Ain Shams University
Faculty of Engineering
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Protection of AC Feeding System for Electrified Railways

M.Sc. Thesis

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Submitted in partial fulfillment of the requirements for the M.Sc. degree in Electrical Engineering

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STATEMENT

This Thesis is submitted to Ain Shams University in partial fulfillment of the requirements of M.Sc. degree in Electrical Engineering.

The included work in this thesis has been carried out by the author at the department of electrical power and machines, Ain Shams University. No part of this thesis has been submitted for a degree or a qualification at any other university or institution.

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ABSTRACT

Railways are a safe land transport system when compared to other forms of transport. Power is provided to locomotives which either draw electrical power from a railway electrification system or produce their own power, usually by diesel engines.

For electrified railways; Power is transmitted to electric railway locomotives using DC or single phase AC networks. For AC electrified railways it is important to ensure a reliable and secure power supply to the traction system, therefore a suitable protection system is required. The protection system shall distinguish between the fault current and the train load current, and isolate the fault as soon as possible.

This thesis presents the modeling and simulation of a 25 kV 50 Hz AC traction system using Power System Block set (PSB) / SIMULINK software package. The model has been used to study different simulation cases considering the common types of faults.

A proposed distance relay algorithm is introduced. The performance of the proposed distance relay is checked in case of earth faults (normal and emergency feeding conditions), wrong phase coupling, and resistive faults. Furthermore, the proposed relay algorithm has a fault location function to detect the faulty subsection. The performance of fault location function is checked. Finally the proposed relay settings is selected to compromise between security requirements and sensitivity of fault detection to meet the operational requirements

The thesis consists of five chapters

Chapter (1): Gives an introduction of the railway systems and electrification systems.

Chapter (2): Introduces a literature survey for protection systems and material helpful for understanding the problem AC feeding system protection for electrified railways.

Chapter (3): Introduces the modeling methodology of the proposed distance relay algorithm.

Chapter (4): Introduces simulation and results for the proposed distance relay algorithm.

Chapter (5): Presents the extracted conclusions and future work suggestions.

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LIST OF ABBREVIATIONS

DC	Direct Current
AC	Alternating Current
OHE	Over Head Equipment
FP	Feeding Post
SP	Sectioning Post
S.S	Substation
C	Catenary
R	Rail
F	Feeder wire
B.T	Booster transformer
A.T	Auto transformer
C.T	Current transformer
V.T	Voltage transformer
BUOC	Back Up Over Current
PSB	Power System Block
WPC	Wrong Phase Coupling
A_{SS}	Area of the subsection
A_C	Calculated area
DFT	Discrete Fourier Transformation