Exercise Set 4 - Short Circuit Currents II

on

Power System Static Analysis

EEH - Power Systems Laboratory
ETH Zrich

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1 Y-Δ connection

For the circuit below (in steady state) identify the short circuit current, in case of a three phase short circuit on point F. The generators nominal values are 200 MVA, 25 kV with $x''_{d1} = 0.2$ p.u.. Consider a constant prefault voltage over the circuit of $1\angle 0°$ p.u.

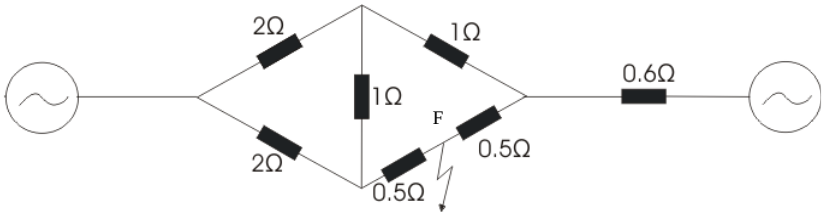

Figure 1: System for Exercise 1.

Hints:

- *Use the Y-Δ transformation to simplify the network*

2 Fault on a long-distance transmission line

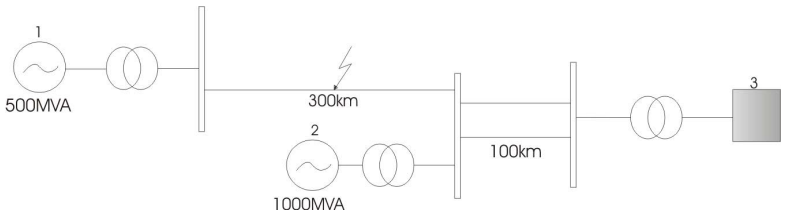

Figure 2: System for Exercise 2.

Two generators are connected to a infinite bus over 380 kV overhead-lines and 25/380 kV transformers as shown in Figure 2. Generator 1 has nominal values of 500 MVA, 25 kV with $x''_{d1} = 0.2$ p.u. and generator 2 of 1000 MVA, 25 kV with $x_{d2}'' = 0.25$ p.u.. We select $S_B = 1000$ MVA, $V_B = 25$ kV on the low voltage side of the transformers and $V_B = 380$ kV on the high voltage side. The reactance of the transformers is 0.15 p.u. according to the selected base. The reactance of the lines is $0.25\,\frac{\Omega}{\text{km}}$. The operating voltages in the terminals of generator 1 and 2 are $1\angle 3°$ p.u. and $1\angle 3.5°$ p.u. respectively.

The voltage of the infinite bus is $1\angle 0°$ p.u.. Consider a three-phase short circuit at the middle point of the $300km$ line and calculate the sub-transient short circuit current.

3 Two-generator system

Consider the network of Figure 3, which is the same as we used for the Newton-Raphson iteration in the first excercise. The nominal values for the generators are 11 kV, 100 MVA, with subtransient reactance 0.1 p.u.. On the transmission lines all the shunt elements are capacitors with an admittance $y_C = 0.01$ p.u., while all the series elements are inductors with an impedance of $z_L = 0.1\mathrm{i}$ p.u.. Consider a three phase fault on bus 3 and calculate the short circuit current.

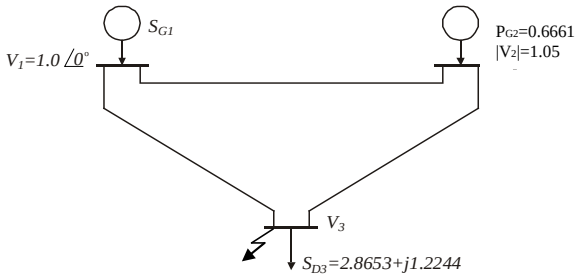

Figure 3: Simple two-generator system

Hints:

- *Recall that you can disregard the loads for the short-circuit calculations (why?)*
- *Use the superposition technique*
- *You can use the results from excercise one. Please note that the admittance matrix changes due to the subtransient reactance, and the voltages at node 1 and 2 will be influenced by the short circuit*