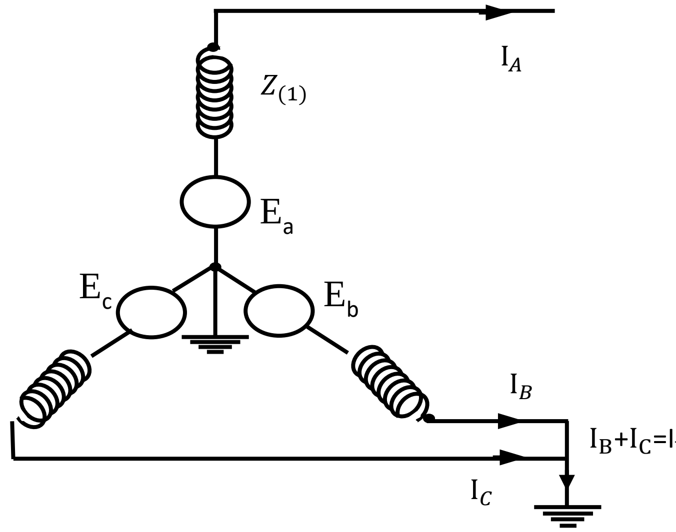
Double line to ground faults

Double line to ground fault takes place on phases B and C, the boundary conditions are:

$I_A = 0$

$V_B = 0$

$V_C = 0$



$$\begin{bmatrix} V_A^{(0)} \\ V_A^{(1)} \\ V_A^{(2)} \end{bmatrix} = \frac{1}{3}\begin{bmatrix} 1 & 1 & 1 \\ 1 & a & a^2 \\ 1 & a^2 & a \end{bmatrix}\begin{bmatrix} V_A \\ V_B \\ V_C \end{bmatrix}$$

$$V_A^{(0)} = \frac{1}{3}(V_A) = \frac{V_A}{3}$$

$$V_A^{(1)} = \frac{1}{3}(V_A) = \frac{V_A}{3}$$

$$V_A^{(2)} = \frac{1}{3}(V_A) = \frac{V_A}{3}$$

$$V_A^{(0)} = V_A^{(1)} = V_A^{(2)}$$

Using this relation of voltage and substituting in the sequence Network equations.

$$V_A^{(0)} = V_A^{(1)}$$

$$-I_A^{(0)} Z^{(0)} = E_A - I_A^{(1)} Z^{(1)}$$

$$I_A^{(0)} = -\frac{E_A - I_A^{(1)} Z^{(1)}}{Z^{(0)}} \qquad (1)$$

Similarly

$$V_A^{(2)} = V_A^{(1)}$$

$$-I_A^{(2)} Z^{(2)} = E_A - I_A^{(1)} Z^{(1)}$$

$$I_A^{(2)} = -\frac{E_A - I_A^{(1)} Z^{(1)}}{Z^{(2)}} \qquad (2)$$

Now from

$$I_A = I_A^{(1)} + I_A^{(2)} + I_A^{(0)} = 0 \qquad (3)$$

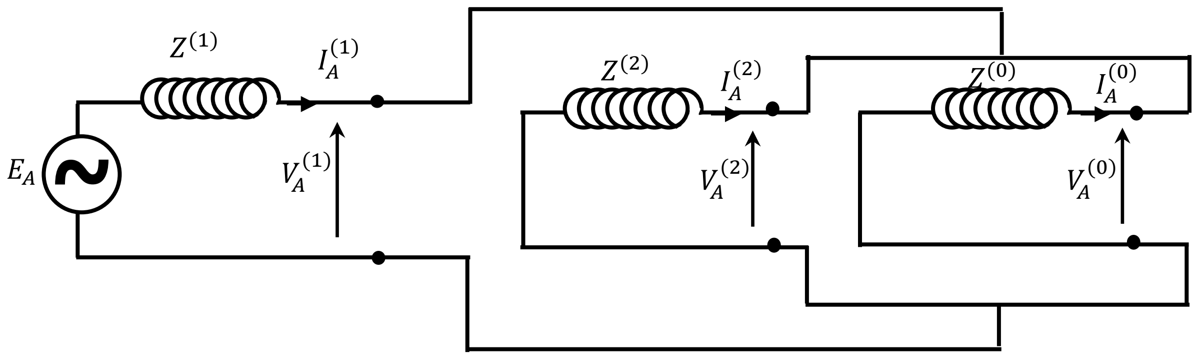
Substituting value of $I_A^{(2)}$ and $I_A^{(0)}$ from equations (1) and (2)

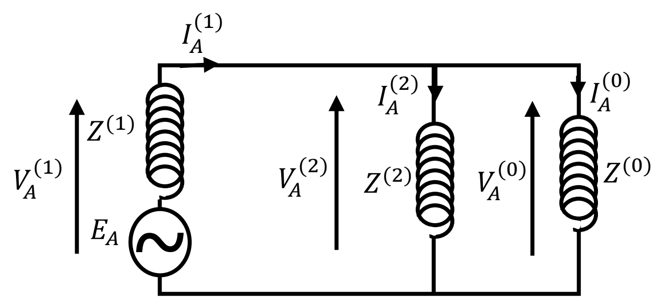
$$I_A^{(1)} - \frac{E_A - I_A^{(1)} Z^{(1)}}{Z^{(2)}} - \frac{E_A - I_A^{(1)} Z^{(1)}}{Z^{(0)}} = 0$$

Gives

$$\boxed{I_A^{(1)} = \frac{E_A}{Z_1^{(1)} + \frac{Z^{(0)} Z^{(2)}}{Z^{(0)} + Z^{(2)}}}}$$

From this equation, it is clear that all three sequence networks are required to simulate LLG fault and also the zero sequence and the negative sequence Network are connected in parallel





the neutral current

$$I_n = I_f = I_B + I_C$$

$$\begin{bmatrix} I_A^{(0)} \\ I_A^{(1)} \\ I_A^{(2)} \end{bmatrix} = \frac{1}{3}\begin{bmatrix} 1 & 1 & 1 \\ 1 & a & a^2 \\ 1 & a^2 & a \end{bmatrix}\begin{bmatrix} I_A \\ I_B \\ I_C \end{bmatrix}$$

$$I_A^{(0)} = \frac{1}{3}(I_B + I_C) \qquad (I_B + I_C) = 3\, I_A^{(0)} = I_n$$

$$\boxed{I_f = 3\, I_A^{(0)} = In}$$

Now:

$$I_A^{(0)} = -(\frac{E_A - I_A^{(1)} Z_1}{Z^{(0)}})$$

$$I_A^{(1)} = \frac{E_A}{Z^{(1)} + \frac{Z^{(0)} Z^{(2)}}{Z^{(0)} + Z^{(2)}}}$$

$$I_A^{(2)} = -(\frac{E_A - I_A^{(1)} Z_1}{Z^{(2)}})$$