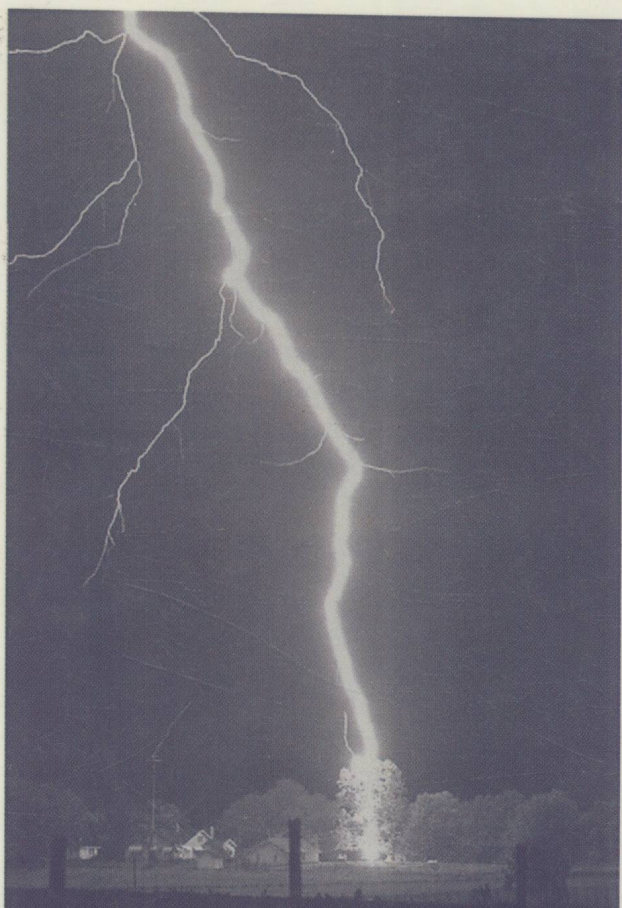




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HIGH VOLTAGE POWER TRANSMISSION SERIES

Electromagnetic Transients in Power Systems Second Edition

Pritindra Chowdhuri



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Electromagnetic Transients In Power Systems - Second Edition

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Electromagnetic Transients In Power Systems - Second Edition

HIGH VOLTAGE POWER TRANSMISSION SERIES

Series Editor: **Dr V. T Morgan**
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*** Forthcoming**

In loving memory of
my parents
AHINDRA and SUDHIRA
CHOWDHURI
who
nurtured and inspired me

Preface to the Second Edition

The contents of the first edition have been revised and several chapters have been extensively enlarged to reflect the new developments in electromagnetic transients. A new chapter (Chapter 12 – Dynamic Overvoltages) has been added in the second edition of the book.

I have freely drawn upon the experience and wisdom of others who have worked in the field of electromagnetic transients. They have willingly permitted me to reproduce some of their previous work. The book is richer because of them.

I am very grateful for the comments and critique of readers from around the world. I am especially grateful to my colleagues in the IEEE and also to my own students who have acted as my mentors, teachers and above all friends. It has been a great learning experience.

I thank Dr. S. Munukutla, Director of the Center for Electric Power, for making available the Center facilities. I also thank Mr. T. Greenway and Ms. L. Lee for their help with word processing. I appreciate the patience of Mr. G. Martinelli of Research Studies Press while I was happily revising the book.

P. Chowdhuri
Cookeville, Tennessee, U.S.A.
August 2004

Editorial Foreword to the First Edition

This excellent monograph on Electromagnetic Transients in Power Systems by Professor Pritindra Chowdhuri is the first book to be published in a new series on High-Voltage Power Transmission. The electricity supply industry is undergoing rapid change, with increasing pressure for the fullest possible utilisation of transmission and distribution assets. Hence, it is essential that the best technical and economic solutions are applied to such problems as overvoltages, power losses, fault currents, protection, electromagnetic interference, current-carrying capacities, insulation failures, excessive sags, corrosion, fatigue, wind-induced oscillations and constraints on line planning.

It is intended that this series will address the electrical, mechanical, civil, environmental and planning aspects of high-voltage power transmission, with authoritative reviews of recent research and developments by experts in their fields.

Professor Vincent T. Morgan
Sydney, Australia
June 1996

Preface to the First Edition

This book has been in preparation during the last 10 years when I joined the Center for Electric Power at Tennessee Technological University. It is the outgrowth of the notes I prepared for two graduate courses on electromagnetic transients in power systems. I felt that graduate courses on this topic should deal not only with the basic mathematical and physical principles of electromagnetic transients and their effects on power systems but should also address the latest problems on electromagnetic transients which the electric power industry is trying to solve. Power-system grounding, lightning-induced voltages on overhead power lines, protection of substations and transients in low-voltage systems with emphasis on power-electronic systems are very important topics today. Although a wealth of knowledge exists on these topics in the published literature, there is no single depository where information on these topics can be found. Separate chapters have been devoted to these topics in this book. Each chapter contains extensive references for those who want to pursue the topic further.

I have drawn heavily on my own involvement during the last 40 years with electromagnetic transients in both high- and low-voltage electrical systems. I have also been benefitted by the knowledge and wisdom of my colleagues, particularly through my association with the Institute of Electrical and Electronics Engineers (IEEE). I hope that this book will be useful not only to the graduate students but also to the specialists who are practicing in this field.

I wish to thank the IEEE and the Electric Power Research Institute (EPRI) for permitting me to reproduce from their publications. I wish to thank ABB Power T&D Company, Cooper Power Systems, General Electric Company, Harris Corporation and Ohio Brass Company for making available to me information on surge protectors. Dr. K. L. Cummins of Global Atmosphericics, Professor K. Feser of Stuttgart University and Dr. D. R. MacGorman of University of Oklahoma were very kind to permit me to reproduce several figures from their publications. My special thanks go to Mr. J. Autery, Dixons Mills, Alabama, for providing the striking photo of lightning flash which is printed on the cover of the book with his permission.

I am grateful to Dr. C. E. Hickman, Director of the Center for Electric Power for making available the Center facilities and his constant encouragement for writing this book. I acknowledge Mr. K. A. Jones, R & D Engineer of the Center for scanning many of the figures in the book, and Ms. Helen Knott for help with word processing. I am thankful to my students for their valuable suggestions and help in weeding out errors in the manuscript. I am indebted to my daughter, Naomi Tyler for reading and correcting the manuscript in spite of her own heavy load in her Ph.D. program. My appreciation and gratitude go to my wife Sharon, for literally living through the vow, 'for better and for worse' that she once took and for her encouragement, understanding and patience in letting me wander into this venture.

Last but not the least, I am indebted to my Series editor, Dr. V. T. Morgan and to my publisher, Mrs. V. A. Wallace for their extraordinary patience and encouragement.

Pritindra Chowdhuri
Cookeville, Tennessee, U.S.A.
July 1996

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