

Deviation Settlement Mechanism: Embracing Challenges and Moving Ahead

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Abstract-This paper briefly describes limitations of present Deviation settlement mechanism. To achieve the target of market development and maintaining grid discipline, it suggests alternatives of deviation settlement Frequency Variation Index (FVI) based Deviation settlement system, balancing market to handle Deviation settlement and VOLL pricing of UI beyond limiting points.

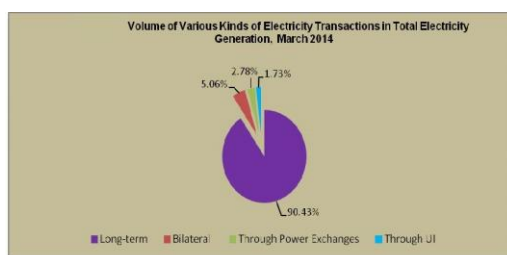
Index Term-Scheduled Injection/Drawl, Frequency Variation Index (FVI), Deviation settlement Mechanism, Value of Loss Load (VOLL)

1. INTRODUCTION

The unscheduled interchange (UI) mechanism introduced in Indian power sector with the implementation of Availability Based Tariff (ABT) in January, 2000 remains a widely debated issue. Its effectiveness as a tool for maintaining grid discipline has become questionable since last 3-4 years especially since enhancement of Deviation settlement rate to Rs. 18 per unit brought almost no change in grid operation parameters.

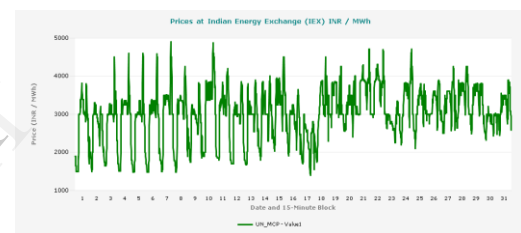
The other challenge to Deviation settlement mechanism came from increasing cost of short term power rates both in bilateral transaction and power exchange collective transaction. The well intended and expressed target of Central Electricity Regulatory Commission to keep the rate of short term power transaction low became difficult because UI rate has become benchmark price for this transaction.

It has been observed that the use of Deviation settlement as trading mechanism by some constituents had resulted in the condition that energy transaction volume under Deviation settlement had increased to 1.73% of total transactions, while the collective transaction at Power Exchange remained as low as 2.78%. The critical mass of trading volume necessary for the success of power exchange does not appear to be achievable in near future. This is hampering power market development.

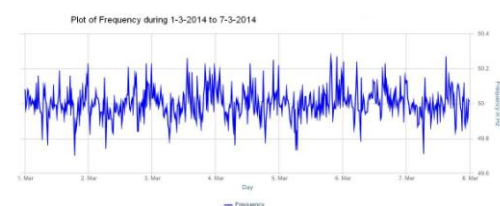


The use of Deviation settlement to gain profit at the cost of customer dissatisfaction by certain DISCOMs may soon become a cause of litigation because it is difficult to ascertain whether a feeder has been switched off to earn Deviation settlement during peak hours or it is genuine fault on feeder or under frequency rotational load shedding to help the grid.

The figure below shows the prices at a power Exchange during the month of March-14



Further a Plot of Frequency during 1-3-14 to 7-3-14 shows that Frequency still goes below 49.8 and above 50.2Hz. This is purely because of load generation mismatch that requires strong deviation settlement mechanism.

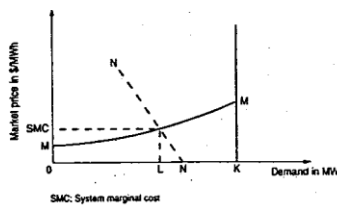


The comfort to system operator through ABT & Deviation settlement mechanism i.e. of schedule based dispatch has also gone because as many as 99 message of grid indiscipline had to be issued to an over drawing constituent in a single month.

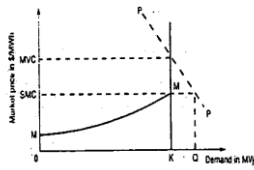
These challenges raise question about suitability of Deviation settlement mechanism in Indian scenario of power shortages. We briefly discuss approaches as a solution to existing situation

2. THE LIMITATIONS OF DEVIATIONAL SETTLEMENT SYSTEM IN INDIAN CONTEXT

The Pricing of imbalance transaction using Deviation settlement ceiling rate is based on system marginal cost or SMC. In Electrical industry the marginal cost of extra output (SMC) is defined as the after price of the highest cost generator which is **currently** running. This cost can be inferred from data on system configuration. The concept taken from countries where the currently running generator or other costly generator can come and fulfill this new demand .What happened in India that there is not sufficient generation margin is available, (as indicated earlier RLNG & Diesel can not fulfill this extra demand) hence this additional demand can be served only through sub frequently operation indicating demand more than generation.



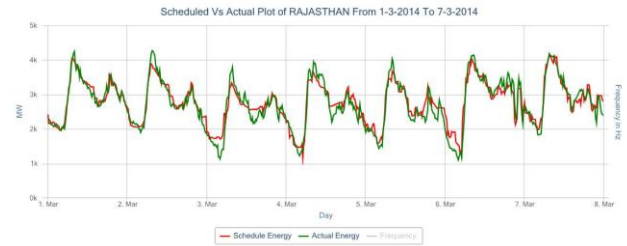
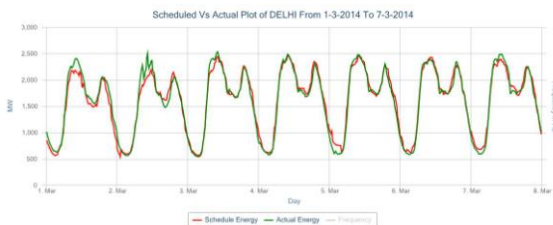
Opportunity cost = system marginal cost of generation



Opportunity cost = marginal value to consumers

The ultimate test of any law or regulation is fulfilling efficient social benefit. This comes from market equilibrium where producer surplus and consumer surplus are equal & shared. The producer can increase his surplus by efficiently utilizing its resources and reducing variable cost. Consumer can increase their surplus by shifting or changing demand curve

Some graphs showing deviation from schedule are given below



So keeping Deviation settlement rate linked to diesel/gas/RLNG may not solve the problem in acute shortage conditions on the presumption that high cost generator would start generating when Deviation settlement rate becomes higher than its variables cost, because such capacity may not exist at that time. Variable energy charges (Paise/kwh) from gas Stations for the month of march-14 are as under

Name of Generating Station	gas	liq	rlng
Anta GAs Power Station	289.8	815.2	878.7
Auraiya Gas Power Station	332.1	1,038.00	1,067.20
Dadri Gas Power Station	344.5	792.9	1,056.50
Faridabad Gas Power Station	266.2	766.9	841.1

This keeps grid frequency low due to persistent shortage & OD from the Grid.

3. DEVIATIONAL SETTLEMENT VECTOR AND PROBLEM OF MERCHANT POWER

The shape of Deviation settlement Vector does not provide sufficient profit opportunities to Merchant Power Plant which is seeking to benefit from low frequency. Consider the case where the frequency is at 49.7 Hz and a 1000 MW Merchant Power start generating power, and frequency improve to 49.8 Hz then Deviation settlement rate drop to Rs. 6.15 (in place of Rs. 8.24/-) . The range of profitable operation for Merchant Power would only be if more load is connected and frequency remains less then or equal to 49.7 Hz which is not good for system operations, hence it was suggested by Mark Lively that Deviation settlement rate should keep rising and not fixed at same value. The rise should be exponential and deterrent to over draws.

4. USING DEVIATIONAL SETTLEMENT AS INVESTMENT AVOIDANCE

Certain states are using Deviation settlement pool as Investment avoidance or postpone strategy. During previous years some states were not deviation settlement receivable for a single week. In **Real option analysis** of investment postpone case it would be always advantage for a Constituent that instead of make an investment for 500 MW (2250Cr.) today, it will keep on drawing Deviation settlement in Morning and evening peak, treating it as an additional generator of higher cost, once its load stabilize (their 500 MW demand's LF become 80%) to a level

sufficient for a base load plant, then corresponding Investment can be made.

Also the non corporative game by constituents is not happening as zero sum game as players have different strength and unbundled competitive utilities like Delhi Discoms having competitive advantage of new management skills, commercial sense, information technology advantage are gaining in this game.

While suggesting any solution to a persistent problem, initial response is governed by intelligence inertia that efforts are made to tailor new solution to existing solution / system and doing certain change in shape of curve or limiting values or anchoring the limiting values to certain parameters. The long term solution lies in searching entirely new solution because every solution had limited life and its effectiveness may weaken due to change scenario and emergence of new niche players.

5. SUGGESTION FOR MODIFICATIONS IN DEVIATION SETTLEMENT MECHANISM

(I) FVI Alternative

The power system operation may be considered as collective game, in which all participants specifically the consumer to switch off load, which is not there in foreign electrical market. The historical allocations of firm power make certain states advantageous due to their load profile. Instead of using this allocation for the benefit of their consumer it is being used as gaming device to gain. Commercial advantage.

Presently in the NEW Grid the frequency bands remain wide on most of days and frequency excursion are very high. The FVI index captures it. To improve grid discipline by overdrawing state it is suggested that it may be to link UI vector with FVI by suitable multiplication factor.

Say on day I, if FVI remain high say more than 4 due to higher frequency variation .then on day 3 the Deviation settlement vector applicable would be 1.25 time for the overdrawing states. This information would result in collective bidding on day 2 morning for day 3 (day ahead) to avail lower rates by buyer and to avail higher rate by seller because for them Deviation settlement would not change and selling in UI may not be profitable as trading at Exchange. There results in less FVI on day 3rd their would provide linkage to Deviation settlement & day ahead market and force frequency band narrow down. Making Deviation settlement rate too predictive shift consumer from Exchange to Deviation settlement market, this alternative would acts as check and balance for both markets.

(ii) Balancing Market with fixed frequency operation

The decentralized dispatch of ABT now needs a small change. In the various discussions at RPC level, RLDC showed its reluctance to schedule URS of NTPC gas and liquid fire station to overdrawing states in absence of explicit request or contract by overdrawing state with NTPC and original allotted of that power (Open Access).

As an alternative it is proposed to implement 'energy balancing' concept in Indian power system operation.

Here NLDC may buy balancing power based on the bidding system .The over drawing constituents would pay the balancing cost.

This would move power system operative to Real time balancing, in which concept of Area Control Error (ACE) is used to measure instantaneous deviation from scheduled interchange and maintain constant frequency at the interconnectivity. Although in present approach of power deficit, it is difficult to achieve zero deviation from frequency. But in longer Deviation settlement mechanism needed to be phased out by learning through experience.

6. MARKET DEVELOPMENT

The Deviation settlement market and collective transaction market are sharing a business pie of shortage of power which can be met through difference between available capacity (availability) and schedule. Only by market development of collective transaction, the system would get free of UI. This can be compared to risk taker and risk adverse investor. A utility that wants an assured supply at assured rate i.e. risk averse would opt for collective transaction and utility which is ready to take risk of supply & price i.e. opting unsure supply for less price would try to avail Deviation settlement power.

The wide difference between Deviation settlement rate and Exchange traded power would generate arbitrage opportunity for a seller i.e. in exchange he sells @Rs. 13/- and then willfully does not provide supply on So traded power rate much higher than upper ceiling rate is not good for market development of power.

7. CONCEPT OF VOLL AND DEVIATION SETTLEMENT USING WOLF METHOD

It was experience in last two years that due to upper ceiling of Rs 16.48 at drawl at frequency below 49.7Hz resulted in situation that even after frequency is going down below 49.7 Hz, constituent keep on over drawing and in few instance if one constituent correct its position, other overdrawing states increases their over draws.

One solution to this problem is strict implementation of penalty at the rate of Rs. 1 Lakhs for each 15 min. block overdraws below 49.7 Hz proposed by CERC.

Another solution could be that in additional to their drawl below 49Hz to be charged at **value of loss of load (VoLL)**

in their respective system. For instance in Australian the yearly VOLL is calculated and presently it is \$10_per kWh. This type of study can be taken in India and below 49.7Hz this can be used as deterrent as all possible channels of persuasion have been exhausted to discipline overdrawn utilities. The VOLL would be applied for transactions beyond limiting point of frequency.

The WOLF (Wide Open Load Following) pricing as suggested by Mark B. Lively is also necessary for success of Merchant Power who want 'one day in 10 year prompt scenario where they are benefited only in period of low frequency to pay investor' capital cost. In present scenario its return has a cap. In this case UI rate increase exponentially beyond limiting points.

The growth of financial derivative market in Electricity market should be encouraged. These non delivery products are traded at all developed from market of NORD pool, European Market, Australian and German power market. The prevailing prices and volatility in these market help in fair price discovery in spot market by using Block-Scholes pricing models and using Real Option approach for new investments in additional Capacity. This also provide hedging opportunities to Generator and large customers this generate a equivalent portfolio to hedge the position

8. CONCLUSION

The Deviation settlement mechanism from his earlier success period has moved into a mature phase where more advantages are difficult to come by. Fuel price volatility had made its effectiveness period shorter and unreliable. The mature players are taking unfair advantage of this mechanism. Hence there is need to review it, by adopting it in a innovative way and by strengthening competitive market under power exchange so that tendency of using Deviation settlement as trading mechanism is curbed. To provide sufficient comfort to system operator schedule based transaction like banking of power, bilateral agreement and collective transaction needs to be encouraged by suitably modifying Deviation settlement mechanism.

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