Unit 2 The Electric Service
Solutions to Review Questions

Note: Refer to the *CEC* or the blueprint package as necessary.

1. A 300-kVA, dry-type transformer bank has a three-phase, 600-volt delta primary and a three-phase, 208-volt wye secondary.

   a. What is the proper size of fuel, in amperes, that must be installed in the secondary?

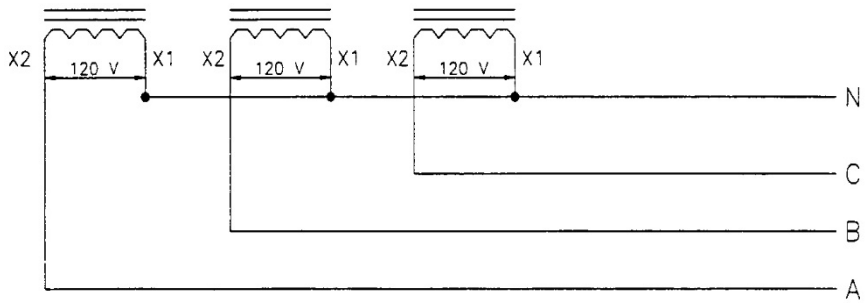
   $$\frac{VA}{E \; x \; 1.73} = I$$

   300 000 = 832.74 A
   208 x 1.73
   832.74 x 1.25 – 1040.92 A

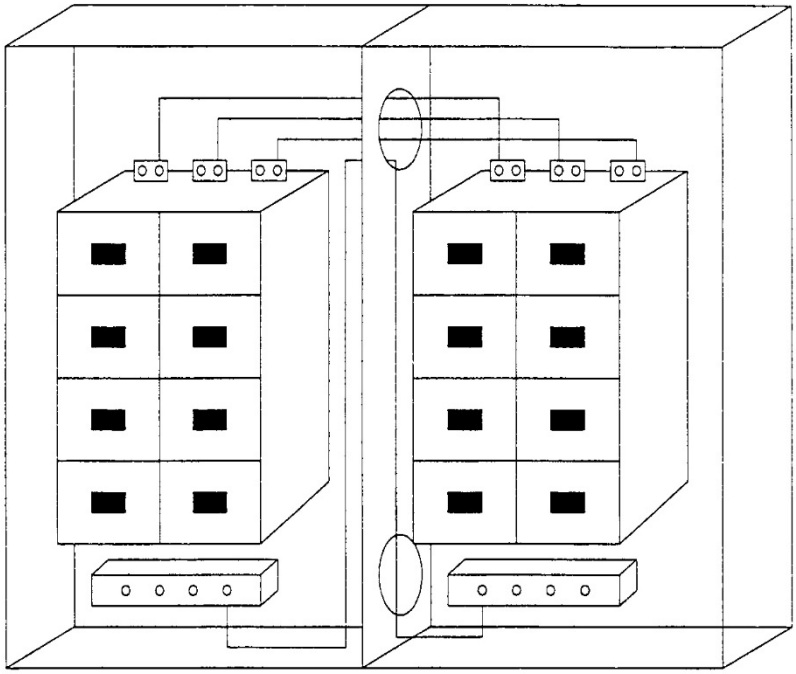
   Therefore, 1000 A fuses.

   b. What is kVA output if one transformer goes bad and it is necessary to use an open delta bank?
   300 kVA x 57.7% = 173.1 kVA

2. Draw the secondary connections for a three-phase, four wire, wye-connected transformer bank. Label the locations where the voltage across a transformer is 120 volts.



3. A panelboard is added to an existing panelboard installation. Two knockouts—one near the top and the other near the bottom—are cut in the adjoining sides of the boxes. Indicate on the drawing the proper way of extending the phase and neutral conductors to the new panelboard. Line side lugs are suitable for two conductors.



4. List any five of the procedures that can be followed to minimize the possibility and/or severity of an arcing fault.

- **Ensure that conductor insulation is not damaged when the conductors are pulled into the raceway.**
- **Ensure that the electrical installation is properly grounded and bonded.**
- **Ensure that locknuts and bushings are tight.**
- **Ensure that all electrical connections are tight.**
- **Tightly connect bonding jumpers around concentric and/or eccentric knockouts.**
- **Ensure that conduit couplings and other fittings are installed properly.**
- **Check insulators for minute cracks.**
- **Install insulating bushings when on all raceways.**
- **Insulate all bare bus bars in switchboards when possible.**
- **Ensure that conductors do not rest on bolts or other sharp metal edges.**
- **Do not allow electrical equipment to become damp or wet either during or after construction.**
- **Ensure that all overcurrent devices have an adequate interrupting capacity.**
- **Do not work on live panels.**
- **Be careful when using fish tape.**
- **Be careful when working with live parts.**

5. A 5-horsepower, three-phase, 230-volt motor is installed. The motor requires the installation of an equipment bonding conductor in the same conduit as the motor branch circuit. The full-load rating of the motor is 15.2 amperes. The circuit consists of No. 12 Type TW75 wire with an ampacity of 25 amperes. However, the circuit is provided with 30-ampere short-circuit protection. What size copper conductor is used for the equipment bonding conductor?

#12 AWG Aluminum or #14 AWG copper ***Table 16A***

6. The service of the commercial building consists of three **78**-mm (**3**-inch) conduits, each containing three **500**-kcmil phase conductors plus one No. **500-kcmil** neutral conductor.

7. What is the purpose of grounding systems and enclosures?

- **Protect life and property.**
- **Limit the voltage on a circuit when exposed to lightning.**
- **In general, limit voltages to ground of interior wiring systems to 150 volts or less.**
- **Facilitate operation of electrical apparatus and systems.**
- **Minimize the impedance to ground.**
- **Minimize voltage differentials between different parts of the system.**

8. What is the kVA capacity of each of the following? (Circle the correct answer.)

a. Three 75-kVA transformers connected closed delta.
(1) **225 kVA** (2) 150 kVA (3) 130 kVA

b. Two 75-kVA transformers connected open delta.
(1) 225 kVA (2) 150 kVA (3) **130 kVA**

c. Three 150-kVA transformers wye-connected.
(1) 300 kVA (2) **450 kVA** (3) 225 kVA

9. Of the following, which is the proper size copper grounding electrode conductor for a 200-ampere service that consists of No. 3/0 RW90 (unjacketed) phase conductors? (Circle the correct answer.)

a. No. 4 AWG b. No. 3 AWG c. No. 2 AWG d. **No. 6 AWG**

10. A service is supplied by three 350-kcmil RW90 (unjacketed) conductors per phase. What is the minimum size copper grounding electrode conductor to be used? (Circle the correct answer.)

a. No. 1/0 AWG b. No. 2/0 AWG c. No. 3/0 AWG d. **No. 6 AWG**

11. Ground-fault sensing equipment is required on certain types of services. For the following systems, indicate where this equipment is used by inserting in the blanks either R (Required) or N (Not Required).

a. 1200 A 120/208-volt three-phase system **R (if more than 2000 A)**
b. 1200 A 347/600-volt three-phase system **R (if more than 1000 A)**
c. Delta systems **N**
d. 2000 A single-phase systems **N (unless rated for more than 2000 A)**
e. 1200-ampere service, three-phase/four-wire wye, 277/480 volts **R**
f. 800-ampere service disconnect **N**

12. The *CEC* requires that if a metal water piping system is available on the premises, the electrical system must be grounded to this water piping system. What type of wire must be used? Cite the pertinent rule.

Copper, aluminum, or other acceptable material
CEC Rule 10–802

Note: CEC Rule 10–700 **indicates that a metal water piping system may be used as an in-situ grounding electrode, but other methods are also acceptable.**

13. Equipment is grounded and bonded so that in the event of a fault, the ground path will be able to **safely conduct any current likely to be imposed on it**.

14. *Rule 10–806(1)* states that a grounding electrode conductor shall not be spliced. However, there are some circumstances where it may be impossible to install a grounding electrode conductor in one piece, without splicing. In such situations, *Rule* ***10–806(1)*** does allow the grounding electrode conductor to be spliced by means of **compression connectors and exothermic welding**.

15. The engineering calculations for an 800-ampere service-entrance call for two 500-kcmil copper conductors per phase, connected in parallel. The neutral calculations show that the neutral conductors need only be No. 3 copper. Yet, the specifications and riser diagram show that the neutral conductor is No. 1/0 copper, run in parallel. The riser diagram and specifications call for two conduits, each containing three 500-kcmil phase conductors, plus one No. 1/0 neutral conductor. Explain why the neutral conductor is sized No. 1/0.

Rule 12–108 **requires conductors that are placed in parallel to have a minimum size of 1/0. An exception is made for bonding conductors (see *Rule 10–814*).**