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Distributed Generation Planning & Grid Partitioning for Voltage Control of Smart Distribution System

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Abstract- Recently the tendency toward renewable energy resources in distribution systems has been significantly increased. So, new approaches in order to model the optimal placement of these resources seem to be required. Moreover, due to the voltage violation problem of these resources, this issue must be considered too. This paper, proposes a new approach for distributed generations (DGs) planning by partitioning the original distribution systems into several separate zones. Then in operation stage a zonal voltage control method is presented which uses only local data and optimizes reactive power of the DGs where have been placed in previous stage. Both planning and operating problem are optimized using the well-known particle swarm optimization (PSO) algorithm. Finally, the proposed methods are evaluated on IEEE 123-bus unbalanced test system. The results demonstrate the ability and efficiency of the proposed methods.

Keywords: distributed generation, distribution system planning, network partitioning, renewable energy, zonal voltage control.

1. Introduction

The distribution systems as an important part in power system need flexible and intelligent planning methodologies in order to meet the demand for future [1, 2]. Conventional methods without distributed generation have been discussed in [3]. Recently, distributed generations have received much attention in distribution system planning. In [4], a method considering distributed generation is proposed to determine the optimal planning scheme including the feeder network, the location and sizing of DG. But in this model the only objective is minimization of total cost. Unlike the previous, another method in [5] has considered distributed generation without conventional method in single and multi-objective functions. Some papers solve this problem as a dynamic and probabilistic problem which considers uncertainness nature of loads, resources, etc. [6,7]. Besides, the customers are directly affected by any problem in distribution system, so it seems that more attention should be paid to the reliability of power distribution systems [8, 9]. In [10, 11] the impact of DG on reliability issue in distribution system planning has been investigated.

In the modern distribution systems, the loads may be supplied locally by DGs and some parts of distribution systems can be considered as zones which may be interconnected to each other's and they can operate in grid-connected or in islanded modes [12]. There are several key aspects for design and operation of zones in order to improve energy supplying and security for both network owner and customers [13-16]; the reliability may be considered as two important concerns in this area [17, 18].

Due to the emerging of renewable DGs in distribution grids, reverse power flow as well as intermittent fluctuations of active power lead to significant variations in voltage magnitudes of buses [19]. Voltage management in distribution networks was fulfilled by traditional devices such as under load tap changer, step voltage regulators, fixed and switching capacitor banks in the past. So, these devices cannot manage the fast variations caused by renewable DGs. Consequently, this issue could be suitably solved by employing the reactive power of DGs based on power electronic interfaces, and voltage regulation can be managed by appropriate control of these interfaces [20]. Unlike power system frequency, the voltage has a local impact [21]; therefore, the voltage profile of a distribution system could be zonally controlled using the regulation of the reactive power of DGs.

The first novelty of this paper is to propose a new method which creates several zones in the original distribution network and allocates renewable DGs with intermittent nature to each zone considering the cost of DG installation as well as the energy not supplied of zones.

Another contribution is to present a zonal control strategy which manages distribution voltage profile of network in each zone independently. This method has two advantages: (i) it has less computational burden in comparison to the global methods due to the reducing problem dimensions; (ii) it does not need to the whole system information to control DGs.

The reminder of the paper is organized as follows: Section 2 explains the DG modelling for planning stage. Section 3 presents the partitioning and planning approach for distribution system. Section 4 describes proposed zonal voltage control strategy. Section 5 demonstrates the application of PSO algorithm for solving both problems presented in section 3 and 4. Simulation results on an unbalanced 123-bus test system are shown in section 5 and finally, the conclusions are drawn in section 6.

2. DG Modelling

Three types of distributed generations are considered for planning stage: wind turbine (WT), photovoltaic (PV) modules and fuel cell (FC). WT and PV are non-dispatchable resource with time varying output and FC is a dispatchable one. In the planning stage these resources are used to balance the power between generation and load in each zone.

The output power of WT is probabilistic and varies with time. The weibull probability distribution function (PDF) is used to represent the wind speed (v) for long term planning as follow:

$$f(v) = \frac{k}{\lambda}\left(\frac{v}{\lambda}\right)^{k-1} e^{-\left(\frac{v}{\lambda}\right)^k} \qquad (k>0,\ \ v>0,\ \ \lambda>0) \tag{1}$$

where k and λ are shape parameter and scale parameter, respectively [22]. The active power generated by WT could be calculated by Eq. (2).

$$P_{WT} = \begin{cases} 0 & 0 \le v \le v_{ci} \\ P_{WT,rated}\dfrac{v - v_{ci}}{v_{rated} - v_{ci}} & v_{ci} \le v \le v_{rated} \\ P_{WT,rated} & v_{rated} \le v \le v_{co} \\ 0 & v_{co} < v \end{cases} \tag{2}$$

where v_{ci}, v_{co}, v_{rated}, P_{WT} and $P_{WT,rated}$ are the cut-in speed, cut-off speed, rated speed, output power and rated output power of the WT, respectively.

The output power of PV depends on the solar irradiance and has a high degree of uncertainty. The beta PDF is mostly used to model the probability of solar irradiance which is expressed by (3) and its output power can be calculated by (4) [22]:

$$f(R) = \frac{\Gamma(\alpha+\beta)}{\Gamma(\alpha)\Gamma(\beta)} R^{\alpha-1}(1-R)^{\beta} \tag{3}$$

$$P_{PV}(R) = \begin{cases} P_{r,PV}\dfrac{R^2}{R_{STD}R_c} & 0 \le R \le R_c \\ P_{r,PV}\dfrac{R}{R_{STD}} & R_c \le R \le R_{STD} \\ P_{r,PV} & R_{STD} \le R_c \end{cases} \tag{4}$$

where R is the solar irradiance, R_C is certain radiation point and usually set to 150 W/m2, R_{STD} is solar radiation in the standard conditions usually set to 1000 W/m2, $P_{r,PV}$ is Rated power of PV.

Finally, the output power of FC is predictable. Thus, developing an output power model of FC is very simple and depends on the operation hours.

2. DG Planning and Network Partitioning

The optimal planning of distribution system and zones design can be formulated effectively as an optimization problem. There are some different objectives in the proposed planning model to consider both cost and zone construction aspects. The decision variables in this problem include the location, type, and size of DGs as well as the boundaries of all zones. The general objective function can be formulated as following:

$$\min \quad f = w_c \cdot f_c + w_z \cdot f_z \tag{5}$$

where f_c and f_z are cost and zone construction objective functions respectively. Moreover, w_c and w_z are weighting factor of objective functions.

2.1. Cost Objective Function

The cost objective function can be formulated as below:

$$f_c = \sum_{i=1}^{N}(C_{WT,i} + C_{PV,i} + C_{FC,i}) \tag{6}$$

where C_{WT}, C_{PV}, and C_{FC} are total costs of wind turbine, photovoltaic and fuel cell respectively [23, 24]. These costs could be calculated by Eq. (7):

$$\begin{aligned} C_{WT,i} &= a_{WT} + b_{WT} \cdot P_{WT,i} \\ C_{PV,i} &= a_{PV} + b_{PV} \cdot P_{PV,i} \\ C_{FC,i} &= a_{FC} + b_{FC} \cdot P_{FC,i} \end{aligned} \tag{7}$$

where a_x and $b_x \cdot P_x$, are fixed and variable components of DG installation cost.

2.2. Zone Construction Objective Function

For a distribution system consisting of several zones, it is necessary for each zone to have minimum annual energy not supplied (ENS). Thus, f_z can be calculated as follows [25]:

$$f_z = \sum_{j=1}^{N_Z} ENS_j \tag{8}$$

To calculate this objective function, each zone is considered as a separate part including a group of DGs and loads. In the proposed zone construction method, the ENS of each zone is added to a positive value which is equal to the probability of unbalancing between load and generation of that zone (probability of not to be supply) multiple by energy not supplied of upstream zones. Therefore, the previous indices can be calculated as follows:

$$ENS_j = ENS_j|_{self} + (1-p_j)\cdot \sum_{k=1}^{N_{us}} ENS_k \tag{9}$$

The subscript "self" indicates the index related to zone j without other parts of the system. N_{us} is the number of upstream zones and p_j is the probability that shows the generation is greater than the total load in the zone j. In the other word, if p_j is zero which means generation is never more than load in the zone and the calculated indices are zone index and plus all upstream zones index. If p_j is one which means the generation level is always more than the load in the zone, so the indices of upstream zones do not have any effect on the reliability of that zone.

For safe operation of a distribution system, the constraints include the network power balance limitation must be satisfied as below [26]:

$$\begin{aligned}\sum P_{DG} - \sum P_{Load} &= V_{t,i}\sum_{j=1}^{nb} V_{t,j}(G_{i,j}*\cos\theta_{ij} + B_{i,j}*\sin\theta_{ij})\\ \sum Q_{DG} - \sum Q_{Load} &= V_{t,i}\sum_{j=1}^{nb} V_{t,j}(G_{i,j}*\cos\theta_{ij} - B_{i,j}*\sin\theta_{ij})\end{aligned} \tag{10}$$

According to [27] in islanding mode operation of each zone, the penetration of dispatchable DGs units must be at least 60% of the total load.

$$0.6\times P_{Li} \le P_{FCi} \tag{11}$$

3. Zonal Voltage Control

The mathematical modelling of coordinated voltage regulation in each zone is as following:

$$\min \quad f_m = \sum_{l=1}^{N_m} R_{m,l}\cdot|B_{m,l}|^2 + \sum_{i=1}^{N_m}|V_{m,i} - V_{m,0}| \tag{12}$$

Subject to:

$$\begin{aligned}&[V]_m - [V_{m,0}] + [DLF]_m[\frac{p-jq}{V^*}]_m = 0\\ &B_{m,l} \le B_{m,l}^{\max} \qquad l = 1,\dots,N_m\\ &V_{m,i}^{\min} \le V_{m,i} \le V_{m,i}^{\max} \qquad i = 1,\dots,N_m\\ &q_{m,i}^{G,\min} \le q_{m,i}^{G} \le q_{m,i}^{G,\max}\end{aligned} \tag{13}$$

where $R_{m,l}$ and $B_{m,l}$ are the resistance and the current flowing through the line l in the m^{th} zone, respectively; f_m and N_m are the objective function and the number of buses or branches in this zone respectively, $[V]_m$, $[p]_m$ and $[q]_m$ are voltage vector, total consumed active and reactive powers in this zone respectively; $V_{m,0}$ is the voltage of the last bus of the adjacent upstream partition; $q_{m,i}^G$ is the reactive power generation of DG unit in bus i in m^{th} partition which must be optimized.

In fact, the problem of voltage regulation is an optimization problem which aims to minimize the power losses of the lines inside the zone m as well as voltage deviation. It optimizes the reactive power of zonal DGs subject to zonal load flow equations, voltage, and line power flow constraints. The Zonal Control Centre (ZCC) in each zone receives the expected power delivered to the downstream zones, the expected power of zonal DGs, and the expected load of each bus inside the zone. After solving optimization problem, ZCC sends the reactive power set points to zonal DGs. Fig. 1. shows the schematic diagram of the communication links.

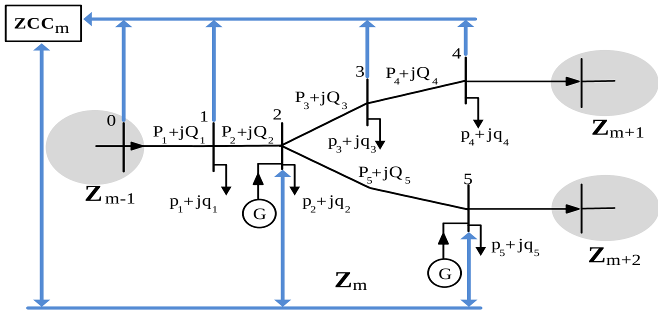

Fig. 1. Communication links for m^{th} partition.

4. PSO Solution for DG Planning and Voltage Control

Intelligent techniques are well suitable for the mixed criteria functions to find optimal results for too large or complicated optimization problems for example in power system. PSO is one of them and has been developed through simulation of social models. This algorithm starts with a population of search points called particles. Each particle is encoded by a position vector and is updated by velocity in successive iterations. The velocity vector of a particle is updated using its own previous best value called the pbest and the best position of all particles called the gbest. The inertia weight is used to control the impact of the previous history of velocities on the current velocity. The velocity and position of a particle are updated as follows [28]:

$$\begin{aligned}&Pos_k^{iter+1} = Pos_k^{iter} + Vel_k^{iter}\\ &Vel_k^{iter+1} = \omega^{iter}\cdot Vel_k^{iter} + c_1\cdot rand_1(Pos_{k,best}^{iter} - Pos_k^{iter})\\ &\qquad\qquad + c_2\cdot rand_2(Pos_{g,best}^{iter} - Pos_k^{iter})\\ &k = 1,2,\dots,N_p\end{aligned} \tag{14}$$

where the decision variables vector, Pos_k^{iter}, is the k^{th} potential solution in the population space with size N_p. Moreover Vel_k^{iter} is the velocity vector of this particle. Moreover $Pos_{k,best}^{iter}$ and $Pos_{g,best}^{iter}$ are own previous best position of each particle and the best position of all particles, respectively. c_1 and c_2 are learning coefficients, ω^{iter} and $iter_{\max}$ are inertia coefficient and the maximum number of iterations for the optimization algorithm respectively. For both planning and operation stage, the appropriate value for ω^{iter} can be linearly determined with respect to iteration number as following:

$$\omega^{iter} = \omega_{\max} - (\omega_{\max} - \omega_{\min}) \cdot iter / iter_{\max} \qquad (15)$$
$$\omega_{\min} = 0.4 \ , \ \omega_{\max} = 0.9$$

In each iteration, personal best position and global best position are updated and new velocity and position of each particle is calculated according to above equations until the convergence criterion is satisfied. In this study for planning and partitioning stage, type, location and size of DGs as well as line sections which split original network to some separate zone are considered as decision variables. In this regard the elements of potential decision vector are as below:

$$Pos = [\mathbf{bus}, \ \mathbf{type}, \ \mathbf{capacity}, \ \mathbf{line}]^T$$
$$\mathbf{bus} = [b_1, \ b_2, \ ..., \ b_n], \ \mathbf{type} = [t_1, \ t_2, \ ..., \ t_n] \qquad (16)$$
$$\mathbf{capacity} = [c_1, \ c_2, \ ..., \ c_n], \ \mathbf{line} = [l_1, \ l_2, \ ..., \ l_m]$$

Where b_i identify the candidate bus which the i^{th} DG is proposed to install. t_i shows the type of DG installed in this bus so that 1, 2 or 3 are considered for WT, PV or FC respectively. Moreover c_i identify the capacity related to this DG unit. Finally l_i is the i^{th} candidate line section which is the separation boundary of two zones.

In the operation stage, PSO algorithm is used to optimize the voltage control problem in each zone. In this situation the elements of Pos_k^{iter} are reactive power set points of N_g zonal DGs inside the zone m:

$$Pos = [q_{m,1}^G \quad q_{m,2}^G \quad \cdots \quad q_{m,Ng}^G]^T \qquad (17)$$

5. Simulation Results

To validate the performance of the proposed DG planning method and voltage regulation solution, a case study is implemented on the 123-bus unbalanced distribution test system which is shown in Fig. 1. The data about this system are presented in appendix. Other detailed data can be found in [29].

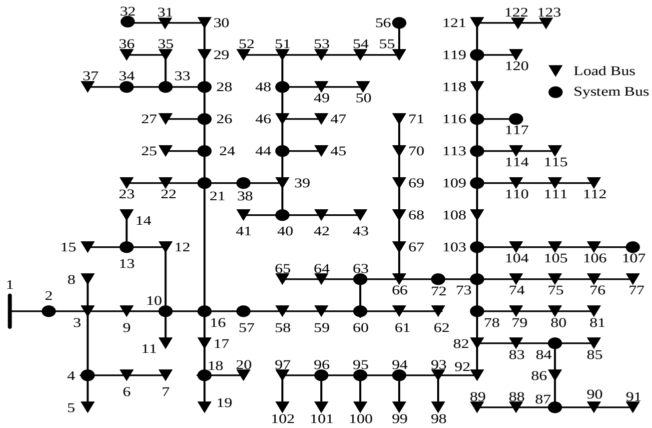

Fig. 2. IEEE 123-bus distribution test system.

For grid partitioning and DG planning stage, c_1, c_2, N_p and $iter_{\max}$ are supposed to be 2, 2, 200, 100 respectively.

After running this stage, the zones are optimally constructed as specified in Table 1. The Optimum location, type and capacity of DGs are also presented in this table. Fig. 3 shows the convergence plot of the optimization procedure for planning and partitioning stage.

Table 1. Optimum zones, location, type and capacity of DG

zone	zone buses	DG bus	cap. (kW)	type
1	1-15	4, 13	25, 25	PV, WT
2	16-20, 57-65	18, 63	25, 25	PV, WT
3	21-38	24, 30, 33, 37	50, 50, 25, 25	FC, FC, PV, WT
4	39-56	46, 49, 52, 53	75, 25, 75, 75	WT, PV, FC, FC
5	66-72	69, 72	50, 75	FC, FC
6	73-77, 103-115	75,105 , 110, 114	25, 100, 25, 25	PV, FC, PV,FC
7	78-91	84, 88, 90	50, 50, 25	FC, WT, PV
8	92-102	93, 95, 96, 102	25, 50, 25, 100	WT, FC, PV, WT
9	116-123	118, 123	25, 50	WT, WT

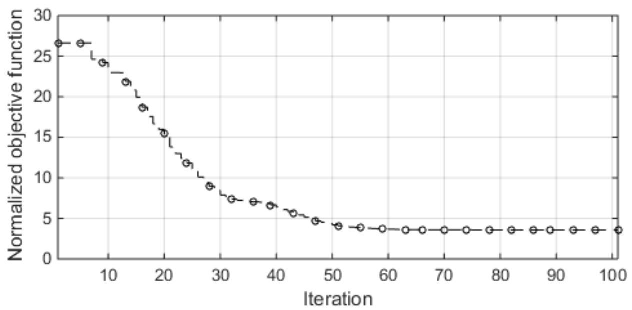

Fig. 3. Convergence plot for planning and partitioning stage.

In the operation stage, in order to solve zonal voltage control problem, both c_1 and c_2 are supposed to be equal to 2. The population size and the convergence criteria are supposed to be change adaptively base on the number of buses and DG units in each zone as below:

$$N_p = N_m + N_g + 6$$
$$iter_{\max} = round(0.5 \cdot (N_m + N_g + 15)) \quad (18)$$

For voltage control stage, the worst extreme scenarios on the mentioned network are tested. Obviously, when the proposed algorithm succeeds to manage the voltage problem of the worst cases, it can manage all other system conditions. In this regard all DGs' interfaces are assumed to be oversized by 20% more than their active power capacity for reactive power cooperation in full active power generation.

2.1. Case 1: nominal load – minimum generation

In this case, all the system loads are at their maximum values and DG active power generations are assumed to be 10% of the rated power. It is assumed that the slack bus voltage is 1.0 pu and the acceptable range for voltage profile is ±1.05 pu. It can be estimated that at the end of the lines, voltage drop can occur. Fig. 4 shows the results of the proposed zonal solution for this test case. When DG units only generate active power without reactive power control (RPC) the voltage profile exceeds the voltage lower limit. In the proposed zonal approaches for reactive power control of DGs, the system voltages return to the admissible range. Moreover, the results of the proposed zonal approach and the results of the same solution in global manner are presented Fig. 5. Although the control processes are independent in different zones but the zonal solution presents remarkable results in comparison with global voltage control solution. However, the minimum execution time for converging global method is more than 90 s; So, due to the zonal optimization, this solution takes less time than 1 s to achieve the optimal set points in each zone. Hence, the zonal solution can give better response when system operating conditions change suddenly.

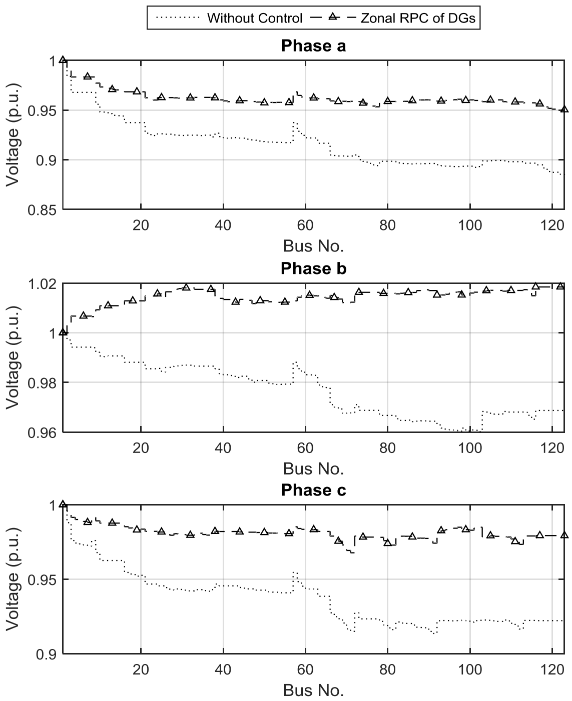

Fig. 4. Voltage profile in case 1.

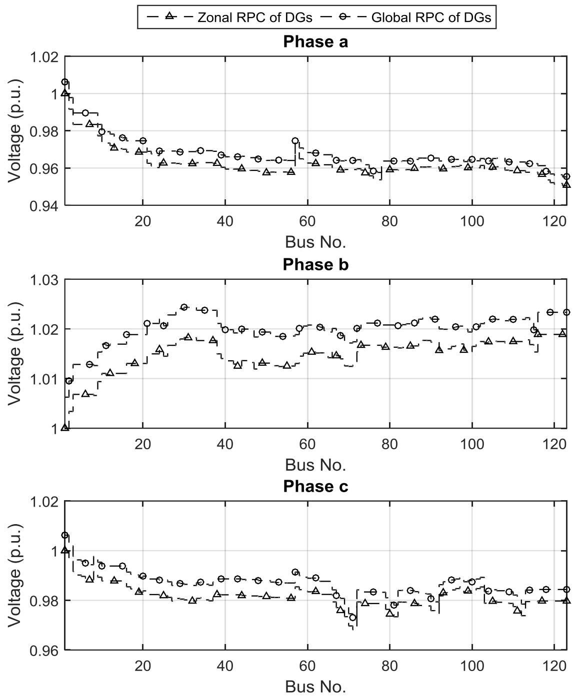

Fig. 5. Voltage profile comparison in case 1

2.2. Case 2: minimum load – full generation

In the second case, the loads and DGs are considered to be 10% and 100% of their rated values. Fig. 6 shows the voltage profile of the system before and after the reactive power control of DGs. As can be seen, without reactive power control of DGs the maximum voltage violation is occur at buses 67-123. So, new voltage profile is within acceptable range. Fig. 7 shows a typical convergence plot of the optimization procedure for zonal voltage control stage.

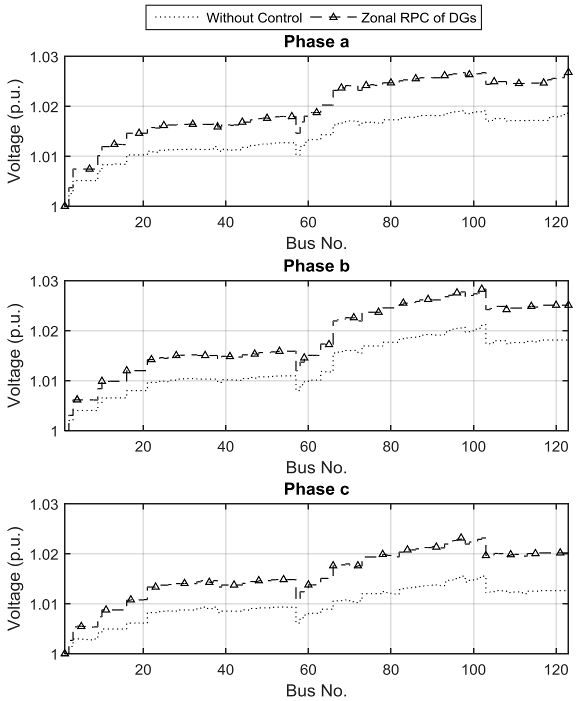

Fig. 6. Voltage profile in case 2

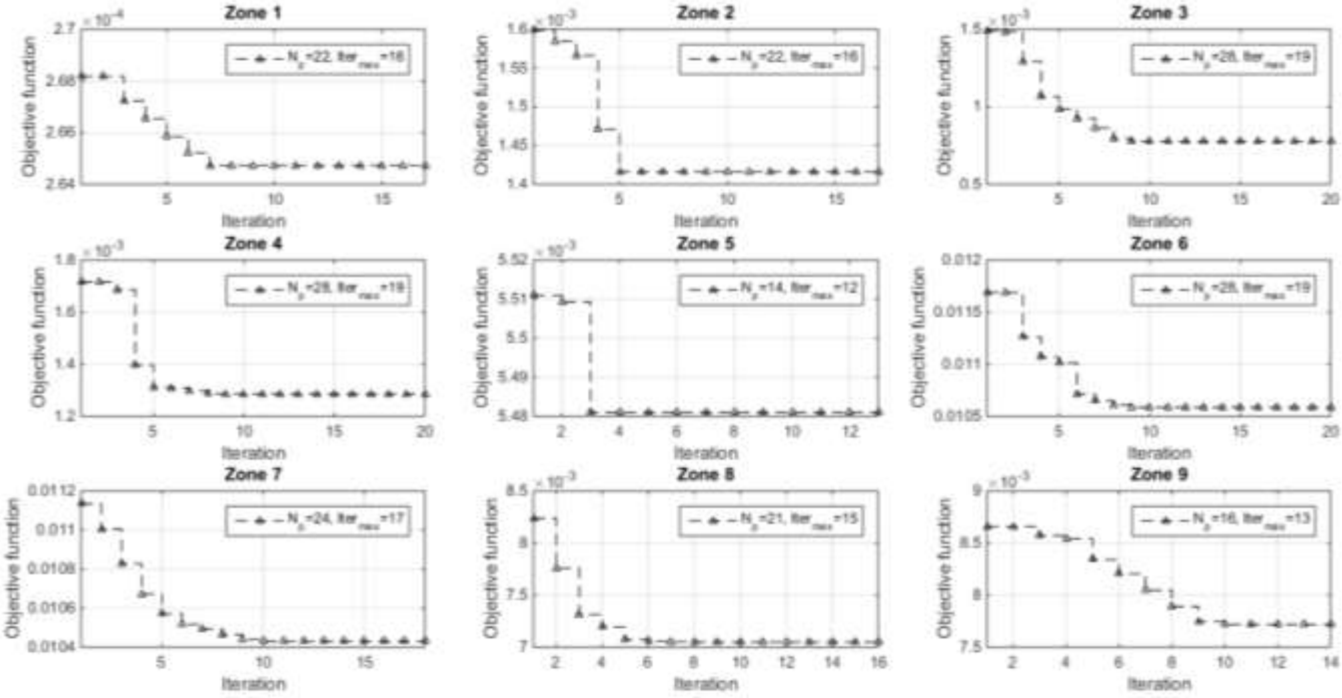

Fig. 7. Convergence plot for zonal voltage control stage

6. Conclusion

This paper in the first stage proposed a partitioning and planning approach for DGs in power distribution system in order to create the most reliable and economic zones from original distribution network. Both dispatchable and intermitted nature DGs have been considered in this study. The optimum location, capacity and type of DGs as well as the optimum boundaries of zones are obtained using the PSO algorithm. In the second stage, a voltage control method in presence of DGs is proposed and optimized based on the zones which are obtained in previous stage. The simulation results on unbalanced 123-bus IEEE test system proved the efficiency and ability of proposed solution.

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Appendix

Table 2. 123-bus unbalanced distribution test system data

No A	No B	Len. (ft.)	Conf.	kWph 1	kVAr 1	kW 2	kVAr 2	kW 3	kVAr 3
1	2	400	1	0	0	0	0	0	0
2	3	400	1	40	20	0	0	0	0
3	4	250	11	0	0	0	0	0	0
4	5	200	11	0	0	0	0	40	20
4	6	325	11	0	0	0	0	20	10
6	7	250	11	0	0	0	0	40	20
3	8	175	10	0	0	20	10	0	0
3	9	300	1	20	10	0	0	0	0
9	10	200	1	0	0	0	0	0	0
10	11	225	10	0	0	20	10	0	0
10	12	225	9	40	20	0	0	0	0
12	13	425	9	0	0	0	0	0	0
13	14	250	9	20	10	0	0	0	0
13	15	250	9	40	20	0	0	0	0
10	16	300	1	0	0	0	0	0	0
16	17	150	11	0	0	0	0	40	20
17	18	100	11	0	0	0	0	0	0
18	19	375	11	0	0	0	0	40	20
18	20	350	11	0	0	0	0	20	10
16	21	825	2	0	0	0	0	0	0
21	22	250	9	40	20	0	0	0	0
22	23	325	9	40	20	0	0	0	0
21	24	300	2	0	0	0	0	0	0

24	25	525	10	0	0	40	20	0	0
24	26	250	2	0	0	0	0	0	0
26	27	550	11	0	0	0	0	40	20
26	28	275	2	0	0	0	0	0	0
28	29	200	2	40	20	0	0	0	0
29	30	300	2	40	20	0	0	0	0
30	31	350	2	0	0	0	0	40	20
31	32	200	2	0	0	0	0	0	0
28	33	350	7	0	0	0	0	0	0
33	34	275	7	0	0	0	0	0	0
33	35	225	11	0	0	0	0	20	10
35	36	300	11	0	0	0	0	20	10
34	37	500	9	40	20	0	0	0	0
21	38	0	13	0	0	0	0	0	0
38	39	375	4	40	20	0	0	0	0
39	40	650	8	0	0	0	0	0	0
40	41	300	9	40	20	0	0	0	0
40	42	250	10	0	0	20	10	0	0
42	43	325	10	0	0	20	10	0	0
39	44	250	1	0	0	0	0	0	0
44	45	325	11	0	0	0	0	20	10
44	46	250	1	20	10	0	0	0	0
46	47	500	10	0	0	40	20	0	0
46	48	200	1	0	0	0	0	0	0
48	49	200	9	20	10	0	0	0	0
49	50	300	9	20	10	0	0	0	0
48	51	250	1	35	25	35	25	35	25
51	52	150	4	70	50	70	50	70	50
51	53	250	4	35	25	70	50	35	20
53	54	250	4	0	0	0	0	40	20
54	55	250	4	20	10	0	0	0	0
55	56	500	4	0	0	0	0	0	0
16	57	0	13	0	0	0	0	0	0
57	58	400	1	40	20	0	0	0	0
58	59	200	1	40	20	0	0	0	0
59	60	125	1	0	0	0	0	0	0
60	61	275	1	20	10	0	0	0	0
61	62	275	1	0	0	20	10	0	0
60	63	350	3	0	0	0	0	0	0
63	64	250	10	0	0	20	10	0	0
64	65	250	10	0	0	20	10	0	0
63	66	750	3	20	10	0	0	0	0
66	67	250	12	0	0	0	0	40	20
67	68	175	12	40	20	0	0	0	0
68	69	350	12	0	0	75	35	0	0
69	70	425	12	35	25	35	25	70	50
70	71	325	12	0	0	0	0	75	35
66	72	0	13	0	0	0	0	0	0
72	73	350	6	0	0	0	0	0	0
73	74	200	9	20	10	0	0	0	0
74	75	275	9	40	20	0	0	0	0

75	76	325	9	20	10	0	0	0	0
76	77	275	9	40	20	0	0	0	0
73	78	275	3	0	0	0	0	0	0
78	79	275	11	0	0	0	0	40	20
79	80	350	11	0	0	0	0	40	20
80	81	400	11	0	0	0	0	40	20
78	82	200	3	105	80	70	50	70	50
82	83	400	6	0	0	40	20	0	0
83	84	100	6	0	0	0	0	0	0
84	85	225	6	40	20	0	0	0	0
84	86	475	6	0	0	40	20	0	0
86	87	475	6	0	0	0	0	0	0
87	88	250	6	40	20	0	0	0	0
88	89	250	6	0	0	0	0	20	10
87	90	675	11	0	0	0	0	20	10
90	91	475	11	0	0	0	0	40	20
82	92	700	3	0	0	20	10	0	0
92	93	450	6	0	0	40	20	0	0
93	94	275	6	0	0	0	0	0	0
94	95	225	6	0	0	0	0	0	0
95	96	225	6	0	0	0	0	0	0
96	97	300	6	0	0	20	10	0	0
93	98	175	9	40	20	0	0	0	0
94	99	225	10	0	0	40	20	0	0
95	100	300	11	0	0	0	0	40	20
96	101	275	9	40	20	0	0	0	0
97	102	200	10	0	0	20	10	0	0
73	103	250	3	0	0	0	0	0	0
103	104	275	3	40	20	0	0	0	0
104	105	550	3	0	0	40	20	0	0
105	106	300	3	0	0	0	0	40	20
106	107	800	3	0	0	0	0	0	0
103	108	0	13	0	0	0	0	0	0
108	109	250	3	0	0	0	0	0	0
109	110	225	11	0	0	0	0	20	10
110	111	325	11	0	0	0	0	40	20
111	112	700	11	0	0	0	0	40	20
109	113	275	3	0	0	0	0	0	0
113	114	225	10	0	0	40	20	0	0
114	115	575	10	0	0	40	20	0	0
113	116	325	3	0	0	0	0	0	0
116	117	1000	3	0	0	0	0	0	0
116	118	450	9	40	20	0	0	0	0
118	119	300	9	0	0	0	0	0	0
119	120	575	9	20	10	0	0	0	0
119	121	125	9	20	10	0	0	0	0
121	122	525	9	40	20	0	0	0	0
122	123	325	9	20	10	0	0	0	0