

Exercise Set 3 - Short Circuit Currents I
on
Power System Static Analysis

EEH - Power Systems Laboratory
ETH Zurich

19 October 2011



Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

1 Fault on a transmission line

In Figure 1 a generator with nominal values of 20 MW and 12 kV feeds a load through a line of total series reactance 3 p.u.. Assume that the generator's terminal voltage is $V_1 = 1 \angle 0^\circ$ p.u. and the subtransient reactance of the generator is 0.2 p.u.. The per unit values are given according to the bases $V_B = 12$ kV and $S_B = 20$ MVA.

Calculate the subtransient short circuit currents on both sides in case of a three phase fault at point F, **using the superposition technique**.



Figure 1: Fault on a transmission line

Hints:

- Start by finding an equivalent circuit for the system
- In this case, it would be possible to directly compute the fault current. However, as you will need the superposition technique for the following problems, you should familiarize yourself with it using this simple problem. The superposition technique is described in a generalized form in the script. Start by adding two voltage sources with opposing sign and with pre-fault voltage at the fault position and then calculate the power flows using one of these voltage sources at a time.

2 Fault at a motor

In Figure 2 a generator and a motor with nominal values of 25 MW and 11 kV are connected through in-phase transformers and a line. The transformers A and B have turns ratio 11/150 and 150/11 respectively. Choosing a basepower of $S_B = 100$ MVA and basevoltage $V_B = 11$ kV in the generator and the motor but $V_B = 150$ kV in the line, the series reactance of the transformers is 0.15 p.u. and the series reactance of the line is 0.1 p.u.. The subtransient reactance of the generator and the motor is 0.15 p.u. The current of the motor is $I_M = 0.6 + 0.4i$ under voltage $V_2 = 0.9 \angle 0^\circ$ p.u. when a three phase fault occurs at node 2. Calculate the subtransient short circuit currents in both the generator and the motor.

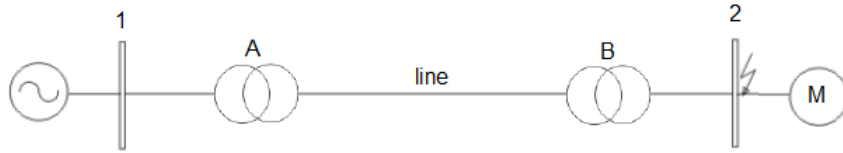


Figure 2: Fault at a motor

3 Fault in the system

In Fig. 3 two generator in parallel are connected with an open line through an in-phase transformer. The nominal values and the corresponding reactances of every component are shown in the picture. Calculate the sub-transient short circuit currents of each generator when a three phase fault occurs in point F. The voltage at point F before the fault is 155 kV. Assume a basepower of 100 MVA.

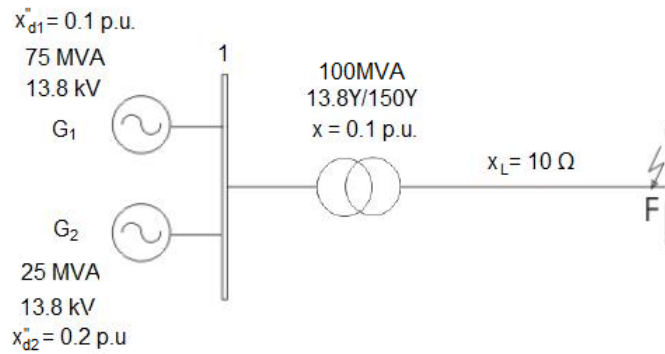


Figure 3: System for Problem 3

Hints:

- For each component the per unit values are given assuming their nominal values as base. Do not forget to transform their values according to the base value that you will choose.