Problem Set #9 Unsymmetrical faults

9-1

A 60-Hz turbogenerator is rated 500 MVA, 22 kV. It is Y-connected and solidly grounded and is operating at rated voltage at no load. It is disconnected from the rest of the system. Its reactances are $X_d'' = X_1 = X_2 = 0.15$ and $X_0 = 0.05$ per unit. Find the ratio of the subtransient line current for a single line-to-ground fault to the subtransient line current for a symmetrical three-phase fault.

9-2

Determine the inductive reactance in ohms to be inserted in the neutral connection of the generator of Prob. 12.1 to limit the subtransient line current for a single line-to-ground fault to that for a three-phase fault.

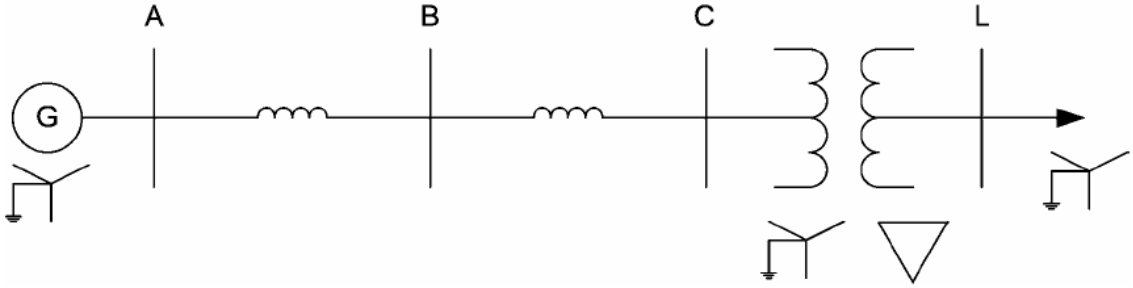
9-3

With the inductive reactance found in Prob. 12.3 inserted in the neutral of the generator of Prob. 12.1, find the ratios of the subtransient line currents for the following faults to the subtransient line current for a three-phase fault:
(a) single line-to-ground fault, (b) line-to-line fault and (c) double line-to-ground fault.

9-4

The reactances of a generator rated 100 MVA, 20 kV, are $X_d'' = X_1 = X_2 = 20\%$ and $X_0 = 5\%$. the generator is connected to a Δ-Y transformer rated 100 MVA, 20Δ-230Y kV, with a reactance of 10%. The neutral of the transformer is solidly grounded. The terminal voltage of the generator is 20 kV when a single line-to-ground fault occurs on the open-circuited, high-voltage side of the transformer. Find the initial symmetrical rms current in all phases of the generator.

9-5 (Keyhani Lecture)
Consider the power system given below:



Given:

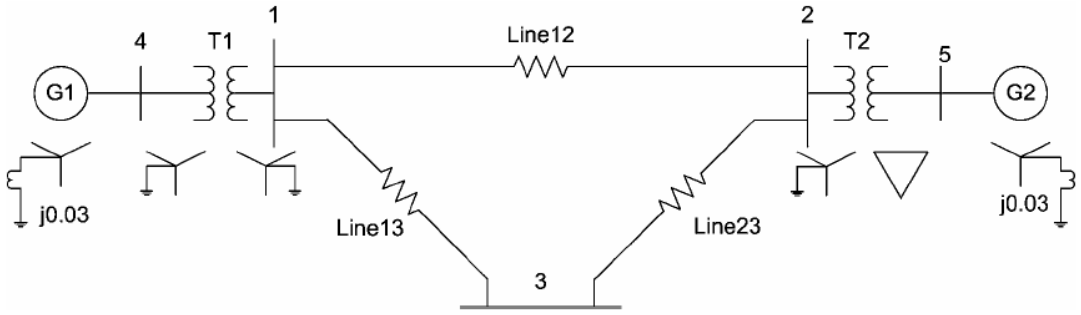
$Z_{G(1)} = Z_{G(2)} = j0.10$ p.u., $Z_{G(0)} = j0.05$ p.u.
$Z_{AB(1)} = Z_{AB(2)} = j0.2$ p.u., $Z_{AB(0)} = j0.4$ p.u.
$Z_{BC(1)} = Z_{BC(2)} = j0.20$ p.u., $Z_{BC(0)} = j0.4$ p.u.
$Z_{T(1)} = Z_{T(2)} = Z_{T(0)} = j0.05$ p.u.
$V_L = 0.9\angle -4.0°$ p.u., $S_L = 1+j0.5$ p.u.

For a single line to ground fault at Bus B, compute the following:

1) The fault currents flowing from Bus A and Bus C to Bus B (faulted bus) when the load is ignored.
2) The same as part (1), but take the load into consideration.
3) The same as part (1), but assume the generator is not grounded.

9-6 (Keyhani Lecture)
Consider the following system. Derive Thevenin equivalent sequence networks looking at Bus 1.

Item	MVA Rating	Voltage Rating	X_1	X_2	X_0
G1	100	25 kV	0.2	0.2	0.05
G2	100	13.8 kV	0.2	0.2	0.05
T1	100	25/230 kV	0.05	0.05	0.05
T2	100	13.8/230 kV	0.05	0.05	0.05
Line12	100	230 kV	0.1	0.1	0.3
Line13	100	230 kV	0.1	0.1	0.3
Line23	100	230 kV	0.1	0.1	0.3



a) Draw the sequence networks.
b) Reduce the networks in (a) to their Thevenin equivalents "looking in" at Bus 1.

9-7 (Keyhani Lecture)
For a 3ϕ fault at Bus "1" in Problem 9-6, calculate the fault phase voltages and currents.

9-8 (Keyhani Lecture)
Repeat Problem 9-7 for a single phase line to ground fault.