EQUATIONS

$$\bar{X} = X_{rms}e^{j\theta} = X_{rms}\angle\theta \tag{1}$$

$$S = V_{rms}^{LN} I_{rms} \quad P = V_{rms}^{LN} I_{rms}\cos(\theta_v - \theta_i) \quad Q = V_{rms}^{LN} I_{rms}\sin(\theta_v - \theta_i) \tag{2}$$

$$S = \sqrt{3}V_{rms}^{LL} I_{rms} \quad P = \sqrt{3}V_{rms}^{LL} I_{rms}\cos(\theta_v - \theta_i) \quad Q = \sqrt{3}V_{rms}^{LL} I_{rms}\sin(\theta_v - \theta_i) \tag{3}$$

$$\cos(\theta_v - \theta_i) = \frac{P}{S} \quad \bar{S} = \bar{V}\bar{I}^* = S\angle\theta_S = P + jQ \tag{4}$$

$$\bar{V}_{ab} = \sqrt{3}\bar{V}_{an}e^{j30^\circ} \qquad \bar{I}_a = \sqrt{3}\bar{I}_{ab}e^{-j30^\circ} \qquad \bar{Z}_\Delta = 3\bar{Z}_Y \tag{5}$$

$$\bar{E}_1 N_2 = \bar{E}_2 N_1 \qquad \bar{I}_1 N_1 - \bar{I}_2 N_2 = 0 \qquad \bar{Z}_2' = \left(\frac{N_1}{N_2}\right)^2 \bar{Z}_2 \qquad v(t) = \frac{d}{dt}\lambda(t) \quad \lambda(t) = Li(t) \tag{6}$$

$$B = \mu_r\mu_0 H \qquad \mu_0 = 4\pi \times 10^{-7} \tag{7}$$

$$S_{base,3ph.} = 3S_{base,1ph.} \quad V_{base,LL} = \sqrt{3}V_{base,LN} \tag{8}$$

$$I_{base} = \frac{S_{base,1ph.}}{V_{base,LN}} = \frac{S_{base,3ph.}}{\sqrt{3}V_{base,LL}} \qquad Z_{base} = \frac{V_{base,LN}}{I_{base}} = \frac{V_{base,LN}^2}{S_{base,1ph.}} = \frac{V_{base,LL}^2}{S_{base,3ph.}} \tag{9}$$

$$Z_{pu}^{new} = Z_{pu}^{old}\left(\frac{V_{base,old}}{V_{base,new}}\right)^2\left(\frac{S_{base,new}}{S_{base,old}}\right) \tag{10}$$

$$\begin{bmatrix}\bar{X}_a\\ \bar{X}_b\\ \bar{X}_c\end{bmatrix} = \begin{bmatrix}1 & 1 & 1\\ 1 & a^2 & a\\ 1 & a & a^2\end{bmatrix}\begin{bmatrix}\bar{X}_{a0}\\ \bar{X}_{a1}\\ \bar{X}_{a2}\end{bmatrix} \qquad \begin{bmatrix}\bar{X}_{a0}\\ \bar{X}_{a1}\\ \bar{X}_{a2}\end{bmatrix} = \frac{1}{3}\begin{bmatrix}1 & 1 & 1\\ 1 & a & a^2\\ 1 & a^2 & a\end{bmatrix}\begin{bmatrix}\bar{X}_a\\ \bar{X}_b\\ \bar{X}_c\end{bmatrix} \qquad a = e^{j120^\circ} \tag{11}$$

$$L_{total} = L_{phase} = \frac{1}{2}L_{loop} = \frac{\mu_0}{2\pi}\ln\left(\frac{R}{e^{-1/4}r}\right) \qquad i(t) = \frac{d}{dt}q(t) \quad q(t) = Cv(t) \tag{12}$$

$$V_{12} = \frac{q}{2\pi\epsilon_0}\ln\left(\frac{R_2}{R_1}\right) \quad C_{xy} = \frac{\pi\epsilon_0}{\ln\left(\frac{R}{r}\right)} \quad C_n = C_{phase} = \frac{2\pi\epsilon_0}{\ln\left(\frac{R}{r}\right)} \quad \epsilon_0 = 8.85 \times 10^{-12} \tag{13}$$

$$\bar{z} = R + j\omega L \qquad \bar{y} = G + j\omega C \qquad \bar{Z}_C = \sqrt{\frac{\bar{z}}{\bar{y}}} \qquad \gamma = \sqrt{\bar{z}\bar{y}} = \alpha + j\beta \tag{14}$$

$$\cosh(\gamma x) = \frac{e^{\gamma x} + e^{-\gamma x}}{2} = \frac{e^{\alpha x}\angle\beta x + e^{-\alpha x}\angle - \beta x}{2} \tag{15}$$

$$\sinh(\gamma x) = \frac{e^{\gamma x} - e^{-\gamma x}}{2} = \frac{e^{\alpha x}\angle\beta x - e^{-\alpha x}\angle - \beta x}{2} \tag{16}$$

$$A(x) = D(x) = \cosh(\gamma x) \quad B(x) = \bar{Z}_C\sinh(\gamma x) \quad C(x) = \frac{1}{\bar{Z}_C}\sinh(\gamma x) \tag{17}$$

$$A(x) = D(x) = \cos(\beta x) \quad B(x) = j\bar{Z}_C\sin(\beta x) \quad C(x) = \frac{j}{\bar{Z}_C}\sin(\beta x) \tag{18}$$

$$\bar{V}(x) = \bar{V}_i e^{\alpha x}e^{j\beta x} + \bar{V}_r e^{-\alpha x}e^{-j\beta x} \qquad where\ \bar{V}_i = \frac{\bar{V}_R + \bar{Z}_C\bar{I}_R}{2} \quad \bar{V}_r = \frac{\bar{V}_R - \bar{Z}_C\bar{I}_R}{2} \tag{19}$$

$$\bar{Z}' = B(x) \qquad \bar{Y}' = \frac{2(A(x) - 1)}{B(x)} \qquad \bar{Z} = \bar{z}x \qquad \bar{Y} = \bar{y}x \tag{20}$$

$$Percent\ V.R. = \frac{|\bar{V}_{R,NL}| - |\bar{V}_{R,FL}|}{|\bar{V}_{R,FL}|} \times 100 \qquad P = \frac{V_R V_S}{X_L}\sin(\delta) \tag{21}$$