FFY600
Inlämningsuppgift 3 **2005 05 13**

Skall vara övningsledaren tillhanda senast fredagen den 20 maj 2005

(*This problem is an adapted form a collection of Alternative Homework Assignments by K. Vick, E. Redish, and P. Cooney from University of Maryland).*

Imagine you get a job with Pacific Electric Company in sunny California. The manager, who is your boss, has learned that you took FFY600 course in Electricity and Magnetism and confronts you with a following problem:
Hoover Dam power plant (see figure below) has been supplying a portion of the electrical power to the southwestern part of the US since 1935. Recently it was modernized and it's output effect was increased to approximately 2000 Megawatts. Your job is to design a portion of this modernization project. The task is to take the energy stored in the gravitational potential energy of the water in Lake Mead, and make it available as electricity for use in an industrial center in the vicinity of LA, nearly 300 miles (1 mile=1.6km) away.

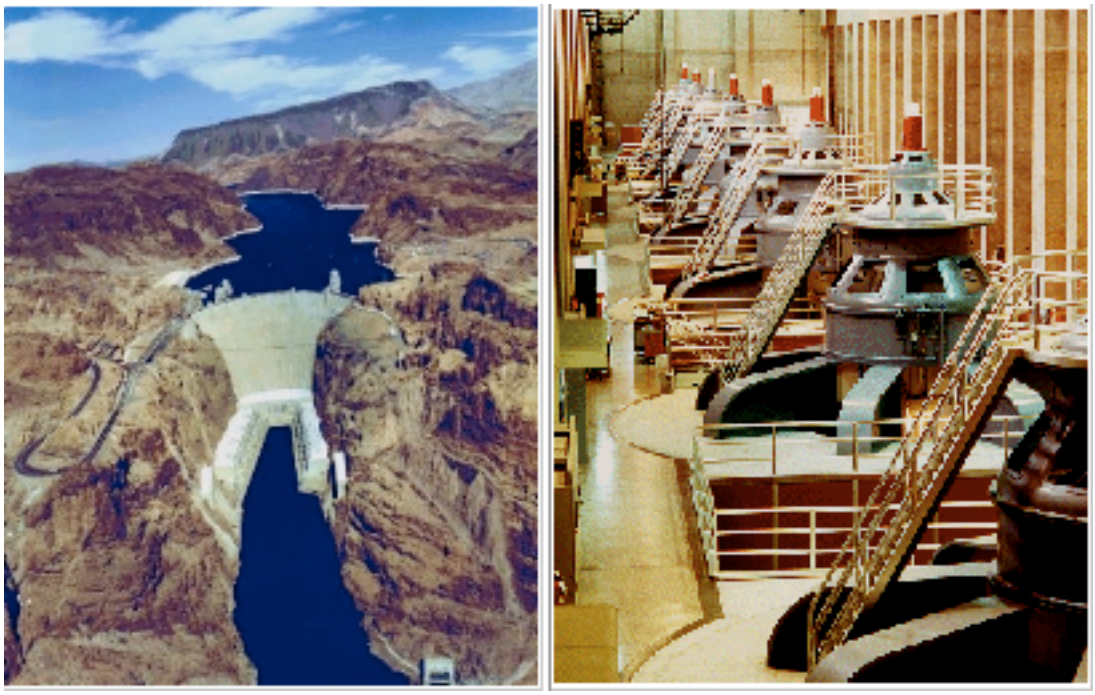

Fig. 1 Hoover Dam (left) and the generator room (right)

At the base of the Dam's there are 17 generators located in a large hall. These generators are powered by water that falls down 220 m shafts onto turbines which turn the generators

1. Each generator consists of a coil of wire with a radius of 1m which is rotated by the turbine at a rate of 60 Hz. The coil is in a 0.1 T magnetic field which induces an AC EMF in the coil. If this generator produces an RMS voltage across its terminals of 16,500 V, how many turns of wire should the coil have? (0.5p)

2. The generator is attached to a transformer which steps up the voltage for transmission. If the generator is producing its maximum power, what is the impedance across the transformer? (0.5p)

3. The power from this generator is to be transmitted to LA via a copper cable that is 5cm in diameter. If this cable is to be 300 miles long, what is the total resistance across this cable? (=.0001p)

4. In LA, the cable will connect to another transformer which will step the voltage down to a level that the factories in the industrial center can use. The power delivered by this transformer will be proportional to the voltage drop across its primary coil. This means that in order to be as efficient as possible, the impedance across the transformer must be large compared to the resistance in the cable. What impedance must the transformer have if the voltage drop across the cable is to be less then the voltage drop across the cable and transformer combined by a factor of 108? (1p)

5. How much power is dissipated by the resistance in the cable? (0.75p)

6. What is the minimal integer number of turns the transformer at the Dam needs to have in each of its coils in order to accomplish this change in voltage? (0.25p)

Lycka till Igor