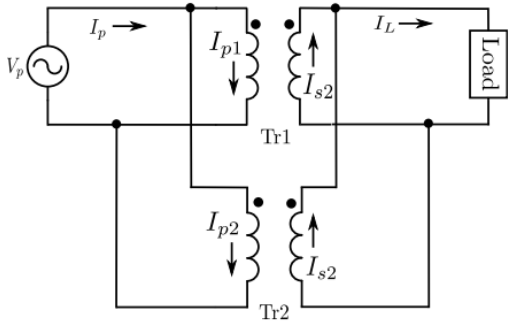
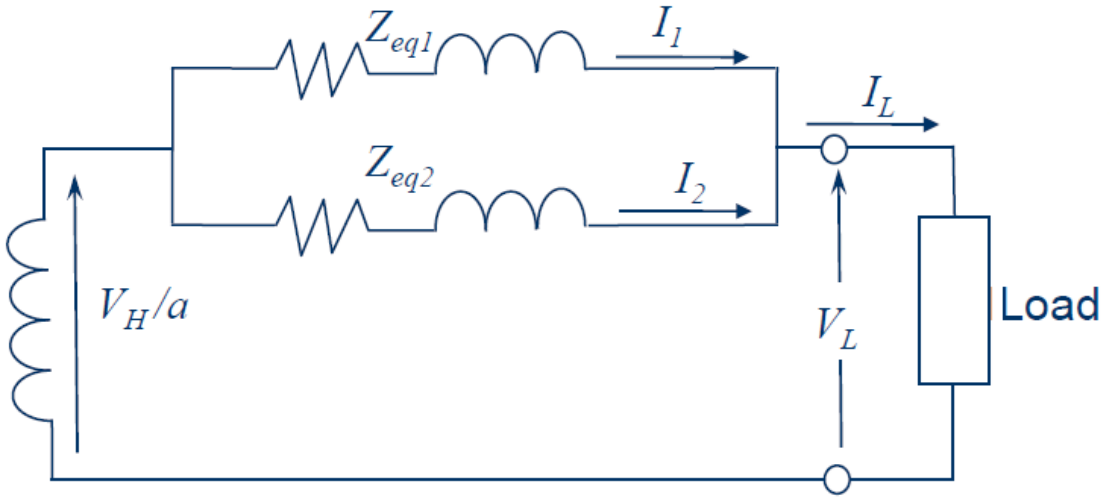
Transformers – Parallel Operation

Adding a transformer in parallel to an existing transformer is often preferred over upsizing existing transformer.
Following specifications must be identical:
Primary/secondary voltage ratings.
Secondary winding polarity (dot convention): Incorrect connections can create a short circuit.
Turns ratio: Difference can result in unequal loading.
Per-unit leakage impedance: Difference can result in unequal loading + power factor difference.
Phase sequence (abc or acb): Risk of short circuit.
Secondary line voltages of parallel transformers shall have zero phase displacement between them.



Equivalent circuit referred to secondary side.
Voltage drop must be equal through each transformer winding.



$$I_1 Z_{eq,1} = I_2 Z_{eq,2} \rightarrow \frac{I_1}{I_2} = \frac{Z_{eq,2}}{Z_{eq,1}}$$

$$Z_{pu,1} = \frac{Z_{eq,1}}{Z_{base,1}} = \frac{Z_{eq,1}}{V^2/S_{base,1}} \rightarrow Z_{eq,1} = Z_{pu,1} \times \frac{V^2}{S_{base,1}}$$

$$Z_{pu,2} = \frac{Z_{eq,2}}{Z_{base,2}} = \frac{Z_{eq,2}}{V^2/S_{base,2}} \rightarrow Z_{eq,2} = Z_{pu,2} \times \frac{V^2}{S_{base,2}}$$

$$\frac{I_1}{I_2} = \frac{Z_{pu,2} \times \frac{V^2}{S_{kVA,2}}}{Z_{pu,1} \times \frac{V^2}{S_{kVA,1}}} = \frac{Z_{pu,2} \times S_{kVA,1}}{Z_{pu,1} \times S_{kVA,2}} \qquad \frac{S_{load1}}{S_{load2}} = \frac{Z_{pu,2} \times S_{kVA,1}}{Z_{pu,1} \times S_{kVA,2}}$$