CHAPTER

8

PARTICLE SWARM OPTIMIZATION FOR DISTRIBUTION NETWORK RECONFIGURATION

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8.1 INTRODUCTION

The electrical power system is the key to technological growth which is vital for the continuous development of the world. Normally, the main components of an electrical power system consist of three stages which are generation, transmission, and distribution. Distributions of electric power are the last phase in the conventional electric power system. It carries electricity from the transmission system to individual consumers such as households and industry. The distribution system is the unit that supplies the distributed electricity to the transmission system and degrades the transmission voltage to medium voltage with the use of a transformer.

As urban and rural towns are growing, energy consumption is constantly rising. The efficiency of distributed system is crucial to cover the load demand growth. In terms of efficiency, the main problem is that the overly lengthy transmission lines lead to high power losses. One of the solutions is by implementing distributed generations (DG). This technology is implemented in the distribution system due to its small size and can be located close to customers. DG is usually used to compensate and supply required electricity demand. The use of DG is increasing and rapidly implemented due to its flexibility, economic and good alternative solution rather than new power plants. Adding DG into conventional systems can reduce power losses and improve efficiency of the system. However, adding more DGs to cope with exponentially increasing load may lead to further complexity and create higher system losses. Therefore, the other alternative to solve the problem is by distribution network reconfiguration (DNR) method, as illustrated in Figure 8.1.

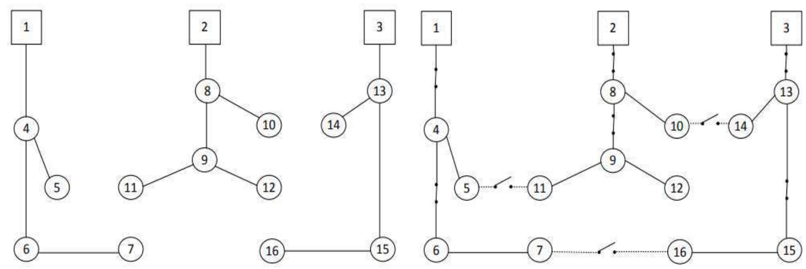

Figure 8.1 Distribution network feeder reconfiguration

Distribution network reconfiguration (DNR) is a way to adjust the topological configuration of the distribution system by changing the open/closed status of switches resulting in altering heavily loaded feeders to the lightly loaded feeders while, at one time maintains the radial structure of distribution feeders. The difficulty of network reconfiguration is in general to place the optimal switching configuration, which results in minimum power losses in the distribution system. DNR is a challenging task since there could be numerous possible combinations of sectionalizing switches and tie switches. There are several constraints which must be solved while finding an optimal solution to that problem. Therefore, the aim of this paper is to determine the optimal configuration of radial distribution network with the presence of DG using particle swarm optimization (PSO) algorithm. This chapter is organized by presenting related work in Section 8.2. Section 8.3 describes the proposed methodology while Section 8.4 explains the simulation results. Section 8.5 provides the conclusion drawn on the study.

8.2 DISTRIBUTED GENERATION AND NETWORK RECONFIGURATION

A comprehensive review about DG implementation and the state of the art of network reconfiguration for losses minimization using meta-heuristic algorithm are explained in this section.

8.2.1 Distributed Generation

Distributed generation (DG) is an electric power source connected directly to the distribution network or on the customer site of the meter it can be located near the consumers in the distribution system due to its small size. DG is often defined as electrical boundaries that act as a single entity with respect to grid and have the ability to be connected and disconnected from the grid. In previous works, researchers have highlighted the benefits and drawbacks of implementing renewable energy DG in a distribution system. Biswas et al. (2017) stated that adding DG with optimal location and size into distribution system able to minimize active and net reactive power loss simultaneously. Power losses in the distribution system affect the level of reliability of a distribution network. Hence, the power loss minimization can be done by the presence of DG, which can increase the system performances, dependability and most importantly can provide adequate electricity to the consumers.

On the other hand, Yuan et al. (2023) proved that excessive DG implementation can increase line losses and increase the voltage profile of the distribution network. DG injects both real or reactive power into the system, therefore reduces the actual demand for power from the substation. Ogunsina et al. (2021) indicated that DG implementation, however, gave negative impact to the system if the units are placed with improper size, as the massive capacity of DG units may lead to higher system losses and gives adverse effects to the voltage profile.