

Role and Responsibilities of Power Exchange in Electricity Markets

Sumit Saroha, V.S. Gupta, Vineet Shekher
EEE, Department
SRM, University, NCR Campus, Ghaziabad, India

Abstract - After the Electricity Act 2003 this sector reforms have enabled a transition from a vertically integrated private or public monopoly market structure to competitive market and the places like power exchange is created for electricity trading. This short-term trading shall be organized on equitable and efficient platform, Power exchanges. The electricity energy is crucial for the growth of any country, especially for the growth of under developing country like India. Under the boundary condition of Central Electricity Regulatory Commission (CERC) there is a regulatory change that leads to create of Indian Energy Exchange (IEX) & Power Exchange of India Ltd. (PXIL), a vibrant, transparent market on which buyers and sellers can trade electricity contracts and meet the diverse needs of their consumers nationwide. So this paper presents salient features of PXIL by considering all the issues and regulatory mechanism related to power exchange.

IndexTerms - Power Exchange, Electricity Market, Power Trading.

I. INTRODUCTION

In India the objective of creating power market is to unleash market forecast and create competition to improve efficiency & reliability of supply, stimulate technical innovation and promote investments. In present time 95% of the capacity is tied up in long term power purchase agreements. It provides power security to buyers and payment security to the suppliers. Economy is growing in India and so is its demand for energy to fuel industrialization and transformation. According to a KMPG report on the Indian Electricity market, the Indian electricity has grown 8-10% and is expected to grow 8% annually in the next decade. Government is of the view that in order to provide better quality and more reliable services to the consumers and create competition in the power sector should be enhanced. It passed Electricity Act 2003 and provided for open access to the marketplace. Out of this Act came two power exchanges Indian Energy Exchange & Power Exchange of India Limited, the nationwide, automated and online electricity trading platforms. Before the Act, India has a vertical electricity Industry, controlled by the monopolistic state electricity boards [1], [2]. Because of the monopolies and a regulated pricing system, it was difficult to improve in the efficiency in the electricity sector.

In India a disparity in the power demands of different states and regions results in seasonal surpluses in some areas and deficit in others. This demand-supply mismatch can be alleviated by the introduction of a bidding platform that brings power industry participants together to buy and sell electricity in an auction based system. The Electricity Sector of India is undergoing fundamental transformation of its institutional structure after the Enactment of Electricity Act 2003, One of the crucial transformations is the creation of Indian Power Market, the objective of the Power Market is to is to unleash power forces to improve efficiencies, stimulate technical innovations and promote investments so as to bring economic benefits for the consumers and societies in the long run. The presence of Power Exchanges is expected to optimize the resources & give the fair deal to customers by increasing the competition [1]-[3].

Power exchange is India's first institutionally promoted power exchange that provides innovative and credible solution to transform the Indian power markets. A deep understanding of local market is matched by PXIL's non partisans unbiased and often fearless functioning at time even in face of uncomfortable solutions. The core values of PXIL are integrity, excellence, commitment and continued innovation. These are the bedrock on which the edifice of PXIL stands. PXIL's unique combination of local insights and global perspectives helps its stakeholders to make better informed business and investment decisions, improves the efficiency of the power markets, and helps shape policies and projects.

II. ELECTRICITY SECTOR IN INDIA

The energy resources in the country are not evenly distributed with snow fed hydro resources concentrated in the north, monsoon dependant hydro in the south and coal reserves in central India. As a result, long transmission lines are constructed from the generating stations located close to the energy sources to the load centers and there is long haulage of power. The Indian power grids are also characterized by a well meshed network. Power flow between two areas may not only be direct but there may also be loop flows. A number of flow-gates, which are corridors comprising of a group of trunk lines, have been identified by the system operators for monitoring the power flows.

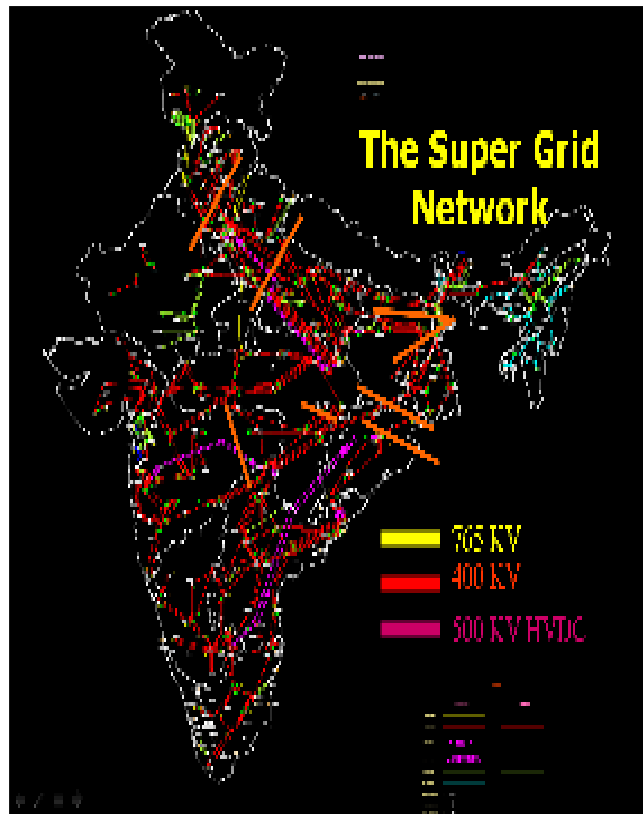


Figure1: Super Grid Network & Power Flow

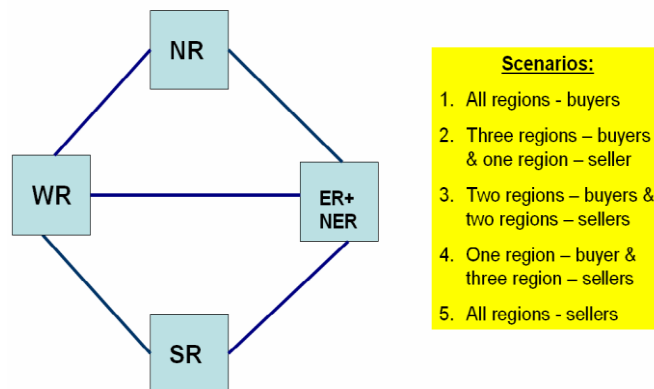


Figure 2: Skewed Load Generation Scenarios

The hydro generation is varying because of seasonal effects. In the Northern Region, it is mostly snow fed run of the river type with a few plants having storage and high silt content sometimes forces outage of these generating stations. In the Southern Region, it is mostly monsoon dependant storage based hydro. The load pattern also varies because of hostile weather conditions, especially in the Northern Region.

Congestion is observed sometimes in cases of skewed load generation balance. Fig. 1 shows some of the possible combinations of the location of the buyers and sellers that may lead to skewed load generation balance. CERC has recognized such congestion and issued orders for levy of a congestion charge of Rs. 3 per kWh [3], [8], [9].

Definition of bid areas in India Market

Due to high growth rate of the Indian power sector, high uncertainty, haulage of power over long distances, it is practically very difficult to identify areas where congestion may occur. To start with each region was divided into two bid areas. Ideally, each State may be defined as a Bid Area. Some of the large States like UP and Maharashtra may have to be sub-divided into 2-3 sub-bid areas. Other criterion for creating/ restructuring the bid areas may be based on the past experience of grid operation, pattern of drawl, seasonal variation and degree of participation of the State and intra-State utilities in the short term open access market. The Power Exchanges have also been advised of this possibility and the need for reconfiguration of bid-areas, if need arises.



Figure 3: Grid Distribution as per Bid Area

III. POWER TRADING AT PXIL

Power trading is activity of buying and selling of power. At Power Exchanges, which are approved by Central Electricity Regulatory Commission (CERC), standardized Products are offered to buy and sell power. The Exchange based power trading is being regulated by the Central Electricity Regulatory Commission (CERC). Power trading helps in matching of buyers and sellers according to various criteria like price, quantum, region etc. The price discovered on exchanges is fair and transparent. It means that the participant is ensured that he has got the best deals based on his preferences and constraints [8].

- Non-partisan & transparent system to participate in electricity trading.
- 100% secure and risk free process.
- For Buyers: Ability to manage portfolio with reduced costs.
- For Sellers: Ability to secure best price available in the market
- rationally distributes transmission losses among the participants
- wide variety of contracts available on exchange to manage load on contingent, day ahead and term ahead basis improves the market environment & provides electricity price signals to the market Trading at PXIL is done electronically wherein the buyer or seller uses electronic interface to connect with PXIL and put bids for buying or selling power.

Following steps are followed at the exchange to ensure smooth trading experience for the buyer or seller margining:

For Day Ahead Market (DAM) i.e., DAS or DAC, Buyer has to deposit margin equal to the total bid he/she intends to put in the DAM and there is no margin requirement for a seller in DAM

For Weekly trades, the Exchange collects margins on a rolling basis. The buyer has to deposit an initial margin and keep it rolling on a day to day basis and seller has to deposit a margin of 10 paisa per unit as bid security.

Bidding: A registered buyer/seller has to enter their Order into the electronic platform provided by the Exchange. There are various kinds of Orders available to the buyer/seller whom they can choose according to their needs and preferences.

Price discovery: Exchange discovers Price through its Matching Engine based on the various bids put by different buyers and sellers. The Matching Engine and Matching Methodology used by the Exchange differ from Product to Product. The Matching Methodologies of all Products is validated and approved by CERC, so that the Price discovery happens in a fair, transparent and efficient manner.

Scheduling: Based on the Prices discovered for various time slots or various Products, Exchange provides schedules that provides client-wise and time slot-wise information related Price, Quantity and Region.

Settlement: After the scheduling is over, the Exchange initiates the settlement process wherein the pay-in collected from various buyers need to be transferred to the sellers. Also, any residual Margins left are transferred back to the buyers, whose bids were not successful [1], [2].

Delivery: Seller starts injecting power into the required node of the grid on the basis of cleared quantum and symmetrically the buyer?

Trading Hours at PXIL

The trading hours for various product categories at PXIL are enlisted below:

S No.	Product Type	Session	Day	Start Time	End Time
1	DAS	N/A	Every calendar day	10:00	12:00
2	DAC	N/A	Every calendar day	15:30	16:30
3	Week Ahead	N/A	Monday, Wednesday and Thursday	10:00	16:00
4	Any Day	N/A	Every calendar day	10:00	16:00
5	Intra day	1	Every calendar day	10:00	11:00
6	Intra day	2	Every calendar day	11:01	12:01
7	Intra day	3	Every calendar day	13:00	14:00
8	Intra day	4	Every calendar day	15:00	16:00
9	Intra day 5	5	Every calendar day 1	16:30	17:30
10	Intra day	6	Every calendar day	18:00	19:00

IV. ROLE OF POWER EXCHANGE

Being a demutualised, nationwide, electronic Exchange it offers an instrument to hedge price risk more efficiently at a reasonably priced cost. The benefits of trading in a Power Exchange being Utilities can adjust their portfolio as a function of demand or generation profile and rebalance their portfolio in DAM and Intraday markets. Utilities can also participate in the Weekly market of the Exchanges and meet their demand on a weekly basis. IPPs & CPPs: DAM is the only national Power Market where demand and supply are aggregated on a national basis. It means that Price discovered on the Exchange is a national Price and the quantum is cleared on national basis rather than locally. It helps the IPPs and CPPs in getting a competitive price for the quantum sold and also diminishes their capacity from being idle [4]-[7]. Open Access consumers can derive the benefit of buying electricity from a national level market through Power Exchanges which will help them in reducing their cost of buying of electricity in comparison to the tariffs levied by the respective utilities of their state. Any consumer, trader, distribution licensee or a generating company of load 1 MW above and who has been granted open access under the Open Access Regulations by the concerned state is an Open Access customer.

Prerequisites for Trading at PXIL

- Membership at PXIL
- Grid connectivity
- SLDC concurrence required for application to nodal RLDC
- Two Settlement Accounts for Settlement of trade
- Installation of Availability Based Tariff (ABT) Meter
- Any Legal Entity that fulfils the criteria mentioned above in question no 8 are eligible to be a member of PXIL. For example Generators, Distribution Utilities, Independent Power Producers (IPPs), Captive Power Producers (CPPs), Merchant Power Plants (MPPs), traders and others.
- PXIL Scheduling: Based on the Prices discovered for various time slots or various Products, Exchange provides schedules that provides client-wise and time slot-wise information related Price, Quantity and Region.
- Settlement: After the scheduling is over, the Exchange initiates the settlement process wherein the pay-in collected from various buyers need to be transferred to the sellers. Also, any residual Margins left are transferred back to the buyers whose bids were not successful.
- Delivery: Seller starts injecting power into the required node of the grid on the basis of cleared quantum and symmetrically the buyer? Starts drawing power from the connected node.

Products offered by PXIL

Physical Category

- Day Ahead Spot Contract (DAS)
- Day Ahead Contingency Contract (DAC)
- Week Ahead Contract
- Intra Day Contract
- Any Day Contract

- Renewable Energy Category
- Renewable Energy Certificates (REC)

V. TRANSMISSION CONGESTION MANAGEMENT METHODS

Some of the commonly used methods for congestion management are:

Explicit Auction: An auction of the available inter-connector capacity is carried out and the capacity reservation is done on the basis of the highest bids received. Energy charges are decoupled from the capacity charges.

Implicit Auction: This method does not separate energy charges and transmission capacity charges and the process is thus simpler for the market participants.

Market Splitting: This is a more evolved form of implicit auction and is carried out in a Power Exchange. The market is split along the congested corridor in the Power Exchange. The prices upstream (surplus area) are reduced and the prices downstream (shortage area) are increased so that the flow on the inter-connector is restricted to the available capacity.

Counter Trade: In some of the markets, the system operator invites bids for sale and purchase. In case of congestion, the system operator selects bids in merit order and enters into counter trade to relieve congestion. It is normally used as a last minute correction method.

Re-dispatching: In this method, the market trades as if there are no barriers. The transmission system operator arranges for dispatch of more generation downstream and less generation upstream of the congested corridor. The cost of congestion is borne by the system operator. This method places the onus for capacity expansion on the transmission system operator and does not provide any signal to the market participants. The first three congestion management methods may be classified as congestion pricing based methods and the last two as remedial methods. In the Indian scenario, both the Power Exchanges use market splitting for congestion management.

Congestion Management Scenario: Multiple Exchanges are operating in the same physical delivery market in India. Different Power Exchanges arrive at solutions based on their own philosophy and algorithms. Scheduling of the trades is possible in case there is no congestion. In the event of congestion, allocation of available transfer margins between multiple Exchanges becomes an issue of prime importance. This would influence the overall economy in the grid and may also trigger realignment of the strategies adopted by the various stakeholders. Therefore, an objective method for allocation of transfer margins between multiple Power Exchanges has to be adopted. Some of the possible criteria that may be considered for sharing of available margins are:

Priority based rules: Pre-defined rules may be agreed upon based on lowest market clearing price (MCP), highest market clearing volume (MCV), highest MCP X MCV, maximisation of social welfare, consumer surplus, etc. Priority based rules may not lead to overall economy. For example, in a surplus scenario, lower MCP may be desirable and in a deficit scenario, higher MCV may be desirable.

Explicit auctioning amongst the Exchanges: Considering the fact that inter-dependencies exist in the Indian scenario, implementation of explicit auctioning would be difficult. The ultimate objective of achieving economy may be defeated in circumstances where one of the Exchanges bids aggressively to reserve the capacity [1]-[4].

VI. CONCLUSION

This paper deals with working, different products, services, and responsibilities provided by Power Exchange of India Limited on the basis of Electricity Act 3003. It has been found that after inaction of PXIL and Electricity Act 2003 the price of electricity supply is decrease, customer & consumer has choice of supply, reliability and quality of supply is increase. A power exchange is an exchange dedicated to electricity trading, where electricity is considered as a commodity. So power exchange provides a platform on which power is traded i.e. bought and sold, either at spot or as derivatives, where the underlying asset is power. An exchange represents a market-driven economy where prices of electricity are decided by the forces of demand and supply.

REFERENCES

- [1] www.powerexindia.com
- [2] www.iexindia.com
- [3] Central Electricity Regulatory Commission Website (<http://www.cercind.org>).
- [4] Ministry of Power, Government of India Website (<http://powermin.nic.in>).
- [5] A.R. Abhyanakar and S.K. Khaparde, "Introduction to Deregulation in Power Industry", Indian Institute of Technology Bombay.
- [6] R.N.Lahiri, Arup Sinha, S.Chowdhury, S.P.Chowdhury, "Privatization of Power Distribution Utility in India through Restructuring and Reformation", IEEE 2010.
- [7] Sumit Saroha and Rohit Verma, "Cross-border Power Trading Model for South Asian Regional Power Pool", Electrical Power and Energy Systems, vol. 44, pp.146-152, 2013.
- [8] Website of "Power Trading Corporation of India", www.ptcindia.com
- [9] Website of "Bureau of Energy Efficiency", <http://www.beeindia.in/>