Method 1: Calculating P, Q, and S Based on Sequence Components

1. Reconstruct Voltages and Currents The sequence components V_{seq} and I_{seq} (positive, negative, zero) are provided as real and imaginary parts. Combine them to reconstruct the complex phasors:

$$V_{seq} = V_{seq,\text{real}} + j \cdot V_{seq,\text{img}}$$
$$I_{seq} = I_{seq,\text{real}} + j \cdot I_{seq,\text{img}}$$

Where: - V_{seq}: Voltage sequence components (positive, negative, zero). - I_{seq}: Current sequence components (positive, negative, zero). - j: Imaginary unit $\sqrt{-1}$.

2. Calculate Total Complex Power (S) Using the sequence components, calculate the total complex power S:

$$S = 3 \cdot \left(V_{\text{pos}} \cdot I_{\text{pos}}^* + V_{\text{neg}} \cdot I_{\text{neg}}^* + V_{\text{zero}} \cdot I_{\text{zero}}^*\right)$$

Where: - $V_{\text{pos}}, V_{\text{neg}}, V_{\text{zero}}$: Voltages for the positive, negative, and zero sequences. - $I_{\text{pos}}, I_{\text{neg}}, I_{\text{zero}}$: Currents for the positive, negative, and zero sequences. - *: Denotes the complex conjugate.

3. Calculate Active and Reactive Power Calculate the active power (P) and reactive power (Q) directly using the sequence components:

- **Active Power (P):**

  $$P = 3 \cdot (|V_{\text{pos}}| \cdot |I_{\text{pos}}| \cdot \cos(\phi_{\text{pos}}) + |V_{\text{neg}}| \cdot |I_{\text{neg}}| \cdot \cos(\phi_{\text{neg}}) + |V_{\text{zero}}| \cdot |I_{\text{zero}}| \cdot \cos(\phi_{\text{zero}}))$$

- **Reactive Power (Q):**

  $$Q = 3 \cdot (|V_{\text{pos}}| \cdot |I_{\text{pos}}| \cdot \sin(\phi_{\text{pos}}) + |V_{\text{neg}}| \cdot |I_{\text{neg}}| \cdot \sin(\phi_{\text{neg}}) + |V_{\text{zero}}| \cdot |I_{\text{zero}}| \cdot \sin(\phi_{\text{zero}}))$$

Where: - $|V_{seq}|$: Magnitude of the voltage sequence components. - $|I_{seq}|$: Magnitude of the current sequence components. - ϕ_{seq}: Phase angle difference between the voltage and current sequence components.

4. Calculate Apparent Power (S) The apparent power is the magnitude of the complex power:

$$S = \sqrt{P^2 + Q^2}$$

Method 2: Calculating P, Q, and S Based on Voltage Current of Each Phase

1. Formulas For an unbalanced three-phase power system, the active power (P), reactive power (Q), and apparent power (S) for each phase are calculated as follows:

- **Active Power (P_ϕ) for each phase:**

$$P_\phi = V_{LN,\phi} \cdot I_\phi \cdot \cos(\phi_\phi)$$

- **Reactive Power (Q_ϕ) for each phase:**

$$Q_\phi = V_{LN,\phi} \cdot I_\phi \cdot \sin(\phi_\phi)$$

- **Apparent Power (S_ϕ) for each phase:**

$$S_\phi = \sqrt{(P_\phi)^2 + (Q_\phi)^2}$$

Where: - $V_{LN,\phi}$: Line-to-neutral voltage for phase ϕ ($\phi = A, B, C$). - I_ϕ: Current magnitude for phase ϕ. - ϕ_ϕ: Phase angle difference between voltage and current for phase ϕ.

2. Total Power for the System The total active, reactive, and apparent power for the system are the sum of the respective quantities for all three phases:

- **Total Active Power (P):**

$$P = P_A + P_B + P_C$$

- **Total Reactive Power (Q):**

$$Q = Q_A + Q_B + Q_C$$

- **Total Apparent Power (S):**

$$S = \sqrt{P^2 + Q^2}$$