Novel Automated Fault Isolation System on Low Voltage Distribution Automation System

Musse Ahmed
ECE Department, Faculty of Engineering, IIUM
Kuala Lumpur Malaysia
mussemoh@gmail.com

Soo Lian
Universiti Teknikal Malaysia Melaka (UTeM), Melaka, Malaysia
ivysoo2004@gmail.com

Abstract-- **This novel automated fault isolation system has been developed and integrated into a new customer side distribution system of 415/240V. The distribution system is based on the Tenaga Nasional Berhad (TNB), the Malaysia's power utility company especially the distribution system. Supervisory Control and Data Acquisition (SCADA), Remote Terminal Unit (RTUs) and power line communication (PLC) system have been used and developed for detecting, fault locating, fault isolating, fault segregating and power restoration in terms of hardware and software. Open loop distribution system is the distribution configuration system used as TNB distribution system. It is the first distribution automation system (DAS) based on fault management research work on customer side substation for operating and controlling between the consumer side system and the substation.**

Keywords -- New Service Substation, Fault Detection, Fault Isolation, Fault Segregation, Open Loop System and Counter.

I. INTRODUCTION

There have been research works on the fault-location problems in the transmission systems [1]. Techniques published in the reviewed research papers and implemented in the utilities for targeting fault location problems in the distribution systems utilize voltages and currents measured at one or more points of a feeder or feeders. Fault location can be categorized into three parts: 1. techniques which are used for traveling wave variables/parameters [2], [3], [21]. 2. Another technique utilizes harmonic components of higher frequency [4] while measuring currents and voltages variables. The second method focuses on using the fundamental frequency voltages and currents [5] measured at the terminals of the line. The final technique is called the impedance-based method that comprises of computing line impedances that are seen from the line terminals with the consideration of the line distances of the faults location. Impedance-based methods are widely used by the utilities because of their advantages in practical application in the transmission line fault locating solutions. Impedance based solution can be sub-classified into two methods that are based on: one which can be taken the measurement from one terminal of the transmission and the other from which the measurement can be tapped from both sides of the terminals of the transmission line. The impedance based solution that is utilized to compute using a fundamental frequency component is the most commonly used technique [3]. In summary of the above discussion, the basic approach to calculate the current and voltage as the fault location measurement variables uses the fundamental frequency component [5], harmonics [4], or unsymmetrical component [6]). Recalculation of the voltage and current at each node of the network is also needed for the compensation of the distribution system characteristics [5], [7], and [8]. It is therefore very important to find suitable solution to the problems of fault location in the distribution systems. However, the fact that a distribution feeder has many branches and sub-braches creates complexity of the problem of locating the fault as the trend of calculating the fault location which is based on finding the voltage and current signals produces more than one fault location that affects the accuracy of the fault location. Application of Heuristic and expert system approaches have also been reported in [9] for locating the fault in distribution systems for carrying out more measurements. It is assumed that the measurements of the fault location variables are available at the sending end of the faulty line portion which may be questionable in terms of accuracy as the real measurements are only feasible at the substation and at limited nodes close to the fault position [10], [11] of the distribution networks by the use of remote terminal devices. The application of Artificial Intelligence (AI) techniques have also been reported to the solution of the problem. In AI areas, a fuzzy logic approach has been suggested in [12], and [18] to solve the best possible fault location. A new method has been reported in [22] that method has proposed an algorithm to calculate the fault location based on the differences between the values of pre-faults and during-faults voltages and currents.

In this research work, distribution automation system (DAS) technique has been proposed, studied and implemented in step by step manner. The research consists of both newly designed substation hardware and software systems to integrate the two together. However, this paper only focuses on fault management system in order to detect, locate, isolate and operate the faults within the distribution automation system scenario. Through the complete DAS, the fault algorithm has been formulated and implemented. No researches have been done in the service substation side of the downstream distribution systems. This is probably due to the limited degree of damages at the downstream. Faults occur in the substations and distribution substations are more severe and affect wider area compared to faults

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