

Massachusetts Institute of Technology
Department of Electrical Engineering and Computer Science
 6.691 Seminar in Advanced Electric Power Systems

Problem Set 3

Issued March 12, 2006
 Due April 5, 2006

Note this is a relatively short set. Despite the fact that it has the normal two week latency (considering Spring Break) you can expect another set to overlap it over the break.

Load Flow Using one of the load flow routines you developed for Problem Set 2, and working with the same sample network as in that problem set (see Figure 2, determine the consequences (both voltage magnitude at the system buses and line currents) of the following:

1. Loss of the transformer between buses 9 and 17,
2. An increase in the load on bus 10 from 15 to 35 MW,
3. A combination of the previous two conditions.

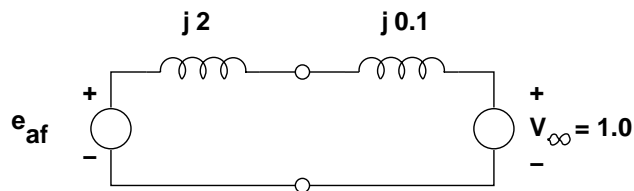


Figure 1: Per-Unit Equivalent: Generator connection to system

Voltage A conventional round-rotor generator is connected to a power system. Assume the power system 'looks' to the generator like a thevenin equivalent circuit that has a voltage of 1.0 per-unit in series with a reactance of 10%. (Assume the real part of system impedance is negligible). See Figure 1

1. For real power output of 0, .5 and 1.0 per-unit, calculate and plot machine terminal voltage as a function of reactive power output, over the range of $-0.5 < q < 0.5$ per-unit. Don't worry about stability or machine capability.
2. Calculate machine internal voltage e_{af} for the same conditions.

Equivalent Impedance Can you estimate the Thevenin Equivalent circuit (per-unit voltage and impedance) facing the generating unit on Bus 1 of the sample network with which we have been working (reproduced in Figure 2. (Of course you can!)

Loads MW + j MVAR
Impedances in Ohms R + jX
 ——— 161 kV
 - - - 69 kV

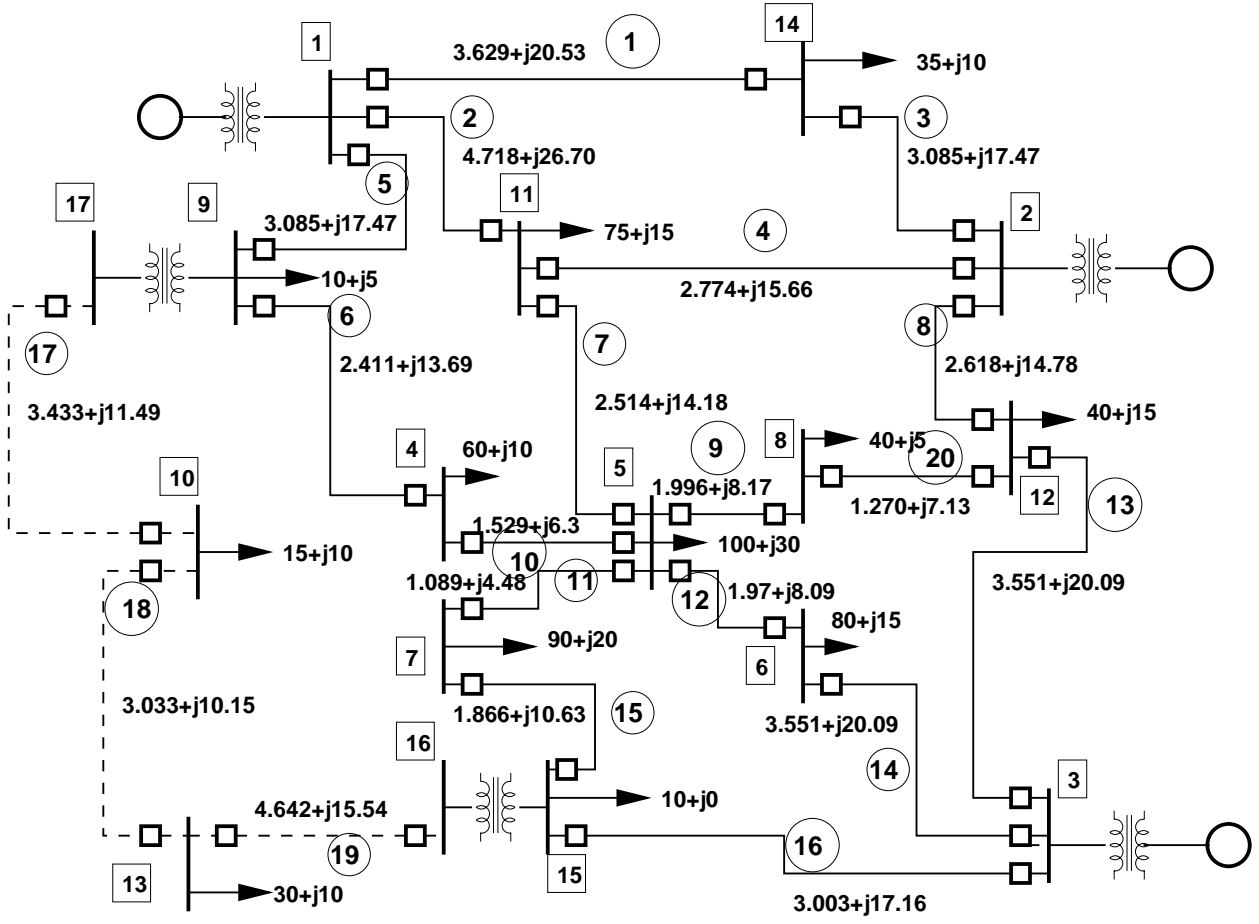


Figure 2: Example Power System