

EE 340 – Take Home Portion of Test 1

Use Powerworld simulation software (<https://www.powerworld.com/>) to solve the following problem. The three-phase power system below consists of 50 MVA, 25 kV generator that supplies 3 loads (each is rated at 6 MW and 3 MVAR) through transmission line segments that are 5 miles long. The cable impedance is $0.06 + j 0.4\Omega/\text{mile}$. Let the voltage at the generator terminals (bus 1) be set to the generator rated voltage (i.e., 1 p.u.).

- 1) Determine the magnitude and phase angle of the voltages at buses 2, 3, and 4, and the resulting power loss in the system.
- 2) It is desired to maintain the voltage within $\pm 5\%$ of the nominal value at all buses. One way to achieve this is to raise the voltage at the generator bus to a value above 1 pu but below 1.05 pu. Determine the minimum generator voltage that results in satisfactory voltage levels at all buses, and the resulting power loss. Use increments of 0.005 pu.
- 3) Readjust the generator voltage back to 1 pu. An alternative way to regulate the voltage is to install shunt capacitor banks. These banks come in increments of 1 MVAR.
 - a. Determine the minimum capacitor bank size to be installed at bus 2 that will achieve acceptable voltage levels, and the resulting power loss.
 - b. Repeat a) above if the capacitor bank is installed at bus 3.
 - c. Repeat a) above if the capacitor bank is installed at bus 4.