PROBABILISTIC APPROACH TO FIX THE OVERHEAD LINE POWER TRANFER LIMITS, WITH EFFECTIVE WIND COOLING

A dissertation submitted to the
Department of Electrical Engineering, University of Moratuwa
in partial fulfillment of the requirements for the
Degree of Master of Science

by
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Abstract

Open distribution line access and economic uncertainties are the reasons why many utilities are operating their lines at much higher loads than they were initially designed for. Because of this, the effects of higher operating temperatures on the safety and reliability of overheads lines were studied in this dissertation.

It is observed that overloading of conductor usually occur during peak hours in according to the average daily load pattern of Sri Lanka. During this time conductor temperature reaches to its maximum. However, conductor temperature may not increase due to the cooling effect on availability of wind. The over temperature causes reduction of the tensile strength of the conductor.

The work has been identified in significant areas where improved analytical methods are relevant. Several such methods have been created and their impact is discussed in this report.

As such, present conductor ratings are studied in accordance to IEC standard [7] and IEEE standard [5, 6]. Wind data at four different sites have been collected and are used for the analysis. Current variations of three different sites are taken for the study.

The probability of over temperature could be determined by applying Rayleigh distribution and cumulative frequency distribution respectively when the wind speed is below 1mls and the current rating is more than 202A. At the second stage, sag at maximum temperature has been calculated for each span. Finally,. Economical optimizations of losses are analyzed.

In the first part, allowable loss of strength of Aluminium is analyzed through a probabilistic approach. Accordingly, it is observed that strength of Aluminium is not

ever reduced below 90% of its original strength during the conductor lifetime of 50 years. This reduction of strength is negligible. Therefore, effective wind speed can be taken as 1m/s.

In the second part, sag variations were analyzed for each span which is presently used in CEB against maximum allowable temperature (90°C) in the absence of wind speed. It is observed that ground clearance is not violated when it is operated at maximum allowable temperature (90°C).

Finally, under this method costs and benefits are evaluated with increase of losses against investment incurred in strengthening of the , CEB network. Net present value is analyzed considering present value of expenses (increase of losses of existing system) and present value of savings (investment incurred in strengthening of the CEB network). Net present value is positive for load patterns of Omara, Ratmalwala and Kudagammana. Therefore those projects are financially viable.

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 for any other degree.

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Abbreviations

ACSR	Aluminium Conductor Steel Reinforced
Avg.	Average
CCC	Current Carrying Capacity
cdf	cumulative density function
CEB	Ceylon Electricity Board
CIGRE	International Council on Large Electrical Systems
EDT	Everyday Tension
EDS	Everyday Stress
IEC	International Electrotechnical Commission
IEEE	The Institute of Electrical and Electronic Engineers
HGSS	Hambantota Grid Sub Station
LKR.	Sri Lankan Rupees
Max.	Maximum
Min.	Minimum
pdf	probability density function
PVF	Present Value Factor
UTS	Ultimate Tensile Strength