S&C's Fault Tamer Fuse Limiter is unlike any other fuse that S&C manufactures. While the literature is successful in providing most of the information required to promote this device, questions continue to arise for which the answers do not conveniently fit in the literature. This publication provides answers to more commonly asked questions relating to the S&C Fault Tamer Fuse Limiter.

Construction and Operation

Q. What is the construction of the backup limiter?

A. The backup limiter is similar to a current-limiting fuse in that it has a punched ribbon surrounded by sand. The ribbon in the limiter is made of copper. When the ribbon melts, the energy is absorbed into the sand. The limiter housing is molded out of a special fiberglass reinforced high-strength high-temperature engineering thermoplastic to achieve its unique shape and performance. The lid of the housing is vibration welded onto the body to form a watertight seal.

Q. Why is copper ribbon used in the backup limiter versus silver ribbon?

A. Copper, like silver, has very specific melting properties. As you may know, copper will completely oxidize given a supply of oxygen and heat which is one of the reasons copper cannot be used for S&C's hellically coiled fusible elements used in power fuses and fuse links. However, since the backup limiter is sealed, the amount of oxygen is limited and the copper ribbon won't be subjected to oxidation that could cause variations in the time-current characteristic.

Q. Both the limiter and the fuse tube are painted. How long will the paint last?

A. The paint used is a cross-linked polyurethane paint which has displayed good field weathering characteristics on S&C Omni-Rupter® Switch interrupters. Samples of the Omni-Rupter interrupter housing with the cross-linked paint have been at the Desert Sunshine Exposure Test (DSET) laboratory for accelerated UV exposure and weathering. To date, the Omni-Rupter housings have experienced 20 simulated Arizona years. Although the paint has suffered severe loss of gloss and moderate chalking, it is still firmly bonded to the housings, therefore it continues to protect the plastic from UV degradation.

Q. What is the construction of the fuse cartridge?

A. The fuse cartridge is similar in construction to S&C Positrol® Fuse Links. It employs a silver element that is swaged to an upper and lower terminal. The threads on the upper terminal are different than the threads on a fuse link to prevent the possibility of loading a fuse link in the Fault Tamer fuse tube. The fuse cartridge also employs a red plastic pull tab that is used to load the cartridge in the fuse tube, similar to the way that the string is used to load SM Refill Units. After the fuse cartridge is loaded, the pull tab must be removed.

Q. How does Fault Tamer material perform at high temperatures?

A. Both the fuse tube and the backup limiter utilize a special fiberglass reinforced high-strength high-temperature engineering thermoplastic which has a glass transition temperature above 160°F (72°C). Provided that the ambient temperature is less than or equal to 125°F (52°C), Fault Tamer should operate as intended. This was confirmed during accelerated creep testing where Fault Tamer samples were heated to 140°F (60°C) for several days. After this test the structural integrity of the samples remained intact.

New Publication

Handling/Re-fusing

Q. Does the backup limiter have to be replaced each time the fuse operates?

A. No, the limiter will only operate for faults above 800 to 1,000 amperes. When Fault Tamer has operated, the limiter need only be checked for continuity, as described in Instruction Sheet 451-500.

Q. At a three-phase application, do all of the Fault Tamers have to be re-fused if only one has operated?

A. No, as stated above, if the limiter has continuity, then it can be reused. In addition, at three-phase installations, fuses that have not dropped open, have not operated and do not even need to be checked for continuity.

Q. Can Fault Tamer be left hanging in the open position?

A. Water can get in the muffler end of Fault Tamer when it is hanging in the open position, therefore, S&C does not recommend leaving Fault Tamers hanging in the open position for extended periods of time.

Q. What is the major handling advantage that Fault Tamer has over backup current-limiting fuses?

A. Fault Tamer can be easily removed or installed in its mounting with either a hot stick or even an extendo stick equipped with a distribution prong. However, to make this process even easier S&C has developed a new fuse handling fitting—Talon™—that attaches on the end of any hot stick or extendo stick, and is designed to prevent Fault Tamer from falling off the end of a stick. In addition, the design of the Talon is also ideally suited to fuse cutouts and overhead distribution power fuses.

Backup current-limiting fuses require operating personnel to climb the pole or use a bucket truck to get their hands on the fuse. Both procedures require approximately 25 minutes more than re-fusing with an extendo stick. Fault Tamer provides reduced re-fusing labor costs and minimal outage time versus conventional backup current-limiting fuses.

Application

Q. I agree that large fusing ratios will allow moving the surge arrester to the transformer tank, thus providing optimal transformer protection, but why shouldn't large fusing ratios be used without current limitation?

A. When a transformer fails, it is important to clear the fault quickly to prevent catastrophic failure. The current-limiting action of Fault Tamer will clear high-magnitude faults in less than 8 msec, thereby minimizing the effects of transformer failures. On the other hand, even fuse links with low ampere ratings must wait for the next naturally occurring current zero to clear these faults. This will take at least 13.8 msec to clear high-magnitude asymmetrical faults, and does so without the benefit of current limitation, thereby allowing approximately 35 times the amount of energy let-through into the transformer.

Q. Can a 25-kv Fault Tamer be used on 15-kv systems?

A. No. All current-limiting fuses generate what is known as peak-arc voltage during an operation. This peak-arc voltage is an overvoltage that drives the current down to zero before the next naturally occurring current zero, thus limiting the energy let-through into transformers. The peak-arc voltage generated by 25-kv Fault Tamers is of the magnitude that is likely to cause typically sized 15-kv system surge arresters to operate. Therefore, S&C does not recommend the use of a 25-kv Fault Tamer on a 15-kv system. However, S&C does make an adapter that allows a 15-kv Fault Tamer to fit into a 25-kv fuse cutout mounting.

Q. If Fault Tamer can be applied on 25-kv systems, why can't it be used on 34.5-kv systems line-to-ground?

A. Fault Tamer can only be applied when the voltage across it does not exceed 8.7 kv and 16.8 kv which corresponds to the line-to-ground voltage on 15-kv and 25-kv systems, respectively. So one might ask, "How can S&C allow the use of Fault Tamer on three-phase transformers where it could be called on to clear phase-to-phase or three-phase faults?" This question is best answered by reviewing the characteristics of these faults.

Secondary phase-to-phase faults—secondary phase-to-phase faults will impress full phase-to-phase voltage across the primary fuse. Fault Tamer can handle this because the primary current will be low. Fault Tamer has passed test series 4 of the cutout interrupting performance test in IEEE C37.41 "Standard Design Tests for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories" which requires interrupting 400 to 500 amperes with full phase-to-phase recovery voltage across the fuse.

Phase-to-phase ungrounded primary faults—Fault Tamer can clear phase-to-phase ungrounded primary faults to its maximum interrupting rating because the maximum voltage across the Fault Tamer is only 50% of rated phase-to-phase voltage. During the interruption process the Fault Tamer on each of the faulted phases operates simultaneously, thus equally sharing the phase-to-phase voltage. This test, which Fault Tamer passed, goes beyond the requirements set by ANSI/IEEE standards.

Three-phase ungrounded primary faults—Fault Tamer would be exposed to full phase-to-phase voltage during a three-phase ungrounded primary fault. However, S&C believes this type of fault at transformer installations is not possible because of all of the ground planes at the installation. The transformer tank, arrester lead, pole ground, and overhead neutral wire are all ground points. Even if a three-phase ungrounded fault is initiated, it will involve ground very quickly. Once the fault involves ground, Fault Tamer will only have phase-to-ground voltage across it and be able to interrupt fault currents through its interrupting rating.

Q. Which ANSI standard did S&C follow when testing?

A. Since ANSI/IEEE standards do not specifically cover this type of device, a test program was developed expressly for the S&C Fault Tamer Fuse Limiter using parameters and conditions considered necessary for Fault Tamer applications. The test program was developed to produce the most severe conditions to which Fault Tamer would be subjected when protecting transformers. IEEE C37.41, "IEEE Standard Design Tests for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories," was used as a guide for developing the test program, selecting the most severe requirements from Section 6.6.2.1, "Cutouts with Single-Voltage Rating," and Section 6.6.5, "Current-Limiting Power and Distribution Fuses." Additional tests beyond these sections were performed to fully demonstrate the performance of Fault Tamer. Primary-fault conditions, secondary-fault conditions, and transformer overload conditions were examined.

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