AUTONOMOUS FAULT ISOLATION AND POWER RESTORATION SYSTEM FOR MV/LV DISTRIBUTION

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Degree of Master of Science

Department of Electrical Engineering

University of Moratuwa

Sri Lanka

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Thesis/Dissertation submitted in partial fulfillment of the requirements for the degree of Master of Science

Department of Electrical Engineering

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DECLARATION OF THE CANDIDATE & SUPERVISORS

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……... ……...

Signature of the supervisor Date

(Dr. W.D.A.S. Rodrigo)

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Signature of the supervisor Date

(Dr. K.T.M.U. Hemapala)

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D.M.D.K. Dissanayaka

ABSTRACT

The term “Distribution Automation” generally refers to a distribution network switching subsystem devices equipped with the advanced technologies dedicated for purposes such as, ease of real time monitoring and controlling, reliability improvement management, integrating of distribution network and electricity market operation. Improving the reliability of electric power delivered to the end users is one of the main targets of employing distribution automation. Therefore, developing autonomous fault isolation and power restoration system for LV/MV distribution can be attractive reliability enhancement solution for the electric utilities.

Electrical utility industries are not focusing on automating Low Voltage (LV) distribution system due to complexity of the LV distribution network feeders. However, there is a room available for automation if an algorithm could be developed for autonomous fault isolation and power restoration. Development of a comprehensive algorithm opens up a new pathway for LV distribution.

Electrical distribution system network consists in large numbers of Remote Switching Subsystem Devices (RSSD) and these devices communicate in different protocol. These devices can be monitored and controlled remotely by linking with Supervisory Control and Data Acquisition (SCADA) system. However, investing on a fully fledge SCADA is not so economical for a small scale distribution utility. As a solution; scalable distribution automation will enable small scale distribution utilities to enter into distribution automation with optimal capital investment. Hence, developing a scalable SCADA is the solution for smaller distribution automation.

Results of this thesis are, a proto type LV distribution system has been developed to demonstrate the algorithm for autonomous fault isolation and power restoration system. Also has been implemented open platform SCADA system in view of acquiring multi-protocol remote switching subsystem devices.

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Key words Distribution automation, Fault management activities, Fault isolation and power restoration, SCADA system, Protocol, Algorithm

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LIST OF ABBREVIATIONS

Abbreviation	Description
ACR	Auto Circuit Recloses
ADSS	All-Dielectric Self-Supporting
AFIPR	Autonomous Fault Isolation and Power Restoration
CB	Circuit Breaker
CIS	Customer Information System
DAS	Distribution Automation System
DCC	Distribution Control Center
DDNS	Dynamic Domain Name System
DDLO	Drop Down Lift Off
DMS	Data Management System
DNP	Distributed Network Protocol
EF	Earth Fault
FI	Fault Indicators
FIS	Feeder Information System
GIS	Geographical Interface System
GPRS	General Packet Radio Service
GSM	Global System for Mobile
GSS	Grid Substation
HMI	Human Machine Interface
IEC	International Electrotechnical Commission
IED	Intelligent Electronic Device
IEEE	Electrical and Electronic Engineers
kWh	kilo Watt hour
LBS	Load Break Switches
LKR	Lanka Rupees
LV	Low Voltage
MFCS	Micro Feeder Control System
Mn	Million
MSCADA	Micro SCADA

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MV	Medium Voltage
OC	Over Current
O&M	Operation & maintenance
OPC	Object linking & embedding for process control
OPGW	Optical Power Ground Wire
RSSD	Remote Switching Subsystem Devices
RTU	Remote Terminal Unit
SCADA	Supervisory Control and Data Acquisition
SIM	Single Inline Module
SMS	Short Message Service
TCP/IP	Transport Control Protocol/Internet Protocol
UF	Under Frequency
UHF	Ultra High Frequency
VHF	Very High Frequency
VPN	Virtual Private Network
VSAT	Very Small Aperture Terminal
WOC	Wrapped Optical Cable
WPS II	Western Province South II

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