CENTRAL ELECTRICITY REGULATORY COMMISSION

MINUTES OF MEETING OF THE COORDINATION FORUM HELD ON 17TH AUGUST, 2009

1.0 The following were present:

1. Dr. Pramod Deo, Chairperson, … **In Chair**
2. Mr. Rakesh Nath, Chairman, CEA (Ex-officio Member, CERC)
3 Mr. R. Krishnamoorthy, Member,CERC
4. Mr. S. Jayaraman, Member, CERC
5. Mr. V.S. Verma, Member, CERC
6. Mr. V. Ramakrishna, Member(PS), CEA
7. Mr. Sudhir Kumar, JS, MOP
8. Mr. S.K. Chaturvedi, CMD, PGCIL
9. Mr. Alok Kumar, Secretary, CERC
10. Mr. Pankaj Batra, Chief (E)
11. Mr. Ravinder, Chief Engineer, CEA
12. Mr. I.J. Kapoor, Director, NTPC
13. Mr. R.K. Madan, Director, Adani Enterprises Ltd.
14. Mr. S.K. Soonee, Exec. Dir (SO), PGCIL
15. Mr. I.S. Jha, ED, PGCIL
16. Mr. M.S. Babu, ED,NHPC
17. Mr. A Basu Roy, NTPC

2.0 Agenda Item No. 1; Presentation by NLDC on instances of congestion on inter-state transmission system:

A detailed presentation was made by Shri S.K. Soonee, a copy of which is enclosed (Annex.I). It was highlighted in the presentation that major reason for congestion was voltage problem. Some delays in commissioning of strengthening schemes also came up for discussions. There was a broad consensus that CTU should come up with appropriate solutions for addressing the increased demand for reactive power. The funds available in UI pool account and the congestion revenue could be utilized for providing such ancillary services. CMD, PGCIL assured to take further action in this regard. The need for reviewing the present charges being levied for reactive power was also felt.

3.0 Agenda Item No. 2: Presentation by NLDC on the need and various aspects of further narrowing the permissible frequency band:

A presentation was made by Mr. S.K. Soonee, Executive Director, PGCIL, a copy of which is enclosed (Annex.II). It was highlighted in the presentation that low frequency situations are also resulting in sub-standard grid voltages. After the discussions, it was generally felt that there was a need to further narrow down the permissible frequency range from 49.5 Hz to 50.3 Hz w.e.f. January, 2010 and from 49.8 Hz to 50.2 Hz w.e.f. January, 2011. The Forum also felt that appropriate measures including disconnection from the level of RLDC needed to be separately established in order to enforce the statutory provisions regarding permissible frequency and overdrawals. One of the ways could also be to set penal UI charges beyond the permissible frequency level at much higher level. There was also a suggestion that public awareness campaign could also be useful in this regard.

4.0 Agenda Item No. 3: Issues relating to development of transmission lines through competitive bidding

After discussions, it was felt that the principles and methodologies for determining tariff for the period after expiry of first licence period should be evolved and the same should be in public domain, so that the bidders take into account these guidelines while submitting their bids. It was also suggested that the model TSA could be amended to provide for that the transmission service provider shall approach the regulatory commission for renewal of licence and determination of tariff well in advance say, two years before the expiry of first licence period.

5.0 Any other issue: CMD, PGCIL mentioned that there are some issues being faced in respect of payment guarantee and bankability of transmission projects being taking up for providing long-term access and connectivity. The Forum desired that PGCIL may make detailed presentation in this regard in the next meeting.

The meeting ended with vote of thanks to the Chair.

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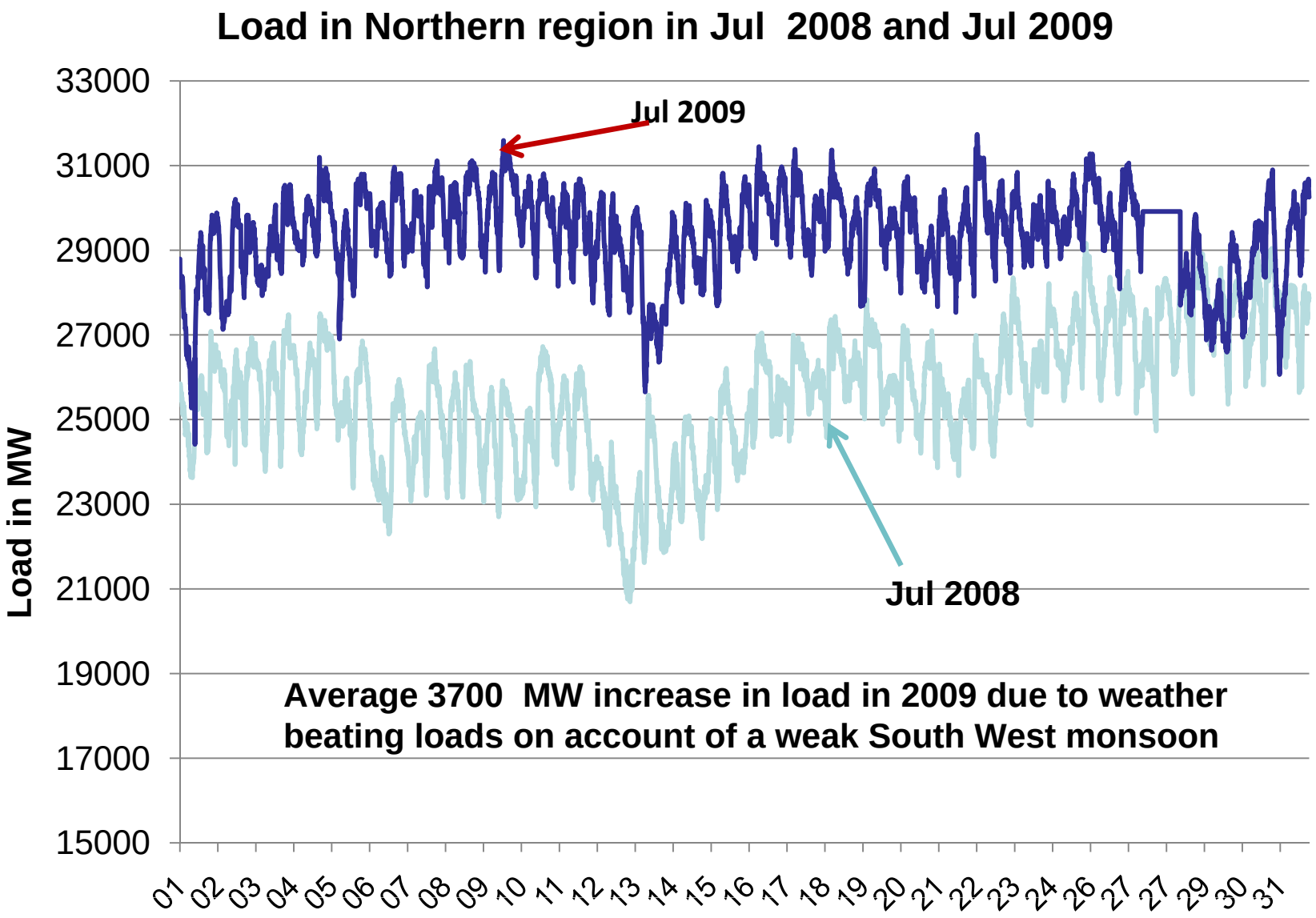
Coordination Forum
4th meeting

17th Aug-2009

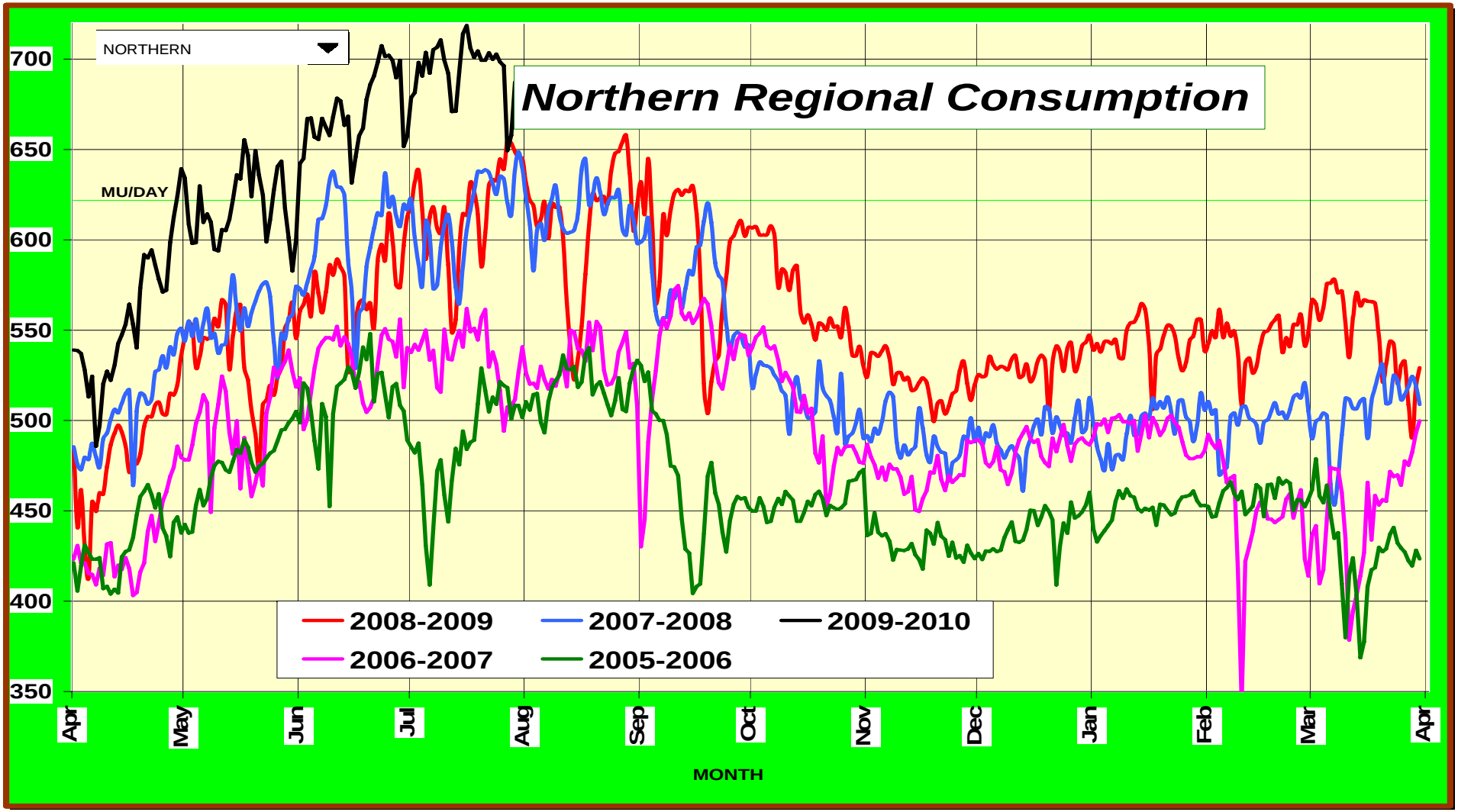
Outline

- **System parameters in NR: June to Aug 09**
- **Experience of Congestion in NR during 2008**
  - Imposition of congestion charge on 31st Jan-08 & 15th Sep-08
- **Experience of Congestion in SR during 2008**
- **Experience of Congestion in NR during 2009**
  - Southwest monsoons
  - Low voltage
  - Transmission constraint due to tower damage
  - Simultaneous multiple element outage
  - Transmission line loading in NR
  - Short-term Open Access in NR
  - Inter regional flow
  - Transfer Capability declarations
- **Summary- Congestion in India**
- **UI regulations- is it adequate to handle congestion ?**
- **Concerns and suggestions**

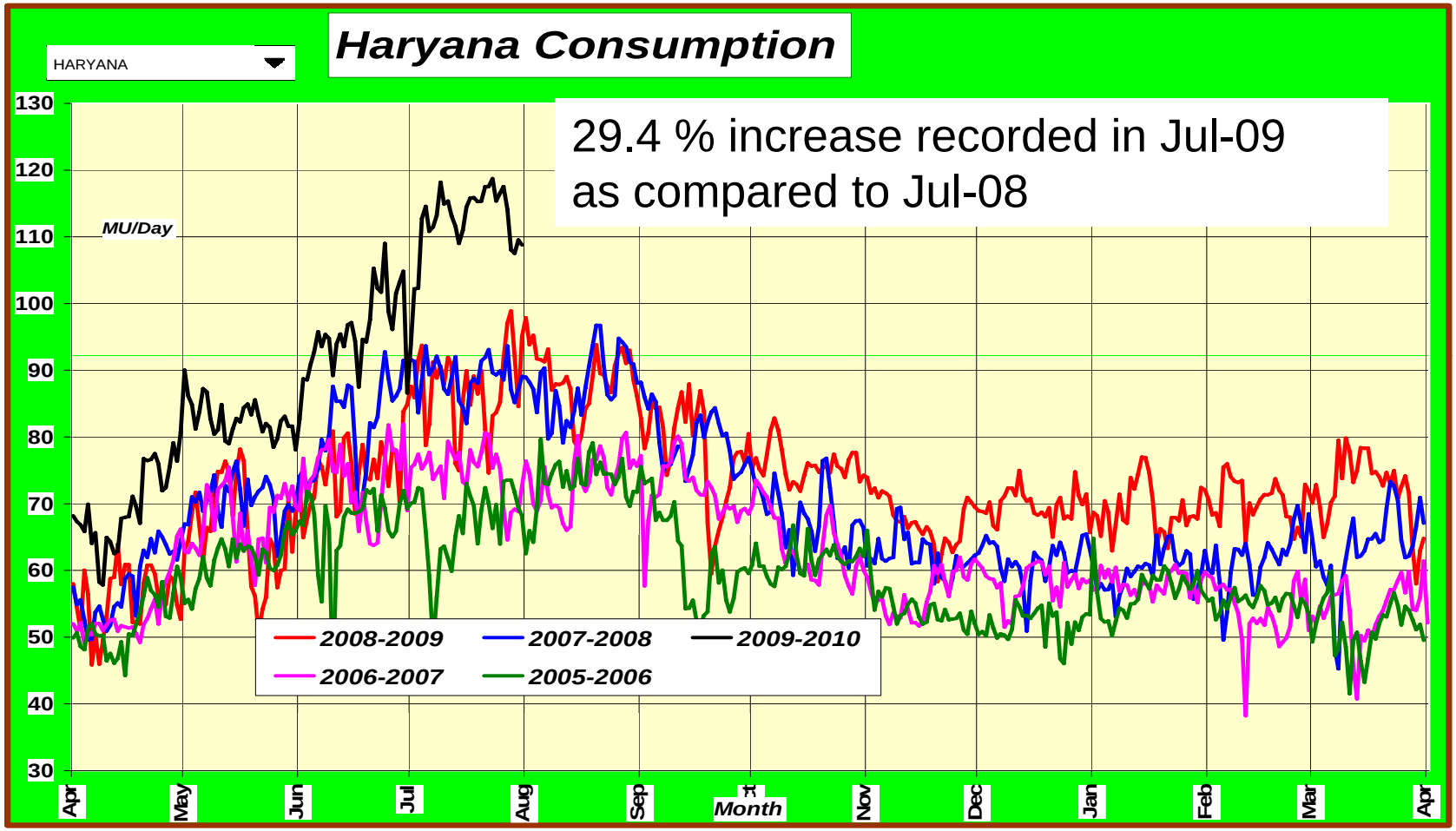

Load in Northern region in Jul 2008 and Jul 2009
Load in MW
33000
31000
29000
27000
25000
23000
21000
19000
17000
15000
Jul 2009
Jul 2008
Average 3700 MW increase in load in 2009 due to weather beating loads on account of a weak South West monsoon
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 26 27 27 29 30 31

Northern Regional Consimption (5 years)

Increase of 76 MU/day in July 2009 compared to July 2008
12.5 % higher as compared to Jul-08



Haryana Energy consumption (5 years)



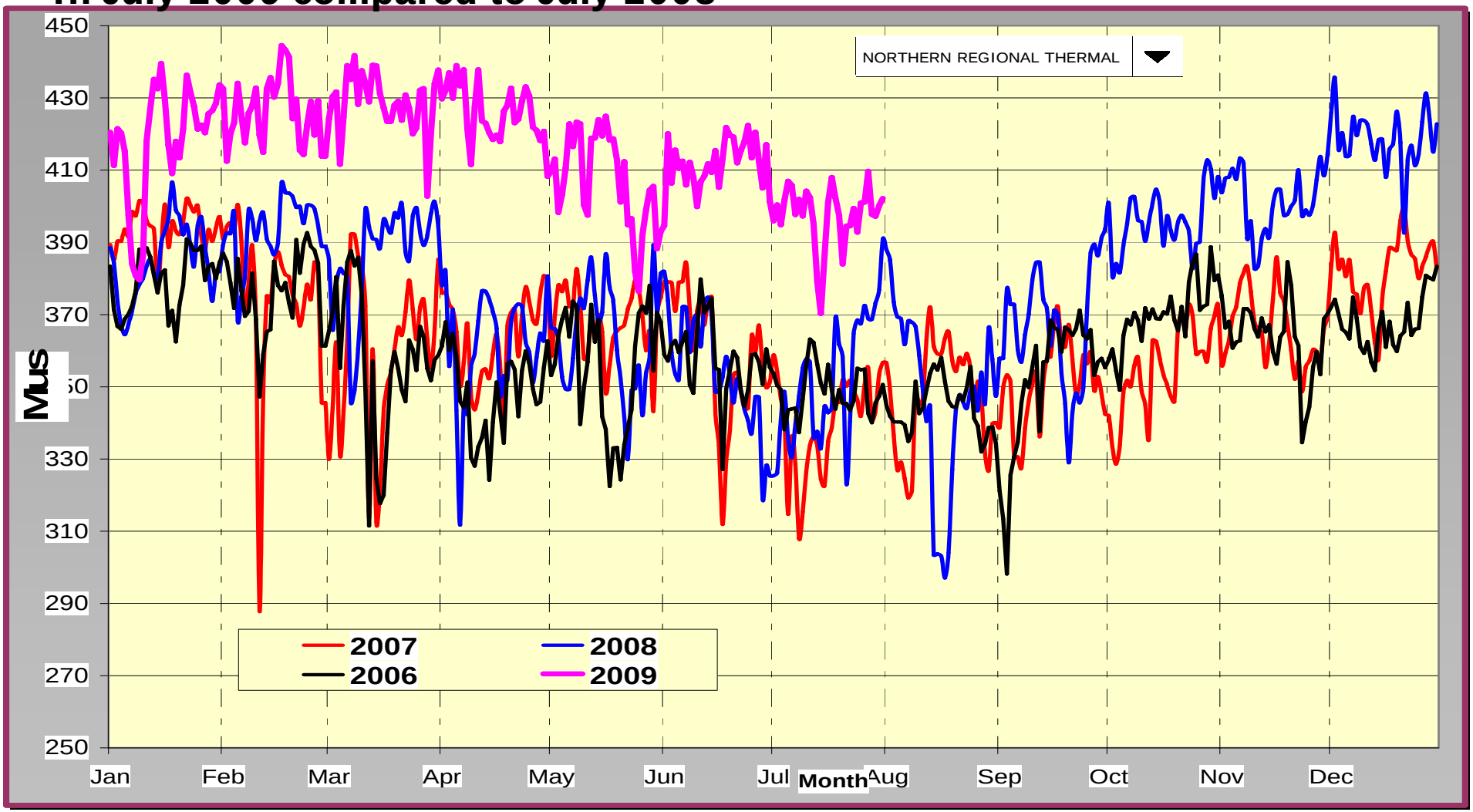
Increase in energy consumption recorded in other States in Jul-09 w.r.t Jul-08

21 % in J&K **>19 % in Uttarakhand** **18 % in Uttar Pradesh,** **>10 % in Delhi**

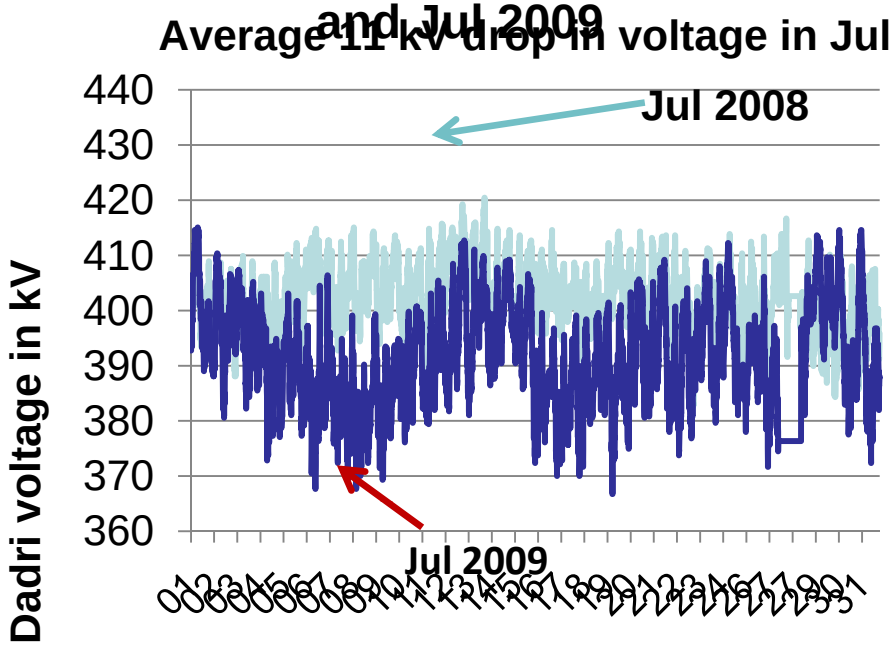
7 % in H.P. **>4 % in Rajasthan** **~ 3 % in Punjab**

Thermal generation in NR (5 years)

Thermal Generation in the Northern Region increased by 46 MU/Day In July 2009 compared to July 2008



400 kV Dadri voltage in Jul 2008 and Jul 2009



Generation Capacity addition (NR)

Punjab:	250 MW
J & K:	450 MW
Rajasthan:	375 MW

Transmission system augmentation 08-09

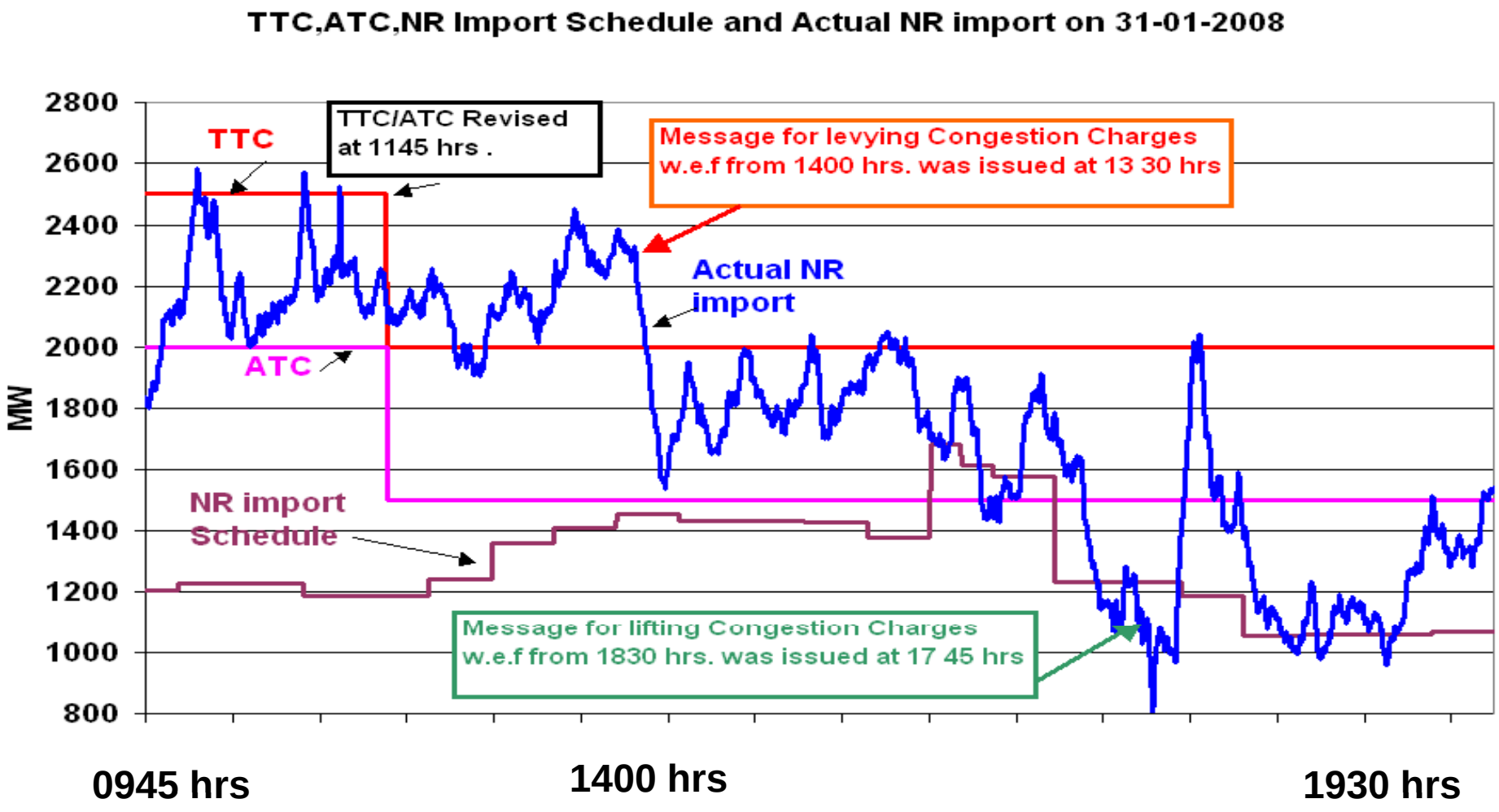
400 kV Bareli-Moradabad-II
LILO of 400 kV Bassi-Hisar at Bhiwadi
400 kV RAPS-C-Kankroli I & II
400 kV Kishenpur-Baghlihar-I & II
400 kV Kota-Merta D/C
400 kV Ratangarh-Merta

State	Maximum MW demand met during July-2009	
Punjab	7368	17th July
Haryana	5618	22nd July
Rajasthan	4963	1st July
Delhi	4371	8th July
U P	8139	19th July
Uttarakhand	1313	27th July
H P	940	16th July
J&K	1457	14th July
Regional	30675	9th July

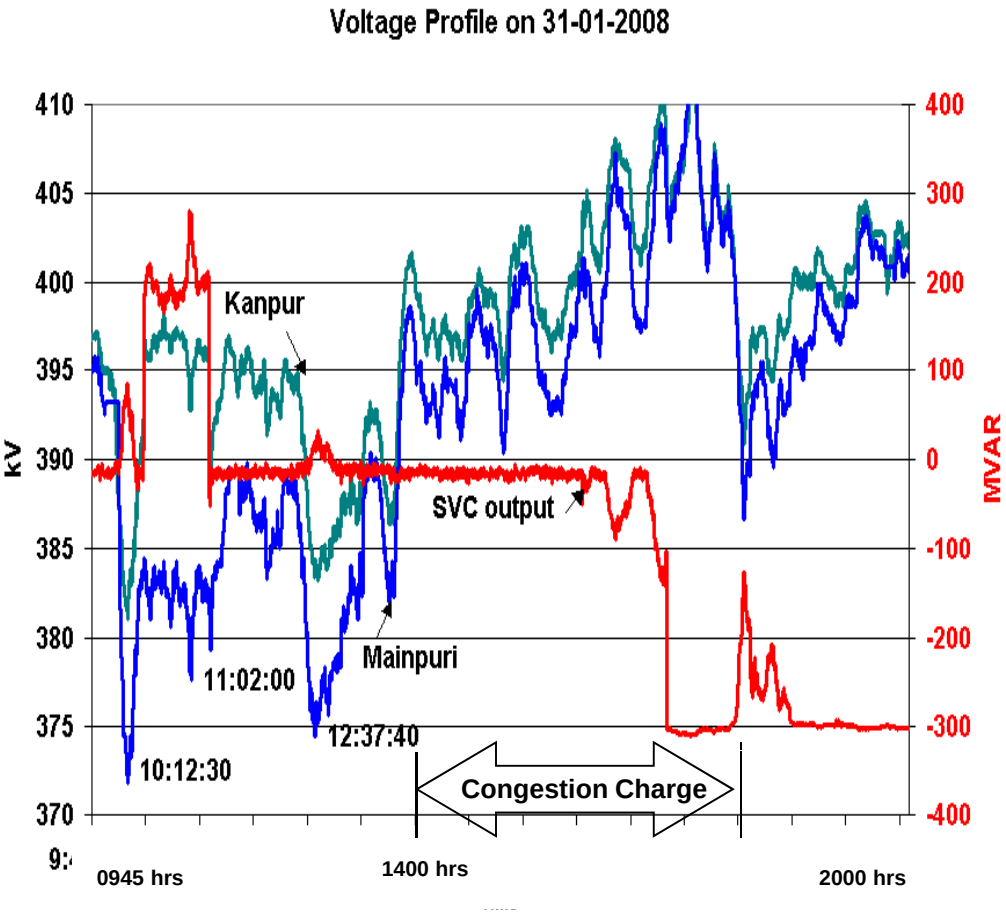
Northern Region- Year 2008

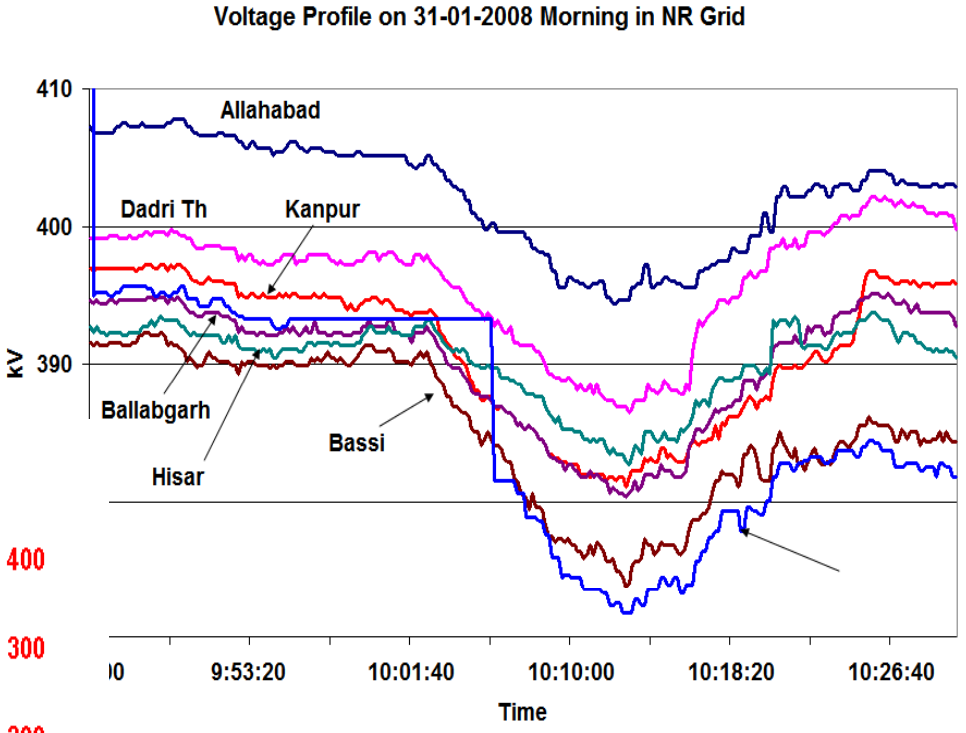
- By and large congestion free
  - Benefits of past transmission system augmentation in 2007-08
  - Good Southwest monsoons in NR
  - Low or negative load growth rate
- Congestion charge in accordance with CERC regulations was kicked in by NRLDC only on two occasions
  - 31st January 2008, 1400 hrs to 1830 hrs
  - 15th September 2008, 0300 hrs to 0800 hrs

Imposition of Congestion Charge in NR on 31st Jan-08



Antecedent condition
31st Jan-08
Morning hours

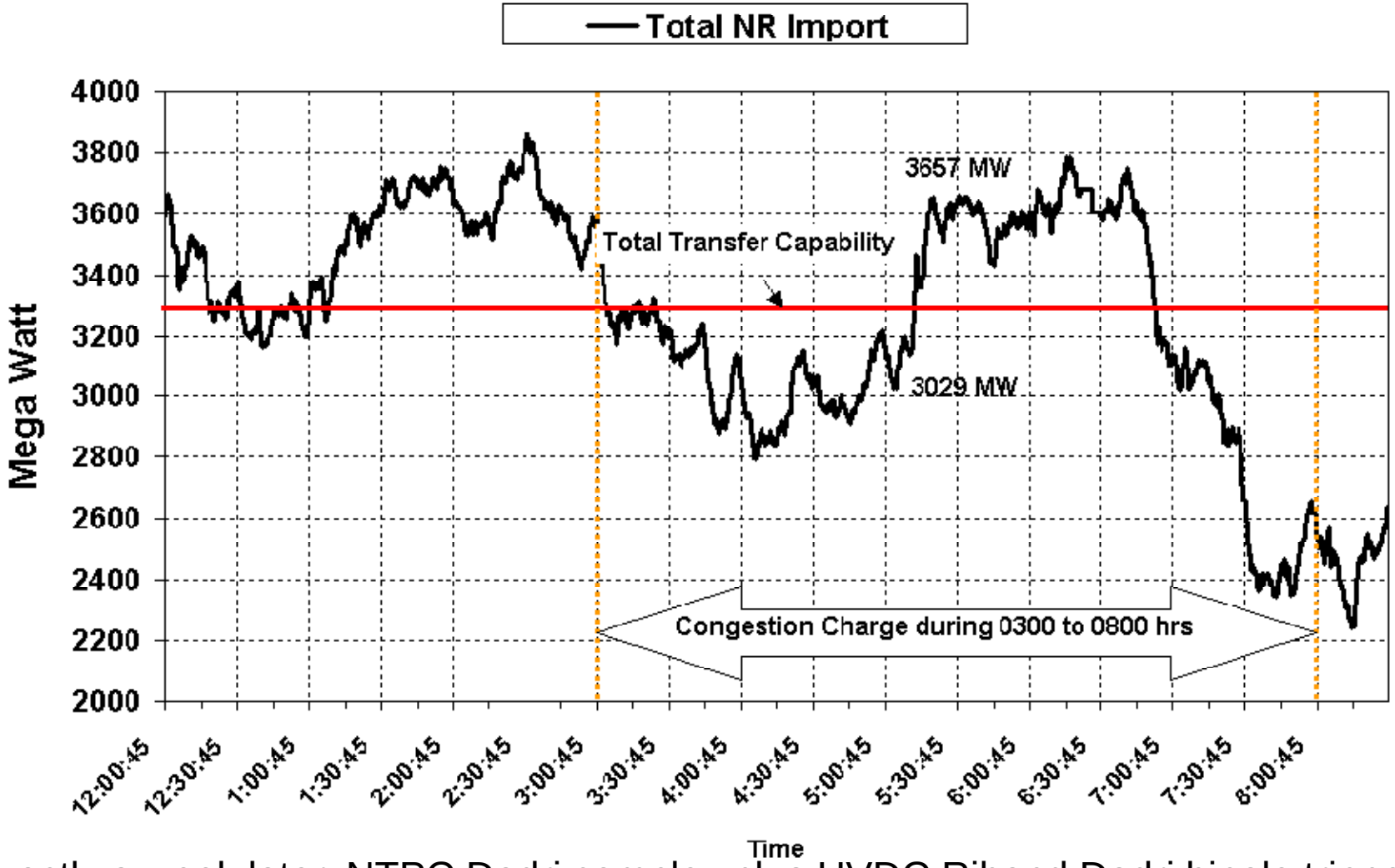




Improvement in voltage profile subsequent to imposition of congestion charge

31st Jan-08, 1400 hrs- 1830 hrs

Imposition of Congestion charge in NR
15th September 2008, 0300 hrs to 0800 hrs



Exactly a week later, NTPC Dadri complex plus HVDC Rihand Dadri bipole tripped During night hours. Low load conditions in NR averted a major blackout.

Congestion charges in NR during 1400-1830 Hrs of 31-Jan-08

ABSTRACT OF CONGESTION CHARGES FOR THE PERIOD - 28/01/2008 TO 03/02/2008

(During 1400 to 1830 Hrs of 31.01.2008)

(All figs. in Rs. Lakh)

Utilities and Amount payable			Utilities and Amount receivable	
J & K	17.64474	:	U.P.	31.27593
NHPC	14.54484	:	HARYANA	8.25168
RAJASTHAN	14.00064	:	NTPC	7.32345
PUNJAB	10.25229	:	NATHPA JHAKRI HEP	5.45754
UTTARAKHAND	4.17780	:	DELHI	0.98244
CHANDIGARH	3.57531	:	RAILWAYS	0.06522
H.P.	3.39426			
TEHRI HEP	2.94264		**BALANCE**	**17.17626**
Total	70.53252	:	**Total**	70.53252

Congestion charges in NR during 0300-0800 Hrs of 15-Sep-08

REVISED ABSTRACT OF CONGESTION CHARGES FOR THE PERIOD - 15/09/2008 TO 21/09

(During 0300 to 0800 Hrs of 15.09.2008)

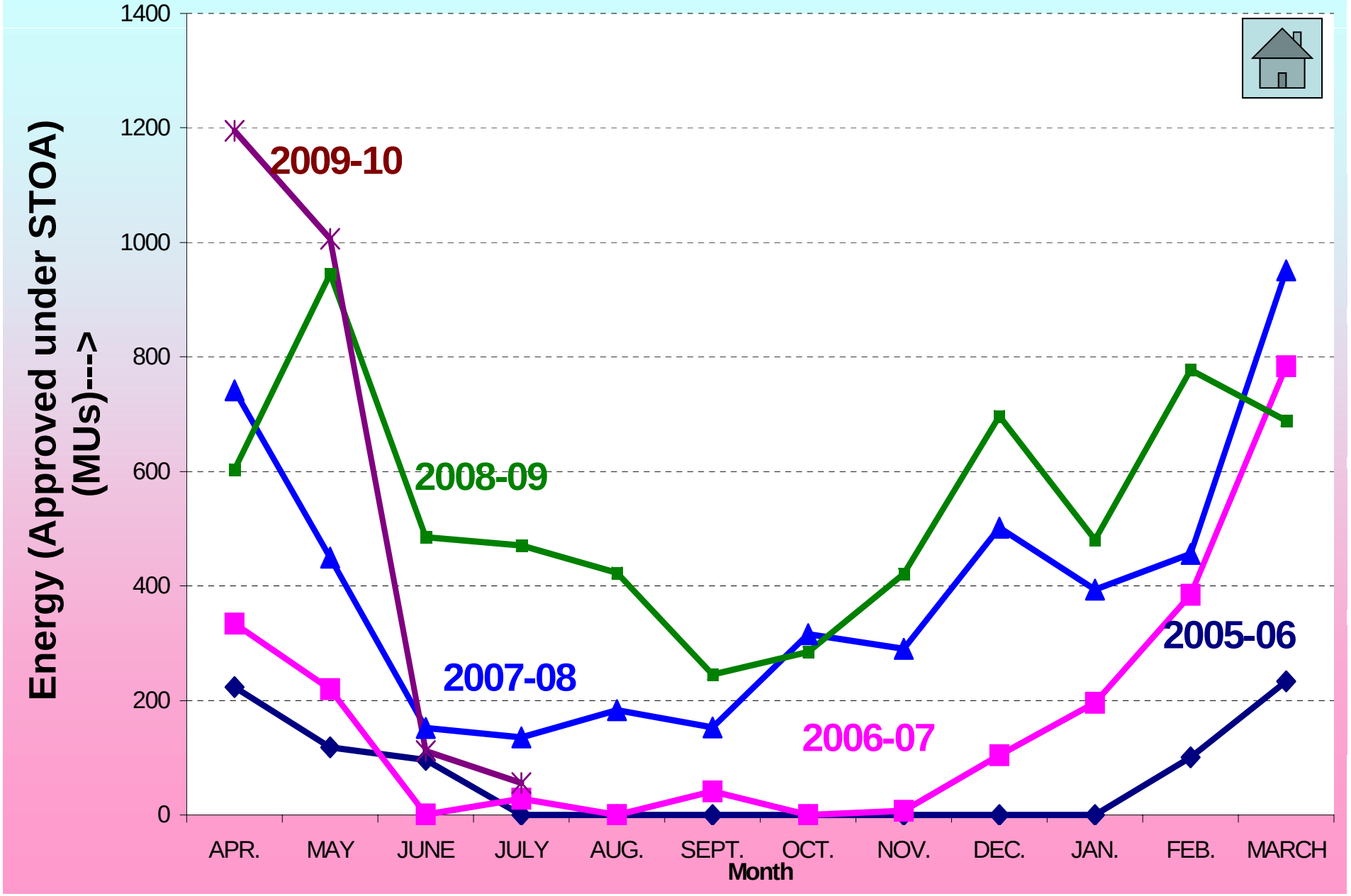
(All figs. in Rs. Lakh)

Utilities and Amount payable		:	Utilities and Amount receivable	
U.P.	71.13870	:	NTPC	0.25002
PUNJAB	38.28792			
J & K	22.40385			
RAJASTHAN	9.44025			
HARYANA	6.73287			
H.P.	4.44246			
RAILWAYS	1.67727			
UTTARAKHAND	1.55286			
DELHI	0.62559			
CHANDIGARH	0.47061			
NHPC	7.72605		**POOL BALANCE**	**170.32536**
TEHRI HEP	5.82918			
NATHPA JHAKRI HEP	0.24777			
Total	170.57538	:	**Total**	170.57538

Case Study (SR)

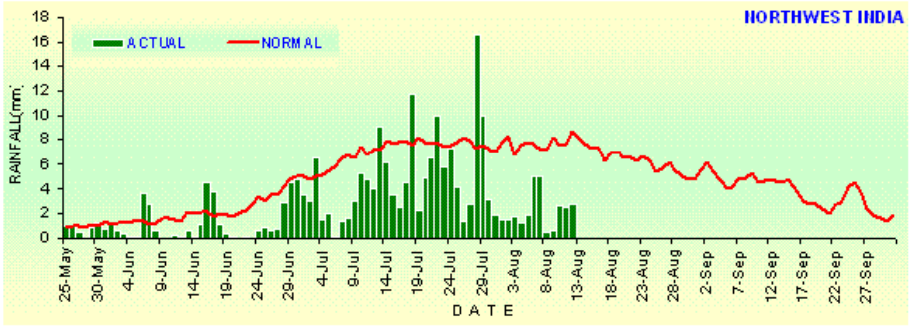
- 12th Dec 2008
  - Period of Congestion: 0500 – 0600 Hrs
  - Congested Corridor: Total import to SR
  - TTC to SR reduced from 4000 MW to 3600 MW
  - Total provisional requisition: 1430 MW
  - Total trades cleared: 1091 MW
  - Market split into NEW Grid and SR Grid
  - MCP [IEX website]:
    - NEW Grid: Rs. 4.80 per kWh
    - SR Grid: Rs. 6.00 per kWh
  - Cost of Transmission discovered
    - Rs. 1.20 per kWh
- Congestion after 12th Dec 08
  - Foggy conditions in Talcher area

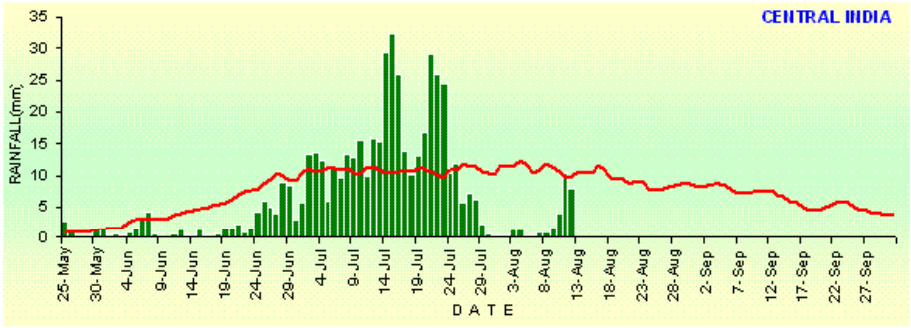
STOA (Bilateral) - SRLDC -Nodal RLDC

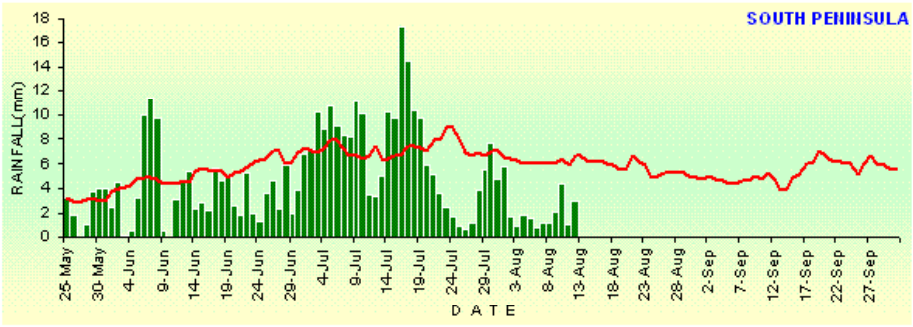


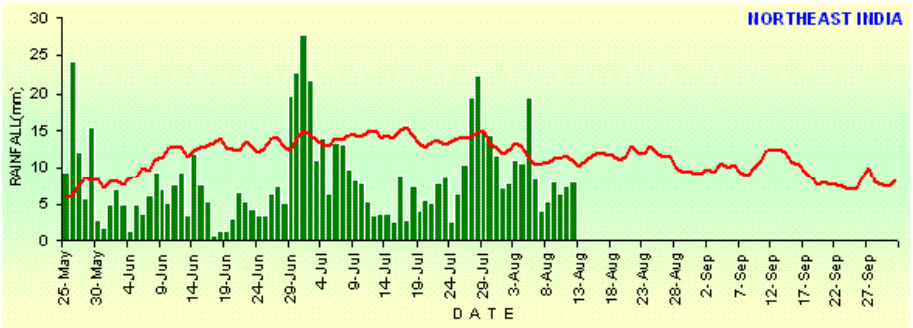
Experience of Congestion in NR : Yr 2009

- Backlog in capacitor installation & Critically low voltage in grid
- Poor South-west monsoon in NR, moderate-good rains in West/East
- Multiple transmission line outage due to tower damage
- Forced Outage due to emergency (400/220 kV Mandola S/S)
- Planned outage of transmission lines to facilitate construction
- Several incidents of multiple element outage
- Limited augmentation in transmission capacity



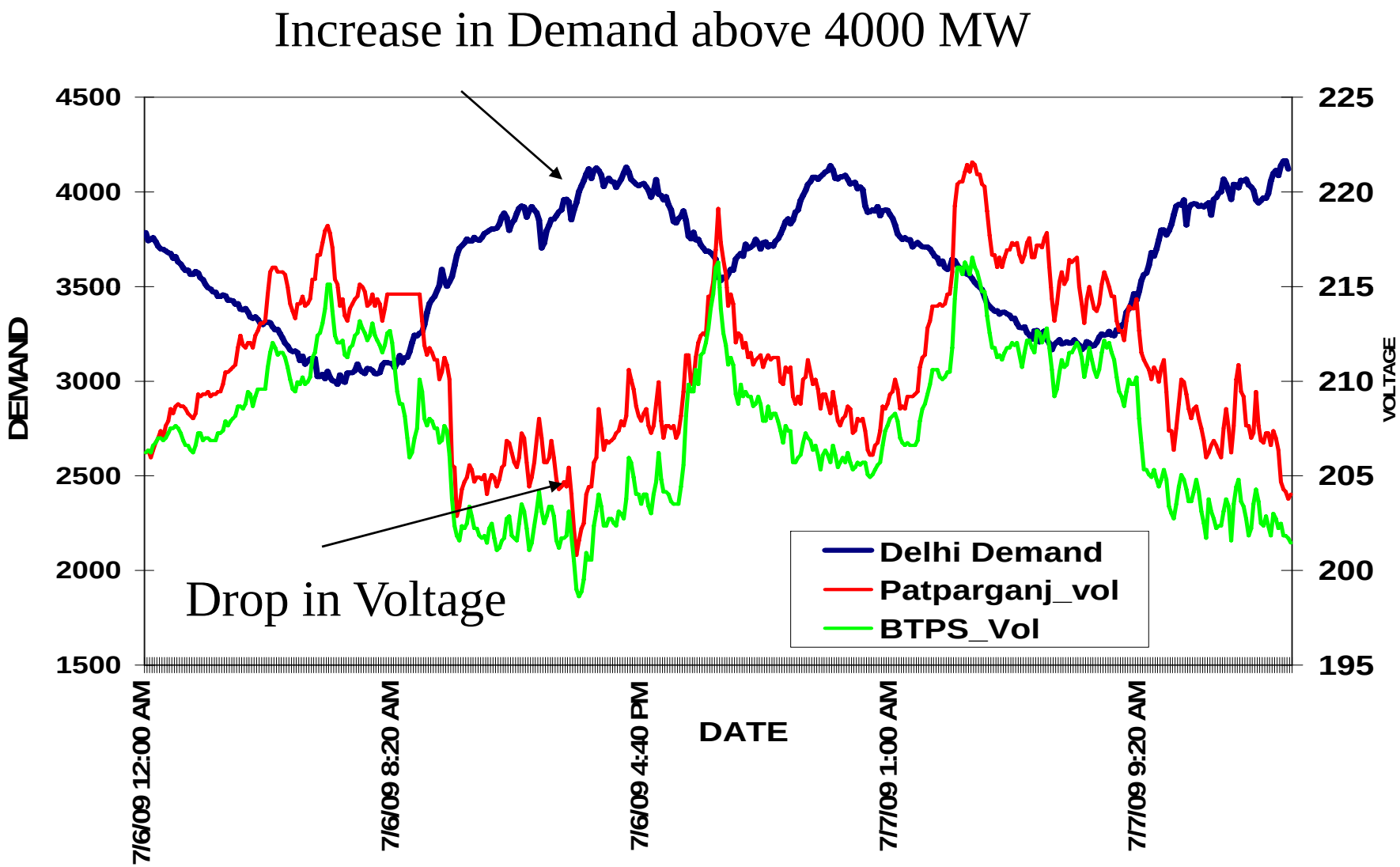




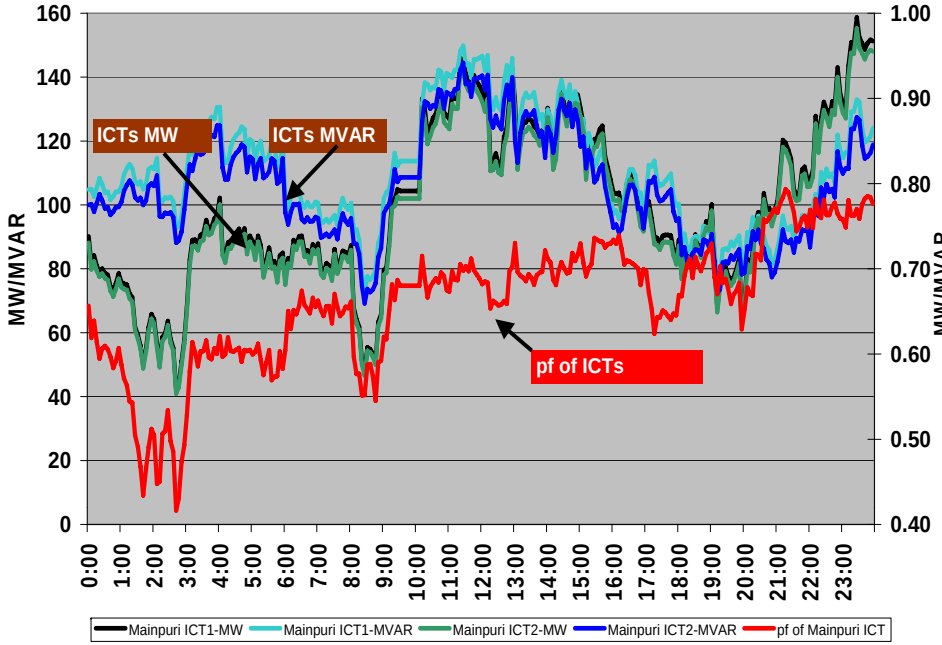


- Poor Southwest monsoons
- Heavy demand on account of weather beating load in urban areas and pumping load in rural areas
- Injection from other regions
- Restrictions on interregional open access imposed to arrest further deterioration of voltage

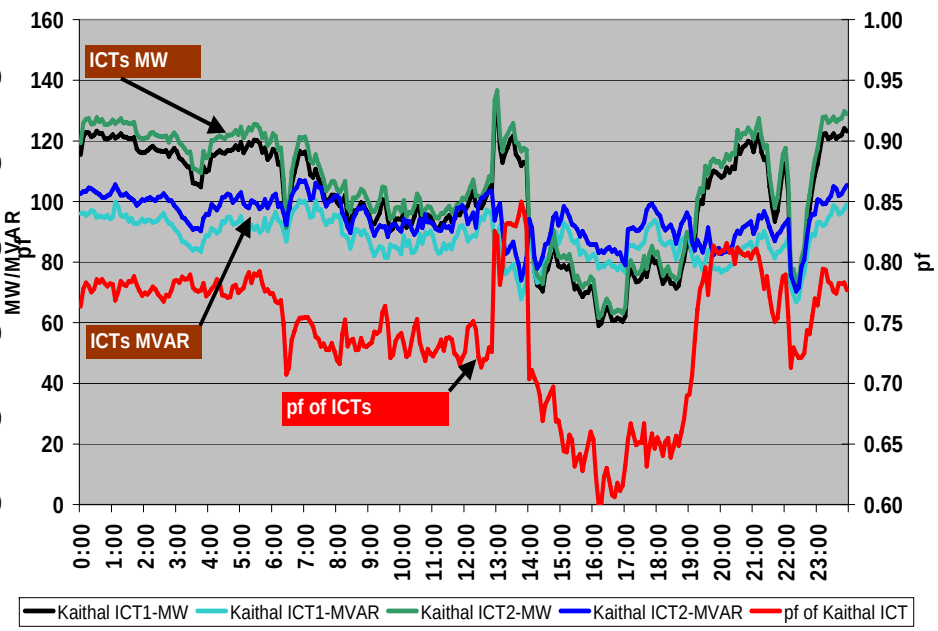
Load vs voltage in Delhi



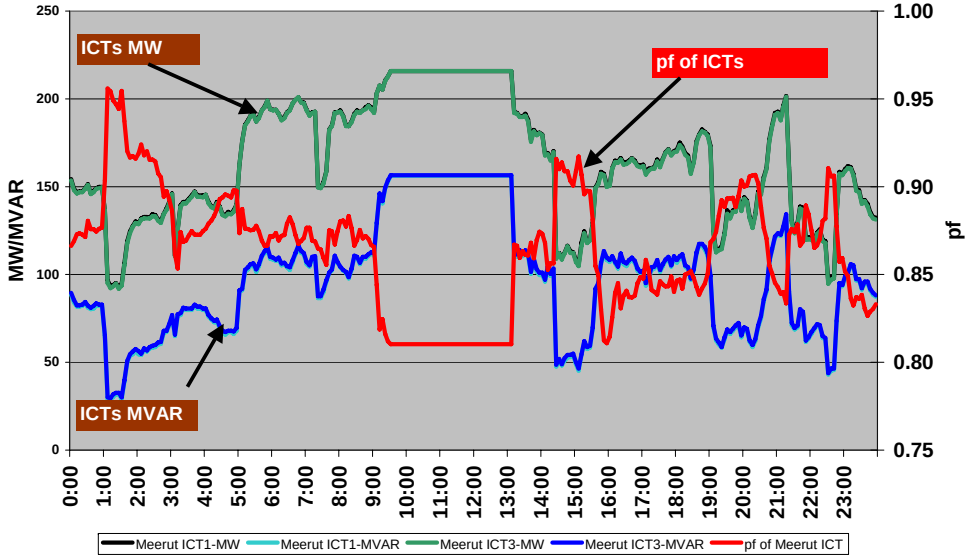
Heavy Reactive Power Demand at Mainpuri
MW/MVAR Loading of ICTs on 4th August 2009



Heavy Reactive Power Demand at Kaithal
MW/MVAR Loading of ICTs on 4th August 2009

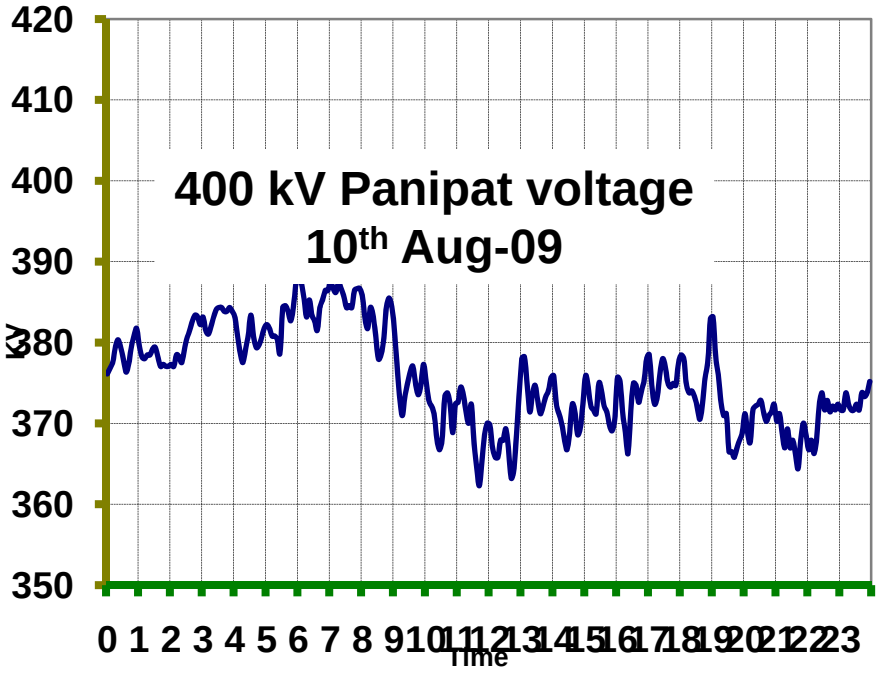


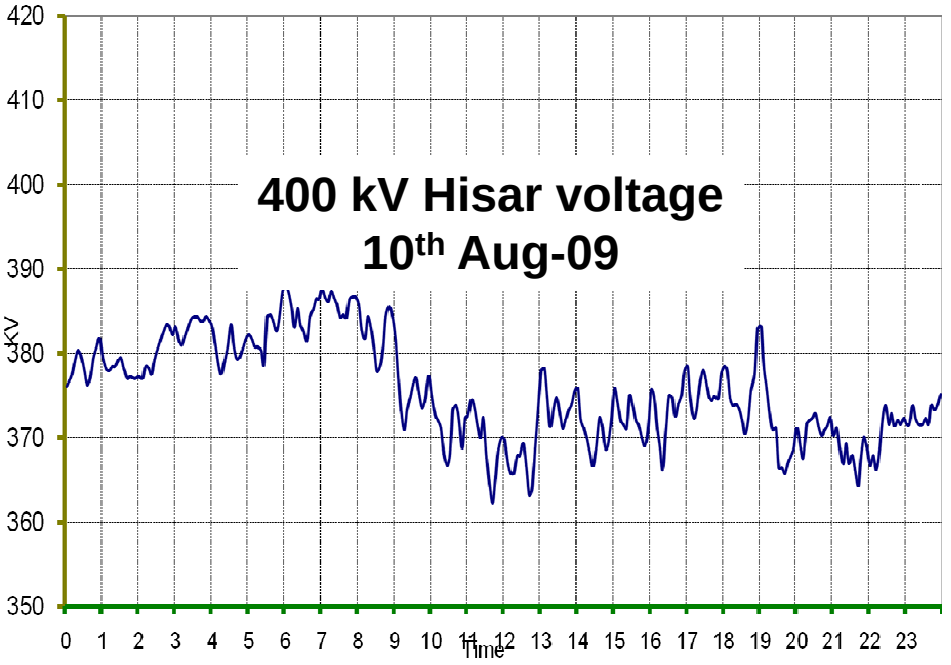
Heavy Reactive Power Demand at Meerut
MW/MVAR Loading of ICTs on 4th August 2009

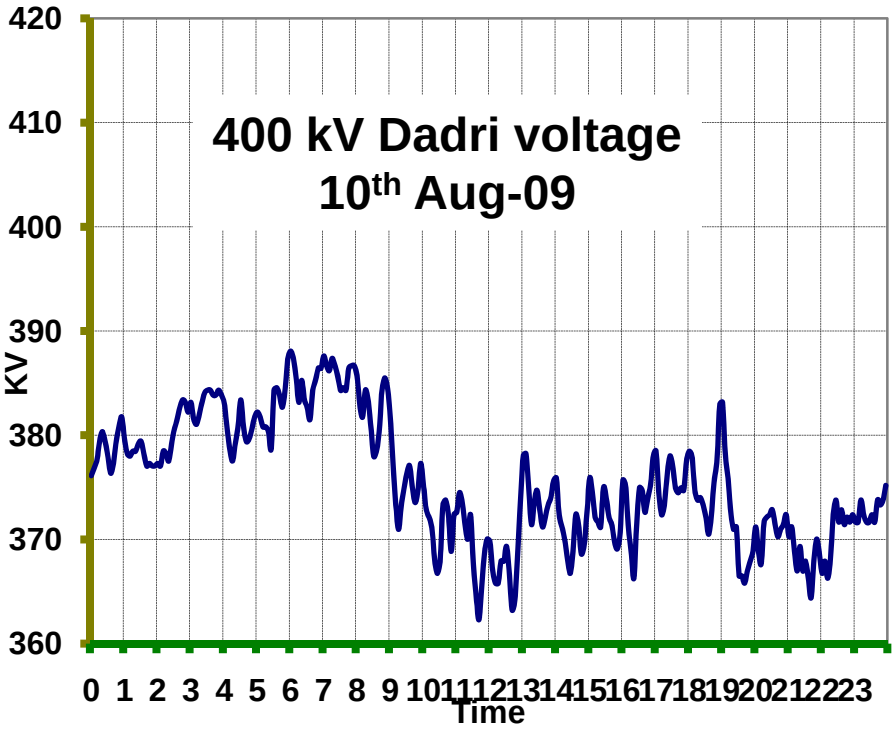


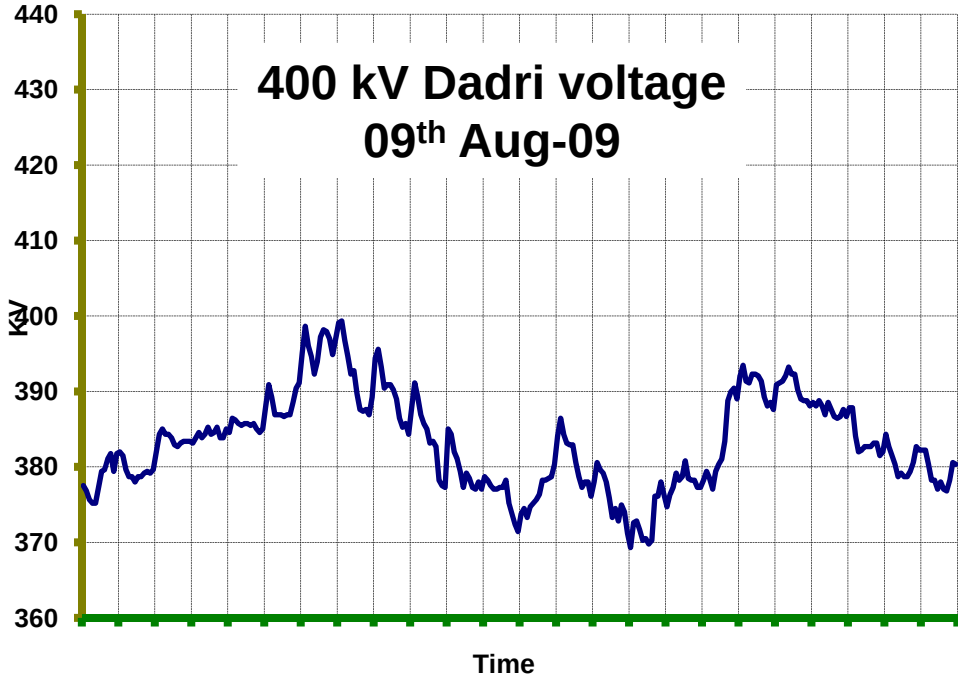
Cascade tripping leading to loss of around 1200 MW load in Punjab system was experienced on 10th June-2007

primarily on account of heavy drawal at critically low voltage


400 kV Panipat voltage
10th Aug-09
KV
Time


400 kV Hisar voltage
10th Aug-09
KV
Time

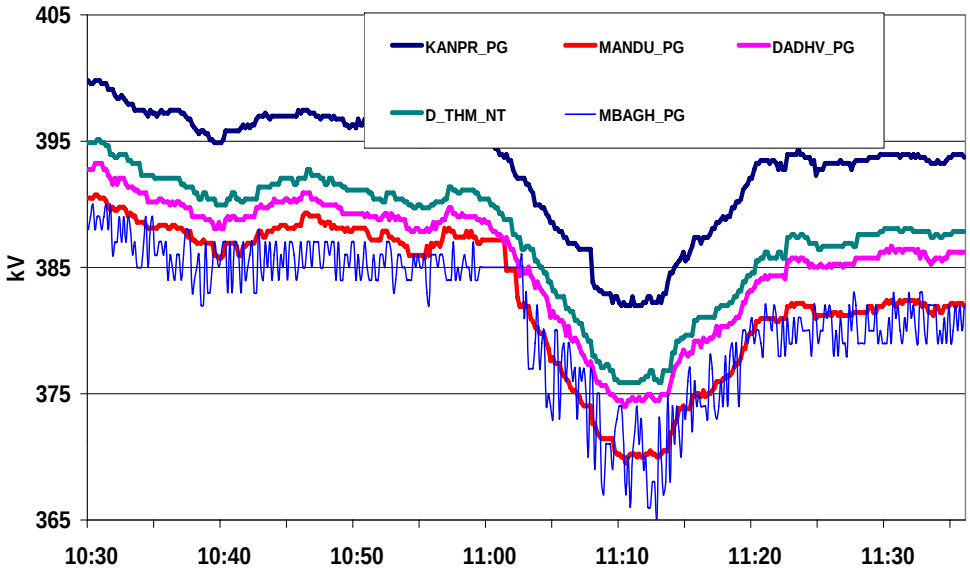

400 kV Dadri voltage
10th Aug-09
KV
Time


400 kV Dadri voltage
09th Aug-09
KV
Time

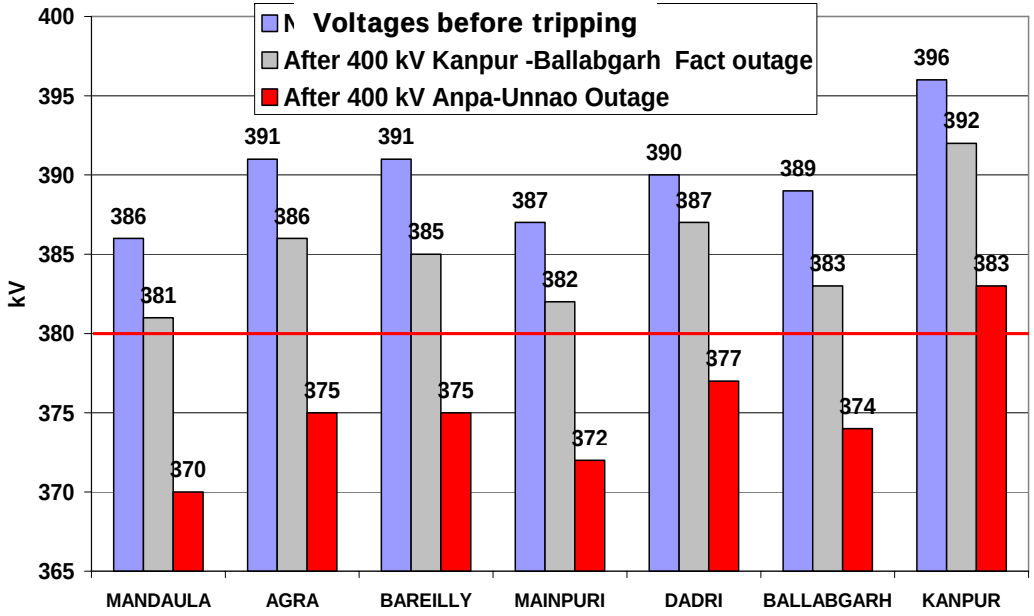
Voltage profile subsequent to

N-1 contingency

Voltage Profile during Tripping of Fact on 400 kV Kanpur - Ballabgarh at 11:02 hrs and Tripping of 765 kV (Charged at 400 kV) Anpara Unnao at 11:07 hrs



Voltages Observed After 400 kV Kanpur-Ballabgarh-Fact Outage & 400 kV Anpar-Unnao Outage



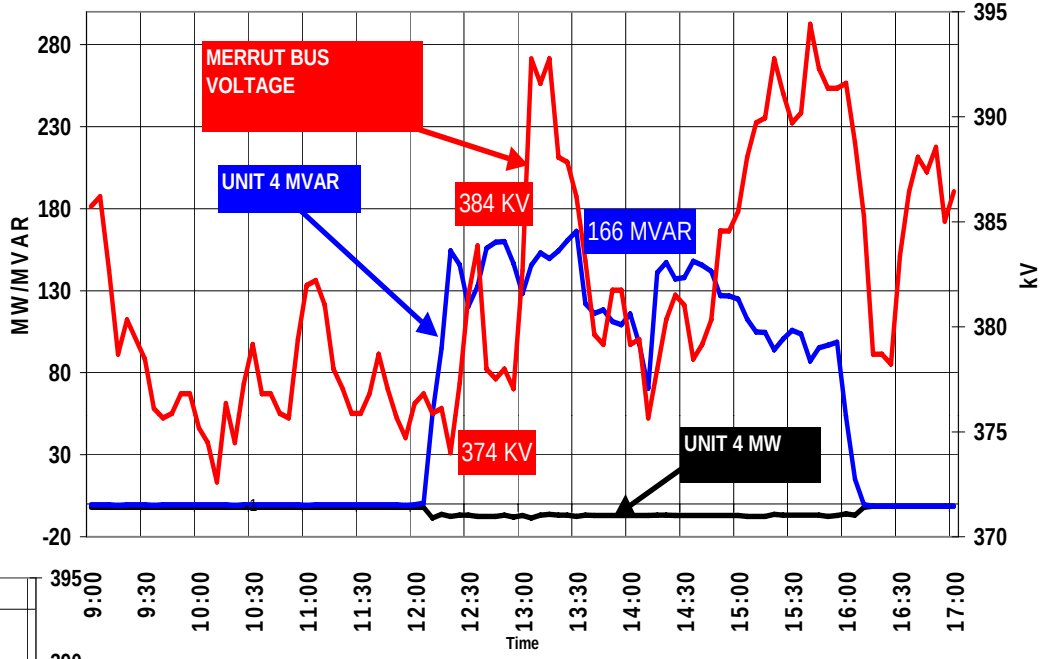
10th June 2009

11:02 hrs
FSC of 400 kV Kanpur-Ballabgarh tripped

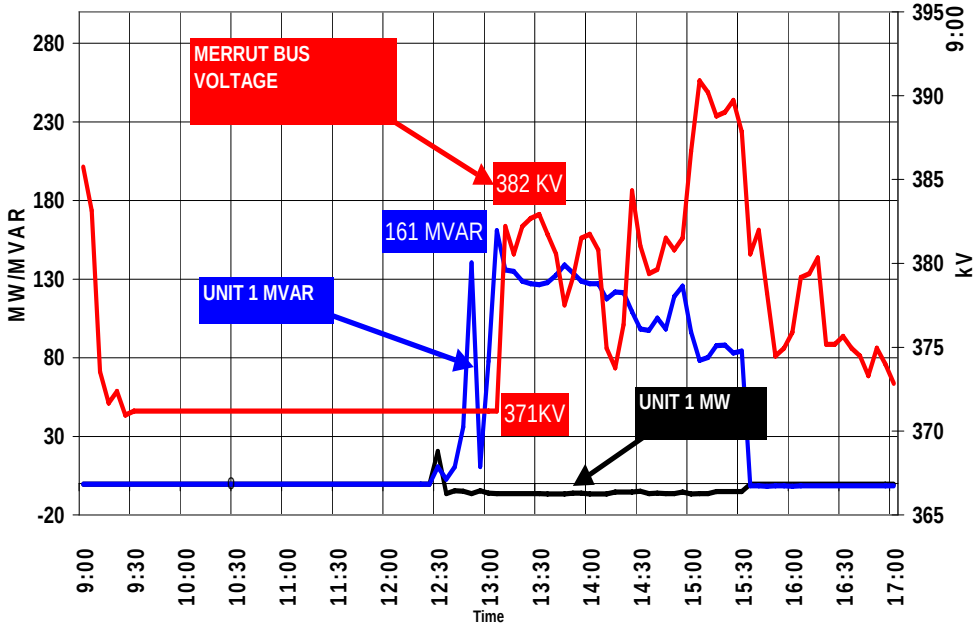
After 5 minutes (11:07 hrs)
765 kV @ 400 kV Anpara-Unnao tripped

In 2008-09
NR States have installed less than 10 % of the 6714 MVAR capacitor Requirement

Synchronous Condenser Mode of Tehri HEP on 3-Aug-2009



Synchronous Condenser Mode of Tehri HEP on 4-Aug-2009



Tehri unit 4 was operated on Synchronous condenser mode

10 kV improvement in voltage observed at 400 kV Meerut

Active Power consumption: 7-8 MW

Tower damage: Northern Region

	Name of Line	Trippng time/date	Reasons of tripping
1	400 kV Ballabhgarh-G.Noida	1551 hrs / 10.05.09	6 Nos. D/Ckts Towers (loc.no.70 to 75 , 4nos. A type , 1no.B type & 1 no.C type) damaged
2	400 kV Ballabhagarh-Maharani Bagh	1551 hrs / 10.05.09	At the same D/Ckts towers as above.
3	400 kV Allahabad-Mainpuri-1 & 2	1851 hrs / 11.05.09	5 Nos. D/Ckts Towers (loc.no.798 to 802 , 5nos. A type) damaged (2 towers at 1st secion and 3 towers at stub level).
4	400 kV Dadri-Mandola-1	2128 hrs/ 19.05.09	2 Nos. D/Ckts Towers (loc.no.32 to 33 , DA type) damaged
5	400 kV Dadri-Mandola- 2	2128 hrs/ 19.05.09	At the same D/Ckts towers as above.
6	400 kV Kanpur- Ballabhgarh	2129 hrs/ 19.05.09	Insulator hardware fitting of B-Phase at loc.no. 928 (suspension tower,Yamuna River x-ing tower)
7	400 kV Kanpur-Ballabhgarh	1736 hrs/ 28.05.09	3Nos. S/ Ckts Towers (loc.no.455 to 457 , 3nos. A type) damaged

Tower damage: Northern Region

	UPPCL Lines		
1	400 kV Unnao-Bareilly-1&2	2310 hrs / 10.05.09	2 Nos.D/Ckt Suspention Towers (loc.no.700 to loc.no.701) damaged (1 towers at middle secion and 1 tower at stub level).
2	220 kV Bareilly- Dohna-C.B. Gunj	2302 hrs / 10.05.09	1 Nos. Tower(loc.no.15- Type A+5) damaged(twisted)
3	220 kV Sitapur -Shahjahanpur	2310 hrs/ 10.05.09	1No. Tower damaged.
4	220 kV Merrut(PG)- Shatabdinagar	2057 hrs/ 19.05.09	3Nos. D/C Towers (loc.no.63,64 &75) damaged.
5	220 kV Shatabdinagar-Modipuram	2057 hrs/ 19.05.09	at the same D/Ckts towers as above.
6	220 kV Orai - Kanpur	0135 hrs/ 20.05.09	9 Nos. towers damaged.
7	220 kV Orai - Parichha ckt-1	1710 hrs/ 28.05.09	3Nos. D/C towers (LOC.NO. 71,72,73) damaged.
8	220 kV Orai - Mainpuri (UP)	1710 hrs/ 28.05.09	on same tower as above
9	220 kV Orai - Parichha ckt-2	1710 hrs/ 28.05.09	3Nos. D/C towers (LOC.NO. 268,269,270) damaged.
10	220 kV Orai - Parichha ckt-3	1710 hrs/ 28.05.09	on same tower as above

Tower damage: Northern Region

	RRVPNL Lines		
1	220 kV S/Ckt Mandawar-Bharatpur	1810 hrs/ 21.05.09	4Nos. Suspention towers and 1no. Tension tower damaged.
2	132 kV S/Ckt Bharatpur-Nagar	1810 hrs/ 21.05.09	5 Nos. towers damaged.
3	132 kV S/Ckt Bharatpur-Nadbai	1810 hrs/ 21.05.09	2 Nos. towers damaged.
	PTCUL Lines		
1	220 kV Bareilly - Pantnagar	2259 hrs/ 10.05.09	1 Nos. Tower(loc.no.56- Type A) damaged.
	DTL Lines		
1	220 kV South of Wazirabad-Kashmiri Gate D/C	1438hrs/ 22.05.09	3Nos. D/C Towers (loc.no.12,13 &14) twisted and damaged.

Tower damage: Western & Eastern Region

	Western Region		
1	400 kV Jabalpur – Itarsi D/C	14/05/09	20 towers damaged
2	400 kV Jabalpur Vindhaychal	24/05/09	3 towers damaged
	Korba (NTPC)-Bhilai {PGCIL Line}	6/6/2009	2 towers damaged
	Korba (W)-Bhilai {Chhattisgarh Line}	5/6/2009	2 towers damaged
	Other line outages reported in Eastern Region		
1	220 kV Joda-Jamshedpur (DVC),	18.05.09	
2	220 kV Bakreshawer- Bidhannagar D/C	27.05.09	
3	220 kV Farakka-Lalmathiya (NTPC)	NA	3 towers damaged

400 kV Purnea-Malda D/C is also out on account of damage to tower

Multiple incidents on 15th Aug-09

- 400 kV Singrauli-Allahabad-I & 400 kV Singrauli-Anpara under S/D
- Following units went under planned/forced outage in NR
  - Rihand # 3, Singrauli # 1, Tanda # 1,
  - Kota # 1, 2, 5 & 7, Anpara # 1, Obra # 9 & 12
- 02:28 hrs, 15th Aug-09
  - Rihand # 1 & 2 tripped due to C.W. pump failure (revived by 0835 hrs)
- By 0600 hrs, 15th Aug-09
  - FSC on 400 kV Kanpur-Ballabgarh and Panki-Muradnagar out
- 1400-1500 hrs, 15th Aug-09
  - All six units (1500 MW) generation closed at Jhakri due to high silt
- 1650 hrs, 15th Aug-09
  - 400 kV Dadri-Muradnagar tripped on pole discrepancy at Muradnagar

- At 21:16 hrs, 15th Aug-09
  - Failure of auxiliary supply at Rihand
  - Rihand # 1 & 2 tripped
  - HVDC Rihand-Dadri Bipole tripped

List of generation loss > 500 MW in NR
01st Apr-08 to 31st Jul-09

Sl No.	Date	Time of disturbance	Affected Area	Type of Disturbance	Plants/Substations Affected	Loss of Generation (MW)
1	28-Apr-08	17:00	Punjab	Loss of Generation	Ropar	750
2	28-Apr-08	23:30	Rajasthan	Loss of Generation	KTPS	980
3	06-May-08	16:19	Rajasthan	Loss of Generation	Suratgarh	1200
4	07-May-08	16:16	Rajasthan	Loss of Generation	Suratgarh	950
5	14-May-08	23.41	Rajasthan	Loss of Generation	Suratgarh	1200
6	23-Jul-08	10:57	Uttrakhand	Loss of Load and Generation	All generating units of Uttrakhand except Khatima	741
7	27-Jul-08	13:25	Uttrakhand	Loss of Load and Generation	All generating units of Uttrakhand except Khatima	578
8	11-Aug-08	5.01	NR Grid	Loss of Generation	Anpara	600
9	22-Sep-08	02:01	NR Grid	Loss of Generation	Dadri Thermal Dadri gas Vishnu pryag	600 + 325 + 425
10	19-May-09	16.37	Baspa,Jhakri,Abdullapur, Nallagarh	Loss of Generation.	Baspa, Jhakri, Abdullapur, Nallagarh	1700
11	21-Jul-09	00.55	Chamera	Loss of Generation	Chamera-I, Chamera-II	840
12	24-Jul-09	20.06	Haryana	Loss of Generation	Panipat	900

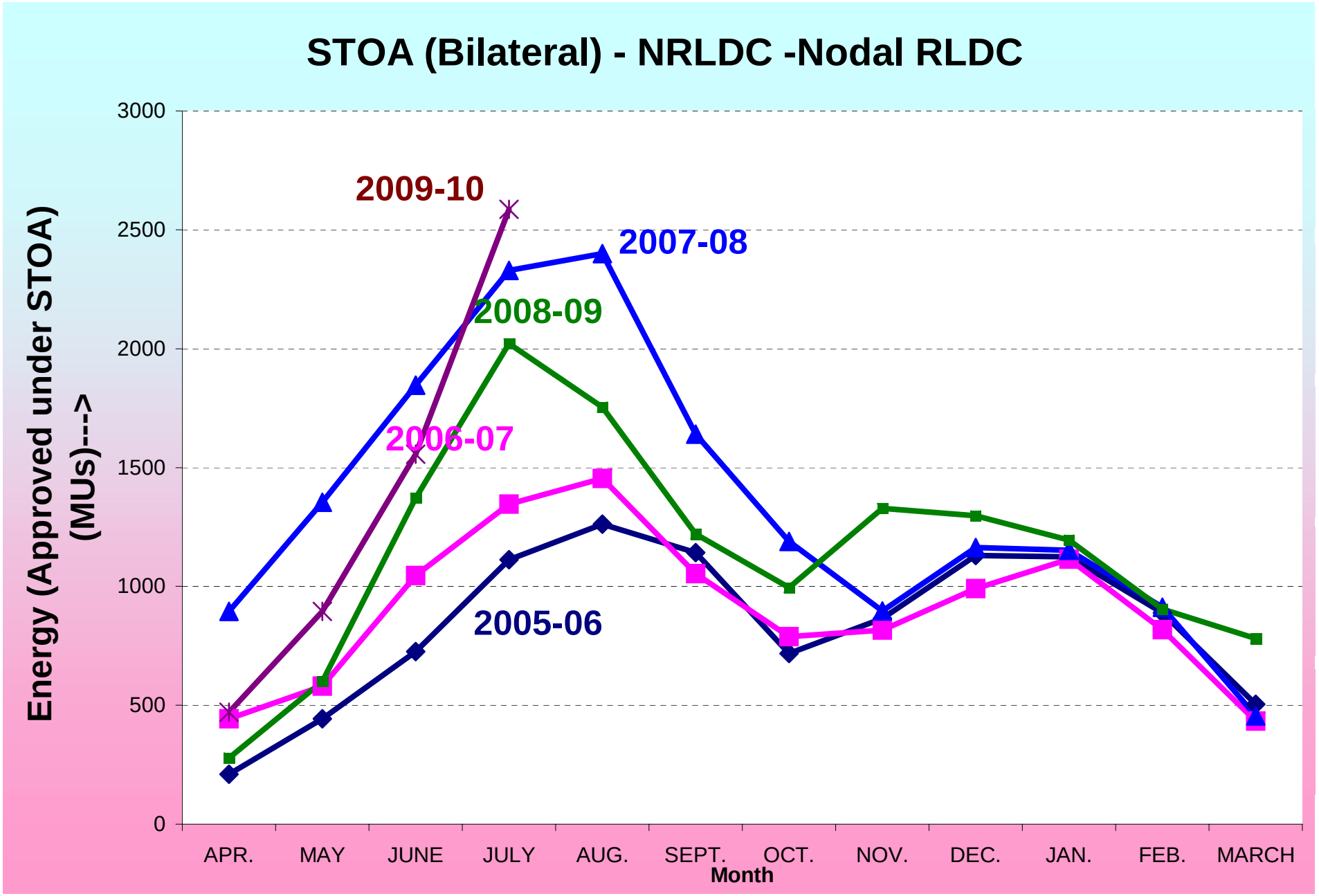
List of simultaneous multiple transmission element tripping in NR from 01st Apr-08 to 31st Jul-09

Sl No.	Date	Time of disturbance	Affected Area	Type of Disturbance	Plants/Substations Affected	Loss of Generation (MW)
16	21-Dec-08	Night of 20th & 21st Dec 08	NR Grid	Fog related tripping	0	0
17	08-Apr-09	14.40	Morak	Line tripping	Morak,Badod	NIL
18	13-Apr-09	23:47	Bawana	Line Tripping	Bawana	NIL
19	02-May-09	13.50	Raibareilly	Bus Fault	Raibareilly	NIL
20	03-May-09	02.20	400 kV Panki (UP)	Line & ICT Tripping	400 kV Panki (UP)	NIL
21	17-May-09	11.25	J & K	Line Tripping	Heeranagar	NIL
22	17-May-09	16.25	J & K	Line Tripping	Heeranagar	NIL
23	18-May-09	17.13	Area Around Anpara	Line Tripping	Anpara	200
24	19-May-09	21.12	Delhi	ICT Tripping	Mandaula	NIL
25	19-May-09	21.17	Muradnagar	Multiple Tripping	Muradnagar	NIL
26	19-May-09	21.28	Delhi	Line Tripping	Dadri & Mandaula	NIL
27	20-May-09	15.18	Area Around Anpara	Line Tripping	Anpara	200
28	04-Jun-09	1754	Meerut (PG)Substation	Line Tripping	Meerut (PG)Substation	NIL
29	10-Jun-09	11.02 hrs /11.08 hrs	NR	FACT/Line outage	0	NIL
30	26-Jun-09	06.30	Delhi	Dead Bus at Mandaula	Mandola	NIL

Transmission Outage to facilitate construction

- Stringing of HVDC Balia-Bhiwadi
  - 400 kV Agra-Bassi- II & III for 2 days
  - 400 kV Mainpuri-Ballabgarh D/C for 2 days
  - 220 kV Mainpuri-Harduaganj for 2 days
  - 132 kV Mainpuri-Etah for 2 days

- Work related to Anpara-D
  - 400 kV Singrauli-Allahabad-I and Singrauli-Anpara for 24 days continuous since 01st Aug 09

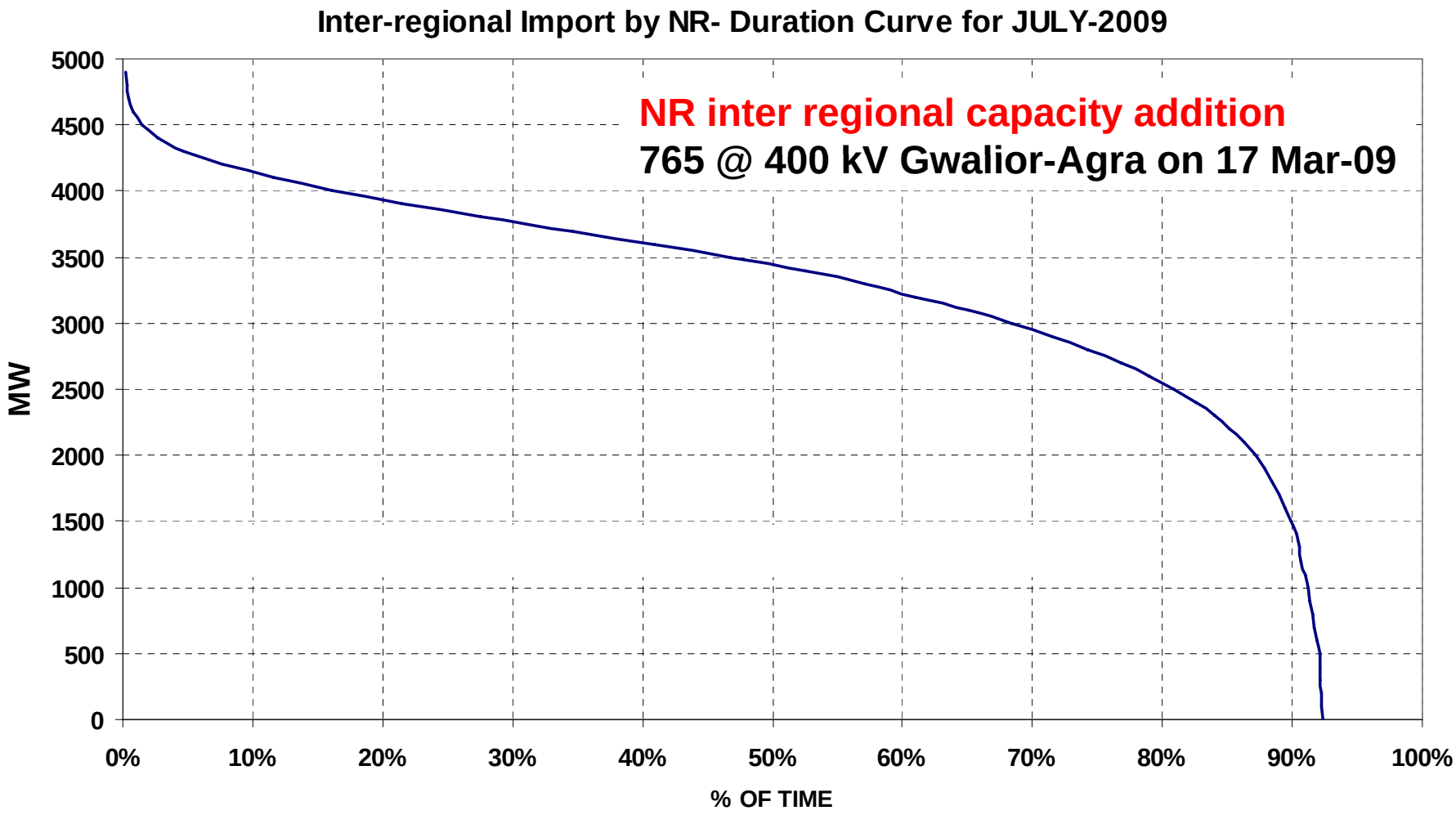

STOA (Bilateral) - NRLDC -Nodal RLDC
Energy (Approved under STOA) (MUs)--->
3000
2500
2000
1500
1000
500
0
2009-10
2007-08
2008-09
2006-07
2005-06
APR.
MAY
JUNE
JULY
AUG.
SEPT.
OCT.
NOV.
DEC.
JAN.
FEB.
MARCH
Month

Transmission Line loading in NR (July-09)

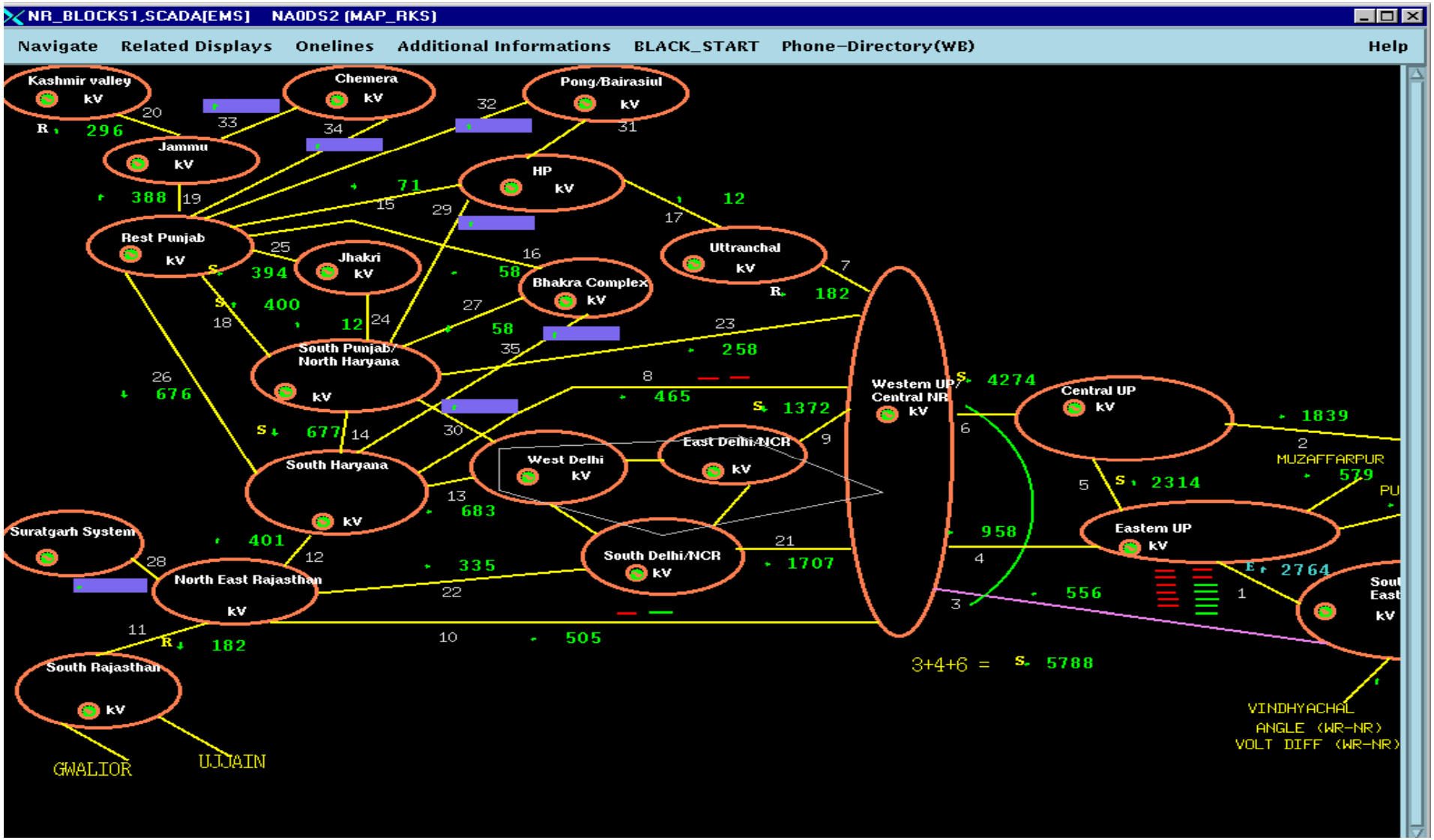
Transmission line Utilization in Northern Region (during the month of July-09)									
S No.	Transmission line	Maximum Powerflow (MW)	Average Powerflow (MW)	Line length (km)	Conductor type	Design Capacity MW	Maximum/Design (%)	Average/Design (%)	Line Load factor = Avg/Max
		A	B	C	D	E	F = A/E	G = B/E	B/A
1	765 kV @ 400 kV Gwalior-Agra-I	748	341	128	Quad Bersimis	1100	68%	31%	0.46
2	400 kV Muzaffarpur-Gorakhpur-II	701	519	261	Quad Moose + TCSC	900	78%	58%	0.74
3	400 kV Panki-Muradnagar S/C	502	378	395	Twin Moose + FSC	664	76%	57%	0.75
4	400 kV Kanpur-Ballabgarh S/C	590	459	386	Twin Moose + FSC	639	92%	72%	0.78
5	400 kV Abdullapur-Bawana-I	432	185	167	Triple Snowbird	605	71%	31%	0.43
6	400 kV Gorakhpur-Lucknow-II	510	355	246	Twin Moose	515	99%	69%	0.70
7	400 kV Singrauli-Lucknow S/C	423	341	409	Twin Moose	515	82%	66%	0.81
8	400 kV Singrauli-Kanpur S/C	457	376	400	Twin Moose	515	89%	73%	0.82
9	400 kV Singrauli-Allahabad-I	506	367	224	Twin Moose	515	98%	71%	0.72
10	400 kV Agra-Ballabgarh S/C	530	337	181	Twin Moose	515	103%	65%	0.64

Northern Region transmission system utilization was significantly high in July-09

Inter-regional Import by Northern Region

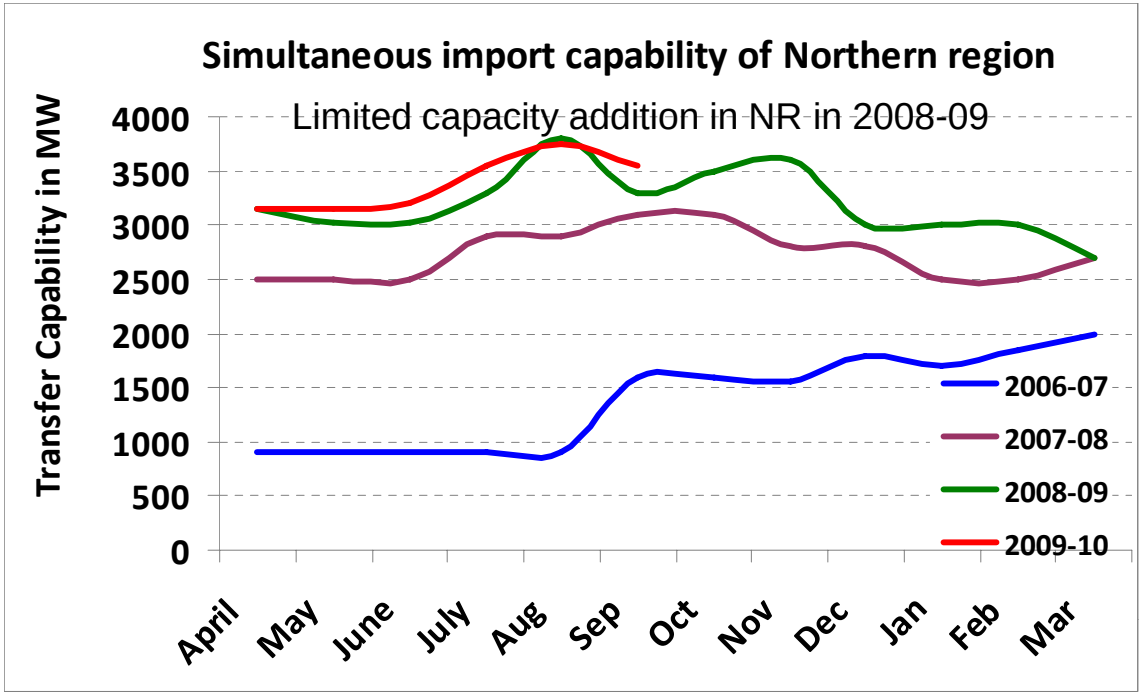


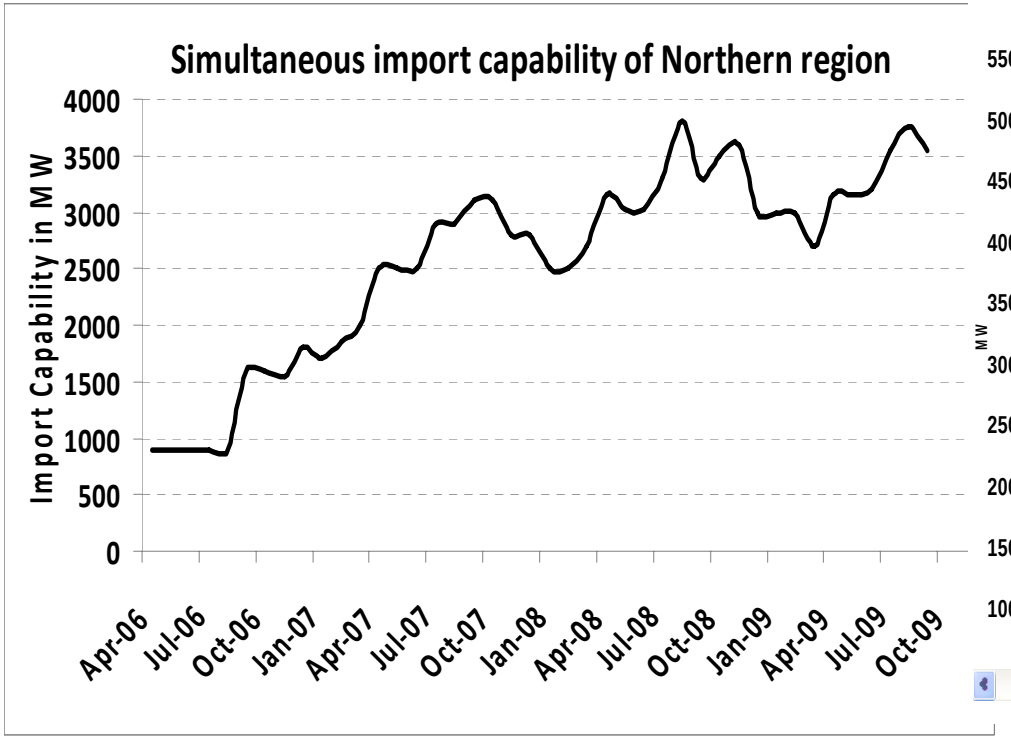
21 Zones and 37 Flowgates in NR

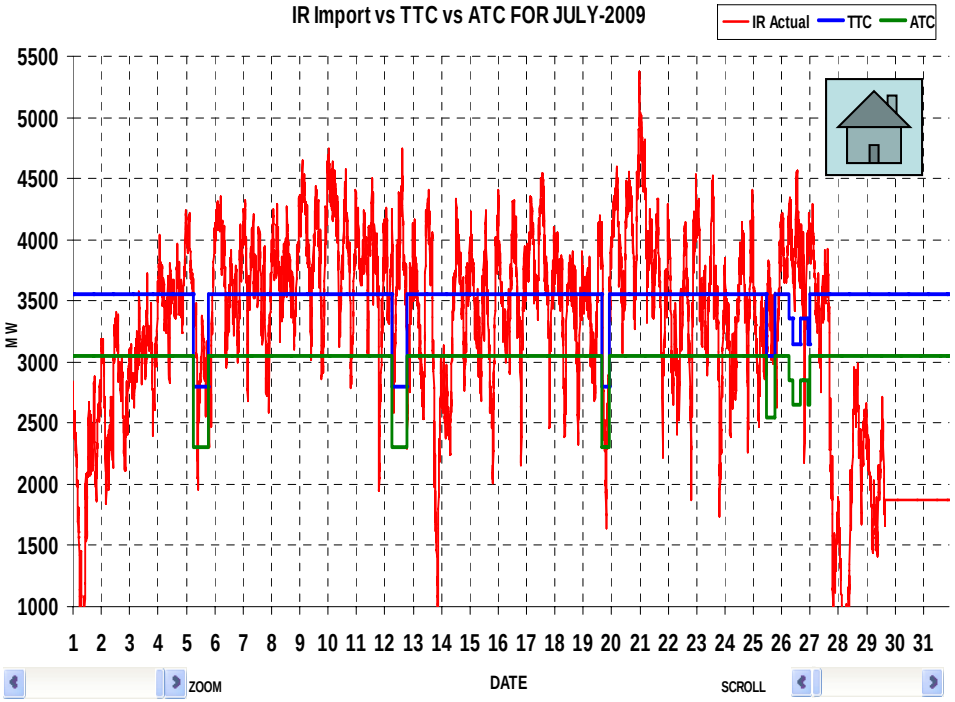


RLDCs have to ensure integrated operation of the grid and schedule in accordance with contracts

Declaration of transfer capability in advance is only a transparent mechanism for executing the mandate





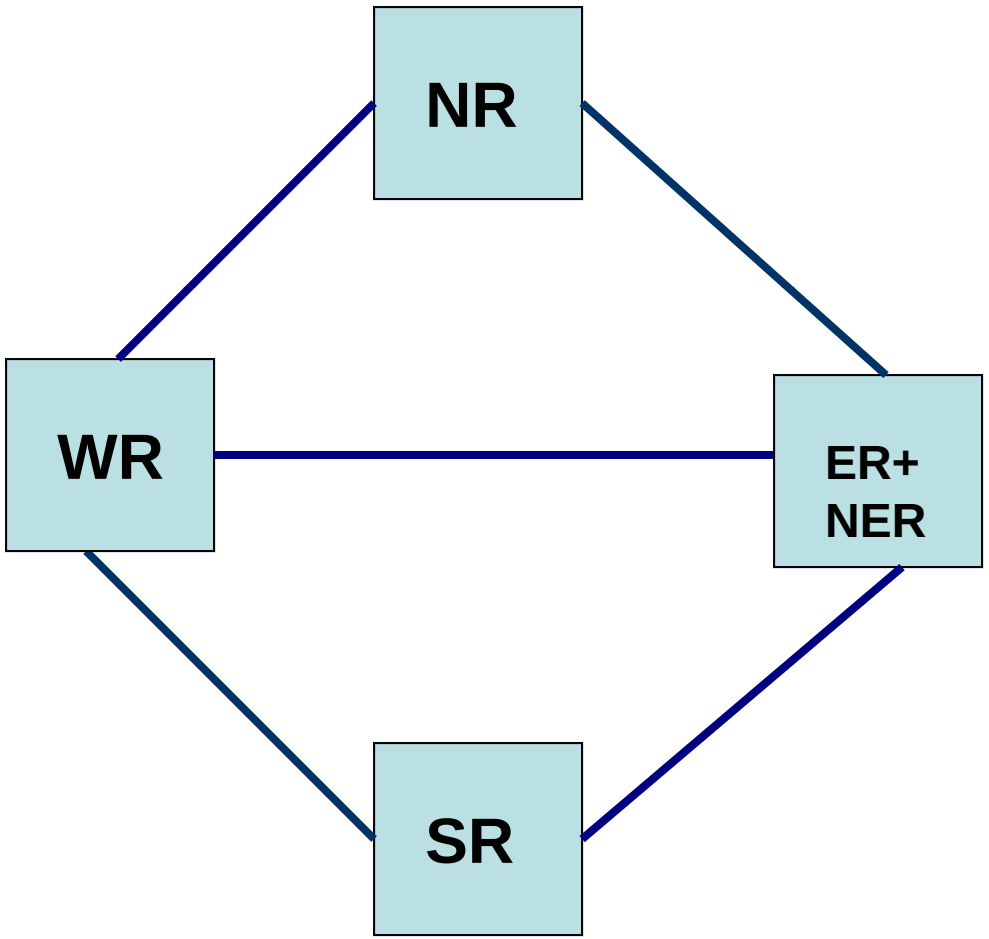


Types of congestion in Indian context

- 3 / 2 / 1 month (s) ahead – advance
- First come first served
- Day ahead PX
- Day ahead bilateral
- Contingency transaction
- Real time

Causes of congestion

- Inadequate transmission – including outages
- Inadequate reactive support
- Weather diversity, seasonal demand variation
- Skewed generation availability – monsoon, planned / forced outages
- Uneven purchasing power of utilities in a shortage scenario
- Compulsion to meet load at all costs (agriculture, festival, election etc.) – Aggressive buying
- Economy (cheaper generation to replace costlier generation)
- Inflated sale / purchase requirement – Pseudo congestion
- Inter play with UI mechanism – Bids based on anticipated UI price



Scenarios

4D

3D 1S

2D 2S

1D 3S (Congestion)

4S

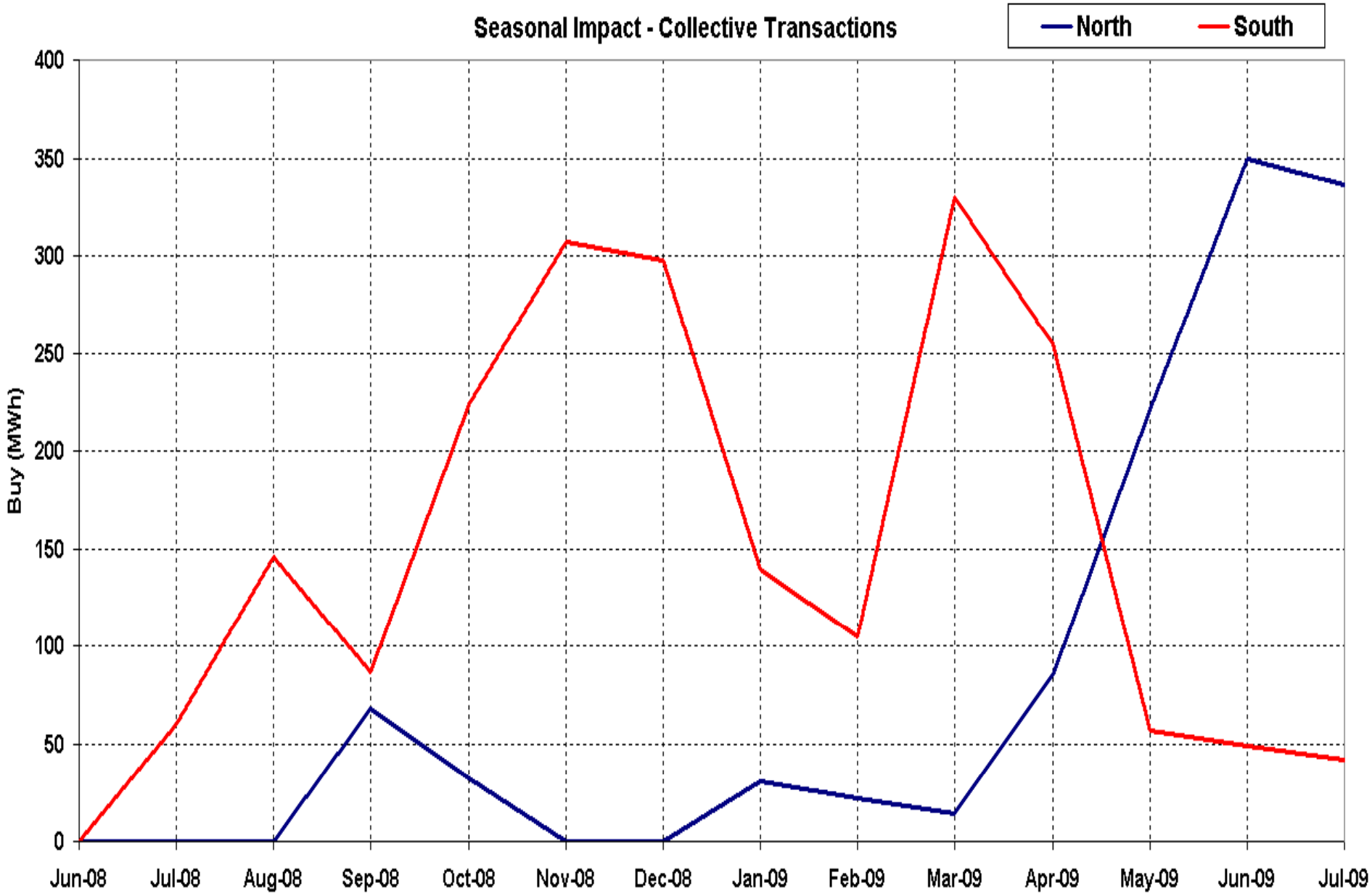
Congestion - Power Exchange

- No congestion till onset of severe winter

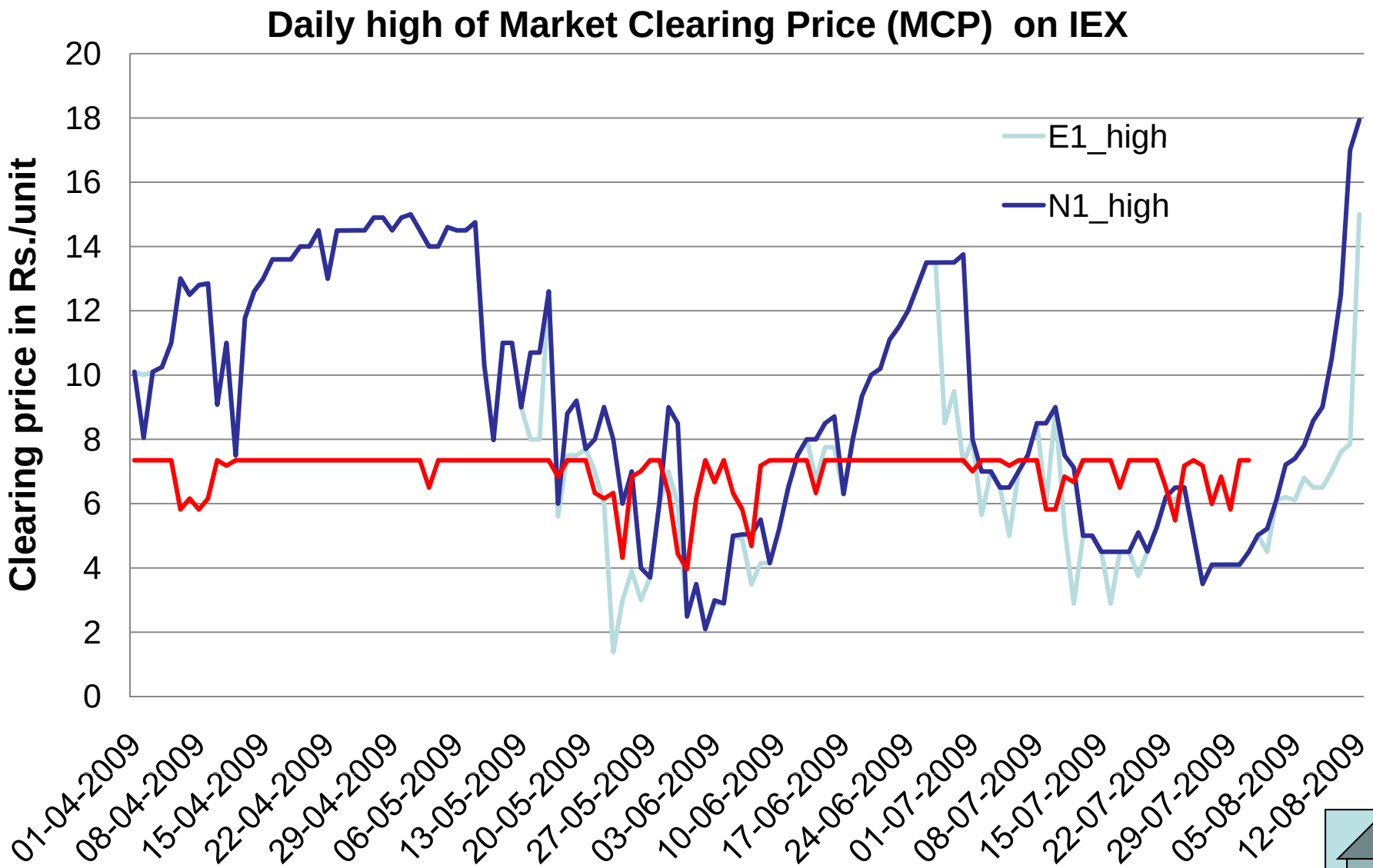
- Winter
  - Since 12th December 2008
  - Congestion for import to SR
  - Failure of monsoon in SR

- Summer / monsoon
  - Congestion for import to NR
  - Aggressive buying by utilities in NR to meet weather beating / agriculture load

Seasonal Impact – Collective Transactions through PX



Congestion Management in Power Exchange



Concerns-1

- Wide range of permissible frequency band
  - Significant interplay of frequency and voltage in a large grid
- ‘UI’ considered as an infinite source / sink
- Limited voluntary participation by utilities for congestion management in real-time
  - Primary response, Reactive Support
- Availability norm falling short of ensuring Dependability
  - Outage of complete power station
  - Outage of complete EHV substation

Concerns-2

- Changes in long-term allocations
- Uncertainties in planned outages of shared resources
- Medium-term inadequacies in transmission/generation
  - Open Loops, Switching arrangement
- Safety net
  - Relay settings/ behavior:
  - Credible N-1 contingency getting converted into simultaneous multiple outages in real-time
- Frequent large scale contingencies
  - Fog, Widespread rains, Cyclone, Silt
  - Limited support from online tools in case of fast events

Suggestions for improving transfer capability-1

- installation of shunt capacitors in pockets prone to high reactive drawal & low voltage
- strengthening of intra-state transmission and distribution system
- improving generation at load centre based generating stations by R&M and better O & M practices
- avoiding prolonged outage of generation/transmission elements
- reduction in outage time of transmission system particularly those owned by utilities where system availability norms are not available

Suggestions for improving transfer capability-1

- minimising outage of existing transmission system for facilitating construction of new lines
- expediting commissioning of transmission system-planned but delayed execution
- enhance transmission system reliability by stregthening of protection system
- strengthening the safety net- Under voltage load shedding schemes, system protection schemes

Conclusion

- It is impossible to plan / design a large congestion-free system
- Mild / occasional congestion indicates optimum investment in transmission
- Regular congestion indicates inadequacy
  - Generation
  - Transmission
  - Reactive compensation
- Utilization of congestion revenue to relieve congestion

Thank You for your attention !

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Narrowing Permissible Frequency Range in Indian Electricity Grids

Meeting of the Coordination Forum

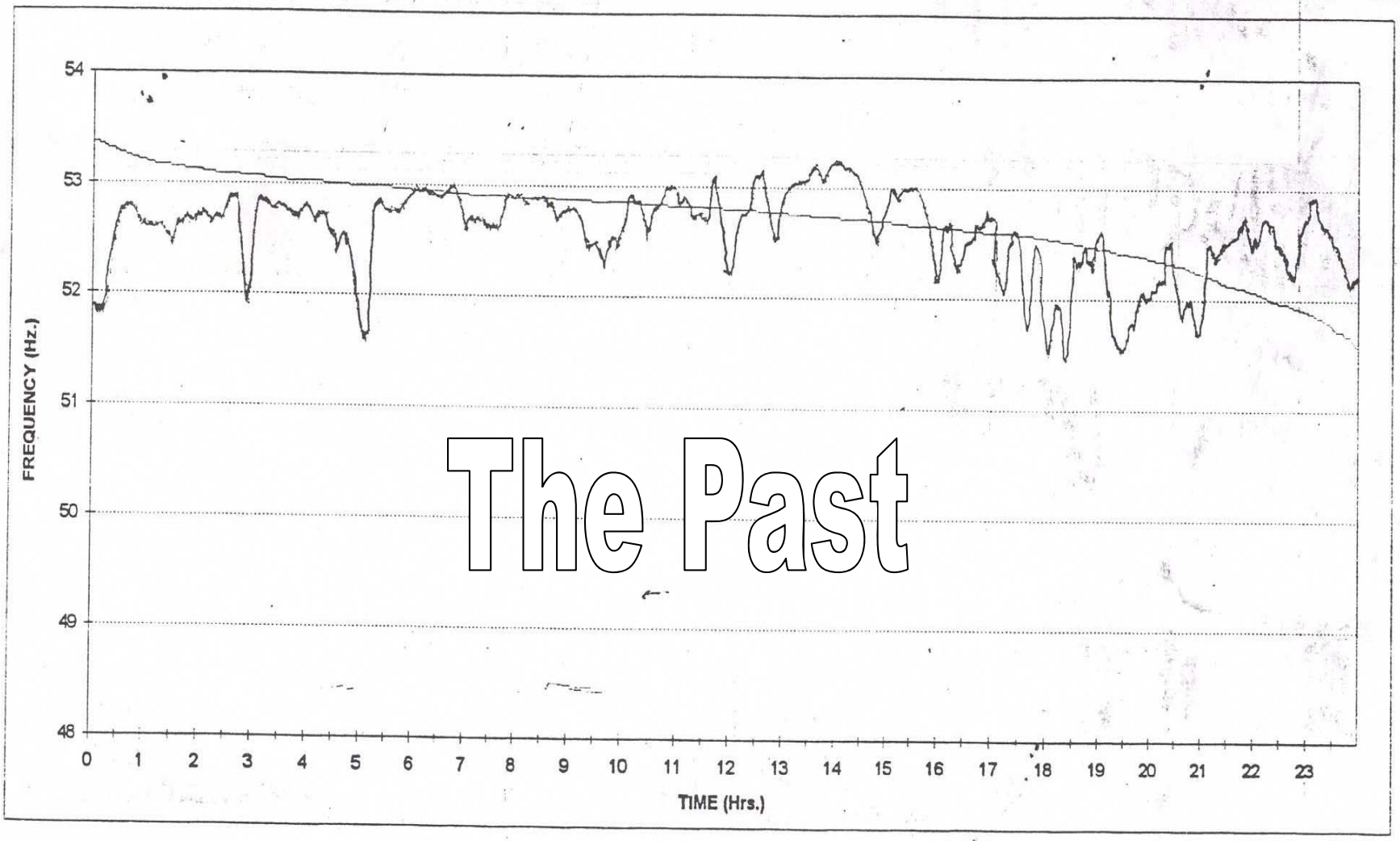
17th August 2009

NLDC

FREQUENCY & FREQUENCY DURATION CURVE

DATE : 27/09/98 Sunday

FVI : 68.38 STD : 0.3 AVG. Freq : 52.6 Hz Max. Freq : 53.3 Hz Min Freq : 51.4 Hz

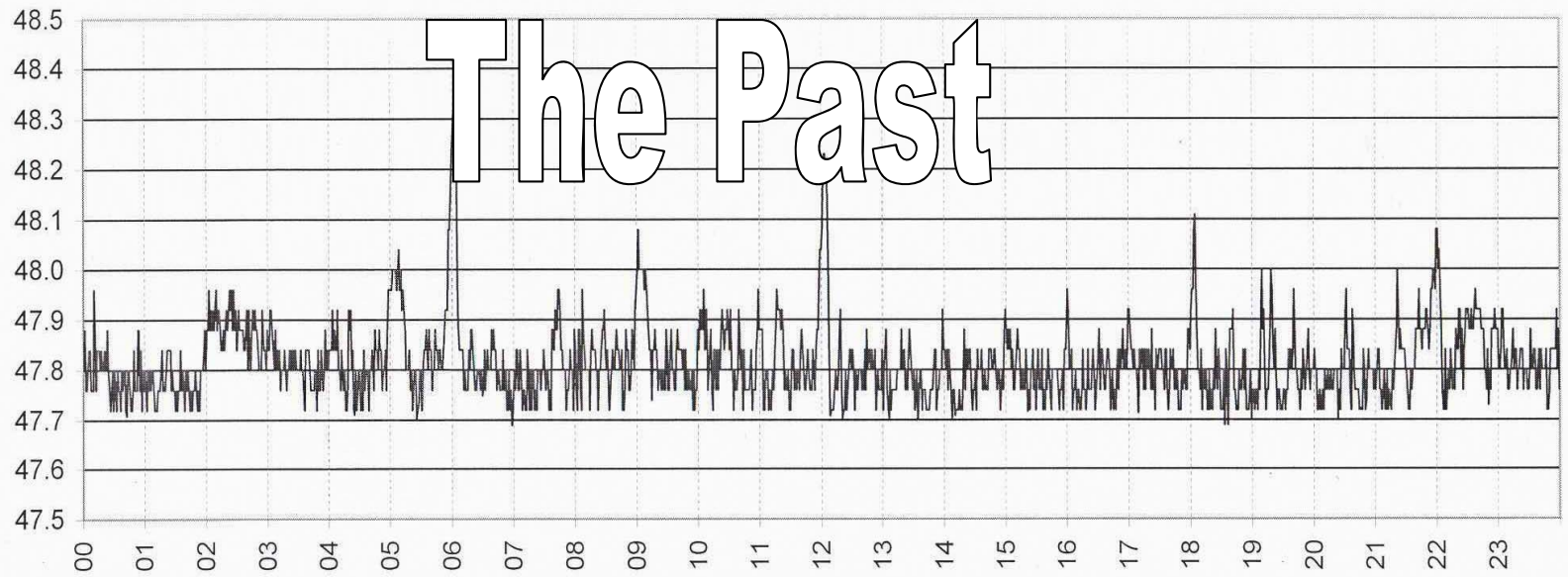


POWERGRID
ERLDC,CALCUTTA

NLDC

POWER GRID CORPORATION OF INDIA LTD.
SOUTHERN REGIONAL LOAD DESPATCH CENTRE

FREQUENCY ANALYSIS FOR 24-04-2002 Wednesday



Frequency Variation based on data integrated over ONE minute interval

	<48.0	48.0 & <48.5	48.5 & <49	49 & <49.5	49.5 & <50	50 & <50.5	50.5 & Above
Minutes	1396	44	0	0	0	0	0
In %	96.9	3.1	0.0	0.0	0.0	0.0	0.0

Average Frequency over the day:	47.82	Standard Deviation:	0.08	Frequency Variation Index :	47.70

	Instantaneous	
	Freq	Time
Max	48.31	06:01
Min	47.69	18:36

	Quarter Hourly Average	
	Freq	Time
Max	47.97	05:15
Min	47.75	13:45

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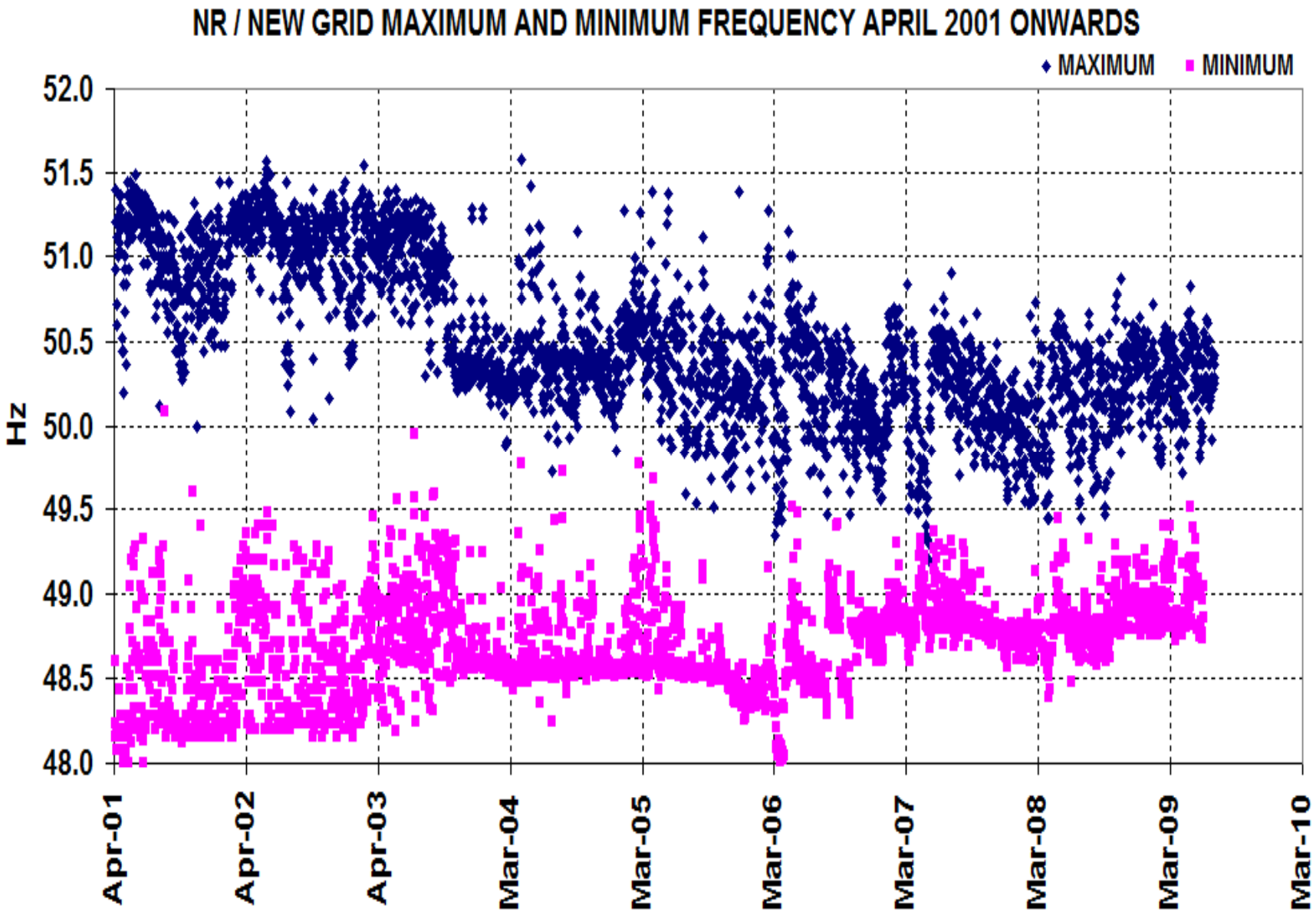
Daily Max & Min Frequency in NR



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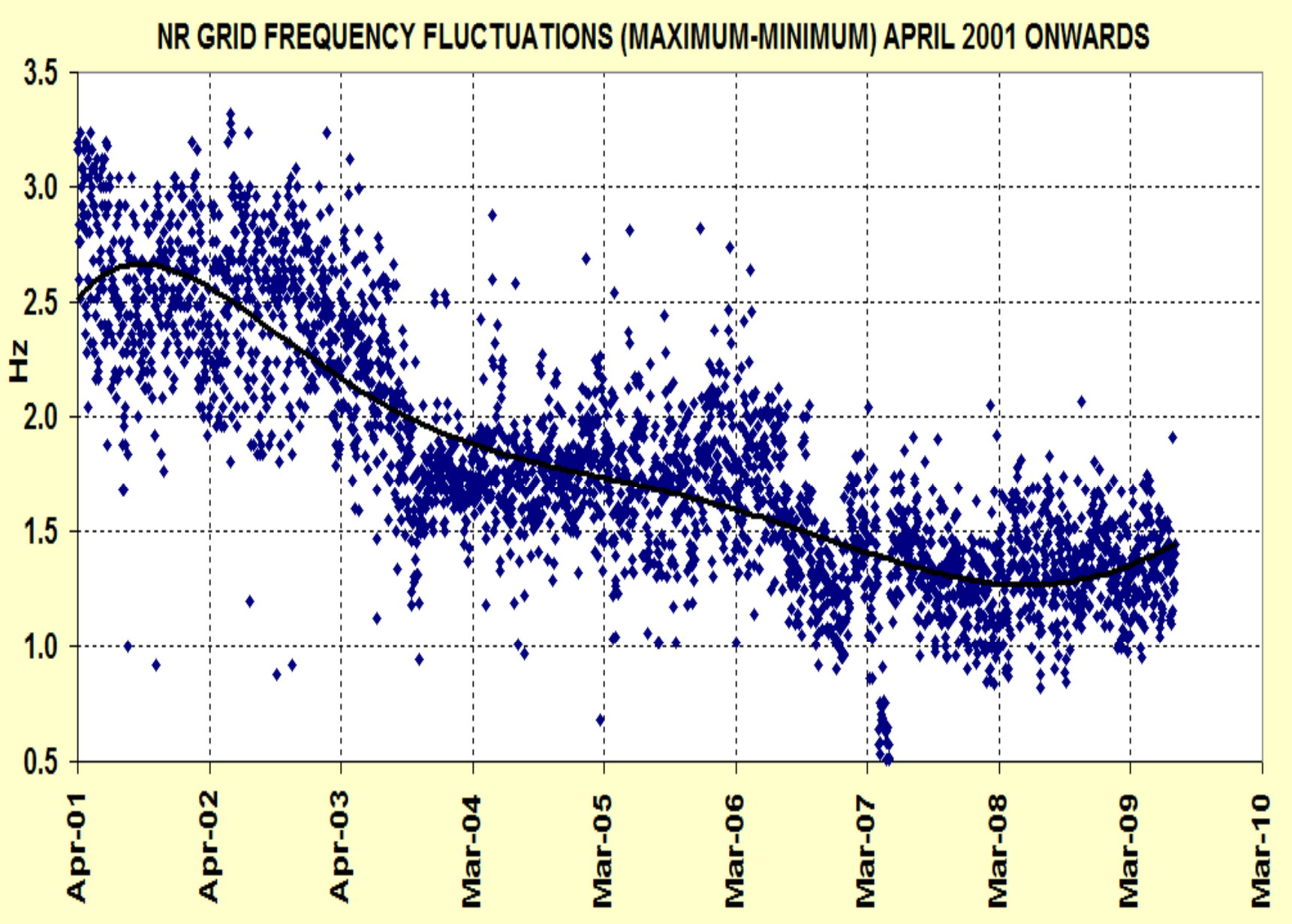
Daily Frequency Fluctuations in NR



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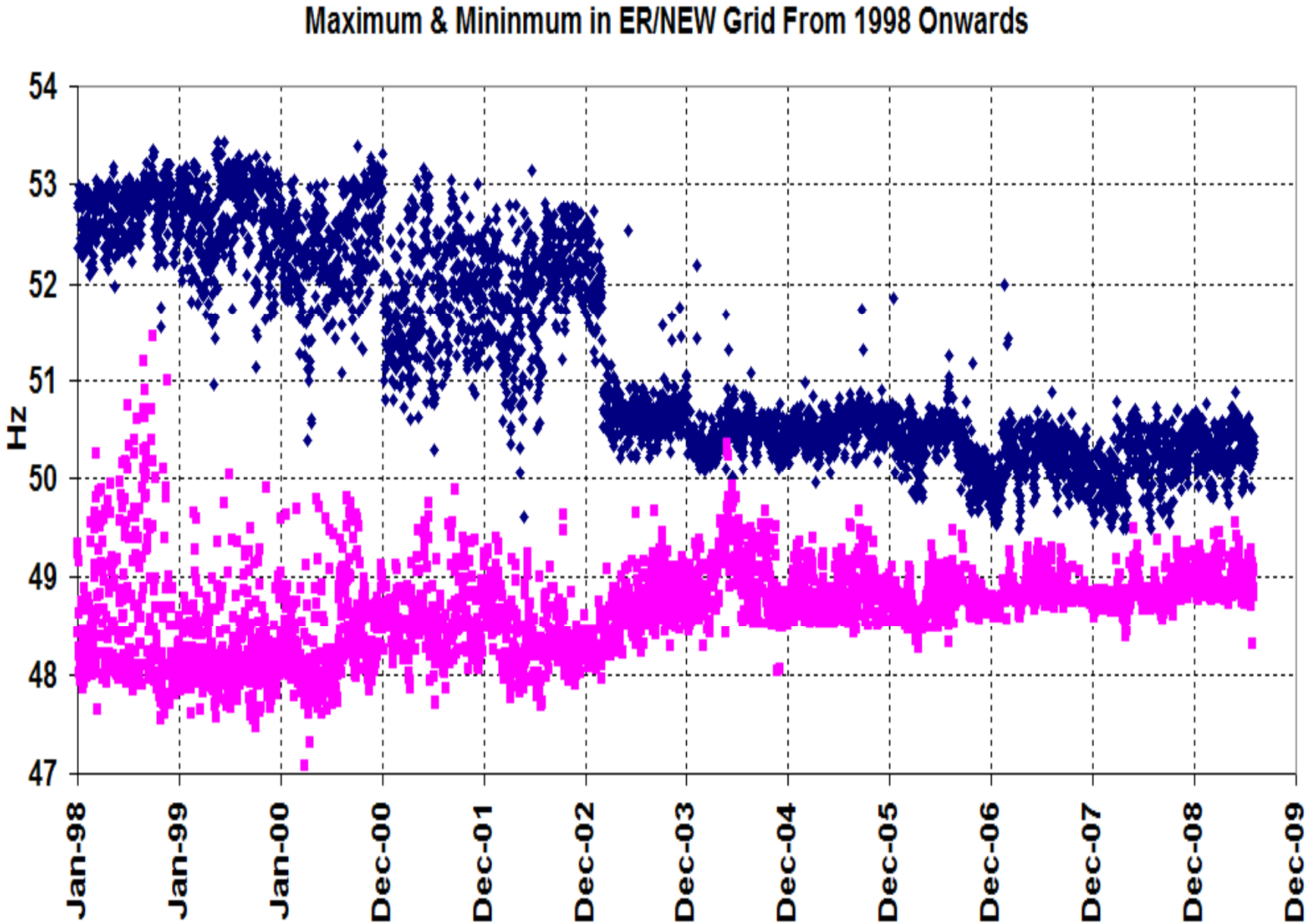
Daily Max & Min Frequency in ER



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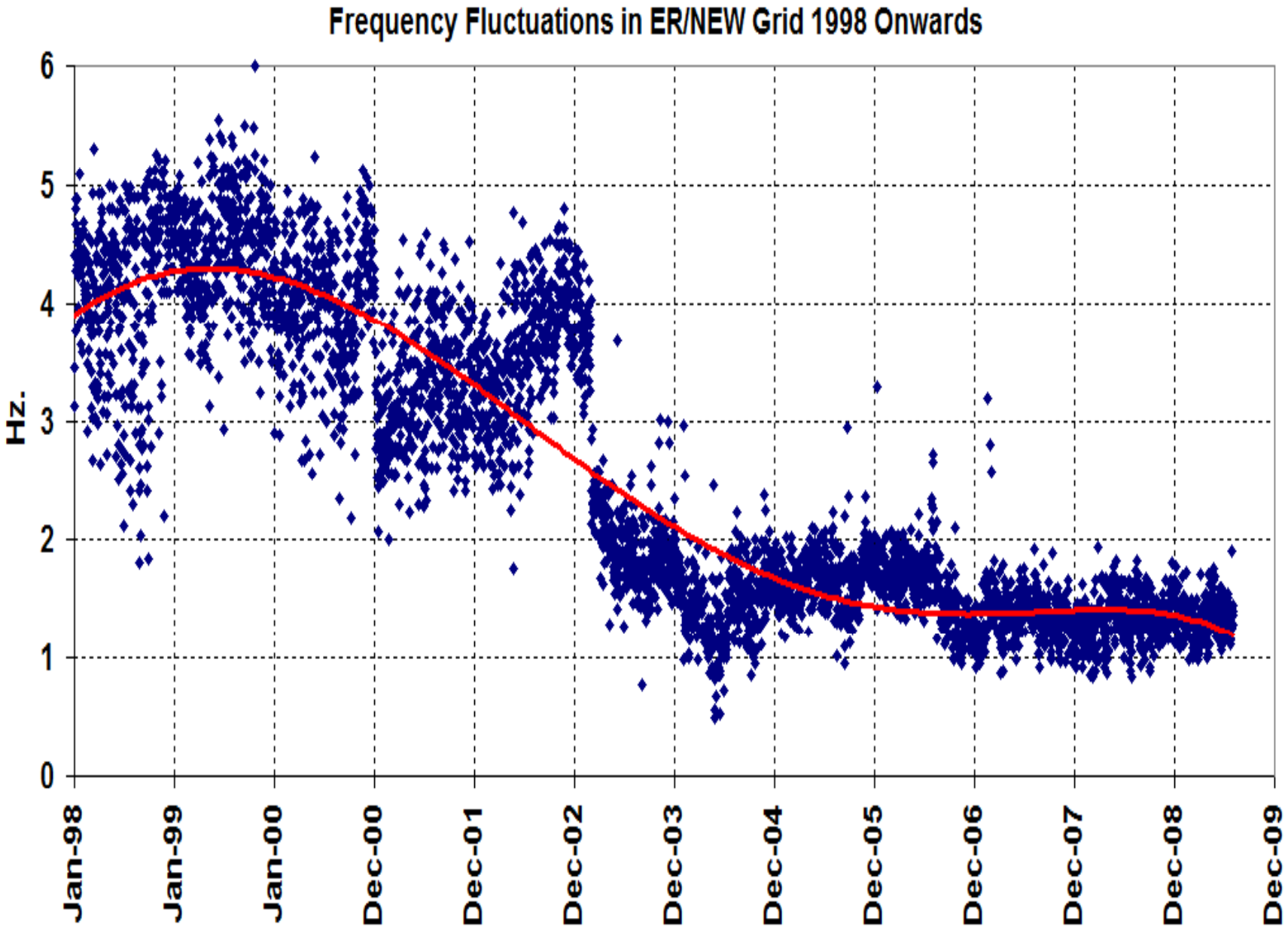
Daily Frequency Fluctuations in ER



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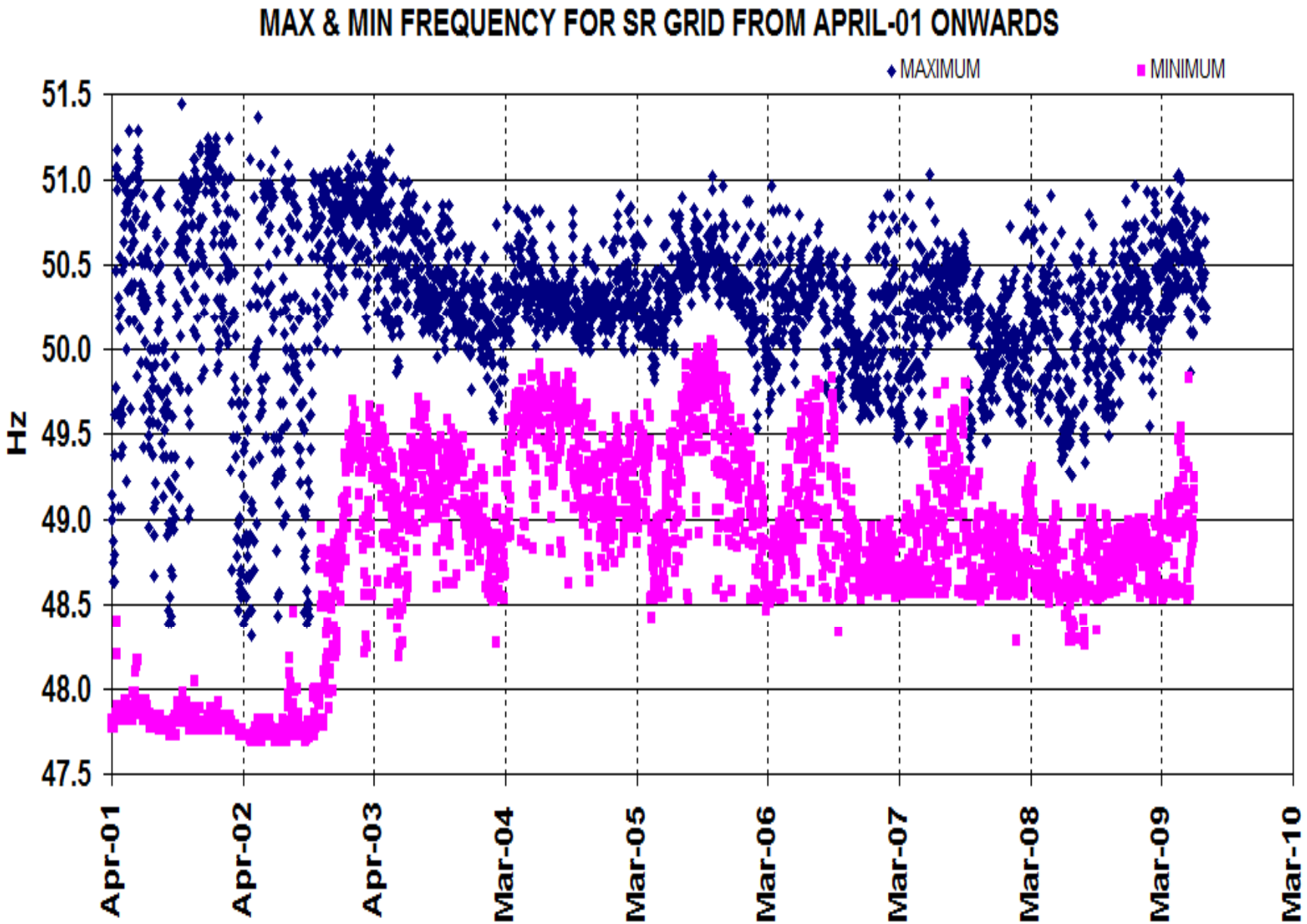
Daily Max & Min Frequency in SR



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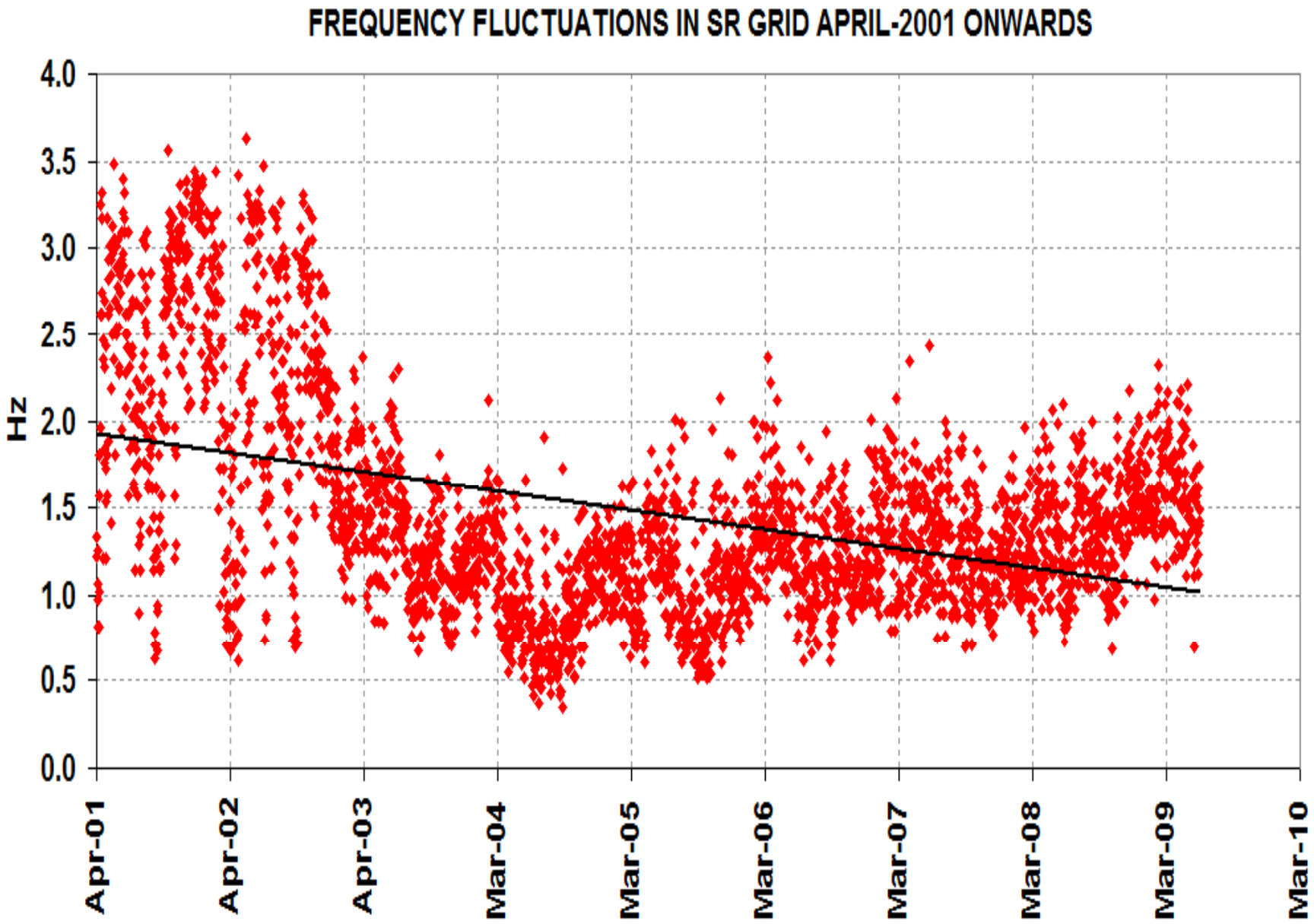
Daily Frequency Fluctuations in SR



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Frequency Profile – India & Neighbors

% of Time frequency (f)	India – NEW Grid	India – SR Grid	Pakistan	Sri Lanka	Nepal	Bhutan
f < 49.0	7	11	0	0	1	7
49.0 < f < 49.5	49	68	20	0	18	49
49.5 < f < 49.8	26	14	33	16	35	26
49.8 < f < 50.2	16	6	40	81	30	16
50.2 < f < 50.5	2	1	7	2	15	2
f > 50.5	0	0	0	0	1	0

Source: SAARC Task Force on Grid Interconnections amongst SAARC members (Data for 2008 -09)

Frequency & Reactive Power

- Correlation between frequency and reactive power
  - Studied using real time SCADA data in NR
- Summary
  - 1% fall in frequency results in 6% to 12% increase in reactive power
  - One Hz change in frequency translates into 8000 to 10000 MVAR, considering an All India reactive power requirement of approx 60000 MVAR

Source: Reactive Power and System Frequency Relationship: A Case Study - CBIP 7th International R&D Conference, Feb 2009

Frequency Response Characteristics

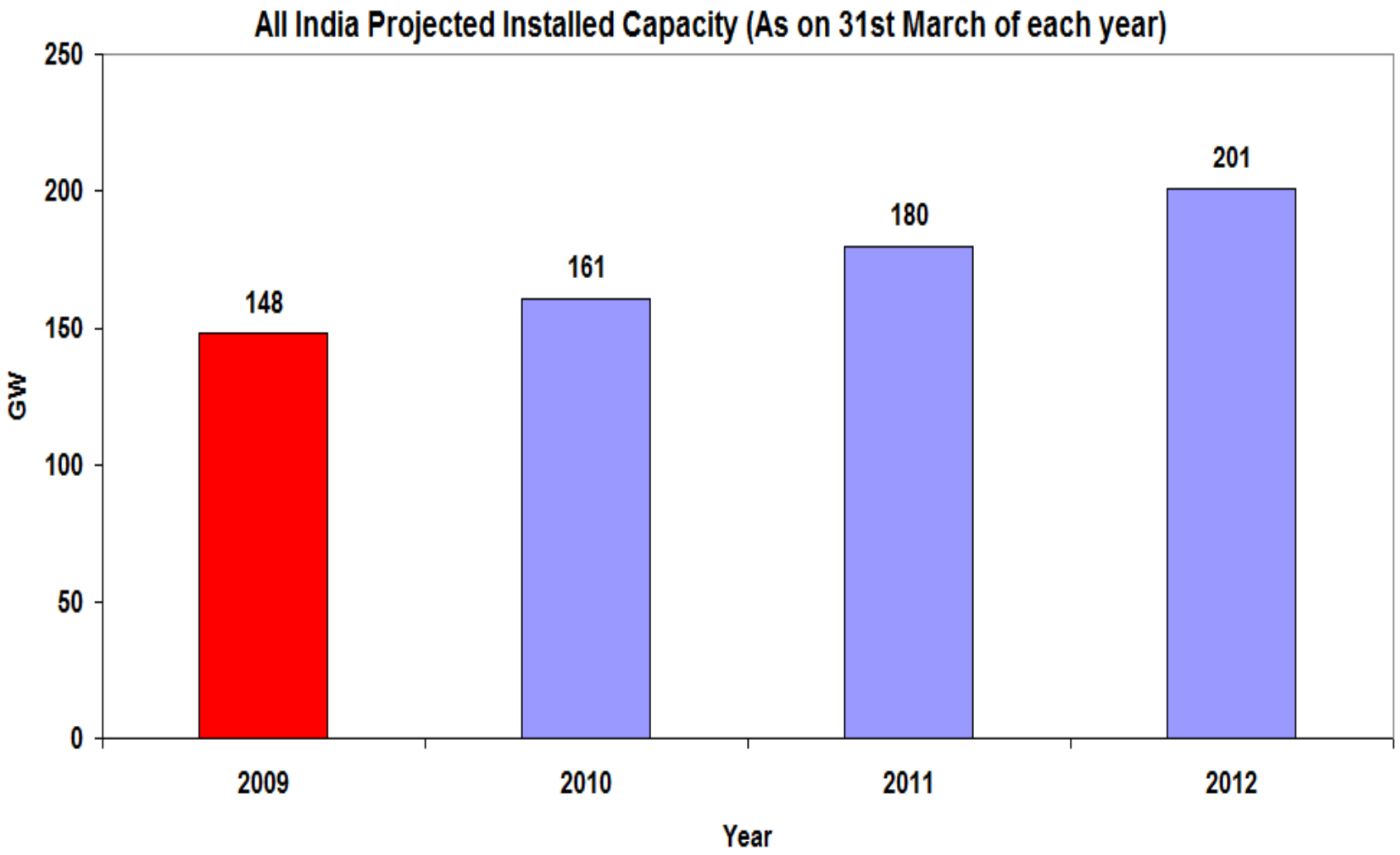
- Study conducted using real time SCADA data in NR and SR Grids
- Summary
  - NR Grid: Average 678 MW/Hz
  - SR Grid: Average 1020 MW/Hz
  - NEW Grid: Approx. 1800 MW/Hz

- Tightening of frequency band by 0.3 Hz translates into approx. 540 MW in NEW Grid and approx. 306 MW in SR Grid

Source: Frequency Response Characteristics of an Interconnected Power System – A Case Study of Regional Grids in India

- CBIP 6th International R&D Conference, Feb 2007

Projected All India Capacity



Source: CEA

Projected Power Supply Position by 2012

Period	Peak Demand (MW)	Peak Met (MW)	Deficit / Surplus (MW)	Deficit / Surplus (%)
2011-12	152746	152899	153	0.1

Period	Energy Req (MU)	Energy Avail (MU)	Deficit / Surplus (MU)	Deficit / Surplus (%)
2011-12	968659	1010346	41687	4.3

Demand as per 17th EPS

Source: Power Scenario at a Glance, July 2009, CEA

CERC Order on ABT Dated 4th Jan 2000

"***5.9.8*** *Another point for consideration is whether charges for overdrawal should be the same at 49.0 Hz and even below 49.0 Hz. It should be noted that the declared frequency in India is 50 Hz. An integrated power system should operate with a grid frequency hovering around 50 Hz. In practice however, the frequency range in India has been 48.5 Hz to 50.00 Hz. This is not desirable for achieving interconnected/integrated operation of the grid. With the additions to generation capacities, it is hoped that there may not be a drop below 49 Hz. .....*

..... ***In fact the attempt should be to further narrow down the range with more generating capacities coming up and redundancy created****."*

Need for Tightening the Freq Band (1)

- Operation of very large grid
  - Reliable & Secure operation
    - Disturbances in one area can propagate
  - Enhance grid security
- Influence of frequency on
  - Voltage
    - One Hz change results in about 8 KV change at 400 KV level
  - Reactive power
    - 1% decrease in frequency causes 6% to 12% increase in MVAR
  - Line loadings
    - One Hz change may result in line flow variations of the order of 1000 MW across regions
    - May lead to congestion
  - Overfluxing of Transformers
    - Low frequency and high voltage combination

Need for Tightening the Freq Band (2)

- IEGC Clause 6.4.7
  - *"Provided that the States, through their SLDCs, shall always endeavour to restrict their net drawal from the grid to within their respective drawal schedules, whenever the system frequency is below 49.5 Hz"*
  - ➢ Encourage demand side management, "Negawatts"
- Encourage implementation of IEGC Clause 6.4.8
  - *"The SLDCs/STUs shall regularly carry out the necessary exercises regarding short-term demand estimation for their respective States, to enable them to plan in advance as to how they would meet their consumers' load without overdrawing from the grid"*
  - ➢ Encourage balanced portfolios
- IEGC Clause 6.4.11
  - *"When the frequency falls below 49.5 Hz, the generation at all ISGS (except those on peaking duty) shall be maximized, at least upto the level which can be sustained, without waiting for an advise from RLDC."*
  - ➢ Encourage voluntary despatch of costly stations below 49.5 Hz

Need for Tightening the Freq Band (3)

- Defense Mechanism
  - Presently first stage at 48.8 Hz
  - Frequent excursions below 49 Hz & operation of UFRs
    - UFRs bypassed, security compromised
  - Operation in a tightened frequency band and planned load shedding would ensure relief through UFRs is always available, enhancing grid security

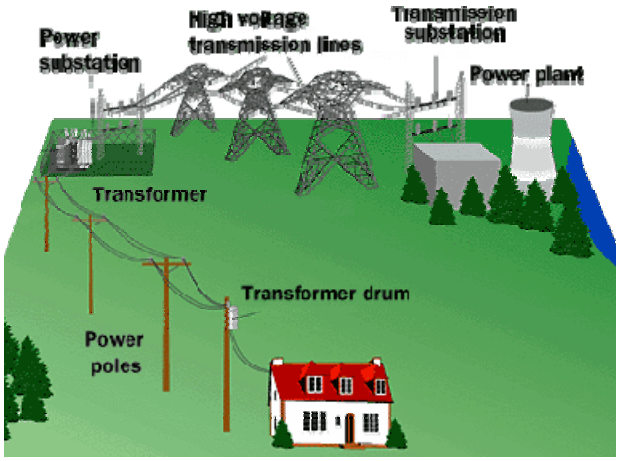
- Primary Response
  - Chicken and egg situation
  - Large frequency variations making implementation of FGMO difficult
  - Tightened frequency band to facilitate implementation of FGMO

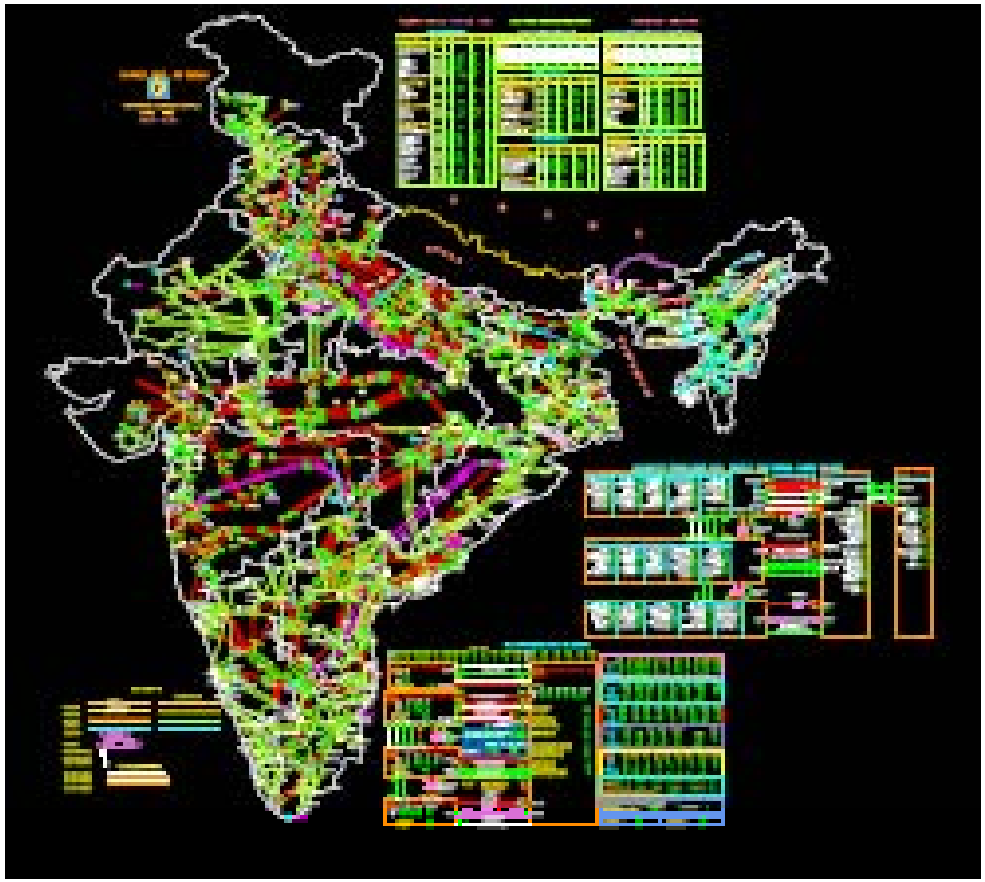
Need for Tightening the Freq Band (3)

- Near Future
  - Commonwealth Games 2010
  - Synchronization of SR Grid with NEW grid by 2012
  - Interconnections with SAARC member countries envisaged

- International practice
  - Operation in narrow frequency band only
    - Nordic Area: 49.9 to 50.1 Hz
    - UCTE Europe Continental: 49.8 to 50.2 Hz
    - US:
      - Eastern Interconnection: 59.95 to 60.05 Hz
      - Western Interconnection: 59.856 to 60.144 Hz

Secure Operation of Very Large Grid





Larger the footprint……

……. More the complexities involved

Road Map

- Present
  - April 2009: 49.2 to 50.3 Hz
- Gradual narrowing
  - Jan 2010: 49.5 to 50.3 Hz
  - Jan 2011: 49.8 to 50.2 Hz

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Thank You !!