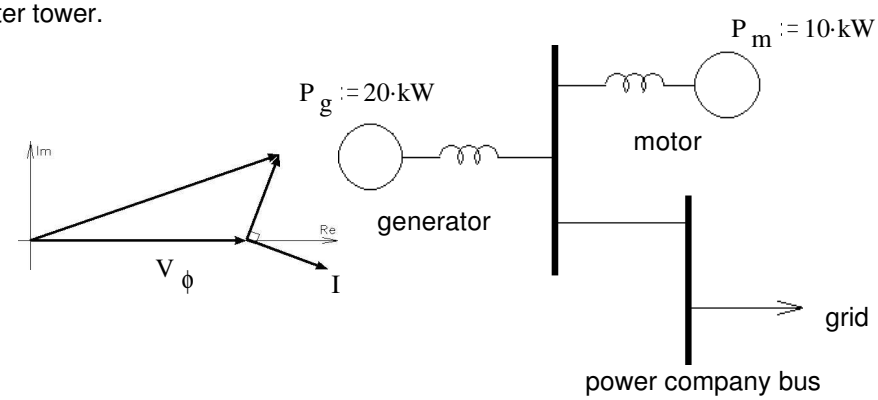
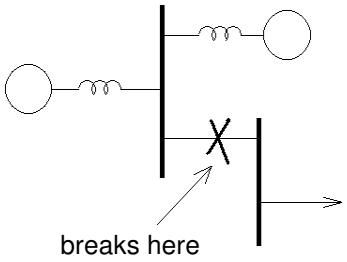
ECE 3600 homework # SG2

b

1. A synchronous generator and a synchronous motor are hooked to a bus which is also hooked to an the power companiy's network, as shown. Phasor diagrams for each are also shown as well as each power. The input power from the prime mover to the generator is constant. The motor runs a pump which pumps water up to a water tower.



One day the connection to the power company is lost. Note: In order to answer the following questions, you may have to abandon some assumptions that you normally make.



a) What will instantly change to rebalance the system? Draw one or more phasor diagrams to show how the currents (including phase angle) and powers now balance.

b) What happens to the "extra" power.

c) What else will change to rebalance the system at a new steady-state? List at least two major things (they are very closely related) that will change. Tell me which way they will change and how that makes the system balance.

2. A 60 Hz, 4-pole, 3-phase synchronous generator supplies 90 kW of power to a 4-kV bus. The synchronous reactance is 50 Ω/phase. The generator emf is 3 kV. Find the following.

a) The power angle, δ.

b) The total reactive power generated.

c) Find a new magnitude of the generator emf so that $Q := 45 \cdot kVAR$

3. You are operating gas-fired, 4-pole, 3-phase synchronous generation plant which supplies power to a 12.5-kV bus. The dispatcher asks for 36 MW and 24 MVAR. The synchronous reactance is 3 Ω/phase.

a) Find the required magnitude of the generator emf.

b) What do you adjust to acheive the require power output?

c) What do you adjust to acheive the require reactive power output?

d) Natural gas costs about $5 per decatherm (ten therm) or MMBtu (one million BTU). A therm is approximately equivalent to 100 cubic feet of gas. A BTU is equal to 1055 joules. Your plant is 37% efficient. How much natural gas are you consumming per hour (in cubic feet)?

e) How much are you spending on natural gas per hour? Per day?

f) How much heat energy must you get rid of every hour?

e) According to the Pacific Gas and Electric Company emissions rate, burning natural gas produces on average 13.446 pounds (6.099 kg) of carbon dioxide per therm. How many pounds of CO2 are you producing each hour?

4. Identify and list the 4 most important concepts that you learned from homeworks SG1 and SG2.

Answers 1. If I gave you the answers, you wouldn't have to *think* about the questions.

2. a) $12.5 \cdot deg$ b) $85.8 \cdot kVAR$ c) $2713 \cdot V$ 3. a) $11.663 \cdot kV$ b) The gas feed to the boiler.

c) Field current to the rotor d) 332010 e) $1660 $39840

f) $1.95 \cdot 10^8 \cdot BTU$ e) 44642