ANACONDA Cable Lore

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FAULT CURRENTS

Do not read any further until rereading Cable Lore No. 31.

A common type of electrical failure is for an electrically energized part or conductor to come into contact with a grounded case or shield. In the case of a cable, this would take place if there were an insulation failure.

When this type of fault developes, large electrical currents may be expected to flow (normally called fault or short circuit currents) from the energy source (usually a substation), through the wires or cable conductors, through the fault, and through all available ground paths back to the substation.

Of course, substations have protection against this sort of thing and when this large current is sensed by relaying devices, circuit breakers open to disconnect the faulted circuit. If there are fuses between the substation and the fault, these will remove the circuit.

The size of the fault currents will depend on:

(1) The electrical power capacity of the substation.
(2) The size and types of wires and cable between the substation and the fault.
(3) Distance between the substation and fault.

The time interval that these short circuit currents will flow depends on the time required for breakers or fuses to operate.

A grounded cable shield is one of the ground paths used by the fault current. Neither the conductor nor shield is sized to carry currents of this magnitude for any length of time. The instant a fault current begins to flow, the conductor and shield begin to over-heat.

If the fault current is not interrupted in time an interesting series of events and consequences can occur.

(1) The insulation and jacket can be badly damaged.
(2) Portions of the conductor and shield in the vicinity of the fault can be burned away.
(3) It is possible that burning is so rapid that the fault path is burned away which in turn quickly reduces the fault current. This situation can lead to interesting but serious consequences:

    (a) The relays or fuses might not sense the fault.
    (b) The resulting lower but still excessive current might damage other parts of the system.
    (c) This will occur until a fault current large enough to actuate the relays is obtained.

These factors either separately or in combination are the major basis for concern by cable users.

(continued)

Note that it is not only the amount but also the time that the fault current exists that is important.

The ability of a conductor or shield to carry fault current increases with AWG size (amount of metal). Unfortunately this is just opposite of what is desirable from a shield loss standpoint (See Cable Lore No. 31). It would appear that an impasse has been reached.

Logically it would appear that a study in depth or comparison of shielding systems is in order. This could be very helpful if every possible fault condition were plugged into this study.

A more practical solution for proper cable selection can be based on consideration of the following.

(1) Shield losses are an every day and continuing expense.
(2) Faults, hopefully, are an occasional event.

As a consequence of these:

(a) Economics would dictate selection of shield size which would be adequate to provide sufficient fault current to operate relays — but no more than this to minimize shield losses.
(b) It appears that a moderate amount of cable damage (in vicinity of the fault) could be tolerated as long as the damages did not "spill over" into the rest of the system.

There is no hard and fast set of technically accepted criteria that dictates that all of the metal required for adequate fault capability has to be in the shield.

If this approach is agreeable there are means through new cable concepts to insure adequate fault current capability consistent with minimum shield losses. Cables are being evaluated under actual fault conditions to substantiate this concept.

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