International Journal of Electrical and
Electronics Engineering (IJEEE)
ISSN(P): 2278-9944; ISSN(E): 2278-9952
Vol. 6, Issue 1, Dec- Jan 2017, 1-14

International Academy of Science, Engineering and Technology
Connecting Researchers; Nurturing Innovations

CONGESTION MANAGEMENT IN POWER SYSTEM USING OPTIMAL POWER FLOW TOPOLOGY

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ABSTRACT

Transmission line outage and generator outage factor are due to the increasing demand, thereby congesting or deregulating the power systems. When the transmission system attains or exceeds the transfer capability limit, it results in congestion of the power systems. The transfer capability limit of the transmission lines involves line voltage limit, thermal limit, stability limit, etc. Power line congestion will lead to huge power losses, poor voltage regulation, increase in temperature etc. For efficient power transfer capability, it is essential to relieve the congestion.

KEYWORDS: Congestion Management in Power System

INTRODUCTION

Recently, we could witness transformation in the control parameters of the power grids in the electric domain. Handling load dispatch is the most chief activity for an economic power system. The transmission and operational constraints, optimal power flow (OPF) is an indicative aspect can attain minimum cost generation. For a competent market, load system operator is crucial, providing the whole dispatch of the facility that gets disposed among the market players. Signing several bilateral contracts for electricity market trades can arrest network congestion due to insufficient resources. Real-time congestion system is the one that operates with no sufficient transmission capacity to accommodate, which is probably due to certain unexpected contingencies. The jamming may be lessened by desegregation transmission capability constraints within the dispatch and programming processes.

By doing so, generation has to be redistributed or load has to be curtailed, so that the congestion is relieved for the operation of phase-shifters or FACTS devices. At the time of serious congestion, the bilateral contracts need to dispatched. The power injections can be modified by changing the bilateral contract. Trading parties must be looked at as system decision factors (apart from the usual generation, loads and flows). A transaction network [1] of a deregulated transmission area is demonstrated in Figure 1.1, showing the link between information and income among varied players. Within the figure, G represents production-providing system; D, the superior system such as demand-providing systems (LSEs or discos procedure); E, marketers; and ISO, the independent scheme operative manner.

The load dispatch trouble can be addressed using two different ways, namely, cost minimization and minimization of transaction deviations. In a pool, real-time market, incremental and decremental bidding prices are submitted by the sellers (competitive generators), which when included in the OPF provides for the generator outputs the incremental/ decremental variations. In the bilateral market, the dealings include a reparation cost that the buyer–seller groups are interested to hire up. With relevancy the latter's devotion to the profaned restraint and congestion, the dealings has to be prioritized. Within a market mode (pool or bilateral dispatch), an OPF solution integrating FACTS devices is to be formulated. FACTS devices structure the facility system supported the dominant energy flows within the network, so the usage potential of transmission systems is inflated. The basis of operation of FACTS devices involves minimizing line congestion and ensuring contractual requirements. Various optimization methodologies aid are provided in solving the optimal power flow troubles, anmely, periodically sequence, quad manner, non linearity principle, linear principle, integer and active programming methodologies G D ISO E 3 principles, the methodologies such as Newton principles based systems, interior point methodologies are established. The objective of non-linearity principle and restraint polynomial equations adjust the earliest outline of OPF procedures because of their capability to replica electric energy systems procedures. By the fine role optimization procedure, the authors, Dommel and Tinney [2] demonstrate the methodology to reduce oil consumption cost and active energy departed. The Fletcher’s quasi-Newton technique [3] involves optimizing the moved penalty features. An active power with constraints relaxation could be solved by a linear programming methodology [4]. A successive linear programming (SLP) minimizes the loss objective of AC-DC system [5]. The operating state are linearized using the linear programming problems, approximating the nonlinear OPF issues, which is an SLP approach. For every iteration, a suboptimal solution is arrived at and therefore a new operating state is achieved, and this is often perennial till the target perform converges to the level of optimum. Megahed et al. [6] proposed the constraints that is non linear progress by applying series of linear and dynamical manner of programs. According to the Dantzig-Wolfe decomposition method as offered by Waight et al. [7], the dispatch problems consist of a major difficulty and other less linearity principle based applications of sub-problems are integrated. The Newton methodology and linear dynamical skilled programming methodologies are derived in the literature survey as given in the content. [8]. The author Burchett and Happ [9] used the methodology that is optimal solution of the application and an augmented Lagrangian-type function for proven a series of linearly constrained sub-problems, namely, directions of conjugation, methodologies such as steepest descent, Newton methods such as quasi methodologies.

In quadratic programming, objective functions are approximated and the constraints are linearized. Nanda et al. [10] provided an OPF algorithm by following the Fletcher’s quadratic programming system. Burchett et al. [11] proposed a successive quadratic programming (SQP) method, involving accurate, solution, and streamline processes. An SQP comprises a chain of quadratic programs from first and second derivatives of the 4-power flow equations and nonlinear objective function. For a security-constrained economic dispatch trouble, Vargas et al. [12] proposed an interior point method. In [13], a quadratic interior point method for OPF problems, economic load dispatch, and reactive power planning.

In the programming manner of quadratic, point functions are approximated and also the limitation are solved in linearly. Nanda et al. [10] provided an OPF procedure by following the Fletcher’s formulation programming methodology. Burchett et al. [11] projected Sequential quadratic programming (SQP) methodology, involving optimal, solution, and curved processes. The SQP procedure contains a sequence of quadratic programs from initial and second derivatives of the 4-power flow equations and nonlinear objective perform. For a security-constrained economic dispatch hassle, solon et al. [12] focused an surrounded assured methodology. In [13], a quadratic interior purpose technique for OPF issues, economic load send off, and reactive power coming up with.

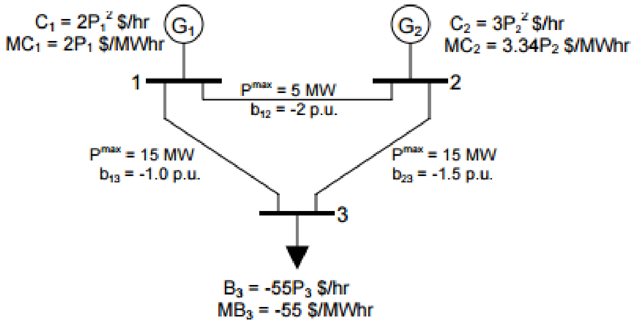


Figure 1: Sample Power System

Chapter 2 is about congestion management methodologies and the modification required in the new proposed framework of power markets for electricity. Chapter 3 is on the expression of different OPF troubles. Chapter 4 discussed FACTS devices in the OPF issues. Chapter 5 is on the OPF results. The concluding chapter is on further research in this field.

CONGESTION MANAGEMENT METHODOLOGIES

New structure structures evolved by vertically integrated operation, namely, unbundling of the electrical installation, which means gap of competition during a vertically integrated structure coordinated with the aim of reducing the full prices of the package. Previously, the system functions like automatic generation management system (AGMS), state estimation, generation dispatch, unit commitment system were controlled by the energy management systems, which are achieved by generation dispatch. The function of both reducing generation costs and avoiding congestion are enhanced by the optimal power flow. The limitations in the line operating flow involve a common procedure that cannot be violated. A signal for rescheduling generation or continual congestion for installation of latest transmission /generation proposals is that the improve within the line flow ability problems.

Un-Bundled Operation

Loads, line flows, contracts between commercial procedures, are the system call factors. In an electricity market, the pool and bilateral competitive structures are (1) single-action power pools whereby wholesale sellers supply to provide power through a single-pool system. The wholesale power in that pool are bought in units at a regulated price, by the load portion procedures (LSEs or group of buyers), then it will be given to the retail dealers for further marketing. (2) In double-action power pools methodology, the special offers and other commitments are all in a single pool will be given for further overcoming the competing buyers to the retail load to enclose the almost special issues of marketing. (3) In bilateral wholesale contract, it consists of solely the wholesale generators in MW and therefore the LSEs, while not third-party intervention. (4) double-action contracts carries with it purchase and sale agreements between many sellers and customers, with the intervention of third parties like forward contractors. In each (3) and (4) the worth and amount are received by the market participants. The ISO maintains power security and carries out congestion management downside. The facility system contracts verify the market conditions. The resultant transactions could also be considered sets of power injections and extractions at the vendor and customer buses, severally. For instance, during a system of n buses, with the generator buses numbered from one to m numbered, the nodal active powers could also be defined as [14]

Sigma= + ∑K + ka∈KA U pos [T^i /K*P* Pi], P and compensation of loss, i =1, 2, …m (2.1)

∑K∈ = + ka KA j pos j [T^j/K*D*D], D,, j= m+1, …n (2.2)

where Pi = active injected power at generator bus and that i Dj = active extracted power from load bus j K = set of bilateral transactions system Ppo,I = pool power injected at bus i Dpo,j = pool power extracted at bus j PTk,I = power injected at bus i with group action TK DTk,j = power extracted at bus j in accordance with group action TK Loss compensation provided at bus i by all transaction participants to form sensible the losses of systems.

Congestion Management Methodologies:

Two different congestion management methodologies are the cost-free suggests that and also the not-cost-free systems [15]. The previous system improves outages of distended lines or operation of electrical device problems, part shifters, on-line dynamic transformers or FACTS devices. Because the various cost concerned in their usage is nominal, they can be known as value free. The not-cost-free options are as follows: (i) rescheduling generation at equilibrium purpose determined by equal space criteria or equal progressive prices. Together with the mathematical models of cost accounting tools to the dispatch framework and also the corresponding value signals is extremely vital. Congestion valuation is obtained based on value signals, and as indicators for market price, participants must arrange their power injections and extractions. By doing this, congestion is eliminated to a good extent. (ii) Prioritization and curtailments of loads/transactions or in other words it is the willingness to pay so that curtailments are avoided [14]. This enables the transaction curtailments added to the optimal power flow frameworks. In the forthcoming chapters, we demonstrate OPF formulations incorporating both (1) and (2) methods. Open access system dispatch models [16] are used as a part of a time period system. To confirm secure and economical installation operation, this module supported the prevailing in operation condition is enforced. To attain uncongested operation of the power management system, the resources and controls are the required curtailment of transactions.

The Economic Dispatch Framework of Congestion Management System

A power system involves computing optimal bus prices and congestion costs, whose transmission system and sets nodal prices are controlled by an independent company (ISO) controls. The dispatch of centralized load is estimated as the part transmission system. Both the congestion charges and load dispatch are derived using a simple power system. Figure 2.1 is a three-bus system with generator costs/marginal costs.

Figure 1 Sample power system and its approximations:

- The base susceptance bij indicates the transmission line.
- A DC power flow line model without loss is considered, wherein the angular variations in the bus voltage angular are thought-about to be lower value and also the voltage magnitudes almost equal to 1.00 p.u.
- As discussed earlyer, this drawback is compensated employing a centralized dispatch framework whose aim is to boost social profit, therefore making certain to decreasing the system operational prices and therefore the client profit (costs), subjecting to the binding G1, G2, 1 2 3 B3 = -55P3 \$/hr MB3 = -55 \$/MWhr C

CONGESTION MANAGEMENT PROBLEM

Optimization Problem building

The functional acvitivities of rescheduling and power optimization can be expressed as follows:

Minimize $Z = f_1 + f_2$

As we proved the equation, the optimal solution of power flow for minimizing the entire operating power and cost can be derived as:

Objective:

$$\text{Min } f(x) = x * \sum_i^{Ng}(a\alpha_i * yPg_i^2 + b\beta_i * xPg_i + f\gamma_i) + fC_{TCSC} \tag{1.1}$$

Based on following Constraints:

Non Linear Equality Constraints or Variable

(load flow equations)

$$\text{LF(x(i))=0} \tag{23}$$

Where g(x) represents equality constraints including system bus power flow equations. i.e.,

$.a * Pg_i - b * Pd_i - PIP_i(V, \theta, T) = 0$

$.pi * Qg_i - pi * Qd_i - PF * Q_i(V, \theta, T) = 0$

i= 0,1,2,….N-1.

Nonlinear difference limitations are line flow constraints, interface flow limitations and straightforward difference limitations of variables like magnitude of voltage, active power generation, reactive powers generation, electrical device tap ratio

$$\text{s}h_j^{min} \leq G * h_j(pi * P_g, H * Q_g, abs(V, \theta, T)) \leq a * h_j^{max} \tag{24}$$

$j=1, 2,\ldots,N_h$

where $x = [abs(V, \theta, T), pi * Pg, H * Qg]^T$, $\alpha_{i,}$ βi, γi are the coefficients of quadratic cost functions at bus i, Pg is that the bus active generation, θ is that the bus angle vector,, Qd is bus reactive load, V is that the bus voltage magnitude, Qg is that the bus reactive generation and Pd is the bus active load, hmin, hmax are bound and boundary vectors, severally,T is that the electrical device faucet quantitative relation vector, for difference constraints, weight unit is that the total variety of generators and N is total number of buses, and Granite State is the entire variety of double-side difference constraints. For a operation of constant system, it is nearly not possible to prepare the region of possible solutions by convincing all limitations. The unfeasible resolution is handled by a nonlinear OPF architecture that presents scheduling reactive load variables and constraint variable, as given in equations 1-4:

Using Fiacco and McCormick's barrier method, we shift the OPF problem (1) into the following equivalent OPF problem, By appling Fiacco and McCormick's methodology, we can utilize the OPF formulation (1) migrate to the following formulation of OPF problem,

Objective:

$$Min\{f(x) - \mu \textstyle\sum_i^{Nh} \mathrm{pi} * \ln(sl_i) - \mu \sum_i^{Nh} abs(\ln(su_i))\} \tag{22.1}$$

Based on the following constraints

$$G(x(i))=0 \tag{22.2}$$

$$H*h(x)-a*sl- H*h^{min}=0 \tag{22.3}$$

$$H*h(x)+a*su- H*h^{max}=0 \tag{22.4}$$

where, μ *is greater than zero*

The equalities optimization is achieved by Lagrangian function

$$.L = f(x) - \mu \textstyle\sum \ln(sl) - \mu \sum \ln(su) - \lambda^T g(x)$$

$$-\pi l^T(h(x) - sl - h^{min}) - \pi u^T(h(x) + sl - h^{max}) \tag{23}$$

Where λ, пl, пu are Lagrangian multiples for constraints (2.2),(2.3),(2.4), respectively, as follows.

The Karush-Kuhn-Tucker (KKT) first-order filter conditions for the Lagrangian function of (3) are,

$$\nabla_x L_\mu = \nabla f(x) - \nabla g(x)^T \lambda - \nabla h(x)^T \pi l - \nabla h^T \pi u = 0 \tag{24.1}$$

$$\nabla_\lambda L_\mu = -g(x) = 0 \tag{24.2}$$

$$\nabla_{\pi l} L_\mu = -(h(x) - sl - h^{min}) = 0 \tag{24.3}$$

$$\nabla_{\pi u} L_\mu = -(h(x) + su - h^{max}) = 0 \tag{24.4}$$

$$\nabla_{sl} L_\mu = \mu e + Sl * nl = 0 \tag{24.5}$$

$$\nabla_{su} L_\mu = \mu e - Su * nu = 0 \tag{24.6}$$

where, Sl=diag(sl_j),

Su=diag(su_j),

Пl= diag(sl_j),

Пu= diag(su_j).

The optimized solution can be utilized by the Newton formulation for non-linear interior point of power flow optimal algorithm,

$$\begin{bmatrix} -nl^{-1}Sl & 0 & -\nabla h & 0 \\ 0 & -nl^{-1}Sl & -\nabla h & 0 \\ -\nabla h^T & -\nabla h^T & H & -J^T \\ 0 & 0 & -J & 0 \end{bmatrix} \begin{bmatrix} \Delta nl \\ \Delta nu \\ \Delta x \\ \Delta \lambda \end{bmatrix} = \begin{bmatrix} -\nabla_{nl} L_\mu + nl^{-1} \nabla_{\mathrm{Sl}} L_\mu \\ -\nabla_{nu} L_\mu + nu^{-1} \nabla_{\mathrm{Su}} L_\mu \\ -\nabla_x L_\mu \\ g(x) \end{bmatrix} \tag{25.1}$$

$$\Delta sl = nl^{-1}(-\nabla_{\mathrm{sl}}\mathrm{L}_{\mu} - \mathrm{Sl}\Delta\pi\mathrm{l}) \tag{25.2}$$

$$\Delta su = nu^{-1}(-\nabla_{\mathrm{su}}\mathrm{L}_{\mu} - \mathrm{Su}\Delta\pi\mathrm{u}) \tag{25.3}$$

where,

$.H(x, \lambda, \pi l, \pi u) = \nabla^2 f(x) - \lambda\nabla^2 g(x) - (\pi l + \pi u)\nabla^2 h(x),$

$J(x) = \frac{\partial g(x)}{\partial x}.$

Resolving the Newton equation based on above derivatives, we can arrive at equation (7),Δnl, Δnu, Δx, $\Delta\lambda$, Δsl, Δsu, thereby updating the Newton solution,

$$sl = sl + \sigma\alpha_p \Delta sl \tag{26.1}$$

$$su = su + \sigma\alpha_p \Delta su \tag{26.2}$$

$$\mathrm{x} = x + \sigma\alpha_p \Delta x \tag{26.3}$$

$$\pi l = nl + \sigma\alpha_d \Delta nl \tag{26.4}$$

$$\pi\mathrm{u} = nu + \sigma\alpha_d \Delta nu \tag{26.5}$$

$$\lambda = \lambda + \sigma\alpha_d \Delta\lambda \tag{26.6}$$

Where σ =0.995~0.999 95. $\alpha_{p,}$ α_d are primary and dual step length factor, respectively, then it can be written as,

$$\alpha_P = min\left\{min\left(\frac{sl}{-\Delta sl}\right), min\left(\frac{su}{-\Delta su}\right), 1.0\right\} \tag{27.1}$$

$$\alpha_d = min\left\{min\left(\frac{-nl}{-\Delta nl}\right), min\left(\frac{nu}{-\Delta nu}\right), 1.0\right\} \tag{27.2}$$

The complementary gap of the nonlinear interior point optimal power flow is,

$$C_{gap} = su^T nu - sl^T nl \tag{28}$$

The barrier parameters can be determined by,

$$\mu = \frac{\beta * C_{gap}}{2 * m} \tag{29}$$

where β=0.01~0.2, m is the number of inequality constraints in (21.3)

Algorithm

This algorithm procedure for the nonlinear interior purpose OPF is summarized as follows:

Step 0) set iterations count k=0,μ=μ0 and the optimal power flow resolution is initialized to getting lower limitations

Step1) if KKT conditions are acceptable and balancing gap is a lesser quantity than a acceptance, the output is drawn. Otherwise move to step 2)

Step 2) solve Newton equation in (25.1), then (25.2) and (25.3)

Step 3) exploitation equation (26) updates Newton resolution

Step 4) exploitation equation (28), cipher complementary gap

Step 5) return to step one, k=k+1.

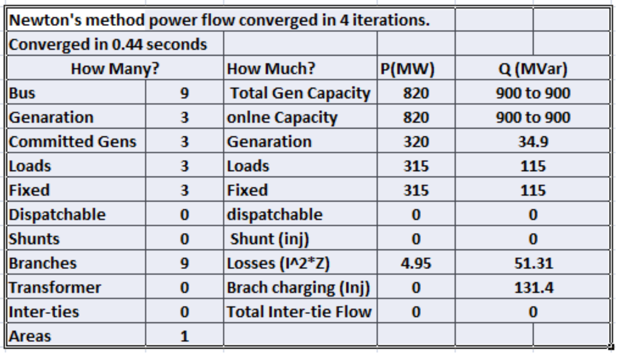
Solution by Descent Gradient Method

RESULTS AND DISCUSSIONS

As we are all aware, software language is implemented and programmed using Matlab software, which is also used for writing OPF. Another successful algorithm is applying the optimal power flow in various kinds of power market on a daily basis. The lower amount of generation dispatch to setting generation voltage calculation could be a method of the power flow optimization. To resolve power flow studies and optimal power flow issues, transformer taps MATPOWER comprising a package of MATLAB M-file is used. In research and education, it is used as a simulation tool as it is easy to use and modify. Developed as part of the power Web Project and as simple code that is easy to modify, MATPOWER is made to give the best performance. The congestion of initial dispatch is solved, providing good offers to re-dispatch for load dispatch issues.

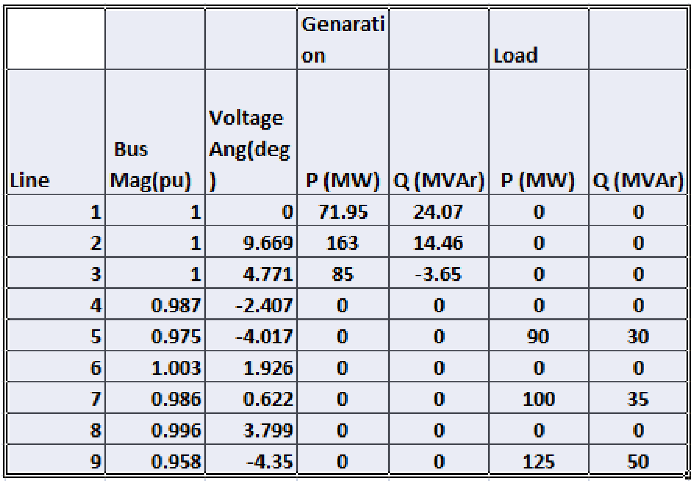
The 9 bus IEEE represents a portion of the American Electric Power System. The data were kindly provided by author Joe H.Chow’s Book page No.70. The figure demonstrates the one-line diagram of an IEEE-9 bus system. Tables 1 and 2 present the line data, bus data and load.. It consists of 3 synchronous generators for production and also 3 load points. The figure below shows the associated flow results, which are on 100MVA base.

Table 1: Generator Capacity, Active and Reactive Power for 9 Bus System using NR Method



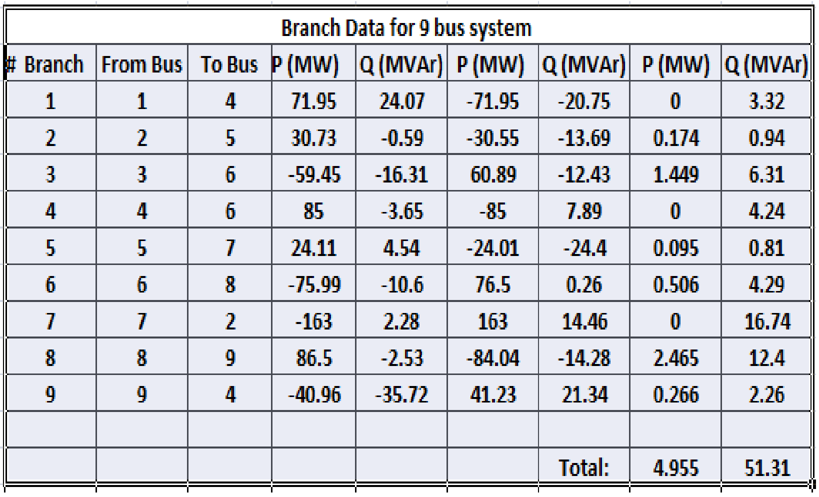
Newton's method power flow converged in 4 iterations.				
Converged in 0.44 seconds				
How Many?		How Much?	P(MW)	Q (MVar)
Bus	9	Total Gen Capacity	820	900 to 900
Genaration	3	onlne Capacity	820	900 to 900
Committed Gens	3	Genaration	320	34.9
Loads	3	Loads	315	115
Fixed	3	Fixed	315	115
Dispatchable	0	dispatchable	0	0
Shunts	0	Shunt (inj)	0	0
Branches	9	Losses (I^2*Z)	4.95	51.31
Transformer	0	Brach charging (Inj)	0	131.4
Inter-ties	0	Total Inter-tie Flow	0	0
Areas	1			

Table 2: Line-To-Line Power Flow Limits



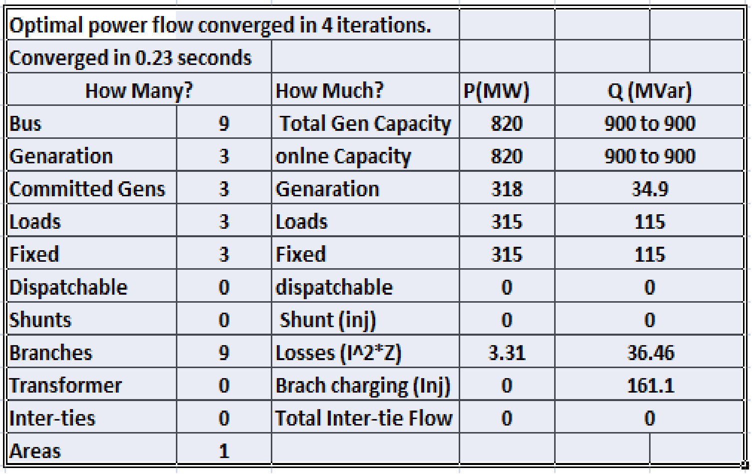
			Genaration		Load	
Line	Bus Mag(pu)	Voltage Ang(deg)	P (MW)	Q (MVAr)	P (MW)	Q (MVAr)
1	1	0	71.95	24.07	0	0
2	1	9.669	163	14.46	0	0
3	1	4.771	85	-3.65	0	0
4	0.987	-2.407	0	0	0	0
5	0.975	-4.017	0	0	90	30
6	1.003	1.926	0	0	0	0
7	0.986	0.622	0	0	100	35
8	0.996	3.799	0	0	0	0
9	0.958	-4.35	0	0	125	50

Table 3: Branch Flow Limits



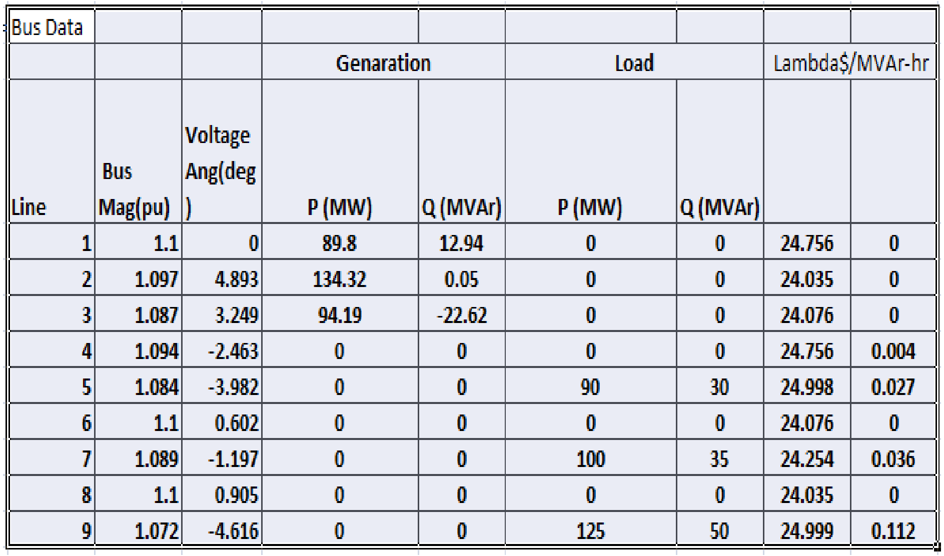
Branch Data for 9 bus system								
# Branch	From Bus	To Bus	P (MW)	Q (MVAr)	P (MW)	Q (MVAr)	P (MW)	Q (MVAr)
1	1	4	71.95	24.07	-71.95	-20.75	0	3.32
2	2	5	30.73	-0.59	-30.55	-13.69	0.174	0.94
3	3	6	-59.45	-16.31	60.89	-12.43	1.449	6.31
4	4	6	85	-3.65	-85	7.89	0	4.24
5	5	7	24.11	4.54	-24.01	-24.4	0.095	0.81
6	6	8	-75.99	-10.6	76.5	0.26	0.506	4.29
7	7	2	-163	2.28	163	14.46	0	16.74
8	8	9	86.5	-2.53	-84.04	-14.28	2.465	12.4
9	9	4	-40.96	-35.72	41.23	21.34	0.266	2.26
						Total:	4.955	51.31

Table 4: Generator Capacity, Active and Reactive Power for 9 Bus System using Optimal Power Flow Method



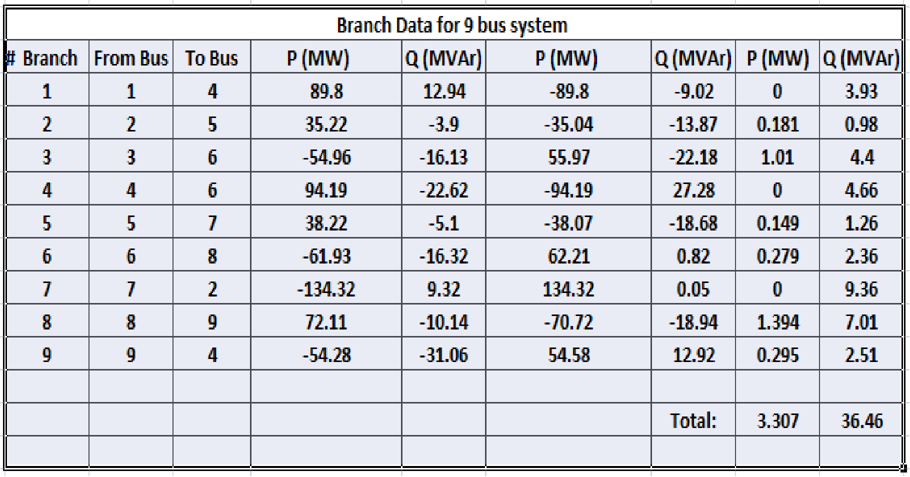
Optimal power flow converged in 4 iterations.				
Converged in 0.23 seconds				
How Many?		How Much?	P(MW)	Q (MVar)
Bus	9	Total Gen Capacity	820	900 to 900
Genaration	3	onlne Capacity	820	900 to 900
Committed Gens	3	Genaration	318	34.9
Loads	3	Loads	315	115
Fixed	3	Fixed	315	115
Dispatchable	0	dispatchable	0	0
Shunts	0	Shunt (inj)	0	0
Branches	9	Losses (I^2*Z)	3.31	36.46
Transformer	0	Brach charging (Inj)	0	161.1
Inter-ties	0	Total Inter-tie Flow	0	0
Areas	1			

Table 5: Line-To-Line Power Flow Limits



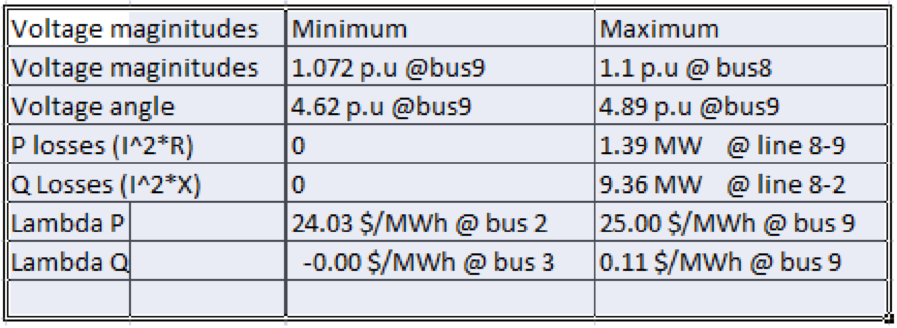
Bus Data								
			Generation		Load		Lambda$/MVAr-hr	
Line	Bus Mag(pu)	Voltage Ang(deg)	P (MW)	Q (MVAr)	P (MW)	Q (MVAr)		
1	1.1	0	89.8	12.94	0	0	24.756	0
2	1.097	4.893	134.32	0.05	0	0	24.035	0
3	1.087	3.249	94.19	-22.62	0	0	24.076	0
4	1.094	-2.463	0	0	0	0	24.756	0.004
5	1.084	-3.982	0	0	90	30	24.998	0.027
6	1.1	0.602	0	0	0	0	24.076	0
7	1.089	-1.197	0	0	100	35	24.254	0.036
8	1.1	0.905	0	0	0	0	24.035	0
9	1.072	-4.616	0	0	125	50	24.999	0.112

Table 6: Branch Flow Limits



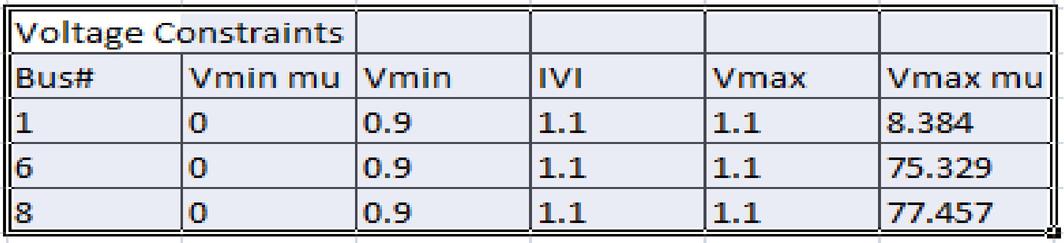
Branch Data for 9 bus system								
# Branch	From Bus	To Bus	P (MW)	Q (MVAr)	P (MW)	Q (MVAr)	P (MW)	Q (MVAr)
1	1	4	89.8	12.94	-89.8	-9.02	0	3.93
2	2	5	35.22	-3.9	-35.04	-13.87	0.181	0.98
3	3	6	-54.96	-16.13	55.97	-22.18	1.01	4.4
4	4	6	94.19	-22.62	-94.19	27.28	0	4.66
5	5	7	38.22	-5.1	-38.07	-18.68	0.149	1.26
6	6	8	-61.93	-16.32	62.21	0.82	0.279	2.36
7	7	2	-134.32	9.32	134.32	0.05	0	9.36
8	8	9	72.11	-10.14	-70.72	-18.94	1.394	7.01
9	9	4	-54.28	-31.06	54.58	12.92	0.295	2.51
						Total:	3.307	36.46

Table 7: System Parameters



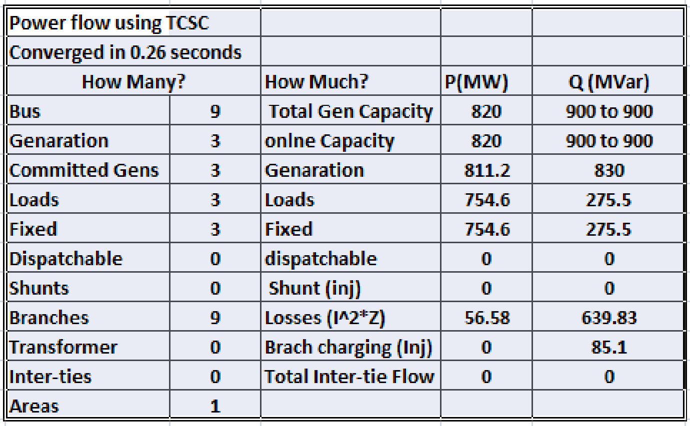
Voltage maginitudes	Minimum	Maximum
Voltage maginitudes	1.072 p.u @bus9	1.1 p.u @ bus8
Voltage angle	4.62 p.u @bus9	4.89 p.u @bus9
P losses (I^2*R)	0	1.39 MW @ line 8-9
Q Losses (I^2*X)	0	9.36 MW @ line 8-2
Lambda P	24.03 $/MWh @ bus 2	25.00 $/MWh @ bus 9
Lambda Q	-0.00 $/MWh @ bus 3	0.11 $/MWh @ bus 9

Table 8: Voltage Constraints



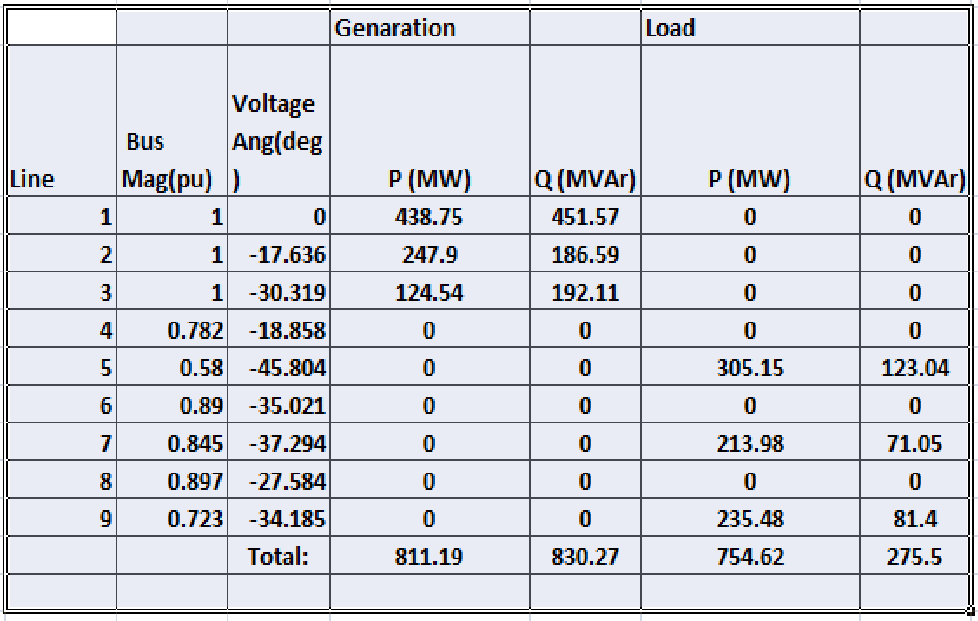
Voltage Constraints					
Bus#	Vmin mu	Vmin	IVI	Vmax	Vmax mu
1	0	0.9	1.1	1.1	8.384
6	0	0.9	1.1	1.1	75.329
8	0	0.9	1.1	1.1	77.457

Table 9: Generator Capacity, Active and Reactive Power for 9 Bus System using TCSC



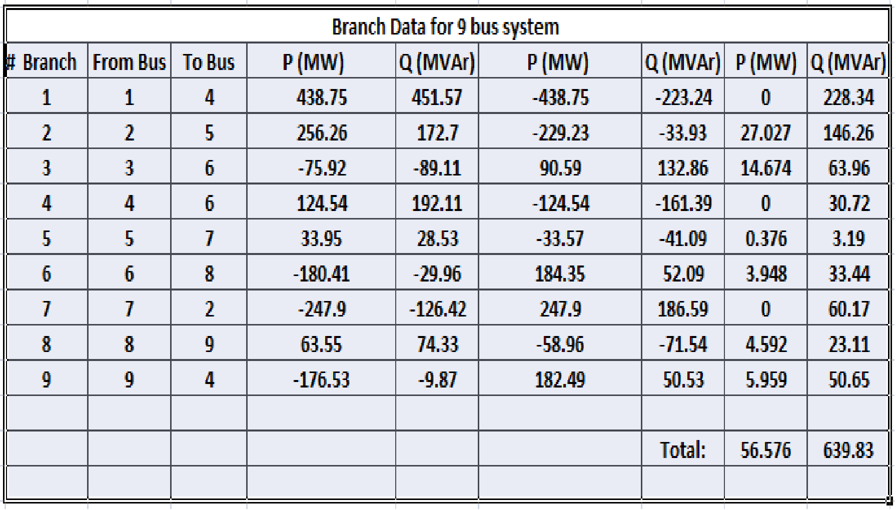
Power flow using TCSC				
Converged in 0.26 seconds				
How Many?		How Much?	P(MW)	Q (MVar)
Bus	9	Total Gen Capacity	820	900 to 900
Genaration	3	onlne Capacity	820	900 to 900
Committed Gens	3	Genaration	811.2	830
Loads	3	Loads	754.6	275.5
Fixed	3	Fixed	754.6	275.5
Dispatchable	0	dispatchable	0	0
Shunts	0	Shunt (inj)	0	0
Branches	9	Losses (I^2*Z)	56.58	639.83
Transformer	0	Brach charging (Inj)	0	85.1
Inter-ties	0	Total Inter-tie Flow	0	0
Areas	1			

Table 10: Line-To-Line Power Flow Limits using TCSC



			Genaration		Load	
Line	Bus Mag(pu)	Voltage Ang(deg)	P (MW)	Q (MVAr)	P (MW)	Q (MVAr)
1	1	0	438.75	451.57	0	0
2	1	-17.636	247.9	186.59	0	0
3	1	-30.319	124.54	192.11	0	0
4	0.782	-18.858	0	0	0	0
5	0.58	-45.804	0	0	305.15	123.04
6	0.89	-35.021	0	0	0	0
7	0.845	-37.294	0	0	213.98	71.05
8	0.897	-27.584	0	0	0	0
9	0.723	-34.185	0	0	235.48	81.4
		Total:	811.19	830.27	754.62	275.5

Table 11: Branch Flow Limits using TCSC



Branch Data for 9 bus system

# Branch	From Bus	To Bus	P (MW)	Q (MVAr)	P (MW)	Q (MVAr)	P (MW)	Q (MVAr)
1	1	4	438.75	451.57	-438.75	-223.24	0	228.34
2	2	5	256.26	172.7	-229.23	-33.93	27.027	146.26
3	3	6	-75.92	-89.11	90.59	132.86	14.674	63.96
4	4	6	124.54	192.11	-124.54	-161.39	0	30.72
5	5	7	33.95	28.53	-33.57	-41.09	0.376	3.19
6	6	8	-180.41	-29.96	184.35	52.09	3.948	33.44
7	7	2	-247.9	-126.42	247.9	186.59	0	60.17
8	8	9	63.55	74.33	-58.96	-71.54	4.592	23.11
9	9	4	-176.53	-9.87	182.49	50.53	5.959	50.65
						Total:	56.576	639.83

CONCLUSIONS

The challenges in restructuring the electric power industry are the equipped aspects of power systems. This work is all about the management system of congestion within a framework of optimal power flow in a scenario of deregulated electricity market. To confirm that the system operation stays within security constraints, it is necessary to modify the conventional OPF problem so that it allows the complete marketing and trading aspects, dealing with ISO's the pool and bilateral load dispatch functions, which are evaluated using numerical examples and simulation tools. In open-access transmission systems, OPF is more often used for transmission costing and transaction evaluation. The market players interaction of a complex manner. Future work should focus on understanding the economic riskbecause of the acceptance and avoidance to give the attention of pay to avoid curtailment. Different dispatch and curtailment strategies are to be designed. In a deregulated environment, the optimal locations for FACTS devices can be approximated for those devices.

For optimal power flow, we need to look at more reliable methods, facilitating the development of simpler and robost OPF packages.

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