SOLVING THE COMPROMISE OF SURGE ARRESTER INSTALLATION METHODS

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INTRODUCTION

Protecting distribution system assets is key to maintaining power reliability and resilience. Commonly used throughout electric utilities' distribution grids, surge arresters are small and lightweight devices designed to safeguard equipment from transient overvoltage events, such as lightning strikes, capacitor bank switching, and industrial load switching.

One location to install surge arresters is above overhead distribution transformers, where they shunt the energy from overvoltage events to a ground connection. There are two arrester installation methods, each having its own benefits and drawbacks. Depending on the installation method, arresters can cause unnecessary outages at the edge of the grid or, when they reach end of life, potentially result in an entire lateral losing power.

Both methods can result in unnecessary system outages that are costly for utilities and frustrating for customers. As storms increase in severity and more people work from home, these challenges will become more pronounced.

ARRESTER INSTALLATION METHODS: PROS & CONS

One typical installation method involves connecting a surge arrester directly to a transformer, which provides the transformer tank with greater protection from transient overvoltages. However, this installation method exposes the overhead distribution transformer fuse to repeated surge events. Over time, the repeated damage weakens the fuse link and shifts the time-current characteristic (TCC) curve leftward, causing sneakouts. These unnecessary outages can hurt overall satisfaction among customers expecting reliable power.

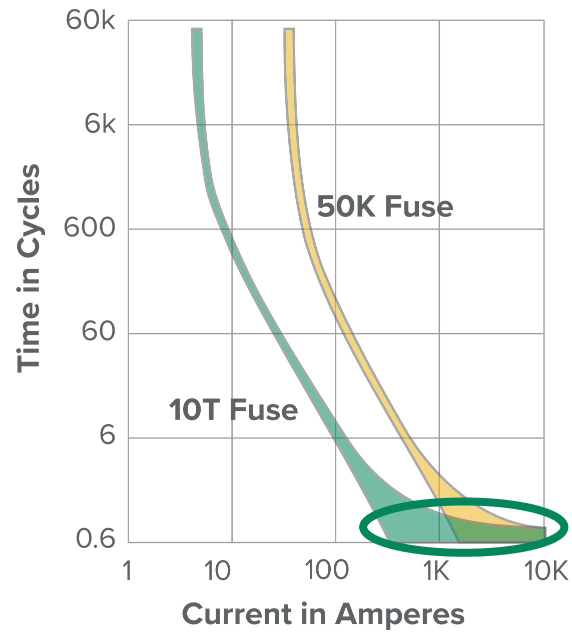
The alternative method is to install the surge arrester upstream of the fuse. When doing so, surge current passes through the arrester, preventing the transient voltage from traveling through the fuse and causing sneakouts. However, the added impedance between the arrester and transformer reduces the arrester's effectiveness and leaves the transformer susceptible to higher-voltage surges that shorten operational life. Utilities incur increased operations and maintenance (O&M) costs servicing or replacing damaged equipment.

Neither method resolves outages created when the surge arrester reaches end of life. Such occurrences lead to a high-current event and create a bolted fault at the transformer site.

The system responds in one of two ways, based on the placement of the surge arrester. When the arrester is connected to the transformer tank, the fault current flows through the transformer fuse and will result in a fuse operation. A line crew must replace the fuse to restore power at the outage location.

Because of TCC coordination limitations at very high current levels, multiple fuses in series can operate in the same half-cycle (overtripping), resulting in the entire lateral losing power and causing a sustained outage for a substantial number of customers. See **Figure 1**. To restore power, utilities must dispatch line crews to multiple blown-fuse locations, further adding to O&M costs.

FIGURE 1. Standard fuse coordination can cause overtripping on high-current faults.



When the surge arrester is mounted upstream of the transformer fuse, this high fault current bypasses the transformer fuse and is seen by the next-upstream protective device. Whether its a lateral fuse or sublateral fuse, overtripping can still occur and lead to a sustained outage for the entire lateral.

ADVANCED PROTECTION: TRANSFORMATIONAL BENEFITS FOR UTILITIES & CUSTOMERS

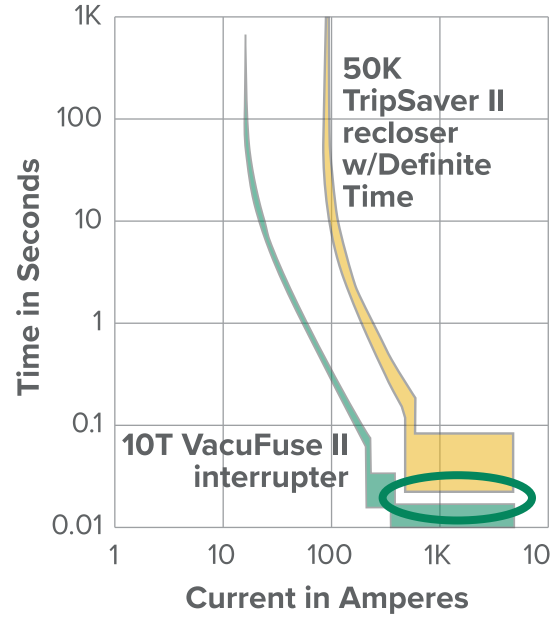
The VacuFuse® II Self-Resetting Interrupter addresses the drawbacks with both surge arrester installation methods by replacing the transformer fuse. The VacuFuse II interrupter tests for faults and can automatically reset, preventing transient events from becoming sustained outages.

Unlike fuses, the VacuFuse II interrupter possesses digital TCC curves not affected by repeated surge current, eliminating sneakouts. This allows utilities to install the surge arrester directly on the transformer tank. These benefits combined provide optimal overcurrent and overvoltage protection, and translate to fewer sustained outages and greater customer satisfaction.

Additionally, the VacuFuse II interrupter works in conjunction with an upstream TripSaver® II Cutout-Mounted Recloser, another fault-testing device, to resolve widespread lateral outages caused when arresters reach end of life. The TripSaver II recloser's definite time elements can coordinate perfectly with the VacuFuse II interrupter's definite-time elements and single-cycle clearing. See **Figure 2**.

The two devices' precise TCC coordination capabilities eliminate overtripping and prevent the entire lateral from unnecessarily losing power. Consequently, utilities save on O&M costs by avoiding an extended truck roll where crews must travel to multiple locations to restore power.

FIGURE 2. Precise TCC coordination capabilities eliminate overtripping.



CONCLUSION

Utilities can solve surge arrester issues by incorporating multiple levels of advanced lateral-protection devices, boosting reliability and resilience throughout the distribution system. Doing so also allows the surge arrester to be placed directly on the transformer tank, providing the best overcurrent and overvoltage protection for distribution transformers and improving customer satisfaction with fewer overall sustained outages.

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