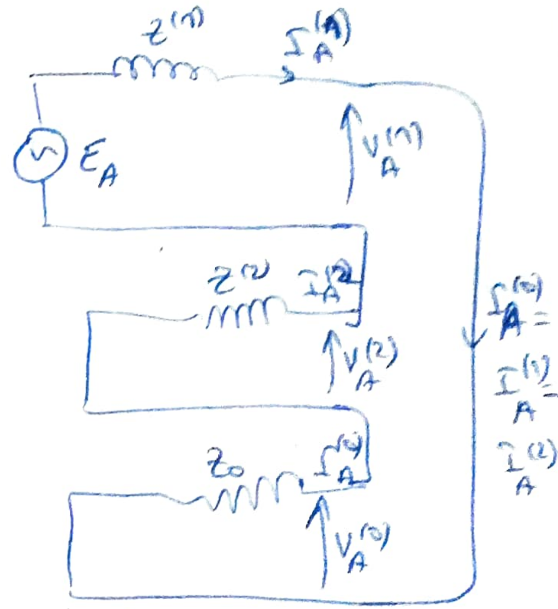
Solution:

$E_A = 1 \angle 0^\circ$

$= 1 + j0.0$ pu

For a line to ground fault the fault impedance is

$j0.25 + j0.35 + j0.1 = j0.7$



interconnection of sequence Network.

the positive sequence impedance may be less than the negative sequence impedance.

$$I_A^{(1)} = \frac{E_A}{Z^{(1)} + Z^{(2)} + Z^{(0)}} = \frac{1 + j0.0}{j0.7} = -j1.428$$

for LG fault: $I_A^{(1)} = I_A^{(2)} = I_A^{(0)} = -j1.428$

the pu fault current:

$$I_A = I_A^{(1)} + I_A^{(2)} + I_A^{(0)} = 3I_A^{(1)} = -j4.285$$

Let the base quantities be 25 MVA, 13,2 kV and hence

the base current $= \frac{25 . 1000}{\sqrt{3} . 13,2} = 1093$ Amps

The fault current in amperes $= 1093 \times 4.285 = 4685$ Amps

to find out the voltages, we first find out the sequence components of voltages.

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

$$= 1 + j0.0 - (-j1.428)(j0,25) = 1 - 0,357 = 0,643$$

$$V_A^{(2)} = -I_A^{(2)} Z^{(2)} = -(-j1,428)(j0,35) = -0,4998$$

$$V_A^{(0)} = -I_A^{(0)} Z^{(0)} = -(-j1,428)(j0,1) = -0,1428$$

As a numeric check $V_A = 0$. Substituting the values of $V_A^{(1)}, V_A^{(2)}, V_A^{(0)}$

$$0,643 - 0,4998 - 0,1428 = 0$$

$V_B = V_B^{(1)} + V_B^{(2)} + V_B^{(0)}$ and $V_C = V_C^{(1)} + V_C^{(2)} + V_C^{(0)}$

* $V_B^{(1)} = a^2 V_A^{(1)} = (-0,5 - j0,866)(0,643) = -0,3215 - j0,5568$

$V_B^{(2)} = a V_A^{(2)} = (-0,5 + j0,866)(-0,50) = 0,25 - j0,433$

$V_B^{(0)} = V_A^{(0)} = V_C^{(0)} = -0,1428$

* $V_C^{(1)} = a V_A^{(1)} = (-0,5 + j0,866)(0,643) = -0,3215 + j0,5568$

$V_C^{(2)} = a^2 V_A^{(2)} = (-0,5 - j0,866)(-0,5) = 0,25 + j0,433$

→ $V_B = -0,3215 - j0,5568 + 0,25 - j0,433 - 0,1428 = -0,2143 - j0,9898$

→ $V_C = -0,3215 + j0,5568 + 0,25 + j0,433 - 0,1428 = -0,2143 + j0,9898$

Now, the Line-to-Line Voltage

$$V_{AB} = V_A - V_B \text{ . Since } V_A = 0$$

$$V_{AB} = -V_B = 0,2143 + j\,0,9898$$

$$V_{AC} = -V_C = 0,2143 - j\,0,9898$$

$$V_{BC} = V_B - V_C = -j\,2 \times 0,9898 = -j\,1,9796$$

Now $V_{AB} = 0,2143 + j0,9898 = \sqrt{(0,4592 + 9,797) \times 10^{-1}} = \sqrt{10,346.10}$

$$= \sqrt{1.0346} = 1,0127 \text{ pu}$$

the Line-to-Line voltage will be

$$V_{AB} = 1,0127 \cdot \frac{13,2}{\sqrt{3}} = \boxed{7,717 \text{ kV}}$$

$$V_{AC} = \boxed{7,717 \text{ kV}}$$

$$V_{BC} = 1,9796 \times \frac{13.2}{\sqrt{3}} = \boxed{15,08 \text{ kV}}$$

Solution Ex n°02

Two generators operate in Parallel,

$$x_1 = j\frac{0.09}{2} = j0.045 \text{ pu}$$

$$x_2 = j\frac{0.05}{2} = j0.025 \text{ pu}$$

$$Z_0 = j0.04 + 3R_n = \left(j0.04 + 3 \times \frac{1 \times 12}{(11)^2}\right) \text{ pu}$$

$$= (0,297 + j0.04) \text{ pu}$$

a/ fault current

$$I_f = I_a = 3I_a^{(1)} = \frac{3E_a}{X^{(1)} + X^{(2)} + Z^{(0)}}$$

$$I_f = \frac{3 \cdot 1.0}{(j0.045 + j0.025 + 0,297 + j0.04}$$

$$= \frac{3}{(0,297 + j0,11)} = \frac{3}{0.3167 \angle 20.32°} = 9,472 \angle -20,3° \text{ pu}$$

b/ Current in the grounding resistor

$$I_f = 9,472 \times \frac{12}{\sqrt{3}\, 911} \text{ kA} = 5,96 \text{ kA}$$

c/ Voltage across grounding resistor

$$= \frac{1 \times 12}{11^2} \times 9,472 = 0,939 \text{ pu}$$

$$= 0,939 \times \frac{11}{\sqrt{3}} = 5.96 \text{ kV}$$