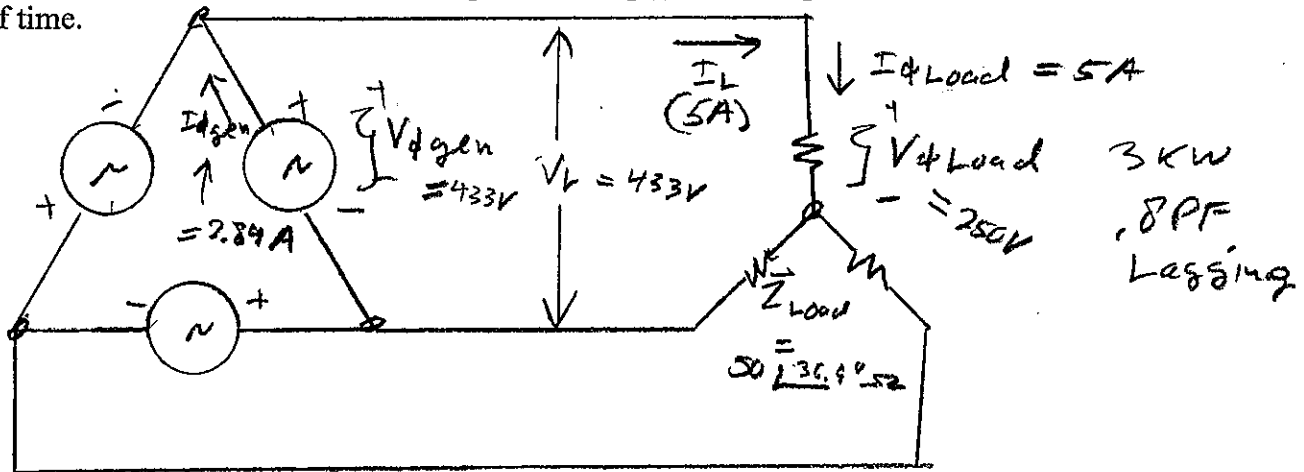


Solution

A three-phase, delta-connected generator is connected through power lines to a balanced Y-connected load. The net load consumes 3 kW at a power factor of 0.8 lagging. The line current is 5 A. Sketch the circuit, labeling it with values and unknowns. Find the phase voltage of the generator, the phase current of the generator, the line voltage, the power consumed in one phase of the load, the phase voltage of the load, the phase current of the load, and the complex impedance of one phase of the load. Relabel the sketch with these values. Write an expression for $p(t)$, the total power delivered to the load as a function of time.



$$\text{For } \Delta, I_L = \sqrt{3} I_{\phi} \rightarrow I_{\phi \text{ gen}} = \frac{I_L}{\sqrt{3}} = \frac{5}{\sqrt{3}} = \underline{\underline{2.89 \text{ A}}}$$

$$\text{For } Y, I_L = I_{\phi} \rightarrow I_{\phi \text{ Load}} = I_L = \underline{\underline{5 \text{ A}}}$$

$$P_T = \sqrt{3} V_L I_L \cos \theta \rightarrow V_L = \frac{P_T}{\sqrt{3} I_L \cos \theta} = \frac{3 \text{ kW}}{\sqrt{3} (5) (0.8)} = \underline{\underline{433 \text{ V}}}$$

$$\text{For } \Delta, V_L = V_{\phi} \rightarrow V_{\phi \text{ gen}} = V_L = \underline{\underline{433 \text{ V}}}$$

$$\text{For } Y, V_L = \sqrt{3} V_{\phi} \rightarrow V_{\phi \text{ load}} = V_L / \sqrt{3} = 433 / \sqrt{3} = \underline{\underline{250 \text{ V}}}$$

$$|Z| = \frac{V_{\phi L}}{I_{\phi L}} = \frac{250}{5} = \underline{\underline{50 \Omega}}$$

$$\cos \theta = 0.8 \rightarrow \theta = 36.9^\circ \text{ (positive, because of lagging PF)}$$

$$\underline{\underline{\vec{Z} = 50 \angle 36.9^\circ \Omega}}$$

$$P_{\phi} = P_T / 3 = 3 \text{ kW} / 3 = \underline{\underline{1 \text{ kW}}}$$

$$p(t) = P_T = \underline{\underline{3 \text{ kW}}} \text{ (for balanced three phase, the power consumed is constant.)}$$