

against the corresponding figures of 7.00% and 7.54% during last year. This could be made possible by sustained efforts towards better resource mobilisation and operational planning including planning of outages of generators and transmission system.

1.2 Frequency regime:

. Frequency profile during 2001-2002 was better than the last year i.e. 2000-2001 due to concerted efforts of NRLDC and active co-operation by the constituents. The frequency remained below 49.0 Hz for 11.17% of total time against 34.23% last year and above 50.5Hz for 12.60% of total time against 10.03% during last year. There was marked improvement in the frequency profile particularly with respect to the trend below 49.0 Hz due to effectively load regulatory measures taken by different states. The high frequency period also could have further improved had all generating stations resorted to backing down to the designated level during all such periods having high frequency .The off nominal frequency operations calls for an early implementation of ABT (Availability Based Tariff).

1.3 Voltage profile:

The month wise maximum & minimum voltage recorded at Dadri during the year 2001-2002 are given under section 9.3. The voltage regime were also better than the last year. The lowest voltage recorded at Dadri was 358kV against 336kV last year on 09.05.2000. At certain instances the voltages had gone down to low level mainly due to increase in reactive energy requirements (drawal) of the constituents with non-commensurate increase in installed capacitors. The constituent wise installation of shunt capacitor vis-à-vis the projected requirement as on 31st March 2002 is given in section 10.2.

1.4 Grid incidents:

- availability of power in Haryana as well as in the region.
- (iii) Commissioning of 2x43 MW Units of Malana power Company (IPP) on 04.07.2001 & 08.07.2001 respectively resulted in increased availability of power in the region.
 - (iv) Commissioning of LILO of 400kV Singrauli-Kanpur-II at Allahabad by POWERGRID on 08.07.2001 and Commissioning of LILO of 400kV Singrauli-Kanpur-I at Allahabad by POWERGRID on 27.10.2001 resulted in system strengthening.
 - (v) Commissioning of 220 kV samaypur-Palla D/C on 24.07.2001 resulted in system strengthening in Haryana system.
 - (vi) Commissioning of 315 MVA, 400kV/220kV ICT-2 at Agra sub-station of U.P. on 08.08.2001 resulted in system strengthening in U.P. system.
 - (vii) Commissioning of Suratgarh Unit-3 and Unit-4 of RRVPNL on 08.12.2001 and 25.03.2002 respectively resulted in increased availability of power in Rajasthan as well as in the region.

1.6 Other important developments:

Inauguration of Northern Region Unified Load Despatch Scheme at NRLDC, New Delhi.

Sh.Atal Bihari Vajpayee, Hon'ble Prime Minister to Govt. of India inaugurated Northern Region Unified Load Despatch Scheme on 11th January,2002 at NRLDC, New Delhi. The inaugural ceremony was graced by Sh.Suresh P. Parbhu, Hon'ble Minister of Power, Smt. Jayawanti Mehta Hon'ble Minister of State for Power, Smt. Shiela Dixit Hon'ble Chief Minister of Delhi and several other dignitaries.

The Hon'ble Prime Minister released a souvenir and also inspected the Control Room. Northern Regional Unified Load Despatch System consists of state of the Art SCADA/EMS system installed at NRLDC, New Delhi along with 8 SLDC's and 24 Sub-SLDC's in different states in the Region to acquire data from 369 RTU's . The project has been completed in a record time and duly appreciated by Hon'ble Prime Minister. The system is based on industry standard Hardware and Software platforms and is supported by wide band communication with digital microwave and optical fibre technologies for interruption free data transfer between various control centres.

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 (9 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 SSTPS) and 400kV transmission system in the country.

Establishment of the first High Voltage Direct Current (HVDC) long distance transmission system in the country (2x750 MW 500kV Rihand-Dadri HVDC bipole).

First HVDC back-to-back interconnection with Western Region (2x250 MW back-to-back HVDC station at Vindhyachal).

First 400kV Static Var Compensators (SVC's) in the country (2x ± 140 MVAR SVC at Kanpur).

Largest capacity of combined cycle gas power station amongst the five regions (2626.04 MW) located along the 700 Kms. Long Hazira-Bijapur-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 system 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.

	--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-Lucknow		408 Kms.
	Largest ICT-400/220 kV ICTs at Bhiwani/Dadri/S/Stn.		500 MVA
6)	Transmission system (as on 31 st March 2002)	± 500 kV HVDC 400 kV 220 kV Total	1630 ckt. kms. 14342 ckt. kms. 26581 ckt. kms. 42553 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. 47 nos. 26 nos. 18 nos.
8)	Regional peak met (2001-2002)	21586 MW	
9)	Regional Peak demand (2001-2002)	22589 MW	
10)	Average energy consumption (2001-2002)	383.57MU / day	
11)	Average energy requirement (2001-2002)	405.57 MU / day	

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.
2001	Preparation of ABT based schedule w.e.f. 01.08.2001. as per CERC order.
2002	Unified Load Despatch Centre inaugurated by honourable Prime Minister of India.

system.

- Operation and maintenance of the Northern Regional Power Control Centre and associated computing & communication facilities.
- 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 winter and rains during summer 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 2001-2002 has been 5.42 % and 4.44 % 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.

around 5000 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 (1992-2002), the Compounded Annual Growth Rate (CAGR) in energy and peak requirement was 5.46 % and 4.62 % respectively while the generation capacity addition rate was only 3.39 %. 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. The issue is being discussed at different forum and it is expected that the implementation of ABT shall commence shortly. ABT

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.

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.

A frequency-linked charge for Unscheduled Interchange (UI) (based on after the-fact meter readings and schedules).

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:

SLDCs and Central generators to back down their generation under high frequency condition

SLDCs to reduce their load under low frequency conditions.

Bilateral agreements between SLDCs and SLDCs-Central Generators.

Harness captive generation in the different systems.

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.

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

New generating units & transmission lines /ICTs commissioned/ de-rated/ up-rated during the year 2001-2002 are given below:

A. Generating Units:

S.No	Generating unit	Agency	Capacity addition (MW)	Date of commissioning	Remarks
1.	Wind energy RPSC	RRVPNL	2.15	OCT.2001	-
2.	Wind energy Pvt.Sect.	RRVPNL	7.60	---	-
3.	Suratgarh St-II (#3)	RRVPNL	250	'08.12.2001	-
4.	Suratgarh St-II (#4)	RRVPNL	250	25.03.2002	-
5.	Upper Sindh Stg-II(#2)	J&K	35	11.09.2001	-
6.	Upper Sindh Ext. HPS (#1)	J&K	35	29.03.2002	-
7.	Sewa Stg.-III (3x3)	J&K	9	---	-
8.	Malana #1	Malana power company	43	04.07.2001	-
9.	Malana #2		43	08.07.2001	-
	Total additional capacity		674.75 MW		

Total addition in effective capacity during the year : 674.75 MW

S. No.	Transmission line	Ckt. Km.	Agency	Date of Commissioning
	<u>400kV Lines:</u>			
1.	NJPC-Nalagarh D/C	290	POWERGRID	31.05.2001
2.	Sasaram-Sarnath-Allahabad D/C	435	POWERGRID	06.11.2001
3.	LILO of Anpara-Sarnath at Obra TPS	21	UPPCL	Jan.2002
4.	LILO of Singrauli-Kanpur I&II at Allahabad	4	POWERGRID	Jul.2001
	<u>220kV Lines:</u>			
1.	RSD-Jessore SC	26	HPSEB	Nov.2001
2.	Bamnoli-Papankala DC	17	DVB	Mar.2002
3.	Palla-Samaypur with charging of ckt-II	25	HVPNL	Jul.2001
4.	Muksar-Jallalabad SC	40	PSEB	Oct.2001
5.	Civil line Amritsar-Khassa SC	31	PSEB	Feb.2002
6.	GGSSTP-Gobindgarh D/C (III&IV)	124	PSEB	Apr.2001
7.	Jamsher-Nakodar SC	15	PSEB	Apr.2001
8.	RSD-Sarna-II	61	PSEB	Apr.2001
9.	LILO of Suratgarh-Ratangarh at STPS	12	RVPNL	Mar.2002
10.	Ratangarh-Suratgarh-II	158	RVPNL	Nov.2001
11.	Sikar-Laxmangarh D/C	44	RVPNL	Mar.2002

S. No.	ICTs	Capacity.	Agency	Date of Commissioning
1.	1x315MVA ICT-I of at Allahabad	315MVA	POWERGRID	Jul.2001
2.	1x315MVA ICT-I at Agra Ext.	315MVA	UPPCL	Dec.2001
3.	2x315MVA ICT-I&II at Bareilly	315MVA	UPPCL	Dec.2001
4.	1x315MVA ICT-I&II at Ratangarh	315MVA	RVPNL	Dec.2001

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.

Before implementation of unified scheme, a PC based data acquisition system designed and developed by M/S CDAC was in service and its layout is shown at Exhibit-2. 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

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

* 63 RTU of Siemens make to be provided by Constituents (Rajasthan 58, J&K 3, Haryana 2)

** 21 RTU of CDAC make to be provided by Punjab.

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

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.

5. Auxiliary Power Supply:

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

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-E4.

4.3 **Auxiliary Facilities:**

- 2x40 kVA Uninterrupted Power Supply System (UPS) supported by two DG sets of 350 kVA and 125 kVA capacity.
- Centralised Air Conditioning plant comprising of 3 compressors each of 80 TR.
- Microprocessor based intelligent fire detection and alarm system.

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.