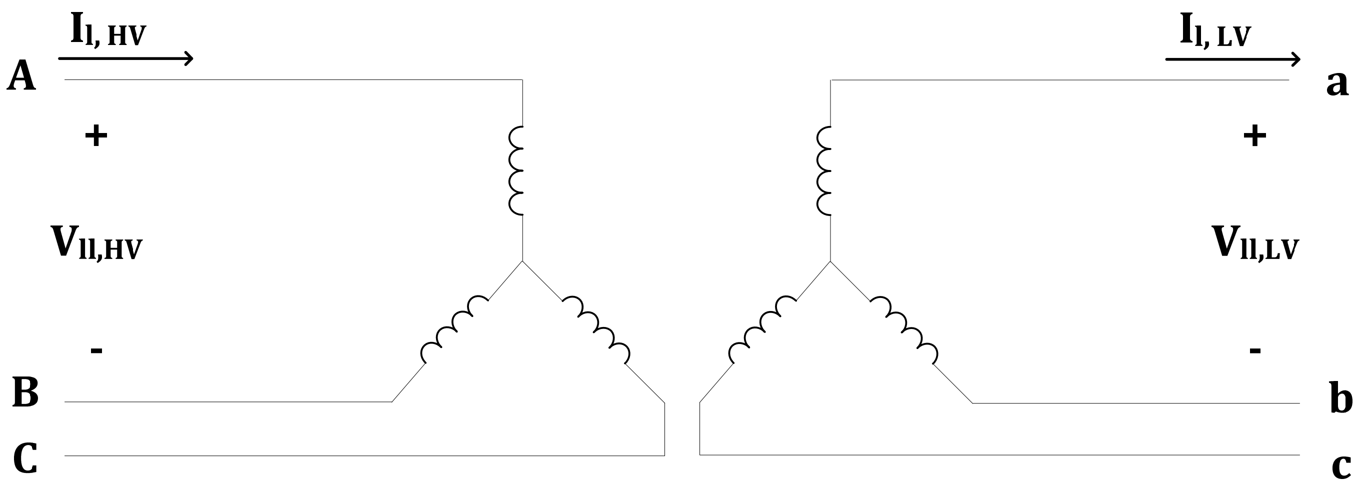
ENEL 487

Voltage and current relationships for three phase transformers

Relationships between line-to-line voltage on either side of the transformer and line current on either side of the transformer are dependent on the winding connection type.

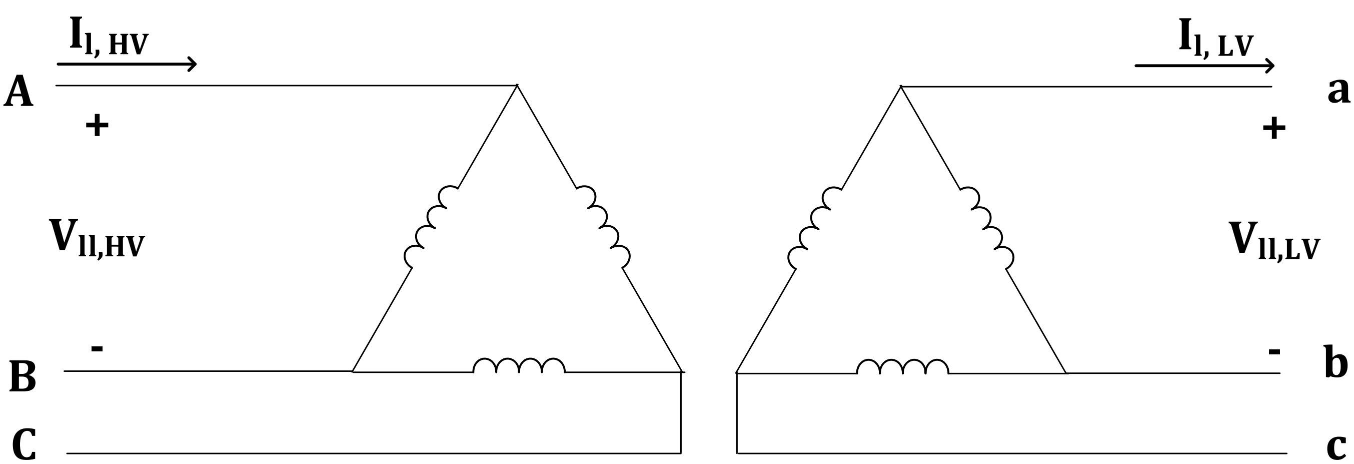
1) Y-Y connection



Magnetic coupling between the two winding gives: $\frac{\overline{V}_{\emptyset,HV}}{\overline{V}_{\emptyset,LV}} = \frac{N_1}{N_2}$ & $\frac{\overline{I}_{\emptyset,HV}}{\overline{I}_{\emptyset,LV}} = \frac{N_2}{N_1}$

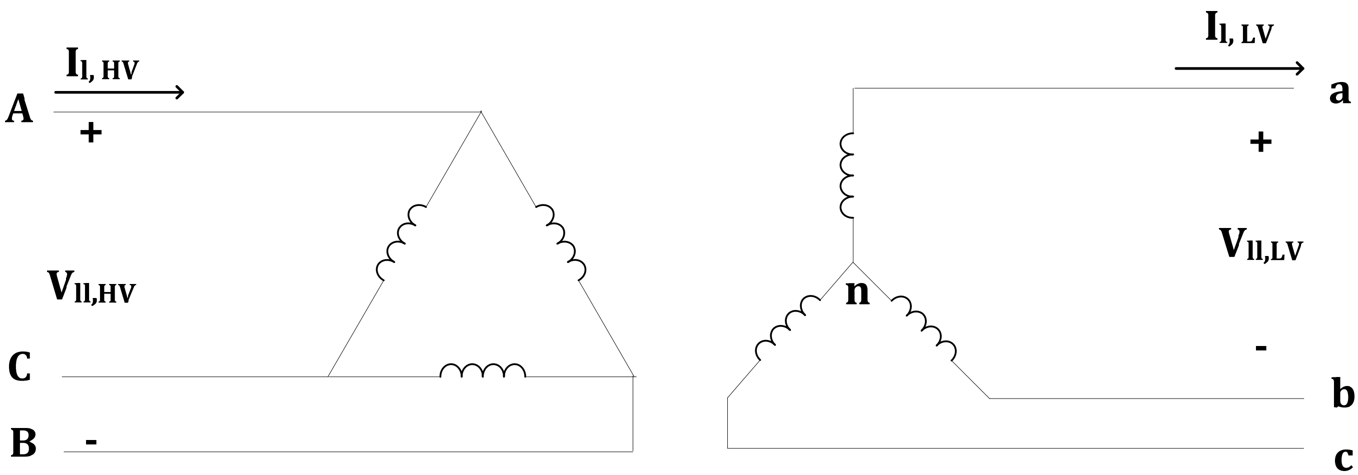
Also know that, in both sides, $\overline{V}_{ll} = \sqrt{3}\angle 30°.\overline{V}_{ln}$ therefore, $\frac{\overline{V}_{ll,HV}}{\overline{V}_{ll,LV}} = \frac{N_1}{N_2}$

2) Δ-Δ connection



Similar to Y-Y, $\frac{\overline{V}_{ll,HV}}{\overline{V}_{ll,LV}} = \frac{N_1}{N_2}$ & $\frac{\overline{I}_{l,HV}}{\overline{I}_{l,LV}} = \frac{N_2}{N_1}$

3) Δ-Y Connection



Magnetic coupling between the two winding gives: $\frac{\bar{V}_{\emptyset,HV}}{\bar{V}_{\emptyset,LV}} = \frac{N_1}{N_2}$ & $\frac{\bar{I}_{\emptyset,HV}}{\bar{I}_{\emptyset,LV}} = \frac{N_2}{N_1}$

Also, from Δ and Y connection properties: $\bar{V}_{ll,LV} = \sqrt{3}\angle 30°.\bar{V}_{\emptyset,LV}$ & $\bar{V}_{ll,HV} = \bar{V}_{\emptyset,HV}$

Therefore, $\frac{\bar{V}_{ll,HV}}{\bar{V}_{ll,LV}} = \frac{\bar{V}_{\emptyset,HV}}{\sqrt{3}\angle 30°.\bar{V}_{\emptyset,LV}} = \frac{N_1}{N_2.\sqrt{3}}.\angle -30°$

- The ratio of line-to-line voltage magnitudes is $\frac{N_1}{N_2.\sqrt{3}}$
- Line-to-line voltage on the Δ side lags line-to-line voltage on the Y side by 30^{o}

Similarly, $\frac{\bar{I}_{l,HV}}{\bar{I}_{l,LV}} = \frac{N_2.\sqrt{3}}{N_1}\angle -30°$

4) Y-Δ Connection

We can show that:

$$\frac{\bar{V}_{ll,HV}}{\bar{V}_{ll,LV}} = \frac{\sqrt{3}.N_1}{N_2}.\angle 30°$$

$$\frac{\bar{I}_{l,HV}}{\bar{I}_{l,LV}} = \frac{N_{2.}}{\sqrt{3}.N_1}\angle 30°$$