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Game Theory Approch on The Decision Making Process for Defining Obtainable Prices At Generator Side in A Deregulated Environment

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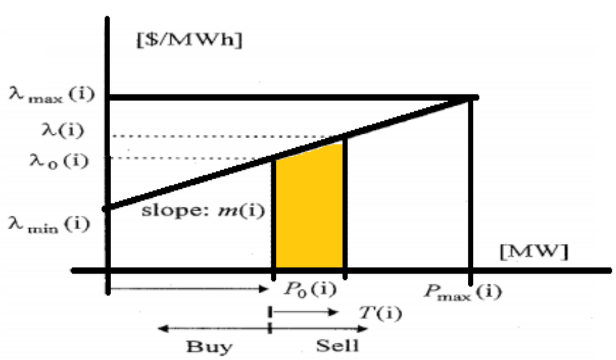
***Abstract*—** For a Deregulated system we assume all Pool participants use a price curve, rather than a cost curve, to exchange the power. Participants think about market prices for which they can maximize their profit, while Pool coordinators try to maximize the system-wide benefits. Using constrained economic dispatch, Pool benefits will be maximized when all participants trade THE power at marginal cost, as participants try to maximize their own benefits, they may either decrease their bids in order to retail more power or increase the price in order to make more profit.

***Keywords*—** Deregulated system, Pool coordinators Formatting, payoff matrix, UI rate, marginal cost

I. INTRODUCTION

In a deregulated system, generation charge is treated as confidential; however, the spot price of electricity may be calculated by searching for the minimum price offering in the market that assures load and generation restraints.



PRICE OFFER IN GENERATOR

When network losses are not considered, the spot price of′ electricity is defined as σ =dC/ dPi for bus i in the Pool Where, σ Spot price of electricity *C Total generation cost Pi* Generation level in bus i,

GENERATOR DATA

Strategies:--

Using constrained economic dispatch, Pool benefits will be maximized when all participants trade power at marginal cost, ᴍ (i) =2c (i). As participants try to maximize their own

Gen. (MW)	Bus No.	Cost Coefficients Power			Power (MW)		Marginal power (MW)	Marginal price
		A (i)	b (i)	c (i)	Min	Max		
A	1	0	3	0.02	0	80	23.54	2.95
B	2	0	2	0.025	0	40	36.98	4.85
C	3	0	1	0.062	0	50	21.6	3.65

benefits, they may either decrease their bids in order to sell more power or increase the price in order to earn more. H- Trade power at 1.15 times the marginal cost, ᴍ (i) = 2.3 c(i). The participant’s strategy is to bid high. M- Trade power at marginal cost, ᴍ (i) = 2c (i) the participant’s strategy is to *cooperate with the Pool.* L- Trade power at 0.85 times the marginal cost, ᴍ (i) = 1.7c (i) the participant’s strategy is to bid low.

Generation of pay off matrix

The monetary benefits of participant ‘r’ is expressed as Benefit (r) =∑ ([a(i) + b(i)Po(i)+c(i)Po(i)2]-[a(i)+b(i)P(i) + c(i)p(i)2] + T(i) [12] Pay off AB =

(A-B)	H	M	L
HH	40.6573	41.5851	42.8378
HM	40.4632	41.3909	42.6436
HL	40.2009	41.1286	42.3813
MH	40.5282	41.456	42.7087
MM	40.3341	41.2618	42.5145
ML	40.0718	40.9995	42.2522
LH	40.3538	41.2816	42.5343
LM	40.1596	41.0874	42.3401
LL	39.8973	40.8251	42.0778

Final Payoff Matrix

As we generate the pay-off matrix we apply maxima of minima proviso to pay-off matrix to find best possible bidding.

Min AB = 39.8973 40.8251 42.0778

Maxmin AB = 42.0778.

Here utility A and B bid at marginal cost because the bid offers the highest benefit when other pool participant is minimizing the coalition's benefit (-ve)

Game theory can be used to increase the benefits of participants.

From the above, we foresee that in a perfect competition, all′ participants try to maximize their benefits by cooperating with the power pool to obtain the maximum system wide benefits.

The investigation may be used by Pool coordinators to recognize non-competitive situations and to promote pricing policies that lead to maximum system-wide advantage.

Gaming Possibilities for Generator

Case 1: Generator over Declaring

Regional load dispatch centre (REGIONAL LOAD DISPATCH CENTRE) can ask to demonstrate this capacity in case it is not convinced. The generators can revise schedule six blocks ahead for planned outage and four blocks ahead for forced outage.

Case	Generator Over Declaring			
Actual capacity	50 (MW)	Loss	Gain	Comment
Declared capacity	60 (MW)	Unscheduled Interchange for 5 MW at peak time taken as 6 blocks	Capacity charge on 10 MW for whole day -96 blocks	Can be applicable to any load condition
Scheduled capacity	55 (MW)			
Actual Generation	50 (MW)			

Loss
= Unscheduled Interchange for 5 MW at peak time
= 5* 1000* (1/4)* 5.06* 8 (At freq. = 49.75 Hz UI rate = 5.06 Rs)
= 50,600 Rs / day (for 8 time block)

Gain
= Capacity charge on 10 MW for the whole day.
= 10* 74*96 = 71,040 Rs per day.

Thus Net Gain = Gain – Loss = 20440/- Rs...

Case 2: Generator under Declaring

Case	Generator Under Declaring			
Actual capacity	50 (MW)	Loss	Gain	Comment
Declared capacity	45 (MW)	Unscheduled Interchange for 5 MW for whole day 96 blocks	Capacity charge on 10 MW at peak time taken as 8 blocks	Can be applicable to peak load condition
Scheduled capacity	40 (MW)			
Actual Generation	50 (MW)			

Loss
= Capacity charge on 10 MW for the whole day.
= 10* 74*96 = 71,040 Rs per day.

Gain
= Unscheduled Interchange for 10 MW at peak time
= 10* 1000* (1/4)* 5.06* 8 (At freq. = 49.75 Hz UI rate = 5.06 Rs)
= 101200 Rs / day (for 8 time block)

Thus Net Gain = Gain – Loss =101200-71040 = 30160/- Rs / day

II. RESULTS AND DISCUSSION

Observation: During peak load periods the generators should under declare in order to gain an advantage and they should over declare during off peak load periods for the same.

III. CONCLUSION AND FUTURE SCOPE

The difference between the declared, actual and scheduled generation is not to exceed 5% in one block and 1% for the whole day according to regional load dispatch centre norms. If the regional load dispatch centre finds that the difference exceeds this limits if declares that gaming has occurred. Then once the gaming is declared the regional load dispatch centre has the discretion of making the charges according to 103 % or 105% at the maximum to the generators.

IV. Gaming by Generators

Provision for mis-declaration in CERC order on terms and conditions on tariff regional load dispatch centre to certify gaming. No bar on ISGS generators in declaring DC (Declared capacity) ISGS generators allowed generating up to 105% of DC in any time block subjected to generation not exceeding 101% of DC in a whole day.

In case of generation is more than 105% of DC in a single time block or generation exceeds 101% in a whole day. regional load dispatch centre to verify whether possibility of gaming is there If REGIONAL LOAD DISPATCH CENTRE permits generation above these limits; generator is allowed payment up to 105%. REGIONAL LOAD DISPATCH CENTRE may declare gaming.

REFERENCES

[1] Bhanu Bhushan, (Power Grid Corporation of India Limited) and Anjan Roy, and P. Pentayya (Western Regional Load Despatch Centre), "The Indian Medicine " IEEE PES General Meet, 2004

[2] Bhanu Bhushan, (CERC, India), "The Indian Medicine" CIGRE 2005, 21, rue d'Artois, F-75008, PARIS.

[3] Bhanu Bhushan "ABC of ABT - A Primer On Availability Tariff " June 2005

[4] Sushilkumar Soonee, S.Ramesh Narasimhan and Vivek Pandey, "Significance of Unscheduled Interchange Mechanism in the Indian Electricity Supply Industry" ICPSODR-2006, Department of Electrical Engineering, ITBHU.

[5] Ashkan Kian and Ali Keyhani, "Stochastic Price Modelling of Electricity in Deregulated Energy Market" IEEE, 34th Hawaii International Conference on System Science-2001 - 0-7695-0981-9/01 2001

[6] Javier Contreras and Tomás Gómez, " Auction Design in Day-Ahead Electricity Markets (Republished) "IEEE Transactions, Power Systems, Vol. 16,pp. 88-96, August 2001.

[7] Claudia P. Rodriguez and George J. Anders , "Bidding Strategy Design for Different Types of Electric Power Market Participants" IEEE Trans, Power Systems, Vol. 19, pp.964-971, May 2004

[8] N.Vaitheeswaran and R.Balasubramanian, "Stochastic Model for Optimal Declaration of Day Ahead Station Availability in Power Pools in India," IEEE Trans, power system, vol.20, pp.701-708, June 2006.

[9] R.W.Ferrero, S.M.Shahidehpour and V.C.Ramesh" Transaction Analysis In Deregulated Power Systems Using Game Theory". IEEE Transactions on Power Systems, Vol. 12, No. 3, August 1997.

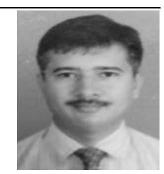
[10] Vasileios P. Gountis and Anastasios G. Bakirtzis, "Bidding Strategies for Electricity Producers in a Competitive Electricity Marketplace" IEEE Transactions On Power Systems, Vol. 19, pp.356-365, February 2004.

[11] R.M.Holmukbea, Ms.Yogini Pawar", R.S.DesaiC, T.S.Hasarmanid "Availability Based Tariff and Its Impact on Different Industry Players-A, Review" Pune, India.

[12] A Game Theory Approach to Demand Side Management in Smart Grids Nadine Hajj and Mariette Awad American University of Beirut, Beirut, Lebanon {njh05,mariette.awad}@aub.edu.lb Springer International Publishing Switzerland 2015 D. Filev et al. (eds.), Intelligent Systems'2014, Advances in Intelligent Systems and Computing 323, DOI: 10.1007/978-3-319-11310-4_70

[13] TRANSACTION ANALYSIS IN DEREGULATED POWER SYSTEMS USING GAME THEORY IEEE Transactions on Power Systems, Vol. 12, No. 3, August 1997 by R.W. Ferrero * & S.M. Shahidehpour & V.C. Ramesh

Authors Profile



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