Pacific Gas and Electric Company

Telecommunications Interference

Harmonic currents flowing on the utility distribution system or within an end-user facility can create interference in communication circuits sharing a common path. Voltages induced in parallel conductors by the common harmonic currents often fall within the bandwidth of normal voice communications. Harmonics between 540 Hz (ninth harmonic) and 1200 Hz are particularly disruptive. The induced voltage per ampere of current increases with frequency. Triplen harmonics (3^{rd}, 9^{th}, 15^{th}) are especially troublesome in four-wire systems because they are in phase in all conductors of a three-phase circuit and, therefore, add directly in the neutral circuit, which has the greatest exposure with the communications circuit.

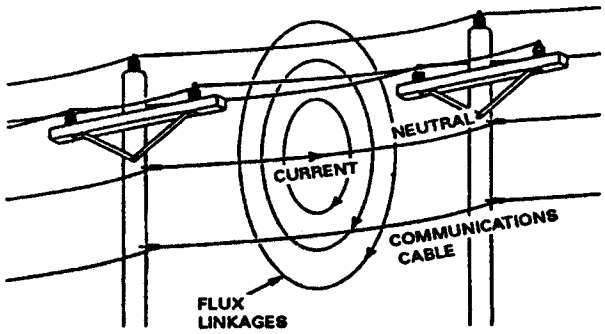

Figure 1. - Inductive coupling of power system residual currents to telephone.

Harmonic currents on the power system are coupled into communication circuits by either induction or direct conduction. ***Figure 1*** illustrates coupling from the neutral of an overhead distribution line by induction. This was a severe problem in the days of open wire telephone circuits. Now, with the prevalent use of shielded, twisted-pair conductors for telephone circuits, this mode of coupling is less significant. The direct inductive coupling is equal in both conductors, resulting in zero net voltage in the loop formed by the conductors.

Inductive coupling can still be a problem if high currents are induced in the shield surrounding the telephone conductors. Current flowing in the shield causes an IR drop (***Figure 2***) which results in a potential difference in the ground references at the ends of the telephone cable.

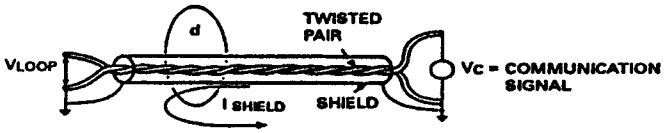

Figure 2. - IR drop cable shield resulting in potential differences in ground references at ends of cable.

Shield currents can also be caused by direct conduction. As illustrated in ***Figure 3***, the shield is in parallel with the power system ground path. If local ground conditions are such that a relatively large amount of current flows in the shield, high-shield IR drop will again cause a potential difference in the ground references at the ends of the telephone cable.

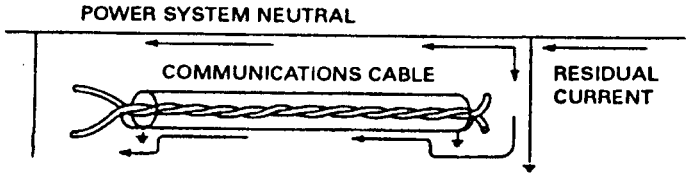

Figure 3. - Conductive coupling through a common ground path.