ANACONDA Cable Lore

BY THE MARION INSULATED PRODUCTS ENGINEERING CENTER

ISSUE NO. 31 March 8, 1971

EFFECTS OF SHIELD LOSS ON AMPACITY

The basic purpose of a cable insulation shield is to confine the electrostatic stresses to a definite pattern and to provide a fixed path to ground for the cable charging and leakage currents.

In order to accomplish this the shield must be both a conductor, and must be grounded.

When a cable carries current there is a magnetic field in addition to the electrostatic field. The cable shield confines the electrostatic field but not the magnetic field. In fact, because the shield is a conductor, an alternating current carried by the cable will magnetically induce a voltage along the length of the shield.

If the shield is part of a closed circuit, as it will be if properly grounded at each joint and termination, this voltage causes a current to flow in the shield. The lower the shield resistance (more copper), the higher the current will be. This is why many users are astounded by the amount of shield current encountered with low resistance shields (such as URD type cables) in three phase applications.

The current flowing in the shield together with the shield resistance cause losses which show up as heat, similar to losses and heat due to current in the phase conductor.

The ampacity of a cable is dependent on the amount of heat generated in a cable and the ability of the cable to dissipate this heat to its surroundings. Once the surroundings have been chosen, the amount of heat that can be dissipated is fixed. So is the amount that the cable can be allowed to generate. Thus any heat that the shield generates must be subtracted from the amount that would otherwise be alloted to the phase conductor. This means a reduction in ampacity.

What are the economic consequences? It means that excessive shield losses are an economic nightmare. An example might illustrate the point.

It has been determined that a three phase circuit of 1000 MCM aluminum 1/3 neutral UD type cables directly buried on 7 1/2 inch centers in 25°C ambient earth and with a 75C conductor operating temperature has an ampacity of approximately 491 amperes per single conductor cable. This same ampacity could almost be obtained with 500 MCM aluminum cables if the shield losses were negligible.

If this has not had sufficient impact, consider the following; with negligible shield loss, the 1000 MCM cables would have had an ampacity of 645 amperes. At 15 kV and 80% Power Factor, the shield losses are responsible for a reduction of 3,200,000 watt hours per hour per 1000 circuit feet of power capability. Or, at 1 1/2 cents per kilowatt-hour, the circuit was made incapable of delivering an additional $48.00 worth of power every hour.

To add insult to injury, each shield consumed approximately 4000 watt hours per hour for a total circuit expense of 18 cents per hour per 1000 ft. This is an actual expense coming out of the users pocket. Multiplying this by the number of hours the circuit may operate per year is left to the reader for maximum effect.

Imagine having to pay a premium to obtain less cable capability. Yet, that is exactly what excessive shield losses extract from the user.

C. Landinger