IMPACT OF PV DISTRIBUTED GENERATION ON LOOP DISTRIBUTION NETWORK IN RIYADH CITY

Mohammed Alruwaili, KSU-SASO, +966504217185, malruwaili11@gmail.com

Overview

Nowadays, renewable energy resources are playing an important role in replacing traditional energy resources such as fossil fuels by integrating solar energy with conventional energy. Concerns about the environment led to intensive search for renewable energy source. The Rapid growth of distributed energy resources will have prompted increasing interest in integrated distributing network in Kingdom of Saudi Arabia next few years, especially after the adoption of new laws and regulations in this regard. Photovoltaic energy is one of the promising renewable energy sources that has grown rapidly worldwide in the past few years, and can be used to produce electrical energy through the photovoltaic process. The main objective of the research is to study the impact of PV in distribution network based on real data and details.

Methods

In this research, site survey and computer simulation will be dealt with using the well-known computer program software ETAB to simulate the input of electrical distribution lines with other variable inputs such as the levels of solar radiation and the field study that represent the prevailing conditions and conditions in Diriah, Riyadh region, Saudi Arabia. In addition, the impact of adding distributed generation units (DGs) to the distribution network, including solar photovoltaic (PV), will be studied and assessed for the impact of adding different power capacities.

Results

The result has been achieved with less power loss in loop distribution network from the current condition by more than 69% decrease in network power loss. However, the studied network contains 78 buses. It is hoped from this research to reduce power losses and enhance voltage profile of the distribution networks in Riyadh City. Simulation results prove that the applied method can illustrate the positive impact of PV in loop distribution generation.

Conclusions

A comparative and deep comprehensive of real distribution network is introduced. The aim of this research is identifying the impact of PVDG on loop distribution network at Saudi Electricity Company substation in Diriah, Riyadh region, Saudi Arabia. An existing Substation and low voltage distribution network 132kV/13.8kV/400V belong Saudi Electricity Company was identified to be the case study. The ETAB software simulation program has been used to model, assess and analyze the applicable data and details from site survey or the accessible documents.

The efficiency, performance, quality and reliability were impacted differently with each case. An enhancement in power loss and voltage profile were investigated in five different cases. A comparative summary between the five cases was shown less power loss on loop distribution network from the current condition (Case I) and the best achieved case (Case V) with more than 69% an enhancement in the efficiency. Moreover, the voltage

profile was enhanced with more flatten pattern over whole network with recorded Marginal under voltage more than 96.6%. The archived results design are becoming encouragement factors to be extensively practical and exploited in loop distribution network regardless other applicable factors.

References

[1] Hasan D, Serhat Y and Zehra N C (2019) "A Strategic Approach to Reduce Energy Imports of E7 Countries: Use of Renewable Energy" Handbook of research on economic and political implications of green trading and energy use. IGI Global, p. 18-38.

[2] A Baras (2012) "Opportunities & Challenges of Solar Energy in Saudi Arabia" World Renewable Energy Forum, Denver. p. 4721

[3] Ngaopitakkul, A., Pothisarn, C., Bunjongjit, S., Suechoey, B., Thammart, C. and Nawikavatan, A (2013) "A Reliability Impact and Assessment of Distributed Generation Integration to Distribution System". Energy and Power Engineering, 05(04), pp.1043-1047.

[4] Al-Sefri, A. and Al-Shaalan, A (2019) "Availability, Performance and Reliability Evaluation for PV Distributed Generation". World Journal of Engineering and Technology, 07(03), pp.429-454.

[5] A Eltamaly, M Al-Saud, A Abokhalil and H Farh (2019) "Photovoltaic maximum power point tracking under dynamic partial shading changes by novel adaptive particle swarm optimization strategy" Transactions of the Institute of Measurement and Control, 42.1: 104-115.

[6] M Ghaffarianfar and A Hajizadeh (2018) "Voltage Stability of Low-Voltage Distribution Grid with High Penetration of Photovoltaic Power Units" Energies, 11(8), p.1960.

[7] Alrumaih, M. and Al-Shaalan, A (2019) "Impact of PV Distributed Generation on Loop Distribution Network". Journal of Power and Energy Engineering, 07(08), pp.27-42.

[8] Y Bakhuraisa1 ,A Al-Shaalan, M Abouelela, A Al-hasani (2020) "Common Mode Reduction of Transformer less Inverter for Grid Connected PV System" Test Engineering and Management 82:15230 - 15238

[9] Z Haidar, A Al-Shaalan (2018) "Reliability Evaluation of Renewable Energy Share in Power Systems" Journal of Power and Energy Engineering, 6.9: 40-47

[10] M Omar, A Taha, A Samak, M Keshek, E Gomaa, S Elsisi, (2021) "Simulation and validation model of cooling greenhouse by solar energy (PV) integrated with painting its cover and its effect on the cucumber production" Renewable Energy, 172: 1154-1173

[11] H Farh, A Al-Shaalan; A Eltamaly; A Al-Shamma (2020) "A Novel Crow Search Algorithm Auto-Drive PSO for Optimal Allocation and Sizing of Renewable Distributed Generation" IEEE Access, 8: 27807-27820.

[12] H Ziar, P Manganiello, O Isabella, M Zeman (2020) "Photovoltatronics: intelligent PV-based devices for energy and information applications" Energy & Environmental Science, 14.1: 106-126.

[13] A Calcabrini, R Weegink, P Manganiello, M Zeman, O Isabella (2021) "Simulation study of the electrical yield of various PV module topologies in partially shaded urban scenarios" Solar Energy, 225: 726-733

[14] A Rathore, N Patidar (2021) "Optimal sizing and allocation of renewable based distribution generation with gravity energy storage considering stochastic nature using particle swarm optimization in radial distribution network" Journal of Energy Storage, 35: 102282