

HIGHLIGHTS

1.1 Power supply position:

During 1999-2000 although the increase in effective generation capacity was only 3.77%, the energy & peak availability increased by 4.67% and 5.27% respectively (energy from 335.07 MU/day average in 1998-99 to 350.73 MU/day & peak MW from 18372 MW in 1998-99 to 19341 MW in 1999-2000). The energy shortages & peak shortages were 6.58% and 8.26% respectively. The energy & peak availability would have been higher but for the following constraints:

- Forced outage of Lehra Mohabbat TPS unit # 1 (210 MW capacity) of PSEB from 14th August 1998 to 10th April 1999 due to damage of turbine bearing.
- Forced outage of unit # 1 (180 MW capacity) at Chamera HPS of NHPC from 30th May 1999 to 2235 hrs of 16th June 1999 due to bursting of R-phase generator transformer.
- Forced outage of unit # 3 (180 MW capacity) at Uri HPS of NHPC from 1619 hrs of 4th June 1999 to 1018 hrs of 20th June 1999 due to bursting of U-phase generator transformer. (Faulty unit was replaced by spare one)
- Forced outage of Unchahar - II TPS unit # 1 (210 MW capacity) of NTPC from 0837 hrs of 27th July 1999 till rest of the year due to problem in the generator stator.
- Planned outage of Bhakra HEP unit # 10 (132 MW capacity) of BBMB for renovation, modernisation & up gradation since 0900 hrs of 9th July 1999 till rest of the year.
- Forced outage of Dadri GPS GT#1 (130.19 MW capacity) since 0505 hrs of 6th October 1999 till rest of the year due to problem in the generator rotor.
- Forced outage of Rihand - Dadri HVDC pole- II from 0031 hrs of 04th January 2000 to 1852 hrs of 15th January 2000 due to failure of B-phase converter transformer at Rihand. This resulted in reduction in power availability to Northern Region, of the order of 300 - 400 MW from Singrauli/ Rihand complex.

- The Kashmir valley power system was operated in an islanded mode from 2350 hrs of 13th January, 2000 to 0905 hrs on 3rd February 2000 due to breakdown of 220 kV Kishenpur - Pampore D/C line of PDD, J&K, caused by a bomb explosion at location no. 112. 220 kV Kishenpur - Pampore circuit II was restored on 3rd February 2000 through the Emergency Restoration System (ERS) provided by POWERGRID. Both circuits of 220 kV Kishenpur – Pampore line were restored through normal tower by 27th May 2000.
- The above problem in the Kashmir valley got further accentuated on the 15th January when at 2040 hrs, the 400 kV Uri - Wagoora D/C line of POWERGRID also went under breakdown due to a tower collapse at location no. 268 caused by bomb explosion. This resulted in the spillage of water at Uri HEP. Severe power shortage conditions persisted in the valley as only the Lower Jhelum hydro units (approx 20 to 30 MW) were in operation against a peak demand of the order of 600 MW. 400 kV Uri - Wagoora -II was revived at 2040 hrs of 25th January 2000 through ERS. 400 kV Uri –Wagoora was restored through normal tower at 1830 hrs of 4th May 2000.
- Industrial unrest by the erstwhile UPSEB employees from 15th to 25th January 2000, resulted in reduction of power generation in UP of the order of 1200-1500 MW. However prompt action by NRLDC with active support and help from all constituents of the region resulted in an incident free period.
- Scarce winter rains in the region, resulted in a reduction in hydro generation. (Approx. 15 MU/day less in comparison to 1998-99)

Other constraints (long outages) also prevailed, which however did not result in reduction of system availability but had a bearing on the system security, were as follows:

- Forced outage of 400 kV Anpara – Sarnath (B2 – L6) line of UPPCL since 0945 hrs of 10th August 1999 till the end of 1999-2000 due to insulator string failure.
- Forced outage of 400/220 kV, 315 MVA ICT –1 at Bawana substation of DVB since 0413 hrs of 27th August 1999 till the end of 1999-2000 due to leakage in 220 kV Y-ph bushing.
- Forced outage of 400 kV Anpara – Sarnath (B1 – L5) line of UPPCL since 0505 hrs of 20th October 1999 till the end of 1999-2000 due to insulator string failure.

1.2 Frequency regime:

Overall frequency profile was similar to that prevailing during 1998-99. The frequency remained between 49.5 to 50.5 Hz. for only 24.81% of time. It remained below 48.5 Hz for 24.83 % of time and above 50.5 Hz for 12.89 % of time. Throughout the year, frequency had remained low for considerable periods (62.57 % of time below 49.5 Hz) due to increase in demand and non-commensurate increase in generating capacity. Proper load management could have avoided low frequency operations. The off nominal frequency operations, calls for an early implementation of the Availability Based Tariff (ABT). Sustained low frequency operations also resulted in lowering/blocking of Under Frequency (U/F) relays by the constituents in to avoid repeated interruptions in particular areas. These developments resulted in endangering the safety of the grid, and resulted in number of disturbances during the October 1999 – January 2000. In these disturbances, one more important factor was the total absence of any primary frequency response from the generating units in the region. The free governor mode operation, on all the generating units, is a must for primary frequency response as mandated by Indian Electricity Grid Code (IEGC).

1.3 Voltage profile:

The voltage profile during 1999-2000 was not satisfactory barring the months of October 1999 & November 1999 when the voltage at 400 kV Dadri bus remained above 360 kV. Lowest voltage recorded at Dadri was 336 kV on 10th July 1999. Month wise maximum & minimum voltage recorded at Dadri are given in section 9.3. This alarming condition was mainly due to increase in reactive energy requirements (drawal) of the constituents and non-commensurate increase in installed capacitors. The constituent-wise gap in installation of shunt capacitors vis-à-vis the projected requirement is given in section 10.2 as on 31st March 2000. (Total regional gap of 6048 MVAR between the capacitors installed and requirement as planned)

1.4 Grid incidents:

Annexe A1 gives the summary of incidents that occurred in the region during 1999-2000.

1.5 System improvements:

- (i) Commissioning of 220 kV network & 400/220 kV ICTs associated with Unchahar stage – II transmission system resulted in increased reliability and redundancy in Central UP system.
- (ii) Commissioning of series compensation on both circuits of 220 kV Kishenpur – Pampore D/C by POWERGRID resulted in increased system security and stable power evacuation from Kashmir valley. It helped in loading these circuits close to their thermal limits without loss of stability.
- (iii) Commissioning of 400/220 kV ICT –3 (250 MVA) at Moga by POWERGRID, resulted in redundancy of transformation capacity at Moga. However 220 kV inter-connectors between 400 kV Moga & 220 kV Moga is still a bottleneck, which would be overcome with the commissioning of new Moga – Moga 220 kV inter connector during 2000-2001.
- (iv) Commissioning of 400/220 kV ICT –4 (315 MVA) at Heerapura (Jaipur) by RSEB, resulted in additional transformation capacity at Jaipur. This would enable Rajasthan to draw additional power from grid/under bilateral agreements during high demand period (December – March) besides helping in system contingencies.
- (v) Commissioning of Faridabad GPS GTs by NTPC & associated 220 kV network by POWERGRID, resulted in increased availability of power and system strengthening in Haryana.
- (vi) Commissioning of RAPS-B unit # 4 by NPC & associated 220 kV network by POWERGRID, resulted in increased availability of power and system strengthening in Southern Rajasthan.
- (vii) Work on Interim Telemetry scheme of Northern Region is in progress, completion of which would help in better supervision of the regional grid on real time basis.
- (viii) Work on the unified System Control & Co-ordination (SC&C) project for the Northern Region is in full swing.

1.6 Other important developments:

i) Implementation of Indian Electricity Grid Code (IEGC):

As per directions issued by the Central Electricity Regulatory Commission (CERC), the Power Grid Corporation of India Limited in its capacity as the Central Transmission Utility (CTU) submitted a draft Indian Electricity Grid Code (IEGC) in April 1999

laying down an operating code specifying the policies & procedures to be followed by various participants (agencies) in the Inter State Transmission System (ISTS). After due process of issue of public notice by the CTU, filling of written objections by all interested parties to the CERC as per its Conduct of Business Regulations (CBR) & oral hearing by the CERC, the final Indian Electricity Grid Code (IEGC) as approved by the CERC through its order dated 21st December 1999, came into effect from 1st February 2000.

The CERC ordered the CTU to make familiarise the contents of IEGC to all concerned. NRLDC organised familiarisation sessions on IEGC for each constituents.

The IEGC has also introduced the concept of reactive energy charges in grid management. This provision would be implemented once necessary metering arrangements are in place.

The IEGC also envisages the formation of region specific document viz “Detailed Internal Operating Procedures for Northern Region”. NRLDC is in the process of preparing such a document in consultation with the constituents of Northern Region.

ii) Order by CERC on Availability Based Tariff (ABT):

The complementary commercial mechanism referred to in the IEGC was ordered in the form of the Availability Based tariff (ABT) for implementation in all the regions of the country in a phased manner by CERC through its order dated 4th January 2000. ABT is a three-part tariff for inter utility active energy exchanges and a scheme for reactive energy exchanges as under:

1. Fixed charges to Central Sector generators linked to availability of station (based on before the fact declaration during scheduling and revisions, if any) and recoverable from SLDCs based on their entitlements in the stations.
2. Energy charges to Central Sector generators based on the schedule given to them (before-the-fact figures) and recoverable from SLDCs based on their individual requisitions ex-power plant from each station.
3. A frequency-linked charge for Unscheduled Interchange (UI) (based on after the-fact meter readings and schedules).
4. Tariff for reactive energy draws/absorption from the grid below 97% or above 103% voltage @4 paise/kVARh (based on after-the fact meter readings)

The charges at 2 and 3 above would be based on 15-minute average energy schedules/drawals. Implementation of ABT is expected to encourage:

- (i) SLDCs and Central generators to back down their generation under high frequency condition
- (ii) SLDCs to reduce their load under low frequency conditions.
- (iii) Bilateral agreements between SLDCs and SLDCs-Central Generators.
- (iv) Harness captive generation in the different systems.
- (v) Encourage investments in reactive power compensation equipment.

It is expected that the above changes would bring about a vast improvement in the system operation and strengthening of the regional grid.

The implementation of the ABT was however stayed by the CERC vide its order dated 7th March 2000 on a review petition dated 9th February 2000 filed by National Thermal Power Corporation Limited (NTPC) on certain provisions of the ABT order.

NRLDC - AN OVERVIEW

2.1 NRLDC is a nodal centre for co-ordinating operation of the Northern Regional power system. The Northern Regional power system is one of the largest amongst the five regional power systems in the country and has several unique features as mentioned below:

- Largest in geographical area amongst the five regions covering 30.7% of the area and 28% of the country's population.
- Largest number of constituents (8 states/UT's, 3 Central Generating Companies, one Central Transmission Utility and Bhakra Beas Management Board).
- Largest sized hydro unit (180 MW at Chamera) in the country.
- Establishment of the first super thermal power station (Singrauli STPS) and 400 kV transmission system in the country.
- Establishment of the first High Voltage Direct Current (HVDC) long distance transmission system in the country (2x750 MW, $\pm$ 500 kV Rihand-Dadri HVDC bipole).
- First HVDC back-to-back interconnection with Western Region (2x250 MW back-to-back HVDC station at Vindhyachal).
- First 400 kV Static Var Compensators (SVC's) in the country (2x $\pm$ 140 MVAR SVC at Kanpur).
- Largest capacity of combined cycle gas power stations amongst the five regions (2480.47 MW) located along the 700 Kms. long Hazira-Bijaipur-Jagdishpur (HBJ) natural gas pipeline of GAIL.

The map of the region indicating constituent-wise and regional installed effective generation capacity is shown alongside.

Real time operation of such a vast and complex power system, with region specific peculiarities of load pattern and power demands, needs special commitment of the team dedicated to this task. Real time data from various generating stations and power control centres are telemetered to this centre (NRLDC, New Delhi) via State Load Despatch Centres (SLDCs) situated at various locations of the Region and are made available for display and monitoring in the NRLDC control room to ensure security and integrity of the Northern Grid. Computer based telemetry, display, data logging and associated auxiliary systems are required to be kept

operational and in healthy condition round the clock through out the year. A reliable communication system is necessary to co-ordinate operations in such a vast and complex power system.

2.2 Salient Features of Northern Regional Power System:

1)	Installed generation capacity (as on 31 st March, 2000)		26469.92 MW
2)	Effective generation capacity (as on 31 st March, 2000)		25957.06 MW
3)	Largest Generating Stations		
	--Thermal (coal fired)	Singrauli STPS (NTPC)	2000 MW
	--Hydro	Bhakra Complex (BBMB)	1437.65 MW
	--Nuclear	RAPS Complex (NPC)	520 MW
	--Thermal (gas fired)	Dadri GPS (NTPC)	829.78 MW
4)	Largest generating unit size		
	--Thermal (coal fired)	Singrauli/Rihand/Anpara	500 MW
	--Nuclear	Narora APS/RAPS-B	220 MW
	--Hydro	Chamera	180 MW
	--Thermal (gas fired)	Faridabad GPS	143 MW
5)	Largest transmission elements		
	Longest-400 kV line-- Singrauli-Kanpur-I		434 Kms.
	Largest ICT-400/220 kV ICTs at Bhiwani/Dadri/S/Stn.		500 MVA
6)	Transmission system (as on 31 st March 2000)	± 500 kV HVDC 400 kV 220 kV	1630 ckt. kms. 11065 ckt. kms. 22247 ckt. kms.

		Total	37942 ckt. kms.
7)	No. of generating units (Thermal/nuclear)	500 MW 200/210/220/250 MW 100/110 MW 50/55/60/62.5/67.5 MW	6 nos. 41 nos. 26 nos. 18 nos.
8)	Regional peak met (1999-2000)	19341 MW	
9)	Regional Peak demand (1999-2000)	21083 MW	
10)	Average energy consumption (1999-2000)	350.73 MU / day	
11)	Average energy requirement (1999-2000)	375.44 MU / day	

2.3 Land marks in development of the Northern Grid:

1964	Formation of Northern Regional Electricity Board (NREB).
1970	BBMB & Delhi systems interconnected.
1975	Rajasthan system interconnected with Delhi/BBMB system.
1976-82	UP system intermittently synchronised with rest of the Northern Grid.
1982	Total integration of entire Northern Regional power system.
1984	First Supervisory Control & Data Acquisition (SCADA) system commissioned in Northern Region.
1990	2x250 MW HVDC back-to-back link with Western Grid commissioned.

	Pole-2 of Rihand-Dadri HVDC bipole (750 MW capacity) commissioned.
1991	Pole-1 of Rihand-Dadri HVDC bipole (750 MW capacity) commissioned.
1992	2x $\pm$ 140 MVAR Static Var Compensator (SVC) commissioned at Kanpur.
1996	Transfer of NRLDC from CEA to POWERGRID
1998	Electricity Laws (Amendment) Act 1998 passed by Parliament designating RLDC as apex body to ensure integrated operation in concerned region.
1999	Approval of the Indian Electricity Grid Code (IEGC) by the CERC. Series Compensation commissioned on 220 kV Kishenpur – Pampore D/C.
2000	Indian Electricity Grid Code (IEGC) in force w.e.f. 1 st February.

2.4 Functions of NRLDC:

The functions presently being discharged by NRLDC are:

- Round-the-clock operation and monitoring of the Northern Regional power system.
- Operation and maintenance of the Northern Regional Power Control Centre and associated computing & communication facilities.
- Daily Generation scheduling for Central Generating Stations/BBMB and drawal schedules for SLDCs.
- Monitoring and control of security limits of system.
- Co-ordination of maintenance programme for generating units and transmission lines on short term (monthly)/ real time basis.

- Analysis of tripping/disturbances in the power system and facilitating implementation of remedial measures.
- Daily energy accounting of Central Sector generation.
- Preparation of daily, quarterly, monthly and annual reports for use by management, planners and energy administrators.
- System studies for resolving operational problems.
- Augmentation of telemetry, computing and communication facilities in the region.

2.5 Present Status of Northern Grid:

The Northern Regional power system has to cater to the high demand in the agriculture sector particularly from the agriculture bowl of Punjab, Haryana & Western U.P. The agriculture sector consumes about 35% of the power produced. The demand in the region is highly sensitive to weather and any western disturbance during summer and rains during winter results in a sharp drop in demand at times as much as 4000 MW. However, Northern Grid system is generally a power deficit region. Average shortage in region during the year 1999-2000 has been 6.58% and 8.26% in terms of energy and peak requirements, respectively. Further, absence of free governing operation on the generating units, results in wide frequency fluctuations.

The Northern Regional power system also caters to the strategically important National Capital Territory of Delhi and railway traction loads on the busy Delhi-Calcutta, Delhi-Mumbai and Delhi-Chennai railway routes traversing through the region.

Electrically, the power system of Northern Region consists of two major generation pockets and one major load centre. The generation pockets are the pithead super thermal power stations located in the south-eastern part of the region near Singrauli coal mines (6112 MW) and the hydro stations at the north/north-west part of the region in Himalayan belt (4684 MW). The load centre is in the central part of the Region comprising Delhi, Haryana, Punjab, Western UP & Eastern Rajasthan. Typically, the power has to be transmitted over distances of 800-900 kms. emphasising the importance of a strong transmission system and adequate reactive power compensation devices in the system (mainly shunt compensation).

Unfortunately, while the Central Sector transmission system has kept pace with the requirements, the State Sector transmission system has, however, been way behind. Further, the installation of shunt capacitors in the SEBs' power system is also much behind

schedule mainly on account of resource constraints. These factors plus the lack of grid discipline has contributed to a poor voltage & frequency profile of the system.

2.6 The task before NRLDC in the days ahead:

The installation of new generating capacity in the region has not been commensurate with load growth. In the last decade (1990-2000), the Compounded Annual Growth Rate (CAGR) in energy and peak requirement was 6.37% and 5.20% respectively while the generation capacity addition rate was only 3.48%. The lack of grid discipline under these conditions has resulted in a poor frequency regime. As the situation on fresh generation capacity addition in the region bleak, the task of NRLDC would indeed be onerous in the days to come as it would have to ensure security of the power system in the face of severe constraints. The situation calls for an early introduction of rationalised tariff structures for Generating Companies/IPP's and inter utility trading besides addition of new generation capacity.

NRLDC would have a crucial role in ensuring implementation of the various provisions of the Indian Electricity Grid Code (IEGC). The complexity of the region calls for maintenance of an extensive database preferably in electronic form for ease of retrieval. Documentation of internal operating procedures and recovery procedures along with periodic updation of the same assumes utmost importance. A system of continuous liaison with the constituents is called for so as to ensure implementation of the provisions of the IEGC by all concerned.

The task of NRLDC would also increase with the implementation of the ABT. Arrangement for scheduling and its revisions, metering and data collection as well as data transfer and its processing would have to be closely co-ordinated by NRLDC with all the constituents.

Improvement in data acquisition & communication system would be required to enable the constituents to fully reap the benefits accruing out of the ABT. Pending the commissioning of the unified System Control & Co-ordination project, improvement in the existing system would be required. NRLDC would have to work closely with the constituents in this area so as to bring about on overall improvement in system operation. It is expected that with an experienced and dedicated team of engineers and support services at its disposal, NRLDC would rise to this challenge.

A brief description of various facilities existing at NRLDC, activities undertaken during the year 1999-2000 and developments in the regional grid is enumerated in the following sections.

DEVELOPMENTS IN SYSTEM OPERATION & ASSOCIATED AREAS

3.1 Commissioning of new generation units/ Transmission lines/ transformers:

New generating units & transmission lines /ICTs commissioned/ de-rated/ up-rated during the year 1999-2000 are given below:

A. Generating Units:

S. No	Generating unit	Agency	Capacity addition (MW)	Date of commissioning	Remarks
1.	Faridabad GPS # 1	NTPC	143	29.06.1999	-
2.	Panki TPS # 1	UPTPCL	-32	31.08.1999	Permanent retirement
2.	Unchahar –II TPS # 2	NTPC	210	22.10.1999	-
3.	Faridabad GPS # 2	NTPC	143	18.10.1999	-
4.	Upper Sindh –2 HPS # 1	PDD, J&K	35	January 2000	-
5.	Indraprastha TPS # 1	DVB	-30	28.02.2000	Permanent retirement
5.	RAPS –B # 2	NPC	220	11.03.2000	-
6.	Suratgarh TPS # 2	RSEB	250	28.03.2000	-

7.	Wind Farm	RSEB	2	March 2000	-
8.	Sal –2 HPS	HPSEB	2	March 2000	-
Total addition in effective capacity during the year:					943 MW

B. Transmission lines / ICTs:

S. No.	ICT /Transmission line	Ckt. Km.	Agency	Date of Commissioning
1.	220 kV Faridabad GPS – Samaypur D/C	35	POWERGRID	07.05.1999
S. No.	ICT /Transmission line	Ckt. Km.	Agency	Date of Commissioning
2.	220 kV Unchahar – Kanpur –I D/C	288	POWERGRID	27.05.1999
3.	220 kV Dehar - Kangoo S/C	3	HPSEB	18.06.1999
4.	400/132 kV, 200 MVA IBT at Rihand	-	NTPC	23.06.1999
5.	220 kV Fatehgarh churian – Batala (2 nd circuit) S/C	35	PSEB	June 1999
6.	220 kV LILO of Goviggarh I – Malarkhla at Amloh (S/C on D/C)	3	PSEB	July 1999
7.	220 kV LILO of Anta – Kota at Dara (Kota)	16	RSEB	July 1999
8.	400 kV Abdullapur – Bawana D/C	334	POWERGRID	18.08.1999

9.	400/220 kV, 315 MVA ICT –2 at Abdullapur	-	POWERGRID	27.08.1999
10.	400 kV Hissar - Nalagarh D/C	499	POWERGRID	30.09.1999
11.	220 kV RAPS-B – Udaipur S/C	230	POWERGRID	27.11.1999
12.	220 kV Panipat – Sonipat (S/C on D/C)	50	HVPNL	Nov. 1999
13.	220 kV Unchahar – Kanpur - II D/C	290	POWERGRID	31.12.1999
14.	400/220 kV, 315 MVA ICT –2 at Kanpur	-	POWERGRID	20.12.1999
15.	220 kV Faridabad GPS – Palla D/C	33	POWERGRID	17.01.2000
16.	220 kV LILO of Mehrauli – Nazafgarh at Bamnauli	1	DVB	Jan. 2000
17.	220 kV LILO of Narela – Nazafgarh at Kanjawala	12	DVB	Jan. 2000
18.	220 kV Mehrauli – Vasantkunj D/C	12	DVB	Jan. 2000
19.	400/220 kV, 250 MVA ICT –3 at Moga	-	POWERGRID	03.02.2000
20.	400/220 kV, 315 MVA ICT –2 at Nalagarh	-	POWERGRID	17.02.2000
21.	220 kV Abdullapur – Yamunanagar D/C	20	HVPNL	29.02.2000
22.	220 kV Yamunanagar - Shahbad D/C	80	HVPNL	Mar. 2000
23.	400/220 kV, 315 MVA ICT –1 at Abdullapur	-	POWERGRID	15.03.2000

S. No.	ICT /Transmission line	Ckt. Km.	Agency	Date of Commissioning
24.	400 kV Dulhasti – Kishenpur S/C	124	POWERGRID	31.03.2000
25.	400/220 kV, 315 MVA ICT –4 at Heerapura	-	RSEB	31.03.2000

Apart from the above list, 132 kV Tanakpur (India) – Mahendranagar (Nepal) was also commissioned on 1st January 2000. Indian portion of this line had been constructed by POWERGRID.

3.2 System network diagram:

The 400 KV network of the region is enclosed at Exhibit- E1.

3.3. Status of new transmission lines and generating units under construction:

Tables 10.3 & 10.4 provide the status/progress of construction of various lines/ICTs and generating units in the Northern Region respectively.

3.4 Status of shunt capacitors installation in Northern Region

Progress of shunt capacitor installation in the Northern Region has been very slow. During the year 1999-2000, a total of 1174 MVAR were commissioned in the region bringing the installed capacity to 14096 MVAR. This is against the requirement of 20144 MVAR, thus leaving a shortfall of 6048 MVAR as on 31st March 2000. A record 722 MVAR capacitors were installed in DVB system and a similar effort is required in other systems also. Table-10.2 provides the status of shunt capacitor installation in Northern Region Grid as on 31st March 2000.

3.5 Status of under frequency relays for load shedding in Northern Region

Table 10.1 indicates the requirement of load shedding through under frequency (u/f) and df/dt (rate of change of frequency) relays at various settings. It also provides the status of implementation of u/f & df/dt relays by the Constituents as on 31st March 2000.

From the table, it would be observed that there is a tendency to lower the settings of under frequency relays from 48.4 Hz. to 47.8 Hz, which is not in the interest of the grid security. This matter needs urgent attention by all the constituents.

3.6 Power System Stabilizer (PSS) tuning of generating units in Northern Region:

The PSS is an integral part of the generator excitation system. PSS tuning is one of the major steps recommended by various committees from time to time on grid disturbances and as mandated by the IEGC also. The exercise was initiated by POWERGRID and a consultancy contract for PSS tuning on three generating units (One 180 MW unit # 1 of Chamera HPS, one 200 MW and one 500 MW unit of Singrauli STPS) was awarded to M/S Power Technologies Incorporated, USA, who are renowned in this field.

A team of officers from NTPC, NHPC, NREB, CEA and POWERGRID was formed, which was expected to be closely associated with entire PSS tuning process. The ultimate objective was to undertake a similar exercise for major generating units in the region so as to damp out the low frequency oscillations in the system quickly.

The PSS tuning exercise involved briefly the following steps:

- (i) First analytical phase: Collection of Generator, Automatic Voltage Regulator (AVR), Exciter and PSS control block diagram and parameters, wiring diagram and instruction manual.
- (ii) First on site test: On site tests conducted at site and measurements taken to enable determining accurate dynamic models for the machine, generator voltage control loop and PSS.
- (iii) Second analytical phase: The appropriate models derived for simulation and stabiliser parameters determined based on data taken during above tests.
- (iv) Final on-site test: Final setting of PSS parameters made in line with above phase and some additional tests conducted to verify the settings obtained from (iii)

PSS of all units of Chamera HPS & unit no. 2 & 6 of Singruali STPS was tuned during 1999-2000. The PSS on the Uri HPS units were tuned in May 2000.

The entire process of PSS tuning of generating units in the Northern region and ultimately the entire country involves mammoth task of data collection, testing and system studies before the actual tuning is done. This stupendous task would be possible only with the active co-operation of all concerned.

3.7 Special Energy meters & data transfer to NRLDC in Northern Region for implementation of revised tariff structure for inter utility trading:

Implementation of the revised tariff structure for inter utility trading in Northern Region required installation of special energy meters at all inter-utility exchange points in the region. NRLDC had identified the locations in the Northern Region where such meters would be installed for the purpose of implementing Availability Tariff. The situation in Northern Region is complex due to a large number of 11 kV, 33 kV & 66 kV inter utility exchange points (in addition to 400 kV, 220 kV & 132 kV levels) and shared projects such as Bhakra Beas Management Board installations. Suitable metering criteria had been proposed to take into account these complexities, provision for back-up meters and the logistics of data transfer from several remote locations to NRLDC. POWERGRID's proposal for installing these meters was approved by NREB in its 114th meeting on 16th January 1998. The energy meters being installed are of 0.2 accuracy class for active power measurement and based on three phase, four wire measurement.

3.9 Co-operation of all the Constituents:

NRLDC gratefully acknowledges the kind co-operation extended by all the constituents of the region in successful operation and control of the Northern Grid during the year 1999-2000.

COMPUTING & COMMUNICATION FACILITIES AT NRLDC

The Northern Regional Load Despatch Centre (NRLDC) is the apex body to ensure the integrated operation of Northern Region at all the time with security, economy & efficiency. To achieve the above objectives, NRLDC requires real time data and needs to communicate with different constituents of regional power system. Therefore the need for state of the art technology in communication & data acquisition need not be over emphasised. The existing facilities as well as the ones under implementation are described in the following sections.

4.1 Existing Data Acquisition Facilities:

The Data Acquisition System is a PC (Personal Computer) based system with distributed architecture of modules, which are connected on a hub based Local Area Network (LAN). Modules, in dual hot standby mode are:

- (i) Data Pre-processor System (DPS)
- (ii) Param Resource Server (PRS)
- (iii) Man Machine Interface (MMIs)
- (iv) Peripheral Server (PS)
- (v) Remote Terminal Server (RTS)

Each module performs its distinct and exclusive function, which includes data acquisition, processing, displaying & report generation. Apart from short-term database, long term archiving & retrieval of system data and trend curves are also available. PCs in the LAN are time synchronised using the Global Positioning System (GPS) based equipment. The Local Area Network (LAN) is also working in dual hot standby mode.

Exhibit-E2 shows the layout of the real time Data Acquisition System existing at NRLDC, New Delhi.

4.2 Communication Facilities:

a) Leased Data circuits:

Communication facilities through leased circuits of Department of Telecommunication (DOT) exist for transmission of data telemetry, speech and fax between NRLDC, New Delhi and SLDCs/ SMCs of various constituents, viz., BBMB Ganguwal, SLDC Delhi, SLDC Jaipur, SLDC Lucknow, BTPS, CPCC (Central Projects Control Centre) Kanpur.

Exhibit-E3 provides an overview of the communication facilities between NRLDC and the constituent systems.

b) V-SAT Communication System:

Very Small Aperture Terminals (V-SAT) links are operational between NRLDC and 16 other locations (important SLDCs/400 kV substations/Generating stations), for reliable and efficient communication system. V-SAT terminals at Sarnath and Jutogh were commissioned during 1999-2000. These VSATs operating as a Closed User Group (CUG) have been supplied by M/s HCL Comnet Systems & Services Limited. This system presently used for speech and fax communication has been upgraded for real time transmission of telemetered data from Data Concentrators (DCs) at Ganguwal, Lucknow, Jutogh, Sarnath, Kishenpur and Wagoora to NRLDC under Interim Telemetry Scheme described in the next section. In addition to data from SLDC patiala, this would also provide real time data to SLDCs and other important locations using the broadcast facility from NRLDC. Access of nodes by other nodes in the network is as given at Exhibit.

This facility has proved to be a very reliable means of communication during 1999-2000 with availability of the order of 99%.

Apart from above V-SAT communication network, NRLDC has nodes of other two V-SAT communication networks viz NHPC's V-SAT network connecting NHPC's corporate centre & hydro stations (Uri, Salal, Chamera, Bairasiul & Tanakpur) to NRLDC and POWERGRID's V-SAT communication network connecting all other Regional Load Despatch Centres (RLDCs) of the country & all the regional head quarters of the POWERGRID to NRLDC. Every node in these two networks has access to all other nodes in the network.

The V-SAT network diagrams having nodes at NRLDC are enclosed at Exhibit- E4.

4.3 Auxiliary Facilities:

- 2x40 kVA Uninterrupted Power Supply System (UPS) supported by two DG sets of 350 kVA and 100 kVA capacity.
- Centralised Air Conditioning plant comprising of 3 compressors each of 75 TR.

Apart from above equipments at NRLDC, equipments such as computer system and associated peripherals, Uninterruptible Power Supply system, interface for DOT microwave/UHF link, interface for PLCC link etc., owned by NRLDC, are also located at SLDC Lucknow, SLDC Chandigarh, SLDC Jaipur, SLDC DVB, Ganguwal, Bhakhra, Pong & BTPS.

4.4 Interim scheme for augmentation of telemetry scheme in Northern Region:

In order to have real time data at NRLDC/SLDCs from sufficient locations of the region for effective monitoring and control of the grid, NRLDC formulated an “Interim Telemetry Scheme” (for the time till the telemetry from “Unified System Co-ordination & Control Project” is made available). The scheme was approved by NREB in its 112th meeting on 16th May 1997.

Following are the broad features of the Interim Telemetry Scheme:

1. Additional data from major generating stations, 400 kV sub-stations and inter-state exchange points of the Northern Region.
2. Only the basic system data (analog values) covering MW, MVAR, voltage and frequency measurands to be telemetered.
3. Installation of thirty eight (38) Remote Terminal Units (RTUs) with modems and necessary transducers. [The RTU's ordered under the Unified System Control & Co-ordination (SC&C) to be used]
4. Installation of seven (7) Data Concentrators (DCs) at various locations.
5. Existing available communication channels such as PLCC, leased DOT circuits & VSAT to be utilised to the maximum extent possible.
6. Strengthening the communication channels for transmission of the additional data along with related up-gradation at NRLDC in respect of hardware/software.
7. Transmission of real time data from NRLDC to the SLDCs (data in respect of the Central Sector generating stations, drawals, etc.).

An overview of the “Interim Telemetry Scheme” is enclosed at Exhibit-E5.

As the scheme envisages data communication through V-SAT over some stretches, testing of data communication by using the existing V-SAT between Patiala and NRLDC was organised and carried out successfully. Further, interface between CEGELEC RTU S 900 (ordered under unified SC&C project) and C-DAC Data Concentrator was successfully tested at the works of M/s CEGELEC during March 1999.

During 1999-2000, 37 out of 38 of RTUs of interim telemetry scheme by M/s ALSTOM (Cegelec) and all 7 Data Concentrator (DCs) by C-DAC have been installed & commissioned. One RTU at Narora is to be commissioned. Data is being received from some locations at NRLDC and is under stabilisation. Efforts are being made to receive data from locations of data concentrator, which are connected through V-SAT links with NRLDC. To achieve this, coordination with M/s HCL-COMNET & C-DAC is in progress.

4.5 Phase-III of Real Time Data Acquisition System at NRLDC:

Interim Telemetry scheme, described in previous section, apart from providing Data Concentrators (DCs) with software, also included changes to be made at NRLDC level software. It includes:

1. Added reporting features at NRLDC on account of increase in data volume
2. Enhanced facilities to the operator (better man machine interface)
3. Integration of schedule prepared off-line to the real time system
4. Provision of shift log for operator to log all activities during the shift
5. Provision for issuing codes and maintaining data base of shutdown/ tripping of power system equipments.

Work on the phase III scheme is under progress.

4.6 Unified System Control & Co-ordination (SC&C) Scheme:

Manifold expansion of the power system network and the need for monitoring network on real time basis to ensure optimum system operation necessitated establishment of modern computerised Load Despatch Centres. To achieve this and in order to have

uniform Supervisory Control & Data Acquisition (SCADA) facilities in all power utilities in the Northern Region & the RLDC, a unified System Control and Co-ordination (SC&C) scheme was envisaged & planned by POWERGRID.

Communication network under the project is designed to have performance level of 99.99%. Some of the existing RTUs, Microwave hops & PLCC channel would be used.

Exhibit E6 & E7 indicates the coverage of SC&C project in the region including the system functions available at each hierarchical level. Exhibit E8 indicates the communication plan for the region under the SC&C project.

The following contracts were awarded:

S.No.	Packages	Vendor	Date of award
1.	SCADA/EMS	M/s ALSTOM T&D, SA,France.	29.01.1998
2.	Fibre Optic Communication	M/s JV of Furukawa, Japan.	12.01.1998
3.	Microwave Communication	M/s IVO Power Engineers Ltd., Finland.	22.01.1998
4.	Power Line Carrier Communication / PABX	M/s Punjab Communications Ltd., Chandigarh., India.	30.10.1998
5.	Auxiliary Power Supply	M/sTata Libert Ltd.,Thane, India.	09.10.1998

The scheme is expected to be fully commissioned by January 2002.

Package wise details of scope of work are given below:

1. SCADA/ EMS:

Awarded to	M/S ALSTOM T&D SA, France	
Package cost	Rs. 192 crores	
Scope of work	RTUs	285+63*+21**
	RSCC	One
	SLDCs	8
	sub-LDCs	24+1***

Note:-

* - 63 RTU of Siemens make to be provided by Constituents (RSEB 58, J&K PDD 3, HVPNL 2)

** - 21 RTU of CDAC make to be provided by PSEB

*** - 1 Moga sub-LDC to be provided by PSEB.

Apart from data acquisition, EMS functions envisaged are Operational Scheduling, Load Forecasting, Inflow Forecasting, Hydro-Thermal coordination, Inter-change Scheduling, Disturbance Data Collection etc.

2. Fibre Optic Communication:

Awarded to	M/S JV of FURUKAWA , Japan	
Package cost	Rs. 86 Crores	
Scope of work	Optical Fibre Ground Wire (OPGW)	1815 Kms

	Terminal Stations	57 nos.
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3. Microwave Communication:

Awarded to	M/S IVO Power Engg., Finland	
Package cost	Rs. 96 Crores	
Scope of work	Microwave Hops	78 nos.
	New Towers	46 nos.
	Radio Equipment	156 nos.

4. Power Line Carrier Communication (PLCC):

Awarded to	M/S PUNCOM , Chandigarh (India)	
Package cost	Rs. 12 Crores	
Scope of work	PLCC Terminals	218 nos.
	EPABX	63 nos.

5. Auxiliary Power Supply:

Awarded to	M/S TATA LIBERT , Thane (India)	
Package cost	Rs. 18 Crores	
Scope of work	DG Sets	32 nos.
	UPS system	33 nos.
	Field Sites (other than control centres)	22 nos.
	DC Supply (48 volts)	34 nos.

Site surveys required for RTU installation, Fibre Optic, Microwave communication, PLCC equipments and power supply equipments were completed during 1998-99.

The following activities under the scheme were completed / carried out during the year:

- i) Data base development was completed by all the constituents.
- ii) Inland/ Overseas training programmes on communication packages viz. Optical Fibre & Microwave communication, SCADA/EMS package hardware & software portion, PLCC package and Power Supply package were conducted in several batches.
- iii) Package wise work completed during 1999-2000 and up to June 2000 is given below:

1. SCADA/EMS:

Progress

RTUs	Manufactured	265 nos.
	Despatched	260 nos.
	Erected	180 nos.
	Powered up	170 nos.
sub-LDCs	Manufactured	19 nos.
	Despatched	10 nos.
	Commissioned	1 nos.

The first sub-LDC under the scheme was commissioned at Panipat (BBMB System) on 22.07.2000.

2. Fibre Optic Communication:

Progress	
OPGW Installed	1650 Kms
Terminal Stations Installed	25 nos.

Stringing of OPGW is being done under live line conditions i.e. without taking line under shutdown.

3. Microwave Communication:

Progress	
Foundation Completed	26 nos.
Radio Equipment Installed	60 nos.
Tower Despatched	15 nos.

4. Power line Carrier Communication (PLCC):

Progress		
PLCC Terminals	Despatched	101 nos.
	Installed	73 nos.
EPBAX	Despatched	49 nos.
	Installed	27 nos.

5. Auxiliary Power Supply:

Progress		
DG sets	Despatched	27 nos.

	Installed	3 nos.
UPS system	Despatched	31 nos.
	Installed	5 nos.
DC supply	Despatched	7 nos.
	Installed	2 nos.