

Homework Problems

1) At a hydroelectric plant on the great Columbia River, a 3-phase, Y-connected synchronous generator is rated at 300 MVA, 60Hz and 25KV. It operates with a lagging power factor of 0.75 and the synchronous reactance is 0.6Ω per phase. Use V_a as the voltage reference. Assume R_s is negligible.

- a) Draw the “a” phase circuit and label E_a , I_L , V_a , R_s and X_s . Indicate polarity and direction.
- b) Find the current **phasor** I . (This would include the angle!).
- c) Find the excitation voltage **phasor** E_a .
- d) Draw the power conversion diagram.
- e) If there are no mechanical losses, find P_{IN} . What is the efficiency of this generator?

2) A Y-connected, 4-pole, 3-phase, 2.2 KV, 60Hz synchronous generator with negligible per phase resistance and per phase reactance of 0.14Ω supplies rated line voltage/current to a Y connected load with a 0.85 lagging power factor. The power converted from mechanical to electrical is 1.492 MW. The mechanical losses are 92KW. Use V_a as the voltage reference.

- a) Find I_L . (This is a magnitude, not a phasor.)
- b) Find I_a (phasor).
- c) Find E_a , the excitation voltage phasor.
- d) What is the efficiency of the generator?
- e) Draw the power conversion diagram.
- f) At what speed does the shaft rotate?
- g) What is the prime mover torque?