THE PLANNING OF OPTIMUM MULTI-TYPE DISTRIBUTED GENERATION (DG) CAPACITY AND LOCATION FOR ELECTRICAL NETWORK POWER QUALITY IMPROVEMENT BASED ON ARTIFICIAL INTELLIGENCE METHOD

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ABSTRACT

The distributed generation (DG) can be classified into three types based on kind of power it injected and absorbed. DG type 1 has active power injection capability only. DG type 2 is capable to inject both active and reactive power. DG type 3 has ability to inject active power and to absorb reactive power.

The DG development by community/consumer is predicted to be a trend in the future. The DG development will be consisted of any types, capacities and connecting with distribution network in wide and random scale.

The capacity and location of DG in an area closely related to network power quality problem. On the other side, network power quality improvement can be resulted by the DG development with optimum capacity and location. The improvement is active power losses reduction and network voltage profile enhancement. The distribution network operator need a planning system to anticipate the DG growth development while maintaining network power quality.

The previous researches about optimum DG capacity and location planning, generally still used single-type DG only. The artificial intelligence methods widely used in those researches were simple genetic algorithm (SGA) and basic particle swarm optimization (BPSO). While, the researches about planning, expansion and optimization of electrical power network connecting with more of one DG type or multi-type DG were still rarely conducted by the previous researchers.

This research discussed the planning of optimum multi-type DG capacity and location for electrical network power quality improvement based on artificial intelligence method. The optimization objective was obtaining minimum active power losses with network voltage still fulfilling determined standard value. The IEEE 30 bus electrical network was used as a research plant. The DG that using in the research had 10 MW maximum active power capacity. While, the DG maximum reactive power capacity was 20 % from its active power capacity. In addition using SGA and BPSO method, the newer artificial intelligence methods like breeder genetic algorithm (BGA) and particle swarm optimization-gravitational search algorithm (PSO-GSA) were also used in this research. This research was included of four optimization scenario.
Scenario 1 was optimization using DG type 1. Scenario 2 was optimization using DG type 2, while scenario 3 using DG type 3. The optimization scenario 1, 2 and 3 used SGA, BPSO, BGA and PSO-GSA method. The best method for the three scenarios, was used as scenario 4 optimization method.

Scenario 4 was optimization using multi-type DG were DG type 1, 2 and 3 that connecting simultaneously with electrical power network. The simulation was conducted on three kinds of multi-type DG configuration. The number of DG type 2 on each configuration was 1, 2 and 3 units, respectively.

For scenario 1, 2 and 3, the best active power losses reduction with voltage still maintaining within determined standard value was generated by PSO-GSA method using DG type 2 distributing to the three network buses. The reduction value was 23.8073 %. The optimization using DG type 1 and DG type 3 generating almost the same reduction value with DG type 2. The difference was 0.2409 % and 0.4661 %, respectively.

For scenario 4, the best optimization result generated by PSO-GSA method using multi-type DG configuration with three units of DG type 2. The active power reduction value was 34.2243 %. The optimization using one and two units of DG type 2 generated almost the same reduction value with 0.6647 % and 0.1574 % difference, respectively.

Keyword: optimization, capacity and location, multi-type distributed generation (DG), power quality, IEEE 30 bus electrical power network, artificial intelligence method