

Small current, High temperature

Lightning arrestors should not carry any current except when lightning causes a voltage greater than their turn-on voltage to be impressed on the line.



In this image we see a hot lightning arrester connected on the primary side of a pad-mount transformer. The hot spot on the arrester is 57°F hotter than a similar location on the bottom arrester on the lower left. To determine the seriousness of any hot spot we must take into consideration any other heating present. If we look at the point on the transformer where the arrester is located, we can see that the transformer is hotter in that area also. This is caused by the normal heating of the transformer and the natural convective circulation of the oil. The difference between the upper right and

the lower left is 14°F. So, the net temperature rise on the arrester is 43°F. This rise must be caused by current flowing through the arrester, meaning it has been damaged and is partially turned-on at all times.

We have a seeming paradox here though. The ground wire from the arrester, i.e. the dark line leading from the bottom of the arrester, shows no heating. Where is the current? The current is in the wire but it is very small. Consider how little current it would take to cause significant heating. The arrester is connected between 7,200 volts and ground. Using Ohm's Law, if there was just one-hundredth (1/100) of an amp flowing through the arrester, the arrester would have a resistance of 720,000 ohms. Using the I^2R heating formula, we find that this small current would result in 72 watts of heat being generated. This is more than enough heat to cause the temperature rise that we are seeing. The ground wire, on the other hand, has nearly zero resistance. With this small current there should be no measurable temperature rise in the ground wire.

If this heating were allowed to continue, the arrester would eventually go into thermal run-away and fail, causing a fault that would blow a primary side fuse on that phase. This would not only take the plant down but it would also result in a single phasing condition and probably cause significant damage to three-phase motors in the building.