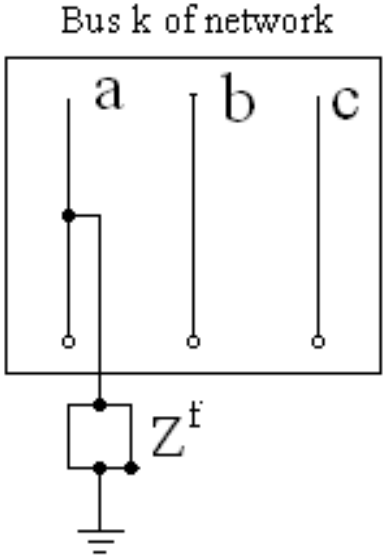
EEE- 601
POWER SYSTEM ANALYSIS
Unit-2

UNBALANCED FAULT ANALYSIS USING BUS IMPEDANCE MATRIX

SINGLE LINE TO GROUND FAULT USING Z_{bus}

- Consider a fault between phase a and ground through an impedance z_f at bus k



For a fault at bus k the symmetrical components of fault current

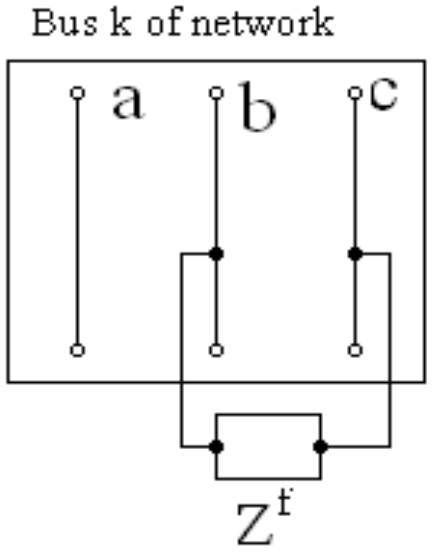
$$I_k^{\,0} = I_k^{\,1} = I_k^{\,2} = \frac{V_k(0)}{Z_{kk}^{\,1} + Z_{kk}^{\,2} + Z_{kk}^{\,0} + 3Z^f}$$

Where $Z_{kk}^{\,1}$, $Z_{kk}^{\,2}$, $Z_{kk}^{\,0}$ are the diagonal elements in the k axis of the z_{bus} & $V_k(0)$ is the prefault voltage at bus k.

Fault phase current $I_k^{abc} = A\, I_k^{012}$

LINE TO LINE (LL) FAULT

Consider a fault between phase b and c through an impedance z_f

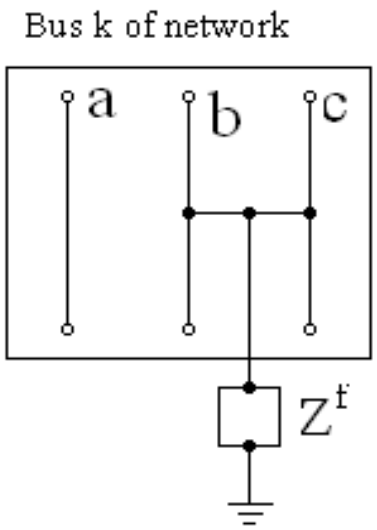


$$I_k^{\,0} = 0$$

$$I_k^{\,1} = -I_k^{\,2} = \frac{V_k(0)}{Z_{kk}^{\,1} + Z_{kk}^{\,2} + Z^f}$$

DOUBLE LINE TO GROUND (LLG) FAULT

Consider a fault between phase b and c through an impedance z_f to ground



$$I_k^{\,1} = \frac{V_k(0)}{Z_{kk}^{\,1} + \dfrac{Z_{kk}^{\,2}(Z_{kk}^{\,0} + 3Z^f)}{Z_{kk}^{\,2} + Z_{kk}^{\,0} + 3Z^f}}$$

$$I_k^{\,2} = -\frac{V_k(0) - Z_{kk}^{\,1} I_k^{\,1}}{Z_{kk}^{\,2}}$$

$$I_k^{\,0} = -\frac{V_k(0) - Z_{kk}^{\,1} I_k^{\,1}}{Z_{kk}^{\,0} + 3Z^f}$$

$$I_k(F) = I_k^{\,b} + I_k^{\,c}$$

BUS VOLTAGES AND LINE CURRENTS DURING FAULT

$$V_i^0(F) = 0 - Z_{ik}{}^0 \mathrm{I}_k{}^0$$

$$V_i^1(F) = V_i^0(0) - Z_{ik}{}^1 \mathrm{I}_k{}^1$$

$$V_i^2(F) = 0 - Z_{ik}{}^2 \mathrm{I}_k{}^2$$

$$\mathrm{I}_{ij}{}^0 = \frac{V_i^0(F) - V_j{}^0(F)}{Z_{ij}{}^0}$$

$$\mathrm{I}_{ij}{}^1 = \frac{V_i^1(F) - V_j{}^1(F)}{Z_{ij}{}^1}$$

$$\mathrm{I}_{ij}{}^2 = \frac{V_i^2(F) - V_j{}^2(F)}{Z_{ij}{}^2}$$

Thank you