

SAARC Training Workshop 'Power System Studies for Synchronization of Multiple Systems'

Introduction to Power System

Day-1-C

Kabul, Afghanistan

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SAARC Energy Centre, Islamabad
www.saarcenergy.org

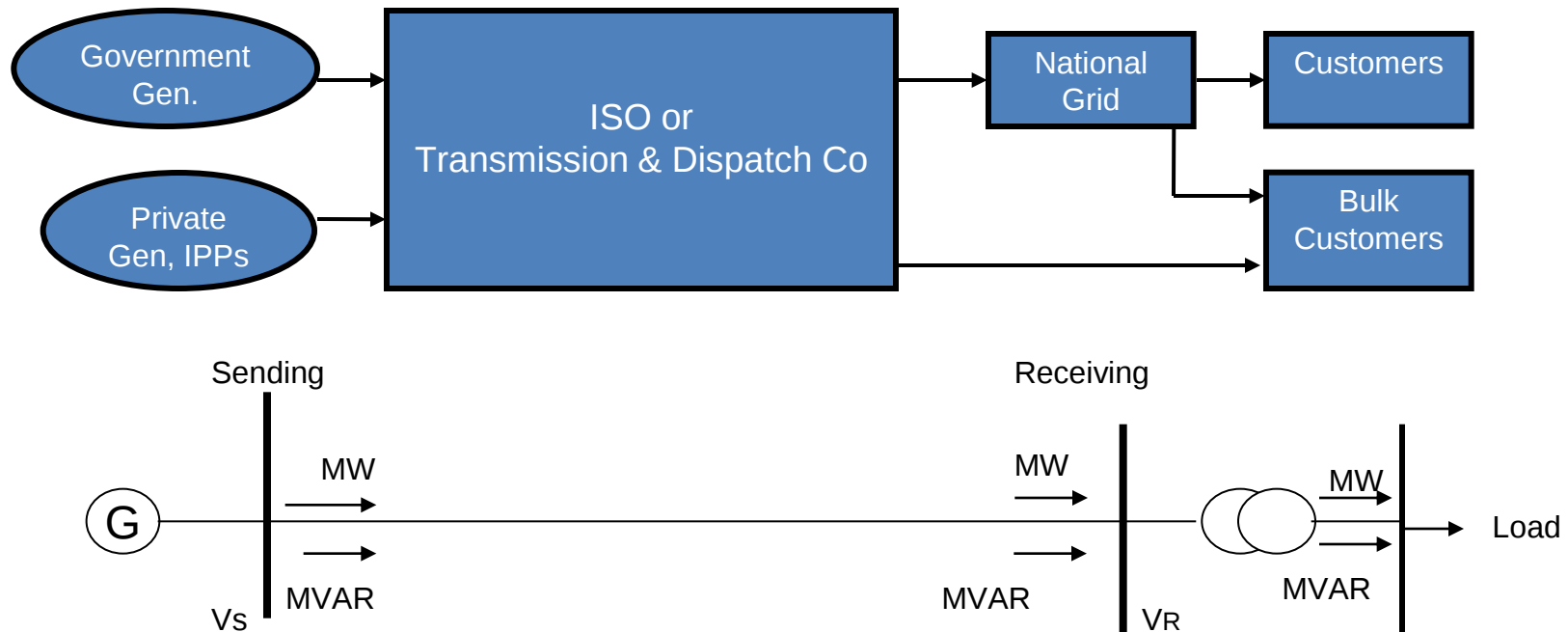


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What is Required of a Power System Analyst ?

- Background of Power System Engineering
- Know-how of analytical software tool (e.g. PSS/E)
- Knowledge of power system under study
- Knowledge of the problem under study

What is a Modern Power System?

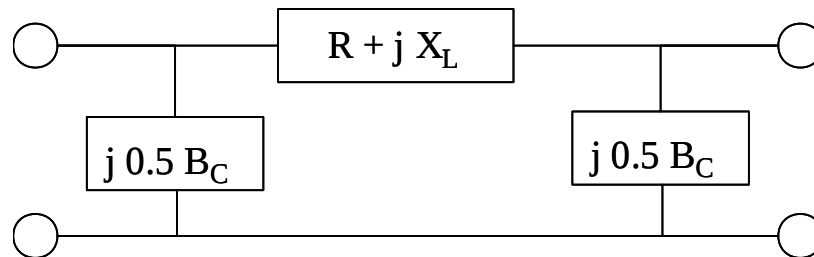


- Generator with Step-Up Transformer
- Transmission Line
- Step Down Transformer
- Load

Equivalent Circuits Overhead Line and Cable Model

- **Model used**

- A simple 'PI' (π) Model :



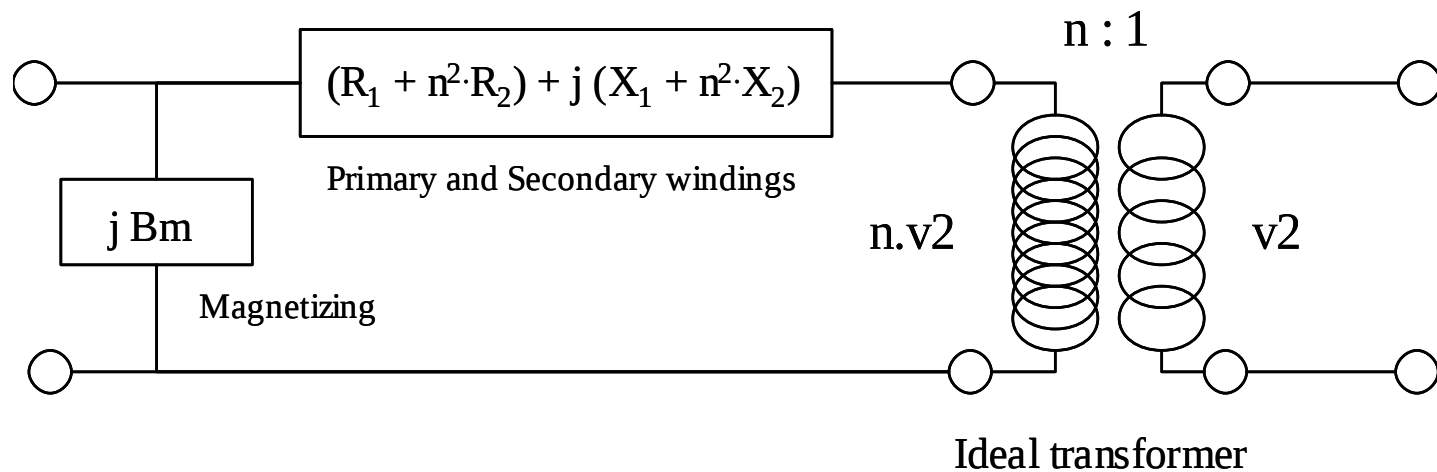
- Represent L by the inductive reactance X_L ($2.\pi.f.L$)
- Represent C by the capacitive admittance B_C ($2.\pi.f.C$), half at each end (positive because this is the admittance, not the impedance)

- **Distributed parameters**

- In reality R , L and C are distributed along the length of the conductor
- For very long lines the model above is not accurate enough

Equivalent Circuits Transformer Model

- These fundamental properties allow the construction of an equivalent electrical circuit for the transformer that we use in the network modelling:

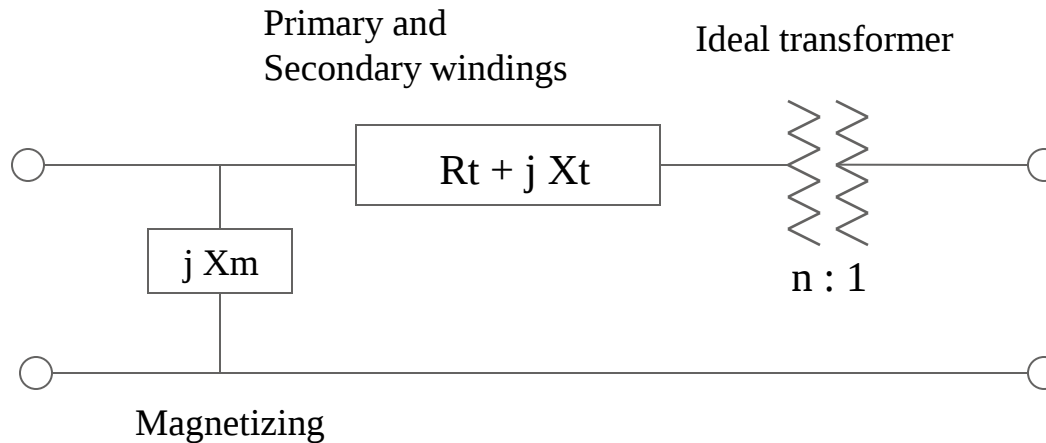


- The secondary impedances are 'referred' to their equivalent values on the primary side (for a voltage ratio of 'n' the impedances are increased by n^2)
- The magnetizing branch is moved to the transformer terminals (often ignored as it only draws a small current)

Equivalent Circuits

Transformer Model (cont.)

- This equivalent model has the same structure as the overhead line or cable model and allows for an ideal transformer connection at one of the terminals to model the transformer tap changer

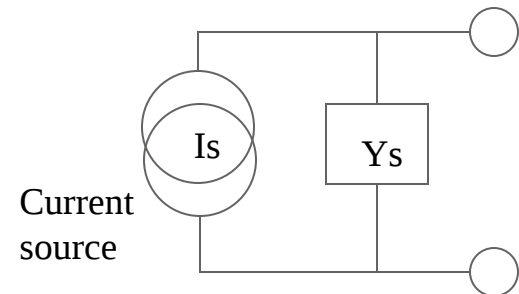
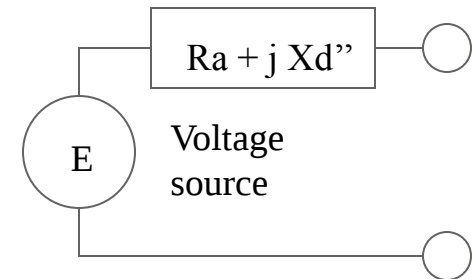


- Voltages will be multiplied by 'n', and currents divided by 'n' when passing through the ideal transformer element

Equivalent Circuits

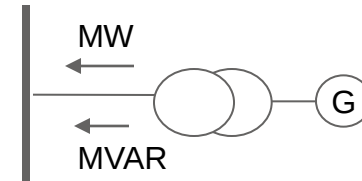
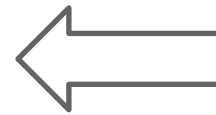
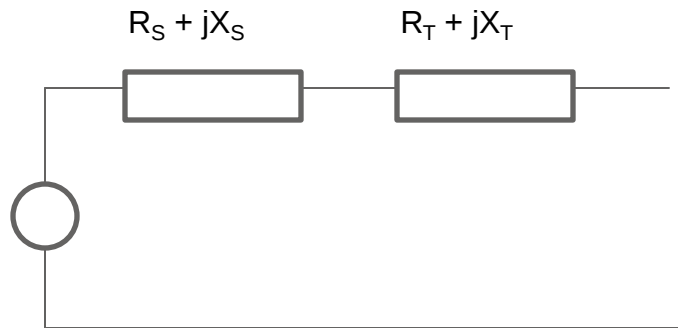
Generator Model

- Have significant resistance (R), and inductive reactance (X_L)
- Capacitance (C) is ignored.
- Network voltage sources
- Provide real and reactive power
- We model them as a voltage source behind their resistance and reactance
- For simplicity analysing the network we convert this to an equivalent current source and shunt admittance

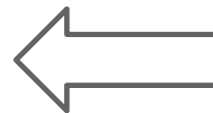
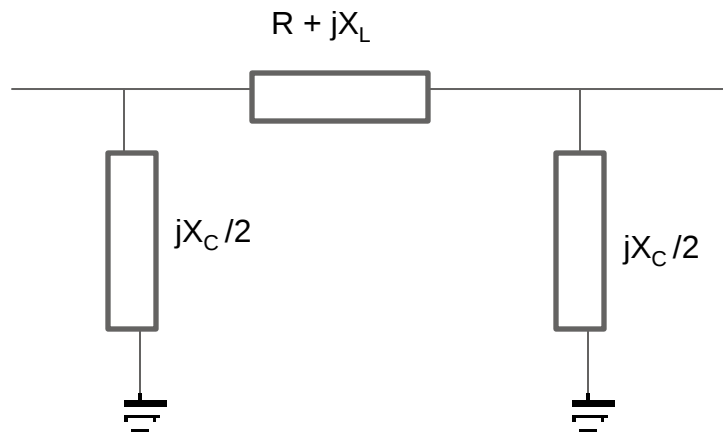


Basic Components of Power System

Generator Equivalent Circuit

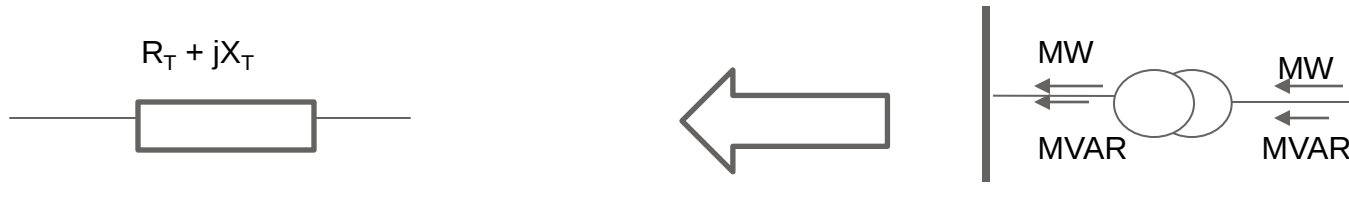


Transmission Line Equivalent Circuit

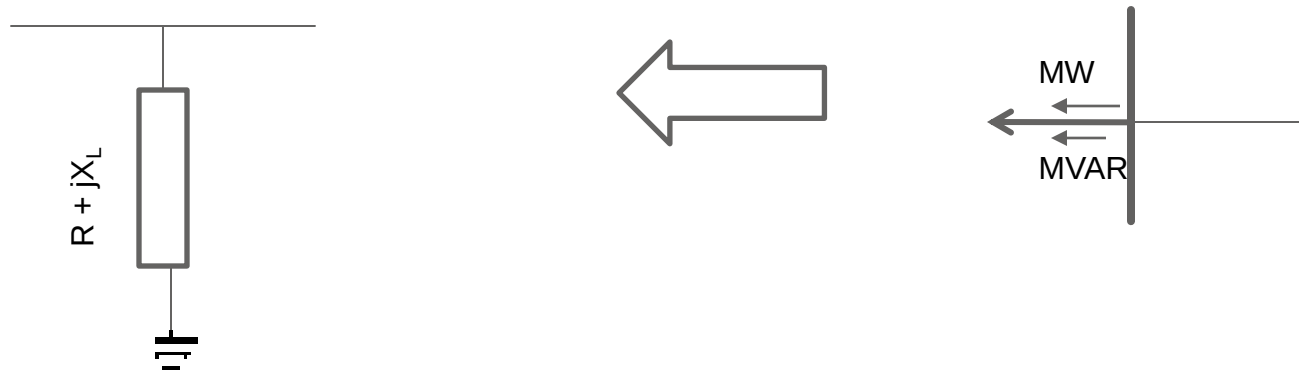


Basic Components of Power System

Transformer Equivalent Circuit



Load Equivalent Circuit



Equivalent Model of a Simple Power System

