VIABILITY OF FIXED TYPE POWER CAPACITORS FOR LOSS REDUCTION IN LOW VOLTAGE (400V) DISTRIBUTION NETWORKS OF POWER UTILITIES

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by

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DECLARATION

The work submitted in this dissertation is the result of my own investigation, except where otherwise stated.

It has not already been accepted for any degree, and is also not being concurrently submitted for any other degree.

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ABSTRACT

The viability of fixed type power capacitors for loss reduction in low voltage (400V) distribution networks of power utilities was studied. Usually, reactive power of the load is compensated at high voltage levels by utility operators, which requires high investment on equipment. This study reveals an alternative low cost reactive power compensation method, which will reduce the capacity requirements of HV reactive power installations.

Fixed type power capacitors had been used at the secondary of few of earlier 11kV/415V distribution transformers in Colombo City distribution system. Most of these units are in operation, even after 20 years of service. But the practice of having fixed capacitors at distribution transformers was not continued thereafter.

It was identified through model simulation and field measurements that installation of fixed value power capacitors at feeder pillars of the power distribution network is more economical compared to the earlier practice in Colombo City. The expected minimum energy saving is approximately 300 kWh/month with a 40kvar, 440V rated capacitor installed at the feeder pillar.

The main advantages of the proposal are low capital requirement and shorter payback period. The expected maximum payback period is 7 months. In the proposed method, the temperature of operation of capacitors was more critical. The reliability of capacitors is to ensure by adapting measures to reduce the operating temperature of capacitor units, housed in steel enclosures.

Encloses, housing capacitor units reduces the case temperature of capacitors. This arrangement was superior to the use of outdoor type capacitors without enclosures. Use of light coloured enclosure with holes for ventilation and thermal insulation will reduce the temperature of operation of capacitor unit at least by 10 ^{0}C, compared to dark green finished enclosure with louvers for ventilation and without thermal insulation on the internal surface.

Field measurements confirmed that the lifetime of capacitors are not affected due to load harmonics. The maximum harmonic current absorbed by capacitors was 50% lower than the continuous over current rating of the capacitor unit. The simulation of the model with different fixed capacitor sizes shows that there is no risk that transformers would fall into resonance along with fixed capacitors under the load harmonics due to the selected size of capacitors and level of load harmonics. The voltage rise due to fixed type capacitors at no load condition is insignificant for the sizes of capacitors proposed in this study, Hence there is no risk that the power transformers would not fall into ferroresonance due to fixed capacitors.

Practical difficulties of usage of LV fixed type capacitors were identified and solutions were recommended so that a cluster of fixed value shunt capacitors can be installed and operated effectively at low voltage distribution level for achieving greater economical benefits.

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