 125/kVA. Energy Charges Rs. 6.10kVAh (kVARh in leading, PF is set to zero)

Due to the above directions the user like DMRC are scot free from penalties for the injection of reactive power during high voltage and discoms suffers as mentioned above.

20 It was pointed out by TPDDL that one of HT consumers has approached CGRF for compensation from the Distribution Licensees for not meeting the voltage band as per Supply Code. They also informed that as per DERC order, the consumers cannot be billed for injection of reactive energy during high voltage conditions. However, a Distribution Licensee can be sued by any consumer if he / she is not provided with normal voltage supply apart from the fact that Discoms are being penalized if he injects reactive power during high voltage conditions. They also cited the penalties paid by the discoms for injection of reactive power during high voltage conditions during the year 2016 as under:-

Month	TPDDL					BRPL				
	MVARh Drawal		Amount in Rs. Lacs (payable)		Net Amount payable in Rs. Lacs	MVARh Drawal		Amount in Rs. Lacs (payable)		Net Amount payable in Rs. Lacs
	High Voltage	Low Voltage	High Voltage	Low Voltage		High Voltage	Low Voltage	High Voltage	Low Voltage	
Jan-16	-12792.4	-4324.8	15.99050	-5.40600	10.58450	-14412.1	-3896.6	18.01513	-4.87075	13.14438
Feb-16	-10162.0	-3535.4	12.70250	-4.41925	8.28325	-13709.5	-3953.1	17.13688	-4.94138	12.19550
Mar-16	-8658.0	-3771.4	11.25535	-4.90282	6.35253	-3699.6	-4458.2	4.62450	-5.57275	-0.94825
Apr-16	1586.9	-2735.5	-2.06297	-3.55615	-5.61912	553.9	-282.2	-0.72007	-0.36686	-1.08693
May-16	-4358.1	3154.1	5.66553	4.10033	9.76586	735.9	25048.9	-0.95667	32.56357	31.60690
Jun-16	-1544.0	683.8	2.00720	0.88894	2.89614	-3062.9	3720.0	3.98177	4.83600	8.81777
Jul-16	-5393.6	717.1	7.01168	0.93223	7.94391	-2119.8	26388.8	2.75574	34.30544	37.06118
Aug-16	-5140.0	1729.5	6.68200	2.24835	8.93035	-1780.5	14485.1	2.31465	18.83063	21.14528
Sep-16	-2945.0	1444.2	3.82850	1.87746	5.70596	-446.4	-1384.7	0.58032	-1.80011	-1.21979
Oct-16	-4986.8	-695.5	6.48284	-0.90415	5.57869	9642.8	-2399.2	-12.53564	-3.11896	-15.65460
Nov-16	-12125.8	-1735.3	15.76354	-2.25589	13.50765	-20122.7	-3325.4	26.15951	-4.32302	21.83649
Dec-16	-22354.7	-3462.9	29.06111	-4.50177	24.55934	-23972.8	-4407.4	31.16464	-5.72962	25.43502
Total	**-88873.464**	**-12532.100**	**114.38778**	**-15.89872**	**98.48906**	**-72393.700**	**45536.000**	**92.52075**	**59.81220**	**152.33295**

Month	BYPL					NDMC				
	MVARh Drawal		Amount in Rs. Lacs (payable)		Net Amount payable in Rs. Lacs	MVARh Drawal		Amount in Rs. Lacs (payable)		Net Amount payable in Rs. Lacs
	High Voltage	Low Voltage	High Voltage	Low Voltage		High Voltage	Low Voltage	High Voltage	Low Voltage	
Jan-16	-9025.5	-6973.3	11.28188	-8.71663	2.56525	1961.8	-2289.9	-2.45225	-2.86238	-5.31463
Feb-16	-7715.4	-7580.8	9.64425	-9.47600	0.16825	2258.5	-1278.7	-2.82313	-1.59838	-4.42150
Mar-16	826.8	-6205.7	-1.03350	-7.75713	-8.79063	5769.6	-1028.3	-7.21200	-1.28538	-8.49738
Apr-16	-281.5	1479.4	0.36595	1.92322	2.28917	6347.7	895.3	-8.25201	1.16389	-7.08812
May-16	1113.1	10853.3	-1.44703	14.10929	12.66226	1892.5	5308.3	-2.46025	6.90079	4.44054
Jun-16	-1288.2	13406.4	1.67466	17.42832	19.10298	1185.1	80.3	-1.54063	0.10439	-1.43624
Jul-16	1381.5	8917.9	-1.79595	11.59327	9.79732	2049.3	3918.2	-2.66409	5.09366	2.42957
Aug-16	-1465.2	5745.9	1.90476	7.46967	9.37443	2144.0	2611.8	-2.78720	3.39534	0.60814
Sep-16	-1886.5	3067.7	2.45245	3.98801	6.44046	1127.4	1972.5	-1.46562	2.56425	1.09863
Oct-16	-4685.8	-4994.7	6.09154	-6.49311	-0.40157	4471.7	439.0	-5.81321	0.57070	-5.24251
Nov-16	3525.7	-6361.1	-4.58341	-8.26943	-12.85284	4025.5	-2096.7	-5.23315	-2.72571	-7.95886
Dec-16	-11627.6	-5704.9	15.11588	-7.41637	7.69951	2255.9	-2470.1	-2.93267	-3.21113	-6.14380
Total	**-31128.600**	**5650.100**	**39.67148**	**8.38312**	**48.05460**	**35489.000**	**6061.700**	**-45.63621**	**8.11006**	**-37.52615**

Month	MES					TOTAL DELHI DISCOMS				
	MVARh Drawal		Amount in Rs. Lacs (payable)		Net Amount payable in Rs. Lacs	MVARh Drawal		Amount in Rs. Lacs (payable)		Net Amount payable in Rs. Lacs
	High Voltage	Low Voltage	High Voltage	Low Voltage		High Voltage	Low Voltage	High Voltage	Low Voltage	
Jan-16	177.3	640.8	-0.22163	0.80100	0.57938	-34090.9	-16843.800	42.61363	-21.05475	21.55888
Feb-16	165.6	308.2	-0.20700	0.38525	0.17825	-29162.8	-16039.800	36.45350	-20.04975	16.40375
Mar-16	108.4	1563.4	-0.13550	1.95425	1.81875	-5652.8	-13900.200	7.49885	-17.56382	-10.06497
Apr-16	11.7	3630.0	-0.01521	4.71900	4.70379	8218.7	2987.000	-10.68431	3.88310	-6.80121
May-16	59.2	4628.8	-0.07696	6.01744	5.94048	-557.4	48993.400	0.72462	63.69142	64.41604
Jun-16	93.3	4231.6	-0.12129	5.50108	5.37979	-4616.7	22122.100	6.00171	28.75873	34.76044
Jul-16	78.3	2670.2	-0.10179	3.47126	3.36947	-4004.3	42612.200	5.20559	55.39586	60.60145
Aug-16	52.3	3903.8	-0.06799	5.07494	5.00695	-6189.4	28476.100	8.04622	37.01893	45.06515
Sep-16	64.2	3068.9	-0.08346	3.98957	3.90611	-4086.3	8168.600	5.31219	10.61918	15.93137
Oct-16	353.1	1766.7	-0.45903	2.29671	1.83768	4795.0	-5883.700	-6.23350	-7.64881	-13.88231
Nov-16	920.1	211.9	-1.19613	0.27547	-0.92066	-23777.2	-13306.600	30.91036	-17.29858	13.61178
Dec-16	279.9	348.2	-0.36387	0.45266	0.08879	-55419.3	-15697.100	72.04509	-20.40623	51.63886
Total	**2363.400**	**26972.500**	**-3.04986**	**34.93863**	**31.88878**	**-154543.364**	**71688.200**	**197.89395**	**95.34528**	**293.23923**

Details of Delhi State to pay Northern Regional Reactive Pool Account

Month	MVARh Drawal		Net Amount Payable in Rs. Lacs
	High Voltage	Low Voltage	
Jan-16	-115382.10	-1.7	144.2255
Feb-16	-84489.8	6.1	105.6199
Mar-16	-90752.9	-0.1	113.441
Apr-16	-15306	38.4	22.32147
May-16	17607.2	1657.8	-6.36065
Jun-16	20496.2	2966.8	-18.5104
Jul-16	8865.2	-716.3	-2.7514
Aug-16	7618.9	323.7	-6.82981
Sep-16	-8586.6	-37.3	13.29042
Oct-16	-26491.7	172.5	34.66346
Nov-16	-89410	10.8	116.247
Dec-16	-131449.2	-116.5	170.7325
Total	-507280.80	4304.20	686.09

21 It was opined that Discoms should approach DERC and request the Commission for modification of the order which prohibits Discoms to charge the HT / LT high load consumers like Delhi Metro etc if they found injecting reactive power during high voltage regime so that consumers deter injection of reactive power during high voltage conditions for stable voltage profile.

22 It was also brought out that due to opening of 66kV feeders to control high voltage also affect the operation of Waste-to-Energy plant at Okhla and East Delhi. East Delhi Power Plant which is now on Trial Run in one of the communications pleaded the following:-

Ref. No. EDWPCL/WTE/1226/SLDC/16-17/15112016 Date : 15-Nov-16

Executive Director
State Load Despatch Centre
1st Floor, SLDC Building, 33kV Sub-station
Tagore Lane, Minto Road
New Delhi-110002

Subject : Over voltage trip at 66kV bay at 220/66kV DTL Substation, Ghazipur

Dear sir,

We have recorded voltage 71.79kV at 66kV at plant end (Refer Annexure-1). This voltage, over voltage protection activated and main grid failed. Due to this, power was got available in between 1.00am to 4.55am on dt. 14.11.16.

At present, out plant is running at 6MW and it is very difficult with us to export the power if over voltage occurs again.

We request you to take necessary action for rectification of this issue.

For East Delhi Waste Processing Company Limited (EDWPCL)

23 It was also pointed out by Waste-to-Energy Plants that if the power supply fails, the Waste to Energy power plant trips resulting into stoppage of municipal waste consumption. The waste which is in the process for burning get struck up and would emit more smoke in the atmosphere which is detrimental to the environment and also against the National Green Tribunal directives. As such, they requested disruption free availability of Grid supply. It was explained by SLDC that disruptions in Okhla and East Delhi Waste to Energy Plants are due to change over of supply due to opening of 66kV feeders to control high voltage.

24 Sensing the severity of high voltage problems engulfing the Grid particularly during off peak seasonôs off peak hours during 11PM to 06.00AM next day Delhi. Delhi Metro representative assured maximum cooperation to run the system in normal condition to ensure reliable power supply to the essential category of consumers like Delhi Metro etc. They also are studying the international practice to control high voltage particularly during low load conditions.

25 Following facts were also revealed with regard to DMRC.:-

i) Delhi Metro has started operation since 24th December 2002. It started services as under:-

Sr. No	Name of the DMRC route	Date of starting operation
A	**Line -1 Dilshad Garden – Rithala**	
(i)	Shahdra ï Tis Hazari	25.12.2002 (Phase-I)
(ii)	Tis Hazari ï Inderlok	04.10.2003 (Phase-I)
(iii)	Inderlok ï Rithala	01.08.2004 (Phase-I)
(iv)	Dilshad Garden ï Shahdra	03.06.2008 (Phase-II)
B	**Line-2 Huda City Center – Jahangiripuri – Samaypur Badli**	
(i)	Vishwa Vidyalaya ï Kashmiri Gate	20.12.2004 (Phase-I)
(ii)	Vishwa Vidyalaya ï Central Secretariat	03.07.2005 (Phase-I)
(iii)	Vishwa Vidyalaya ï Jahangirpuri	03.02.2009 (Phase-II)
(iv)	HUD City Centre ï Qutab Minar	21.06.2010 (Phase-II)
(v)	Central Secretariat ï Qutab Minar	03.09.2010 (Phase-II)
(vi)	Jahangirpuri ï Samaypur Badli	10.11.2015 (Phase-III)
C	**Line – 3 Dwarka Sec-21 – Noida City Centre**	
(i)	Barakhamba ï Dwarka	31.12.2005 (Phase-I)
(ii)	Dwarka ï Dwarka Sec-9	01.04.2006 (Phase-I)
(iii)	Barakhamba ï Indraprastha	11.11.2006 (Phase-I)
(iv)	Indraprastha ï Yamuna Bank	10.05.2009 (Phase-II)
(v)	Yamuna Bank ï Noida City Centre	13.11.2009 (Phase-II)
(vi)	Dwarka Sec-9 ï Dwarka Sec 21	03.10.2010 (Phase-II)
D	**Line-4 Yamuna Bank – Vaishali – Blue Line**	
(i)	Anand Vihar ISBT ï Vaishali	27.01.2010 (Phase-II)
E	**Line -5 Green Line Inderlok – Mundka**	
(i)	Inderlok ï Mundka	03.04.2010 (Phase-II)
(ii)	Kirti Nagar ï Ashok Park Main	27.08.2011 (Phase-II)
G	**Line-6 ITO – Escort Mujasar**	
(i)	Central Secretariat ï Sarita Vihar	03.10.2010 (Phase-II)
(ii)	Sarita Vihar ï Badarpur	14.01.2011 (Phase-II)
(iii)	Central Secretariat ï Janpath ï Mandi house	28.06.2014 (Phase-III)
(iv)	Mandi House ï ITO Station	08.06.2015 (Phase-III)
(v)	Sarai ï Escort Mujasar (Faridabad section)	06.09.2015 (Phase-III)
H	**Airport Metro Express Line**	
(i)	New Delhi ï IGI Airport T-3 ï Dwarka Sec.21	23.02.2011 (Phase-III)

iii) The power supply arrangements of the DMRC system was also explained as under:-

Sr. No	Line	RSS Locations	Feeding source	Existing contracted demand MVA)
1	Line-1	Rithala	Rohini-I	10.5
2		Kashmiri Gate	Kashmiri Gate	11
3	Line-2	Jahangirpuri	Shalimar Bagh	13.5
4		New Delhi & IP	GTPS	29
5		Chattarpur	Mehrauli	10
6	Line-3/4	Dwarka	Pappankalan-II	8
7		Subhash Nagar	Pappankalan-I	10
8	Line-5	Mundka	Khanjawla & Neelwal	8
9	Line-6	Park Street	Park Street	8
10		Sarita Vihar	Sarita Vihar	12
11	Airport LIne	Airport line	Park Street	3

iv) Due to frequent acceleration and de-acceleration, requirement of DMRC power demand varies time to dime. DMRCôs traction is about 65% of total demand.

v) On applying brakes of trains, about 35% of the energy is regenerated. Thus, regenerated energy is used by the trains in powering mode. As on date, DMRC is having about 1456 Coaches (235 trains). It comprises 406 Standard Gauge Coaches and 1050 Broad Gauge coaches. Another 750 new coaches are under supply / commissioning.

vi) At present, Delhi Metro has 12 Sub-stations to feed the traction load as detailed hereunder ï

Sr. No	Feeding source of DTL	RSS Locations of DMRC	Traction Load Feeding Zone/Line
1	Rohini-I	Rithala	Traction load in part of Red Line
2	Kashmiri Gate	Kashmiri Gate	Traction load in part of Red Line
3	Shalimar Bagh	Jahangirpuri	Traction load in part of Yellow Line
4	GTPS	New Delhi	Traction load in part of Yellow Line
5	Mehrauli	Chattarpur	Traction load in part of Yellow Line
6	Pappankalan-II	Dwarka	Traction load in part of Blue Line
7	Pappankalan-I	Subhash Nagar	Traction load in part of Blue Line
8	GTPS	Indraprastha	Traction load in part of Blue Line
9	Khanjawla & Neelwal	Mundka	Traction load of Green Line
10	Park Street	Park Street	Traction load in part of Violet Line & Airport Express Line
11	Sarita Vihar	Sarita Vihar	Traction load in part of Violet Line
12	Mehrauli	Airport line	Traction load in part of Airport Express Line

In case of failure of electrical supply of any RSS the traction supply is extended from adjacent RSS.

Reactive power control.

vii) At present DMRC is having electrical network consisting 313.7 circuit kilometers, 20.8 kilometers at 220kV level, 42.9 kilometers at 66kV level and 250 kilometers at 33kV levels.

At each stations in 3phase 415V system, typical capacitor bank rating is 160 kVAr in Rail corridor stations (in various step of 5-37.5 kVAr) and 950 kVAr in underground stations (in various step of 25-100 kVAr) respectively. No capacitor bank is provided at higher voltage levels.

viii) DMRC representative for the informed that Metro activities are also on during off peak hours i.e. 00.00hrs. to 05.00hrs to make the trains operative from 05.00AM onwards and hence it would not be possible to switch off all light loaded cables circuits during night time after metro train services. However, he provided following feeders list to open during nigh time as a short term measure:

a) For KG RSS switching-off of one 220 kV circuit during night (already started w. e. f. 12th Feb 2017.

b) Switching-off one circuit each of Rithala RSS (from Rohini-I of DTL), Park Street RSS (from Park Street of DTL) and Subhash Nagar (from Pappankalan-I of DTL) has been agreed (implemented from 09.02.2017).

c) Switching-off of one circuit of Dwarka RSS (from Papankalan-II of DTL), Mundka RSS (from Neelwal or Kanjahwala of DTL), Sarita Vihar RSS (from Sarita Vihar of DTL), Airport RSS (from Mahipalpur of DTL) and Chattarpur RSS (from Mahipalpur of DTL) has also been agreed by DMRC.

d) In case of 3 RSS namely Jahangirpuri RSS (from Shalimar Bagh of DTL), Indraprastha & New Delhi RSS (from GTPS) switching-off of one circuit is not agreed being single source at these RSS.

ix) DMRC representative also intended to know the reactive VAr injection other consumers, industries and domestic consumers as SLDC has only projected the VAr injection of DMRC and it gives the impression that DMRC only the cause of high voltage. It was also informed that long term solution would be drawn out to control high voltage issue and requested DTL draw out plans for installations of reactors to control high voltage.

x) It was informed by DTL that at three ISTS namely Dwarka, Maharani Bagh and Tuglakabad proposed to be installed have the provisions of 125MVAR reactors. These systems are expected to be available only by summer 2019. As such, winter operations for 2017 and 2018 should be planned accordingly. It was also confirmed that the capacitors are kept off at all substations of DTL and Discoms to control voltage. The utilities can monitor reactive power flow on real time basis through the website of Delhi SLDC which is available in sub station wise as well as line wise.

xi) It was noticed that New Delhi Municipal Council (NDMC) has not been opening lightly loaded cable circuits during night time to control high voltage. NDMC was requested to switch off lightly loaded circuits from both ends during night time. NDMC representative informed that they are not switching off circuits considering the important load being catered by them.

xii) BYPL representative complaint that due to injection of reactive power injection by NDMC and DMRC, the voltage remains high at Park Street etc causing paying penalty by BYPL and requested SLDC to intervene and get the lightly loaded feeders opened

xiii) NDMC and DMRC were advised to identify more lightly loaded feeders and get them opened from both ends during low load conditions to control high voltages.

xiv) Concluding the discussion, it was opined that

a) All utilities should open lightly loaded lines especially cables from both ends during high voltage conditions.

b) Discoms should approach State Electricity Commission to incorporate proper provisions to charge reactive power injections during high voltage (leading power factor) operation conditions to deter the consumers particularly high end consumers to inject reactive power during high voltage conditions.

c) DMRC should ensure that it should not inject reactive power during high voltage conditions to avoid high voltage induction in the sub stations where DMRC feeders are emanating to avoid destabilization of supply including that DMRC.

24 Meeting concluded with thanks to Chair.

List of participants attended the meeting to discuss about high voltage operation of grid on 09.02.2017 at 03.00PM at Delhi SLDC, New Delhi-110002

Sr.No.	Name of officer	Designation	Company	Phone No.	E.Mil.
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