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Determining optimum capacitor in relation to load curve in harmonic systems

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SUMMARY

Because of the variable nature of loads and the presence of harmonics in a network, the variation of capacitor bank steps results in the reduction of capacitor life. Previous studies calculated the optimum capacitor in networks with variable loads to maximize the power factor. This paper calculates the optimum capacitor in harmonic networks, taking into consideration the effect on capacitor lifetime of load variation and harmonics. For this purpose, genetic algorithm was employed to determine the optimum capacitor. The proposed method was applied to an actual network in the Province of Markazi in Iran. The results showed this method to be flexible and reliable. Copyright © 2012 John Wiley & Sons, Ltd.

KEY WORDS: capacitor lifetime; harmonic; load change; optimum capacitor; distribution engineering; power quality

1. INTRODUCTION

Increased use of semiconductor devices in power networks and the creation of non-sinusoidal voltages and currents have a significant effect on the determination of the optimum capacitor [1], [2]. The equivalent Thevenin impedance of the network can resonate with parallel capacitors [3]; consequently, the resonance amplifies the harmonic component. Using capacitors in a harmonic network may lead to an undesirable power factor. Therefore, the optimum capacitor is one which performs power factor correction while not causing resonance.

R. F. Chu and R. H. Avedano [1] were the first to present a method in which the optimum capacitor was determined by maximizing the power factor. In their method, a mathematical expression was presented to determine the optimum capacitor, considering the equivalent Thevenin impedance of the network. Hence, account was taken of the significance of the network equivalent impedance at the point where the load meets the network, but not of the effect of harmonics on capacitors and their life.

In subsequent studies, the effects of variations in load time and impedance time were considered. It was concluded that considering the variations of load may lead to a significant change in the value of the optimum capacitor [2].

In the two studies mentioned above, harmonics were considered as the constraints of the objective function (OF). This required that the optimum capacitor not cause network resonance. This was accomplished using an intelligent technique called golden area searching technique [2], [4], [5].

In some studies, such economic benefits as loss reduction, increased efficiency of transmission line, correction of power factor, and energy costs are considered as OF to determine optimum capacitor [6],

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