

CASE STUDY

# Energy-limiting protection for overhead systems



Industry: Electric utility  
 Challenge: Improving protection for overhead equipment  
 Product: Hi-Tech® Trans-Guard™ EXT current-limiting backup fuse

**Abstract:**

Current-limiting fuses have been available for many years for both padmount and overhead applications, but most utilities commonly use them only with three-phase padmount transformers. These applications typically use a bayonet-style expulsion fuse in series with an oil-submersible current-limiting fuse. The combination of the two fuses provides full-range protection of the transformer (up to 50 kA), while it significantly reduces energy let-through when low impedance faults occur. This not only protects equipment from damaging overloads and secondary faults, but also from catastrophic failures if a low-impedance fault occurs.

**Solution:**

This same type of coordination and the benefits it provides can be applied to overhead equipment protected with cutout expulsion fuses, such as pole-top transformers and capacitor banks. External current-limiting fuses can be applied in series with the already installed cutout fuses to increase the interrupting rating, reduce energy let-through and significantly improve the overall safety of the installation when a fault occurs.

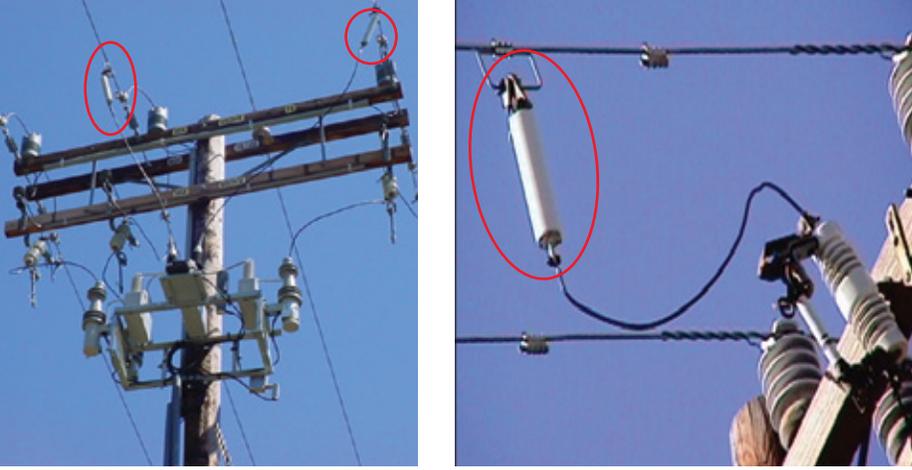
Cutouts have maximum interrupting ratings greater than bayonet-style expulsion fuses and may be

sufficient for most applications. Expulsion fuses, however, subject the equipment and system to high peak currents and energy let-through during fault conditions, because these fuses are designed to wait for a current zero to clear.

A distinct design advantage of using current-limiting fuses is that faults are modified and cleared prior to the first current zero, as opposed to waiting for a zero-crossing interval. This capability is what allows current-limiting fuses not only to interrupt, but limit the damage and potential for catastrophic equipment failures that can occur during a fault event.

The illustrations on the following page compare the energy let-through and peak current during a 5,000 amp symmetrical fault current of a cutout alone and a cutout in series with the Hi-Tech 12K external backup fuse.

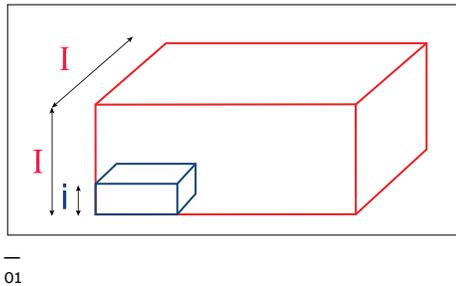
The red square in Figure 1 represents the 875,000a<sup>2</sup> seconds of energy the cutout could let through during the first half cycle of fault current. Using the Hi-Tech 12K EXT current-limiting backup fuse in series with a cutout would limit the energy to only 10,000a<sup>2</sup> seconds, indicated by the blue square. This results in a 99% reduction in energy by adding a current-limiting fuse in series with the cutout.



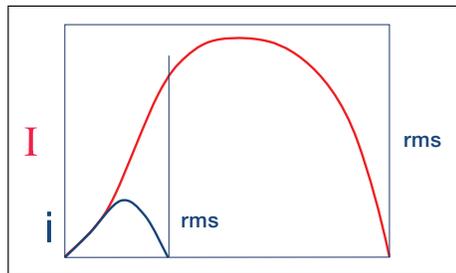
Since current-limiting fuses introduce high resistance into the circuit prior to the first current peak, the peak fault current is also limited as illustrated in Figure 2. The traditional cutout fuse alone would be subjected to 12 kA peak current (red), but limited to only 3.2 kA by use of the current-limiting fuse (blue).

Even though 5,000 amp fault levels may not be considered severe, falling within the capabilities of a cutout device, the addition of an external current-limiting fuse clearly improves the level of equipment protection and significantly reduces the risk of catastrophic equipment failures during fault events.

01 Figure 1  
02 Figure 2



01



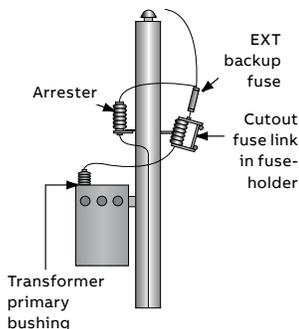
02

**Conclusion:**

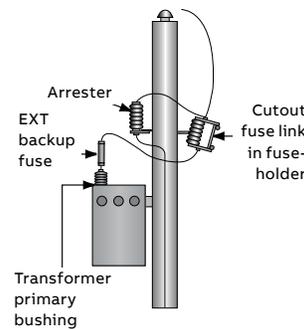
Current-limiting fuses have been available and effectively used for many years, but limited in applications for various reasons. Today's redesigned external backup current-limiting fuses are smaller, lighter and easier to install than those of the past. Ratings have also increased up to 100 kA, allowing utilities to increase and expand protection.

These recent improvements to external current-limiting fuses, their ability to limit peak current and energy let-through and an increasing awareness of safety for utility personnel and the general public warrant consideration of the small investment in a two-fuse protection design for overhead applications.

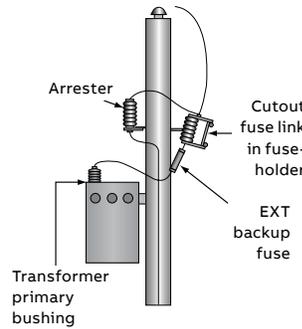
**Type of installations**



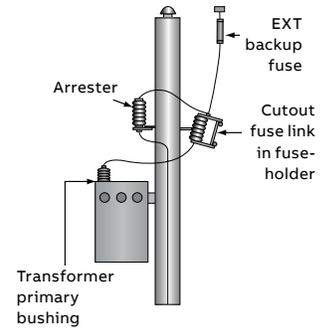
Source side cutout installation



Bushing mount installation



Load side cutout installation



Hot-line/bail installation

ABB Inc.  
Electrification Products  
860 Ridge Lake Blvd.  
Memphis, TN 38120  
Customer Service: 800-816-7809

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