

**MODELLING OF LIGHTNING SURGE PROPAGATION IN
RAILWAY TRACK AND PROPOSE AN EFFECTIVE
PROTECTION SYSTEM**

W. Ireshani Jayatunga

159364K

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Department of Electrical Engineering

University of Moratuwa

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W. Ireshani Jayatunga

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Abstract

The Signalling Network is considered as the brain of the Railway Department, which ensures the safety of the train operations as well as for enhancement of the capacity of trains in the network. The track circuit is the basic logic circuit, which uses in all the other major circuits for selecting and locking routes for trains. Since these track circuits are directly connecting to the rails, it is critically important to protect those track circuits and other expensive equipment connected via track circuits from direct and indirect lightning surges through rails. Rails are the main invasion path of lightning surge into the railway signalling system.

So far, the railway department has not properly standardized the surge protection devices attached to the signalling system and it directly affects the railway operations and train delays, which may cause social disruption.

Since it is among the major concerns of the signal department is struggling with; this thesis addressed the issue by analysing characteristics of the rail and connected circuit components and all possible paths where surges can be entered into the system. Simulation has done by using the rail model prepared using PSCAD software and ground test results were validated with them.

Direct and indirect surge currents were calculated theoretically for 50 kA, 100 kA and 200 kA surges of 10/350 μ S and 8/20 μ S by applying the calculated surge currents to the above rail model. Induced surge currents of injected rail and induction rail were obtained graphically for different rail lengths.

Finally, by analysing all above results and protection levels of different surge protecting devices, this thesis suggests Category A type surge-protecting device according to IEEE C62.41.2 standard as the best suitable and economical type for including in the track circuits to avoid damages through surge currents via rail lines.

Keywords: *Track circuit, Surge current, Surge Protecting Devices, induced rail, induction rail, rail characteristics, PSCAD*

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List of Abbreviations

SLSI	SriLanka Standards Institute
IEC	International Electrotechnical Commission
ANSI	American National Standards Institute
IEEE	Institute of Electrical and Electronics Engineers
SPD	Surge Protection Devices
SLR	SriLanka Railway
PSCAD	Power System Computer Aided Design
FE	Feeding End
RE	Relay End
FDTD	Finite Difference Time Domain method
GDT	Gas Discharge Tube
TOV	Transient Over Voltage