



A realistic approach for reduction of energy losses in low voltage distribution network

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ARTICLE INFO

Article history:

Received 18 August 2009

Received in revised form 24 March 2010

Accepted 13 August 2010

Available online 30 December 2010

Keywords:

Current unbalance
Distribution automation
Distribution system
Expert system
Fuzzy logic
Lab VIEW

ABSTRACT

This paper proposes reduction of energy losses in low voltage distribution network using Lab VIEW as simulation tool. It suggests a methodology for balancing load in all three phases by predicting and controlling current unbalance in three phase distribution systems by node reconfiguration solution for typical Indian scenario.

A fuzzy logic based load balancing technique along with optimization oriented expert system for implementing the load changing decision is proposed. The input is the total phase current for each of the three phases. The average unbalance per phase is calculated and checked against threshold value. If the average unbalance per phase is below threshold value, the system is balanced. Otherwise, it goes for the fuzzy logic based load balancing. The output from the fuzzy logic based load balancing is the value of load to be changed for each phase. A negative value indicates that the specific phase is less loaded and should receive the load, while a positive value indicates that the specific phase is surplus load and should release that amount of load. The load change configuration is the input to the expert system which suggests optimal shifting of the specific number of load points, i.e., the consumers.

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1. Introduction

Among three functional areas of electrical utility namely, generation, transmission and distribution, the distribution sector needs more attention as it is very difficult to standardize due to its complexity. Transmission and distribution losses in India have been consistently on the higher side in the range of 21–23%. Out of these losses, 19% is at distribution level in which 14% is contributed by technical losses. This is due to inadequate investments for system improvement work.

To reduce technical losses, the important parameters are inadequate reactive compensation, unbalance of current and voltage drops in the system. There are two main distribution network lines namely, primary distribution lines (33 kV/22 kV/11 kV) and secondary distribution lines (415 V line voltage). Primary distribution lines are feeding HT consumers and are regularized by insisting the consumers to maintain power factor of 0.9 and above and their loads in all three phases is mostly balanced. The energy loss control becomes a critical task in secondary distribution network due to the very complex nature of the network.

Distribution Transformer caters to the needs of varying consumers namely Domestic, Commercial, Industrial, Public lighting, Agricultural, etc. Nature of load also varies as single phase load and three phase load. The system is dynamic and ever expanding. It requires fast response to changes in load demand, component failures and supply outages. Successful analysis of load data at the distribution level requires procedures different from those typically in use at the transmission system level.

Several researchers have proposed methods for node reconfiguration in primary distribution network [1–11]. Two types of switches used in primary distribution systems are normally closed switches (sectionalizing switches) and normally open switches (tie switches). Those two types of switches are designed for both protection and configuration management and by altering the open/closed status of switches loss reduction and optimization of primary distribution network can be achieved. Siti et al. [12] discussed reconfiguration algorithms in secondary distribution network with load connections done via a switching matrix with triacs and hence costly alternative for developing countries.

Much work needs to be done in the secondary distribution network where lack of information is an inherent characteristic. For example in most of the developing countries (India, China, Brazil, etc.) the utilities charge the consumers based on their monthly electric energy consumption. It does not reflect the day behaviour of energy consumption and such data are insufficient for distribution system analysis.

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