3 phase transformer connections

1. YY → primary, secondary each Y connected

A B C
N₁ : N₂

might have \( R_p \) and \( Z_p = 0 \)
\[
\frac{V_{AN}}{N_1} = \frac{V_{An}}{N_2} \quad \frac{V_{AN}}{V_{AN}} = \frac{N_1}{N_2} \quad \frac{I_A}{I_a} = \frac{N_2}{N_1}
\]
Per phase equivalent circuit

\[ \vec{I}_A \]

\[ \vec{V}_{AN} \]

\[ \vec{S}_1 = \vec{V}_{AN} \vec{I}_A^* \quad \text{refer V & I to secondary winding} \]

\[ \vec{S}_2 = \vec{V}_{AN} \vec{I}_a^* \]

\[ \vec{S}_1 = \vec{V}_{AN} \left( \frac{N_2}{N_1} \right) \vec{I}_A^* \left( \frac{N_1}{N_2} \right) \]

If \( R_1, x_1, e_2, x_2, e_c, x_m = 0 \)

\[ \vec{S}_1 = \vec{S}_2 \]
- will have voltage drops across series ten branches
- P, Q absorbed

30 complex power
- balanced voltages and loading

\[
S_{3\phi_1} = V_{AN} I_A^* + V_{BN} I_B^* + V_{CN} I_C^*
\]

\[
\alpha = 1 \angle 120^\circ
\]

\[
\begin{align*}
\alpha^2 V_{AN} & \rightarrow (\alpha^2 I_A)^* \\
\end{align*}
\]

\[\alpha^2 (\alpha^2)^* = 1\]

rotate by -120°
(\theta + 240°)
$S_{301} = 3 \frac{V_{An} \cdot I_A^*}{\sqrt{3}}$

Apparent Power

$|S_{301}| = 3 |V_{An}| |I_A| = \sqrt{3} |V_{An}| |I_A|$}

$|S_{301}| = 3 |V_{An}| |I_A| = \sqrt{3} |V_{An}| |I_A|$

Nameplate data for 3Ø & transformer

$V_{LL} = V_{An}$, impedance in per unit, sec. to voltage transformation ratio
\[ Y-Y \rightarrow \text{I}_{\text{rated}_1} = \frac{|530|}{\sqrt{3} |V_{LL}|} \]

\[ \text{I}_{\text{rated}_2} = \frac{|530|}{\sqrt{3} |V_{LL}|} \]

**Impedances**: Referring impedance from primary to secondary (or vice versa)
Refer $R_1$ to secondary secondary

$V_{R1} = R_1 I_1 = \phi_1$

$\frac{R_1'}{I_1} = \frac{V_{R1} \left( \frac{N_2}{N_1} \right)}{I_1} = \frac{V_{R1}}{I_1} \left( \frac{N_2}{N_1} \right)^2 = R_1 \left( \frac{N_2}{N_1} \right)^2$
Primary is $\Delta$, Secondary $\gamma$.
- ANSI/IEEE Standard:

V_{LN} on HV side
Leads V_{LN} on LV side by 30°

Y: DAB Connection

1 | If Y is HV side

\[ |V_{an}| = \frac{1}{\sqrt{3}} |V_{an}| \frac{N_2}{N_1} \]

Y: Dac. C
\[ \Delta \text{ is HV side} \]