

Testing Times

A newsletter for the construction and maintenance industry

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Benefits of a Short Circuit, Coordination and Arc Flash Hazard Study

With the increasing reliance that we have on electric power, it is accurate to say that our safety and welfare depend upon its availability. **The benefits of having electric power at our disposal are accompanied by a risk: it can also be destructive if not properly controlled.** "One of the major considerations in the design of a power system is the adequate control of short circuits or faults as they are commonly called. Uncontrolled short circuits can cause service outage with the accompanying production downtime and associated inconvenience, interruption of essential facilities or vital services, extensive equipment damage, personnel injury or fatality, and possible fire damage" according to IEEE Standard 551-2006. In spite of the disastrous consequences of some system failures, many facilities have been built where these hazards have not been adequately addressed.

A fuse or circuit breaker is used in a power system to protect against two kinds of problems: an *overload* and a *short circuit*. An *overloaded* wire can have its insulation destroyed or the high temperature of the wire can cause a fire. This type of failure is almost unheard of today because of the universal application of the requirements of



A short circuit and coordination study can optimize power system safety and reliability

the National Electrical Code in correlating the wire size with the fuse or circuit breaker rating.

The other problem that a fuse or circuit breaker is intended to protect against is a *short circuit*. If a short circuit occurs, it almost always involves an electric arc. This is the most likely and violent form of failure and is the **most frequently ignored in the design and construction of an electrical distribution system**. Powerful explosions can occur in the locations of arcing short circuits. In many of these failures, the electrical equipment can sustain severe damage. In some, additional property loss and loss of life can result.

Short Circuit Study

These hazards are addressed by a short circuit study. If a short circuit were to occur, would the protective devices operate safely

or would they catastrophically fail? This question can only be answered when a study is performed where the magnitude of short circuit current has been determined and compared with the manufacturer's stated interrupting rating for each piece of equipment. If the equipment cannot safely interrupt the available short circuit current, then the equipment is overdutied. Overdutied equipment is unsafe and must be upgraded or replaced with appropriately rated equipment. Results of the Short Circuit Study are also used in the Coordination Study and in an Arc Flash Analysis.

Coordination Study

After a Short Circuit Study has indicated the magnitudes of short circuit currents that would accompany a failure on the system, the next step is to perform a Coordination Study. There are two objectives that can be achieved with a coordination study: *selectivity* and *protection*.

The most generally recognized objective is to determine the correct selection, ratings, and adjustments of protective devices so that if an overload or short-circuit were to occur, the protective device nearest the problem would operate, leaving

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the rest of the power system undisturbed. This is known as *selectivity*. Selectivity is accomplished when a minimum portion of the system is affected. Without selectivity, larger portions of the system would unnecessarily experience a loss of power. The minimal impact of this occurrence would be an inconvenience to users of the system. The greater impact might be the loss of power to vital operations such as computers, elevators, air conditioning, refrigeration or manufacturing processes, where a delay can cause a product or equipment to be damaged.

A second objective of a coordination study is *protection* of the power distribution system within a facility. The purpose of equipment protection is to minimize damage to the electrical distribution system or building if an arcing short circuit was to occur. If the energy in an arcing short circuit is limited to less than 10,000 kilowatt-cycles, on a 480 volt system, the arc will not burn through the steel enclosure. It is necessary to first perform a short circuit study in order to know the magnitude of short-circuit currents to consider in a coordination study.

Arc Flash Hazard Study

The purpose of Arc Flash Analysis is to calculate the level of incident energy which may be present at

various system locations during a fault and to determine a category of personal protective equipment (PPE) that should be worn to protect the electrical worker from life-threatening injuries.

The results of the Short Circuit Studies for maximum and minimum operating conditions and the overcurrent protective device settings determined in the Coordination Study are used in Arc Flash Analysis to determine appropriate PPE for each system location at which the electrical worker may be exposed to live electrical parts. Arc Flash Hazard warning labels are printed based on the results of the Arc Flash Analysis and are applied to the various electrical equipment within the scope of the study.

Summary

A properly protected and coordinated system can provide: power system reliability, increased safety, reduced equipment damage, sustainability, and power system stability. A study should be performed during construction and again every 5 to 7 years or anytime changes are made to the system. Changes can include expansions, reconfigurations, load changes, or utility source changes. Any of these alterations can render the original study results obsolete. ❖

Newsletter Name Contest

We first published the *Testing Times* in 1993. Not only has our readership grown over the years, but Hood-Patterson & Dewar has grown beyond testing to include electrical and mechanical commissioning, power system studies and consulting services. We would like you to help us rename our newsletter to reflect our expanded services. Please submit suggestions to Lyn Cosby at Lcosby@hoodpd.com. The winner will be announced in our next issue and will receive a \$50.00 American Express gift card.

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