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Reliability Improvement of distribution systems (Case study: roudbar city)

Yaser bostani amlashi*
Department of Electrical Engineering, Roudbar Branch, Islamic azad university, Roudbar, Iran

Abstract*—Use of distributed generation in the (DG) power systems is very common. The production costs by eliminating unnecessary transmission and distribution, the power supply in a place close to their consumer. Also, the use of these resources reduces pollution from fossil fuel use, investment costs, maintenance costs and equipment will improve feeder voltage profiles. In this paper, the amount of capacity, optimal location and number of installed DG units to assist PSO algorithm for a real radial distribution network with 20 buses with the aim of reducing losses is determined by considering the costs

***Keywords*—Distribution Generation, Distribution System, Optimization, PSO**

I. INTRODUCTION

One of the biggest problems can be produced by centralized power plants, despite large losses in transmission lines, which caused a lot of distance between production and consumption [1]. One of the ways that can reduce electrical power losses, the use of products is distributed. Distributed generation in international energy agencies, unions and has a different definition of major differences in levels of production output. For example, the International Energy Agency IEA distributed production unit to which the consumer is the spot service, is introduced. CIGRE Institute distributed to manufacturing products that have the following profile,

Define: Concentrated form of energy emitted does not, Distribution networks are usually connection capacity less than 50 to 100 mega watts. Generally, any type of electric power production with limited capacity (less than 100 mega watts) irrespective of technology used in its production process is a kind of distributed generation [2]. Advantages of distributed generation in distribution networks can reduce losses and improve voltage profiles, improve reliability, reduce investment costs in transmission and ... Noted. But with all these benefits may negatively impact the use of these products also have the network because it may in some cases even increased losses and voltage profiles, and even talk to protect our network capacity allocation optimization. Since many studies to determine the optimal location and capacity of distributed generation in distribution networks is presented. In references (6-3) reduce losses in the network has been studied. Their method used in genetic algorithms have been references (11-8) improved voltage profile and reduce losses by using SA and ACO algorithms have been studied but so far to determine optimal number of DG has been studied less.

In this paper a new method for determining the location, number and capacity of distributed generation in distribution networks is presented. Method presented in this paper considering DG units and the cost price per kilo watt hours of energy to optimize the location, capacity and number of deals with these units. Continue the structure of this paper consists of the following. In the second part of the problem formulation based on speech will reduce losses. In the Third review of PSO algorithm as one of optimization methods are discussed.

In the fourth method presented in the third stage on the actual distribution network that is part of Roudbar implementation and final part the results of simulation analysis will be.

II. FORMULATION OF PROBLEM

The idea behind this article, the real power loss reduction in distribution networks with is distributed generation. Real power losses at the beginning of the projection period to study the system using the relationship (1) counts

$$P_L(KW)=\sum_{i=1}^{N}\left(P_{Gi}-P_{Di}\right) \qquad (1)$$

(P_{Gi}): Power of Produce bus

(P_{Di}): Power of Consumption bus

Net present value of the true total cost of power losses using the term relationship (2) counts:

$$Cost(\$)=8760(h)\times\sum_{j=1}^{L}T^{j}\times P_L(KW)\times(1+\alpha)^{i}\times rate\left(\$/_{KWh}\right) \qquad (2)$$

One economic factor was worth the cost to convert the
Using relationship (3), be considered:

$$T=\frac{(1+a)}{(1+b)} \qquad (3)$$

Inflation in relation to the above a and b is the interest rate.
PL: Distribution system losses at the beginning of the study period system.
L: the time period studied.
α: rate of growth for all posts at the same has been considered
Rate: the base cost per kilo watt hours of energy is per Rail / kwh .
Main objective function considered in this paper, is the relationship (4):

$$\min(of) = Cost(\$) + \sum_{i=1}^{No} \left(Cost_{Ins\,i} DG + \sum_{j=1}^{L} Cost_{Pm\,ij} DG \times T^{j} \right) \quad (4)$$

$Cost(\$)$: Costs related to the real power loss during the study noted.

$Cost_{Ins_i} DG$: Costs of production and distributed generation units installed

$\sum_{j=1}^{L} Cost_{Pm\,ij} DG$: Repair and maintenance costs related to the dispersed production units.

N: number of units produced is dispersed

III. PAGE OVERVIWE OF PSO ALGORITHM

When using analytical methods for the system can not be a mathematical equation stating the subject is difficult to optimize. That's why today, more innovative methods such as GA, ACO, SA and PSO is used to solve optimization problems. Algorithm, PSO, a rules-based approach was likely in 1995 by Kennedy and Eberhart with the modeled life class or group of birds in search of fish meal was developed [7]. In this algorithm, every answer in the problem is a particle position in the search space. These particles using certain operators , position and speed up their response when they reach their optimum.

$$x_{id}(t+1) = x_{id}(t) + v_{id}(t+1) \quad (5)$$

In this method, first a bunch of random answers is produced. Then to find the optimal answer timed relation to two generations by the following search will continue.

$$v_{id}(t+1) = v_{id}(t) + c_1\phi_1\left[\rho_{id}(t) - x_{id}(t)\right] + c_2\phi_2\left[\rho_{Gd}(t) - x_{id}(t)\right] \quad (6)$$

In the above relations:

$X_{id}(t)$: Position of the objective function variables

$V_{id}(t)$: Objective function variable speed

$\rho_{id}(t)$: The best answer I've obtained for particle i to repeat t

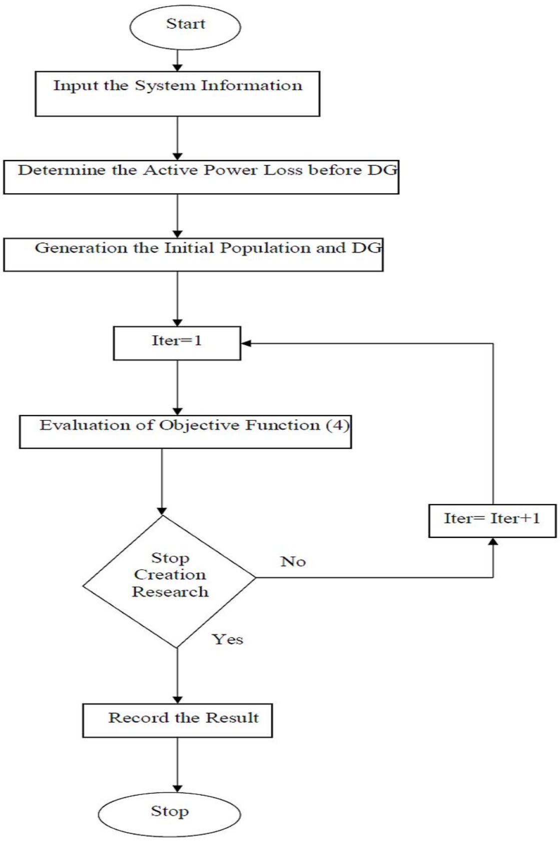
$\rho Gd(t)$: The best response obtained for all particles to repeat t

To optimize the objective function (1), buses No. Candidate installed on the network and resource DG active and reactive power sources, as the initial response in PSO algorithm is considered. Each particle then using relations (5) and (6) to the best possible answer in the search space becomes available. Suggested steps for optimizing the objective function using PSO algorithm is as follows.

First stage: First, the amount of active power losses in the network without the presence of distributed generation is calculated studied.
Step Two: Submit value parameter algorithms PSO, a set of initial response, we formed.
Third stage: We compute the objective function value.
Step Fourth : Position value in the various iterations and speed of particles using relations (5) and (6), is timed.
Step Five: We timed the objective function.
Step Sixth: If the number of iterations is sufficient, the algorithm stops, otherwise the optimization process continues and all up to the third stage.

The flowchart of performing the algorithm is depicted in Fig 1.

Figure 1. Location flowchart of distributed generation by PSO



IV. CASE STUDY

Capabilities to evaluate the proposed method, a real radial distribution network, which is part of Roudbar city network as the test network has been studied. Network of distributed power is above a feeder ,with 20 bus. Total active load at the beginning of the study period 2370 network kW and 1220 KVAR of the reactive load is like.

Table (1) - data on the network studied

from bus	to bus	r(Ω)	x(Ω)	p(kw)	Q(kvar)
1	2	0.3645	0.377	150	71
2	3	0.126	0.111	247	115
1	4	0.09	0.1064	268	126
1	5	0.3243	0.341	186	89
1	6	0.401	0.37	1.76	2.09
6	7	0.2903	0.2888	24	15
6	8	0.2337	0.25	31.2	13.3
8	9	0.3283	0.4	136	64
8	10	0.2045	0.2145	152	105
6	11	0.1342	0.125	12.6	9.17
6	12	0.1597	0.1538	26.3	16.7
12	13	0.2044	0.205	211	104
12	14	0.1233	0.1229	25.3	24.6
14	15	0.1145	0.116	62.7	36
15	16	0.1251	0.12545	195	103
16	17	0.088	0.0872	296	137
17	18	0.09	0.105	58	33.3
15	19	0.194	0.189	108	60.2
19	20	0.158	0.102	186	98.5

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Initial values are initialized in the simulation below.
α: 5 percent of the amount has grown at every post.
UE: Energy cost per kilowatt hour on the 1.55 $ /kilowatt hours.
L: Time course study of the system in 10 years is considered.

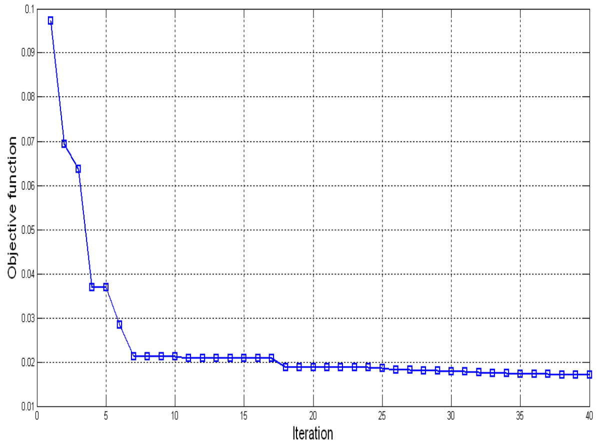

Figure (2), the objective function value in the process of implementing the simulation algorithm, PSO, is shown. Amount equal to the interest rate equal to 10 percent and 15 percent inflation rate is considered.

Table (2) - number, location and capacity of distributed optimal production.

Capacity of DGs		Installation allocation	Number of DGs
P(KW)	500	8	DG1
Q(Kvar)	320		
P(KW)	466	16	DG2
Q(Kvar)	258		

Figure (2) - objective function value in the simulation process with the PSO algorithm (2) - the amount of system losses with PSO algorithm. As Figure (2) visible amount of iterations to increase the objective function reached its minimum value.
As the table (3), is visible, present value of production losses spread radioactive dropped.
Also in Figure (2), mortality curves in the active branches of the system, before and after the presence of distributed generation is shown.
Since distributed generation sources also produce reactive power and voltage profiles, network with reactive power control is thus also improve the network voltage profile, which comes in the form (4), the amount of network buses changes in voltage profiles are shown.
As Figure (4), is visible after the present value of the voltage profiles scattered production improves.

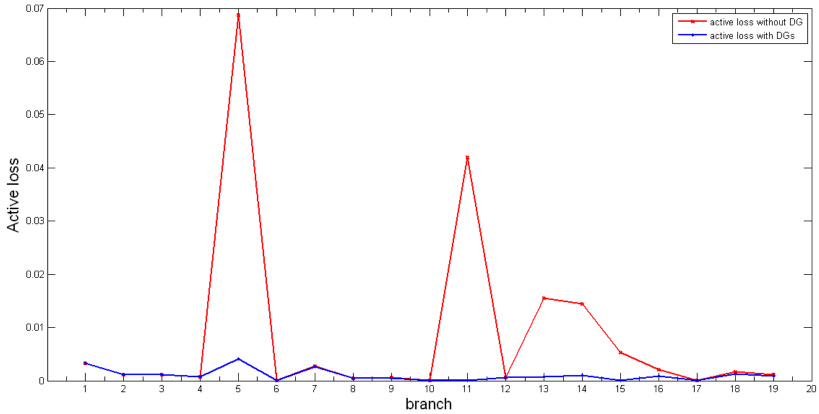

Figure (3) - active loss before and then INS DGs

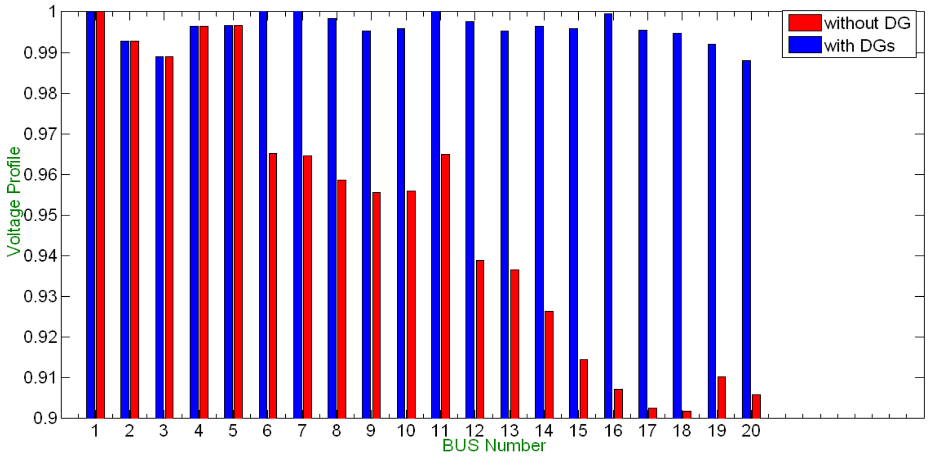

Figure (4) - the amount of voltage profiles on the buses network before and after Presence of DG

Table (3) - the amount of loss before and after the active presence of distributed generation.

	Active loss PL(kw)
Before ins dgs	162
Then ins dgs	15.5

V. CONCLUSION

In this paper a new method for determining the number, capacity and optimal location to install distributed generation (DG) with regard to the objective function in the recipient installation costs and maintenance costs as well as distributed generation to produce electrical energy is provided. Results obtained in simulation with pso algorithm on a real radial distribution network, which is part of the city of Roudbar , shows that connect DG units to the power system, improve voltage profile and reduce losses will be.

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