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ANNUAL GRID REPORT

2000-2001



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NORTHERN REGIONAL LOAD DESPATCH CENTRE

NEW DELHI – 110 016

JANUARY, 2002

SALIENT FEATURES OF NORTHERN REGION

S. No.	Parameters	2000-2001	1999-2000	Increase	% Increase
1	Effective capacity (on the last day of the year) (MW)	27226.92	25957.06	1269.86	4.89
2	Average energy (MU/day net)				
2(a)	Demand met	364.45	350.73	13.72	3.91
2(b)	Requirement	391.89	375.44	16.45	4.38
2(c)	Shortage	27.44	24.71	2.73	11.05
2(d)	% shortage	7.00	6.58		
3	Peak MW				
3(a)	Demand met	19860	19341	519	2.68
3(b)	Requirement	21479	21083	396	1.88
3(c)	Shortage (non-coincidental)	1619	1742		
3(d)	%Shortage (non-coincidental)	7.54	8.26		
3(e)	Demand met at max. reqt. Hrs.	19448	19053		
3(f)	Shortage (coincidental)	2031	2030		
3(g)	%Shortage (coincidental)	9.46	9.63		
4	Frequency (Hz)				
4 (a)	Average	49.38	49.27		
4 (b)	% of time above 50.5 Hz	10.03	12.89		
4 (c)	% of time below 49.0 Hz	34.13	43.91		
4 (d)	% of time between 49.0 to 50.5 Hz	55.84	43.20		
4 (e)	% of time below 48.5 Hz	15.19	24.83		
5	Generation at the time of regional peak demand met				
5 (a)	Hydro (MW)	5806	6076	-270	-4.44
5 (b)	Thermal (MW) coal Fired	11016	10653	363	3.41
5(c)	Thermal (MW) gas Fired	1990	1998	-8	-0.40
5(d)	Nuclear (MW)	698	579	119	20.55

5(e)	Inter regional exchange (MW)	-350	-35	-315	
5(f)	Total (MW)	19860	19341	519	2.68
6	Gross generation (MU/day Average)				
6 (a)	Hydro	79.65	86.71	-7.06	-8.14
6 (b)	Thermal (coal fired)	250.87	235.93	14.94	6.33
6 (c)	Thermal (Gas fired)	46.20	42.15	4.05	9.61
6 (d)	Nuclear	18.27	14.56	3.71	25.47
6 (e)	Total	394.99	379.36	15.63	4.12
7	PLF (%)				
7 (a)	Thermal (coal fired)	69.98	68.58	1.40	
7 (b)	Thermal (Gas fired)	69.06	68.05	1.01	
7 (c)	Nuclear	72.80	80.61	-7.81	
7 (d)	Total (coal+gas+nuclear)	70.00	69.02	0.98	
7 (e)	Central sector (Coal)	83.70	84.78	-1.08	
7 (f)	Central sector (gas)	77.16	78.91	-1.75	
7 (g)	Central sector (Nuclear)	72.80	80.61	-7.81	
7 (h)	Central sector (Total)	80.82	82.90	-2.08	
7 (g)	State sector (gas fired)	31.60	22.36	9.24	
7 (f)	State sector (coal fired)	59.70	58.59	1.11	
7 (g)	State sector (total)	59.10	56.63	2.47	
8	Water level on Last day of the year (In Mtrs.)				
8 (a)	Bhakra	457.54	462.15	-4.61	
8 (b)	Pong	394.92	403.04	-8.12	
8 (c)	Rihand	262.34	262.07	0.27	
8 (d)	R.P.S.	344.60	345.77	-1.17	
8 (e)	G.S.	380.60	385.72	-5.12	

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SECTION – 1

HIGHLIGHTS

HIGHLIGHTS

1.1 Power supply position:

During the year 2000-2001 although the increase in effective generation capacity was only 4.89 %, the energy & peak availability increased by 3.91 % and 2.68 % respectively (energy from 350.73 MU/day average in 1999-2000 to 364.45 MU/day & peak MW from 19341 MW in 1999-2000 to 19860 MW in 2000-2001). This could be made possible by carrying out sustained efforts towards better resource mobilisation and generating units shutdown planning. The energy shortages & peak shortages were 7.00 % and 7.54 % respectively and the following major constraints were experienced during the year:

- Due to breakdown of 220 kV Kishenpur - Pampore D/C line of PDD, J&K, caused by a bomb explosion at location no. 112, 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. The 220 kV Kishenpur - Pampore circuit II was restored on 3rd February 2000 through the Emergency Restoration System (ERS) provided by POWERGRID. However both circuits of 220 kV Kishenpur – Pampore line could be restored through normal tower by 27th May 2000. This resulted in spillage of water at Uri HEP with 100-200 MW generation backdown at certain instances in the month of April & 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. Due to this 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. This also resulted in the spillage of water at Uri HEP for few days. 400 kV Uri - Wagoora -II was revived at 2040 hrs of 25th January 2000 through ERS and both the 400 kV circuits between Uri - Wagoora were restored through normal tower at 1830 hrs of 4th May 2000.
- On a number of times in the month of May 2000, dust storms were experienced in the region, which caused tripping of several 400 / 220 kV circuits and resulted in grid incidents. In one such incident at 1849 hrs on 12th May 2000, towers at location nos. 445 to 449 of 400 kV Moga – Hissar D/C were completely damaged and tower at location no. 450 was partially damaged. The circuit I of the above section was normalised at 0033 hrs of 22nd May 2000 by erecting ERS (Emergency Restoration System). During the 10 days period i.e. from 12th to 21st May 2000, at times backing down of the order of around 90 MW was carried out at Chamara to avoid over loading of inter-connector circuits between 400 kV and 220 kV Moga substations. The line was completely restored through new erected normal tower at 1943 hrs of 23rd June 2000. [Circuit I restored through normal tower at 2259 hrs of 17th June 2000 & Circuit II was shifted to normal towers from ERS towers by 1943 hrs of 23rd June 2000]. In the past also in a similar incident on the same section around two year back, the 400 kV Moga – Hissar D/C had remained under forced outage w.e.f. 28th June to 10th July 1998.

- 400 kV Abdullapur –Bawana D/C line remained out of service from 1525 hrs of 1st June 2000 to 1947 hrs of 16th June 2000 due to tower damage at location no. 396.
- 400 kV Anpara – Sarnath (B1 – L5) line of UPPCL was under forced outage between 0505 hrs of 20th October 1999 & 1315 hrs of 27th June 2000 intermittently due to the problem related to insulator string failure.
- 220 kV Auraiya – Malanpur line of MPEB was under forced outage since 0203 hrs of 25th April 2000 to 1930 hrs of 2nd June 2000 due to collapse of six towers.
- 400/220 kV, 315 MVA ICT –1 at Bawana substation of DVB was under forced outage since 0413 hrs of 27th August 1999 to 1310 hrs of 17th June 2000 due to damaged 220 kV side Y-ph bushing.
- Bhakra HEP unit # 10 of BBMB was under shutdown for renovation, modernisation and up gradation (132 to 157 MW) since 0900 hrs of 9th July 1999 to 1500 hrs of 9th June 2000. Unit # 6 of Bhakra was under shutdown from 0800 hrs of 23rd June 2000 to February 2001 for similar renovation & up gradation (132 to 157 MW).
- 400 kV Anpara – Sarnath (B2 – L6) line of UPPCL was under forced outage between 10th August 1999 and 3rd July 2000 intermittently due to problem related to insulator string failure. However it again tripped at 1539 hrs of 3rd July and later on restored at 1340 hrs of 19th July 2000.
- 400 kV Nalagarh - Hissar D/C line of POWERGRID was under forced outage from 1611 hrs of 27th April 2000 to 1534 hrs of 27th July 2000 due to tower collapse at location no. 558. This line was available by 2120 hrs of 20th July 2000 after erection of new tower and stringing. (The line however was not charged immediately due to persistent high voltages.)
- 400/220 kV, 315 MVA ICT –2 at Ballabgarh substation of POWERGRID was under forced outage since 1802 hrs of 17th July 2000 to 1106 hrs of 29th September 2000 due to 220 kV side B-ph LA bursting on lightning & damage to the bushing in consequent fire.
- 400 kV Uri – Wagoora circuit II of POWERGRID was under forced outage intermittently during the period 8th August 2000 to 26th September 2000 due to fault in the under ground cable at Uri HPS.
- 220 kV Salal – Jammu II circuit of POWERGRID remained under forced outage since 2300 hrs of 25th August 2000 to 2115 hrs of 11th September 2000 due to tower damage at location nos. 108 & 109 in a bomb explosion.
- Unchahar - II TPS unit # 1 (210 MW capacity) of NTPC was under forced outage from 0837 hrs of 27th July 1999 to 1729 hrs of 20th November 2000 due to problem in the generator stator.
- Dadri GPS GT#1 (130.19 MW capacity) was under forced outage since 0505 hrs of 6th October 1999 to 0847 hrs of 21.04.2000 due to problem in the generator rotor.

- Panipat TPS unit # 3 (110 MW capacity) of Haryana Power Generation Corporation Ltd. (HPGCL) was under breakdown since 0925 hrs of 31st December 1999 to 0040 hrs of 30th August 2000 due to rotor damage.
- Panipat TPS unit # 2 (110 MW capacity) of Haryana Power Generation Corporation Ltd. (HPGCL) was under shutdown during whole of the year 2000-2001 starting from 0850 hrs of 22nd January 2000 for renovation work by M/S ABB.
- RAPS unit # 1 (100 MW capacity) of Nuclear Power Corporation was under shutdown during whole of the year 2000-2001 starting from 22nd March 2000 for maintenance work.
- Rihand – Dadri HVDC pole –II remained out of service from 0413 hrs of 15th November 2000 to 0013 hrs of 21st November 2000 due to failure of R-ph Converter Transformer at Rihand end. (Faulty transformer of BHEL make was replaced by spare one of ABB make)
- Rihand – Dadri HVDC pole –II again rendered out of service at 0502 hrs of 14th December 2000 due to failure of the B-ph Converter Transformer of BHEL make at Dadri. This faulty transformer of BHEL make was replaced by spare one of ABB make at Dadri end. However the B-ph Converter Transformer of BHEL make at Rihand end also failed during revival of pole – II at 1511 hrs of 18th December 2000. This resulted in prolonged outage of pole –II due to non-availability of any spare transformer at either end. Outage of pole –II resulted in reduction in stability margins in the system. A contingency plan was prepared and circulated to all the constituents by NRLDC on 19th December 2000 and the pole –II was subsequently revived on 30th April 2001.
- Transmission tower of 220 kV Kishenpur – Pampore D/C line of PDD, J&K at location no. 30 collapsed at 0046 hrs of 18th February 2001. Subsequently Kashmir valley power system operated in isolated mode with Uri units. There were several instances of collapse of this small island due to absence of free governor operation on generating machines & under frequency relay load shedding. Circuit –I of the above line was restored at 2225 hrs of 23rd February 2001 using Emergency Restoration System (ERS) of POWERGRID. However tripping of this circuit (220 kV Kishenpur – Pampore circuit – I) at times resulted in isolation & collapse of Kashmir valley power system. The 220 kV Kishenpur – Pampore D/C line was restored through normal towers by 08.04.2001.

1.2 Frequency regime:

Due to concerted efforts of NRLDC & active cooperation from all the constituents, the overall frequency profile was better in comparison to that of during the last year (last year's figures are in bracket). The frequency remained between 49.0 to 50.5 Hz. for 55.84% (43.20 %) of time. It remained below 49.0 Hz for 34.13 % (43.91 %) of time and above 50.5 Hz for 10.03% (12.89 %) of time. The main reason for the low frequency period was increase in demand with non-commensurate increase in generating capacity and thereby overdrawals by certain States. The high frequency conditions during certain period were

mainly due to reluctance by generators to backdown to the designated level. The off nominal frequency operations, calls for an early implementation of the Availability Based Tariff (ABT). There were also instances of critically low frequency excursions in the event of sudden loss of generation/revival of loads which indicate that the under frequency relays designated to be available in the system were not made functional by all the states.

1.3 Voltage profile:

The month wise maximum & minimum voltage recorded at Dadri during the year 2000-2001 are given in section 9.3. This shows that the voltage in the region particularly at the strategic locations was not satisfactory during the considerable period. The lowest voltage recorded at Dadri was 336 kV on 09.05.2000. 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 2001. (Total regional gap of 6806 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 2000-2001.

1.5 System improvements:

- (i) Commissioning of 800 (400) kV Kishenpur-Moga-I & II Single Circuits transmission system by POWERGRID resulted in increased reliability and redundancy in inter connection of J&K system with the rest of grid. However, link of valley system of J&K with the rest of grid is still weak (existing only through 220 kV Pampore-Kishenpur D/C).
- (ii) Commissioning of 800 (400) kV Anapara-Unao S/C & 400 kV Agra-Muradnagar S/C transmission system by UPPCL resulted in increased system security by way of providing one more parallel path in all-important east-west corridor.
- (iii) Commissioning of 400 kV Bawana- Bamnauli & 400/200 kV ICT-1 at Bamnauli and associated 200 kV circuits resulted in system strengthening in DVB system to some extent.
- (iv) Commissioning of LILO of 400 kV Chamera-Moga D/C at Jalandher, 400/220 kV ICTs at Jalandher along with 220 kV feeders from Jalandher by POWERGRID, resulted in system strengthening & redundancy in Punjab system.
- (v) Commissioning of 400/220 kV ICTs at Bassi by POWERGRID and LILO of 220 kV Dausa-Heerapura D/C at Bassi, resulted in redundancy & system strengthening. This would enable Rajasthan to draw additional power from grid/under bilateral

agreements during high demand period (December – March) besides helping in system contingencies.

- (vi) Commissioning of LILO of 220 kV Panki-Mainpuri at Kanpur (PG) by POWERGRID resulted in system strengthening besides increased reliability in power supply in central UP.
- (vii) Commissioning of Faridabad GPS Steam Turbine (ST) by NTPC & associated 220 kV network by POWERGRID, resulted in increased efficiency, availability of power and system strengthening in Haryana.
- (viii) Commissioning of RAPS-B # 2 by NPC & associated 220 kV network by POWERGRID, resulted in increased availability of power and system strengthening in Southern Rajasthan.
- (ix) Commissioning of Ranjeet Sagar hydroelectric power plant by PSEB resulted in increased power availability to Punjab, HP & J&K.
- (x) Interim Telemetry scheme of Northern Region was completed during the year resulting in better transparency in supervision & coordination of the regional grid on real time basis.
- (xi) Work on the unified System Control & Co-ordination (SC&C) project for the Northern Region was carried out on accelerated pace.

1.6 Other important developments:

i) Unbundling of Rajasthan State Electricity Board:

Unbundling of the Rajasthan State Electricity Board (RSEB) into 5 (five) companies took place w.e.f. 0000 hrs of 20th July 2000. The five entities formed were as under:

1. Generating Company

- Rajasthan Rajya Vidyut Utpadan Nigam Limited (RRVUNL)

2. State Transmission Utility (STU)

- Rajasthan Rajya Vidyut Prasaran Nigam Limited (RRVPNL)

3. Distribution companies

- Jaipur Vidyut Vitran Nigam Limited
- Jodhpur Vidyut Vitran Nigam Limited
- Ajmer Vidyut Vitran Nigam Limited

This is the third case of unbundling of SEBs in Northern Region. The earlier instances were that in Haryana (on 17th August 1998 into one generating company, one transmission utility & two distribution companies) and in Uttar Pradesh (on 16th January 2000 into two generating companies, one transmission & distribution company).

ii) Development after 2nd January 2001 grid disturbance:

There was a major grid disturbance in the region on the morning of 2nd January 2001. A detailed report of this disturbance was prepared and circulated to all the constituents of Northern Region during the month of January 2001. Highlights of the disturbance are indicated at Annex. Government of India constituted a committee headed by Chairman CEA to investigate & recommend the remedial measures. This report was submitted by the committee to the Ministry of Power. NRLDC being the apex body for controlling the grid in the region also issued a detailed report on the above disturbance.

There were several meetings convened at the Ministry of Power, CEA and CTU viz. POWERGRID level for the implementation of remedial measures to avoid recurrence of such incidents. Further, the Central Electricity Regulatory Commission (CERC) also conducted suo-moto hearing on this disturbance on 15th & 16th January 2001 and passed orders on the matter.

iii) Documentation of “Operating Procedures for Northern Region”:

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. As ordered by the CERC, the CTU/NRLDC organised familiarisation sessions on IEGC for different constituents. The IEGC has also introduced the concept of reactive energy charges in grid management. This provision would be implemented once necessary metering arrangements and its account management procedures are in place.

The IEGC through its clause 6.1(d) specifies the requirement to prepare the set of detailed internal operating procedure for each regional grid to be developed & maintained by respective RLDC in consultation with the regional constituents. NRLDC after extensive & detailed consultation with the constituents of Northern Region has prepared the document “ Operating procedures for Northern Region”. This document was issued by NRLDC in September 2000 and contains detailed guidelines, rules/regulation & procedures on Network Security & System Operation, Demand Estimation & Control, Outage Planning, Bilateral Agreements, Scheduling & Dispatch, Grid disturbance & Revival, Event information & Reports and on

Settlement System. This document also contains list of important elements of the Northern regional grid.

iv) Documentation of “System Restoration Procedures For Northern Regional Grid”:

The IEGC through its clause 6.8 specifies the requirement to prepare a detailed plan & procedures for restoration of the regional grid by RLDC in consultation with all the constituents. Earlier in February 1998 also NRLDC had prepared a document named as “Black Start Procedures”. However with current requirement of IEGC, NRLDC revised the document “System Restoration Procedures For Northern Regional Grid”. This document provides philosophical guidelines & macro-level sequencing of various operations to be performed during system restoration.

v) Installation & Commissioning of Special Energy Meters (SEMs) in Northern Region:

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. 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 was proposed to take into account these complexities including 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 list of inter-utility exchange points on which SEMs were to be installed was circulated by NRLDC/POWERGRID in July 1999 and comments were sought from constituents. Thereafter, commissioning & installation of SEMs started and expedite during the year 2000-2001. In between doubts/queries of various constituents were cleared. The installation of SEMs in Northern Region was almost completed during the year with the exceptions of some locations where constraints exists. These constraints are also being removed with the help of constituents and it is expected that by the implementation date of ABT i.e. 01.08.2001 all meters will be in place.

SECTION – 2

NRLDC – AN OVERVIEW

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 approx 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 (2626.04 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, 2001)		27739.78 MW
2)	Effective generation capacity (as on 31 st March, 2001)		27226.92MW
3)	Largest Generating Stations		
	--Thermal (coal fired)	Singrauli STPS (NTPC)	2000 MW
	--Hydro	Bhakra Complex (BBMB)	1490.15 MW
	--Nuclear	RAPS Complex (NPC)	740 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	138 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 2001)	± 500 kV HVDC 400 kV 220 kV Total	1630 ckt. kms. 12672 ckt. kms. 22928 ckt. kms. 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. 44 nos. 26 nos. 18 nos.
8)	Regional peak met (2000-2001)	19860 MW	
9)	Regional Peak demand (2000-2001)	21479 MW	
10)	Average energy consumption (2000-2001)	364.45MU / day	
11)	Average energy requirement (2000-2001)	391.89 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 and on 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, monthly, quarterly 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.
- Finalisation of inter-utility points for installation of Special Energy Meters (SEMs).
- Validation & processing of data collected from SEMs of all locations in the region and its onward transmission to NREB.

2.5 Present Status of Northern Grid:

The Northern Regional power system has to cater to the high demand in the different parts of the region which includes the lighting, heavy load industries and commercial loads as well as agriculture load particularly to the agriculture bowl of Punjab, Haryana & Western U.P. The agriculture sector forms a considerable part of the total demand met i.e. around 35% of the total power produced. Therefore 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 4000-5000 MW. However, Northern Grid system is generally a power deficit region. Average shortage in region during the year 2000-2001 has been 7.00 % and 7.54 % in terms of energy and peak requirements, respectively. Further due to absence of free governing operation on the generating units, the wide frequency fluctuations in the region continue to persist.

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 & Northern 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. These factors plus the lack of grid discipline is mainly responsible to the poor voltage & low frequency instances in the system.

2.6 The task before NRLDC in the days ahead:

The demand of power has outstripped the availability in Northern Region due to the non-commensurate increase in generating capacity vis-à-vis load growth in the region. In the last decade (1991-2001), the Compounded Annual Growth Rate (CAGR) in energy and peak requirement was 5.77 % and 4.44 % respectively while the generation capacity addition rate was only 3.60 %. Though there has been improvement in grid parameters due to sustained efforts made by NRLDC and others, however at times 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 is not very much encouraging, 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 in real terms 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 operating procedures and recovery procedures has been done by NRLDC in consultation with all the constituents and the periodic updation of the same assumes utmost importance.

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. The Availability Based tariff (ABT) was to be implemented in all the regions of the country in a phased manner as per the CERC's order dated 4th January 2000. 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. Now CERC has ordered its implementation in Northern Region w.e.f. 1st August 2001. However drawal base accounting (as prevailing before ABT implementation) would also be done besides the ABT accounting upto 31st December 2001. 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 drawals/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 with commercial implications 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.

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 has been done. A brief description of various facilities existing at NRLDC, activities undertaken during the year 2000-2001 and developments in the regional grid is enumerated in the following sections.

SECTION - 3

DEVELOPMENTS ON SYSTEM OPERATION & ASSOCIATED AREAS

DEVELOPMENTS IN SYSTEM OPERATION & ASSOCIATED AREAS

1. Commissioning of new generation units/ Transmission lines/ transformers:

New generating units & transmission lines /ICTs commissioned/ de-rated/ up-rated during the year 2000-2001 are given below:

• Generating Units:

S. No	Generating unit	Agency	Capacity addition (MW)	Date of commissioning	Remarks
1.	Devgarh Wind Farm	RRVUNL	2	03.06.2000	-
2.	Bhakra HEP #10	BBMB	25	09.06. 2000	Up-rated from 132 to 157 MW
3.	Faridabad GPS #ST	NTPC	146	31.07.2000	-
4.	Ranjit Sagar HPS # 1	PSEB	150	12.08.2000	-
5.	Ranjit Sagar HPS # 3	PSEB	150	20.08.2000	-
6.	Ranjit Sagar HPS # 4	PSEB	150	15.09.2000	-
7.	Ganguwal HPS # 3	BBMB	2.5	27.09.2000	Up-rated from 24.2 to 26.7 MW
8.	Gumma HPS	HPSEB	3	September 2000	-
9.	Ranjit Sagar HPS # 2	PSEB	150	12.10.2000	-
10.	RAPS –B # 2	NPC	220	17.11.2000	-
11.	Ghanvi HPS # 1	HPSEB	11.25	15.11.2000	-
12.	Ghanvi HPS # 1	HPSEB	11.25	January 2001	-
13.	Bhakra HEP #6	BBMB	25	February 2001	Up-rated from 132 to 157 MW
S. No	Generating unit	Agency	Capacity addition (MW)	Date of commissioning	Remarks

14.	Pong HEP #6	BBMB	6	February 2001	Up-rated from 60 to 66 MW
15.	Chenani Stage-III #1,2,3	J&K	3x2.5=7.5	February 2001	-
16.	Panipat TPS #6	HPGCL	210	31.03.2001	-
Total addition in effective capacity during the year:					1269.86 MW

B. Transmission lines / ICTs:

S. No.	ICT /Transmission line	Ckt. Km.	Agency	Date of Commissioning
1.	800 (400) kV Kishenpur-Moga S/C-I	275.0	POWERGRID	30.04.2000
2.	LILO of 220 kV Rajpura-Patiala at Bahadurgarh	2.0	PSEB	May 2000
3.	220 kV Alwar - Kotputli	82.0	RVPNL	May 2000
4.	800 (400) kV Anpara – Unnao S/C	409.0	UPPCL	12.07.2000
5.	220 kV RAPS-B – Anta S/C	114.0	POWERGRID	22.07.2000
6.	LILO of 220 kV Ratangarh-Kishengarh at Jhunjhunu	2.0	RVPNL	July 2000
7.	400/220 kV, 315 MVA, ICT – 1 at Nalagarh	-	POWERGRID	09.08.2000
8.	220 kV Shahabad – Panchkula D/C	134.0	HVPNL	12.08.2000
9.	400/220 kV, 315 MVA, ICT – 1 at Bassi	-	POWERGRID	30.09.2000
10.	LILO of 400 kV Moga – Chamera D/C at Jallandher	10.40	POWERGRID	30.09.2000
11.	220 kV RSD – Sahpurkandi ph-1	34.0	PSEB	September 2000
12.	220 kV Sikar – Kuchmancity part1	33.0	RVPNL	September 2000
13.	400 kV Naptha Jhakri (NJPC) – Abdullapur D/C	360.0	POWERGRID	06.10.2000
14.	400 kV Bawana – Bamnauli D/C	74.0	DVB	15.10.2000
15.	400/220 kV, 315 MVA, ICT – 1 at Bamnauli	-	DVB	22.10.2000
16.	LILO of 220 kV Dasua – Heerapura II at Bassi	2.895	POWERGRID	03.11.2000

17.	LILO of 220 kV Panki – Mainpuri I (UPPCL) at Kanpur	10.40	POWERGRID	04.11.2000
18.	220 kV Auraiya – Phaphund D/C	9.0	RAILWAYS	29.11.2000
19.	400/220 kV ICT – 2 at Jallandhar	-	POWERGRID	19.12.2000
20.	400 kV Agra – Muradnagar S/C	194.0	UPPCL	20.12.2000
21.	400/220 kV ICT – 1 at Jallandhar	-	POWERGRID	29.12.2000
22.	220 kV Jallandhar – Dasua D/C	99.0	POWERGRID	29.12.2000
23.	800(400) kV Kishenpur–Moga S/C–II	285.0	POWERGRID	19.01.2001
24.	LILO of 220 kV Ipext-BTPS at Sarita Vihar	1.0	DVB	January 2001
25.	220 kV Sikar – Kuchmancity part2	35.0	RVPNL	January 2001
26.	220 kV Bamnauli – Naraina D/C	34.0	DVB	January 2001
27.	400/220 kV, 315 MVA ICT-2 at Bassi	-	POWERGRID	25.02.2001
28.	220 kV Samaypur – Palli D/C	19.0	HVPNL	February 2001
29.	220 kV CB Ganj- Bareilly	13.0	UPPCL	February 2001
30.	220 kV Suratgarh – Udyog Vihar	57.0	RVPNL	March 2001

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 2000-2001, a total of 1514 MVAR were commissioned in the region bringing the installed capacity to 15613 MVAR. This is against the requirement of 22419 MVAR, thus leaving a shortfall of 6806 MVAR as on 31st March 2001. Table-10.2 provides the status of shunt capacitor installation in Northern Region Grid as on 31st March 2001.

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

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 Chamara 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 Chamara HPS & unit no. 2 & 6 of Singrauli 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.

SECTION – 4

COMPUTING & COMMUNICATION FACILITIES AT NRLDC

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 fast communication with different constituents of regional power system. The existing facilities in this regard 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 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 and SLDC Patiala.

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 also provides 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 2000-2001 with availability of the order of 99%.

Apart from the 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, Bhakra, 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.

Further, All the CEGELEC RTU S 900 (ordered under unified SC&C project) were interfaced with the C-DAC Data Concentrators. Data communication from SLDC Patiala to NRLDC was also established successfully during the year and now Punjab data is being acquired at NRLDC through this link.

4.5 Augmentation of Real Time Data Acquisition System at NRLDC:

Interim Telemetry scheme, described in previous section, apart from providing vital data from Data Concentrators (DCs) , also included following enhancements at NRLDC:-

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.

The scheme was successfully completed in all respect in March 2001.

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 Project is being executed as per schedule and it is expected that the scheme would 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	
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	
Scope of work	Optical Fibre Ground Wire (OPGW)	1815 Kms
	Terminal Stations	56 nos.

3. Microwave Communication:

Awarded to	M/S IVO Power Engg., Finland	
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)	
Scope of work	PLCC Terminals	218 nos.
	EPABX	63 nos.

5. Auxiliary Power Supply:

Awarded to	M/S TATA LIBERT , Thane (India)
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Scope of work	DG Sets	28 nos.
	UPS system	33 nos.
	DC Supply (48 volts)	59 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 1999-2000:

- 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.

The status of various activities under the project (Package wise) completed during 2000-2001 is as given below:

1. SCADA/EMS:

(i) RTUs:

Constituent	No. of RTUs	Progress			
		Supplied	Erected	End to End test Completed	Commissioned* RTUs of '0' batch
BBMB	21	21	21	17	0
PSEB	19	19	19	6	0
HPSEB	16	16	15	5	2
UPPCL	82	82	79	18	12
RVPNL	21	21	20	19	0
HVPNL	40	40	39	0	0
J&K	13	13	13	0	1
DVB	31	31	23	0	3

CENTRAL SECTOR	42	41	27	0	8
TOTAL	285	284	256	65	26

* No of RTUs commissioned in '0' batch is 37. 11 of them have been included in the list of RTUs for which end to end test have been commissioned.

ii) Sub-LDCs/CPCC:

Total Number: **24** Delivered: **23** Installed: **16** Commissioned: **12**

Constituent	No. of Sub-SLDCs	Installed	Commissioned
BBMB	4	4	4
PSEB	2	2	2
HPSEB	2	2	1
UPPCL	5	5	3
RVPNL	3	3	2
HVPNL	2	0	0
J&K	1	0	0
DVB	4	0	0
CENTRAL SECTOR	1	0	0
TOTAL	24	16	12

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

(iii) SLDCs:

Total Number: **8** Delivered: **8** Installed: **2** Commissioned: **0**

(iv) RSCC:

Total Number: **1** Delivered: **1** Installed: **0** Commissioned: **0**

(v) Weather Stations:

Total Number: **10** Delivered: **10** Installed: **2**

2. Fibre Optic Communication:

Progress	
OPGW Installed	1815 Kms/ Stringing Complete
Terminal Stations Installed	48 nos. out of 56

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

3. Microwave Communication:

(ii) 43 tower erected.

(iii) All Electronics except NMS (Network Management System), test equipments and spares shipped.

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

4. Power line Carrier Communication (PLCC):

Progress	
PLCC Terminals	Erection Completed except at few locations
EPBAX	Erection Completed except at few locations

5. Auxiliary Power Supply:

All equipment except DC supply spares have been supplied.

Constituent	DG Sets		UPS		DC Supply	
	Installation	Commissioning	Installation	Commissioning	Installation	Commissioning
BBMB	1	0	5	5	5	5
PSEB	3	0	3	3	3	3
HPSEB	3	0	3	3	3	3
UPPCL	4	0	6	5	15	11
RVPNL	3	0	4	4	4	4
HVPNL	3	0	3	3	3	3
J&K	1	0	1	1	1	1
DVB	0	0	3	1	14	12
CENTRAL SECTOR	0	0	2	1	6	5
TOTAL	18 of 28	0	30 of 33	26	54 of 59	47