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B10690

A NEW ALGORITHM FOR HIGH RESISTANCE EARTH FAULTS DETECTION USING PHASE COMPARISION TECHNIQUE

THESIS

SUBMITTED FOR THE DEGREE OF M.SC. IN ELECTRICAL ENGINEERING

BY

OMAR SALAH EL SAYED

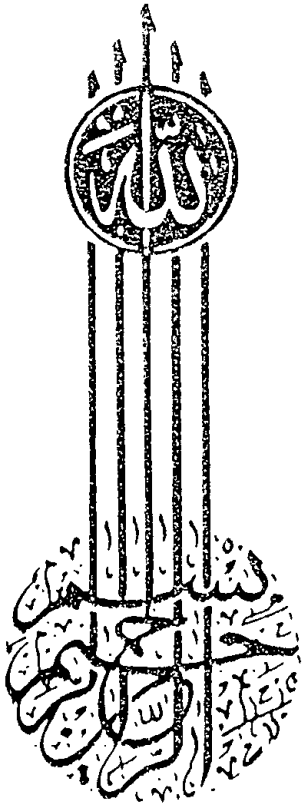
TO

ELECTRICAL POWER AND MACHINES DEPARTMENT
FACULTY OF ENGINEERING
CAIRO UNIVERSITY

(1993)

SUPERVISED BY

DR. MOHAMED AHMED HASSAN EL SAYED
DR. HUSSAIN MAGDY ZEIN EL-DIN



وقل رب زدني علما

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PREFACE

The work described in this thesis was carried out by the author at the Electrical Power and Machines department,Faculty of Engineering, cairo university between July 1990 and July 1993,under the supervision of professors EL SAYED AND ZEIN EL-DIN.

I would like to express my sincere thanks to DR.MOHAMED AHMED HASSEN EL SAYED AND DR.HUSSAN MAGDY ZEIN EL-DIN for their continous advice,encouragment and guidance throughout the work of this thesis. And for their valuable advice significantly contributed to the development of the proposed relay algorithm that can accurately and reliably detect high resistance earth faults in power system network.

ABSTRACT

Distance relaying is one of the main schemes in the protection of overhead transmission lines. Recently digital relaying techniques provided many algorithms that present higher performance and better accuracy than the conventional electromagnetic and solid state relays. The problems associated with distance relaying make any proposed scheme very difficult in hardware and software.

This thesis outlines the problems associated with the effect of high resistance earth faults on distance relay measurements and presents a new digital relaying technique to overcome these problems. The main features of the technique is the avoidance of using complex mathematical analysis.

The proposed relaying scheme solves the relay problems by using a phase comparison technique in a digital form. The outlined technique was applied to 400 KM line and used the restricted reactance characteristic to overcome the problems of the effect of high resistance on the distance relay measurments during earth faults. A suggested arrangment for the relay hardware has been introduced.

INDEXING TERMS.

* DIGITAL RELAY.

* DISTANCE PROTECTION.

* PHASE COMPARISON TECHNIQUE.

* ARC RESISTANCE (EARTH FAULT RESISTANCE).

* FAULT LOCATION.

LIST OF SYMBOLS.

I(K) = Fault current measured at relay point.

V(K) = Fault voltage measured at relay point.

C.T = Current transformer.

V.T = Voltage transformer.

V(D) = Voltage difference between V(K) and V(I).

$\delta(g)$ = The limit angle of the relay characteristic.

β = The phase differance between V(D) and V(I).

X(F) = Line fault reactance.

ϕ l s.c = The angle between the fault voltage and the fault current for the line.

C = The phase shift of of V(I) with the R-axis in R-X plan.

X setting = the setting value of the line reactance to protect a difinite distance of the transmission line.

S = Sample rate of the A/D converter.

Z(r) = Replica impedance of the line in the secondary circuit of the C.T.

Z(I) = Line impedance.

Z(I)1 = Positive sequence impedance of the line.

V(RN) = Phase voltage of phase R.

I(ao) = Zero sequence current of phase a

k_o = Zero sequence current compensation.

I(S) = Current of phase S.

V(ST) = Line voltage between phase S and phase T.

M = Mho relay characteristic,

O = Ohm relay characteristic.

$\not{p}$ = additional reactance.