LOAD HARMONIC MITIGATION: A CASE STUDY AT UVA PROVINCIAL COUNCIL BUILDING

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By
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Abstract

This thesis presents the application of active filters to mitigate the harmonic problems in an office building. Harmonics in electrical system induce additional heating. This causes premature aging, reduction of efficiency and life of the electrical equipments and components in the system. Harmonic problems can be caused by disturbances originating in the supply system, from customer's premises and from the nearby installations. The problem is due to the non-linear loads showing different current waveforms when supplied by a distorted or perfect sinusoidal voltage. Growing use of non-linear load equipment and technologies in commercial buildings has increased the severity of the problem.

This is common to Uva Provincial Council (UPC) building, as well, where a large number of connected computers, UPS and other peripherals are major sources of harmonics. The site measurements revealed that the non-linear loads generate TDD up to 15 % and the individual harmonic distortion up to 38 % of the fundamental. These values exceed the maximum limits prescribed by the power quality standards, lEE 519-1992.

To mitigate the harmonic effects, various available techniques are reviewed. The active power filter (APF) is selected as a solution, as it has become the popular and advantageous options among the many practices available today. The operation of common APF topologies, namely the shunt, series and hybrid APF s are discussed in detail, and shunt APF is identified as the most simple and advantageous choice for this purpose. This is followed by a review of various strategies of harmonic detection and APF controlling. After comparing the performances of these strategies with the real life applications, suitable techniques for harmonic detection and APF controlling are formulated.

Finally, a computer model of thus developed shunt active filter is simulated using MATLAB / Simulink environment.

Based on the case study, the thesis discusses alternatives and provides some practical solutions to the problem of harmonics in office buildings.

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 not being concurrently submitted for any other degree.

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Abbreviations

ac	alternating current
APF	Active Power Filter
ASD	Adjustable Speed Drive
CEB	Ceylon Electricity Board
CFL	Compact Fluorescent Lamp
dc	direct current
HPF	High Pass Filter
HV	High Voltage
IEC	International Electro technical Commission
IGBT	Insulated Gate Bipolar Transistor
MV	Medium Voltage
MCB	miniature Circuit breaker
MCCB	Molded Case Circuit breaker
PC	Personal Computer
PCC	Point of Common Coupling
PQ	Power Quality
PWM	Pulse Width Modulation
RMS	Root Mean Square
SMPS	Switch Mode Power Supply
TDD	Total Demand Distortion
THD	Total Harmonic Distortion
UPC	Uva Provincial Council
UPS	Uninterruptible Power Supply
VSI	Voltage Source Inverter