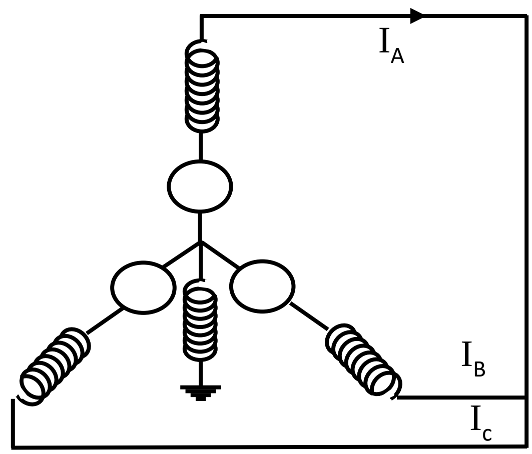
Three phase faults

As shown in the figure, the boundary conditions are:

$$I_A + I_B + I_C = 0$$

$$V_A = V_B = V_C$$

Since $|I_A| = |I_B| = |I_C|$



And if I_A is the reference $I_B = a^2 I_A$, $I_C = a\ I_A$

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

Now

$$I_A^{(1)} = \frac{1}{3}(I_A + aI_B + a^2 I_C)$$

And substituting the values of I_B *and* I_C in terms I_A

$$I_A^{(1)} = \frac{1}{3}(I_A + a^3 I_A + a^3 I_A) = I_A \quad \Longrightarrow I_A^{(1)} = I_A$$

$$I_A^{(2)} = \frac{1}{3}(I_A + a^2 I_B + a\ I_C)$$

$$I_A^{(2)} = \frac{1}{3}(I_A + a^4 I_A + a^2 I_A) = \frac{1}{3}(1 + a\ I_A + a^2 I_A) = \frac{1}{3}\ I_A(1 + a + a^2\ )$$

$$I_A^{(2)} = 0\ , \quad I_A^{(0)} = \frac{1}{3}(I_A + I_B + I_C) \qquad I_A^{(0)} = 0$$

Which means a three-phase fault zero as well as negative sequence components of current are absent and the positive-sequence component of current is equal to the phase current.

Using the voltage relation we have

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

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$$V_A^{(1)} = \frac{1}{3}V_A(1 + a + a^2) = 0$$

$$V_A^{(2)} = \frac{1}{3}(V_A + a^2V_B + aV_C) = 0$$

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

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

$$\boxed{I_A^{(1)} = \frac{E_A}{Z^{(1)}}}$$

the sequence network is shown in the figure in below