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Optimized investment to decrease the failure rate of distribution lines in order to improve SAIFI

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Abstract--**This paper presents a novel mathematical model to calculate system average interruption frequency index (SAIFI). Then a proper objective function relevant to improve the SAIFI is proposed. The proposed objective function increases the reliability of the distribution system by minimizing the costs of decreasing the failure rates of the distribution lines. The results of the optimization problem can minimize the SAIFI by a minimum cost. It means the proposed method leads electrical companies to optimize investment in order to improve reliability indices by minimized cost.**

Index Terms-- Keywords: SAIFI, failure rate, optimization, genetic algorithm (GA), distribution systems

I. Introduction

Many studies are accomplished about reliability and power quality in distribution systems. These subjects are interesting for power system researchers and electrical companies. Because of the competitive power market, customer orientation is an important role. Therefore, electrical suppliers have high tendency to improve the reliability of the systems and increase the customer satisfaction [1-10].

Improving the reliability indices in distribution systems has been provided in recent papers. Optimization of protective and switching device allocation is used to improve the system reliability in these papers [1-3]. But increasing the reliability or power quality in distribution systems with improving the characteristics of system components is not incorporated seriously until now.

There are many scenarios to improve the characteristics of the system components. Because of limitation of supplier's investment, optimized scenario selection is very important.

In this paper, decreasing the temporary and permanent failure rate is incorporated to improve the system reliability. There are some methods to decrease the failure rates such as installing shield wires in overhead lines, change the line types from overhead to cable; where bad events usually occur, pruning trees, etc.

Optimal budget reserve can be achieved by solve the proper objective function included the reliability indices and the system costs. SAIFI minimization is considered to increase the reliability while the minimized budget is need. The concept of the above discussion is optimal investment to take maximum improvement in SAIFI and minimum cost.

Optimization helps the companies to find the critical section in the system. Optimization would allocate the sections that if there failure rates are improved by limited budget, maximized SAIFI improvement will be achieved.

Another advantage of the proposed method is novel model to calculate the SAIFI. This model simplifies the calculation of reliability indices in distribution systems.

This method is applied to a 33-bus distribution system. The topology of the test system is selected from [11]. The results include appropriate sections to decrease the failure rate and improve the SAIFI of the distribution system. Genetic algorithm is used to optimize the proposed nonlinear objective function.

II. PROBLEM FORMULATION

This paper presents a novel optimization methodology. The purpose of the proposed optimization methodology is achieving the best distribution system reliability with decreasing the failure rate of overhead lines while simultaneously minimizing the capital cost. There are many reliability indices used to evaluate electric power distribution systems [10]. The most common indices used by electric utilities are system average interruption frequency index (SAIFI) and system average interruption duration index (SAIDI). They are used to measure the impact of power

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