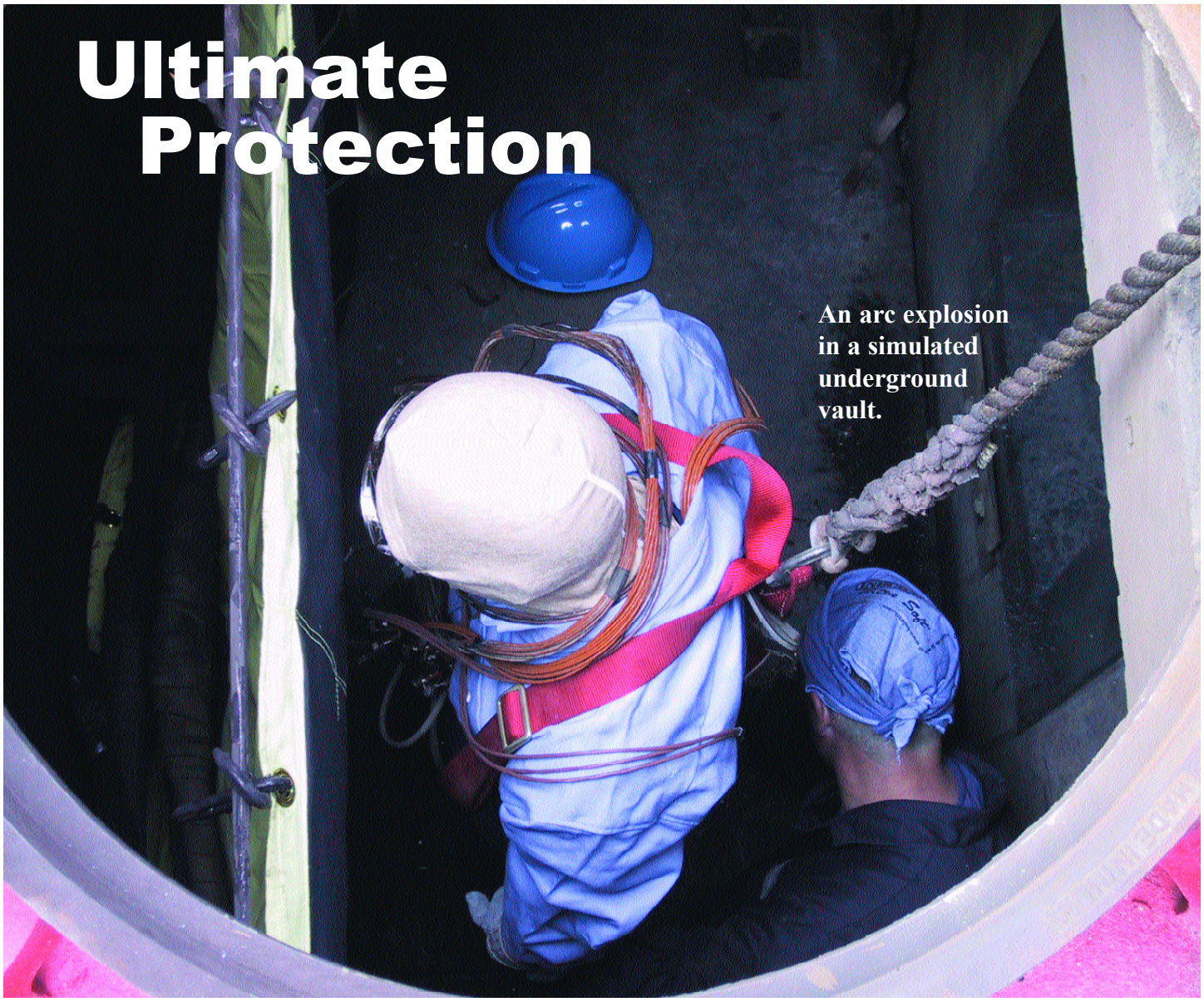
Ultimate Protection



An arc explosion in a simulated underground vault.

Properly designed, constructed and installed arc-suppression blankets can help abate the dangers of arc-flash explosions and arc blasts for utility workers.

By Victor L. Petrovic, Ph.D.

More than 2,000 workers are injured yearly in arc-flash incidents. High incident electrical energy traveling through the air results in an arc flash. Electricity jumps across a gap in milliseconds, heating a small quantity of air to temperatures reaching as high as 35,000 degrees F—three-and-a-half times the temperature of the surface of the sun—forming an intense fireball that vaporizes metal and burns everything combustible in the immediate area.

When an arc flash occurs, energy is released in a number of forms. One is UV, causing injuries similar to sunburn, which can damage the eyes. Another is the plasma arc, a combination of super-heated ionized air and vaporized metal from the conductors that can burn, melt, vaporize or degrade any materials near the fault. Even PPE items labeled FR burn

readily if touching a 2,500-degree surface. Furthermore, burning items may be on or near a worker, causing injury by producing noxious gases and consuming oxygen.

An arc blast occurs when the small quantity of air next to the fault is quickly super-heated and forms a pressure wave that has the energy of several sticks of dynamite and may result in a force of over 1,000 pounds being exerted on the worker. Evidence indicates that an arc blast is sufficiently strong to violently throw workers, rupture eardrums, collapse lungs and break bones. Since most underground vaults consist of reinforced concrete with steel projections to support cables, how and where the worker impacts also determines the extent of injuries.

REDUCING DANGER

Arc-suppression blankets (ASBs) are designed to reduce the danger from both arc flash and arc blast. To combat arc flash, an ASB forces the arc to travel around the edges of the blanket before it reaches the worker, allowing greater cooling because a plasma arc decreases in temperature as it moves further from the fault. ASBs also have an ablative component to absorb a portion of the energy. In addition, effective ASB installation redirects most of the arc blast energy to a safe area, such as an open manhole.

To offer the greatest protection, the largest possible ASB should be used. ASBs rely on the effective interaction of three factors—materials, construction and installation. Inferiority in any one of these areas will sacrifice optimum protection:

Materials used in an ASB must be inherently strong at high temperatures and self-extinguish. Typical blankets use a combination of flame-retardant layers to form an arc-protection system. The outer layers consist of an ablative material, providing protection to the strong inner layers that protect against the blast and shrapnel.

Construction involves a design that allows the blanket to resist the arc blast and provide for ease of installation. Better ASBs entail quilting to re-direct the stress of a blast to the entire blanket. Double stitching around the perimeter enhances the strength of the ASB, to which grommets or straps are attached for installation.

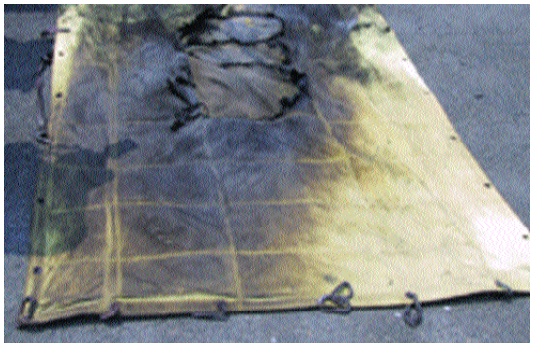
All proper installation methods require placing the ASBs between the potential fault and the worker. At least

eight inches should separate the potential fault from the ASB to allow for cooling before the arc blast reaches the blanket and to provide a buffer to protect the worker from being hit by the ASB. The recommended installation method, "J" installation, places the long side of the blanket vertically with the bottom of the blanket shaped like the letter "J". The advantage of this method is that the arc blast traveling down is redirected upward while the top of the blanket points the blast into an open area.

Other ASB installation methods include "wall," which involves placing the blanket between the potential fault and the worker by attaching it at the corners and every two feet. While allowing the blanket to absorb energy through ablative materials and travel longer distances, this method may not provide adequate protection since the arc flash and blast may be reflected around an enclosed bunker instead of being directed to a safe opening. Similarly, the "wrapping" installation method of rolling the blanket around a line, switch or connector leaves a high probability for arc blow-through. Additionally, with wrapping the ASB may not self-extinguish with its proximity to hot fault surfaces, causing smoke, noxious gases and oxygen reduction.

The cost of an arc flash incident can reach and occasionally exceed $1 million in lost time, medical bills, litigation and settlements. Though arc flash incidents cannot be eliminated, proper use and installation of an effectively designed ASB can reduce injuries and their associated costs. ***ip***

"J" method of installation.



Blanket exposed to 25,000-amp arc blast.

Unprotected mannequin after a chest level arc blast.

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