Determination and Allocation of Reactive Power Loss in Deregulated Power Systems in The Presence of Multilateral Multiple Contracts

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Abstract- Competition in restructured deregulated power systems is the most important factor in electric energy trade. Recognition and determination of accurate and precise energy transmission from one place to another point in the network, reactive power support for this contract and transmitting the loss are the most issues in the new changing trade world. Carrying out modified Y_{bus} method for active and reactive power tracing, and obtained results, in this article two subjects, i.e. providing reactive power support, and loss related to each transaction contract are discussed simultaneously together by introducing and indicating power injection vector and signifying distributed slack bus idea. The proposed method is experimented on a test system.The results show that the features of this method are large in scope, in compliance with network mathematical equations, and also physical power flow perception in multiple multi transaction power systems.

Key words: Contract, Loss, Power injection vector, Reactive power, Restructuring.

I.INTRODUCTION

Deregulation and restructuring are on the way and being pursued in most countries around the world. Demand for electric energy, and its form is constantly changing. To determine energy price, in addition to starting cost, generating off times along with other system constraints shall be considered and taken into account. Using reactive power controller source in transmission network (such as capacitors, switching reactors, SVCs and tap changing transformers) can increase power transmitted from one part of the network to other parts. On the other hand, providing reactive power source in the network is necessary to regulate system voltage. Therefore, in order to efficiently use available sources, it is necessary to supervise voltage controller systems by System Operators (SO). Voltage control service for power system is not only vital for normal operation, but also is a need for managing emergency conditions. In the case of disconnecting a line out of the power system, reactive power loss increases. Undoubtedly, Power transmission from one point to another point causes energy loss in the system. There are some constraints on transmission lines for connecting power system elements. As generators must compensate and share system loss, because of their excess generation, there is expectance for extra payment that shall be considered to these generators. Thus there should be a mechanism for accounting loss and its cost in an electricity market. To ensure whether a contract can be committed in a network, the transmission lines capability margins shall be investigated. If a line or equipment in a network becomes congested, it will be Power System Operator's (PSO) responsibility to redistribute loads and generations until system optimum condition is achieved. Independent System Operator body will consider the contract offers that shall make power market and system security condition optimally balanced. Like other problems in these new systems, determination and allocation of reactive power and system losses are stem from different rules and points of view which exist in deregulation and restructuring concept. While a specific subject is being explored, a little different output might result [1-4]. Up to now, several allocation methods are proposed in accordance with a range of assumptions and approximations. In Ref. [5] active and reactive power flows are considered individually. In Ref. [6] decomposition of injected power based on active and reactive currents is presented. Ref. [7] uses operating point state in bilateral contracts. In Ref. [8] quadratic formula is used for loss determination. In Ref. [9-11] tracing methods are used to determine power loss in restructured power networks. In this article line power flow, interaction among power injection vectors in buses, and new modified Y_{bus} method to allocate reactive power and loss in multiple multi-transaction power networks is presented.

II. REACTIVE POWER ALLOCATION STRATEGY

Assume M is the number of transaction in a system. A contract will be clear with determination of buyers and sellers. Reactive power support is an essential necessity for providing transmission service. Here, a set of generators buses that deliver certain amount of active power is considered as sellers. A contract can be defined for instance as below:

$$T^{(m)} = \left\{t^{(m)}, S^{(m)}, B^{(m)}, l^{(m)}\right\} \tag{1}$$

where $t^{(m)}$ is contract amount in MW, $S^{(m)}$ is sellers set, $B^{(m)}$ is buyer buses set, and $l^{(m)}$ is loss associated with the transaction. $S^{(m)}$, the sellers set, can be defined as below:

$$S^{(m)} = \left\{\left(s_i^{(m)}, \sigma_i^{m}\right), i = 1,2,..., N_S^{(m)}\right\} \tag{2}$$

where $s_i^{(m)}$ provides $\sigma_i^m t^{(m)}$ of transaction. $\sigma_i^{(m)}$ must satisfy condition $\sum_{i=1}^{N_S^{(m)}} \sigma_i^{(m)} = 1$, $\sigma_i^{(m)} \in [0,1], i = 1,2,...N_S^{(m)}$

B^m is the buyer buses set defined as:

$$B^{(m)} = \left\{\left(b_i^{(m)}, \beta_j^{(m)}\right), j = 1,2,..., N_b^{(m)}\right\} \tag{3}$$

where buyer bus $b_j^{(m)}$ will receive $\beta_j^{(m)} t^{(m)}$ MW of total contract amount. $\beta_j^{(m)}$ Also must satisfy the condition $\sum_{j=1}^{N_b^{(m)}} \beta_j^{(m)} = 1$, in which $\beta_j^{(m)} \in [0,1],\ j = 1,2,...N_b^{(m)}$.

For each transaction m, injection vector $\underline{p}^{(m)}$ can be defined as below:

$$p_n^{(m)} = \delta_n^{(m)} t^{(m)}, n = 0,1,2,...N. \tag{4}$$

For all buses in the network, except reference bus or buses, injection power is considered as follow:

$$\delta_h^{(m)} = \begin{cases} \alpha_i^{(m)}, & if\ s_i^{(m)} = h, i = 1,2,...,N_s^{(m)} \\ -\beta_j^{(m)}, & if\ b_j^{(m)} = h, j = 1,2,...,N_b^{(m)} \\ \alpha_i^{(m)} - \beta_j^{(m)} & ,if\ s_i^{(m)} = b_j^{(m)},\ h \neq n \\ & i = 1,2,....,N_s^{(m)}, j = 1,2,...,N_b^{(m)} \\ 0 & otherwise \end{cases} \tag{5}$$

For network with multi reference bus injection, the vector is considered as below:

$$\delta_h^{(m)} = \begin{cases} \alpha_i^{(m)} + l_\gamma^{(m)}, & if\ s_i^{(m)} = h, i = 1,2,...,N_s^{(m)} \\ l_\gamma^{(m)} - \beta_j^{(m)}, & if\ b_j^{(m)} = h, j = 1,2,...,N_b^{(m)} \\ \alpha_i^{(m)} - \beta_j^{(m)} + l^{(m)} & ,if\ s_i^{(m)} = b_j^{(m)},\ h \neq n \\ & i = 1,2,....,N_s^{(m)}, j = 1,2,...,N_b^{(m)} \\ l_\gamma^{(m)} & otherwise \end{cases} \tag{6}$$

where γ is one of the distributed slack buses, and the sum of them shall equal to total system loss. Since injected power in each node is the sum of all individual contracts, injected power volume in that node can be stated as below:

$$p_n^{net} = \sum_{m=1}^{M} p_n^{(m)} = \sum_{m=1}^{M} \delta_n^{(m)} t^{(m)} \tag{7}$$

For each bus $i = 0,1,2,...,N$ in a network, H_i is a neighbor bus connecting to bus i. therefore:

$Q \overset{\Delta}{=}$ Generator set $|Q|$

$Q^C \overset{\Delta}{=}$ Non generating buses $|Q^C|$

Real flow in bus n can be written as below:

$$\sum_{m=1}^{M} \delta_n^{(m)} t^m = V_n \sum_{k \in H_n} V_k [G_{nk} \cos(\theta_n - \theta_k) + B_{nk} \sin(\theta_n - \theta_k)] \\ + G_{nn} V_n^2,\ n = 1,2,...N \tag{8}$$

The above formulation will be completed with reactive power balance statement. Reactive power equation in a bus is:

$$-Q_j^d = -B_{jj} V_j^2 + V_j \sum_{i \in H_j} V_i [G_{ji} \sin(\theta_j - \theta_i) - B_{ji} \cos(\theta_j - \theta_i,)], j \in Q^C \tag{9}$$

First injected active power toward line connecting generating bus $j \in Q^C$ and neighbor buses must be calculated for the case when there is no contract in the system. For reactive power allocation two elements are considered: one variation in bus phase and another variation in voltage magnitude with respect to each transaction.

$$V_i = V_i^o + \Delta V_i\ for\ i \in H_k \tag{10}$$

$$\theta_i = \theta_i^o + \Delta\theta_i\ for\ i \in H_k \tag{11}$$

Two elements are completely associated with transactions.

$$Q_k^{g,\Delta\theta} = \sum_{i \in H_k} Q_{ki}^{\Delta\theta},\ Q_k^{g,\Delta V} = \sum_{i \in H_K} Q_{ki}^{\Delta V} \tag{12}$$

Voltage magnitude variation element and phase variation in connecting line might be related to generating buses.

$$Q_k^{g,\Delta V} = \sum_{i \in H_k} Q_{ki}^{\Delta V} = \sum_{m=1}^{M} v_k^{(m)} t^{(m)}\ k \in Q \tag{13}$$

$$v_k^{(m)} = \sum \{ v_k^{(m)} = \sum_{i \in H_k} \left\{ -\frac{V_k}{z_{ki}^2} \left[r_{ki}(\theta_k - \theta_i) + x_{ki} \frac{(\theta_k - \theta_i)^2}{2} \right] \cdot \frac{\sum_{n=0}^{N} [-\min(0, \delta_n^{(m)}) \omega_{in}]}{\sum_{n=0}^{N} P_n^d \omega_{in}} \right\} \Delta V_i \\ k \in Q \tag{14}$$

For voltage variation element:

$$\hat{\theta}_k - \hat{\theta}_i = \sum_{m=1}^{M} \pi_{ki}^{(m)} t^{(m)}\ k \in Q, i \in H_k \tag{15}$$

$$\pi_{ki}^{(m)} = \mu_k^{(m)} - \mu_i^{(m)}, m = 1,2,...M. \tag{16}$$

$$\mu_n^{(m)} = -\sum_{v=1}^{N} d_{nv} \delta_v^{(m)} = \sum_{i=1}^{N_b^{(m)}} d_{nb_j^{(m)}} \beta_j^{(m)} - \sum_{i=1}^{N_s^{(m)}} d_{ns_i^{(m)}} \sigma_i^{(m)} \tag{17}$$

Using dc power flow and injection to each bus will result in following formulas, in which $\underline{D} = [d_{ij}] = (\underline{B'})^{-1}$, where B is dc power flow matrix, and $\hat{\Theta} = [\hat{\theta}_1, \hat{\theta}_2, ..., \hat{\theta}_n]$ is bus voltage angle calculated by dc power flow. From these expressions voltage variation will be obtained as below:

$$\tilde{Q}_k^{g,\Delta\theta} = \sum_{i \in H_k} \tilde{Q}_{ki}^{\Delta\theta} = \sum_{m=1}^{M} \varsigma_k^{(m)} t^{(m)} \tag{18}$$

$$\varsigma_k^{(m)} = \sum \frac{V_k V_i^o}{z_{ki}^2} \left(-r_{ki} + \frac{x_{ki}^2}{2} (\theta_k - \theta_i) + \frac{x_{ki}}{2} \frac{(\theta_k - \theta_i)^2}{2} \right) \pi_{ki}^{(m)} \tag{19}$$

Therefore reactive power changing associated with a change in bus angle will be as follow:

$$Q_{k,a}^{(m)} = \eta_{k,a}^{(m)} t^{(m)}\ \ m = 1,2,...,M \tag{20}$$

$$\eta_{k,a}^{(m)} = v_k^{(m)} + \varsigma_k^{(m)}\ \ m = 1,2,...,M. \tag{21}$$

$$Q_{ki} = Q_{ki}^o + Q_{ki}^{\Delta V} + Q_{ki}^{\Delta\theta} \tag{22}$$

Allocation will be considered as the sum of two components. Using above model, loss allocation can be approximated as following equations, and total loss in power system will be:

$$l = \frac{1}{2} \sum_{i=0}^{N} \sum_{j \in H_i} \frac{R_{ij}}{R_{ij}^2 + X_{ij}^2} [V_i^2 + V_j^2 - 2V_i V_j \cos(\theta_i - \theta_j)] \tag{23}$$

Considering approximation introduced in equation (17) there will be:

$$\lambda^{(m)} = \frac{1}{2} \sum_{i=0}^{N} \sum_{j \in H_i} \left\{ \frac{R_{ij}}{R_{ij}^2 + X_{ij}^2} (\theta_i - \theta_j) \pi_{ij}^{(m)} \right\} \tag{24}$$

$$\bar{l} = \sum_{m=1}^{M} \lambda^{(m)} t^{(m)} \tag{25}$$

So approximate value of network loss is achieved in the form of linear function of contract interchanging amount.

III.LOSS MATRIX USING POWER INJECTION

Loss expression in a power system in terms of active and reactive currents can be written as:

$$P_L = \sum_{i=1}^{n}\sum_{j=1}^{n} R_{ij}(I_{xi}.I_{xj} + I_{yi}.I_{yj}) \tag{26}$$

$$\begin{aligned} P_L = &\sum_{i=1}^{n}\sum_{j=1}^{n}\frac{R_{ij}}{V_iV_j}(P_i\cos\theta_i + Q_i\sin\theta_i)(P_j\cos\theta_j + Q_j\sin\theta_j) \\ &+\sum_{i=1}^{n}\sum_{j=1}^{n}\frac{R_{ij}}{V_iV_j}(P_i\sin\theta_i - Q_i\cos\theta_i)(P_j\sin\theta_j - Q_j\cos\theta_j) \end{aligned} \tag{27}$$

where:

$$I_{xi} = (P_i\cos\theta_i + Q_i\sin\theta_i)/V_i \tag{28}$$

$$I_{yi} = (P_i\sin\theta_i - Q_i\cos\theta_i)/V_i \tag{29}$$

$$P_j = \sum_{m2=1}^{M}\delta_h^{(m2)}t^{(m2)} + \gamma_j\,, P_i = \sum_{m1=1}^{M}\delta_h^{(m1)}t^{(m1)} + \gamma_i \tag{30}$$

where γ_i is considered as loss proportion compensated in bus i.

Using power injection equation in contracts introduced in (5) and (6) and by arranging mathematics equation, equation loss matrix can be written as below:

$$TL = \begin{bmatrix} P_L^{(1,1)} & P_L^{(1,2)} & \dots & P_L^{(1,m)} \\ P_L^{(2,1)} & P_L^{(2,2)} & \dots & P_L^{(2,m)} \\ \dots & \dots & \dots & \dots \\ P_L^{(m,1)} & P_L^{(m,2)} & \dots & P_L^{(m,m)} \end{bmatrix} \tag{31}$$

In this matrix diagonal elements (self loss) will be as:

$$\begin{aligned} P_L^{(m,m)} = &\frac{t^{(m)}}{\sum_{i=1}^{M}t^{(i)}}P_{LQQ} + \sum_{i=1}^{n}\sum_{j=1}^{n}\frac{R_{ij}}{V_iV_j}\cos\theta_{ij}\delta_i^{(m)}\delta_j^{(m)}t^{(m)} \\ &+\sum_{i=1}^{n}\sum_{j=1}^{n}\frac{R_{ij}}{V_iV_j}\sin\theta_{ij}(-\delta_i^{(m)}Q_j + Q_i\delta_j^{(m)}).t^{(m)} \end{aligned} \tag{32}$$

And non diagonal elements (interaction loss) can be calculated as:

$$\begin{aligned} P_L^{(m,k)} = &\sum_{i=1}^{n}\sum_{j=1}^{n}\frac{R_{ij}}{V_iV_j}\cos\theta_{ij}.\delta_i^{(m)}.\delta_j^{(k)}.t^{(m)}.t^{(k)} \\ &+\sum_{i=1}^{n}\sum_{j=1}^{n}\frac{R_{ij}}{V_iV_j}\cos\theta_{ij}\,\delta_i^{(k)}.\delta_j^{(m)}.t^{(m)}.t^{(k)} \end{aligned} \tag{33}$$

Loss allocation to each contract can be obtained from the following equation:

$$P_L^{(m)} = P_L^{(m,m)} + \frac{1}{2}\sum_{k=1,k\neq m}^{M}P_L^{(m,k)} \tag{34}$$

Since power system loss is not clear before solving power flow, this figure shall be calculated using different iterative mathematical methods.

IV.SIMULATION RESULTS

This method has been experimented on a 30 bus network. Here the result of network simulation is presented. Some different arbitrary contracts are defined as table 1. In order to evaluate generators performance for providing reactive power, shunt capacitors in the network are disconnected. Allocation results are shown in table 2.

To calculate loss matrix and making a simple and understandable example, normal operation is considered as the first contract and a 30 MW selling power from bus 5 to bus 3 is considered as second one. Loss matrix in this case will be

$$TL = \begin{bmatrix} 17.351 & -1.610 \\ -1.610 & 0.175 \end{bmatrix} \tag{35}$$

$$P_L^{(1)} = 16.546 \quad P_L^{(2)} = -0.630$$

By increasing size of contract 2, system loss is increasing. When the size of transaction 2 approaches to nearly 150MW, the loss allocated to second transaction will become positive. This is due to the changes in network flow directions and its redistribution.

Loss matrix in this situation will be calculated as:

$$TL = \begin{bmatrix} 16.089 & -11.602 \\ -11.602 & 7.523 \end{bmatrix} \tag{36}$$

$$P_L^{(1)} = 10.288 \quad P_L^{(2)} = 1.722$$

If we consider two slack buses in the system, the above matrix will be as:

$$TL = \begin{bmatrix} 14.101 & -10.122 \\ -10.102 & 6.121 \end{bmatrix} \tag{37}$$

$$P_L^{(1)} = 9.040 \quad P_L^{(2)} = 1.06$$

This shows that total power system loss has a reduction trend. Fig.1 shows reactive power change with respect to a change in contracts volumes.

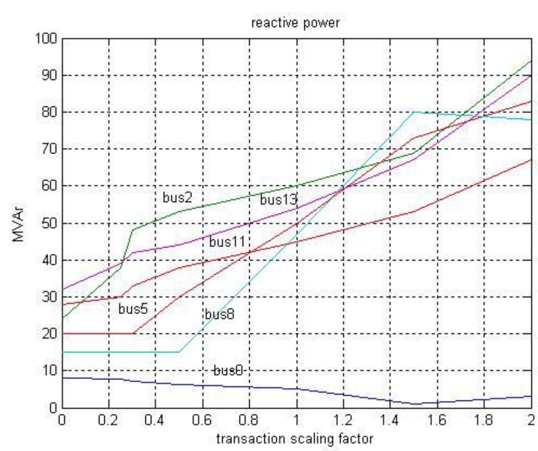

Fig.1 Reactive power change related to transaction change

Fig.2 shows how the power in bus 13 is changing. Fig.3 depicts a change in loss related to a change in transaction 2 when two slack buses are considered in the system. As it can be seen the total loss is decreased by about 8%.

The algorithm can be summarized as the following steps:

1. Solving Power flow equations
2. Network loss Approximation

TABLE.I
ARBITRARY CONTRACTS DEFINED IN TEST SYSTEM

m	$B^{(m)}$	$S^{(m)}$	$t^{(m)}$ [MW]
1	(24،%16) ؛ (21 ،%23) ؛ (10،%14) ؛ (7،%47)	(8،%100)	36
2	(8،%93) ؛ (3،%7)	(14،%7) ؛ (11،%93)	32.4
3	(24،%16) ؛ (23،%6) ؛ (5،%78)	(13،%28) ؛ (2،%72)	56.1
4	(5،%100)	(5،%100)	50
5	(21،%52) ؛ (19،%29) ؛ (14،%19)	(2،%100)	33.2
6	(2،%100)	(14،%100)	21.7
7	(15،%15) ؛ (10،%11) ؛ (7،%41) ؛ (4،%14) ؛ (2،%19)	(2 ،%85) ؛ (5،%15)	55
8	(4،%100)	(2،%100)	20
9	(17،%100)	(5،%100)	10
10	(29،%100)	(8،%100)	15
11	(18،%100)	(11،%100)	17

TABLE.II
GENERATORS REACTIVE POWER (MVAr) ALLOCATION RESULTS

GEN Contract	13	11	8	5	2	1	
Reactive Power	$Q_{13,a}^{(m)}$	$Q_{11,a}^{(m)}$	$Q_{8,a}^{(m)}$	$Q_{5,a}^{(m)}$	$Q_{2,a}^{(m)}$	$Q_{1,a}^{(m)}$	loss
1	1/0548	1/4018	-3/8414	3/4171	2/8551	0/7242	0/842
2	0/04496	1/7929	4/3276	-0/8349	-1/7482	-0/5904	0/043
3	0/0202	0/7995	1/6918	17/4705	-6/2006	-0/6152	5/333
4	0	0	0	11/3241	0	0	0
5	2/4381	2/3880	8/7800	1/3523	-4/6405	2/1679	2/147
6	1/0385	0/0282	-3/3944	-0/4395	4/0217	-1/5538	-0/338
7	1/6633	1/2019	7/8405	1/3795	-5/7435	2/1535	1/844
8	0/6941	0/3112	0/8534	0/4121	-3/5263	1/5736	0/602
9	0/4516	0/6751	2/2933	-3/3724	0/2214	0/6257	-0/148
10	0/4918	0/5561	1/9518	0/8345	1/7936	0/3142	1/356
11	1/7137	1/5463	0/7516	0/1487	0/6218	0/2521	0/7371
$Q_{k,a}^{g}$	7/534	10/701	21/254	20/4680	-12/3455	5/1700	-
$Q_{k}^{g,0}$	31/6354	29/0502	12/4487	20/1870	24/0351	4/0016	6/520
$\widetilde{Q}_{k}^{g,net}$	39/1694	39/7512	33/7027	40/655	11/689	9/1716	-

3. Putting zero for counter
4. Calculating $l_\gamma^{(m)}, \delta_i^{(m)}$
5. Obtaining all matrix elements
6. Allocating loss to each transaction
7. Identifying counter "*n*"
8. Convergence Checking $\left\| P_L^{(m)^n} - P_L^{(m)^{n-1}} \right\| \le \xi$
9. Loss allocation results output

If the constraint in stage 8 is not satisfied we must go back to stage 4. Convergence depends on the size of the network and its configuration as well as its operating state point. For instance, in a well configured system convergence can be approached approximately in 4 to 5 iterations.

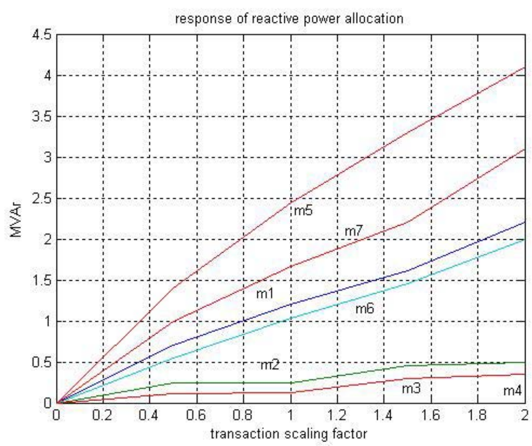

Fig.2 Bus 13 performance with respect to a change in transaction amount

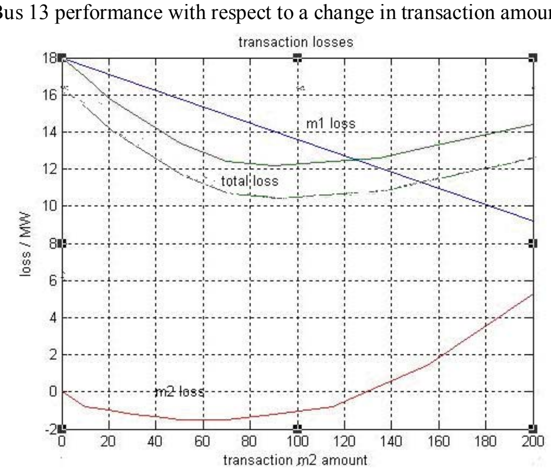

Fig.3 Changes in loss with respect to a change in contract 2

V.CONCLUSION

In this paper bus power injection method is used for solving reactive power and allocating loss in single and multi slack bus power systems. This method is largely based on physical flows considering system constraints. More difficult problem arises when less-well-conditioned systems are encountered. Positive and negative allocation figures means generating and absorbing reactive power. This method has a beneficial mechanism that double charging will not be occurred and transaction will be treated equitably. Loss matrix is obtained through system fundamental and general equations. Loss formulation is achieved with less approximation assumptions in comparative to the ways have already introduced. Results are meaningfully compatible with physical flow sense and performance. This method can be extensively used to allocate sharing in multiple multi-transaction restructured power networks.

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APPENDIX

The Y_{bus} method mentioned in introduction has been used to trace reactive power and it is formulated as below:

$$\left[\begin{array}{c|c} Y_{GG} & Y_{GL} \\ \hline Y_{LG} & Y_{LL}' \end{array}\right]\left[\begin{array}{c} V_G \\ \hline V_L \end{array}\right] = \left[\begin{array}{c} I_G \\ \hline 0 \end{array}\right] \tag{38}$$

$$[V_L] = -[Y_{LL}']^{-1}[Y_{LG}][V_G] \tag{39}$$

$$[V_L] = [Y_A][V_G] \tag{40}$$

The load impact on network voltage generation will be:

$$V_{Lj} = \sum_{i=1}^{g} YA_{i,j} \times V_{Gi}\ ,\ V_{Lj} = \sum_{i=1}^{g} \Delta V_{Li,j} \tag{41}$$

The active and reactive share among generation entity will be real and imaginary part of above formula as:

$$P_{Li,j} = \Re\{\Delta V_{Li,j} \times I_I^*\} \tag{42}$$

$$Q_{Li,j} = \Im\{\Delta V_{Li,j} \times I_{Lj}^{*}\} \quad (43)$$

Table.III shows the results of applying above mentioned partitioning method to test the system used in this article and to its fundamental equation network known as Y_{bus}.

TABLE .III
REACTIVE POWER TRACING / ALLOCATION (MVAr)

BUS	GEN 6	GEN 5	GEN 4	GEN 3	GEN 2	GEN 1	LOAD
7	0/10396	0/09333	3/5177	5/2285	1/4859	0/47054	10/9
8	0/020586	0/015906	0/36099	0/066692	0/33339	0/40243	1/2
9	0	0	0	0	0	0	0
10	0/55549	0/35567	0/57233	0/099704	0/29717	0/11964	2
11	0	0	0/59151	0/11544	0/66239	0/36707	1/6
12	3/7345	0/66189	1/4708	0/25511	0/91539	0/46231	7/5
13	0	0	0	0	0	0	0
14	0/56775	0/19422	0/40176	0/07012	0/25052	0/11564	1/6
15	0/99728	0/2681	0/58941	0/10294	0/36965	0/17262	2/5
16	0/71532	0/24157	0/42383	0/073512	0/23702	0/10874	1/8
17	1/7281	1/1356	1/5873	0/27326	0/7600	0/31571	5/8
18	0/32483	0/10931	0/22713	0/039815	0/13763	0/061279	0/9
19	1/1498	0/50161	0/88941	0/1546	0/49203	0/21259	3/4
20	0/22854	0/10275	0/18692	0/032625	0/10464	0/04452	0/7
21	2/8485	2/3658	3/3306	0/56285	1/479	0/59524	11/2
22	0	0	0	0	0	0	0
23	0/58524	0/21327	0/41929	0/069664	0/21637	0/096157	1/6
24	1/8164	1/1723	2/1289	0/33584	0/88799	0/35864	6/7
25	0	0	0	0	0	0	0
26	0/46053	0/30039	0/94724	0/13308	0/33386	0/1249	2/3
27	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0
29	0/15568	0/093905	0/39531	0/055078	0/14694	0/053091	0/9
30	0/42396	0/20264	0/66362	0/10804	0/36613	0/13561	1/9