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Optimal Operating Strategy for Distributed Generation Considering Reliability Index of SAIDI

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ABSTRACT

Deciding the optimal operation mode for Distributed Generation (DG) is of a crucial importance in increasing the efficiency of these resources. This paper presents a method to determine optimal operating strategy for distributed generation (DG) according to the improvement of SAIDI reliability index. The considered operation modes of this paper includes, peak shaving and standby. The use of DG for peak shaving could reduce the overall system operating cost and its use as standby power could reduce the customer interruption cost. The SAIDI index is used in the strategy proposed in this paper to determine the optimal operating decision for the DG. In addition, Monte Carlo method is incorporated, in order to determine the occurrence and duration of the failure of each distribution network elements. Using the approach proposed in this paper, the distribution companies could determine the optimal operating strategy for their DG. To validate the proposed strategy, bus 2 of the standard distribution network of RTBS is simulated in DIgSILENT software and the simulation results are presented and discussed.

KEY WORDS: Distributed Generation (DG), Distribution System, Monte Carlo method, SAIDI Index, Reliability Indices.

INTRODUCTION

DG is usually defined as electrical power resources, which are directly connected to the system [1]. Nowadays, DG plays an increasingly significant role in the electrical power systems due to the developments in DG technologies, the increase in the electricity demand, the importance of reliability of the system, and the increasing attention to the environmental issues [2].

The applications of DG include combined heat and power, standby power, islanding mode, peak shaving, and grid support. Nowadays, customers are interested in having electricity with a reduced cost and increased reliability. Power system reliability, is defined as ability of a system to provide electrical energy for costumers. In addition, the issue of reliability of distribution networks is becoming one of the most important problems in electrical industry due to its impacts on electricity price and the satisfaction of the costumers [3]. In the other hand, on the most important benefits of having a high reliability is the reduction of interruptions. Since the electrical companies have to pay dues for interruptions, reduce in interruption amount is desired for both customers and utilities [4].

Many studies have been carried out regarding the impacts of DG on reliability of system. Authors in [5] discussed the negative impacts of DG on distribution system reliability. Dynamic behavior and transient states associated with DG are considered in this paper. The work of [4] has considered the hourly reliability worth to determine the optimal operation strategy of DG. This study considered peak shaving and standby modes. Authors in [6] presented an analytical method to evaluate the reliability of the power system having DG resources considering the peak shaving and backup modes. This study proposes connectivity matrixes to state the condition of connectivity of resources and costumers. Ref. [7] has discussed the impacts of DG on distribution networks reliability. In addition, the impact of the location of DG on the reliability of distribution system is analyzed in this paper. Ref. [8] and [9] proposed a reliability model to identify DG equivalent to use DG instead of adding a new feeder in peak load. In these studies, reductive transformers and fuses are assumed to have the reliability of 100%. In the other hand, the interruptions due to simultaneous failures and the impacts of DG modes on reliability of system are not considered. The applications of DG with old technologies such as diesel are discussed in [10] and the benefits of islanding mode of operation are presented. Authors in [11] expressed intentional islanding mode as an option to improve the reliability of power system. In this study, the other operational modes of the DG are not considered. Studies [12] and [13] proposed a method to identify the optimal location and capacity of DG in order to improve reliability, voltage profile and reduce the power losses.

Analyzing the reliability indexes is carried out in these studies based on the modified analytical methods in order to manage number of generators. DG unit is considered in backup unit and the peak shaving and islanding modes are ignored. The problem of reducing the loading of the distribution feeders due to installing DG units in distribution

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