Shorts, Grounds, and Faults

Most industrial plants have experienced an electrical failure at some point. These failures, commonly called "shorts" or "grounds," are the subject of involved engineering analysis. In this article, shorts and grounds are lumped under the term "faults." Our goal is to build an electrical system that can withstand a fault and limit the resulting damage.

The first line of defense against a fault's destructive potential is to de-energize the electrical system at the point of the fault. This is done with circuit breakers or fuses. When the fault occurs, the fuse blows or the circuit breaker trips and electrical power is removed from the circuit.

The picture gets a little cloudier from here. The electrical system can be compared to a manlift or elevator cable. A fault can be compared to a break in a manlift or elevator cable. When the cable breaks, the manlift beings to fall. When the pulley at the top of the manlift begins to spin too fast, a brake is applied to stop the fall of the cage. If the break cannot stop the loaded cage, the cage will fall to the bottom.

Each component of your electrical system should be analyzed to reduce the possibility of damage during a fault. The analysis does not stop with the main switch. Anything that is connected to the electrical power system is subject to increased current if a fault occurs.

In electrical sense, a fault is analogous to the break in the cable. When the fault occurs, more current flows than normal. This extra current causes the circuit breaker to trip or a fuse to blow. If the circuit breaker or fuse cannot stop the extra current, something in the circuit is going to be damaged.

How much extra current goes through the device?

Engineering analysis can determine the amount of current available at any point in an electrical system. As an example, a typical 2000A service can develop about 40,000A during a fault. This available current must be compared to the amount of current that each component can safely handle, called the "short-circuit withstand rating." The National Electrical Code Section 110-10 requires us to use fuses or circuit breakers that "clear a fault ... without extensive damage to the electrical components of the circuit."

As stated before, the current increases when a fault occurs. This current is supplied by a combination of the power company and your plant. If your plant is close to the nearest substation, the power company may supply a lot of fault current. The motors at your plant also contribute to the available fault current by acting as a generators for a few cycles as they wind down to a stop. An industrial plant generally has a large proportion of the electrical load in motors, and the sum of these can add a lot of available fault current.

Any electrical system needs to be designed to limit the amount of power that can be delivered in the event of a failure. Each component of the electrical system (cables, ground wires, panelboards, motor control centers, control panels, etc.) should be analyzed to reduce the possibility of damage during a fault. Notice that the analysis does not stop with the main switches. The panelboards and motor control centers must also be evaluated. Even then, the fault analysis may not be complete. Anything that is connected to the electrical power system is subject to increased current if a fault occurs.

The Engineering company at Interstates performs a computerized short-circuit analysis of each new power distribution system we design.

- by Darrel Ramhorst, P.E

For more information...

*or if you have any questions about your plant's available fault current, contact Doug Post at **(800) 827-1662, ext. 159** or e-mail him at **doug.post@interstates.com**.*