EMBEDDED GENERATION IMPACTS TO MEDIUM VOLTAGE DISTRIBUTION NETWORK AND MITIGATION TECHNIQUES

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by

B. A. P. THILAK KUMARA PERERA

Supervised by: Dr. J. P. Karunadasa

Department of Electrical Engineering
University of Moratuwa, Sri Lanka

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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.

UOM Verified Signature

B. A. P. T. K. Perera

Date : 30/01/2009

I endorse the declaration by the candidate.

Dr. J. P. Karunadasa

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Abstract

As a result of increasing of electricity demand, the electrical transmission and distribution systems are continuously expanding. Connection of Distribution Generators (DG) to the distribution network and upgrading of the transmission lines are more frequent expansions. Connection of new mini hydro power plants (MHPs) in Sri Lanka is one good example. In most of the cases these DGs, which are mainly based renewable energy are located in remote areas. The main bottleneck barrier of connecting DG is violation of fault current ratings at some parts of the network. Some expansions may result in higher fault current level at some points of the power system and thus exceeding the short circuit ratings of equipment such as switchgears and expulsion switches. As upgrading of equipment is not feasible both economically and technically, introduction of fault current limiting devices has become an essential requirement.

Fault Current Limiter (FCL) is series device connected to the power system, which shows the high impedance to the current during a fault while showing a zero or low impedance during normal loading condition. Although several FCL topologies were introduced by researchers, there are some technical and economical problems to be solved before introducing them to the power system effectively. It demands the investigation of new FCL topologies which are more feasible or modifications of available topologies to increase feasibility. FCL introduces additional impedance to the system depending on the system operating conditions. It is not only reduces the fault current but also effects on a number of power system related phenomena such as power losses, protection coordination, interrupting duty of switchgears, transient stability and voltage sag.

This research work is mainly focus on application of Fault Current Limiter (FCL) to overcome this problem and facilitate the equipment safety.

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List of Abbreviations

AAAC	All Aluminium Alloy Conductor
ABS	Air Break Switch
ACSR	Aluminium Conductor Steel Reinforced
CB	Circuit Breaker
CEB	Ceylon Electricity Board
CSC	Consumer Service Centre
DDLO	Drop Down Lift Off
DG	Distributed Generator
FCL	Fault Current Limiter
GSS	Grid Substation
GTO	Gate Turn Off
HTS	High Temperature Superconducting
I	Current
I_c	Critical current
J_c	Critical Current density
LBS	Load Break Switch
LT	Low Tension
LV	Low Voltage
MFCL	Magnetic Fault Current Limiter
MHP	Mini Hydro Power
MOV	Metal
MV	Medium Voltage
PSS	Primary Substation
RGSS	Rathnapura Grid Substation
SC	Superconductor
SFCL	Superconducting Fault Current Limiter
SIN	System Identification Number
SPP	Small Power Producers
SPPA	Small Power Purchase Agreement

StFCL	Static Fault Current Limiter
T_c	Critical Temperature
TCSC	Thyristor Control Series Capacitor
TCR	Thyristor Controlled Reactor

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