EFFECT OF DISTRIBUTION GENERATION ON DISTRIBUTION NETWORK AND COMPARE WITH SHUNT CAPACITOR

S. Pazouki and R.F. Kerendian
Islamic Azad University–South Tehran Branch (IAU), Tehran, Iran

ABSTRACT

The electric power industry to adapt to new technologies, market and environment has been deregulated. The most advantages of it is reducing carbon, increasing energy efficiency, improving power quality. Distribution network is the most expensive section in power system. Voltage regulation is one of the usual problems. Due to this problem there is some way to solve that. In this paper, at first the distribution generation (DG) and the advantages of that are explained and the traditional solution such as shunt capacitor is presented then the effect of Distribution Generation like fuel cell on the network is discussed. By using the MATLAB software the simulation results shows the effect of DG on a feeder in distribution network. At end, conclusion debates the comparison between the impact of installing DG and shunt capacitor on the distribution network.

KEYWORDS: *distribution generation, feeder, fuel cell, shunt capacitor*

I. INTRODUCTION

Distributed generation is determined as the use of external sources of electrical power connected directly to an existing power distribution infrastructure. These sources are marked as Distributed Generators or DGs [1].
Known as distribution generation could include:

1. Small gas turbines
2. Wind energy
3. Fuel cell
4. Solar energy
5. Micro turbines

In distribution systems, distribution generation has many benefits for customer as well as for the utilities, especially in case the production center is not able to transfer the energy to the load or where there is not enough energy in transmission system [2].
Deregulation is one cause for the high level of interest in Distributed Generation. Distributed generators are introduced to a distribution system principally for improving energy efficiency, economical benefit, improving power supply reliability and using renewable energy [3][4], Other benefits connect to distributed generation [5]:

- Reliability
- Environmental Benefits
- Power Quality
- Transmission Benefits

Nowadays, using distributed generation in low voltage network, distribution network and installing them into consumption area for improving voltage profile instead of traditional solutions like tap changer transformer and shunt capacitor is growing. Actually the main role of shunt capacitor is

voltage regulation and reactive power flow at the connection point with distribution feeder. By the value of shunt capacitor the voltage of the far-end feeder point is improved [6][7].
Installation of DG can have positive impacts in the distribution system by enabling reactive compensation for voltage control, reducing the losses.
A distribution network designer by using multiple designs such as open feeder, closed feeder and radial network must be able to transfer electricity energy from substation to distribution network. On the other hand, distributed generation are capable to make distribution generation change from passive state to active state and in this way, they can supply parts of requirement [7].
The fuel cell and a brief overview of advantages of this DG are presented in section II. Section III provides detail configuration of feeder and DG and shunt capacitor. Simulation results and comparisons are debated in section IV. Finally, conclusions are drawn in section V.

II. FUEL CELL

Fuel cell is an electrochemical device that converts chemical energy into electrical energy by using the fuel. All fuel cells comprise two electrodes (anode and cathode) and an electrolyte (usually retained in a matrix). They operate much like a battery except that the reactants (and products) are not stored, but continuously fed to the cell.

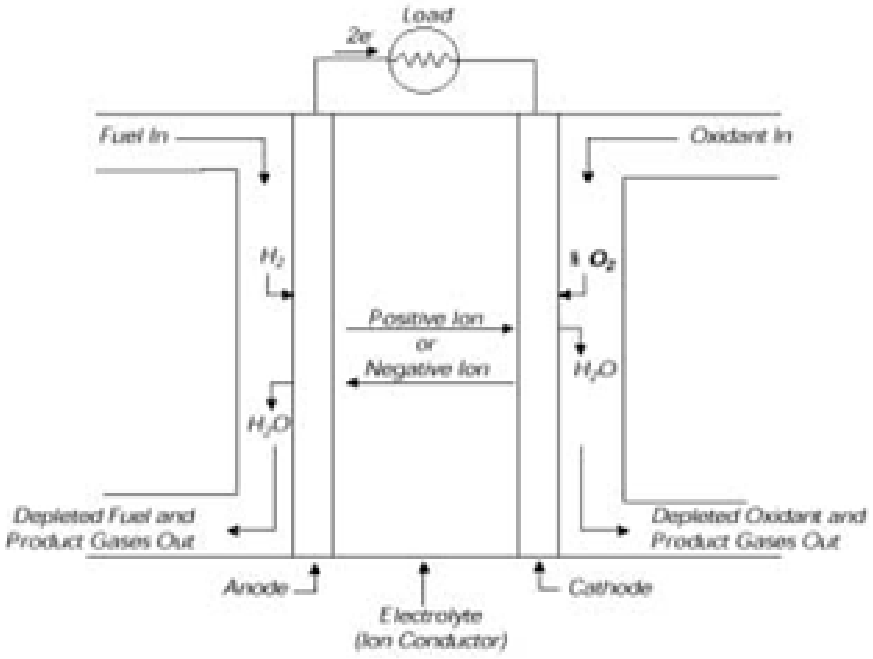


Figure 1: Schematic of an individual fuel cell

Fuel cells have a number of advantages over conventional power generating equipment:

1. High efficiency
2. Fuel flexibility
3. Low maintenance
4. Reliability
5. Low chemical, acoustic, and thermal emissions
6. Siting flexibility
7. Excellent part-load performance
8. Modularity

Due to higher efficiencies and lower fuel oxidation temperatures, fuel cells emit less carbon dioxide and nitrogen oxides per kilowatt of power generated. And since fuel cells have no moving parts (except for the pumps, blowers, and transformers that are a necessary part of any power producing system), noise and vibration are practically nonexistent [8]. Given the above specifications, the fuel cell is used in this study.

III. SYSTEM CONFIGURATION

In this part, we explained the feeder that used in the simulation, shows in figure 2. Its includes 8 equal segments with equal impedance in line and equal impedance in load. The DG and shunt capacitor are connected to the beginning the feeder. To show the impact of shunt capacitor, there are two values of that in simulation.

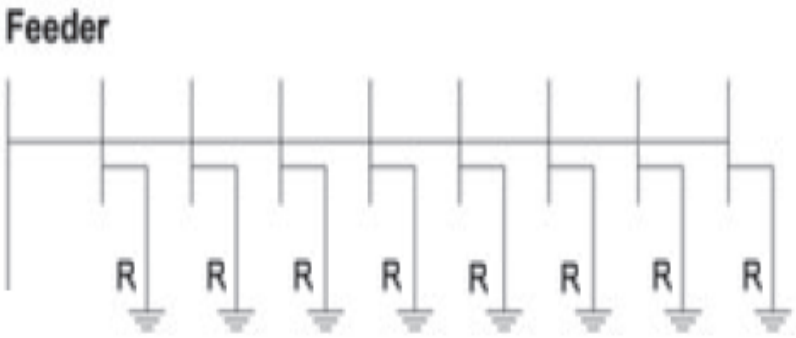


Figure 2: Simple schematic of feeder

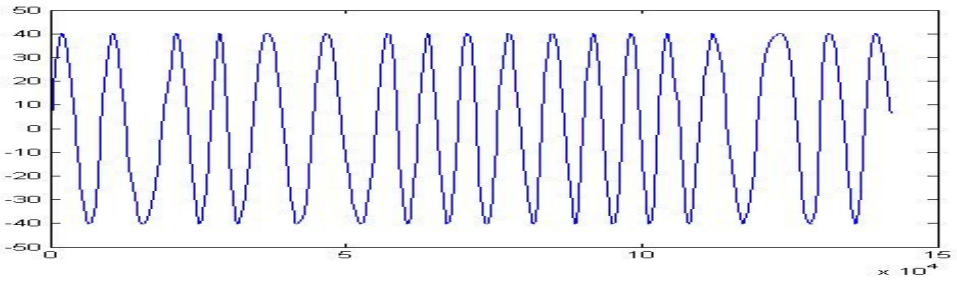
The system parameters used in this configuration are shown in table 1:

Table1: System parameter

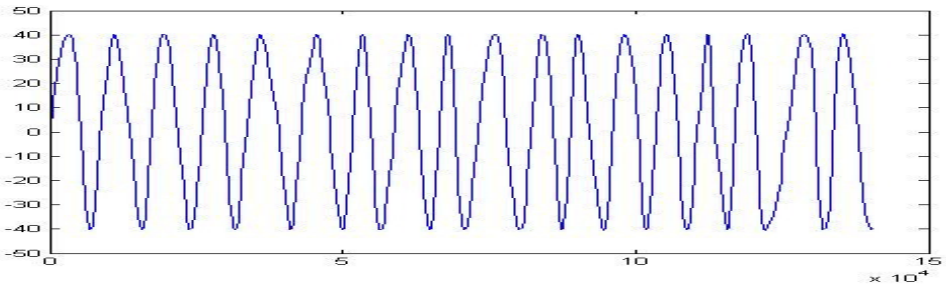
DG	1.26 kw
Shunt Capacitor	50 μf , 1mf
L_{line}	0.0308e-03 H
R_{line}	0.003ohm
L_{load}	5.02e-03 H
R_{load}	1 ohm

IV. SIMULATION RESULTS

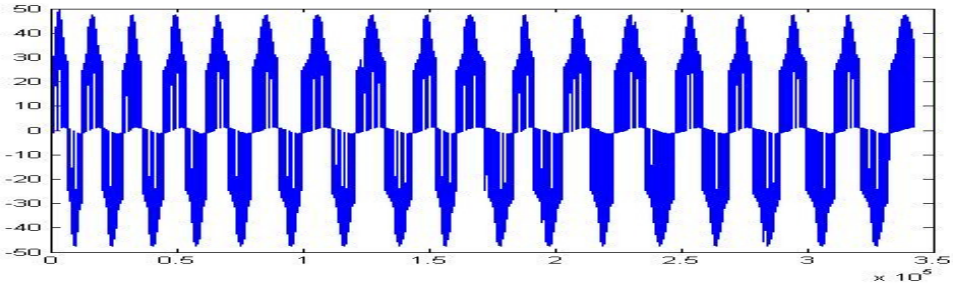
In this part the results of simulation are presented. DG and shunt capacitor are connected to the beginning the feeder. The voltage at the first point is shown in figure 3 and the voltage at the end of the feeder is shown in figure 4.



a. Voltage without DG and capacitor

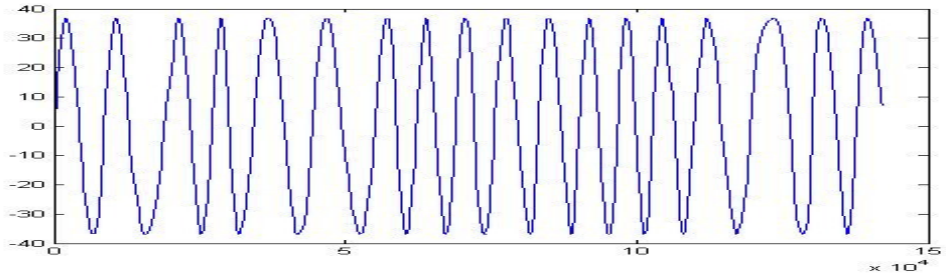


b. Voltage with capacitor

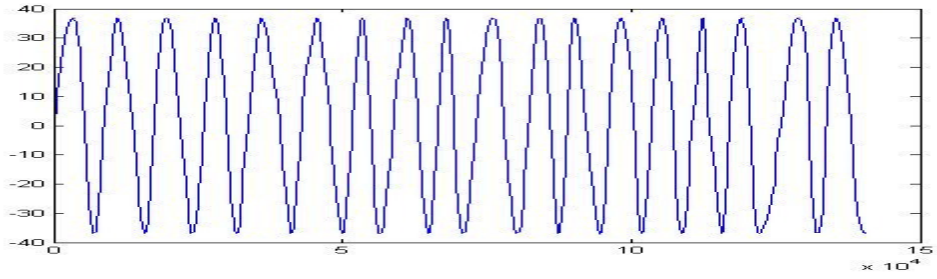


c. Voltage with DG

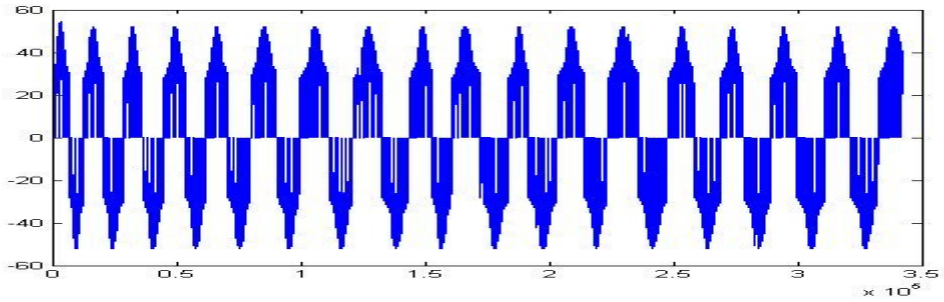
Figure 3: The voltage at the first point



a. Voltage without DG and capacitor



b. Voltage with capacitor



c. Voltage with DG

Figure 4: Voltage at the end point

Figure 5 shows the voltage during feeder without DG and capacitor, voltage during feeder with shunt capacitor show in figure 6 and 7 by different value of that. The voltage profile by using DG presented in figure 8.

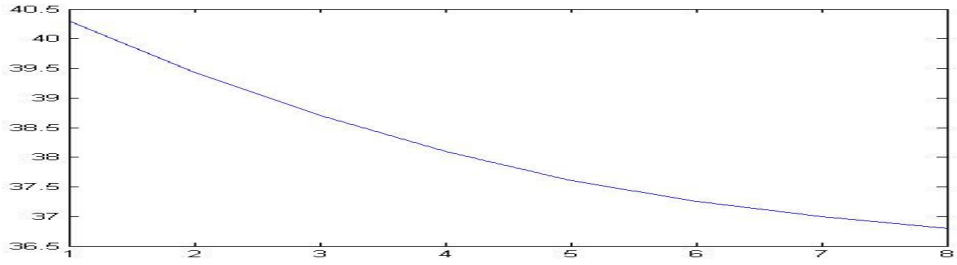


Figure 5: Voltage during feeder without DG and capacitor

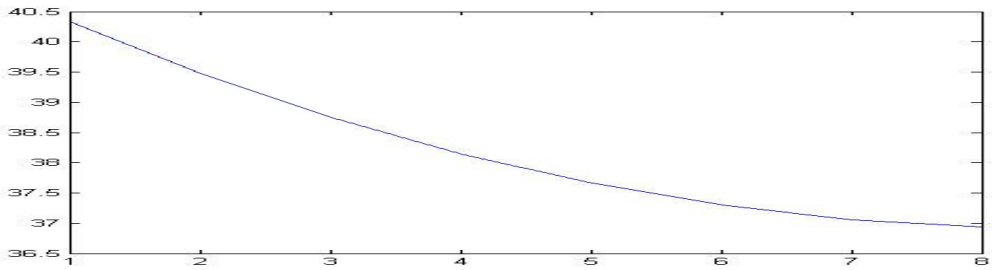


Figure 6: voltage during feeder with capacitor (50 μf)

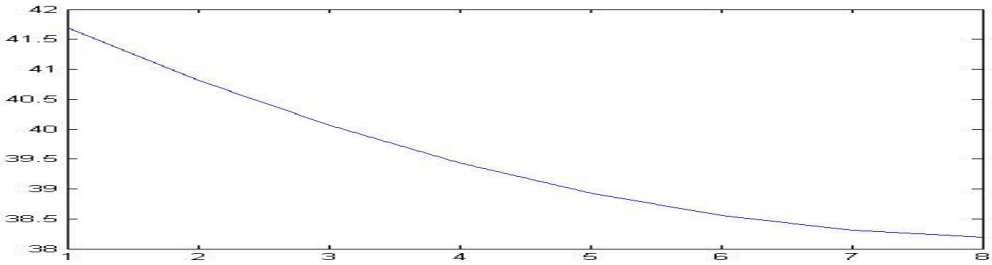


Figure 7: voltage during feeder with capacitor (1mf)

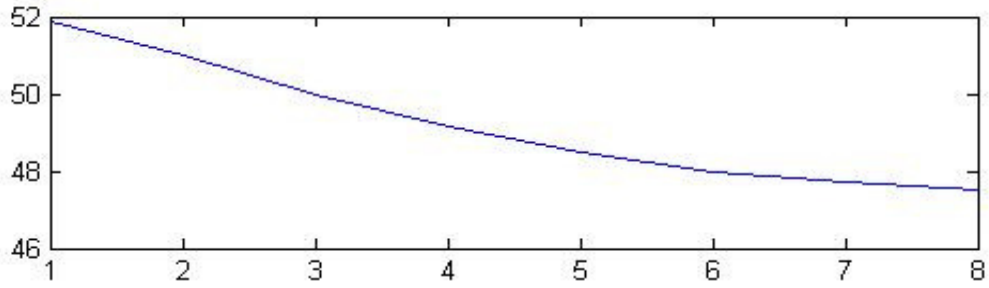


Figure 8: Voltage during feeder with DG

V. CONCLUSION

The distribution generation (DG) has impact to improve the voltage profile and it can provide a piece of energy that the customer needs due to electrical power. Comparison between the figures in previous part shows using shunt capacitor slimly provide in voltage and it is clear by using the DG there is better results than shunt capacitor.

REFERENCE

[1]. J. E. Kim, H. K. Tetsuo and Y. Nishikawa, 'Methods of determining introduction limits of Dispersed Generation systems in a distribution system', Scripta Technical, Kyoto University, Japan, 1997.
[2]. Carmen L. T. Borges, Member, IEEE, and Djalma M. Falcão, Senior Member, IEEE , "Impact of Distributed Generation Allocation and Sizing on Reliability, Losses and Voltage Profile ", Paper accepted for presentation at 2003 IEEE Bologna Power Tech Conference, June 23yh-26th,Bologna,Italy.
[3]. H.L.Willis & W.G.Scott, "Distributed Power Generation –Planning and Evaluation –", Marcel Dekker, 2000
[4]. A.B.Lovins *et al*., "Small is Profitable", Rocky Mountain Institute, 2002
[5]. Rakesh Prasad," Benefits of Distributed Generation on Power Delivery System Distribution Engineering", 2006
[6]. Glover, J.P & Sarma,"Radial Distribution Test Feeder Distribution System Analysis Subcommite Report", 2004
[7]. Gonen, T"Electric Power Distribution System Engineering" Mc Graw-Hill, New York, 1986
[8]. Energy center," Fuel Cells for Distributed Generation" March 2000

Authors

Samaneh Pazouki was born in Tehran, Iran. She received her B.S degree from Islamic Azad University-Garmsar Branch. She is currently M.S student in the Islamic Azad University-South Tehran Branch. Her research interests concern Smart Grid, FACTS, Distributed Generation and Electrical Storages, Power Distribution System.

Rasool Feiz Kerendian was born on 1988 in Kermanshah, Iran. He received his B.S degree from K.N Toosi University of Technology. He is currently M.S student in the Islamic Azad University-South Tehran Branch. His research interests include Power Distribution System.