Effects of distributed generations on power quality of the distribution network

Hossein Sedghifard¹
Zanjan Regional Electric Co

Corresponding Author email: hossein.sedghifard @ gmail.com

ABSTRACT: In this paper, effects of distributed generation (DG) on the power quality of distribution network are studied. A typical network is considered and simulation results are obtained in the presence of DG and without it from Digsilent software environment. By comparing these results, it is demonstrated that the injected power of DG can improve the voltage profile and reduce the network losses. Moreover, DG has good effect on the reliability of network. Keywords: distributed generation, power quality, voltage profile.

INTRODUCTION

Electricity demand has increased in the world. This growing demand has led to generate more electricity by Small-scale generators from 1kW to 100MW (Ackermann et al., 2000). Penetration of DG with different generation technologies in the distribution network can solve some problems such as stability, power quality and security (Amyrany et al., 2002). Furthermore, small scale units have lower construction cost and can decrease transmission lines cost by installing on site. By using renewable technologies, greenhouse gases emissions will be decreased. These factors cause more installation of distributed generations on the distribution network.

Most distributed generation technologies in various aspects such as performance, size and capacity expansion are flexible. Moreover, the use of distributed electricity prices are set for a flexible response.

Radial distribution systems usually are designed, there is no load on the generator. Therefore, the generator in the power distribution network of current and voltage and load conditions, and this can affect the electrical equipment on the functional parameters of the system is positive or a negative. Given these premises are close to consumption centers, they need to transmit energy over long distances, there is no output. The manufacturer is closer to the consumer; the energy costs will be reduced. The issues and problems that have been caused as a choice for distributed generation and demand response to be considered.

In this paper, the effect of network throughput and Quality of distributed generation connected distribution system voltage profile and its effect on the peak load has been evaluated.

Aimed utilize of distributed generation

Targets using distributed and shared vision differs from visual distribution company. If the owner is a distribution company DG, targets can release distribution network capacity, improve system reliability, combined heat and power production, improve quality and reduce power loss and voltage profile. If the property is a member of DG, the targets can sell power and energy market, electricity sales as an ancillary service, improving reliability or encouragement from distributors and Is. Unfortunately, the most distributed property of subscribers; therefore, distribution companies have less control over the size and location of distributed.

Consequently, to avoid the negative influence of various parameter son the distributed system, a general and comprehensive standard for the control, installation and placement of these products exist (Dugan et al., 2002). In general the use of DG in distribution networks, providing all or part of the power grid is fulltime or part time. (EPRI, 2001).

Formulation

In the first method load flow calculations Gauss-Saydel the relationship between (1) the amount of voltage gain, then from equation (2) we calculate the flow rate. (Jvrabyan et al., 2005).

(1)
\[ v_i^{(k+1)} = \frac{v_i^{(k)} + \sum_{j \neq i} I_j^{(k)}}{y_{ij}} \]

Active power: \( P_i \)

Reactive power: \( Q_i \)

The real value of the admittance

Active and reactive power transfer is calculated from the following relationship:

1. \( P_i = \frac{v_i |I_i|}{x} \sin(\Delta \delta) \)
2. \( Q_i = \frac{v_i}{x} \left| v_i \right| \cos(\Delta \delta) \)

**Simulation of Systems**

A sample network in Figure 1 is considered and the desired run on it. The grid voltage 132kv if (EX) External Grid fed through a transformer 132/20kv connection Y/ Δ and a transmission line 35km and Generator local (DG) with a voltage of 6.6kv and trans 6.6 / 20 KV is connected to 20kv bus and the four rural feeder voltage level 0.4kv connected.

**Effect of DG on power quality network**

In this section, the computation load in the presence and absence of DG non DG bus voltage profiles obtained are given in the table and graph below.

<table>
<thead>
<tr>
<th>Bus bars</th>
<th>Voltage non presence dg (kv)</th>
<th>Voltage presence dg (kv)</th>
<th>Amount voltage improvability (kv)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B2</td>
<td>19.52∠ - 2.57</td>
<td>19.71∠0.84</td>
<td>190</td>
</tr>
<tr>
<td>B3</td>
<td>18.2∠ - 2.44</td>
<td>19.9∠2.69</td>
<td>1700</td>
</tr>
<tr>
<td>B4</td>
<td>0.36∠ - 4.89</td>
<td>0.39∠0.65</td>
<td>30</td>
</tr>
</tbody>
</table>

According to Table 1 and Figure 1 it is clear that improved voltage profile of the DG and the DG is injected in to Q. It also improves the angle of the voltage at the DG compared with the absence of DG active power injection at all buses shows that the DG network that improves power quality and power factor networks.
study was carried out to determine the presence of DG, (EX) has 11.72MW active power and reactive power is 5.17 MVAR

Format of External Grid

One of DG for enhancing the reliability and continuity of service is common, hence the cut EX, DG should be able to work some of the time. In order to stop the effects of EX DG review has been stabilized by the presence of DG results in the table below.

<table>
<thead>
<tr>
<th>Bus bars</th>
<th>Voltage non presence EX(kv)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>129.58∠−2.02</td>
</tr>
<tr>
<td>B2</td>
<td>19.63∠−2.02</td>
</tr>
<tr>
<td>B3</td>
<td>19.63∠−2.02</td>
</tr>
<tr>
<td>B4</td>
<td>0.39∠−4.11</td>
</tr>
</tbody>
</table>

Figure2. Bus bars voltage presence dg and non-presence

Figure3. Bus bars dg and after format EX voltage before of presence
Clearly stabilized due to reactive power injection by DG Shin and Shin far a scan be seen from the DG voltage stabilizers are less reactive due to losses. But the main task of the DG supply the local demand, the less important the further consolidation of bus voltages. In the case of DG MVAR 4.63 MW 10.89 and can be generated.

Changes of power losses in the network, the network is characterized by the presence of DG EX can be downloaded be low 0.54 MVAR and 0.83 MW that the network losses are improve Q indicates that the DG could reduce network losses are injected.

Improve the voltage profile and power supply by DG reduces the network elements that make the show so reduce their losses.

CONCLUSIONS

Power quality issue or topic that is well-defined and yet so much attention to solutions to the problems associated with it. It seems that currently only a small number of large consumers of power quality is important, however, in recent years, increasing the associated equipment in buildings, especially in the information technology business, has increased problems associated with harmonic. It is anticipated that in the near future, the number of consumers for whom this will be a significant increase. Installation of distributed generation of stable voltage, power factor correction, reactive, reactive power injection and keep the mains frequency and ultimately prove the quality and increase the quality of the network will have a positive effect.

REFERENCES

The authors of Renewable Energy organ is at ion (SUNA) Renewable Energy Agency.
WWW.SUNA.ORG.IR

Figure 4. Active and reactive power before of presence dg and after format EX and solely presence dg