

पावर ग्रिड कारपोरेशन ऑफ इंडिया लिमिटेड

(भारत सरकार का उद्यम)

POWER GRID CORPORATION OF INDIA LIMITED

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Dated: 26th December 2003

To,
As per mailing list

Sub: A position paper on one year of Availability Based Tariff (ABT) in Northern Region

Dear Sir,

Northern Regional Grid completed one year of operation under the ABT regime on 30th November 2003. From time to time, we have been keeping you apprised of the performance of the grid under ABT in the form of feedback reports as the present one. This report as well as the earlier feedback reports are available on our website www.nrldc.org on the HOME PAGE under the link 'Reports/ABT Feedback.'

A. Frequency profile: There has been considerable improvement in frequency profile of the Northern grid month after month after the implementation of ABT as shown in Fig. 1 below. It would be seen that for the entire one year of ABT period (Dec 2002 to Nov 2003), the frequency remained within the Indian Electricity Grid Code (IEGC) mandated band of 49.0-50.5 Hz for 88% of the time against 76% for the corresponding pre-ABT period. The improvement during October 2003 and November 2003 is significant. This coincides with the introduction of the Free Governor Mode of Operation (FGMO) of major generating units in the region with effect from 7th October 2003. The region recorded the lowest ever Frequency Variation Index (FVI) of 0.34 on 27th October 2003.

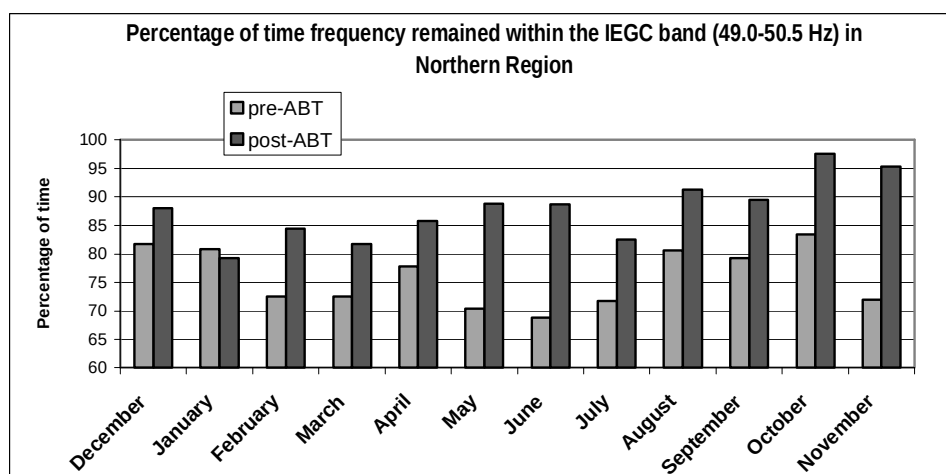


Fig. 1

Figure 1 also indicates that only January 2003 month was an aberration in respect of frequency profile and the reason for the same was primarily due to high demand following intense cold wave conditions (worst in 40 years as declared by Met department) coupled

with some unscheduled outages. It is also pertinent that the above improvement in frequency profile has occurred despite a meagre addition of only 1024 MW (including the Jhakri 250 MW unit and 100 MW Chamera-II unit commissioned very recently) to the effective generating capacity over the year (3.6 %) as against the increase in power demand by approximately 6.5%. The improvement in frequency profile has also encouraged the constituents to raise the underfrequency relay settings for load shedding from 48.2 to 48.5 Hz and from the previous 48.0 Hz to 48.3 Hz respectively. Further studies are required in respect of the settings of relays based on rate of change of frequency (df/dt). This is important considering the increase in system size as well as primary response from the generating units.

B. Free Governor Mode of Operation (FGMO) of generating units: Governing system available on the generating units is a fundamental control in any power system and its normal operation is mandated by Sections 6.2(e), f and g of the IEGC. Unfortunately, this had not been possible in our regional grids so far due to various reasons and one of the reason was wide fluctuation in the frequency band during the entire day varying from 48.0 Hz to 52 Hz. Introduction of ABT had narrowed this band to 49.0-50.5 Hz and therefore introduction of FGMO was the next logical step.

The Northern Regional Electricity Board (NREB) in its 130th meeting held on the 14th June 2003 at Shimla resolved to implement FGMO in Northern Region with effect from 1st October 2003. NRLDC in the first phase identified about 12,000 MW generating capacity that would go into FGMO in the initial phase which included all coal fired units of 200 MW and above and reservoir based hydro stations. NRLDC engineers spent considerable time and effort in traveling to the different coal fired power stations in the region, explaining the requirement of the regional grid and the behaviour expected from their generating units. Detailed instructions were issued to all the targeted units for commencement of FGMO with effect from 1100 hours of 7th October 2003.

An exhaustive system for monitoring the frequency response of generating units scheduled to go into FGMO was set up at NRLDC using the telemetered data available under the Unified Load Despatch and Communication (ULDC) scheme. A sample output of the frequency response exhibited by one 157 MW unit as captured at NRLDC is indicated in Fig. 2 alongside. Similar response by all the targeted units was also analysed and the whole process made transparent by summarizing the results on the NRLDC website.

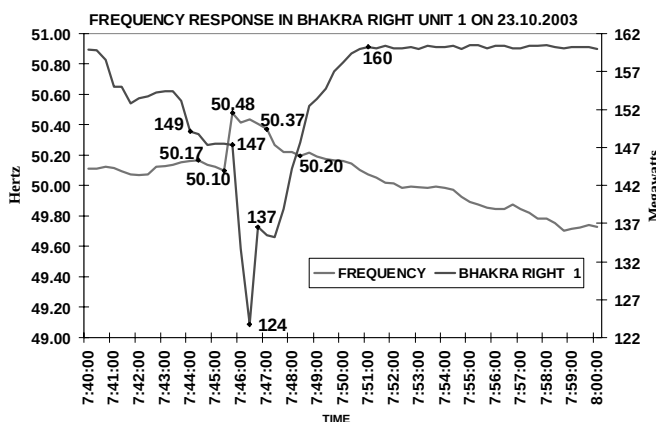


Fig 2

Salient features of this still ongoing exercise in Northern Region are as under:

- i) Only about 40-50% of the targeted capacity of 12,000 MW exhibited frequency response. Out of this, only 1500-2000 MW capacity exhibited true free governor

operation viz. units at Bhakra, Pong, Unchahar, Suratgarh, Ropar and Jhakri during the period of a rise in frequency.

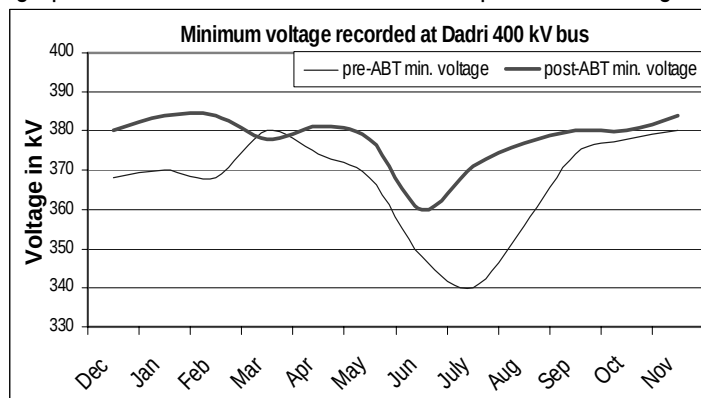
- ii) Excursions above 50.5 Hz came to almost NIL after 7th October 2003 despite the modest response from the generating units.
- iii) No response from generating units for a fall in frequency in respect of the 5% overload capability of generating units expected for five minutes as per Section 6.2 g of IEGC was available except from the Jhakri unit (where 10% overload capability came into effect automatically). Reported reasons for the same are non-availability of a written confirmation from the manufacturers and/or commercial reasons in respect of NTPC generators. Our earlier reports have already highlighted as to how due to certain provisions in the ABT order, generators are not getting any payment for generation above their Declared Capability (DC) and that this was resulting in bottling up of capacity even at cheaper coal pithead stations of NTPC under normal conditions.
- iv) In many of the generating units, dead band/limiters/time delay settings available through the software of Electro Hydraulic Governing (EHG) systems and Unit controls like Coordinated Master Control (CMC) were used to suppress normal governor action violating clause 6.2f of the IEGC.

In the meantime, SRLDC had filed a petition before the Honourable Central Electricity Regulatory Commission (CERC) against Ramagundam STPS of NTPC for not participating in FGMO in the Southern Region from the scheduled date of 1st August 2003. In the hearing on this petition on the 4th December 2003, the Honourable Commission has enlarged the scope of this petition to cover all generating units in the country and in line with its direction, the Central Transmission Utility viz. POWERGRID shall appraise the Honourable Commission the exact status of FGMO on all generating units in the country through an affidavit by 31st January 2004 clearly indicating:

- (a) Statement giving break-up of all the units identified for putting under FGMO, in the first instance, along with their ownership and status of implementation, that is, partial or full.
- (b) Statement, unit-wise and ownership-wise of units which were brought on FGMO but were withdrawn subsequently by the generator, and
- (c) A scheme for watching and monitoring of continuity on FGMO on regular basis.

C. Voltage profile: The voltage profile has also shown considerable improvement during the

year as would be seen from the minimum voltage recorded at a nodal point, 400 kV Dadri on monthly basis indicated in the figure alongside. Occasional occurrences of high voltage were experienced in the Singrauli/Rihand belt in southeastern part of the



grid and in parts of Southern Rajasthan and northwest Punjab. The reactive energy charges under the ABT mechanism for reactive energy drawals/injection outside the 97-103% voltage band have had a salutary affect on the voltage profile. This has in fact

helped in controlling the high voltage in Singrauli/Rihand complex as the generator transformer taps at Anpara TPS were changed by UPRVUN. This helped in controlling the heavy MVAR flow from Anpara to Singrauli, which was earlier causing high voltage in Singrauli/Rihand complex and also resulting in a levy of reactive energy charges on UPPCL.

The problem of low voltage in the Kashmir Valley, particularly during the winter peak continues to be a cause for concern. Overloading of sub-transmission and distribution network in the Valley area coupled with grossly inadequate capacitive compensation is the principal cause for this. Further, PDD J&K is not making payment against the reactive energy charges.

The transmission losses for the Inter State Transmission System (ISTS) have been in the range of 2.69 to 5.05% post-ABT (with average pooled loss at 3.70%). The week-wise loss is represented graphically at Annex-I. The losses for the corresponding period last year with effect from 15th July 2002 (for which the detailed computation is readily available at NRLDC) are also indicated. The pooled loss has reduced by 0.25% approximately in the post-ABT period July 2003-November 2003.

- D. Merit order:** Merit order is also being followed by the constituents going by their station-wise requisition, which is reflected by NRLDC while scheduling. This would be clear from Figure 3 below indicating schedules as a percentage of Declared Capability (DC) for NTPC Inter State Generating Stations (ISGS) in the Northern Region. It would be seen that while the pithead stations are being scheduled upto 99% of their DC, combined cycle ISGS is being scheduled to only 81.3% of the DC (on account of less off-take from liquid fuel firing). This is in contrast to the pre-ABT period when the requisition from pithead was lower than the post-ABT period while that from combined cycle was higher than the post-ABT period.

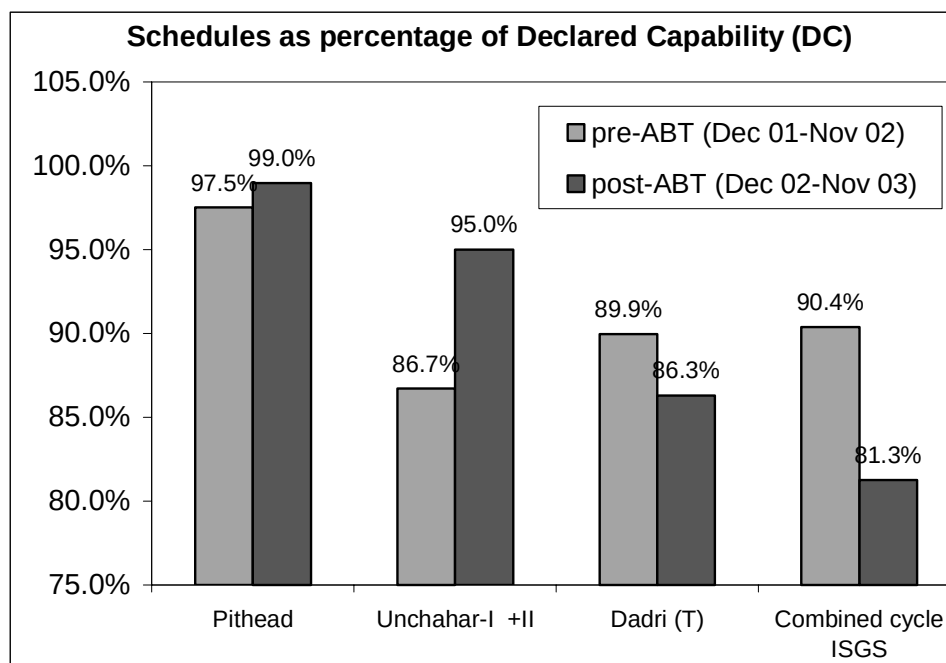


Fig 3

E. Under-utilisation of capacity at nuclear and combined cycle stations of NR:

A cause for concern is the under-utilisation of capacity at the nuclear and the combined cycle power stations in Northern Region even during the period when demand in the region was quite high. Fig. 4 below indicates typical values during the period 6th to 12th October 2003 from which it would be seen that this under-utilised power is of the order of 550 MW. This does not include the power under-utilised at Faridabad GPS of NTPC, which is of the order of 100 MW. Thus upto 650 MW capacity in the region is not requisitioned by the NR constituents, the reasons for which are indicated in the foregoing paragraphs.

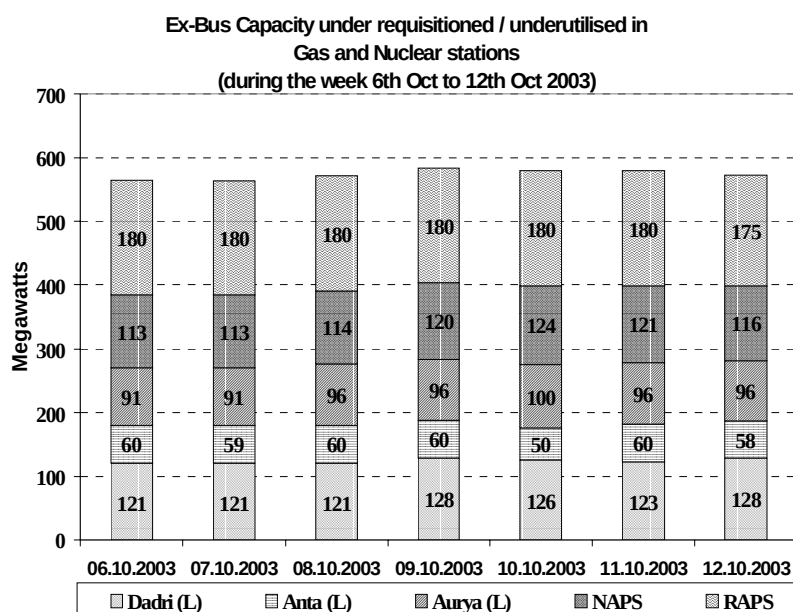


Fig 4

- a) **Under-utilisation at nuclear power stations:** Nuclear power stations in the country are presently having a single part tariff based on norms fixed in 1996. This single part tariff is based on a normative deemed availability or deemed plant load factor (plf) of 62.8%. However, the actual plf of the nuclear ISGS in Northern Region has consistently been much higher (85% and above) and pending the changeover to a two-part tariff, off-take from these stations reduced from 100% to 70% since August/September 2003. With the intervention of NRLDC, the situation has improved somewhat with the capacity utilization going upto 80-85% in December 2003. However, a permanent solution lies in the form of a two-part tariff for these nuclear stations and their changeover to the ABT regime at the earliest so that cheap power (energy charges of the order of 50 paise/kwh) is utilized to the maximum.
- b) **Under-utilisation at combined cycle ISGS:** Anta and Auraiya combined cycle plants use naphtha while Dadri GPS uses High Speed Diesel (HSD) as liquid fuel for generation under a natural gas shortage situation. The energy charges using naphtha ranges between Rs. 3 to Rs. 3.25 per kwh while on HSD it is of the order of Rs. 5 per kwh based on the current price level. During the month of November 2003, even when the frequency was below 49.5 Hz for nearly 35% of the time, the average MW capacity unrequisitioned on liquid fuel was as under:

Anta	73 MW
Auraiya	88 MW
Dadri GPS	167 MW
Total	328 MW

It is important that a solution to this problem is found out so that this capacity is better utilized in a power shortage scenario and the grid security is not endangered. Any solution would have to look into the following areas:

- i) Section 7.4.5 of the IEGC mandates that the SLDCs/STUs shall regularly carry out the necessary exercises regarding short-term and long-term demand estimation for their respective states to enable them to plan in advance as to how they would meet their consumer load without overdrawing from the grid. Further section 6.4.2 (a) of the IEGC mandates that the constituents shall endeavour to restrict their net drawal from the grid to within their respective drawal schedules whenever the system frequency is below 49.5 Hz.

A natural corollary of the above two stipulations is that SLDCs/STUs/distribution licensees need to plan for power purchases from all the available sources to meet power shortages and project the same in their Annual Revenue Requirements (ARRs) filed before the State Electricity Regulatory Commissions (SERCs). This would enable retail tariff to be fixed appropriately. Alternatively, if any SLDC/STU/distribution licensee anticipates a power shortage despite tapping all the cheaper sources, but still does not wish to source power from liquid fuel, then it is important that a load-shedding schedule is announced in advance and implemented to ensure that the frequency does not go below 49.5 Hz in real time.

- ii) Liquefied Natural Gas (LNG) is also expected to be available in Northern Region by March 2004 from the Dahej terminal of Petronet LNG in Gujarat. About 20 Million Standard Cubic Metres per Day (MSCMD) of natural gas is expected to be available through the HBJ pipeline from this LNG terminal. As on date, the pricing arrangements and the quantity available for power sector is not clear. It is however expected to be more competitive than naphtha. It is important however that the prices of natural gas (from GAIL), LNG, naphtha, HSD becomes predictable either through regulatory certainty or otherwise so that the power sector is not subject to unnecessary fuel price shocks and situations like under-utilisation of capacity in a power shortage scenario does not arise.
- iii) A related issue is the UI ceiling rate of 420 paise/kwh fixed on the basis of HSD prices sometime in end 1999. Since then the prices have undergone a change, particularly after the dismantling of the Administered Price Mechanism (APM) for petroleum products with effect from 1st April 2002. Prompt revision of UI rates is a prime requirement. A quarterly revision is suggested based on the average of the HSD retail prices at Chennai, Delhi, Mumbai and Kolkata (as taken in computation of the Wholesale Price Index). Average of these prices as on 1st April, 1st July, 1st October and 1st January could form the basis of the UI ceiling rate for the quarter beginning from these dates.

With a normative calorific value of HSD at 9000 kcal/litre and an average price of Rs. 23.25 per litre for diesel as of 16th Dec 2003, the energy charges using an internal combustion DG set (assuming a normative heat rate of 2500 kcal/kwh) works out to Rs. 6.45 per unit. This is against Rs. 2.67 per unit worked out by the Honourable CERC in their ABT order dated 4th January 2000 based on the HSD prices prevailing in end 1999. This indicates the need for a periodic revision in UI rates, say every quarter.

It is important that all the above factors are considered by all the stakeholders, a rational decision taken and the right despatch signal is sent to all the players in the regional grid. This would enable utilization of the idle generating capacity available in the grid.

- F. Operation of reservoir based ISGS:** Presently, the Northern Region has only one major reservoir based ISGS viz. Chamera-I. However, Tehri power station, another major reservoir based station (4 x 250 MW capacity) is expected to be commissioned shortly. Filling and depletion pattern of the reservoir on an annual basis is basically the responsibility of the concerned generator. While discharging this responsibility, it has to be ensured that the water inflows are optimally utilized and margins be created judiciously such that it gives maximum support to the regional grid during the peak demand periods as well as any contingency occurring in real time.

The above aspect assumes importance considering that in this season, Chamera-I reservoir is left with absolutely little or no reserve, having exhausted the available reserves in October and November 2003. These two months should ideally have been utilized by the station in a manner that before the commencement of the peak winter period, the reservoir should have been filled to a reasonably good level. This leaves no margin for any real-time contingency during winter.

It is therefore important that the hydro generators should plan the reservoir's operating pattern in a judicious manner and if required it should be decided jointly by the generator, its customer and NRLDC on a monthly basis in the true spirit of ABT and taking into account the security of the regional grid.

- G. Network loading and system security:** After the implementation of ABT in all the regional grids in the country and with the cheaper Eastern grid power replacing the costlier load centre based power in the Northern Region (mainly through trading), the loading on the circuits in the transmission corridor from the Kanpur/Lucknow axis to the Dadri/Ballabgarh and there onwards to Panipat/Malerkotla/Hissar has further enhanced. During the winter peak period, particularly during December and January, heavy fog and Suspended Particulate Matter (SPM) level result in disc insulator flashovers on the 400 kV lines and the Rihand –Dadri HVDC Bipole. Steps have been taken by the utilities concerned in ensuring proper cleaning of disc insulators and completing all preventive maintenance activities well before the onset of winter period.

Nevertheless, loss of one pole of Rihand-Dadri HVDC or one of the 400 kV lines in the above corridor is still a credible contingency to reckon with and the system has to be operated in a manner that it could withstand this contingency without a loss to the grid security and safety. The fixed series compensation on the 400 kV Kanpur-Ballabgarh line has already been commissioned in July 2002 and it gives valuable support to the grid. It is expected that commissioning of Flexible AC Transmission System (FACTS) on 400 kV Kanpur-Ballabgarh line and series compensation on 400 kV Panki-Muradnagar line (likely to be commissioned shortly) would further enhance the system stability.

- H. Trading arrangements:** Bilateral agreements provide a suitable mechanism to the state constituents to meet their power demand without overdrawing from the grid. It also provides a suitable hedging tool against UI charges. ABT has been implemented in all the regional grids of the country now with the Northeast regional grid also moving to this mechanism with effect from 1st November 2003.

The number of agreements and the quantum of energy traded with the Northern Region have gone up by 50% in the entire one year of ABT as would be evident from Fig. 3 alongside. A part of the increase could be attributed to the commissioning and continuous availability of the 500 MW Pusauli HVDC back-to-back station connecting Eastern Region with Northern Region in September 2002 and its

	Average no.of Agreements/month	Total Energy Traded (million units)
Pre-ABT(Dec Nov)	7.50	3550.12
Post-ABT(Dec0 Nov)	11.25	5146.59

Fig. 5. Power trading with Northern Region

stable operation for over the last one

year. However, implementation of ABT has also provided the necessary impetus to trading. The setting up of an interim National Power System desk (NPSD) by POWERGRID located within the NRLDC premises with effect from 1st July 2003 has also facilitated the above trading.

Introduction of open access and trading as conceptualized in the Electricity Act 2003 and finalisation of the terms and conditions thereof by the CERC would provide further impetus for more power transactions. The RLDCs stand fully geared to meet this challenge. Inter-regional transactions would ultimately be constrained by network capacity and system security. As on date, the 500 MW capacity available on the Pusauli HVDC back-to-back station between ER and NR is fully utilized. Inter-regional transactions also involve a lot of co-ordination with two or more RLDCs, two or more SLDCs as well as the transmission service providers. It is therefore important that apart from facilitating inter-regional exchanges, the potential for intra-state and inter-state transactions within a regional grid is fully harnessed by all stakeholders.

- I. **Settlement system:** Weekly Unscheduled Interchange (UI) Accounts and Reactive Energy (RE) Accounts are being issued on a regular basis by the NREB Secretariat and payments being routed through the pool accounts being maintained by NRLDC. For the UI Accounts issued upto 30th November 2003, an amount of Rs. 588.46 crores has been collected and disbursed as of 19th December 2003 besides a sizeable component remaining outstanding due to non-payment by some of the constituents. In respect of the RE Account, an amount of Rs. 15.83 crores has been collected out of which Rs. 6.47 crores has been disbursed, leaving an amount of Rs. 9.36 crores as surplus in the RE account. A modus operandi for utilization of the funds accumulated in the RE account needs to be finalised at the earliest. Like UI Account, in case of RE Account also, there are outstanding against some constituents.
 - i) Details of all receipts and disbursements against the above accounts are being updated regularly on our website www.nrldc.org and the status of outstanding is also indicated regularly. Payment default by some constituents was a cause for concern and NRLDC took up the matter earnestly with all constituents and in the absence of any favourable response filed petitions against these defaulting constituents before the CERC. Despite the hearings before the Commission, the payment defaults by PDD J&K continues and constitutes a grave threat to the settlement system under the ABT regime.
 - ii) Another cause for concern is NTPC's stand in not forwarding to NRLDC the data from the standby Special Energy Meters (SEMs) installed on the High Voltage (HV) side of

Generator Transformers (GTs) and Station Transformers (STs) at their power stations. Non-availability of this data had resulted in problems in accounting on three occasions at Dadri (Gas), one occasion each at Dadri (Thermal) and Rihand STPS in the first year of ABT when the main metering system had a partial failure due to CT/CVT secondary input supplies to one or more meters. On this account a sizeable energy generated by the respective stations could not be accounted for and has also resulted in a financial loss to NTPC (approximately Rs. 2.5 crores). It is important that the organization must come forward to amend their rather unreasonable and adamant stand on this issue.

- iii) The complexity of the settlement system in Northern Region with 28 pool members, 170 metering locations and over 900 SEMs spread across the region are well known. A comparative table with the other regions is also indicated in Figure 6 below, which illustrates the complexity of the Northern Region.

Summary of Special Energy Meters (SEMs) in India used in settlement system

Region	Number of metering locations		Number of Special Energy Meters (SEMs)	
	Total	State sector	Total	State sector
Northern	170	131 *	926	543 *
Eastern	77	56 **	267	90 **
Western	59	16	352	24
Southern	68	46	271	64
Northeastern	43	23	148	35
All India	417	272	1964	756

* includes 23 locations / 267 SEMs in BBMB system

** includes 12 locations / 12 SEMs in DVC system

Fig 6

Needless to mention a sense of collective responsibility by all the stakeholders and a system of checks and balances is essential to make it a well-oiled mechanism. The indifferent response by some of the constituents in not forwarding the SEM data to NRLDC on weekly basis had already been indicated in our earlier reports. This situation still persists in respect of UPPCL, UPCL, RVPNL, DTL and two locations of PSEB although all constituents agreed to render the necessary co-operation in the matter in the 131st meeting of NREB held on 21st October 2003. A discrepancy in computation of UPPCL's drawal from Allahabad (POWERGRID) from 31st December 2002 to 9th November 2003 also came to the fore only in mid-November 2003. All this vindicates the stand NRLDC had been taking right from the beginning that in order to make the settlement system foolproof, all the stakeholders should actively participate and play their respective roles.

- J. Role of Information Technology (IT):** This report would be incomplete without mentioning the role of IT and the website hosted by us www.nrlcdc.org which has played a key role in implementation of ABT in a region as complex as the Northern Region. Starting from the pre-dispatch activity of scheduling to the metering and settlement system, the entire operations would simply not have been possible with the conventional paper working. Therefore migration to a paper-less system was driven primarily by the functional requirements of the task at hand. The entire system was developed and maintained in-house by NRLDC engineers. This is only the beginning and improvements in this area are an on-going process.

THE ROAD AHEAD

The last one year of ABT in Northern Region has witnessed a paradigm shift in all activities related to system operation (pre-dispatch activity such as scheduling, real time operation and post despatch activity such as accounting etc.). What next? Already three out of five regional grids in the country are operating in synchronism since March 2003. The Southern grid is also strongly connected asynchronously with the NER/ER/WR grids. The Northern Region is also expected to be synchronized with the NER/ER/WR grid by mid 2006. Most of the provisions in the Electricity Act 2003 would be in force by June 2004. The introduction of more players through open access/trading only re-emphasizes the need for stronger co-ordination at the CTU/STU level for system planning and expansion and at the RLDC/SLDC level in system operation. A renewed thrust in the area of system security and reliability (including cyber security looking into the role of IT) is called for on the part of all SLDCs/RLDC. The blackout in northeastern US-Canada power system on the 14th August 2003 serves as a grim reminder to this important fact.

We, at NRLDC would like to reiterate our commitment to meet this challenge and look forward to the co-operation of all stakeholders in this exercise.

Encl: as above

(ALOK ROY)
General Manager

Week wise transmission losses in Northern Region from 1st Dec 2002

