The Big Bang - Distance equals safety

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When a bomb goes off, the further you are from the explosion, the safer you will be. This same concept applies to arc flash hazards. Whether you are a properly protected and qualified person performing the work or just an observer, the distance between you and the arc flash can make all the difference in the world.

Distance and the electrical worker

Minor sparks? Deadly explosion? An arc flash calculation study, typically based on equations from Institute of Electrical and Electronics Engineers (IEEE) 1584, can be used to predict how much incident energy (IE) in calories per centimeter squared (cal/cm2) can reach a worker. This assumes the person is standing at a specific distance from the source of the arc known as the “working distance.” Depending on the type of equipment, this working distance is typically defined as either 18 or 36 inches; however, other distances may be used.

Once the IE has been calculated, it can be used to select the appropriate personal protective equipment (PPE). This seems simple enough, but caution must be exercised because the calculated IE is based on the “working distance” between the potential arc source and the worker’s torso, face and head. Move closer, and the incident energy can go up dramatically.

What about a person’s hands and arms? The National Fire Protection Association’s (NFPA) 70E 130.3(B)(1) states: “… as the distance from the arc flash decreases, additional PPE shall be used for any parts of the body that are closer than the distance at which the incident energy was determined.”

Since hands and other parts of the body will likely be closer, additional protection usually is necessary.

IE also decreases as the distance is increased. The energy drops off as the inverse square of the distance. As an example, if a person standing one foot away from the arc could receive an incident energy of 8 cal/cm2, doubling the distance to 2 feet will reduce the incident energy from 8 cal/cm2 to approximately 2 cal/cm2 or one-quarter of its original value—quite a drop!

I write “approximately” because the actual rate at which the energy decreases also is dependent on the type of equipment. An arc flash in open air does drop off as the inverse distance squared. However, if the arc flash occurs inside an enclosure, such as a panel or motor control center, the energy behaves more like it is being shot out of a cannon, and a greater distance will be required.

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Distance and the unprotected person

People who are not adequately protected must stay away from a potential arc flash source by a minimum distance known as the arc flash protection boundary (AFPB). NFPA 70E defines the AFPB as, "… a distance from a prospective arc source within which a person could receive a second degree burn if an electrical arc flash were to occur."

Since 1.2 cal/cm2 is widely accepted as the minimum energy that can cause the onset of a second-degree burn, the AFPB is the minimum distance required to reach this level. Stand any closer, and there is a possibility of serious burn injury or worse!

Keep it simple

The results of an arc flash calculation study likely will produce a different AFPB for each piece of equipment depending on its individual upstream protective device clearing time and the available short- circuit current. With the possibility of so many different boundaries, it can be easy to make a mistake.

A simpler approach is to adopt one standardized AFPB. This requires that the study results are reviewed and the largest boundary within reason is adopted. I suggest "within reason" because it is possible to have an unusually large AFPB that may not be realistic. The existing IEEE 1584 formulas use the protective device clearing time as one of the many input variables. If the arcing short-circuit current is low, a protective device's time current characteristic may indicate an unusually long clearing time, perhaps tens of seconds.

This can result in an AFPB of 100 feet or more. What about for lower level arcing currents? Is this realistic? Probably not, but currently there is not enough research available to determine what a reasonable time cutoff should be. IEEE 1584 currently suggests a maximum cut off time of two seconds depending on individual circumstances.

Now it's easy!

Let's say an arc flash study shows AFPBs from 0.5 feet to 5.3 feet. Using the simplified method, a standardized AFPB can be based on the largest value of 5.3 feet. Perhaps round it up to 6 feet. This makes the electrical safety program much easier.

The AFPB in this case? Six feet. Period! People within this boundary must be trained, qualified and wearing proper protection. If not, keep out of the way!

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