# SYSTEM IMPEDANCES FOR FAULT CALCULATIONS

- **Transmission Lines**
- **Simplified Synchronous Generator Representation**
- **Transformer Representation**

# Transmission Lines

- Assuming perfectly transposed lines, positive and negative sequence impedances are the same.
- The zero-sequence impedance that involves ground return is greater in value and it can be calculated using a line-constants program such as EMTDC.

# Simplified Synchronous Generator Representation

- Positive sequence reactance: $X_d^{"}$
- Negative sequence: $X_2 = \frac{X_d^{"} + X_q^{"}}{2}$
- Zero-sequence Reactance
- The positive-sequence network: the sub-transient reactance and a voltage source behind it, such that, together they yield the pre-fault voltages and currents in the network

# Transformers for Fault Studies

- Positive and Negative-Sequence Reactances
- Zero-Sequence Reactance

# Path for Zero-Sequence Currents

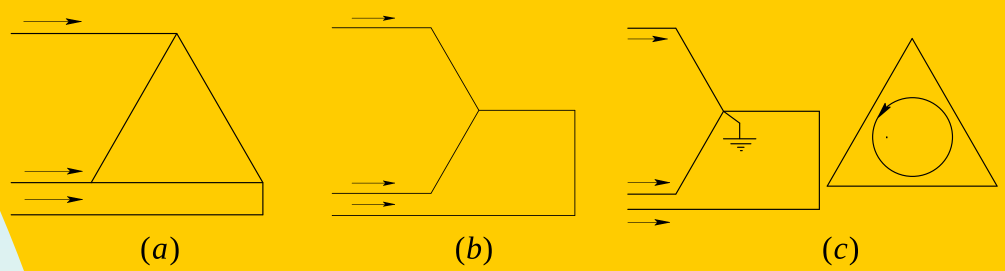


Fig. 13-8 Path for zero-sequence currents in transformers.

# Neutral Grounded through an Neutral Impedance)

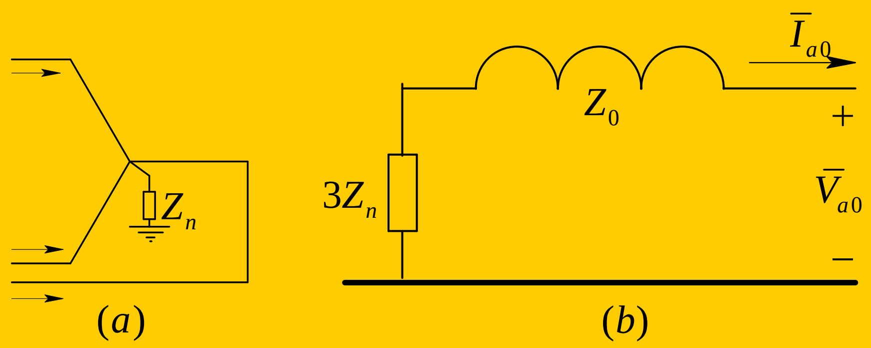


Fig. 13-9 Neutral grounded through an impedance.

# One-Line Diagram of a Simple System)

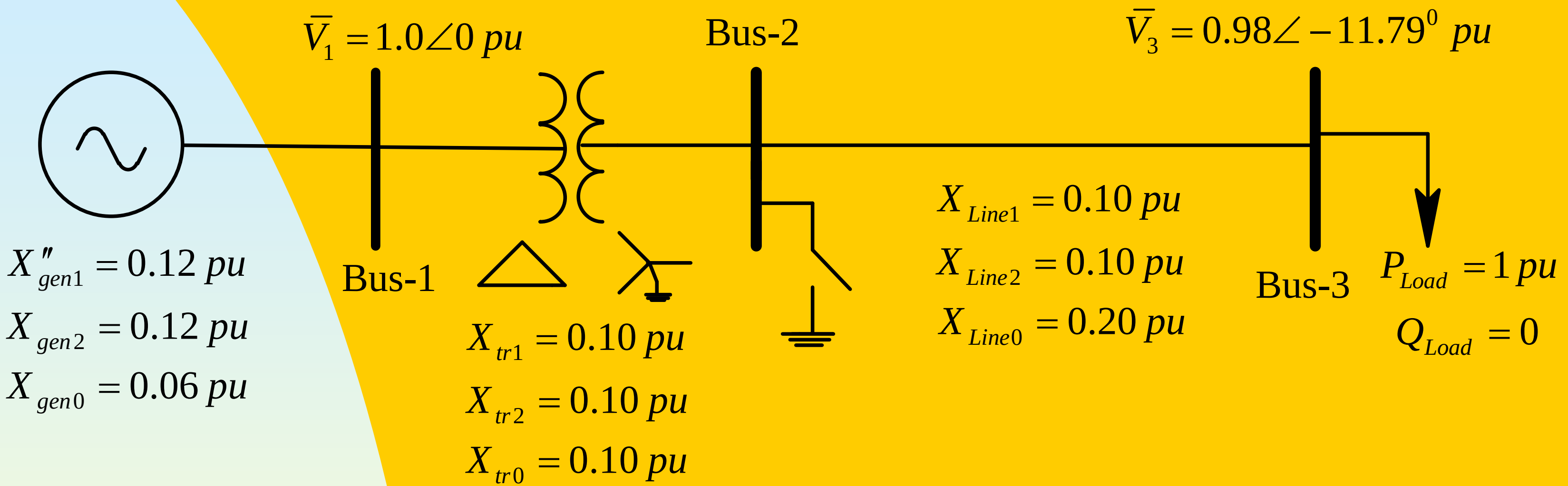


Fig. 13-10 (a) One-line diagram of a simple power system and bus voltages.

# An SLG Fault in the Example 3-Bus System

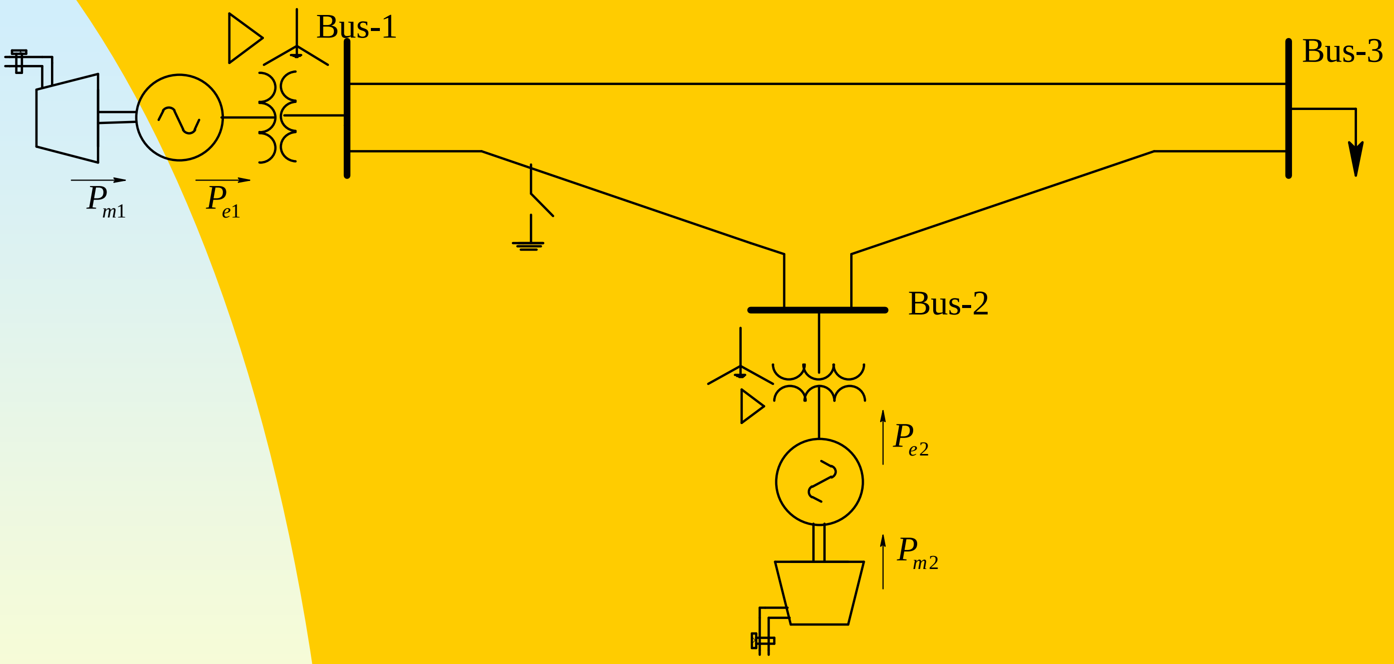


Fig. 13-13 A SLG fault in the example 3-bus power system.

# CALCULATION OF FAULT CURRENTS IN LARGE NETWORKS

$$\bar{I}_{pos} = Y_{pos}\bar{V}_{pos}$$

$$\bar{V}_{pos} = Z_{pos}\bar{I}_{pos}$$

$$Z_{pos}(= Y_{pos}^{-1})$$

# Summary

TRANSMISSION LINE FAULTS

- CAUSES OF TRANSMISSION LINE FAULTS
- SYMMETRICAL COMPONENTS FOR FAULT ANALYSIS
- TYPES OF FAULTS
- SYSTEM IMPEDANCES FOR FAULT CALCULATIONS
- CALCULATION OF FAULT CURRENTS IN LARGE NETWORKS