DESIGNING A PROTECTION COORDINATION LOSS ASSESSMENT TECHNIQUE FOR DG INTEGRATED MV NETWORKS

GR Kodikara

(109225P)

University of Moratuwa, Sri Lanka.
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University of Moratuwa

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Gayan Rakitha Kodikara

(109225P)

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
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Department of Electrical Engineering

University of Moratuwa

Sri Lanka

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Declaration

I declare that this is my own work and this dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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The above candidate has carried out research for the Masters Dissertation under my supervision.

Signature of the supervisor: Date:

Dr. Lidula N. Widanagama Arachchige

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Abstract

Conventional distribution system is generally passive, which means power flow is unidirectional, from its grid substation to the loads. With addition of Distributed Generation (DG) in to the system, several issues, such as power flow bi-directionality and increase of fault current in the system influence the existing protection scheme, which is originally designed for a passive network, which has limitations. Protection issue may become a crucial factor and more attention is required in designing the protection system at increased DG penetration levels. If it is possible to calculate loss of protection coordination quantitatively, utility can clearly identify the measures to be taken on their protection system in advance.

The objective of this research study is to introduce a technique, which can be used to assess the protection coordination loss quantitatively, for a DG integrated network. Study is focused on the typical Medium Voltage (MV) network, mainly 33 kV and 11 kV in Sri Lanka. MV distribution system of Mawanella area of Ceylon Electricity Board (CEB), Sri Lanka is selected for the case study where, a total capacity of 6.4 MW of mini-hydro plants is integrated to the system.

Fault current contribution to the system heavily depends on DG type, capacity and location. The effect of these decisive factors on the protection system is analyzed using the Power World Simulator. A tabulation method is used to record the data. Based on the table, decision on protection coordination loss in the system is segregated, protection coordination is maintained or not. Using the segregated data, protection coordination loss percentage is presented to get an overall idea for the system.

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The proposed technique can be used to analyze the loss of protection coordination quantitatively for existing networks where DGs are already in operation. The same can also be used as a powerful tool at planning stage at the time of studying new DG proposals. The proposed technique can be integrated as a new dimension to the currently practicing tools of over voltage check and short circuit capacity check.

Key words – Distributed Generation, Protection Coordination, Protection Coordination loss, Distribution System Planning, Fault Level

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List of Abbreviations

Abbreviation	Description
AR	Auto Recloser
CB	Circuit Breaker
CEB	Ceylon Electricity Board
CIGRE	International Council on Large Electricity Systems
DD	Distribution Division
DG	Distributed Generation
DOE	Department of Energy
EPRI	Electric Power Research Institute
GSS	Grid Substation
HV	High Voltage
IEA	International Energy Agency
IEEE	Institute of Electrical and Electronics Engineers
IPP	Independent Power Producers
LBS	Load Break Switch
LV	Low Voltage
MHP	Mini Hydro Plant
MV	Medium Voltage
NCRE	Non-Conventional Renewable Energy
PSS	Primary Substation
RES	Renewable Energy Sources
TR	Transformer
USA	United States of America

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