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ELECTRICAL POWER ENGINEERING

Impact of Protection System on Distribution System Reliability

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Abstract - Modern society generally expects high reliability power supply. Electricity interruption may cause high damage to consumers. Most of load interruptions are due to breakdowns in distribution systems. Therefore, the improvement of reliability for a distribution system including its protection system is of interest in this paper. Equipment failure may occur electricity interruption. However with a proper protection system, the interruption will be confined in a particular area, resulting in better reliability performance. In this paper, impact of protective devices installation, e.g. disconnecting switch and fuse on distribution system reliability will be analyzed. In addition, impact of voltage dip on each interested load point will also be calculated and presented. The developed method has been tested with the Reliability Test System (RBTS) [2].

Keywords: impact of protection, distribution system reliability, voltage dip

1. INTRODUCTION

A key function of a power system is to supply customers with electrical energy as economically and reliably as possible. Electrical service interruption can have a profound economic impact on certain customers. Not only sustained interruption results in lost production, but momentary interruptions may also cause damages to the consumers.

In general, customers will be reluctant to increase their service reliability locally, exerting in higher pressure for utilities to improve their service reliability. Apart from replacing high failure rate components, i.e. replacing bare conductor by insulated conductor, it is widely known that the utility can improve its reliability by improving its protection system. Better coordination or more appropriate protective devices, e.g. recloser, fuse and disconnecting switch, put into the system can help improve its reliability.

The coordination of protective devices aims to maintain the selectivity among the devices involved in several fault possibilities, in order to assure the safe operation and the reliability of the system. In an efficient and coordinated protection system, faults are eliminated in the smallest possible time, isolating the smallest part of the system containing the cause of the fault.

The disconnected switches, reclosers or fuses can be properly placed on radial systems which result in better system reliability. This paper will analyse the impact of protective devices on distribution system reliability. The analysis will focus on permanent outage events. Results of system and load point reliability indices will be presented.

When a fault occurs, the voltage level of each load point will be decreased. It is known as voltage dip or voltage sag. The voltage dips have to be compared with customer voltage envelope. If the customer cannot tolerant the dip or the dip violates the envelope, it will be cut off from the supply permanently. Therefore, this event will impact on reliability of the system. In addition the impact on voltage dip due to protective device operation and fault locations will also be analyzed. The bus 2 of Reliability Test System (RBTS) will be used in this analysis.

II. RADIAL DISTRIBUTION SYSTEM PROTECTION

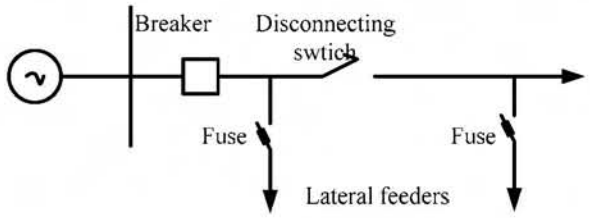

Fig. 1 Typical radial distribution feeder

The main aspect of the protection coordination is that the primary device, closer to the fault point, should act before the backup device [5]. Additional protection is frequently used in practical distribution systems. One possibility in the case of the system shown in Fig. 1 is that a short circuit on a lateral distributor causes its appropriate fuse to blow. The event causes disconnection of its load point until the failure is repaired. However, it does not affect or cause the disconnection of any other load points.

A second or alternative reinforcement or improvement scheme is the provision of disconnecting switches or isolators at judicious points along the main feeder. These are generally not fault-breaking switches and therefore any short circuit on a feeder still causes the main breaker to operate. After the fault has been detected, however, the relevant disconnect can be opened and the breaker reclosed. This procedure allows restoration of all load points between the supply point and the point of isolation before the repair process has been completed. Whether these devices are used on the system or not have great effect on the system. A