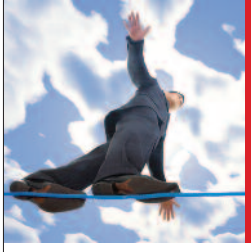

BY DAN CARNOVALE

INHERENT DANGER

Establishing safety protocols will protect both people and equipment, minimizing risk and increasing uptime

Electricity poses an inherent danger, particularly to the men and women maintaining and operating energized electrical systems and equipment. Electric shock hazards have been understood for as long as electricity has existed. However, a more complicated electrical hazard—the arc flash—is now driving safety practices and regulations.

An arc flash is the explosive energy released when an electrical fault, such as a short circuit, causes an arc. The dangers associated with an arc flash include heat, flying debris, sound and UV radiation. A seemingly small event, such as the drop of a tool or accidental contact with a live electrical system, can trigger an arc flash and instantly generate an energy explosion that releases temperatures in excess of 36,000 degrees Fahrenheit—four times hotter than the sun.

The most frequent occurrences of arc flash events take place during routine maintenance of power system equipment or troubleshooting controls. They can trigger an electric arc flash from inadvertent movement or accidental contact, causing a phase-to-ground and/or phase-to-phase fault.

An arc flash can be immensely destructive. An enormous amount of concentrated radiant energy explodes outward from electrical equipment, creating pressure waves that can damage hearing; high-intensity arc flash can harm eyesight; and a superheated ball of plasma gas during an arc-flash event can severely burn a worker's body.

Training and education

Protecting personnel and equipment is everyone's responsibility. Electrical workers must be trained and should understand the importance of arc flash safety. And while codes and standards are constantly changing, it is imperative that organizations maintain compliance.

The Occupational Safety and Health Administration (OSHA) and the National Fire Protection Association (NFPA) 70E-2009 standard require all employees working on electrical equipment to be trained in arc flash hazards and all electrical equipment must carry arc flash labels. standards include the following six-point facility plan to minimize potential arc-flash danger for personnel:

1. Provide and demonstrate a safety program with defined responsibilities.
2. Use calculations or other methods to determine the degree of the arc-flash hazard.
3. Provide correct personal protective equipment (PPE) for workers.
4. Train workers on the hazards of arc flash. Provide appropriate tools for safe working. Include warning labels on equipment.

Companies that fail to comply with these requirements could be cited and fined following the investigation of an electrical workplace incident.

The NFPA 70E-2009 standard includes a requirement that "equipment should be field marked with a label containing the available incident energy or required level of PPE."

Arc flash labels indicate two key pieces of information: The expected incident energy (measured in calories per centimeter squared) at a working distance of 18 inches or 24 inches, which drives the proper PPE required for protection, and the distance a worker without PPE must work to avoid a non-curable burn (typically measured in feet).

Conduct an arc flash study

The best and most comprehensive way to address problems is to conduct an arc flash study. Companies can review the results of the study and determine areas where the hazard risk category is unacceptable.

To mitigate arc flash hazards, follow good safety practices first. De-energize equipment before maintenance, if possible, instead of working it live; perform scheduled maintenance; close and tighten door bolts and latches before operating a switch; and warn personnel to stand to the side and away, as much as possible, during switching.

In addition, specially designed low-voltage motor control centers and switchgear can reduce the probability of electrical shock and arc flash energy during maintenance. Time and distance are the most controllable variables reducing the risk of arc flash issues. Reducing the time that an event persists by tripping a breaker or blowing a fuse significantly reduces the arc flash incident energy. Increasing distance to the arc flash by remote operation, or with closed doors or protective barriers, protects workers in case an event occurs.

No one single technique for managing exposure applies everywhere; a total system approach is the best solution. Modifying equipment, protective devices, specifications utilizing "safety by design" concepts, use of robots, alternate maintenance procedures, etc., can all effectively improve electrical safety significantly. Excessive time in high-level PPE should be all but eliminated. Many of the techniques and suggested solutions are very cost effective; but even the higher-cost solutions are small compared to the consequences of a major electrical accident. ■

Dan Carnovale, PE (danieljcarnovale@eaton.com) is the manager of Eaton's Power Systems Experience Center in Pittsburgh, PA (www.eaton.com/experience). Prior to Eaton, Dan worked for Westinghouse Engineering Services and ABB Power T&D. He has a BSEE from Gannon University, a MSEE from Rensselaer Polytechnic Institute and MBA from Robert Morris University. He is a registered Professional Engineer in Pennsylvania, California and Alaska, a Certified Energy Manager and a Senior Member of IEEE.