STUDY OF CURRENT TRANSFORMER PERFORMANCE DURING TRANSIENT CONDITIONS AND DEVELOPMENT OF A SELECTION CRITERION IN PROTECTION APPLICATIONS

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Index No: 118678 G

Degree of Master of Science

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July 2015

DECLARATION

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ACKNOWLEDGEMENT

First, I pay my sincere gratitude to Eng. Anura Wijayapala and Eng. Jayasiri Karunanayake who encouraged and guided me to perform this research and on preparation of final dissertation.

I extend my sincere gratitude to Prof. J.P. Karunadasa, the former Head of the Department of Electrical Engineering, Dr. Prinath Dias, present Head of the Department, and all the lecturers and visiting lecturers of the Department of Electrical Engineering for the support extended during the study period.

I would like to thank Mr. D. N. Nawarathne, Chief Engineer, Asset Management (Generation Hydro Electrical) Branch, and Ceylon Electricity Board who gave me the initiative to study of current transformer performance during transient conditions and developing selection criteria for current transformers for protection application.

I would also like to take this opportunity to extend my sincere thanks to Dr A.P.Tennakoon, Chief Engineer Protection (CEB, Asset Management - Hydro), Mr. D.Wedamestrige, Electrical Engineer (CEB, Kelanitissa Power Station) Mr. Saliya Liyanage, Project Manager (CEB, Norochcholei Coal Power Project), Mr. Sisira Dissanayake, Electrical Engineer & Mr. Krishantha Hemarathna Electrical Engineer (CEB, Asset Management - Thermal Electrical), Mr. Kushan Dinusha Bandara - Electrical Engineer & Mr. Waruna Rasanjana - Electrical Engineer (CEB, Asset Management - Hydro Electrical), Mr. Keerthi Samarasinghe - Electrical Engineer (CEB, Samanala Power Station), Mr. T.D Guluwita - Electrical Engineer, Mr. Ajith Peliarachchi - Electrical Engineer, Mr. Harsha Viraj - Electrical Engineer, Mr. H. D. Dharmasena - Engineering Assistant, Mr. N. Fernando - Electrical Superintendent (CEB, Kelanitissa Power Station) and all the Staff of Kelanitissa Power Station of Ceylon Electricity Board who gave their co-operation to do my research successfully.

It is a great pleasure to remember the kind co-operation extended by the colleagues in the post graduate program, friends, my mother, specially my wife Narmada and two kids Anuda and Isuru who helped me to continue the studies from start to end.

ABSTRACT

The optimum selection of current transformers is one of the most crucial requirements of correct protection functioning of power systems. In the case of CT selection, protection engineer has to pay attention on transient behavior as well as steady state performance of current of transformers. Transient performance of current transformers varies with system parameters and current transformer parameters. System parameters vary with fault level and inductance to resistance ratio (L/R) at fault location. In Sri Lankan power system, these parameters rapidly vary due to network development. Type of selected protection relay, type of protection function and switchgear arrangement make huge influence on current transformer selection. This dissertation focuses on developing a current transformer selection criterion with analysis of current transformer transient performance and protection application. The developed selection criterion is mainly focused on protection relay based selection and generalized CT selection.

In addition to analysis of the current transformer transient performance, PSCAD software is used for current transformer performance simulation on fault conditions and a case study is used to validate the developed selection criteria.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATION

AIS	Air Insulated Switchgear
ALF	Accuracy Limit Factor
CT	Current Transformer
CVT	Capacitive Voltage Transformer
E_{al}	Rated Equivalent Limiting Secondary e.m.f.
E_{ALF}	Secondary Limiting e.m.f. for Class P and PR Protective Current Transformers
E_{FS}	Secondary Limiting e.m.f for Measuring Current Transformers
E_{k}	Rated Knee Point e.m.f.
F	Mechanical Load
F_{c}	Factor of Construction
f_{R}	Rated Frequency
F_{rel}	Relative Leakage Rate
FS	Instrument Security Factor
GIS	Gas-Insulated Switchgear
$\hat{I}_{al}$	Peak Value of the Exciting Secondary Current at Eal
I_{cth}	Rated Continuous Thermal Current
I_{dyn}	Rated Dynamic Current
I_{e}	Exciting Current
I_{PL}	Rated Instrument Limit Primary Current
I_{pr}	Rated Primary Current
I_{psc}	Rated Primary Short-Circuit Current
I_{sr}	Rated Secondary Current
IT	Instrument Transformer
I_{th}	Rated Short-Time Thermal Current
I_{ε}	Instantaneous Error Current
K	Actual Transformation Ratio
k_{r}	Rated transformation ratio
K_{R}	Remanence Factor
K_{ss}	Rated Symmetrical Short-Circuit Current Factor

K_{td}	Transient Dimensioning Factor
K_{tf}	Transient Factor
K_x	Dimensioning Factor
L_m	Magnetizing Inductance
R_b	Rated Resistive Burden
R_{ct}	Secondary Winding Resistance
R_s	Secondary Loop Resistance
S_r	Rated output
t'	Duration of the First Fault
t''	Duration of the Second Fault
t'_{al}	Specified Time to Accuracy Limit in the First Fault
t''_{al}	Specified Time to Accuracy Limit in the Second Fault
t_{fr}	Fault Repetition Time
T_P, T_N	Specified Primary Time Constant
T_S	Secondary Loop Time constant
U_m	Highest Voltage for Equipment
U_{sys}	Highest Voltage for System
VT	Voltage Transformer
Δ_φ	Phase Displacement
ε	Ratio Error
ε_c	Composite Error
$\hat{\varepsilon}$	Peak Value of Instantaneous Error
$ac\hat{\varepsilon}$	Peak Value of Alternating Error Component
Ψ_r	Remanent Flux
Ψ_{sat}	Saturation Flux