ASSESSMENT OF EFFICIENCY AND CONDITION BASED OPTIMUM LOADING OF TRANSMISSION LINES

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Degree of Master of Science

by

WITHANAGE DON ANANDA JAYASIRI CHANDRAKUMARA

Supervised by: Prof. HYR Perera and Eng. LAS Fernando

Department of Electrical Engineering
University of Moratuwa, Sri Lanka

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Abstract

Transmission lines in any transmission network is the critical part or the one of the major limiting factors for power transfer capability of the transmission network.

The thermal power transfer capability of Overhead Transmission lines is primarily a function of the height of the conductor above the ground. This height affects the safety of the public and is therefore clearly specified in legislation.

Different methods for determination of Power Transfer capability of transmission lines are available. These include deterministic and various probabilistic approaches. The latter include a model simulating condition that affect the safety of the transmission line relating specially to the conductor position from which a measure of safety is developed. This measure can be used by designers to optimally design the transmission line from current loading point of view.

The deterministic approach has been used by most utilities around the world, as it is quick and simple. That method assumes bad cooling conditions that will result in the line design temperature being achieved.
Probabilistic methods use actual weather data and conditions prevailing on the line to determine the likelihood or probability of a certain condition. In this project, condition was taken as the conductor temperature rising up to the design temperature, which is 75 degree Celsius.

Designing of transmission lines in Sri Lanka has been done considering average weather conditions through out the year. Whereas in the real situation, weather conditions are seasonally varying. Therefore, based on the seasonal variation of weather condition in Sri Lanka, existing transmission network can be optimally loaded delaying future construction of transmission lines.

DECLARATION

The work submitted in this dissertation is the result of my own investigation, except where otherwise stated.

It has not already been accepted for any degree, and is also not being concurrently submitted in whole or part to any University or Institution for any other degree.

WDAJ Chandrakumara
29.11 . 2005

We / I endorse the declaration by the candidate

UOM Verified Signature

Prof. HYR Perera

UOM Verified Signature

Eng. LAS Fernando

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List of Symbols

Symbols	Description
I	Conductor current, A
q_c	Convected heat loss, W/ft
q_r	Radiated heat loss, W/ft
q_s	Heat gain from the sun, W/ft
t_a	Ambient temperature, ^oC
t_c	Average temperature of conductor, ^oC
t_f	Air film temperature, ^oC
R	AC resistance, Ω/ft
d	Conductor diameter, in
d_0	Conductor diameter, ft
ρ_f	Density of air, lb/ft^3
V	Velocity of air stream, ft/h
μ_f	Absolute viscosity of air, lb/h
k_f	Thermal conductivity of air at temperature t_f W/ft.
K_c	Temperature of conductor, K
K_a	Ambient temperature, K
e	Coefficient of emissivity, 0.23 to 0.91
a	Coefficient of solar absorption, 0.23 to 0.91
Q_s	Total solar and sky radiated heat, W/ft^2
A'	Projected area of conductor = d/12
θ	Effective angle of incidence of the sun's rays, degrees
H_c	Altitude of sun, degrees
Z_c	Azimuth of sun, degrees
Z_l	Azimuth of line, degrees
H_e	Elevation of conductor above sea level, ft
W_c	Conductor weight
W_w	Wind force on conductor
S	Catenary length along conductor
D	Sag
f	Stress or T/A
E	Young's modules
T	Tension of the conductor
a	Coefficient of linear expansion of conductor
L	Span