Flexible Approach for Optimization of Distance and Overcurrent Protection Coordination

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***Abstract*— In this paper, a new approach is presented to solve the optimization problem of coordination of overcurrent and distance relays using genetic algorithm. Because the existing objective function of overcurrent relays can not be directly applied to combined overcurrent and distance relay coordination, the OF is improved. Various overcurrent relays characteristics are considered within the approach to select the best of them by GA to fulfill optimal coordination. The proposed method is applied to an interconnected power system networks. From the results, it has been revealed that the new approach is the successful one.**

***Index Terms*— Distance Protection, Optimal Coordination, Overcurrent Protection y, Relay Modeling.**

I. Introduction

Overcurrent and distance relays are mostly used for transmission and subtransmission protection systems [1]. To consider comprehensive coordination, a distance relay with a distance one, an overcurrent relay with an overcurrent one and finally an overcurrent relay with a distance one, must be coordinated when one of them is considered to be the main relay and the other is the backup.

For overcurrent relays, the optimal coordination has been performed using linear programming techniques, including simplex [2], two-phase simplex [3] and dual simplex [4] methods. The disadvantage of the above optimization techniques is that they are based on an initial guess and may be trapped in the local minimum values [5]. In [6], the optimal solution is made by constraints only. The disadvantage of this method is that if the constraints are not fulfilled, we do not have optimal solution. Intelligent optimization techniques such as genetic algorithm (GA) can adjust the settings of the relays without the mentioned difficulties. In these methods the constraints are included in objective function (OF) [5], [7] and [8]. The optimal coordination in [7] has been done by a method based on GA. In [8], the optimal coordination has been performed by a method based on particle swarm optimization (PSO) whilst in [9] the same has been done by using an evolutionary algorithm. The coordination made in these methods has two problems. One is miscoordination and the other poses the lack of solution for relays with both discrete and continuous time setting multipliers (TSMs). In [5] the mentioned problems have been solved. The existing GA is improved by adding a new expression to the OF, such that the miscoordination problems are solved. The coordination algorithm can also handle both continues and discrete TSMs.

It should be noted that all of the above optimal coordination by GA (as in [5] and [7]) has been done for overcurrent relays only. However, in transmission systems, the coordination of overcurrent and distance relays should be considered. On the other hand, in all mentioned references overcurrent relay characteristics have been considered to be fixed whilst in digital relays, different overcurrent relay characteristics can be selected. Therefore, the coordination algorithm should have the capability of selecting the best characteristic for overcurrent relays to have the optimal solution.

In [1] and [10] coordination of overcurrent, distance and definite time relays have been done using linear programming technique. In [1], overcurrent relays have been coordinated optimally with definite time relays including distance and breaker failure relays (BFR). In this reference, the optimal coordination is performed by linear programming technique. In addition to the constraints of overcurrent relays coordination, the constraints of overcurrent and definite time relays coordination have been considered in solving optimization problem. The operating time of distance relays and BFRs have constant values and TSMs of overcurrent relays are determined by linear programming technique to have optimal coordination between overcurrent and definite time relays. In [10], the optimal second zone operating time of distance relay considering coordination of overcurrent and distance relay coordination is obtained using linear programming technique. In this reference, in addition to TSMs of overcurrent relays, second zone operating time of distance relay is added to the OF as a new variable and by minimizing the OF, their optimal values are obtained.

It can be seen that in [1] and [10], the optimal coordination has been performed by linear programming technique based on an initial guess and may be trapped in the local minimum

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