

## *Electrical High Energy:* **the Dragon Behind the Door**

Infrared thermography is an exciting and dynamic field, but potential arc flash due to electrical high-energy makes inspection of typical motor control centers quite dangerous. Never, under any circumstances, perform an energized inspection unless an arc flash assessment has been done and you are wearing the proper personal protective equipment (PPE) and taken the appropriate precautions. Arc flash boundaries should be calculated according to *NFPA 70E* or other industry reference to determine the level of PPE. New technology, such as the UL-approved viewport and fisheye lens, allows inspection with the doors closed, but if you have to open the doors, here are a few things you should know.

“High energy” does not necessarily mean high voltage. Most often, it stems from high available fault current, which can be encountered in 480 volt motor control centers – considered low voltage. Typically, arc flash begins when one of the three phases faults to ground, and then it propagates phase-to-phase. The amount of energy unleashed depends on whether the incoming line has switches or fuses in it, the type of fuses, and the length of the cable.

Arc flash temperatures can reach 35,000°F – hotter than the surface of the sun – for a duration of up to a second or longer and be accompanied by a deafening blast (160 dBA) and pressure wave. Third degree burns and other trauma are the results. This does not take into account the lasting neurological damage and personality changes caused by these electrical accidents.

Arc flash intensities are rated in calories per square centimeter. For working purposes, one cal/cm<sup>2</sup> is roughly equal to the burn you would get from sticking a fingertip into a butane lighter flame for one second. Arc flashes occurring today range from 20-200 cal/cm<sup>2</sup>. Thus, mere safety glasses and hard hat are totally inadequate.

The basic level of PPE starts with gloves, shirt and slacks of six-ounce per yard Nomex®. (Nomex is a registered trademark of E.I. du Pont de Nemours and Company.) Lab coats may not properly protect the lower extremities. No other synthetic-fiber clothing (e.g., polyester, rayon, nylon, etc.) should be worn – it can melt and fuse to the skin in an arc flash. Two layers of six-ounce Nomex provide about 20 calories of protection. A typical green face shield provides about eight calories of protection and shields harmful ultraviolet and infrared radiation. A step up from this



by Jon Chynoweth  
Vice President  
Mikron Infrared

is the Nomex beekeeper’s hood and face shield, which provides 31 calories of protection. There are protective suits that provide up to 100 calories of protection. This type of PPE can be hot and tiresome to work in, so it is critical to have a good plan for the inspection. Never hesitate to simply back off, cool off, and take a few deep breaths.

At the substation level with incoming 115,000 volt or 69,000 volt power, no thermographer should be inside the barrier fence unless certified and qualified to be in there. All inspections should be done from outside the fence, where PPE is not required, using zoom lenses. Even after the power has been stepped down to 11,500 volts, the thermographer should never open and inspect switchgear panels if the covers are bolted on. If the covers are hinged and an arc flash assessment has been performed beforehand, it may be possible to inspect using the proper PPE and all specified precautions.

When inspecting motor control centers, avoid opening doors on any cabinets that might be behind you and minimize the number of doors you have open at one time. If working in an area where non-electrical personnel have access, the arc-flash boundary must be barricaded. Unless you are a qualified electrician, never point at or touch anything in an open electrical cabinet.

We strongly recommend arc-flash assessments per *NFPA 70E* for all high-energy equipment. Equipment should be labeled with the proper PPE requirements and other precautions spelled out. Stay alert, wear your PPE, and if anything unexpected comes up, back off and replan. Better yet, update your enclosures and thermography tools so that you rarely have to perform open door inspections. 

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Jon Chynoweth has been involved in the development and marketing of thermal imaging cameras and related software for 20 years. He began developing imaging software needed for process control and utility applications, leading to a position at Raytheon as manager of sales and marketing for uncooled cameras in North America. He later formed a business, acquired by Mikron Infrared, to develop thermal cameras and software. Certified as an ASNT Level I thermographer, he is currently Vice President of Mikron's Thermal Imaging Division.