

ECE471 Industrial Power Systems

Course Design Project Outline

Attached you will find the technical description of the facility for which you will be designing the power distribution system. Assume that this is a new facility and that all equipment has to be specified so that the electrical contractor can obtain and install it.

The attached description includes a dimensioned floor plan and a listing of the electrical loads. Some loads are indicated as **critical**. These will need to be provided with an emergency power supply of some type that you will determine.

Project Schedule

- 1st Submittal: January 19, load center calculations and preliminary one-line diagram.
2nd Submittal: February 2, final one-line configuration, all equipment sizes, initial load-flow study results.
3rd Submittal: February 9, final load-flow study results with taps & pf correction, fault study results.
Final Report: This will be due at the end of the scheduled final exam period. The report format will be specified later.

INSTRUCTIONS

A building floor plan is shown on the attached drawing. The numbered circles indicate locations of loads. Load specifications and additional load data are included with this document. You are to do the following:

1. Find the load center for the facility. Determine a suitable location and size for the electrical equipment vault. Provide it with lighting and air conditioning.
2. Specify all equipment to the panel level including protective devices, starters, conductors, lighting panel requirements etc. The voltage at switch 76 is 12.47 kV.
3. Show the location of all transformers, panels, and motor control centers on the plant drawing.
4. Develop a complete one-line diagram for the three-phase system.
5. Perform load flow and short circuit studies.
6. Verify that no equipment is overloaded.
7. Verify that no motor starting conditions cause more than 10% voltage drop anywhere on the system. You may need to specify current limited starting.
8. Provide two secondary-selective feeders whose protection schemes are coordinated from the largest load up to the utility.
9. Provide electrical isolation for the computer room.
10. Provide power factor correction so that the overall facility power factor is above 0.97 lag.
11. Submit a professional report that fully describes and justifies your design.

GENERAL INFORMATION

1. The facility is fed from switch 76. This is an S & C Electric switch that accommodates SM-4, 5 fuses. The fuse that provides power to switch 76 is a SM-5, 400A slow; the utility engineer is having a problem co-coordinating this fuse, so suggest an alternative (the fuse may need to be replaced with a circuit breaker). The fault capacity at switch 76 is 10.0 kA, 3 ϕ and 7.0 kA, 1 ϕ -G. The X/R ratio is 7.0.
2. The height of the trusses in the chiller bay is 20 feet. The ceiling height in the office and computer room is 10 feet.
3. All motors are squirrel cage induction motors, NEMA Design B, with 0.88 lag power factors unless otherwise indicated. Assume 85% efficiency, 4 poles for each motor.

LOAD DATA

- 1 & 2. 2 - 500 hp chillers, 4.16 kV, model as one 1000 hp motor.
3. 10 hp pump, 480 V.
4. 150 hp pump, 480 V.
- 5, 6 & 7. 3 - 15 hp pumps, 480 V, model as one 45 hp motor.
- 8, 9 & 10. 3 - 20 hp pumps, 480 V, model as one 60 hp motor.
- 11 & 12. 2 - 10 hp motors for the water treatment plant, 208 V (critical), model as one 20 hp motor.
13. 1000 hp chiller, 4.16 kV
- 14, 15 & 16. 3 - 300 hp pumps, 480 V, model as one 900 hp motor.
- 17 & 18. 2 - 75 hp pumps, model as one 150 hp motor.
19. Cooling tower, 50 hp, 480 V, motor and 20 hp, 480 V motor.
20. Air compressor, 350 hp, 480 V, synchronous motor capable of operating between 0.85 lag and 0.85 lead power factor
21. Diesel generator for backup of critical loads (you need to specify kVA).
22. 150 foot-candle lighting, fluorescent
23. Air conditioner, 15 tons (critical)
24. Computer, 15 kVA, 208 V (critical)
25. Air conditioner, 5 tons (critical)
26. 70 foot-candle lighting, fluorescent

In addition to the above, the chiller bay area is illuminated to 30 foot-candle by metal halide lamps, and has 120 V convenience outlets as needed in appropriate locations along with small lights for doors etc., these have to be fed from one of the panels you have designated.