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Arc-Resistant Switchgear Construction or Arc-Detection Devices?

In Powell Tech Brief #51, I discussed the arc-resistant construction which is now available in Powell's PowlVac® metal-clad switchgear. As noted in the PTB, arc-resistant switchgear must resist two phenomena — increased internal pressure and burnthrough. These two phenomena operate in two different time frames. Burnthrough is a relatively long-time event. The test to prove resistance to burnthrough is of one second duration.

Internal pressure, on the other hand, reaches its peak in five to ten milliseconds after the arc begins. Any damage that is going to be done by the pressure wave will happen in that time frame. For instance, in one of our first tests of a preliminary arc-resistant design, the front door of a breaker cell was launched across the test cell at that time, digging a divot out of the concrete wall on the other side of the test cell.

Several manufacturers are now offering optical arcing sensors as an alternative to arc-resistant construction. These sensors will detect an arc within the switchgear and signal a backup breaker to trip, clearing the arcing fault. However, consider the timing involved. Assuming that the sensor itself has a zero time of response to the presence of an arc, the backup breaker must still open and interrupt before the arc is extinguished. The fastest circuit breakers commonly used in metal-clad switchgear are three-cycle breakers. This breaker takes three cycles, or 50 milliseconds on a 60 Hz system, to interrupt a circuit once its trip coil is energized. This time of operation will give good protection against burnthrough, but by this time the internal pressure in the switchgear has long since reached its peak, and any physical damage that pressure is going to cause has already happened.

Optical arc sensors may offer excellent protection to gas-insulated substations where the principal problem is protection against burnthrough. However, no detection system can protect metal-clad switchgear of normal, unreinforced construction against damage from arc-generated pressure because the backup breaker cannot open fast enough to prevent this damage. If resistance to dam-

age due to arc generated pressure is desired, the arc-resistant design of metal-clad switchgear must be used.



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