SOFTWARE GUIDED SAFE LOADING OF TRANSFORMERS AND ITS ECONOMICS

K B M I Perera

Thesis Supervisor Prof. J R Lucas

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The Department of Electrical Engineering
University of Moratuwa
Sri Lanka

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CONTENTS

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CONTENTS

LIST OF SYMBOLS

θ_a = Ambient temperature

θ_g = Hottest-spot conductor rise over top-oil temperature (°C)

$\theta_{g\text{-}R}$ = Hottest-spot conductor rise over top-oil temperature under rated conditions (°C)

θ_{g1} = Hottest-spot HV conductor rise over top-oil temperature (°C)

$\theta_{g1\text{-}R}$ = Hottest-spot HV conductor rise over top-oil temperature under rated conditions (°C)

θ_h = Ultimate (steady state) hot spot temperature

θ_{TO} = Top-oil rise over ambient temperature (°C)

$\theta_{TO\text{-}R}$ = Top-oil rise over ambient temperature under rated conditions (°C)

$\theta 2$ = Power factor angle

$\Delta\theta_{oi}$ = Initial top oil temperature rise

$\Delta\theta_{on}$ = Top oil temp. rise at end of n^{th} interval

$\Delta\theta_{o(n-1)}$ = Top oil temp. rise at end of $(n-1)^{th}$ interval

$\Delta\theta_{or}$ = Top oil rise at rated current

$\Delta\theta_{ot}$ = Top oil temp. rise after time t

$\Delta\theta_{ou}$ = Ultimate top oil temp. rise corresponding to load during time t

$\Delta\theta_{oun}$ = Ultimate top oil temp. rise in n^{th} interval

$\Delta\theta_{our}$ = Ultimate top oil temp. rise corresponding to rated current

$\Delta\theta_{td}$ = Temperature difference between hot spot and top oil

$\Delta\theta_{tdr}$ = Temperature difference between hot spot and top oil at rated current

Hg_r = Temperature difference between hot spot and top oil at rated current

a = per unit loading

A = peak of load curve / kVA rating

F_{HL} = Harmonic loss factor for winding eddy currents

$F_{HL\text{-}STR}$ = Harmonic loss factor for other stray losses

F_{IR} = Harmonic loss factor for winding I^2R loss

h = Harmonic order

I = RMS load current

I_1 = RMS fundamental load current (amperes)

I_h = RMS current at harmonic "h" (amperes)

I_R = RMS fundamental current under rated frequency and rated load conditions (amperes)

$I_{1\text{-}R}$ = High voltage (HV) rms fundamental line current under rated frequency and rated load conditions (amperes)

$I_{2\text{-}R}$ = Low voltage (HV) rms fundamental line current under rated frequency and rated load conditions (amperes)

K = Load factor during t = $\frac{\text{Load}}{\text{Transformer capacity}}$

L = Loss of Life in per unit days

LL_R = Transformer rated load loss

P = I^2R loss portion of the load loss (watts)

P_{EC} = Winding eddy-current loss (watts)

$P_{EC\text{-}R}$ = Winding eddy-current loss under rated conditions (watts)

$P_{EC\text{-}O}$ = Winding eddy-current loss at the measured current and the power frequency (watts)

P_K = nominal load losses

P_{LL} = Load loss (watts)

$P_{LL\text{-}R}$ = Load loss under rated condition (watts)

P_{NL} = No load loss (watts)

P_0 = idle losses

P_{OSL} = Other stray loss (watts)

$P_{OSL\text{-}R}$ = Other stray loss under rated conditions (watts)

$P_{TSL\text{-}R}$ = Total stray loss under rated conditions (watts)

P_V = Losses at actual loading

R = Loss ratio = $\frac{\text{Load loss at rated current}}{\text{No load loss}}$

R = DC resistance (ohms)

R_1 = DC resistance measured between two HV terminals (ohms)

R_2 = DC resistance measured between two LV terminals (ohms)

$R(a)$ = % voltage regulation

t = time interval of application of specific load

t_1, t_2 = period under consideration; $t_2 - t_1 = T$

T = total time interval of application

T_p = Peak duration

τ_o = Oil time constant

V = Relative ageing rate

V_r = % resistance voltage at full load

V_x = % leakage reactance voltage at full load

x = Oil exponent

y = Winding exponent