Cable Lore

ANACONDA

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SHORT-CIRCUITS

The term short-circuit refers to the uncontrolled flow of electrical current along unintentional paths. This situation usually occurs as a consquences of the failure of electrical insulation at one or more locations on a circuit.

Modern power systems are required to supply their normal loads at a constant, stable voltage. To meet this criterion, they are, inevitably, also capable of delivering — for short periods of time — short-circuit currents that are hundreds of thousands of times their normal load current.

The uncontrolled release of such energy during a short-circuit results in a violent explosion that is a hazard to life, property, and the power system itself. To minimize such consequences of a short-circuit, it is imperative that the flow of the short-circuit current be interrupted in as short a time as possible. This can be accomplished with overcurrent protective devices such as fuses, or relays and circuit breakers.

However, it does require time for these devices to detect the existance of a fault current, and still more time for them to accomplish the total interruption of a short-circuit current. In addition, some systems operate with one or more automatic reclosures of the breakers after the initial interruption.

Obviously, all of the cables that are on the source side of a short-circuit must carry the fault current from the time of the initial fault until the overcurrent protective devices ultimately interrupt the current. The temperature that a cable conductor will attain as the result of the fault current depends upon:

1. The conductor temperature prior to the fault.

2. The magnitude of the fault current.

3. The time the fault current is permitted to flow.

To help the system designer plan for this type of system emergency, power cables carry an allowable short-circuit temperature rating. This is the maximum allowable conductor temperature that may be attained in the very short times that are usually associated with system short-circuits. These times are measured in cycles, normally on the basis of 60 Hz systems, i.e., a 16 cycle fault current will exist for 16/60ths or 0.2667 of a second.

Most power cables that are rated for 90°C continuous operation carry a 250°C short-circuit rating.

The magnitude of the short-curcuit current that a given cable circuit can carry within its allowable temperature limitation depends upon the time required for the fuses or circuit breakers to interrupt the flow of the fault current. The greater the time required to open the circuit, the less short-circuit current a cable can tolerate without exceeding its temperature limitation.

As mentioned above, the standard 250°C short-circuit ratings of cable applies for a time period of seconds at most. In a laboratory test, a length of 4/0 AWG copper 15 kV EP UniShield was current loaded for 4 hours to 252°C conductor temperature, and then passed all factory voltage and corona level tests. A similar cable insulated with XLPE would be ruined long before 4 hours had elapsed.

This Cable Lore concludes the series that began December 5, 1975 with Cable Lore No. 41 "EP or XLPE Medium Voltage Power Cables." The data presented in this series show that EP insulated medium voltage Power Cables will perform better in modern power systems than similarly rated XLPE insulated cables.

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