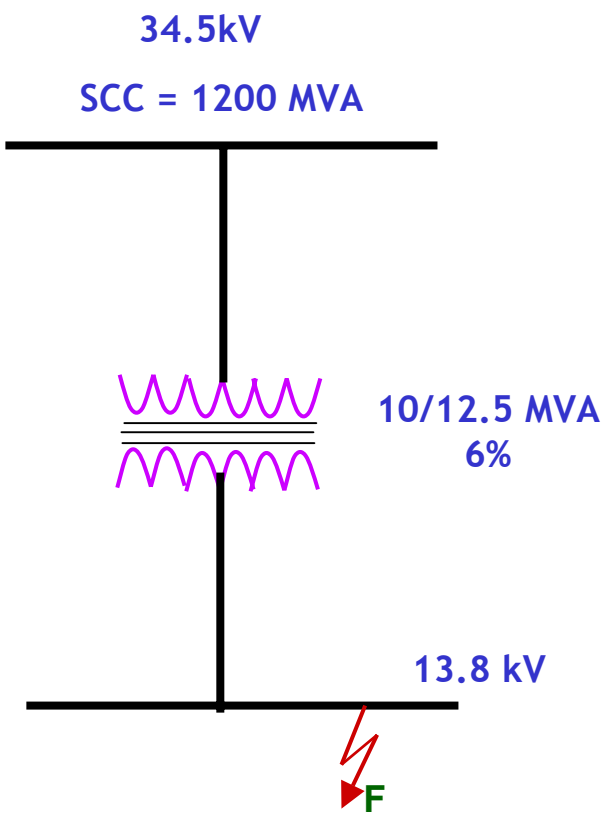
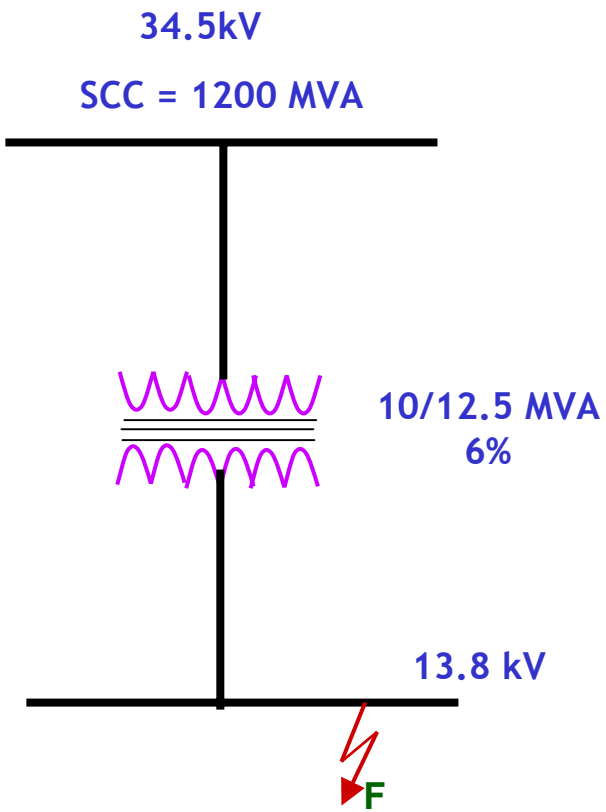
Symmetrical Fault Calculations

Example 1



Calculate the fault current at F

Example 1



Step 1: Calculate Base Values

$$MVA_{base} = 100$$

$$kV_{base} = 34.5$$

$$Z_{base} = \frac{kV_{base}^2}{MVA_{base}}$$

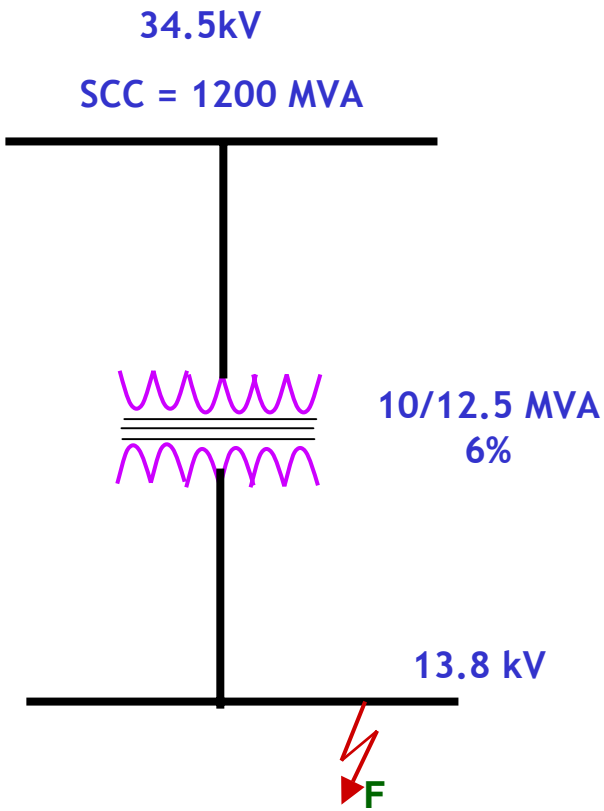
$$= \frac{34.5^2}{100} = 11.9 ohms$$

$$I_{base} = \frac{MVA_{base}}{kV_{base}} = \frac{100 MVA}{34.5 kV}$$

$$= 2898.55 A$$

Calculate the fault current at F

Example 1



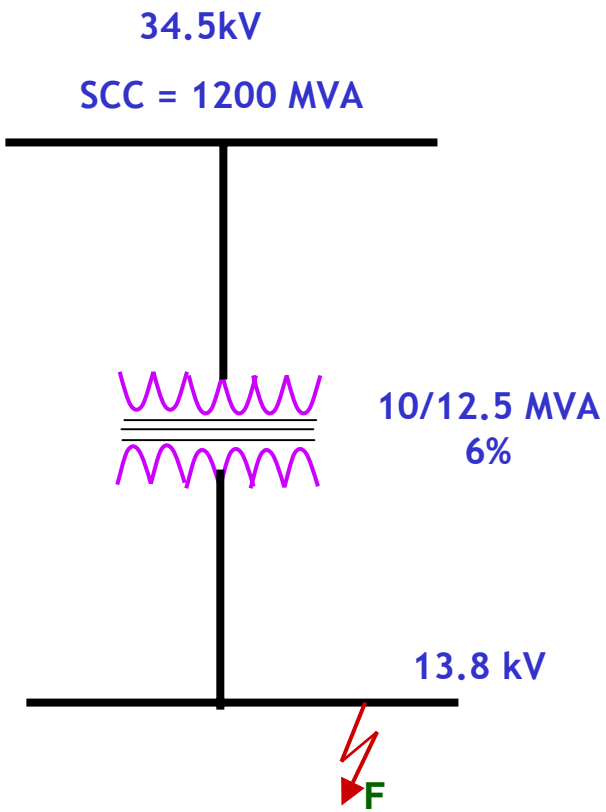
Step 2: Calculate p.u impedances

$$Z_{Tpu} = Z_t x \frac{MVA_{base}}{MVA_{oldbase}}$$

$$= 0.06 x \frac{100}{12.5} = 0.48$$

Calculate the fault current at F

Example 1



Calculate the fault current at F

Step 2: Calculate p.u impedances

$$Z_{Tpu} = Z_t \times \frac{MVA_{base}}{MVA_{oldbase}}$$

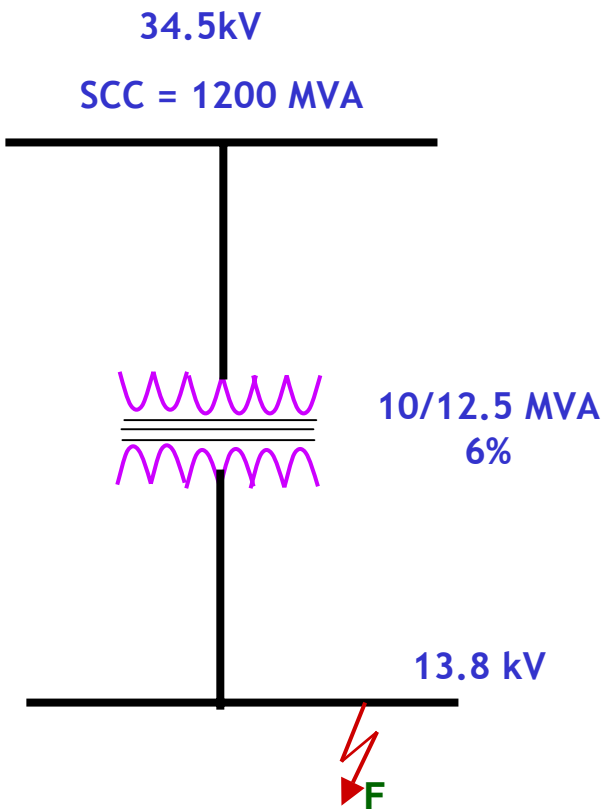
$$= 0.06 \times \frac{100}{12.5} = 0.48$$

$$Z_{utility} = \frac{MVA_{base}}{MVA_{oldbase}} \times \frac{kV_{oldbase}}{kV_{base}}$$

$$= \frac{100}{1200} \times \frac{34.5}{34.5}$$

$$= 0.0833$$

Example 1



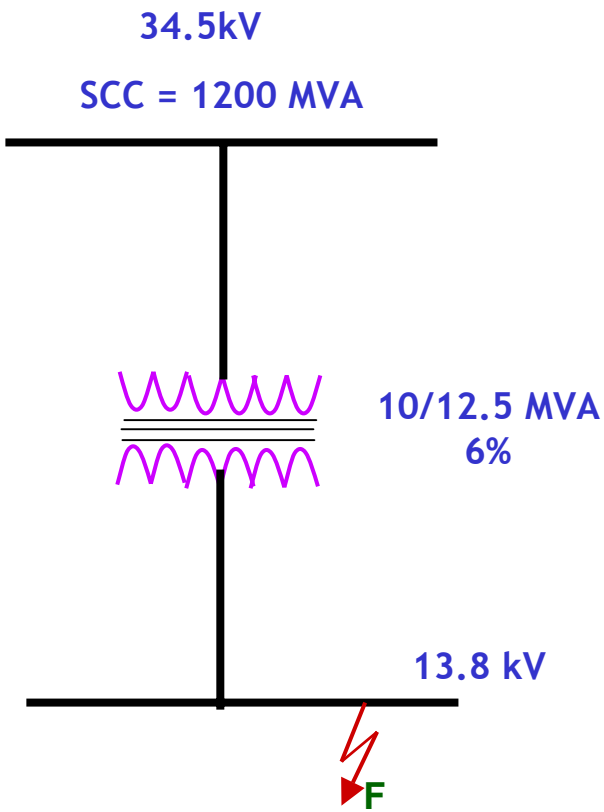
Step 3: Calculate fault current

$$I_{Fpu} = \frac{V_{pu}}{Z_{total}}$$

$$= \frac{1.0}{0.48 + 0.0833} = 1.775 \text{ pu}$$

Calculate the fault current at F

Example 1



Calculate the fault current at F

Step 3: Calculate fault current

$$I_{Fpu} = \frac{V_{pu}}{Z_{total}}$$

$$= \frac{1.0}{0.48 + 0.0833} = 1.775 \text{ pu}$$

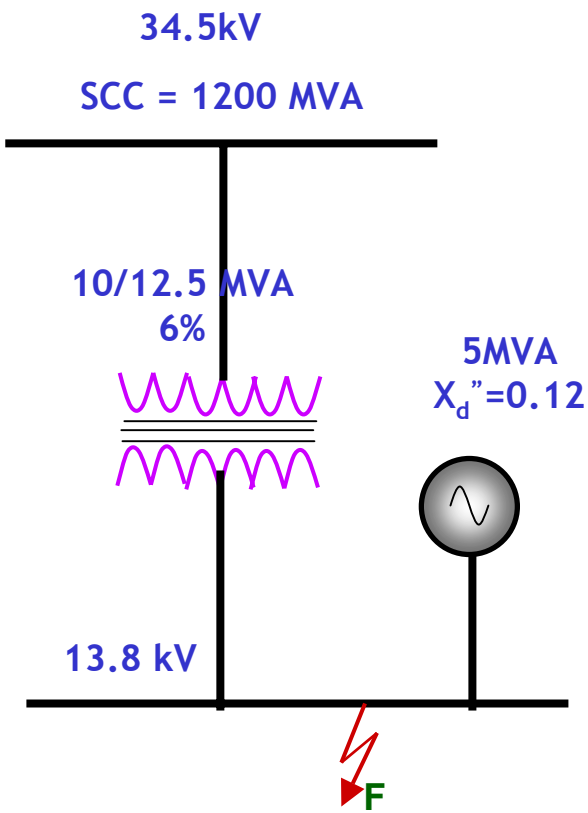
$$I_{FHV} = I_{Fpu} \times \frac{I_{base}}{\sqrt{3}}$$

$$= 1.775 \times \frac{2898.55}{\sqrt{3}} = 2970 \text{ A}$$

$$I_{FLV} = \frac{I_{FHV}}{13.8} \times 34.5$$

$$= 7426 \text{ A}$$

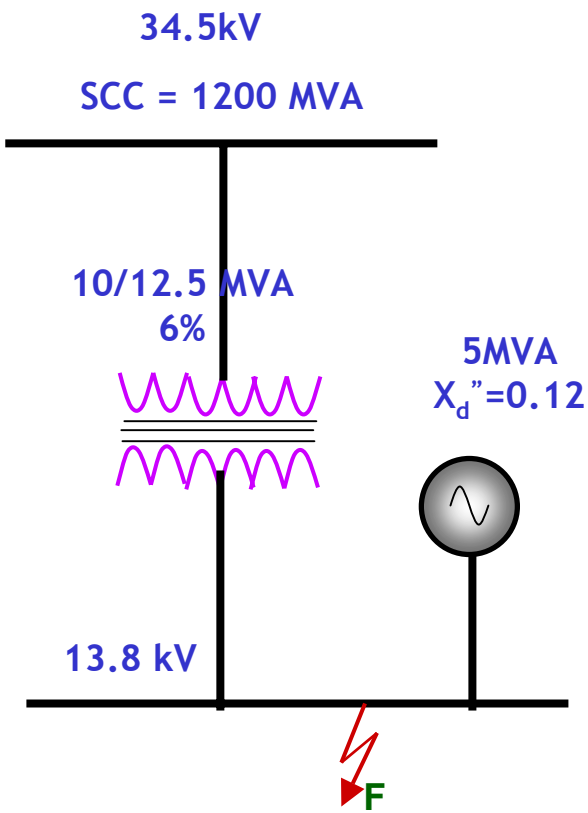
Example 2 - Addition of a Generator



Calculate the fault current at F

Example 2 - Addition of a Generator

Step 1: Calculate impedances



$$Z_{utility} = \frac{MVA_{base}}{MVA_{oldbase}} x \frac{kV_{oldbase}}{kV_{base}}$$

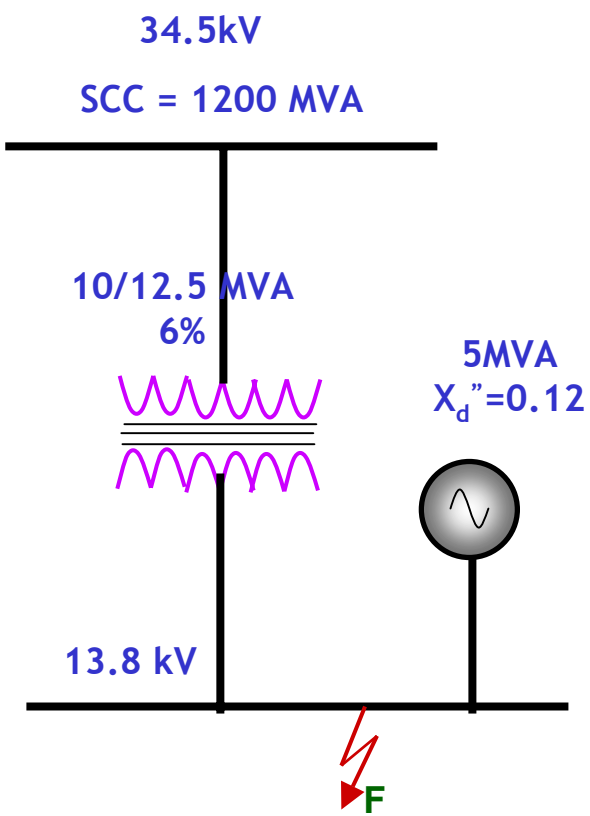
$$= \frac{100}{1200} x \frac{34.5}{34.5}$$

$$= 0.0833$$

Calculate the fault current at F

Example 2 - Addition of a Generator

Step 1: Calculate impedances



$$Z_{utility} = \frac{MVA_{base}}{MVA_{oldbase}} x \frac{kV_{oldbase}}{kV_{base}}$$

$$= \frac{100}{1200} x \frac{34.5}{34.5}$$

$$= 0.0833$$

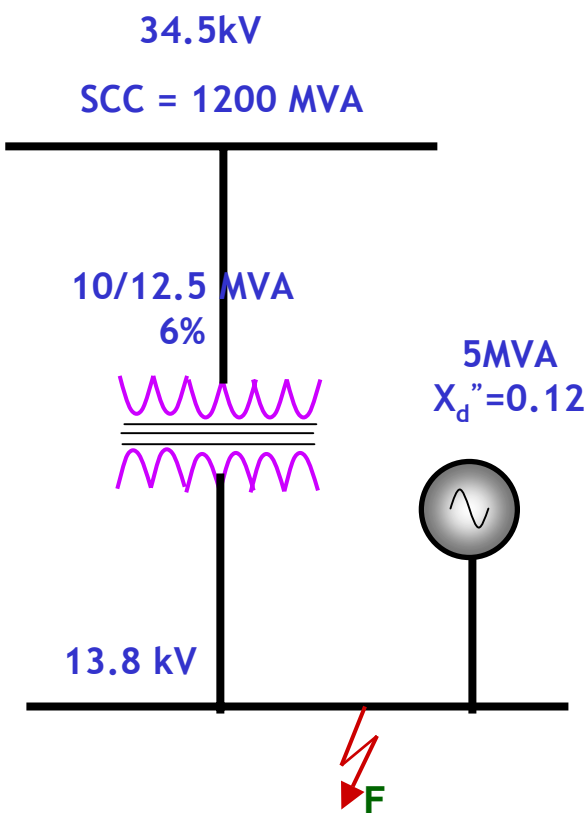
$$Z_{Tpu} = Z_t x \frac{MVA_{base}}{MVA_{oldbase}}$$

$$= 0.06 x \frac{100}{12.5} = 0.48$$

Calculate the fault current at F

Example 2 - Addition of a Generator

Step 1: Calculate impedances



Calculate the fault current at F

$$Z_{utility} = \frac{MVA_{base}}{MVA_{oldbase}} x \frac{kV_{oldbase}}{kV_{base}}$$

$$= \frac{100}{1200} x \frac{34.5}{34.5}$$

$$= 0.0833$$

$$Z_{Tpu} = Z_t x \frac{MVA_{base}}{MVA_{oldbase}}$$

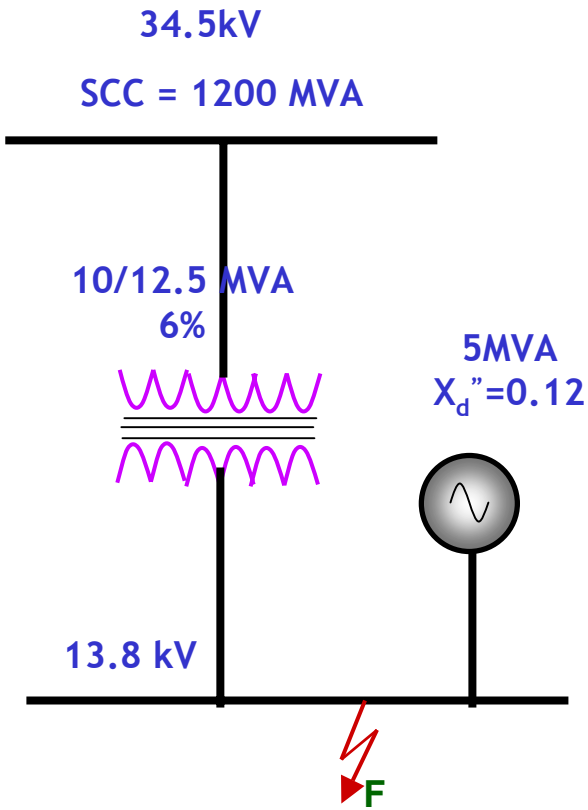
$$= 0.06 x \frac{100}{12.5} = 0.48$$

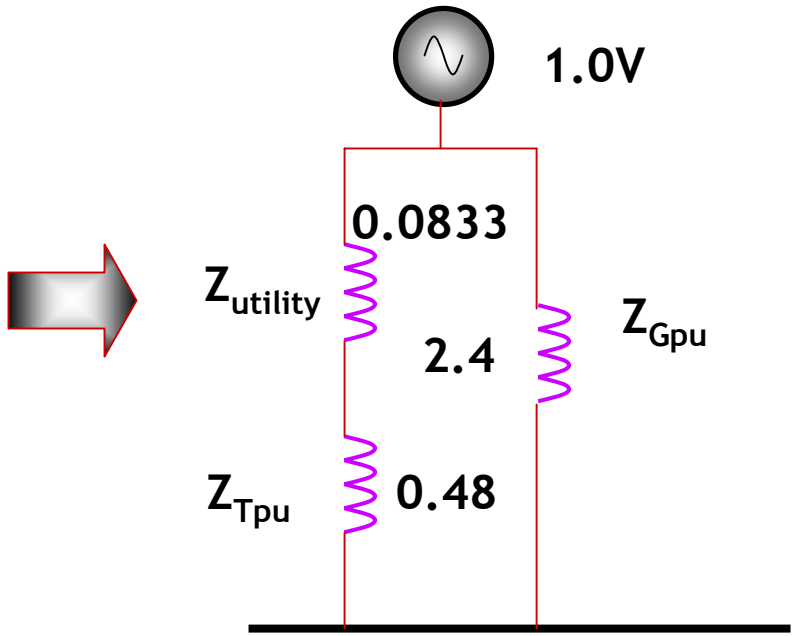
$$Z_{Gpu} = Z_G x \frac{MVA_{base}}{MVA_{oldbase}}$$

$$= 0.12 x \frac{100}{5} = 2.4$$

Example 2 - Addition of a Generator

Step 2: Calculate equivalent impedances

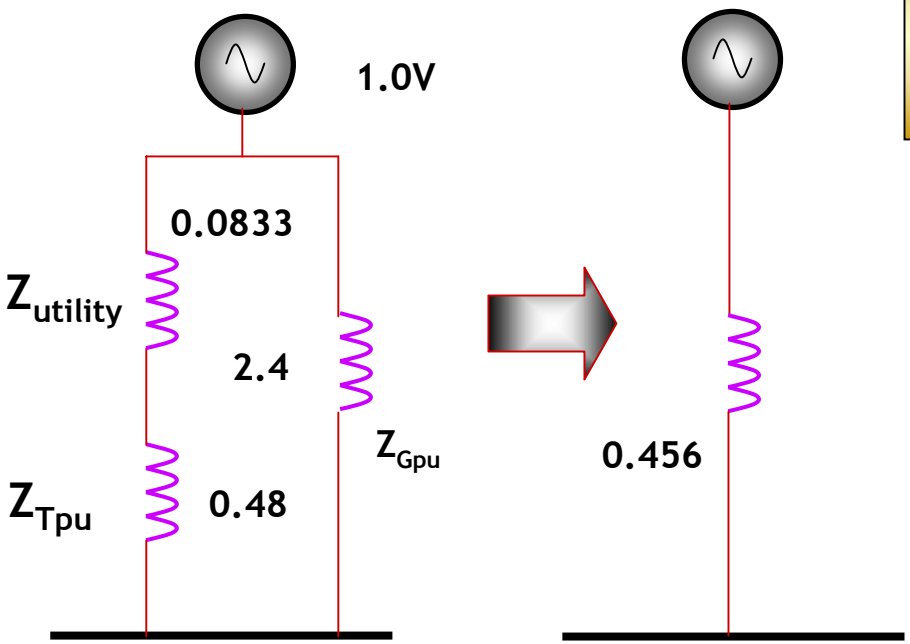




Calculate the fault current at F

Example 2 - Addition of a Generator

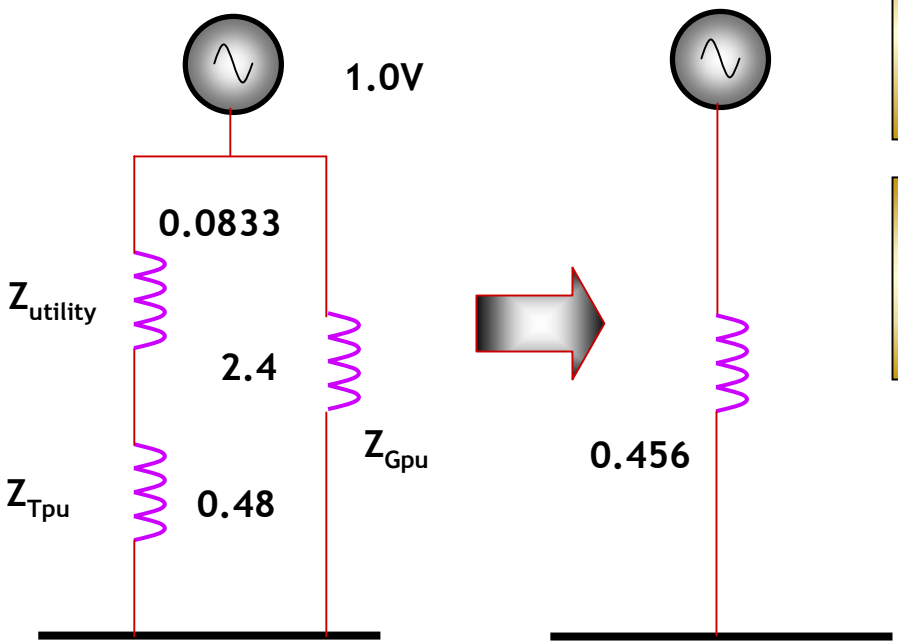
Step 2: Calculate equivalent impedances



$$Z_{Eq} = \frac{0.5633 * 2.4}{0.5633 + 2.4} = 0.456$$

Example 2 - Addition of a Generator

Step 3: Calculate fault current

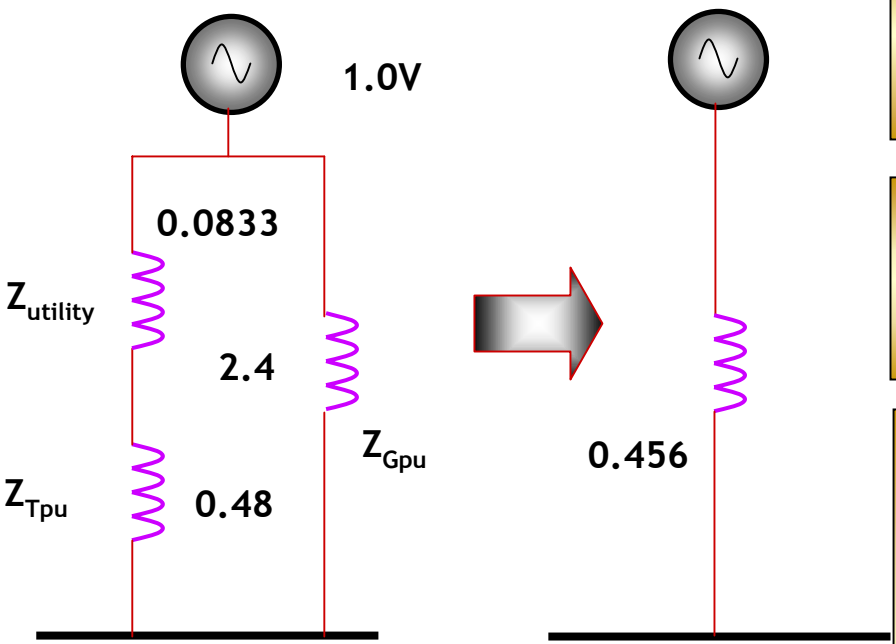


$$Z_{Eq} = \frac{0.5633 * 2.4}{0.5633 + 2.4} = 0.456$$

$$I_{Fpu} = \frac{V_{pu}}{Z_{Eq}} = \frac{1.0}{0.456} = 2.192 \text{ pu}$$

Example 2 - Addition of a Generator

Step 3: Calculate fault current



$$Z_{Eq} = \frac{0.5633 * 2.4}{0.5633 + 2.4} = 0.456$$

$$I_{Fpu} = \frac{V_{pu}}{Z_{Eq}} = \frac{1.0}{0.456} = 2.192 \text{ pu}$$

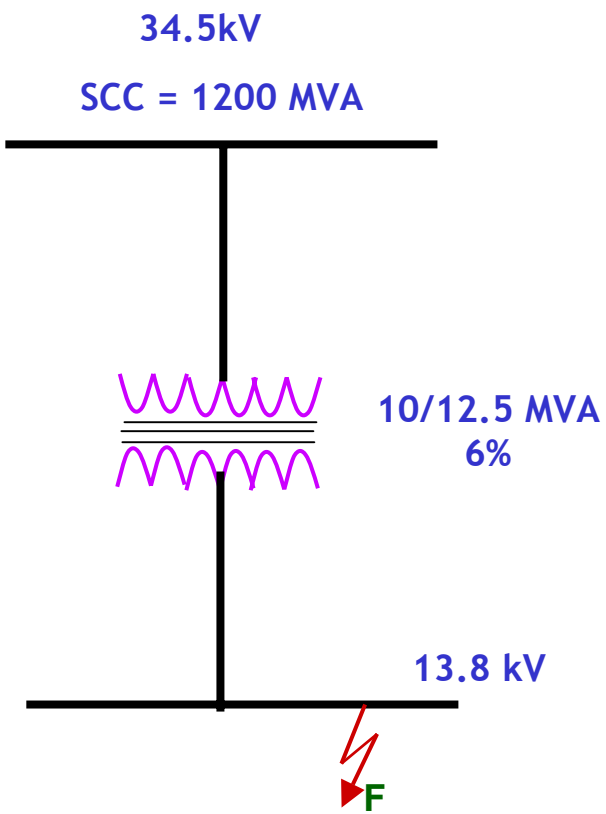
$$I_{FHV} = I_{Fpu} x \frac{I_{base}}{\sqrt{3}}$$

$$= 2.192 \text{ x } \frac{2898.55}{\sqrt{3}} = 3668 \text{ A}$$

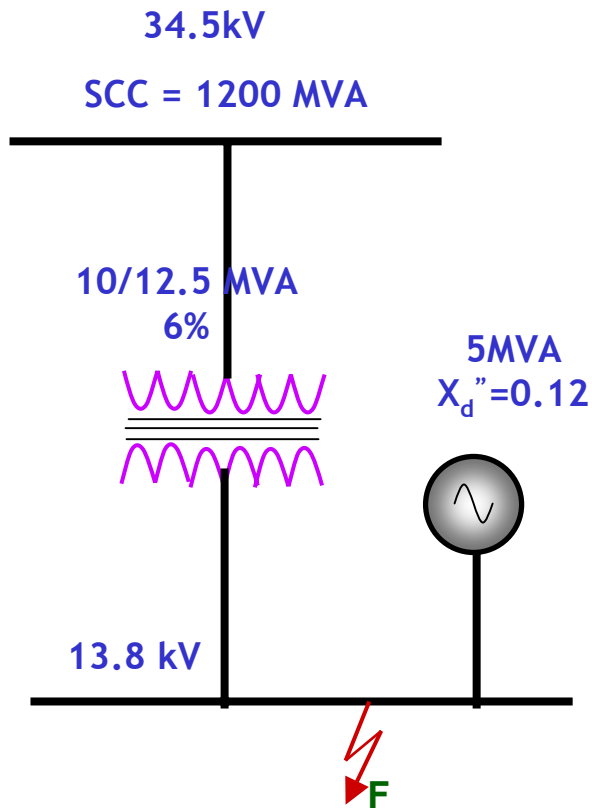
$$I_{FLV} = \frac{I_{FHV}}{13.8} x34.5$$

$$= 9170 \text{ A}$$

Example 1 & 2 Comparison

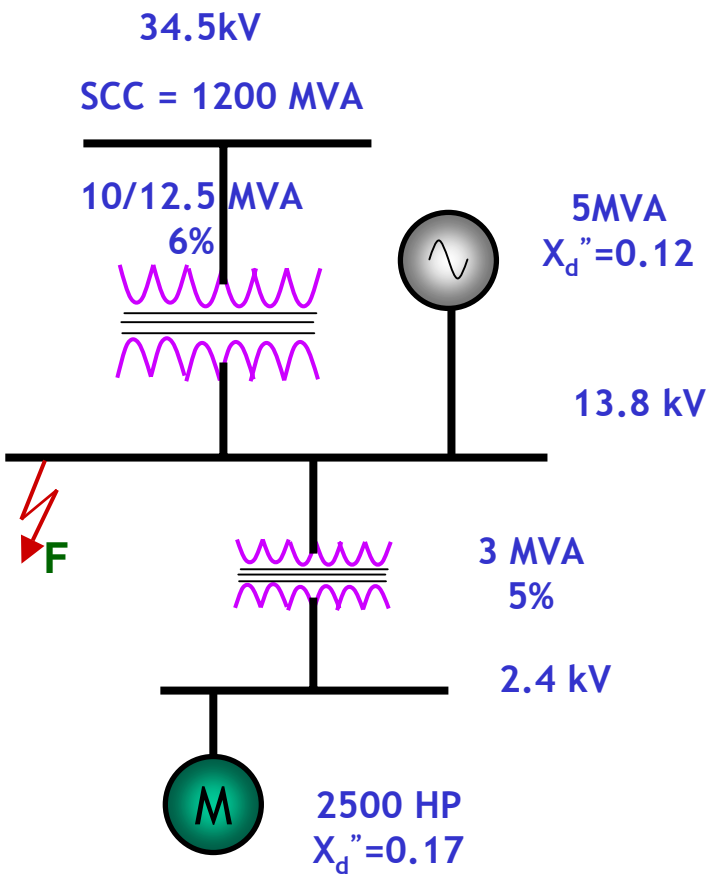


I_F =7426 Amps



I_F =9170 Amps

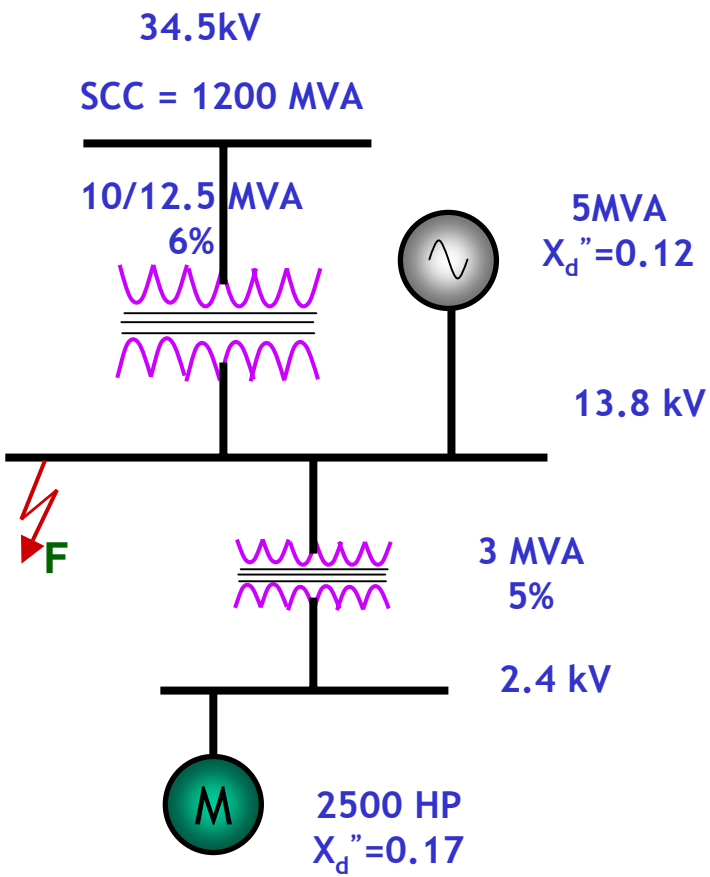
Example 3 -Presence of transformer & motor



Calculate the fault current at F

Example 3 -Presence of transformer & motor

Step 1: Calculate impedances



$$Z_{utility} = \frac{MVA_{base}}{MVA_{oldbase}} \times \frac{kV_{oldbase}}{kV_{base}}$$

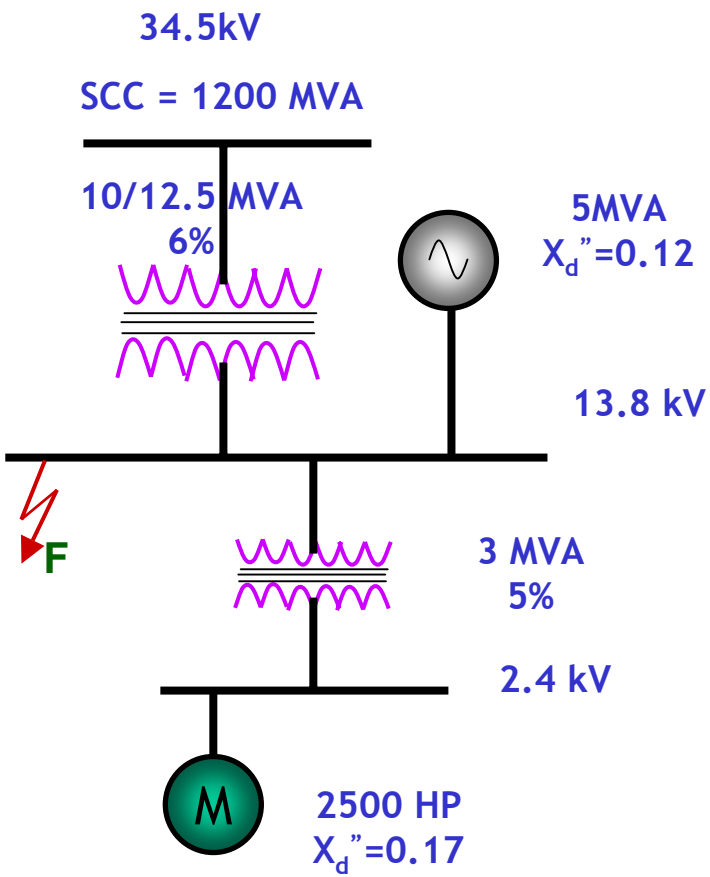
$$= \frac{100}{1200} \times \frac{34.5}{34.5}$$

$$= 0.0833$$

Calculate the fault current at F

Example 3 -Presence of transformer & motor

Step 1: Calculate impedances



$$Z_{utility} = \frac{MVA_{base}}{MVA_{oldbase}} x \frac{kV_{oldbase}}{kV_{base}}$$

$$= \frac{100}{1200} x \frac{34.5}{34.5}$$

$$= 0.0833$$

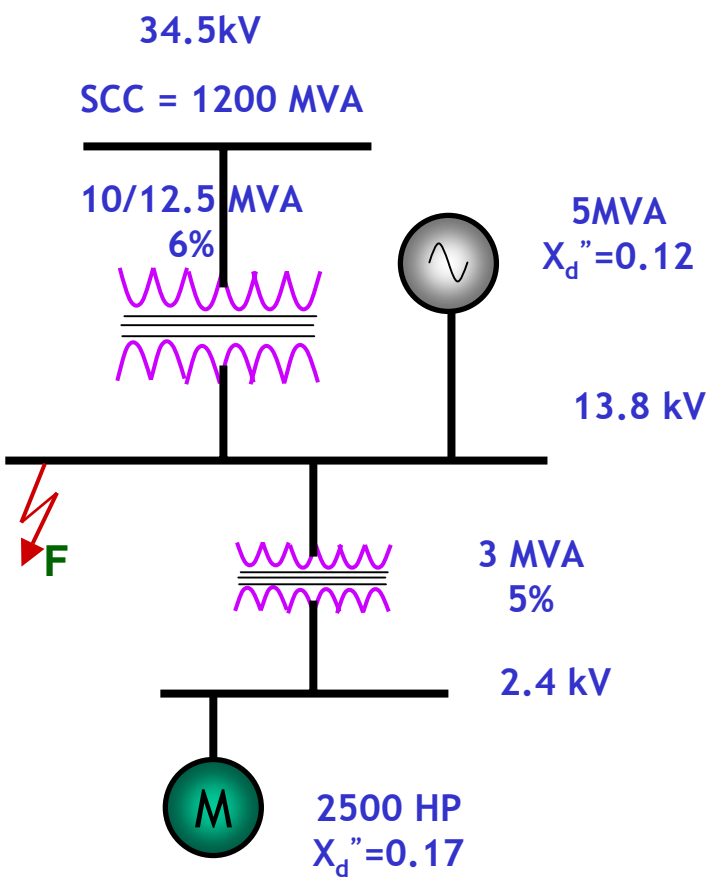
$$Z_{Tpu1} = Z_t x \frac{MVA_{base}}{MVA_{oldbase}}$$

$$= 0.06 x \frac{100}{12.5} = 0.48$$

Calculate the fault current at F

Example 3 -Presence of transformer & motor

Step 1: Calculate impedances



$$Z_{utility} = \frac{MVA_{base}}{MVA_{oldbase}} x \frac{kV_{oldbase}}{kV_{base}}$$

$$= \frac{100}{1200} x \frac{34.5}{34.5}$$

$$= 0.0833$$

$$Z_{Tpu1} = Z_t x \frac{MVA_{base}}{MVA_{oldbase}}$$

$$= 0.06 x \frac{100}{12.5} = 0.48$$

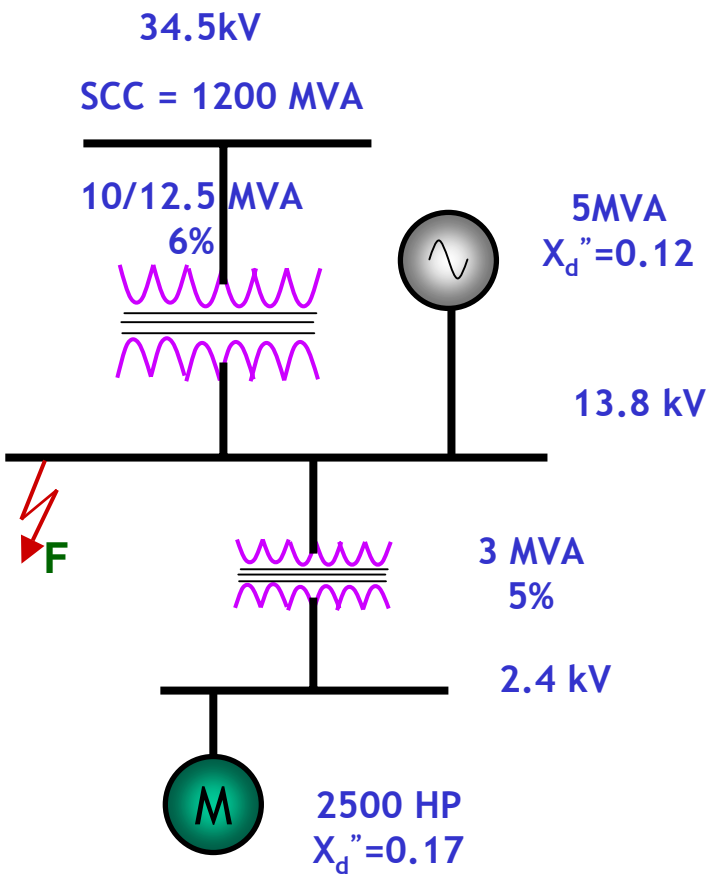
$$Z_{Gpu} = Z_G x \frac{MVA_{base}}{MVA_{oldbase}}$$

$$= 0.12 x \frac{100}{5} = 2.4$$

Calculate the fault current at F

Example 3 -Presence of transformer & motor

Step 1: Calculate impedances



$$Z_{utility} = 0.0833 \text{ pu}$$

$$Z_{Tpu1} = 0.48 \text{ pu}$$

$$Z_{Gpu} = 2.4 \text{ pu}$$

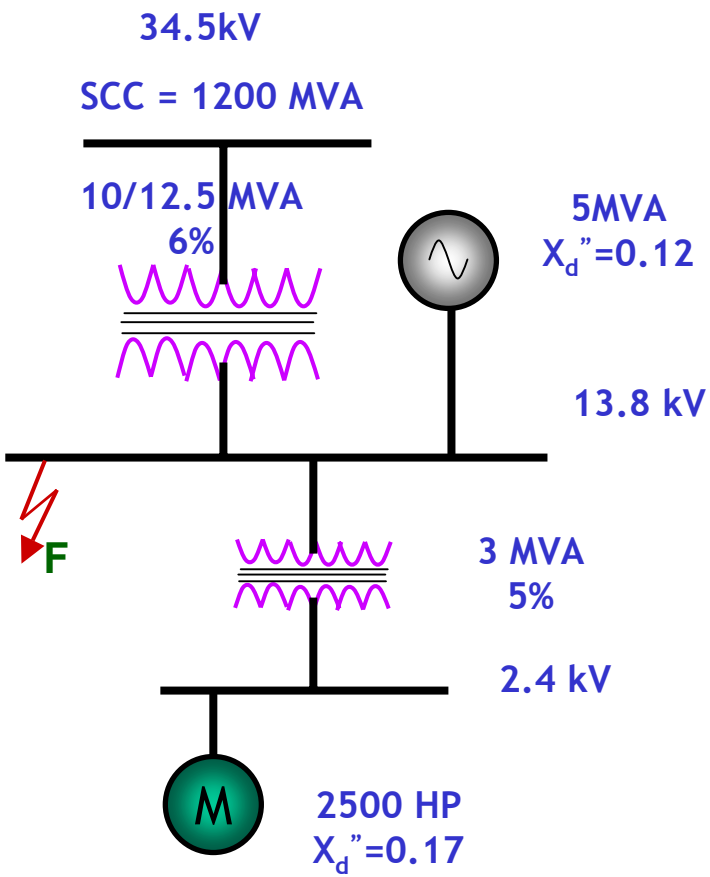
$$Z_{Tpu2} = Z_t \times \frac{MVA_{base}}{MVA_{oldbase}}$$

$$= 0.05 \times \frac{100}{3} = 1.667$$

Calculate the fault current at F

Example 3 -Presence of transformer & motor

Step 1: Calculate impedances



$$Z_{utility} = 0.0833 \text{ pu}$$

$$Z_{Tpu1} = 0.48 \text{ pu}$$

$$Z_{Gpu} = 2.4 \text{ pu}$$

$$Z_{Tpu2} = 1.667 \text{ pu}$$

$$\text{Motor rating} = \frac{2500 * 0.746}{pf}$$

$$= \frac{1865}{0.866} = 2154$$

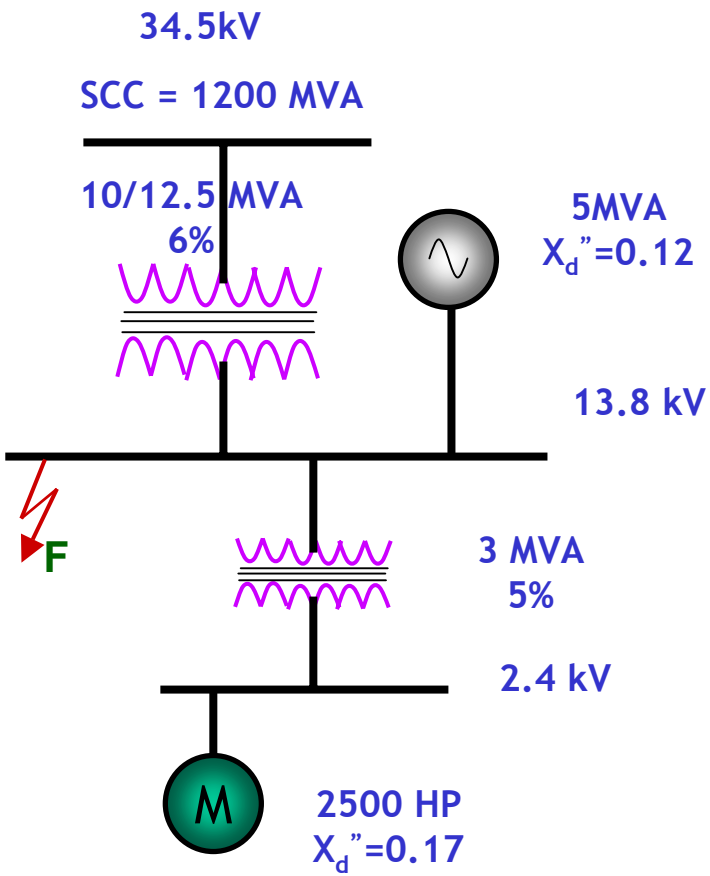
$$Z_{Mpu} = Z_m x \frac{MVA_{base}}{MVA_{oldbase}}$$

$$= 0.17 x \frac{100}{2.154} = 7.89$$

Calculate the fault current at F

Example 3 -Presence of transformer & motor

Step 1: Calculate impedances



$$Z_{utility} = 0.0833 \text{ pu}$$

$$Z_{Tpu1} = 0.48 \text{ pu}$$

$$Z_{Gpu} = 2.4 \text{ pu}$$

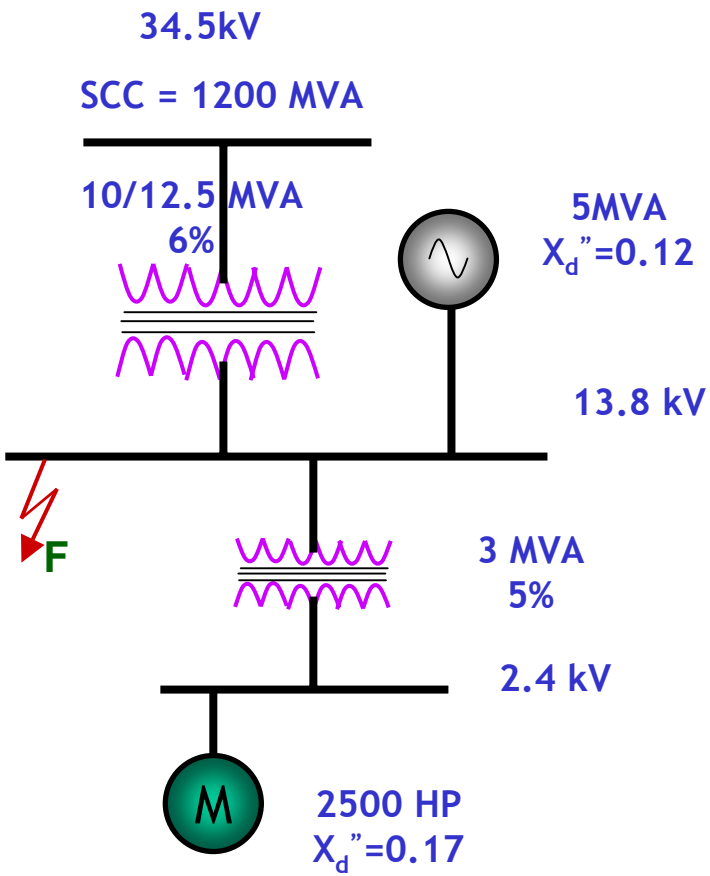
$$Z_{Tpu2} = 1.667 \text{ pu}$$

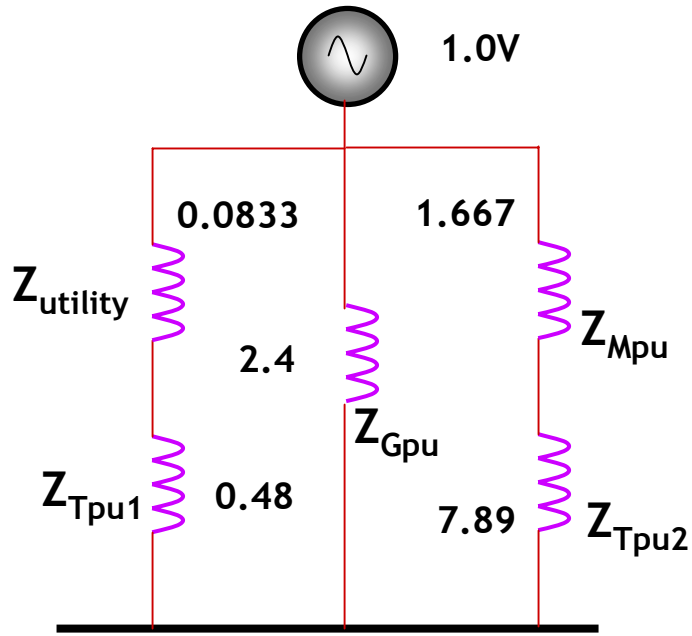
$$Z_{Mpu} = 7.89 \text{ pu}$$

Calculate the fault current at F

Example 3 -Presence of transformer & motor

Step 2: Calculate Equivalent impedances

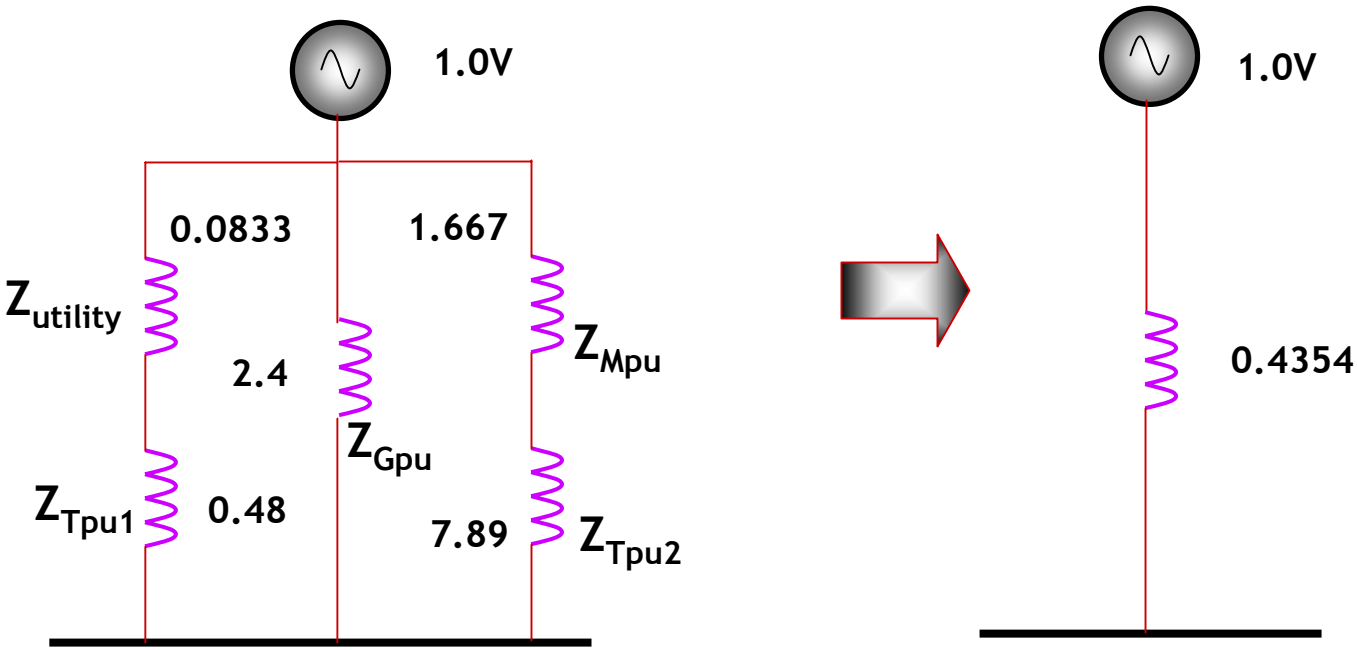




Calculate the fault current at F

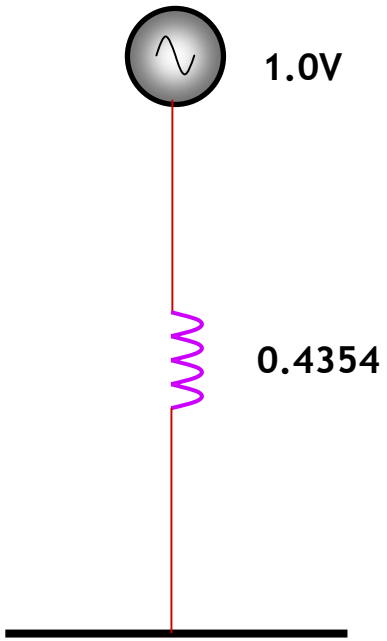
Example 3 -Presence of transformer & motor

Step 2: Calculate Equivalent impedances



Example 3 -Presence of transformer & motor

Step 3: Calculate fault current



$$I_{Fpu} = \frac{V_{pu}}{Z_{Eq}} = \frac{1.0}{0.4354} = 2.297 \text{ pu}$$

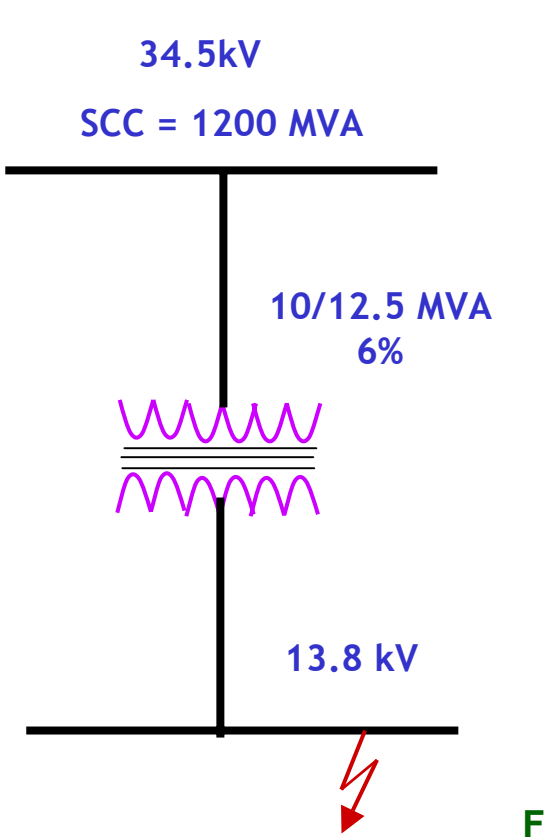
$$I_{FHV} = I_{Fpu} \times \frac{I_{base}}{\sqrt{3}}$$

$$= 2.297 \times \frac{2898.55}{\sqrt{3}} = 3844 \text{ A}$$

$$I_{FLV} = \frac{I_{FHV}}{13.8} \times 34.5$$

$$= 9609 \text{ A}$$

Symmetrical Fault



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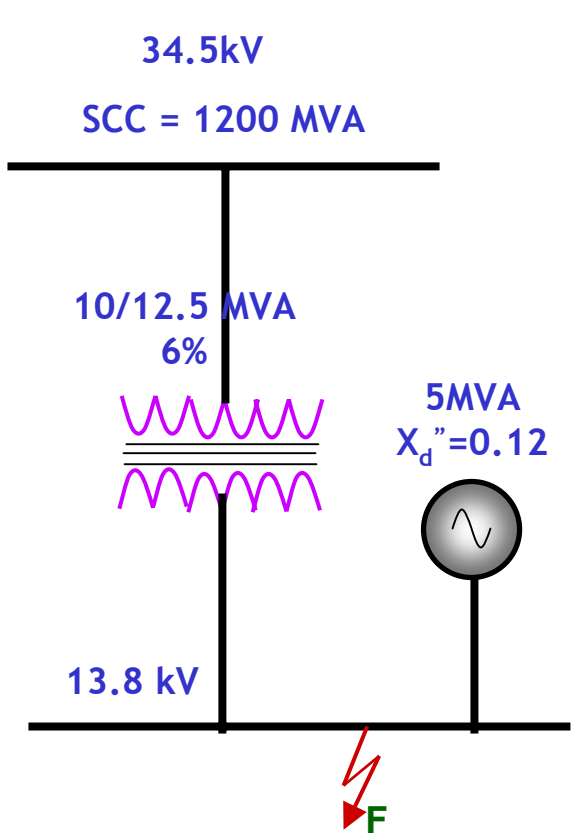
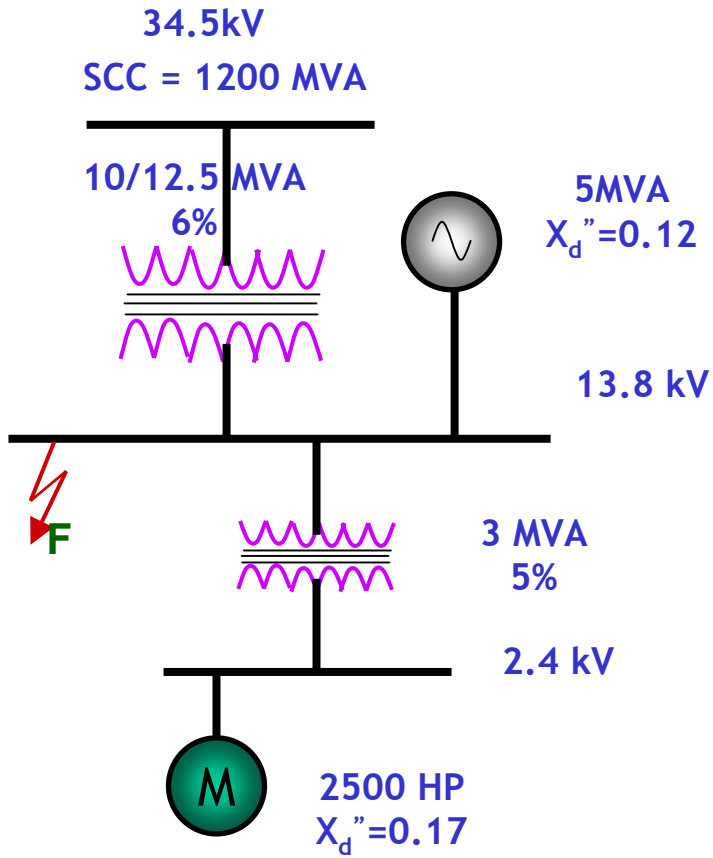


I_F =9170 Amps



I_F =9609 Amps