

Power Trading in Punjab:- A Case Study Of An Industry

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Abstract- Active contribution from demand side makes electricity markets more efficient and more competitive. Bidding of electrical unit at Power Exchange makes consumer to optimize load of industry and reduce cost of electrical consumption. In competitive electricity market, power seller is not a price maker. Concept embraces that the optimal bidding strategy for a supplier is to simply bid marginal cost. It also promotes more optimal allocation of economic resources. The purpose of the present study is to obtain the load in kW of an organization in Punjab, India for bidding in open day-ahead electricity market at Power Exchange including Transmission Constraints and to obtain the marginal bidding price and building the optimal bidding strategy for consumers. The average load of industry for the month of October 2012 was 6061kW and the average volume i.e. load for bidding on exchange including transmission constraints results to be 6709kW for arbitrary period of 31 days. The study supposed to help to optimize the scheduling of load at Power exchange and reduce the losses occur due to the market risks. The study highlighted that the bidding in Punjab depends on the consumers demand i.e. Load(kW), some constant charges (one time charges or charges for open access) and charges applicable on volume(Load kW) at Power Exchange and at Periphery. Strategically bidding maximizes profit and minimizes the hidden costs which are not in picture at the time of bidding. It optimizes the scheduling of load and reduce the losses occur due to sudden break down or shut down of industrial unit. It reduces the losses due to fluctuation of load of industry. The result shows the bidding must be done under marginal price (Rs.5.120 – Rs.5.161) per unit to remain at safe side and to gain profit..

Keywords – Power Market, Open Access , Bidding, Marginal Bidding Price.

I. INTRODUCTION

It is important to have a healthy trading system for unrestricted and reasonable viable electricity market maneuver. Trading scheme must accomplish the of protection ambiguousness related with price instability and further unpredicted changes. Working of an economical power market is considerably affected by the exchange transactions, strategic bidding, market model and regulation. Trading procedure has been suitably planned to take caution of misuse of market. Subjected to necessity of flawless and unbiased electricity market, these provisions must be kept on changing in a particular interval [1]. There is a massive segment of consumers in India, who remain power depressed, number of Captive Power Plants which are under operation and in future much more is likely to add, it is essential to inspire the power plants which can operate at peak load conditions and carry the spare captive generation on the grid. The Act 2003, authorize development of electricity market by suitable directives over empowering guidelines. This paved the mode intended for the fresh developments to arise like open access. In February, 2007, the Central Electricity Regulatory Commission (CERC) gives out plans for allowance of action of operation of power exchanges within a whole regulatory context. This will give benefits to flow of power to deficient region from power surplus region and accordingly affects the maintaining equilibrium in the power segment. The National Policy of Electricity, manifest in the month of February and year 2005, specified that empowering protocols for inter and intra-state trading, to be reported by suitable Commissions in the period of 6 months. As On 6, Feb, 2007, the Central Electricity Regulatory Commission hand out guiding principle for

allowance of authorization of planning, developing and operation of power exchanges inside an whole regulatory arrangements. Entrepreneurs are also permissible to accomplish its part.

A. *State Electricity Trading*

I Central Electricity Regulatory Commission (CERC) approved the final Regulations for Inter-State Trading of Electricity after including the commendations and explanations received from the investors. The Regulatory Commission likewise to start arrangements for provision of Guidelines for formation of a market mechanism for electricity. The Regulatory Commission previously expected requests from a number of firms for grant of exchange transaction licenses directly after the illustration of the Electricity Act, 2003 and the Command authorize all to continue trading till 31.3.2004. Indian Electricity Act, 2003, discriminates trading as an autonomous body and therefore recommends the matter of trading licenses by the CERC for inter-state trading. Afterwards the announcement of Trading Protocols, the concerned marketers can put a new request before CERC, in quest of inter-state trading authorizations. The Guidelines for market mechanism have to be prepared after following a clear procedure as standard exercise of the Commission.

Following are the places of concern of inter-state trading:

1. The Regulation specifies the method for publishing of the license application. Publication of Application in two English newspapers and one in economic news papers also one in local newspaper and also one must be in the language of applicant.
2. Investment capability constraint for various categories have to be specified.
3. Application form for trading license must be prescribed by the Regulation. The fee is Rs.1.00 lakh for application which can be adjusted after approval of the same by the Central Government.
4. Trading must be done bilaterally among the generating corporation, distribution agency and trader of electricity or among the electricity trader and the distribution agency, as provided by Supervisory body.
5. Official requirements for electricity trader needs a minimum one full-time expert with experience in i) Power System Operations, ii) Commercial aspects of Power Transfers and ii) Economics, Commerce and Accounts.
6. Candidate can file the remarks on the doubts or recommendations as to reply to the public notice.
7. License of Inter-State Trading may approved for 25 years [2].

B. *Power Market*

Due to the enormously complex configuration of unstructured electricity market, progression of this deregulation faces a number of challenges:

- Moderating power market of the contributors,
- Optimal auction approach for electricity,
- Upholding dependability of system,
- Choice of AC or DC optimal Power Flow for the calculation of nodal prices,
- Improving transmission overloading and interrelates local price marketers,
- Keeping an account for market equilibrium and market economy.

Five aspects of energy markets:

(1) Estimating Price:- Within rationalized market, estimating price becomes a significant bustle for conjointly generators and bulky buyers. Cost of a unit in a market be governed by numerous aspects so as competing bids of the market contributors (generators and retailers), forward contracts, stochastic demand, auction centered evaluating approaches, and system constraints comprising transmission restrictions, limit of reactive power, and security of producers. By the application of predictions of load, producers and buyers can correctly charge their bilateral agreements. Corporations using superior calculations for estimation may organize their production plans in a profitable mode. Price forecasts/estimation helps to recognize movements of market power, transmission restrictions, and possible investments

(2) Bilateral Markets:- Bilateral transactions are prescribed contracts of power supply b/w generator and distributor. These contracts may be long or short-term, for immediate electrical supply and investments for backup power.

(3) Bidding:- Great share of unrestricted power markets, counting trading, features an auction mechanism which is called as day-ahead energy market. In which generators and consumers simply bids, containing quantity of power required and charges of unit. By the virtue of economic dispatch of energy, merit order is created independently for each participant for the hours of the subsequent day. This day-ahead energy market is done on power exchange. Buyer can participate by the means of bidding [3].

(4) Evaluating optimal bidding strategy:- Due to competition in Power market, applicants lean towards to bid deliberately to make revenues. Thus performing strategically, results in variable rates with dissimilar mechanisms for auction [4]

Two facts need to be focused.

I) Bidding strategy determination

II) Optimization of individual bidding strategies

C. Open Access

It is the platform in which allows to sell electricity openly to anybody and purchase electricity openly from anybody at our willing price. There are three types of contracts In Open Access in India:-

- 1.) Bilateral contracts:- It is a long/short term agreements sell/purchase electricity directly from Generator to consumer.
- 2.) Banking of power:- In this type of contract the power is brought for some time(may be 1 or 2or 3 months or a season) and given back 5% more or depending on the contract at the time as agreement.
- 3.) Day ahead or week ahead market:- In this the load is forecasted a day or a week before respectively on the power exchange and bidding is done on the load scheduled. Which is cleared on exchange depending on conditions (called Market Clearing Price).

D. Power Exchange

Power exchange is the platform which allows open access of electricity.

It is the central counter-party for all transactions

- Supervision of safety for all entities
- Overwhelms the matters of credit-values of State Utilities.

There are two Exchange in India

1. Power Exchange India Ltd
2. Indian Energy Exchange

II. PROPOSED ALGORITHM

A. Study of bidding procedure and regulations

Bidding procedure was studied from viewing the literature and regulations. Discussions with the market consumers and suppliers were done, the regulations were studied from website [5].

B. Data Collection

The electric power (kW) required at periphery of an industry of feeder 66kV in Punjab is taken for 30 days for October 2012. And State Grid losses and Northern Grid losses were taken from available www.nrlc.com & www.sldc.com for 66kV feeder have been considered.

C. Analyzing of Data

Volume required for the bidding at power exchange has been obtained by the calculation State and Northern Grid losses and adding it to the volume scheduled by industry at periphery. Charges applicable to this

volume are calculated. Thus by adding all the applicable charges, Marginal Bidding Price Per-Unit can be determined.

Say 'X' volume scheduled by industry, 's' State Grid Losses and 'n' Northern grid Losses

Then Volume required for bidding =

$$\text{say 'Y'} = X + s*X + n*X \quad (1)$$

D. Bidding Strategy

For building a Bidding Strategy different charges applicable for bidding procedure are calculated and are as follows:-

D.1. Constant Charges:-

a.) N.O.C (No Objection Certificate) from State Electricity Board = Rs.10,000/- per month or Rs.333.33/- per day (Approximately equals to Rs.335/- per day).

b.) NLDC (Northern Load Dispatch Center) Application Fee = Rs.5000/(No. of Successful Portfolios) per day Tentatively Maximum Approximate = Rs.100/- per day for each consumer (as present scenario of Indian Energy Exchange).

c.) NLDC Scheduling & Operating Charges = Rs.5000 * (Regional Entity buyers + Regional Entity Sellers)/(No. of Successful Portfolio)*{No. of Entities}.

Tentatively Maximum Approximate = Rs.500/- per day for each consumer (as present scenario of Indian Energy Exchange).

d.) SLDC Scheduling & Operating Charges = Rs. 2000/- per day.

Net Total = Adding all above charges = Rs.2935/- Per Day.

D.2. Variable Charges:-

These charges are applicable on total bidding volume (Y) at Power Exchange and are as follows:

a.) CTU Transmission Charges =

$$\text{Rs.100/MWh. Or Rs.0.10/kWh. } (=0.10*Y) \quad (2)$$

b.) STU Transmission Charges

For 66KV and above =

$$\text{Rs.0.284/kWh. } (=0.284*Y) \quad (3)$$

c.) Exchange Transaction Fee =

$$\text{Rs.0.01/kWh. } (=0.10*Y) \text{ say 'c'} \quad (4)$$

d.) Service tax on total exchange transaction = 12% of Exchange Transaction Fee + 2% of 12% of Exchange Transaction Fee.

$$=(0.12*c + 0.024*c)=(0.012*Y + 0.0024*Y) \quad (5)$$

D.3. Other Charges:-

These charges are applicable on volume at periphery and are as follows:

a. Cross subsidy Rs.0.7448/-per kWh. On the volume at periphery.

$$=(0.7448*X) \quad (6)$$

b. Electricity duty 13% of tariff of Punjab on volume at periphery.

$$\text{Approximately Rs.0.76/-per kWh. } (=0.76*X) \quad (7)$$

D4. Marginal Bidding Price

On the basis of the result of previous steps, results, & conclusion the Load at power exchange for bidding and Marginal bidding can be drawn. Hence the range of price to bid on Power exchange can be determined.

The Total charges applicable on Bidding volume per day are =

$$(2395 + 0.10*Y + 0.284*Y + 0.10*Y + 0.012*Y + 0.0024*Y) \quad (8)$$

And sum of total Charges applicable on Volume required at periphery are = (0.7448*X + 0.76*X) (9)

Difference Between the per-unit charges of Punjab State i.e. Rs.7 and above calculated per-unit charges is Margin for bidding.

III. DATA

The data is taken for the month of October, 2012 of an industry ABC Udyog in Punjab. The purpose of the present study is to obtain the load in kW for bidding in open access at Power Exchange which consist of some constraints

(State grid losses and Northern Regional grid losses) and to obtain the marginal bidding price. The marginal bidding price has been calculated on the basis of some constant and variable charges which are applicable on bidding volume and volume required on periphery.

Table -1 Data Required at Periphery of Industry

Date	Volume required in kW	Date	Volume required in kW
1-Oct-12	102134	17-Oct-12	69237.8
2-Oct-12	98587	18-Oct-12	66381.8
3-Oct-12	99348	19-Oct-12	68971.5
4-Oct-12	108149	20-Oct-12	61014.7
5-Oct-12	0	21-Oct-12	64767.4
6-Oct-12	105657	22-Oct-12	80557.4
7-Oct-12	113866	23-Oct-12	78586.2
8-Oct-12	64626	24-Oct-12	0
9-Oct-12	73045.4	25-Oct-12	0
10-Oct-12	75124.5	26-Oct-12	0
11-Oct-12	65993.3	27-Oct-12	0
12-Oct-12	0	28-Oct-12	0
13-Oct-12	58958.1	29-Oct-12	76377
14-Oct-12	78112	30-Oct-12	0
15-Oct-12	54469.1	31-Oct-12	78241.9
16-Oct-12	0		

Table no.1 shows the total load of industry of a day and is taken as a sum of load required per hour. The study has been conducted on hourly bases each day and the same has been shown in this paper for 14th-Oct-2012.

IV. RESULTS AND DISCUSSIONS

For the study volume of 14th of October 2012 had been studied and similarly applied to whole month.

Table -2 Volume Required at Periphery of Industry on 14-Oct-2012

Time	Volume required at periphery (In kW)	Time	Volume required at periphery (In kW)
1:00:00 AM	6856.32	1:00:00 PM	1410.88
2:00:00 AM	8231.68	2:00:00 PM	1419.52
3:00:00 AM	7113.6	3:00:00 PM	1432
4:00:00 AM	8162.24	4:00:00 PM	1497.92
5:00:00 AM	7882.24	5:00:00 PM	1314.56
6:00:00 AM	6799.04	6:00:00 PM	1388.48
7:00:00 AM	7585.28	7:00:00 PM	1104.96
8:00:00 AM	6689.92	8:00:00 PM	1144.32
9:00:00 AM	1371.52	9:00:00 PM	1248.96

10:00:00 AM	1362.56	10:00:00 PM	1572.16
11:00:00 AM	1244.48	11:00:00 PM	0
12:00:00 PM	1279.36	12:00:00 AM	0

Table 2 shows the Volume Required at Periphery of Industry on 14-Oct-2012

A. Grid Losses

Northern Grid Losses:

Northern Grid Losses are variable for whole year and are available on website www.nrlc.org. these losses are need to be consider in order to calculate the volume required at power exchange for bidding. Northern & State Grid Losses Of 14th October, 2012 which are 3.10% and 5.05% respectively of volume required at periphery the same day. The Northern Grid losses are variable weekly for whole year [6].

State Grid Losses:

State Grid Losses are constant as per State Electricity Board = 5.05% of per Unit (kW) i.e. 0.0505 per kW [7].

B. Volume required for the bidding at Exchange

Volume required for the bidding at periphery has been obtained by calculating the State and Northern Grid losses and adding it to the data in form of scheduled load (kW) of industry at periphery from (1).

Table-3 B. Volume required for the bidding

Time	Volume required at periphery (In kWh)	% Northern Region losses per kWh (n)	Net Northern losses in kWh	% State losses (s)	Net State grid losses in kWh	Total Bidding Volume at Exchange (In kWh)
1:00:00 AM	6856.32	3.10%	212.55	5.05%	346.24	7415
2:00:00 AM	8231.68	3.10%	255.18	5.05%	415.70	8903
3:00:00 AM	7113.6	3.10%	220.52	5.05%	359.24	7693
4:00:00 AM	8162.24	3.10%	253.03	5.05%	412.19	8827
5:00:00 AM	7882.24	3.10%	244.35	5.05%	398.05	8525
6:00:00 AM	6799.04	3.10%	210.77	5.05%	343.35	7353
7:00:00 AM	7585.28	3.10%	235.14	5.05%	383.06	8203
8:00:00 AM	6689.92	3.10%	207.39	5.05%	337.84	7235
9:00:00 AM	1371.52	3.10%	42.52	5.05%	69.26	1483
10:00:00 AM	1362.56	3.10%	42.24	5.05%	68.81	1474
11:00:00 AM	1244.48	3.10%	38.58	5.05%	62.85	1346
12:00:00 PM	1279.36	3.10%	39.66	5.05%	64.61	1384
1:00:00 PM	1410.88	3.10%	43.74	5.05%	71.25	1526
2:00:00 PM	1419.52	3.10%	44.01	5.05%	71.69	1535
3:00:00 PM	1432	3.10%	44.39	5.05%	72.32	1549
4:00:00 PM	1497.92	3.10%	46.44	5.05%	75.64	1620
5:00:00 PM	1314.56	3.10%	40.75	5.05%	66.39	1422
6:00:00 PM	1388.48	3.10%	43.04	5.05%	70.12	1502
7:00:00 PM	1104.96	3.10%	34.25	5.05%	55.80	1195
8:00:00 PM	1144.32	3.10%	35.47	5.05%	57.79	1238
9:00:00 PM	1248.96	3.10%	38.72	5.05%	63.07	1351
10:00:00 PM	1572.16	3.10%	48.74	5.05%	79.39	1700

11:00:00 PM	0	3.10%	0.00	5.05%	0.00	0
12:00:00 AM	0	3.10%	0.00	5.05%	0.00	0

Table 3 shows the volume required at Power Exchange for bidding

C. Charges applicable on bidding volume and volume at periphery on 14th October,2012

The charges applicable on bidding volume which includes center utility charges, state utility charges, exchange transaction fee & service tax and volume at periphery which includes cross subsidy & electricity duty from (2), (3), (4), (5), (6), (7), (8) & (9).

Table-4 Total Charges

Time	Application & Charges Rs. 2935/- per day (In Rs.)	Center Utility Charges (In Rs.)	State Utility Charges (In Rs.)	Exchange Transaction Fee (In Rs.)	Service Tax (In Rs.)	Cross subsidy(In Rs.)	Electricity Duty (In Rs.)	Total Charges per unit (In Rs.)
1:00:00 AM	123	741.51	2105.89	74.15	10.68	5106.59	4456.61	1.840
2:00:00 AM	123	890.26	2528.33	89.03	12.82	6130.96	5350.59	1.837
3:00:00 AM	123	769.34	2184.91	76.93	11.08	5298.21	4623.84	1.840
4:00:00 AM	123	882.75	2507.00	88.27	12.71	6079.24	5305.46	1.838
5:00:00 AM	123	852.46	2421.00	85.25	12.28	5870.69	5123.46	1.838
6:00:00 AM	123	735.32	2088.30	73.53	10.59	5063.92	4419.38	1.841
7:00:00 AM	123	820.35	2329.79	82.03	11.81	5649.52	4930.43	1.839
8:00:00 AM	123	723.51	2054.78	72.35	10.42	4982.65	4348.45	1.841
9:00:00 AM	123	148.33	421.26	14.83	2.14	1021.51	891.49	1.912
10:00:00 AM	123	147.36	418.50	14.74	2.12	1014.83	885.66	1.913
11:00:00 AM	123	134.59	382.24	13.46	1.94	926.89	808.91	1.921
12:00:00 PM	123	138.36	392.95	13.84	1.99	952.87	831.58	1.919
1:00:00 PM	123	152.59	433.35	15.26	2.20	1050.82	917.07	1.910
2:00:00 PM	123	153.52	436.00	15.35	2.21	1057.26	922.69	1.909
3:00:00 PM	123	154.87	439.83	15.49	2.23	1066.55	930.80	1.908
4:00:00 PM	123	162.00	460.08	16.20	2.33	1115.65	973.65	1.905
5:00:00 PM	123	142.17	403.76	14.22	2.05	979.08	854.46	1.916
6:00:00 PM	123	150.16	426.47	15.02	2.16	1034.14	902.51	1.911
7:00:00 PM	123	119.50	339.38	11.95	1.72	822.97	718.22	1.934
8:00:00 PM	123	123.76	351.47	12.38	1.78	852.29	743.81	1.930
9:00:00 PM	123	135.08	383.61	13.51	1.95	930.23	811.82	1.921
10:00:00 PM	123	170.03	482.88	17.00	2.45	1170.94	1021.90	1.901
11:00:00 PM	123	0.00	0.00	0.00	0.00	0.00	0.00	0.000
12:00:00 AM	123	0.00	0.00	0.00	0.00	0.00	0.00	0.000

Table 4 shows the Charges applicable on bidding volume and volume at periphery on 14th October,2012

The total charges payable at exchange which is the sum of charges on bidding volume and charges on volume at periphery

Total charges per-unit determined by dividing the total sum of all charges by volume required at periphery.

D. Marginal Bidding Price

Difference Between the per-unit charges of Punjab State Rs.7/- and above calculated per-unit charges is Margin for bidding Price.



Figure 1 Marginal Bidding Price

Figure 1 shows the Marginal bidding price for bidding on Power exchange.

IV. CONCLUSION

The study shows that by considering the transmission constraints i.e. losses, the volume required at Power Exchange for bidding is greater than that of volume required at periphery. The grid losses need to be considered by consumer to bid on Power exchange to avoid market risk and losses associated with the same. The average load of industry for the month of October 2012 was 6061kW and the average volume i.e. load for bidding on exchange including transmission constraints results to be 6709kW. For bidding charges applicable on bidding volume which includes center utility charges, state utility charges, exchange transaction fee & service tax and volume at periphery which includes cross subsidy & electricity duty needs to be considered which helps to determine accurate Marginal Bidding Price for bidding each unit on power exchange which comes to be Rs.5.120 – Rs.5.161 per-unit for arbitrary period of 31 days.

Table-5 Total Marginal Bidding Price for Oct/2012

Date	Charges per Unit (in Rs.)	Marginal Price for bidding (in Rs.)	Date	Charges per Unit (in Rs.)	Marginal Price for bidding (in Rs.)
1/10/2012	1.88	5.12	17/10/2012	1.844	5.156
2/10/2012	1.88	5.12			
3/10/2012	1.875	5.125	18/10/2012	1.845	5.155
4/10/2012	1.872	5.128	19/10/2012	1.845	5.155
5/10/2012	0	0	20/10/2012	1.852	5.148
6/10/2012	1.871	5.129	21/10/2012	1.857	5.143
7/10/2012	1.866	5.134	22/10/2012	1.839	5.161
8/10/2012	1.86	5.14	23/10/2012	1.84	5.16
9/10/2012	1.841	5.159	24/10/2012	0	0
10/10/2012	1.839	5.161	25/10/2012	0	0
11/10/2012	1.842	5.158	26/10/2012	0	0
12/11/2012	0	0	27/10/2012	0	0

13/10/2012	1.853	5.147	28/10/2012	0	0
14/10/2012	1.887	5.113	29/10/2012	1.842	5.158
15/10/2012	1.853	5.147	30/10/2012	0	0
16/10/2012	0	0	31/10/2012	1.842	5.158

Table 5 shows the Marginal bidding price for given load of October 2012

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