


SOFTWARE GUIDED SAFE LOADING OF TRANSFORMERS AND ITS ECONOMICS

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LIST OF SYMBOLS

- θ_a = Ambient temperature
 θ_g = Hottest-spot conductor rise over top-oil temperature ($^{\circ}\text{C}$)
 θ_{g-R} = Hottest-spot conductor rise over top-oil temperature under rated conditions ($^{\circ}\text{C}$)
 θ_{g1} = Hottest-spot HV conductor rise over top-oil temperature ($^{\circ}\text{C}$)
 θ_{g1-R} = Hottest-spot HV conductor rise over top-oil temperature under rated conditions ($^{\circ}\text{C}$)
 θ_h = Ultimate (steady state) hot spot temperature
 θ_{TO} = Top-oil rise over ambient temperature ($^{\circ}\text{C}$)
 θ_{TO-R} = Top-oil rise over ambient temperature under rated conditions ($^{\circ}\text{C}$)
 θ_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 $(n-1)^{\text{th}}$ interval
 $\Delta\theta_{or}$ = Top oil rise at rated current
 $\Delta\theta_{ot}$ = Top oil temp. rise after time t
 $\Delta\theta_{on}$ = 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-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-R} = High voltage (HV) rms fundamental line current under rated frequency and rated load conditions (amperes)
 I_{2-R} = Low voltage (LV) 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-R} = Winding eddy-current loss under rated conditions (watts)
 P_{EC-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-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-R} = Other stray loss under rated conditions (watts)
 P_{TSL-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_0 = 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

