MITIGATION OF VOLTAGE VIOLATIONS IN JAFFNA PENINSULA DISTRIBUTION SYSTEMS

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DECLARATION

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ABSTRACT

Mitigation of voltage violations are always a challenging task in distribution networks. Because the distribution networks are directly connected to the consumer loads, which are continuously varying. Under voltage and over voltage, voltage sag, swell and transients/fast variations are the voltage violations that limit the expansion of the electrical distribution networks. This can be eliminated by a step by step systematic approach/methods while providing a cost effective solution. Few examples are use of de-energized tap changer, on-load tap changer and the STATCOM to improve the performance of the distribution system.

This thesis presents the work of studying voltage violations in distribution systems and the case study was done with Jaffna peninsula electrical distribution system. The full day load pattern showed voltage problem in some bus bars especially during peak load conditions. Solutions are proposed, and healthy operation are validated using PACAD simulations to overcome the said problems.

Further a simple network was modelled to study the OLTC operations and a control system was developed to achieve the best customized operation to avoid voltage violation.

Considering the future development of Sri Lanka's potential renewable energy development, the STATCOM applications were studied to eliminate the fast variations in the voltage. A STATCOM detail model using IGBT switches and a small scale distribution network were modelled. STATCOM converter control, AC terminal voltage droop control and DC-Link voltage regulatory control were designed to study the performance of the network on eliminating the voltage violations during the transient operations or fast variations on voltage. This was studied under the STATCOM control and its integrated applications together with the OLTC.

The study proposed three methods to mitigate voltage violations in distribution system network. This was done using de-energized tap changer, on-load tap changer and the STATCOM to improve the performance of the distribution system network. And it is validated using simulation results.

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LIST OF ABBREVIATIONS

BRK	Breaker
DETC	De-Energized Tap Changers
IGBT	Insulated Gate Bipolar Transistor
OLTC	On Load Tap Changers
PLL	Phase Lock Loop
PSCAD	Power System Computer Aided Design
pu	Per Unit
STATCOM	Static Synchronous Compensator
SVC	Static Var Compensator
BSC	Breaker Switched Capacitor