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ENERGY TRADING AND CONGESTION MANAGEMENT USING REAL AND REACTIVE POWER RESCHEDULING AND LOAD CURTAILMENT

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ABSTRACT
Congestion is termed as the operating condition in which there is not enough transmission capacity to implement all the desired transactions. This paper deals with the power trading in electricity market to ensure regular supply at competitive rates with multi congestion case. Bidding process of 75 Indian bus systems is analyzed. It is shown that how can congestion cost can be addressed through active & reactive power rescheduling and load curtailment with transmission line constraints. With rescheduling of generation the congestion is removed with some congestion cost.

Keywords: GENCO, DISCO, Congestion management, Disco participation matrix (DPM), Pool based transaction, Bidding, Market clearing price (MCP), Locational marginal price (LMP), Congestion cost, Rescheduling.

Contribution/ Originality

The paper's primary contribution is to find MCP and LMP for Pool based transaction. The Congestion so addressed by the real and reactive power rescheduling bids of generators. The revised rates for MCP and LMP are calculated. It is obtained that the congestion is relieved in problem under study.

1. INTRODUCTION

The open access environment may try to purchase the energy from the cheaper source for greater profit margins, which may lead to overloading and congestion of certain corridors of the transmission network. This may result in violation of line flow, voltage and stability limits and thereby undermine the system security. Utilities therefore need to determine adequately their available transfer capability (ATC) to ensure that system reliability is maintained while serving a wide range of bilateral and multilateral transactions [1]. System Operator (SO) is to manage congestion as it threatens system security and may cause rise in electricity price resulting in market inefficiency. In corrective action congestion management schemes, it is crucial for SO to select the most sensitive generators to re-schedule their real and reactive powers for congestion management [2], [3]. Whenever transmission network congestion occurs how it segregates the wholesale electricity market and forces the market to change its price from a common market clearing price to locational market price [4]. The voltage profile become poor during peak loading of the network and can lead to congestion during such events [5]. The security of the

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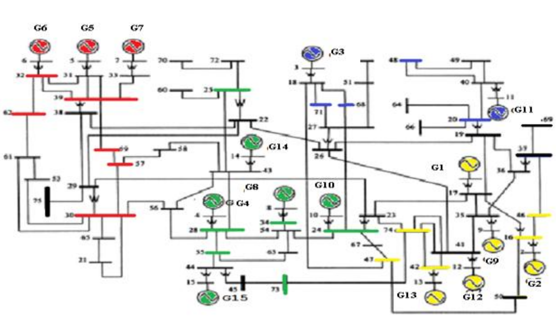
transactions has become essential in the new environment for better planning and management of competitive electricity markets. This paper proposes a new method of secured bilateral transaction determination using AC distribution factors based on the full Jacobian sensitivity and considering the impact of slack bus for pool and bilateral coordinated markets [6]. The impact of TCSC on the amount of rescheduling of power and decreasing the congestion cost after placing it optimally in the system is presented in [7]. In some inevitable cases, moderating the congestion by load shedding is the only solution which is not good in practice. Hence this paper addresses a solution for congestion relief, i.e. re-scheduling of generators if required simultaneously with load reduction. In re-schedule method, some of the generators are required to increase/decrease their actual market schedule which causes to increase/decrease transmission losses. Simultaneously, the increase in production cost so called congestion cost [8]. In the restructuring era, the task of ISO is the congestion free power system. Generator rescheduling is one of the important techniques to reduce congestion in power system. The proposed paper [9] uses the Genetic Algorithm based rescheduling of generators for alleviation of congestion and PSO technique is also used for removing congestion [10]. Relative Electrical Distance (RED) concept is used to optimize rescheduling of generators in order to relieve congestion in transmissions lines. In RED concept [11], relative location of the load nodes is found with respect to the generator nodes. Also contribution of each generator for overloading to the loads and line flows and tried to reschedule with the minimum losses in the system for relieving congestion in transmission system. An intelligent technique based on the neural network for on line congestion management is also proposed in pool based electricity market [12]. The control action strategies to limit line loading to the security limits are by means of minimal adjustments in the generation from the market clearing value.

2. SYSTEM UNDER STUDIES

The possibility of controlling power flow in power system can improve its performance with generation re-scheduling. The congestion is relieved by changing the line flows. In this paper 400 kV and 200kV reduced network of one of the Electricity Boards in India which consists of 15 generators and 97 lines, including 24 transformers is considered [3], [13]. This system is robust in nature. The single line diagram of 75-bus system is shown in Fig. 1.

Fig-1. A 75 bus system under study



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This system is divided into four areas to demonstrate the bidding process. Red, yellow, blue and green color represents Control area 1, 2, 3 & 4 respectively. Detail for Control areas is given in Table 1 [8].

Table-1. Control Areas in 75 Bus Systems

Control Area	Owner	Discos	Buses
AREA 1	Gencos-5,6,7	1 2	30,57,59,61,65,75 32,38,39,53,62
AREA 2	Gencos-1,2,9,12,13	3 4	16,46,50 42,47,74
AREA 3	Gencos-3,11	5 6	52,71,27,26,51,68 20,48,49,64,66,69,37
AREA 4	Gencos-4,8,10,14,15	7 8	40,56,58,60,70,72,25 28,24,34,55,63,54,73,67

Distribution companies (DISCOs) make the binary contracts with GENCOs which is confirmed by the Power Exchange on the availability of ATC [7]. Such contract is represented by Distribution Participation matrix (DPM). DPM for 75 bus system for a particular schedule is shown in Table 2.

Table-2. Disco Participation Matrix

	D1	D2	D3	D4	D5	D6	D7	D8
G6	0.1	0	0	0.05	0	0	0	0
G5	0	0.1	0	0	0	0	0	0.2
G7	0	0	0	0	0	0	0	0
G1	0	0	0.05	0	0	0.1	0	0
G2	0	0.05	0	0.1	0	0	0.15	0
G9	0.1	0	0.2	0.15	0	0	0	0
G12	0	0	0	0	0	0	0	0
G13	0	0	0	0	0	0	0	0
G3	0	0.05	0	0	0.15	0.2	0	0
G11	0	0	0	0	0	0.1	0	0
G14	0.1	0.15	0.1	0	0.25	0	0.25	0
G4	0.1	0	0.05	0.1	0	0.1	0	0.25
G8	0.1	0.15	0.1	0.1	0.1	0	0.1	0.05
G10	0	0	0	0	0	0	0	0
G15	0	0	0	0	0	0	0	0
Pool(P)	1.1363	4.4388	2.4973	13.1255	5.4463	5.3367	5.9501	13.7502
Total (P)	1.6363	4.9388	2.9973	13.6255	5.9463	5.8367	6.4501	14.2502
Total(Q)	0.931	0.589	1.409	0.088	0.781	2.014	1.105	2.287

The balance demand of DISCOs is met by Pool based transaction for active power which is shown in the second last raw of the Table 2. Active power demand by area 1 from pool (P_{d1}) is 5.5751 pu, by area 2 (P_{d2}) is 15.6228 pu, by area 3(P_{d3}) is 10.783 pu and by area 4 is (P_{d4}) is 19.7003 pu. Total active power given by Gencos of area 1 in pool (P_{g1}) is 3.15 pu, Gencos of area 2

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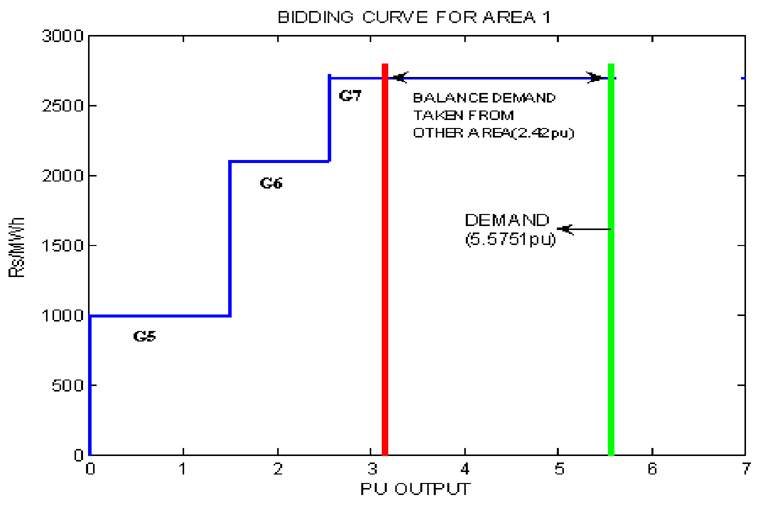
(P_{g2}) is 41.45, Gencos of area 3 (P_{g3}) is 2.39 pu and Gencos of area 4 (P_{g4}) is 6.49 pu. The reactive power demand by area 1 from pool (Q_{d1}) is 1.52 pu, by area 2 (Q_{d2}) is 1.497 pu, by area 3(Q_{d3}) is 2.975 pu and by area 4 is (Q_{d4}) is 3.392 pu. Total reactive power given by Gencos of area 1 (Q_{g1}) is 0.7 pu, Gencos of area 2 (Q_{g2}) is 13.7 pu, Gencos of area 3 (Q_{g3}) is 1.88 pu and Gencos of area 4 (Q_{g4}) is 3.03 pu. The Gencos quotes for its maximum reactive power generation for bidding.

3. BIDDING PROCESS FOR ACTIVE POWER

The bidding process is for time block of 15 minutes one day ahead. Considering the bidding from 9 am to 9.15 am on any particular day where market bidders from all areas must submit separate bids for the area in which they have generation & loads.

Bidding Curve for area 1: It is assumed that in area 1 the Genco 6 bids for 1.05 pu power at Rs 2100/- , Genco 5 bids for 1.5 power at Rs 1000/- and the Genco 7 bids for 0.6 pu power at Rs 2700/-. The supply and demand curve intersects at 2700 Rs/MWh which is MCP as shown in fig. 2. MVA base is taken 100.

Fig-2. Bidding Curve for Active Power (Area 1)



Bidding Curve for area 2: In Area 2 the Genco 1 bids for 7.10 pu power at Rs 1200/- , Genco 2 bids for 2.30 pu power at Rs 2500/- , Genco 9 bids for 5.05 pu power at Rs 4600/- , Genco 12 bids for 18 pu power at Rs 3800/- and the Genco 13 bids for 9 pu power at Rs 5000/- . The supply and demand curve intersects at 3800 Rs/MWh which is MCP of this area as shown in fig. 3.

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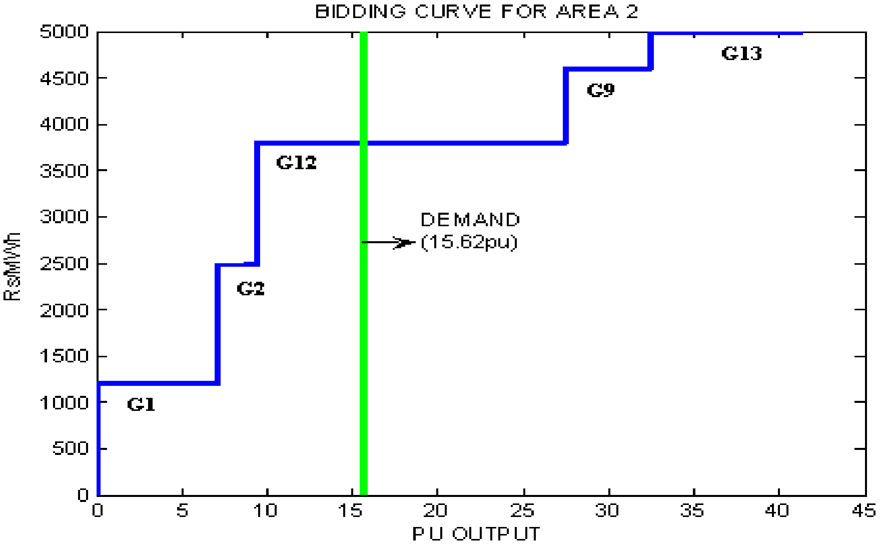
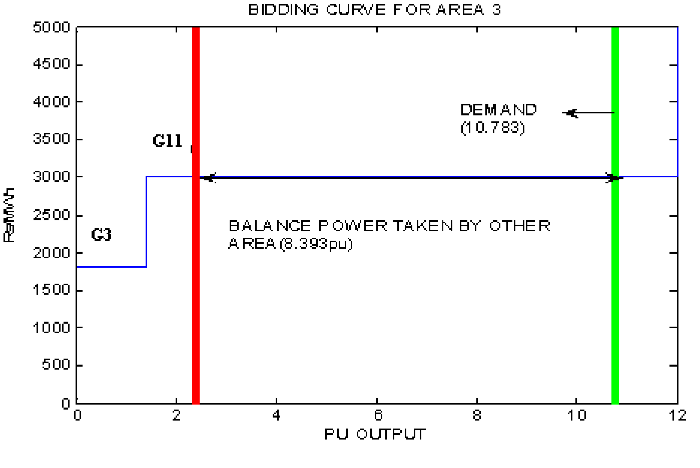
Fig-3. Bidding Curve for Active Power (Area 2)



Bidding Curve for area 3: In Area 3 the Genco 3 bids for 1.4 pu power at Rs 1800/-, Genco 11 bids for 0.99 pu power at Rs 3000/. The supply and demand curve intersects at 3000 Rs/MWh which is the MCP of this area as shown in fig. 4.

Fig-4. Bidding Curve for Active Power (Area 3)



Bidding Curve for area 4: In Area 2 the Genco 14 bids for 0.65 pu power at Rs 1000/- , Genco 4 bids for 0.4 pu power at Rs 2100/- , Genco 8 bids for 0.1 pu power at Rs 2800/- , Genco 10 bids for 0.8 pu power at Rs 3200/- and the Genco 15 bids for 4.54 pu power at Rs 3600/- . The supply and demand curve intersects at 2700 Rs/MWh which is MCP as shown in fig. 5.

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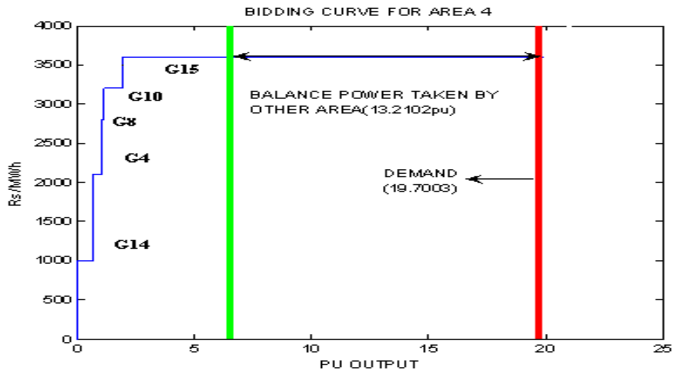
Fig-5. Bidding Curve for Active Power (Area 4)



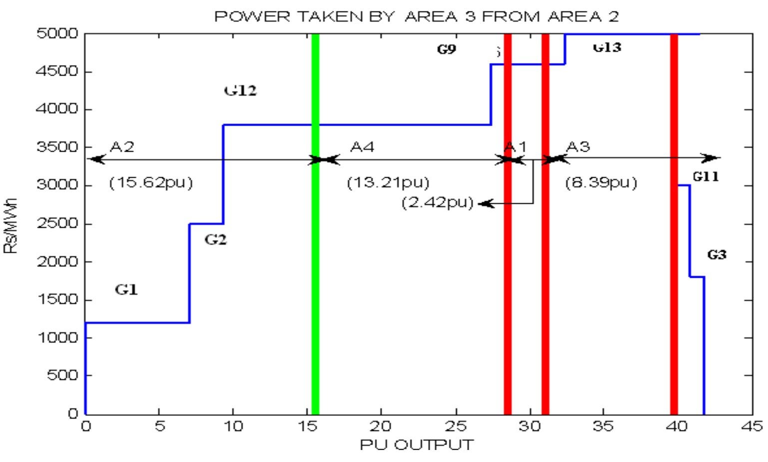
Thus the interchange of active power between the Control areas is given in Table 3.

Table-3. Interchange of Active power between Areas

Area	Power by Gencos	Pool demand	Power injection to system	Pool drawl from other area (s)
1	3.15pu	5.5751pu	0pu	2.4251pu
2	41.45pu	15.6228pu	25.82pu	0pu
3	2.39pu	10.783pu	0pu	8.39pu
4	6.49pu	19.7003pu	0pu	13.2103pu

The LMP for inter area transactions are obtained as shown in Fig. 6.

Fig-6. Power Transaction from area 2 to 1, 3 & 4 for Active Power



4. BIDDING PROCESS FOR REACTIVE POWER

Bidding Curve for area 1: It is assumed that in area 1 Genco 5 bids for 0.2 power at Rs 900/- and the Genco 7 bids for 0.19 pu power at Rs 950/-. The supply and demand curve intersects at 950 Rs/MVRh which is MCP as shown in fig.7. The Price of Genco 6 is considered as 1.25 times of MCP of this area i.e. Rs 1187.5/-.

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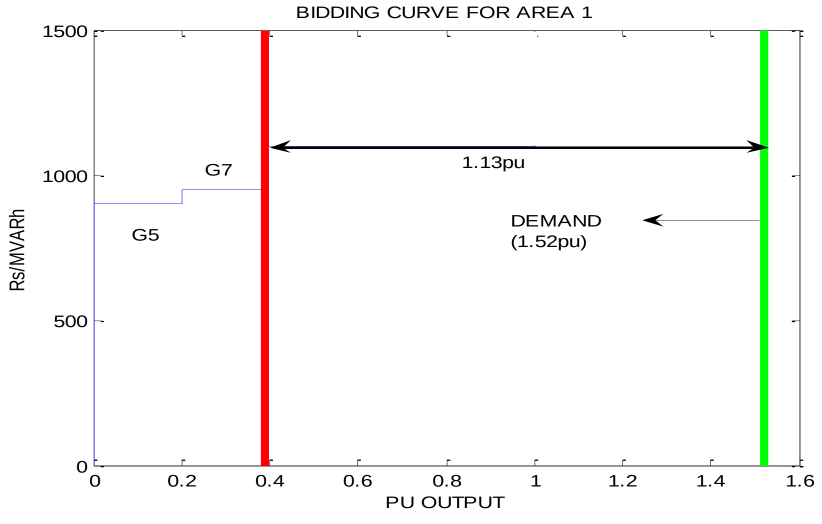
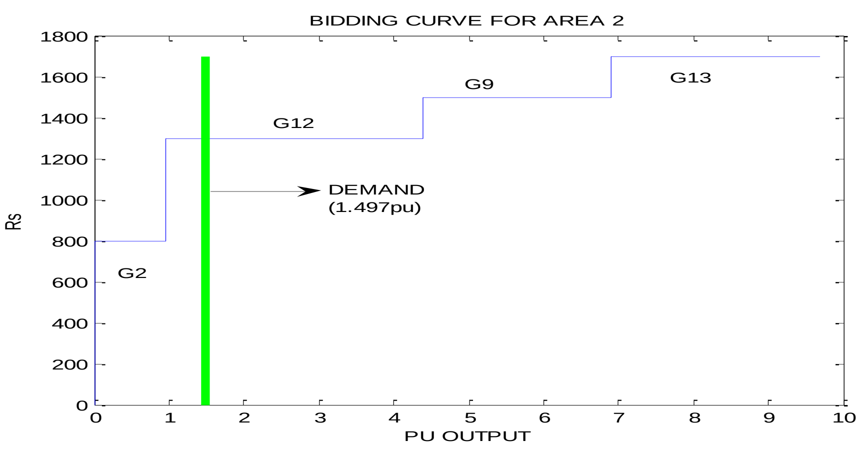
Fig-7. Bidding Curve for Reactive Power (Area 1)



Bidding Curve for area 2: In Area 2 the Genco 2 bids for 0.96 pu power at Rs 800/- , Genco 12 bids for 3.44 pu power at Rs 1300/- , Genco 9 bids for 2.5 pu power at Rs 1500/- and the Genco 13 bids for 2.8 pu power at Rs 1700/- . The supply and demand curve intersects at 1300 Rs/ MVRh which is MCP of this area as shown in fig.8. The Price of Genco 1 is considered as 1.25 times of MCP of this area i.e. Rs 1625/-.

Fig-8. Bidding Curve for Reactive Power (Area 2)



Bidding Curve for area 3: In Area 3 the Genco 11 bids for 1.05 pu power at Rs 800/. The supply and demand curve intersects at 800 Rs/ MVRh which is the MCP of this area as shown in fig.9. The Price of Genco 3 is considered as 1.25 times of MCP of this area i.e. Rs 1000/-.

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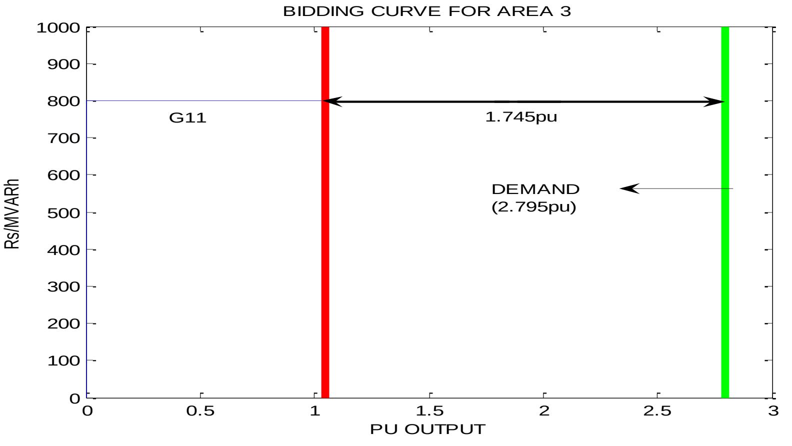
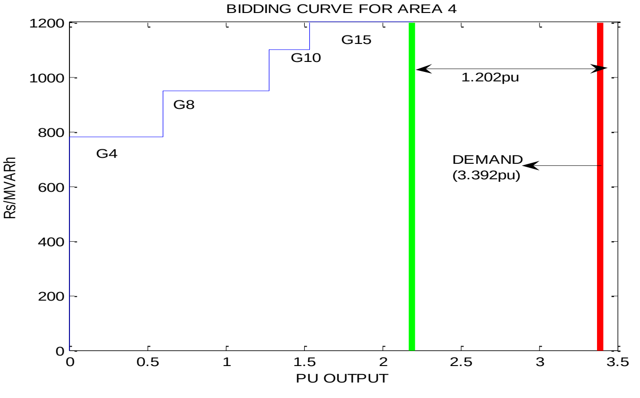
Fig-9. Bidding Curve for Reactive Power (Area 3)



Bidding Curve for area 4: In Area 2 the Genco 4 bids for 0.6 pu power at Rs 780/- , Genco 8 bids for 0.68 pu power at Rs 950/- , Genco 10 bids for 0.56 pu power at Rs 1100/- and the Genco 15 bids for 0.35 pu power at Rs 1200/- . The supply and demand curve intersects at 1200 Rs/ MVRh which is MCP as shown in fig.10. The Price of Genco 1 is considered as 1.25 times of MCP of this area i.e. Rs 1625/-.

Fig-10. Bidding Curve for Reactive Power (Area 4)



The interchange of reactive power between the Control areas is given in Table 4.

Table-4. Interchange of Reactive power between Areas

Area	Power by Gencos	Demand	Power injection to system	Power drawl from other area (s)
1	0.7pu	1.52pu	0pu	0.82pu
2	13.7pu	1.497pu	2.097pu	0pu
3	1.88pu	2.795pu	0pu	0.915pu
4	3.03pu	3.392pu	0pu	0.362pu

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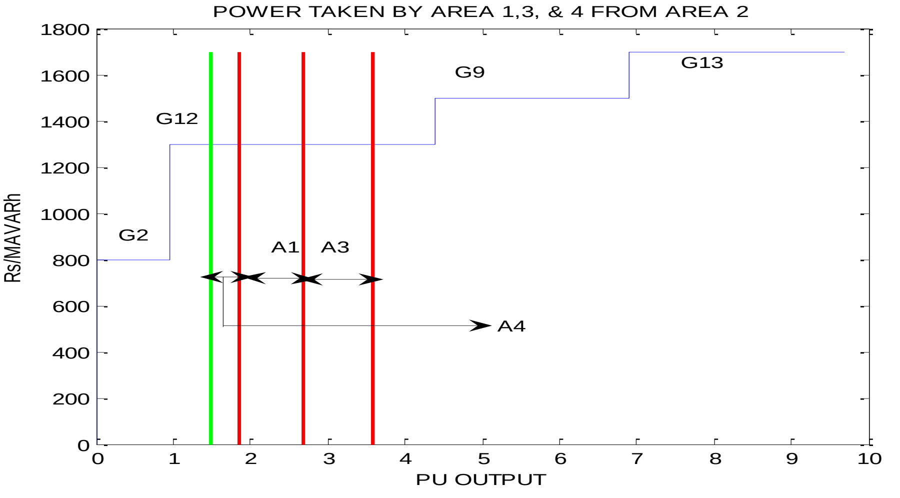
The LMP for inter area transactions are obtained as shown in Fig. 11.

Fig-11. Power Transaction from area 2 to 1, 3 and 4 for Reactive power



The money flow for active & reactive power is summarized in Table V.

5. RESCHEDULING OF GENERATION

As six line nos. i.e. 6, 10, 20, 71, 81 & 91 in this problem, causes congestion the schedules are not confirmed by the Power Exchange (PX) so bids are re-invited for rescheduling the generation. Gencos may come with incremental and decremental congestion bids. The selection of sensitive generators which may relieve the congestion by re-scheduling their generation is on the basis of their power transmission congestion distribution factors (TCDF) [3] can be calculated as

$$PTCDF_n^k = \frac{\Delta Pij}{\Delta Pn} \qquad QTCDF_n^k = \frac{\Delta Qij}{\Delta Qn}$$

Where PTCDF & QTCDF represents the real and reactive power flow sensitivities of line "n" with respect to real & reactive power injection at bus 'i' and drawl at bus 'j' and termed as real & reactive power transmission congestion distribution factors. Objective function is chosen as minimization of the total congestion cost, CC, subjected to various operating constraints. This method is applicable to various bus systems. Mathematically, the objective function can be

Minimize

$$CC = \sum_{r=1}^{Ng,up} c_{Pg,r}^{+} \Delta P_{g,r}^{+} + \sum_{s=1}^{Ng,dn} c_{Pg,s}^{-} \Delta P_{g,s}^{-} + \sum_{t=1}^{Ncl} c_{Pd,t}\, \Delta P_{D,t} + \sum_{v=1}^{Nqg} C_{Qg,v}(\Delta Q_{g,v}) \Delta Q_{g,v}$$

The constraints are as follows:

$$(\Delta P_{ij} + P_{ij}^{0})^2 + (Q_{ij}^{o} + \Delta Q_{ij})^2 \leq (S_{ij}^{max})^2$$

$$\Delta P_i^{min} \leq \Delta P_i \leq \Delta P_i^{max} \qquad i=1, 2, \ldots\ldots\ldots\ldots N_b$$

$$\Delta Q_i^{min} \leq \Delta Q_i \leq \Delta Q_i^{max}$$

$$\sum_{i=1}^{N_b} \Delta P_i - \Delta P_L = 0$$

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$$\sum_{I=1}^{N_b} \Delta Q_i - \Delta Q_L = 0$$

Table-5. Money flow for active & reactive Power

S. No.	Control Areas	Active Power		Reactive Power		Net Amount paid to Gencos(Rs) & fund collected from Discos
		Total Amount paid to Gencos of (Rs.)	Fund to Be collected from Discos (Rs.)	Total Amount paid to Gencos of (Rs.)	Fund to Be collected from Discos (Rs.)	
1.	Area 1	2063050	D1-420431	180462	D1-110532	
			D2- 1642060		D2-69929	
2.	Area 2		D3-948974		D3-183170	
		5936664	D4-4987690	194610	D4-11440	
3.	Area 3	4913500	D5- 2481468	285950	D5-79902	
			D6- 2431532		D6-206047	
4.	Area 4	8941550	D7- 2700625	435860	D7-141988	
			D8- 6240925		D8-293871	
Total		2,18,54,764	2,18,54,764	10,96,882	10,96,882	2,29,51,646

Where ΔP_L & ΔQ_L is change in the total real and reactive power transmission loss in the system, P_{ij}^0 and Q_{ij}^0 are the power flow caused by all the contracts previously settled and utilizing the transmission services. Depending upon PTCDFs & QTCDFs some of the Gencos & loads participates in rescheduling. Let the G-1 bids to increase its power by a maximum of 3 pu at a bid price 4000 Rs/MWh while it offers to reduce it by -7.1 pu at a price of 1000 Rs/MWh. The bidding prices for Genco G-4, G-5, G-7, G-8, G-12, G-13, G-14, G-15 and L-20 participating are given in

Table 6.

Table-6. Re-scheduled Bids

Gencos	c_{Pg}^{+} (Rs/MWh)	c_{Pg}^{-} (Rs/MWh)	ΔP_{gmin} (pu)	ΔP_{gmax} (pu)
G-1	4000	1000	-7.1	3
G-12	4000	2000	-10	4
G-13	5200	2000	-9	3
G-14	4000	900	-0.65	0.5
L-20	2000	-	-	0.1
	c_{qg}^{+} (Rs/MVARh)	c_{qg}^{-} (Rs/MVARh)	ΔQ_{gmin} (pu)	ΔQ_{gmax} (pu)
G-4	1500	650	-0.6	1
G-5	1000	700	-0.2	0.2
G-7	1000	750	-0.19	1
G-8	1300	700	-0.68	0.5
G-12	1500	750	-3.44	2
G-15	1300	700	-0.35	0.35
L-20	500	-	-	0.3

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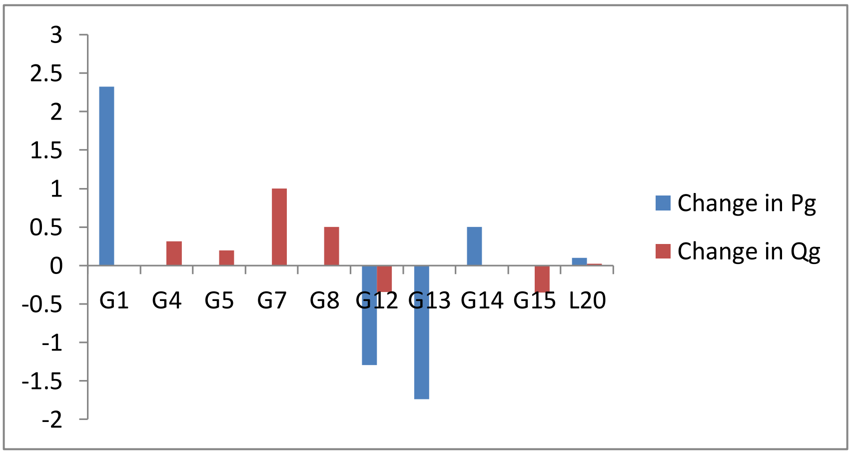
6. RESULTS AND DISCUSSION

This optimization problem can be formulated using the GAMS solver [14]. The change in generation after rescheduling the rates of Gencos is shown in Fig.12 and congestion cost comes out to be Rs.779224/- which is much higher compared with single congested line case. With the change in generation, as shown in Fig 12, the bidding is evaluated again.

Fig-12. Change in Generation



The total amount paid to Gencos & funds collected from Discos (revised) is shown in Table 7. From the result of load flow [15] (after rescheduling) it can be observed that none of the line is congested.

Table-7. Money Flow after Rescheduling

S. No.	Control Areas	Active Power Rescheduling		Reactive Power Rescheduling		Net Amount paid to Gencos(Rs) & fund collected from Discos
		Total Amount paid to Gencos (Rs.)	Fund to Be collected from Discos (Rs.)	Total Amount paid to Gencos of (Rs.)	Fund to Be collected from Discos (Rs.)	
1.	Area 1	2236784	D1-455894	193862	D1-118740	
			D2-1780889		D2-75121	
2.	Area 2		D3-964958		D3-186202	
		6036662	D4-5071703	197832	D4-11629	
3.	Area 3	5494774	D5-2801290	277445	D5-78140	
			D6-2693483		D6-199304	
4.	Area 4	9801958	D7-2960524	461250	D7-141988	
			D8-6841434		D8-293871	
Total		2,35,70,178	2,35,70,178	1130389	1130389	2,47,00,567

7. CONCLUSION

In this paper MCP and LMP are calculated for Pool based transaction. The case studies for active and reactive power bidding are taken. The Congestion so obtained is addressed by the real and reactive power rescheduling bids of generators. A suitable objective function is chosen for calculation the congestion cost. Using GAMS solver the change in generations of Gencos is calculated. The revised rates for MCP and LMP are calculated. It is obtained that the congestion

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is relieved in problem under study. The money flow after rescheduling found increased from Rs.(2,29,51,646) to Rs. (2,47,00,567) due to CC i.e. Rs. 7,79,224/-.

NOMENCLATURE:

Nl Number of Lines in the system,

Nb Number of Buses in the system,

Pg Power generation in each area,

Pd Power demand in each area,

P_{ij}^{0} Base case real power flow,

Q_{ij}^{0} Reactive power flow at normal operation,

CC Congestion Cost,

Ng,up Number of participants for incremental-bid congestion,

Ng,dn Number of participants for decremental -bid congestion,

$c_{Pg,r}^{+}$ Incremental congestion bid of r^{th} generator,

$\Delta P_{g,r}^{+}$ Increase in the real power output of r^{th} generator,

$c_{Pg,s}^{-}$ Decremental congestion bid of s^{th} generator,

$\Delta P_{g,s}^{-}$ Reduction in real power output of s^{th} generator,

$\Delta P_{D,t}$ Reduction in power consumption by a t^{th} generator,

$\Delta Q_{g,v}$ Adjustment in reactive power output of r^{th} generator,

$C_{Pd,t}$ Load Curtailment Bid

ΔP_{L} Changes in the total real power transmission loss,

S_{ij}^{max} Line flow limit,

TCDFs Transmission Congestion Distribution Factors,

$C_{Qg,v}$ ($\Delta Q_{g,v}$) Reactive Bid Function

REFERENCES

[1] S. K. Gupta and R. Bansal, "ATC in competitive electricity market using TCSC," *International Journal of Electrical, Electronic Science and Engineering*, vol. 2, p. 8, 2014.

[2] A. Kumar, S. C. Shrivastava, and S. N. Singh, "A zonal congestion management approach using real and reactive power rescheduling," *IEEE Transaction on Power Systems*, vol. 19, 2004.

[3] A. Kumar, S. C. Shrivastava, and K. S. Himanshu, "Sensitivity based approach for transmission congestion management utilizing bids for generation rescheduling and load curtailment," *International Journal of Emerging Electric Power Systems*, vol. 2, 2006.

[4] N. S. Modi and B. R. Parekh, "Transmission network congestion in deregulated wholesale electricity market," *IMECS*, vol. 2, 2009.

[5] A. Kumar and M. Ram Kumar, "Congestion management with generic load model in hybrid electricity markets with FACTS devices," *Electric Power and Energy System*, 2013.

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[6] A. Kumar and S. Chanana, "Power flow contribution factors based congestion management with real and reactive power bids in competitive electricity markets," *Electric Power and Energy System, Sept.*, 2008.

[7] S. K. Gupta and R. Bansal, "TCDF based congestion based management using TCSC," presented at the Fifth IEEE Power India Conference, 2012.

[8] C. Naga Raja Kumari and M. Anitha, "Re-dispatch approach for congestion relief in deregulated power systems," *International Journal of Engineering Trends and Technology*, 2013.

[9] R. Harish and G. Kannan, "Congestion management by generator rescheduling using genetic algorithm optimization technique," *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering*, 2014.

[10] K. P. Kaushik and K. P. Nilesh, "Generation rescheduling for congestion management using relative electrical distance," *Journal of Information, Knowledge and Research in Electrical Engineering*, 2013.

[11] K. Joshi and K. S. Pandya, "Active and reactive power rescheduling for congestion management using particle swarm optimization," presented at the University Power Engineering Conference Paper, 2011.

[12] B. Sujatha and N. Kamaraj, "Real time congestion management in deregulated electricity market using artificial neural network," *Interntional Journal on Electrical and Computer Engineering*, vol. 10, 2011.

[13] S. Gupta, *Power system engineering*. Umesh Publication First Edition 2009, 2009.

[14] A. Brooke, D. Kendrick, A. Meeraus, R. Raman, and R. Rasentha, "A user's guide, GAMS software," *GAMS Development Corporation*, 1998.

[15] S. Haadi, *Power system analysis*, 2nd ed.: TMH Edition, 2002.

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