Corona and Electromagnetic Transient Study in Overhead Transmission Lines

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***Abstract*—This paper presents a new most complete model for corona analyzing in overhead transmission lines with considering skin effect and conductance originate from corona in PSCAD. The transmission line is divided into adequate identical sections which include nonlinear (voltage dependent) capacitor and resistor branch for corona modeling and series resistor and inductor and shunt capacitor-resistor branch for longitudinal transmission line modeling. The corona discharge is simulated by means of v-q (voltage-charge) curve of the transmission line which can be easily measured or found analytically. Time-domain technique are used for the computation of the power frequency and surge response of a transmission line with corona.**

I. INTRODUCTION

Corona is an electrostatic discharge phenomena which occurs due to ionization in an insulation material if electric field intensity exceed critical level. It can cause power loss on overhead transmission lines, audible noise, and electromagnetic interference in communication systems. Because of important effects of the corona, it has drawn great attention and becomes a vital aspect in many engineering areas. Analysis of corona is important for power system protection since lightning surges travelling on transmission lines are significantly influenced by corona, and determination of electromagnetic transients for the prediction of insulation level and design of the surge arrestors requires that corona effects be included [1-11].

The analysis of the electromagnetic transients on transmission lines can be done according to one of the following two basic approaches [12-14]:

A. Frequency domain analysis

Assuming linear circuit parameters (resistance, inductance, capacitance, etc.), it is possible to apply Fourier or Laplace domain techniques to derive closed form solutions for the relevant signals, such as the voltages and currents, this will then be followed by inverting these expressions to the time domain. This approach is straight forward when dealing with energization transients, and needs careful consideration of the initial conditions otherwise. However, the requirement of linearity makes it impossible to apply this method of solution to nonlinear problems such as those involving saturated iron-cores or corona discharges.

B. Time-domain analysis

This technique is based on the solution of the set of differential equations relating the problem's state variables. When dealing with transmission lines or cables, it is necessary to divide the line into an adequate number of identical short sections. The number of sections depends mainly on the highest frequency needed to be faithfully reproduced by their solution.

From the above discussion, if follows that time-domain solutions are the ones suited for simulating line transients involving corona discharges.

This paper presents a new model for analyzing these transients along lines which can be totally or partially under corona. The line under study will be divided into an adequate number of sections. Each section includes the fundamental elements (resistance, inductance and capacitance) in addition to a new corona model simulating the line's voltage-charge characteristic and conductance because of corona.

II. MODELLING OF OVERHEAD TRANSMISSION LINE

In this paper most complete model for overhead transmission line is used. In this model HV transmission line is divided into small sections which contains series inductance and resistance and shunt resistor-capacitor branch that depicted in Fig. 1.

In Fig. 1 L and R is the longitudinal line inductor and resistor and R_S and C presented current leakage at towers and capacitance of the transmission line to ground.

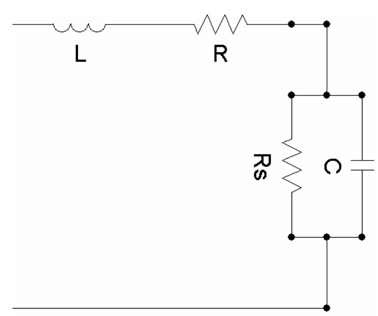

Fig. 1. Section of transmission line