

MSc Thesis Abstract:

Title:

Selection of Appropriate Penetration Factor and Location for Photovoltaic Power Plant from the Viewpoint of Distribution System

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The main aim of this project is finding an appropriate size and location for a photovoltaic power plant in Iran's electrical network. Recently, Distributed Generation (DG) has become an attractive field for researchers due to some worldwide problems such as global warming, lack of crude oil and etc. Among different kind of DGs, Photovoltaic power plants have its especial considerations. Size and location of the power plant has been evaluated from different aspects: the point of view of the government and legislators, investors, and the distribution companies.

In the first step, using multi attribute decision making, the problem is solved from viewpoint of the government and legislators. The problem of sitting is formulated for Iran's transmission network. Considering economical, technical, and environmental issues the solution, which is suitable places for constructing photovoltaic power plant, is found using Expert Choice Software. Some different scenarios are defined by changing the priority of different attributes and sitting problem is solved in all these cases.

Because of fluctuation in output power of photovoltaic and variable nature of the loads in network, for evaluating power loss and the bus voltages, the grid should be simulated for all days of the year and all hours of the day but this simulation is really time consuming and costly. Consequently a Clustering-based Method is used to find some days as representatives and simulate the grid for these days rather than all days of the years. If the representatives indicate the nature of whole data very well, the error of simulating the grid in this case comparing with simulating it for all days is negligible. For evaluating performance of the clustering methods and finding optimal number of clusters three clustering validity indices is used. As an example, the 33 buses test system and irradiation profile of Tehran in a year are considered. Different types of loads, residential, commercial, agricultural, and industrial are assigned to loads in selected network. In this case, the network is simulated for all days and its result is compared with

clustering-based method. Using meteorological database and power flow simulation the annual power loss and voltage profile for all busses are calculated and used for evaluating the best size and place of Photovoltaic power plants.

Finally, the problem is solved from standpoint of investors. Net present value and payback period are calculated for different regions of Iran. Considering discount rate new tariff rate is calculated in order to achieve acceptable value for payback period in all regions. This can act as an incentive policy.

To sum up, in this project a solution for solving the problem of sizing and sitting the photovoltaic power plant is presented. Different attributes, such as economic, technical, and environmental issues in transmission network of Iran is considered. Moreover clustering based approach for finding suitable size and location for this power plant in distribution network is proposed. In addition, the quality of voltages is evaluated. Finally, payback period and net present value from viewpoint of investors is calculated considering different scenarios and incentive policies.