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# Hangin' Your Repairs on Temperature?

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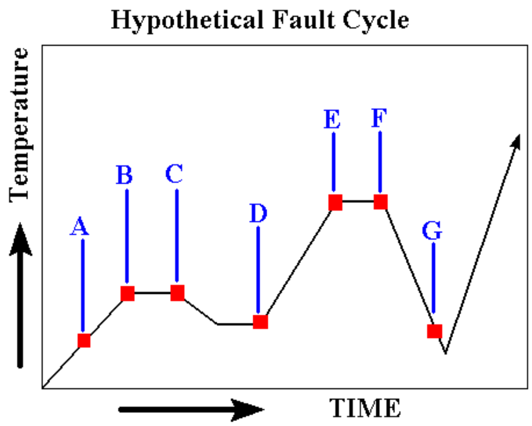
Infrared technology has been heavily utilized by the utility industry for over 25 years and yet it is still vastly misunderstood. In a perfect world, utility engineers want to qualify the results of infrared inspections and use the temperature data collected from anomalies (a connector or other component that is found operating at a higher than normal temperature for system conditions) as the sole source for deciding the severity of a problem and consequently, the urgency for repair. While it is a natural tendency given the need to prioritize repairs, especially when there are limited man hours and repair budgets, unfortunately the entire picture cannot be revealed by infrared alone.

So, what is the problem with using temperature as the sole indicator of an anomaly's severity? It all starts with a concept called the "Hypothetical Fault Cycle" (see diagram below).




A. At Point "A" the anomaly is rising in temperature: no deterioration visible if inspected
B. Internal arcing and deterioration starting
C. A weak weld develops and temperature starts to drop
D. The weld breaks and the temperature rises again
E. More deterioration occurs and welding takes place
F. Due to welding, resistance has decreased considerably and temperature drops drastically
G. At this point, there is low temperature and high deterioration if inspected at this time

Thermal problems can be detected at any time during the failure cycle and thus, one can never be sure if the anomaly was found when it is just starting to rise in temperature such as at point B or if the anomaly had just re-welded itself as at point F. If the temperature is relatively low, then the problem could just be starting OR it could be about to spike severely. Sufficient evidence exists to substantiate that once a connector begins heating, it will eventually reach a point of thermal runaway, although it may live for hundreds of additional cycles. Some thermal anomalies will actually repeat the welding cycle over and over and may not fail for a long time, while others could appear as a minor problem and yet, fail in the next hour. While use of infrared is a valuable tool, especially because it is fast, and does not require contact with the energized component, it is clear temperature alone really is not a sufficient indicator of imminent component failure. Once a thermal anomaly is detected, it is prudent to schedule a repair, as the connector is likely to fail, but temperature alone cannot accurately predict when.

There are a great many factors in determining when a thermal problem will fail and unfortunately, none of them are exact. One must consider the loading of the line at the time of detection, the weather conditions, the criticality of the particular line and the temperature of the problem. In addition, utilities should consider the history of the line and/or problem component. Priorities should be determined on the basis of safety and reliance on critical systems, not solely on temperature of an anomaly. For example, a line with a hot connector crossing a freeway or parking lot where a mechanical failure thereof would have a high risk of contacting a person or vehicle and could possibly contribute to a wreck or electrocution, should have higher priority than a similar line in a rural setting. Likewise, a line serving a hospital or a water pumping station, where failure might result in more than just the inconvenience of a few households ought to have a higher priority.

The bottom line is that while there is no scientific way to qualify “time to failure” of thermal anomalies, infrared is a cost effective tool in quickly determining the location of thermal problems on transmission, distribution and substation systems. If you ask me – I say treat every problem like it could fail tomorrow, then you won’t be surprised if it does!