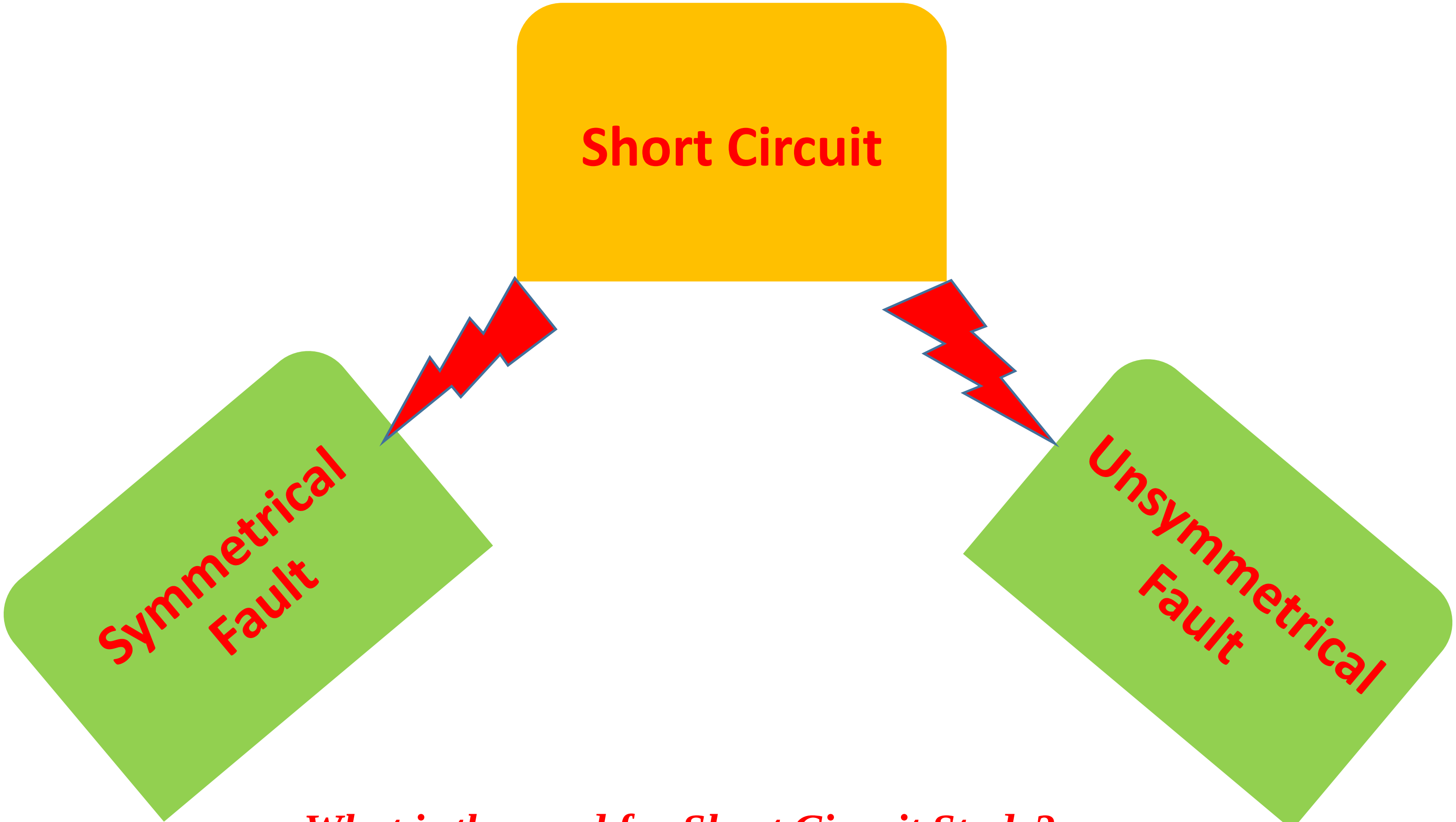
Lecture 6: Short Circuit Analysis-----Symmetrical Fault



What is the need for Short Circuit Study?

Introduction

The cause of electric power system faults is insulation breakdown

❑This breakdown can be due to a variety of different factors

- ✓wind blowing together in the wind
- ✓animals or plants coming in contact with the wires
- ✓pollution on insulators
- ✓Lightning

Classifications:

Shunt Faults:

- ➢ Three phase faults
- ➢ Line to ground fault
- ➢ Line to line fault
- ➢ Double line to ground fault

….Cont'd

- ***Shunt fault is characterized by minimum voltage and maximum current*.**

Series Faults

  - ✓Open conductor fault
  - ✓Two open conductor fault.

- ***Series fault is characterized by maximum voltage and minimum current.***

Bolted fault or solid fault

- A fault represents a structural network change equivalent with that caused by the addition of impedance at the place of fault. If the fault impedance is zero, then the fault is referred as bolted fault or solid fault.

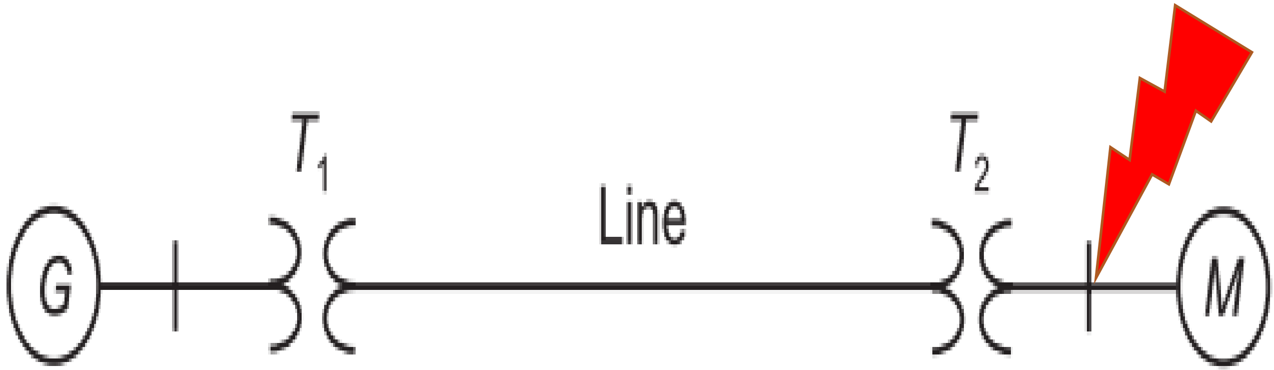
Fault Calculation

Assumptions to be made to simplify the short circuit study:

- ✓ Representing each machine by constant voltage source behind proper reactance.
- ✓ Pre-fault load currents are neglected
- ✓ Transformer taps are assumed to be nominal.
- ✓ Shunt elements in the transformer model that accounting for magnetizing current and core losses are neglected.
- ✓ Shunt capacitance of the transmission line is ignored.
- ✓ Series resistance of transmission lines is neglected.

Examples

1. A synchronous generator and a synchronous motor each rated 20MVA, 12.66kV, 15% sub transient reactance are connected through transformers and a line as shown in Figure 1. The transformers are rated 20MVA, 12.66/66kV and 66/12.66kV with leakage reactance of 10% each. The line has reactance of 8% on a base of 20MVA, 66kV. The motor is drawing 10MW at 0.8 leading power factor and a terminal voltage 11kV when a symmetrical three-phase fault at the motor terminals. Determine the generator, motor and fault current?



Single line diagram

Example 2

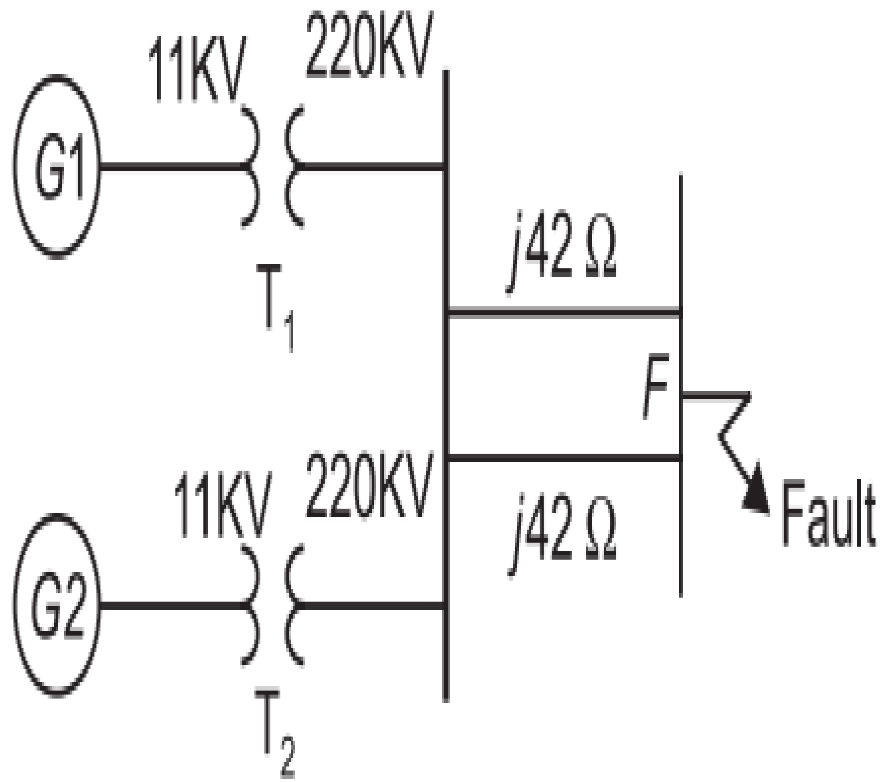
2. A generating station is feeding a 220kV system as shown in Fig. below. Determine the total fault current, fault level and fault current supplied by each generator for a three phase fault at the receiving end of the line?

$G1$: 11 KV, 100 MVA, $x'_{g1} = j0.15$

$G2$: 11 KV, 75 MVA, $x'_{g2} = j0.125$

$T1$: 100 MVA, $x_{T1} = j0.10$, 11/220 KV

$T2$: 75 MVA, $x_{T2} = j0.08$, 11/220 KV

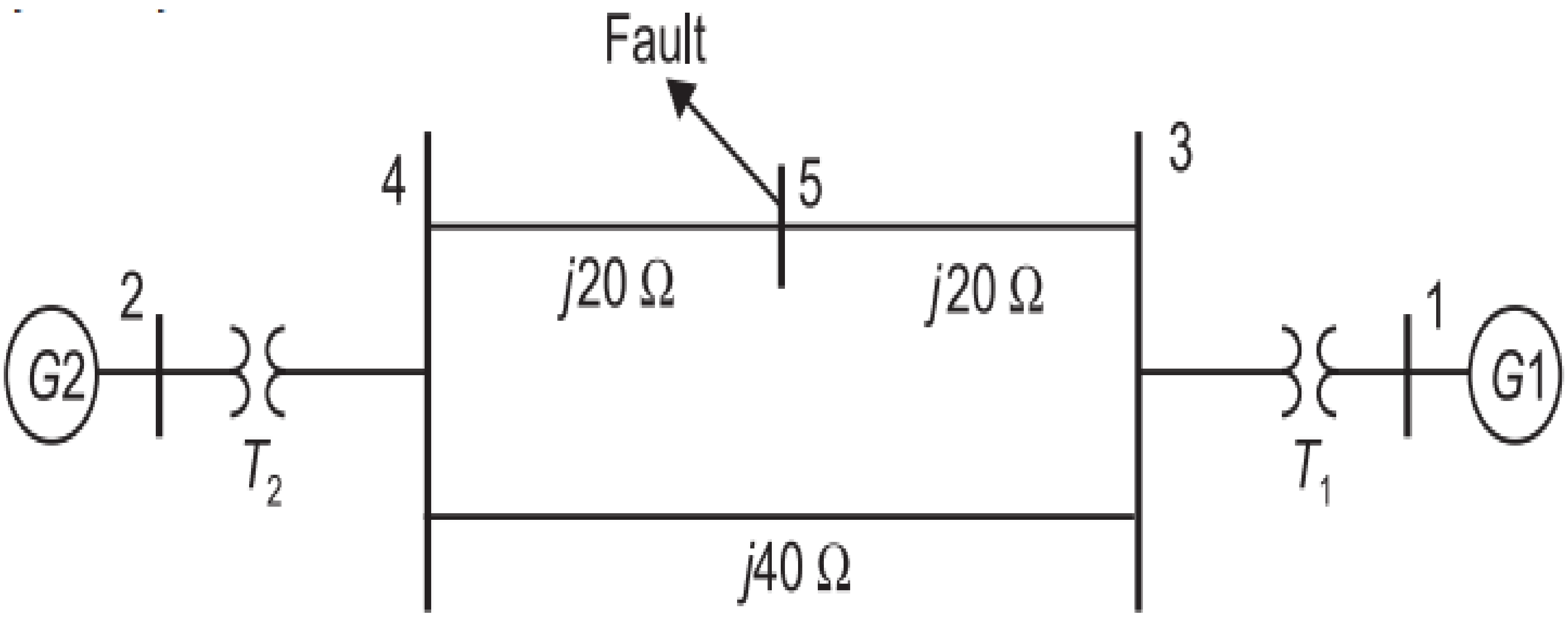


Home Work

1. As shown in the Fig each of the generators G1 and G2 is rated at 125MVA, 11kV and has a sub-transient reactance of 0.21p.u. each of the transformers is rated at 125MVA, 11/132kV and has leakage reactance of 0.06p.u. Find

a) Fault MVA

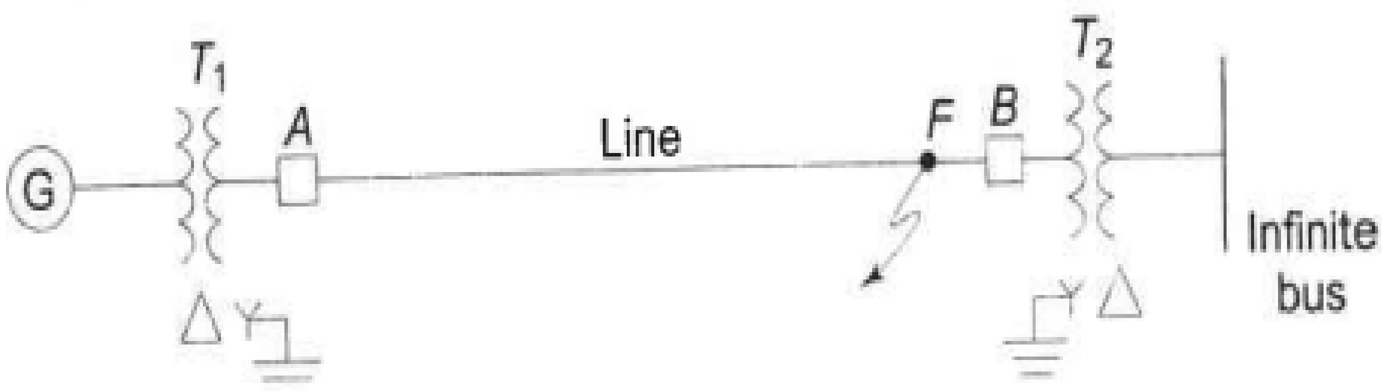
b) Fault current at fault point



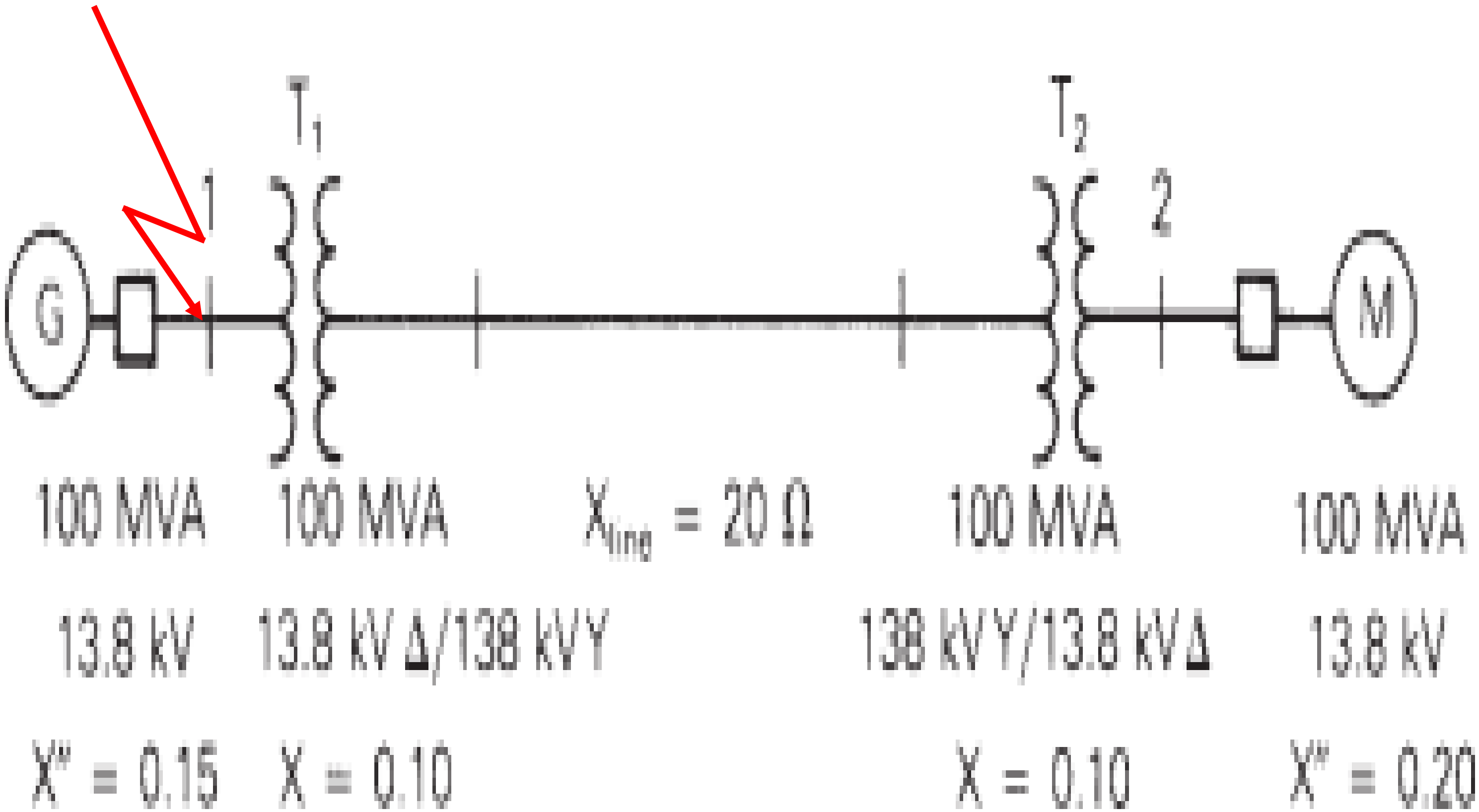
2\. The system shown in Fig. P-9.8 is delivering 50 MVA at 11 kV, 0.8 lagging power factor into a bus which may be regarded as infinite. Particulars of various system components are:

Generator:	60 MVA, 12 kV, $X_d' = 0.35$ pu
Transformers (each):	80 MVA, 12/66 kV, $X = 0.08$ pu
Line:	Reactance 12 ohms, resistanc: negligible.

Calculate the symmetrical current that the circuit breakers A and B will be called upon to interrupt in the event of a three-phase fault occurring at F near the circuit breaker B.



3. Calculate the fault current at the point of the fault point using super position theorem.



Thank You!