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Optimal Allocation of Different Type of Distributed Generation in Order to Improve the Performance of Power System Networks

R. B. Singh[1]
Goverment Polytechnic, Kenura
Sultanpur-228159, U.P., India
rbsinghgovt@gmail.com

Dr. R.P. Payasi[2]
Kamla Nehru Institute of Technology
Sultanpur-228118, U.P., India
payasirp@rediffmail.com

Dr. K. S Verma[3]
Kamla Nehru Institute of Technology
Sultanpur-228118, U.P., India
ksv211@rediffmail.com

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Abstract – The Optimal use of DG is essential for future necessity in electrical power system networks. The optimal allocation of DG is essential for proper functioning of electrical power method networks. To condense the active power losses and advance the overall voltage profile, these are main concerns for safe operation of power system networks. In this paper, we have compared four different types of DG with different characteristics. In IEEE-9 bus system, the optimum losses are almost same which is 2.9404MW for DG type-1, type-2 and type-4 but for type-3 it is 4.7326MW and improvement in voltage profile is better as compared to other types of DG . In IEEE-24 bus system, the optimum losses for DG type-1, type-2 and type-4 are almost same but for DG type-3 it is 50.4028MW and enhancement in voltage profile is better as associated to other types of DG. In IEEE-33 bus system, the optimum losses for DG type-2 is minimum as compared to type-1, type-3 and type-4 and also improvement in voltage profile is better for type-2 as related to other types of DG. The optimal allocation of DG is done using PSO technique with the help of MATLAB tool mat power 6.0.

Keyword – Distributed-Generation, OptimalDG Location, DG Optimal Size, PSO

I. INTRODUCTION

The distributed Generation (DG), is a tiny generator strewn around a power system network that provides electricity to load users on a local level [1]. Industrial, commercial, and residential applications can all benefit from DG. In some regions, DG uses cutting-edge technology that is efficient, dependable, and simple enough to compete with traditional huge generators [2-3]. Major changes are seen in power industries recently, owing smart-grid technologies and the gradual implementation of distributed generation. DG is simply defined as the decentralization of power facilities by locating smaller generating units closer to the point of consumption, often 10 megawatts or less. While DG is not a new concept, but it is gaining popularity because to the following factors: increased customer demand, technological improvements, economics, deregulation, environmental concerns, and national security concerns. The distribution system is radial in design and does not have any installed generation units. At the Supply Point, electrical energy is sent to the distribution network via transmission. As a result, power flows from transmission to distribution in one direction. At this time, a growing number of generators are connected to the distribution system, which is referred electricity as Distributed Generation. The distribution system's operation is influenced by the location and amount of power delivered by the DG into the system. They have the power to improve the system's efficiency and stability. The DG's large power output can even reverse the direction of power flow. As a result, the finest position and size for the DG are preferred. Using the particle swarm optimization technique, the ideal location of a certain size DG is discovered in [4-5]. The goal is to reduce the system's losses. The preeminent locus and sizing of the DG are gritty in this research in order to minimize the distribution network's total losses.

Technological advancements, environmental policies, and the expansion of the financial and electrical markets are all driving new conditions in the energy generation industry today [6-8].

Electricity may now be generated in small plants obligations to new technologies. Furthermore, as the usage of renewable energy sources grows in order to lessen the environmental impact of power generation, new electrical energy delivery schemes are developed and implemented [9-10].

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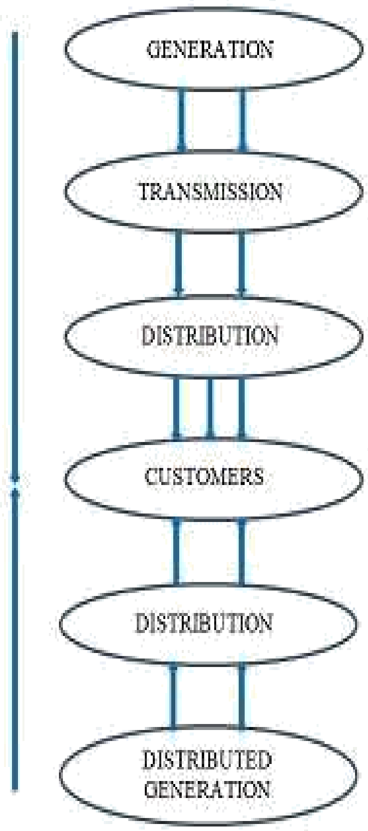

Fig.1 New industrial conception of the electrical energy supply

II. DISTRIBUTED GENERATION

As a result of "deregulation in the electric power sector", a new name for "distributed generation" arose on the electric system map (DG). DG is a new technique of delivering electricity at the center of the power grid. It is primarily dependent on the installation of a portfolio of tiny, compact, and environmentally friendly electric power generators. The electric power generation trend, according to new technology, is to use distributed generation units ranging in size from "KW to MW at load sites" rather than outdated federal generation's units ranging in size from 100 MW to several GW [13-15]. These distributed technologies offer numerous advantages, including great fuel efficiency and fast implementation times, which contribute to their increasing popularity. When you consider how the first power utilities produced and delivered electricity, it's easy to see why.

Utilities have their own designated zone in which they produce and transport electricity. National orregional grids emerged as a result of the vast interconnected system, making electricity systems more cost-effective and reliable [16-18]. New problems have lately emerged in the power business, such as the difficulty in finding new locations for hydro power plants, despite the fact that hydro power plants are known to be environmentally beneficial. Furthermore, certain nations, including as Germany and Sweden, have enacted lows for decommissioned nuclear power stations, and retired nuclear power facilities are not expected to be replaced. Furthermore, it is difficult to persuade market participants to invest billions of dollars in power generation and transmission projects with long payback periods in the pronominal deregulated power business.

These difficulties, as well as the decentralization of the power system an deregulation of the electrical industry, have made DG an appealing option that has been reviewed by a variety of organizations, including customers, distributors, power producers, regulators, and researchers [19-20]. Various DG devices can be strategically placed in the grid to reduce power losses, improve voltage profile and load factors, eliminate the need for system improvements, and improve system integrity, reliability, and efficiency.

The particle swarm optimization technique was employed in this research to find the ideal size and location of DG for minimizing system power loss, maintaining voltage control at each bus, and keeping the system's frequency steady. The type-1 DG can only deliver active electricity from photo-voltaics, micro turbines, and fuel cells that are connected to the main grid via converters/inverters. However, photovoltaics can and are occasionally required to generate reactive electricity as well, depending on the present situation and grid rules. The Type- 2 DG with ability to provide both of "active and reactive" power. Only reactive power can be delivered by Type-3 DGs. Gas turbines are an example of synchronous compensators, which run at zero power factors. The Type- 4 DG with ability to deliver active power while consuming the reactive power. This category mostly includes induction generators, which are commonly employed in wind farms [21].

III. P A R T IC L E SWARM OPTIMIZATION (PSO)

The Kennedy and Eberhart described "PSO" approach for the first time in 1995. The "PSO" is a multiple-agent with parallel search strategy that preserves a throng of particle's which signifies "potential swarm" solution [22]. At each step t, if xi^t denotes the "position vector" of particle I in the multi-dimensional pursuit space (i.e. R^n), then the location of every particle in exploration cosmos is updated by,

[$x_i^{t+1} = x_i^t + v_i^{t+1}$ with $x_i \sim U(x_{min}, x_{max})$] (1)

Where,

vi^t is the "particle's velocity vector", which initiatives the "optimization process and reflects both the particle's own experience knowledge and the collective experience knowledge of all particles $U(x_{min}, x_{max})$ is the uniform distribution, with x_{min} and x_{max} being its minimum and maximum values, respectively". In this paper, "global best PSO (or gbest PSO)" is a process and situation for every particle is prejudiced through finest-fit particle's in entire swarm. It uses a star social network topology to collect social data from all particles in the swarm. Every particle in this process has a current position in search space, x_i, a current velocity, v_i, and a personal best position in search space, $P_{best,i}$, where n>1. The best place for yourself $P_{best,i}$ agrees with the case in which particle I had the lowest value as determined by objective function f, indicating a minimization problem. In addition, the global best position, denoted by Gbest [23], is the position with the lowest value among all the personal best $P_{best,i}$. The equations below demonstrate how personal and global optimal values are altered. In the case of minimization problems, $P_{best,i}$ at the following time step, t+1, where t[0,......N], is determined as,

$$P_{best} = \begin{Bmatrix} P_{best,i^t} \; if \; f({x_i}^{t+1}) > P_{best,i^t} \\ x_i^{t+1} \; if \; f({x_i}^{t+1}) \leq P_{best,i^t} \end{Bmatrix}$$

where [$f : R^n \rightarrow R$] is the fitness function . The "global best position Gbest" at time step t is calculated as,

$G_{best} = \min\{P_{best,i}\}$, where $i \in [1,\ldots,n]$ and n>1

As a result, it's crucial to remember that $P_{best,i}$ is the particle's best location since the first time step. G_{best}, on the other hand, is the best position discovered by any particle in the entire swarm. The typical PSO technique is used to compute particle velocity.

$V_{ij}^{t+1} = v_{ij}^t + c_1 r_1 [P^t_{best,i} - x^t_{ij}] + c_2 r_2 [G_{best} - x^t_{ij}]$

Where,

Where, "V^t_{ij} is the velocity vector, of particle i in dimension j at time t, x^t_{ij} is the position vector of particle in dimension j at time t, $P^t_{best,i}$ is the personal best position of particle i in dimension j found from initialization

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through time t, G_{best} is the global best position of particle i in dimension j found from initialization through time t", C_1 and C_2 are "position acceleration constants" and r_1 and r_2 are random integers from the uniform distribution U(0,1) at time t, which are used to level the contribution. During using of PSO technique, we find that the DG of "optimal size at optimal bus location" is placed. The overall power losses are condensed at equivalent time as the "overall voltage profile of the power system network" is also improved during the process without using DG. Three test bus systems IEEE9, IEEE 24 and IEEE30 for this purpose are taken for test. The Flowchart shows the "gbest PSO" algorithm.

Algorithm 1: The framework of PSO algorithm applied to solve OPF problems

Initialize the population size (values DGs in MVA) 'P', number of dimension (buses) 'D', termination criterion i.e. maximum number of iteration 'N' and the value of position accretion constant c_1 & c_2. Initialize the value for power factor i.e. 1 for leading & -1 for lagging and 1 for unity power

Generate the initial solutions equals to population size 'P' i.e. values DGs in MVA in the form of array x.

For *j*= 1:D
For *i*= 1: *P*

Evaluate optimal power flow solution for given values of DG for bus *j* i.e $f^t_{ij}(x)$.
End For

Identify minimum loss corresponding to optimum value of DG for bus *j* i.e. $f^t_{best,j}(x)$.
For *k*= 1:*N*

$x_{i,j}^{t+1}$ → modified values of $X_{i,j}^t$ based on equations (1) & (2).
For *i* = 1:*P*
Evaluate optimal power flow solution for given values of DG for bus j *i.e* $f^{t+1}(x)_{i,j}$.

Identify minimum loss corresponding to optimum value of DG for bus *j* i.e. $f^{t+1}(x)_{best,.j}$. ***If***
$f^{t+1}(x)_{best,j} < f^t(x)_{best,j}$

$P^t(x)_{best} = f^{t+1}(x)_{best,j}$;

else

$P^t(x)_{best} = f^t(x)_{best,j}$
End If

End For

For *i*= 1: *P*

Evaluate optimal power flow solution for given values of DG for bus *j* with above input *i.e.* **position best** solution.

End For

Identify minimum loss corresponding to optimum value of DG for bus *j* among position best solution *i.e* .***global best*** .

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End For

Forward ***position best*** solutions and global best solution as input to next iteration.

End For

IV. OBJECTIVE FUNCTION

The basic ordinary kind of Optimal Power Flow complications proceeds the subsequent form.

$\min f(a)$ (1.0)

$X(a) = 0$ (1.1)

$Y(a) \leq 0$ (1.2)

$amin \leq a \leq amax$ (1.3)

Where, equations 1.1 to 1.3 are known as equality constrains, inequality constraints and limit to design variables.

The Standard form of AC OPF:

The "optimization vector, a for the standard form of AC OPF" problem involves of the [nb × 1] vector's of "voltage angles α and magnitudes V_m" with real and reactive power is [ng × 1] vector's real and reactive power injections Pg and Qg generators.

$$a = \begin{bmatrix} \alpha \\ Vm \\ Pg \end{bmatrix}$$

The objective function for the allocation of DG which is 1.0, basically addition of separate polynomial cost functions f^j and fj of " real and reactive power injections", correspondingly, for every generator.

$$\min_{\alpha,V_{m},P_{g},Q_g} \sum^{n_g} f_p\left(p_g^j\right) + f_Q(q^i)_g \quad (1.4)$$

The equality constraints are the 2 nb nonlinear real and reactive power balancing equations in their entirety. The inequality constraints are made up of two sets of nl "branch flow limitations", one for the from end and one for the to end of every branch, that are nonlinear functions of "bus voltage angles" and magnitudes .Flow's" resilient the subsequent three conceivable form's for the flow constraints.

$F_f(\alpha, V_m) = Sf(\alpha, V_m)$, apparent power

$$[h_f(\alpha, V_m) = |F_f(\alpha, V_m)| - F_{\max} \leq 0] \quad (1.5)$$

$$[ht(\alpha, Vm) = |Ft(\alpha, Vm)| - Fmax \leq 0] \quad (1.6)$$

$Pf(\alpha, V_m)$, real power

$I_f(\alpha, V_m)$, current

The flow's are characteristically deceptive power flow's uttered in MVA, but can be "real power or current. The optimal allocation of DG is done using PSO technique with the help of MATLAB tool mat-power 6.0.

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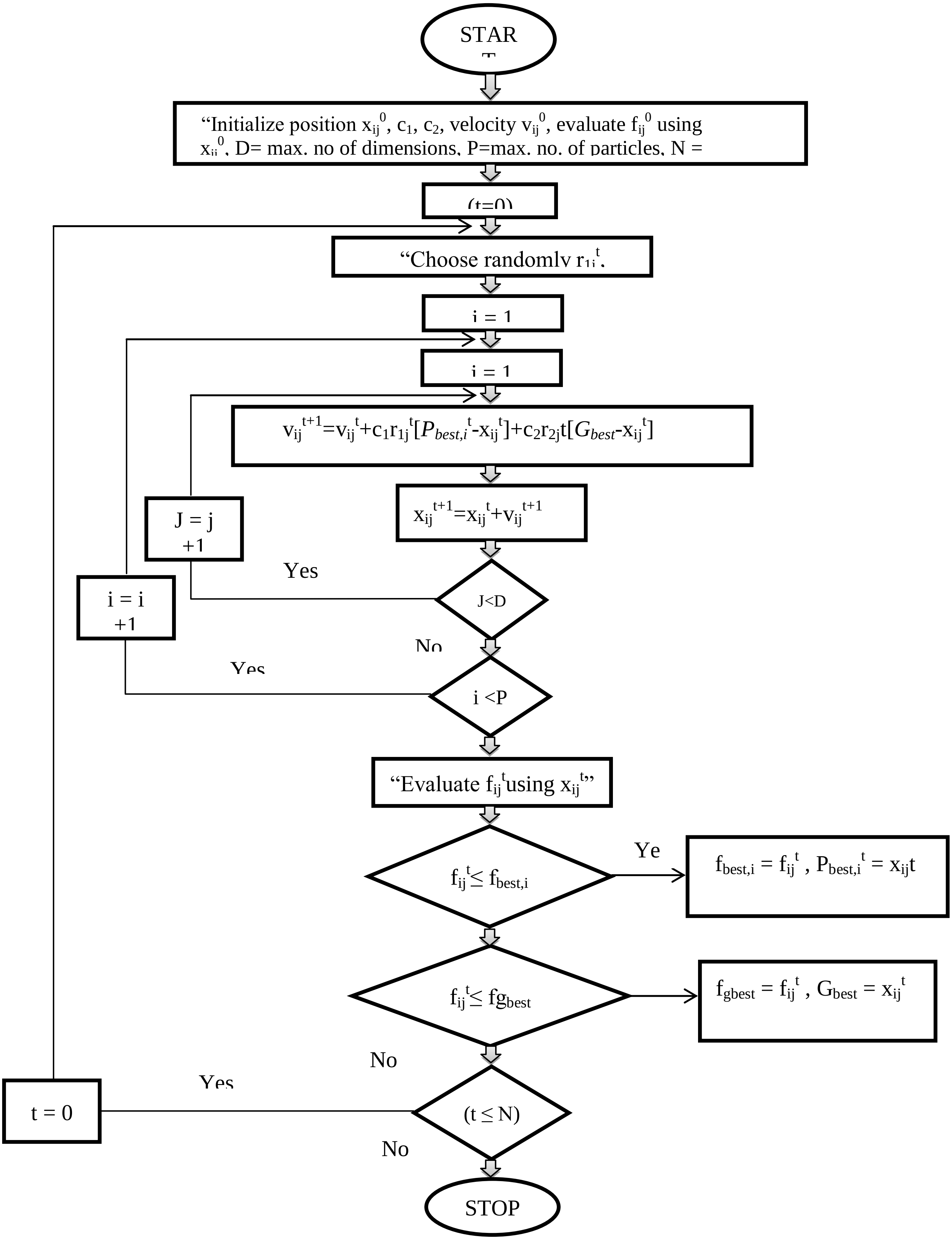

Flowchart of gbest PSO

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Bus No	Bus voltage Without DG	Bus voltage With DG (Type-1)	Bus voltage With DG (Type-2)	Bus voltage With DG (Type-3)	Bus voltage With DG (Type-4)
1	1	1	1	1	1
2	1	1	1	1	1
3	1	1	1	1	1
4	0.9871	0.9907	0.9907	1.0026	0.9907
5	0.9755	0.9797	0.9797	0.9878	0.9797
6	1.0034	1.0038	1.0038	1.0081	1.0038
7	0.9857	0.9867	0.9867	0.9939	0.9866
8	0.9962	0.9975	0.9974	1.0065	0.9974
9	0.9576	0.9646	0.9645	0.9991	0.9645

Table no - 1 IEEE 9 Bus Systems for Bus Voltage

V. RESULTS & DISCUSSION

A. IEEE 9 bus system:

After installation of various type's of DG in power system networks, the comparative study of voltage profiles which are shown in figure2. In the case of DG type-3 is more appreciable as associated to DG "type-1, type-2, type-4" and without use of DG.

The overall power loss after installation of various types of DG are almost same in case of DG "type-1, type-2, type-4" which is 2.9404MW and in case of DG type-3 is 4.7326MW and without use of DG which is 4.9550MW. The use of type-3 DG is more effective for improvement of voltage profile point of view but it is less effective in case of overall power loss in power system networks.

B. Voltage Profile for 24 Bus and Branch System:

After installation of dissimilar types of DG in power system networks, the comparative study of voltage profiles which are shown in figure 4. In the case of DG type-3 is more appreciable as compared to DG "type-1, type-3, type-4" and without use of DG.

The overall power loss after linking of different types of DG, are almost same and in case of DG type-1 is 31.7260MW DG "type-2 is 32.5893 MW", DG type-3 is 50.4028MW and in case of DG type-4 is 32.5893MW and without use of DG is 51.2460MW. The use of type-3 DG is more effective for improvement of voltage profile point of view but it is less effective in case of overall power loss in power system networks.

C. Voltage Profile for 33 Bus and Branch System:

After installation of diverse types of DG in power system networks, the comparative study of voltage profiles which are shown in figure 6. In the case of DG type-2 is more appreciable as compared to DG "type-1, type-3, type-4" and without use of DG.

The overall power loss after installation of different types of DG are almost same in case of DG "type-1, type-2, type-3, type-4" and without use of DG which is 0.2030MW. The use of type-2 DG is more effective for improvement of voltage profile point of view but it is less effective in case of overall power loss in power system networks.

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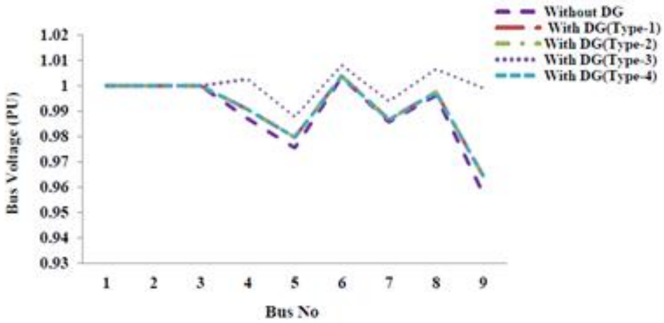

Fig.2 IEEE 9 Bus voltage profile with and without installation of DG

BRANCH			Without DG	With DG (Type 1)	With DG (Type 2)	With DG (Type 3)	With DG (Type 4)
Branch No	From	To					
1	1	4	0.0000	0.0000	0.0000	0.0000	0.0000
2	4	5	0.1736	0.6355	0.6360	0.1820	0.6360
3	5	6	1.4486	0.3845	0.3840	1.4095	0.3840
4	3	6	0.0000	0.0000	0.0000	0.0000	1.4211
5	6	7	0.0955	0.3680	0.3684	0.0855	0.3683
6	7	8	0.5062	0.1902	0.1900	0.4964	0.1900
7	8	2	2.8422	0.0000	0.0000	2.8422	0.0000
8	8	9	2.4645	0.4316	0.4308	2.3942	0.4308
9	9	4	0.2663	0.9306	0.9314	0.1651	0.9314

Table no-2 IEEE 9 Bus System Power Loss without and with DG

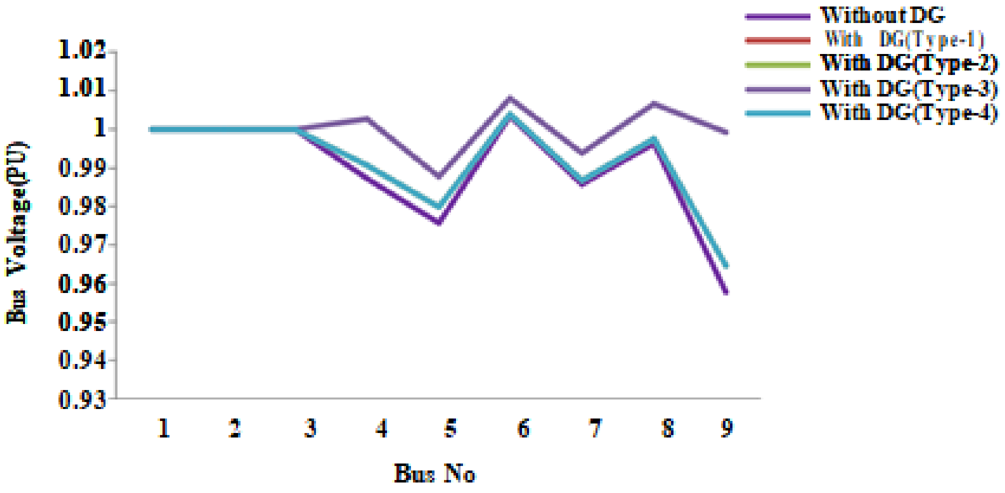

Fig.3 IEEE 9 system network losses with and without installation of DG

S.N.	Description of DG	Without DG	DG Type-1	DG Type-2	DG Type-3	DG Type-4
1	Optimum Location		2	2	9	2
2	Optimum Loss	4.9550	2.9404	2.9404	4.7326	2.9404
3	Optimum Size		-83.3014	-104.2045	45.7014	-104.2045
4	Real Power(MW)		-83.3014	-83.3014	2.7984	-83.3636
5	Reactive Power (MVAR)		0	-62.5227	45.7014	62.5227

Table: 4 IEEE 24 Bus Systems for Bus Voltage

Bus No	Bus voltage Without DG	Bus voltage With DG (Type-1)	Bus voltage With DG (Type-2)	Bus voltage With DG (Type-3)	Bus voltage With DG (Type-4)
1	1.0350	1.0350	1.0350	1.0350	1.0350
2	1.0350	1.0350	1.0350	1.0350	1.0350
3	0.9926	0.9926	0.9924	1.0422	0.9924
4	0.9988	0.9988	0.9988	1.0054	0.9988
5	1.0186	1.0186	1.0187	1.0198	1.0187
6	1.0124	1.0124	1.0126	1.0144	1.0126
7	1.0250	1.0250	1.0250	1.0250	1.0250

8	0.9930	0.9930	0.9930	0.9962	0.9930
9	1.0028	1.0028	1.0028	1.0146	1.0028
10	1.0283	1.0283	1.0286	1.0311	1.0286
11	0.9894	0.9894	0.9899	0.9928	0.9899
12	1.0015	1.0015	1.0020	1.0061	1.0020
13	1.0200	1.0200	1.0200	1.0200	1.0200
14	0.9800	0.9800	0.9800	0.9800	0.9800
15	1.0140	1.0140	1.0140	1.0140	1.0140
16	1.0170	1.0170	1.0170	1.0170	1.0170
17	1.0403	1.0403	1.0402	1.0386	1.0402
18	1.0500	1.0500	1.0500	1.0500	1.0500
19	1.0224	1.0224	1.0227	1.0233	1.0227
20	1.0375	1.0375	1.0378	1.0385	1.0378
21	1.0500	1.0500	1.0500	1.0500	1.0500
22	1.0500	1.0500	1.0500	1.0500	1.0500
23	1.0500	1.0500	1.0500	1.0500	1.0500

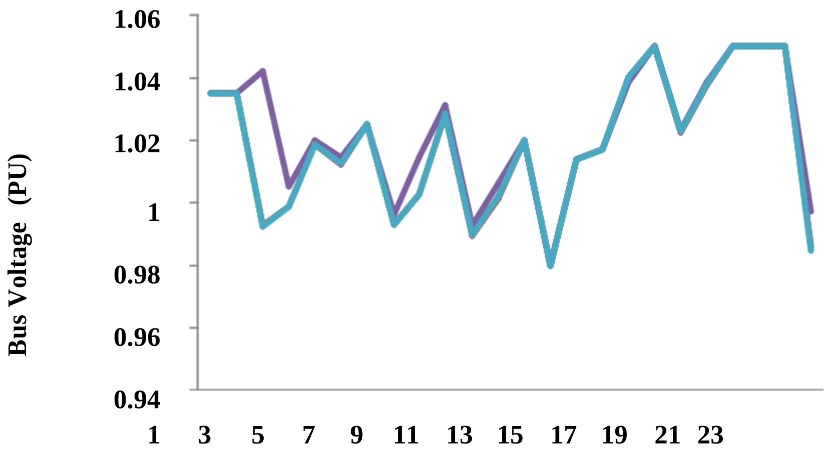

Fig: 4 IEEE 24 Bus voltage profile with and without installation of DG

Bus No

Without DG
With DG(Type-1)
With DG(Type-2)

With DG(Type-3)
With DG(Type-4)

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Table: 5 IEEE 24 Bus Systems for Branch Loss

BRANCH			**Without DG**	With DG (Type-1)	With DG (Type 2)	With DG (Type 3)	With DG (Type 4)
Branch No	**From**	**To**					
1	1	2	0.0036	0.0002	0.0006	0.0041	0.0006
2	1	3	0.3415	0.2229	0.2095	0.0579	0.2095
3	1	5	0.7407	0.5327	0.5725	0.7818	0.5725
4	2	4	0.5872	0.5227	0.5335	0.5140	0.5335
5	2	6	1.0927	0.8396	0.8892	1.1449	0.8892
6	3	9	0.2399	0.0765	0.0306	0.3080	0.0306
7	3	24	1.1129	0.5968	0.6881	1.1187	0.6881
8	4	9	0.3642	0.4200	0.4074	0.3516	0.4074
9	5	10	0.0456	0.1039	0.0886	0.0455	0.0886
10	6	10	1.0669	1.2089	1.1780	1.0378	1.1780
11	7	8	2.1177	2.1133	2.1124	2.0745	2.1124
12	8	9	0.6042	0.5238	0.5396	0.6232	0.5396
13	8	10	0.3029	0.3360	0.3292	0.2783	0.3292
14	9	11	0.2770	0.3133	0.3052	0.2549	0.3052
15	9	12	0.3692	0.5630	0.5185	0.3413	0.5185
16	10	11	0.5464	0.5250	0.5288	0.5263	0.5288
17	10	12	0.6411	0.8141	0.7759	0.6232	0.7759
18	11	13	0.6180	3.3079	2.5332	0.5735	2.5332
19	11	14	1.7779	0.0988	0.2650	1.7312	0.2650
20	12	13	0.2708	1.6342	1.2417	0.2349	1.2417
21	12	23	6.3988	3.8827	4.3416	6.2703	4.3416
22	13	23	5.4383	1.2839	1.8944	5.3582	1.8944
23	14	16	7.0537	2.8339	3.5238	6.9030	3.5238
24	15	16	0.2901	0.0068	0.0153	0.2604	0.0153
25	15	21	2.9126	1.1666	1.4433	2.9312	1.4433
26	15	21	2.9126	1.1666	1.4433	2.9312	1.4433
27	15	24	3.2186	1.7167	1.9826	3.2630	1.9826
28	16	17	3.3528	0.6606	1.0025	3.3236	1.0025
29	16	19	0.4325	0.1029	0.0287	0.4093	0.0287
30	17	18	0.6375	0.3723	0.4170	0.6297	0.4170
31	17	22	2.4542	0.0511	0.0357	2.4471	0.0357

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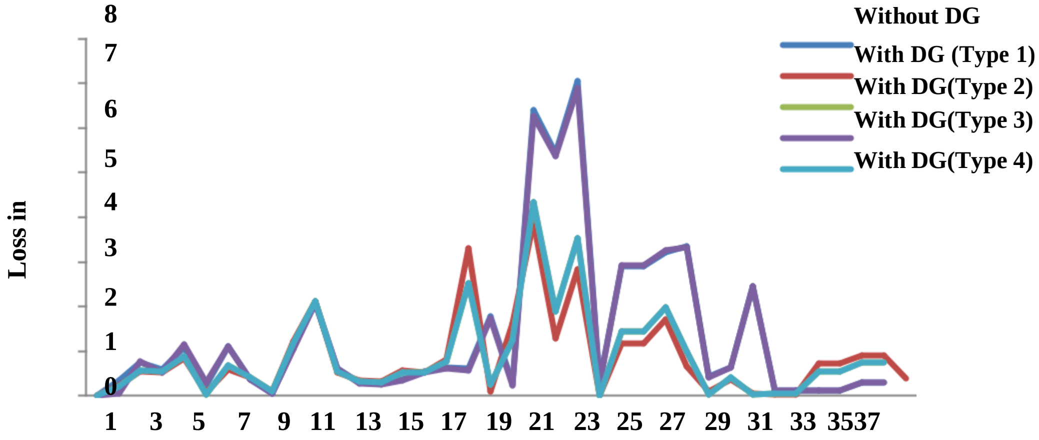
32	18	21	0.1108	0.0416	0.0529	0.1084	0.0529
33	18	21	0.1108	0.0416	0.0529	0.1084	0.0529
34	19	20	0.1131	0.7158	0.5318	0.1179	0.5318
35	19	20	0.1131	0.7158	0.5318	0.1179	0.5318
36	20	23	0.2913	0.9084	0.7481	0.2995	0.7481
37	20	23	0.2913	0.9084	0.7481	0.2995	0.7481
38				0.3966			



Branch No

Fig:5 IEEE 24 system network losses with and without installation of DG

Table. 6 Comparison of different type of DG's at various specifications

S.N.	Description of DG	Without DG	DG Type-1	DG Type-2	DG Type-3	DG Type-4
1	Optimum Location		22	22	3	22
2	Optimum Loss	51.2460	31.7260	32.5893	50.4028	32.5893
3	Optimum Size		-386.6614	-386.6614	94.3267	-386.6614
4	Real Power(MW)		-386.6614	-309.3291	5.7758	-309.3291
5	Reactive Power (MVAR)		0	-231.9968	94.3267	231.9968

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Table: 7 IEEE 33 Bus Systems for Bus Voltage

BUS NO	Bus voltage Without DG	Bus voltage With DG (Type-1)	Bus voltage With DG (Type-2)	Bus voltage With DG (Type-3)	Bus voltage With DG (Type-4)
1	1	1	1	1	1
2	0.9970	0.9986	0.9991	0.9974	0.9973
3	0.9829	0.9928	0.9961	0.9856	0.9846
4	0.9755	0.9915	0.9967	0.9797	0.9781
5	0.9681	0.9905	0.9978	0.9741	0.9718
6	0.9497	0.9860	1.0012	0.9618	0.9547
7	0.9462	0.9827	0.9979	0.9584	0.9500
8	0.9413	0.9780	0.9933	0.9536	0.9476
9	0.9351	0.9720	0.9874	0.9474	0.9414
10	0.9292	0.9664	0.9819	0.9417	0.9356
11	0.9284	0.9656	0.9811	0.9408	0.9348
12	0.9269	0.9642	0.9796	0.9393	0.9333
13	0.9208	0.9583	0.9739	0.9333	0.9272
14	0.9185	0.9561	0.9717	0.9311	0.9249
15	0.9171	0.9548	0.9704	0.9297	0.9235
16	0.9157	0.9534	0.9691	0.9283	0.9222
17	0.9137	0.9515	0.9672	0.9263	0.9202
18	0.9131	0.9509	0.9666	0.9257	0.9196
19	0.9965	0.9981	0.9986	0.9969	0.9968
20	0.9929	0.9945	0.9950	0.9933	0.9932
21	0.9922	0.9938	0.9943	0.9926	0.9925
22	0.9916	0.9931	0.9937	0.9920	0.9918
23	0.9794	0.9892	0.9925	0.9820	0.9810
24	0.9727	0.9826	0.9859	0.9754	0.9743
25	0.9694	0.9794	0.9827	0.9720	0.9710
26	0.9477	0.9842	0.9993	0.9608	0.9528
27	0.9452	0.9817	0.9969	0.9595	0.9503
28	0.9337	0.9707	0.9861	0.9560	0.9389
29	0.9255	0.9628	0.9783	0.9539	0.9307
30	0.9220	0.9594	0.9750	0.9526	0.9272
31	0.9178	0.9554	0.9710	0.9485	0.9231
32	0.9169	0.9546	0.9702	0.9476	0.9221
33	0.9166	0.9543	0.9699	0.9474	0.9219

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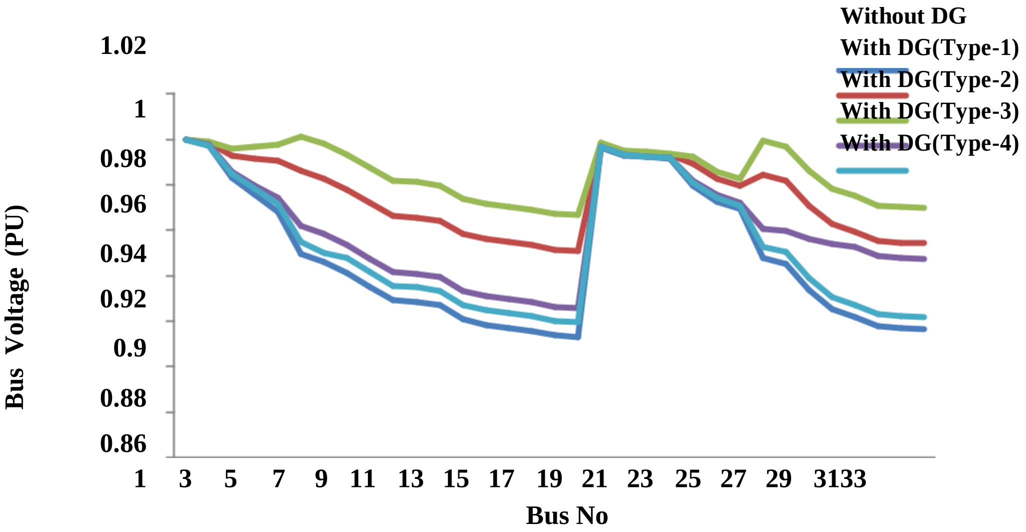

Fig: 6 IEEE 33 Bus voltage profile with and without installation of DG

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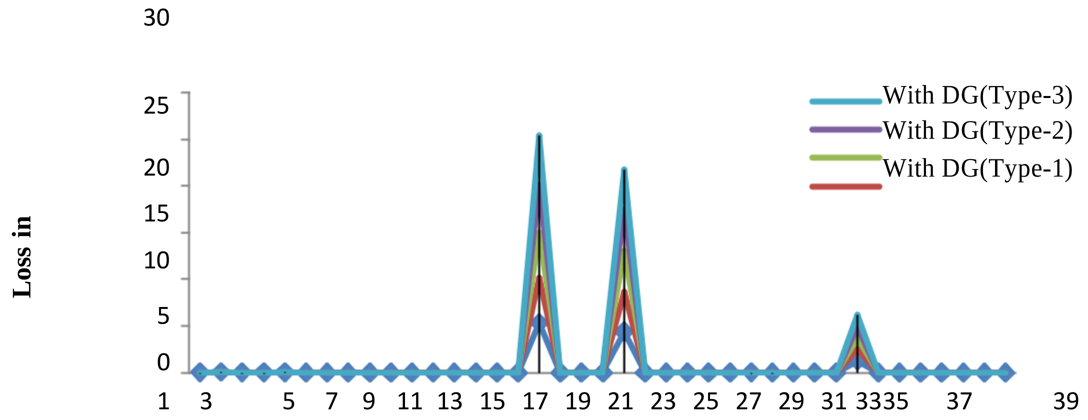
Table. 8 IEEE 33 Bus Systems for Branch Loss

BRANCH			Without DG	With DG (Type 1)	With DG (Type 2)	With DG (Type 3)	With DG (Type 4)
Branch No	**From**	**To**					
1	1	2	0.0122	0.0041	0.0011	0.0093	0.0109
2	2	3	0.0518	0.0162	0.0024	0.0380	0.0461
3	3	4	0.0199	0.0064	0.0002	0.0130	0.0179
4	4	5	0.0187	0.0063	0.0004	0.0121	0.0168
5	5	6	0.0382	0.0132	0.0013	0.0245	0.0345
6	6	7	0.0019	0.0018	0.0017	0.0019	0.0016
7	7	8	0.0048	0.0045	0.0043	0.0047	0.0045
8	8	9	0.0042	0.0039	0.0037	0.0041	0.0041
9	9	10	0.0036	0.0033	0.0032	0.0035	0.0035
10	10	11	0.0006	0.0005	0.0005	0.0005	0.0005
11	11	12	0.0009	0.0008	0.0008	0.0009	0.0009
12	12	13	0.0027	0.0025	0.0024	0.0026	0.0026
13	13	14	0.0007	0.0007	0.0007	0.0007	0.0007
14	14	15	0.0004	0.0003	0.0003	0.0003	0.0004
15	15	16	0.0003	0.0003	0.0003	0.0003	0.0003
16	16	17	0.0003	0.0002	0.0002	0.0002	0.0002
17	17	18	5.3136	4.8993	4.7415	5.1696	5.2389
18	2	19	0.0002	0.0002	0.0002	0.0002	0.0002
19	19	20	0.0008	0.0008	0.0008	0.0008	0.0008
20	20	21	0.0001	0.0001	0.0001	0.0001	0.0001
21	21	22	4.3634	4.3498	4.3452	4.3598	4.3612
22	3	23	0.0032	0.0031	0.0031	0.0032	0.0032
23	23	24	0.0051	0.0050	0.0050	0.0051	0.0051
24	24	25	0.0013	0.0013	0.0013	0.0013	0.0013
25	6	26	0.0026	0.0024	0.0023	0.0013	0.0026
26	26	27	0.0033	0.0031	0.0030	0.0017	0.0033
27	27	28	0.0113	0.0104	0.0101	0.0056	0.0111
28	28	29	0.0078	0.0072	0.0070	0.0039	0.0077
29	29	30	0.0039	0.0036	0.0035	0.0021	0.0039
30	30	31	0.0016	0.0015	0.0014	0.0015	0.0016
31	31	32	0.0002	0.0002	0.0002	0.0002	0.0002
32	32	33	1.3169	1.2149	1.1760	1.2327	1.3019
33	21	8	0	0	0	0	0
34	9	15	0	0	0	0	0
35	12	22	0	0	0	0	0
36	18	33	0	0	0	0	0
37	25	29	0	0	0	0	0

With DG(Type-4)



Branch No

Fig.7 IEEE 33 system network losses with and without DGinstallation

Table. 9 Comparison of different type of DG's at various specifications

S.N.	Description of DG	Without DG	DG Type-1	DG Type-2	DG Type-3	DG Type-4
1	Optimum Location		6	6	30	8
2	Optimum Loss	0.2030	0.1040	0.0616	0.1436	0.1867
3	Optimum Size		2.5657	3.0839	1.2650	0.8470
4	Real Power(MW)		2.5657	2.4671	7.7458	0.6770
5	Reactive Power (MVAR)		0	1.8504	1.2650	-0.5082

V. CONCLUSION:

The Optimal use of DG is essential for future requirement of the electrical energy in the electrical power system networks. There are four types of DG with different characteristics and the finest allocation of DG at optimal place is essential for proper functioning of electrical power system networks. To diminish the active power losse's and advance the overall voltage profile, are main concerns for safe operation of power system networks. In this paper, the optimal allocation of different types of DG at optimal location is done using PSO technique. The performance of electrical power system networks is compared using PSO technique to condense power losse's and progress the overall voltage profile. In "IEEE-9 bus system" the optimum losses are almost same which is 2.9404MW for DG "type-1, type-2 and type-4" but for type-3 it is 4.7326MW and improvement in voltage profile is better as associated to other types of DG. In IEEE-24 bus system, the optimum losses for DG "type-1, type-2 and type-4" are almost same but for DG type-3 it is 50.4028MW and improvement in voltage profile is better as compared to other types of DG. In "IEEE-33 bus system" the optimum losses for DG type- 2 is minimum as compared to "type-1, type-3 and type-4" and also improvement in voltage profile is better for type-2 as matched to further type's of DG.

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