PIQ Quiz Notes

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Short Circuit Current Quiz 1

Is it important to determine short circuit current?

- Short circuit current must be known to meet National Electrical Code requirements; electrical equipment must be applied within the equipment ratings.
- Most industrial control equipment has a short circuit current rating. Proper application requires the equipment have a short circuit current rating greater than the short circuit current at the point of application.
- Overcurrent protective devices must have an interrupting rating that exceeds the maximum current the device may be required to interrupt.
- The 2011 NEC contains a new labeling requirement for service equipment. Article 110.24 requires service equipment in commercial facilities be marked in the field with the maximum available fault current. The marking needs to include the date the fault current calculation was performed. If future modifications affect the maximum available fault current, the new value needs to be determined and marked on the equipment.

Question 1: What sources contribute to fault current?

A. The utility

B. Generators

C. Motors

D. Capacitors

E. All of the above

Explanation

In most facilities, the largest contribution to short circuit current comes from the electric utility. There are additional sources that contribute as well. When a short circuit occurs, motors in the facility will temporarily act as generators and feed current into the shorted circuit. Capacitors can also contribute to the short circuit current. If a facility generates its own power or has a standby generator that is operating, the generator will be a source of short circuit current.

Question 2: What is the basic formula for determining current flow in an AC circuit?

A. I = E/Z

B. I = E/R

C. $E = mc^2$

D. None of the above

Explanation

I represents the current flow in amperes. E represents the electromotive force measured in volts. Z represents the circuit impedance. Answer B would be correct for a direct current circuit. Answer C is Einstein's formula summarizing his theory of relativity.

Question 3: What is the best approach to determining short circuit current?

A. Quick estimation method

B. Hand calculations

C. Free software

D. Power system design software (SKM, ESA, EDSA)

E. Depends on the circumstances

Explanation

Each approach has merits and some have limitations:

- **The quick estimate method** is good for uncovering oversights. It is particularly useful to inspectors and electricians. For example, an electrician is asked to assist in moving an existing machine from one location in the plant to another. The electrician checks the equipment label and sees it's marked with a five thousand ampere short circuit current rating. Based upon the size of the transformer that will be feeding the machine in the new location, the electrician estimates the short circuit current at more than ten thousand amperes. The electrician notifies management of this potential misapplication and an engineer is called in to further evaluate the situation.

  Estimation methods tend to overstate short circuit current and for this reason are not suitable for arc flash hazard evaluations. At high current, current limiting fuses open quickly and incident energy can be very low. At lower currents, the opening time can extend and the total energy can be greater. Thus, short circuit current estimates may not provide conservative arc flash energy values.
- **Hand calculations** can be tedious and prone to error in complex circuits. However they have their place. In the preceding example, an electrician uncovered a possible misapplication. The engineer who was called in to analyze the application could have used hand calculations to obtain a more accurate answer.
- **Free short circuit current calculators** are available from a number of companies. Mersen's SAF 4.1 allows one to factor in the impedance of all significant circuit components. It is easy to use and well suited for determining short circuit current in simple radial systems.
- **Power system design software packages** are capable of performing short circuit, co-ordination, and arc flash studies. They are also capable of generating over-dutied equipment lists. These programs can handle complex power systems. Updating calculations when system changes occur is relatively easy. Though expensive, these programs are generally the approach preferred by engineers tasked with performing frequent or complex studies.

Additional Resources

- Estimating Short Circuit Current: The Quick Estimate Method training module

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