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PREVENTION EASIER THAN CURE OF POWER LINE RADIO INTERFERENCE

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TELECOMMUNICATION REGULATORY SERVICE

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PREVENTION EASIER THAN CURE OF POWER LINE RADIO INTERFERENCE

Practical construction rules followed in designing and erecting distribution lines will eliminate the common sources of radio interference which cause most trouble. L.V. Blake, Arkansas Power & Light Co., Pine Bluff, Ark.

(Extract from "Electrical World", September 21, 1940)

1. We believe that any distribution engineer who swaps one ounce of radio interference prevention for a pound of cure has made a bad bargain. But, fortunately, he does not have to abide by his bargain, for there are some simple rules which, if followed consistently, will result in construction of distribution lines essentially free from avoidable sources of interference. Our bargain-minded engineer can start his prevention program with his next line extension.

2. All the construction rules which can be laid down are corollaries of one simple, general rule which will keep sources of radio interference at a minimum.

3. Connect all pole hardware solidly together, or keep it spaced well apart. The corollaries are these:

   (a) See that all hardware remains tight by periodic tightening.

   (b) Keep ground wires on poles clear of all ungrounded hardware.

   (c) Keep guy wires clear of all other wires and hardware.

   (d) Keep tie wires tight; on lines of above 5 000 volts, avoid weatherproof insulation at ties and dead-ends.

   (e) In disk insulator assemblies use only standard type brass cotter pins.

   (f) Remove all pieces of "haywire" found hanging on line wires.

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4. The explanation of radio interference caused by violation of these rules has not been given the attention it deserves. Briefly, it may be said that most important causes of radio interference are associated with the electric field such as exists between any two conductors across which a voltage exists. Just as a magnetic field induces a voltage in conductors within its range, isolated conductors, such as line hardware, in an electric field are subject to electric induction. On an a.c. line a charge and discharge take place in such hardware exactly as in the plates of a capacitor. Finally, if two units of hardware thus acted upon are almost touching, the intense electric field in the small gap may ionize the air at this point and allow the formation of a continuous arc. This explains the reason for the basic rule already given that: In constructing lines of 2 300 volts and above, all pole hardware should be either solidly connected together or spaced well apart.

5. Five centimetres or more spacing between units of hardware is sufficient, although it is well to instruct linemen to provide as much spacing as is consistent with good construction.

6. Interference is caused most frequently by lines which operate in the voltage region between 5 000 and 15 000 volts, although under "ideal" conditions the same trouble will occur in 2 300 volt lines. Lines of above 15 000 volts are generally used for transmission rather than distribution; there is less hardware on the poles, and accordingly, fewer chances for this kind of trouble.

7. It is occasionally difficult for some linemen to understand exactly what occurs. As a result, some may tend to laxity in observing the rules. Seriousness of radio interference will be appreciated, however from the fact that in many cases radio interference caused by an arc between two units of hardware on a 13 kV line has been found to affect radio reception of customers along the line fifteen or more kilometres from the actual source of trouble. Frequently, customers within 1.5 kilometres of such a source of interference cannot receive any programs whatsoever.

Watch out for:

8. Discussion of the corollary rules laid down in the early part of the article may disclose some vulnerable points of construction which might otherwise be overlooked.

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(a) Keep all hardware tight. Periodic retightenings are recommended. Loose hardware is as frequent a source of radio interference as is hardware improperly spaced. If lagscrews, carriage bolts or through-bolts become loose a solid electrical connection may no longer exist between units of a hardware assembly. Arcing may therefore occur across the tiny gaps thus formed. Shrinkage of wood poles and cross arms almost inevitably results in loose hardware four or five years after a line is built. Loose cross arm braces are very often found to be causing radio interference. A periodical "tightening up" is about the only thorough remedy that can be suggested at present.

(b) Keep ground wires on poles clear of all ungrounded hardware. This rule is often violated in connection with lightning arrester ground wires on transformer poles. Particular care should be taken to keep arrester grounds clear of such electrically charged objects as insulator pins and switch assemblies, as well as cross arm braces, transformer hangers and metal "kickers". If weatherproof insulated ground wire is used, staples should not be driven hard enough to crush the insulation. If bare ground wire is used staples should be driven tight. Staples within a few feet of a high-voltage lead wire become charged, and will discharge to the ground wire if these rules are not observed.

(c) Keep guy wires clear of all other wires and hardware. An ungrounded section of guy wire (the section above the strain insulator) becomes electrically charged and care should be taken to insure against guy and neutral wires touching or slapping together in windy weather.

(d) Provide solid electrical connection between line and tie wires. This means keep tie wires tight. On circuits of above 5 000 volts, if the line wire is weatherproof insulated, the insulation should be removed at insulator ties and disk insulator dead-ends. If this is not done arcing or "spitting" will occur between the line and tie wires, especially after the insulation has aged a few years.

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(e) Avoid the use of any metals which will rust or corrode. Where rust or corrosion occurs good electrical connection no longer exists. Even such small articles as the cotter pins used in disk insulator assemblies are important in this respect - only the standard brass type should be used. Steel cotter pins or makeshifts should never be substituted. Electric discharge to a rusted or corroded cotter pin will cause considerable radio interference. Metals which ordinarily will not corrode may do so when in contact with a different metal; this principle has, of course, been recognized and taken into account in the design of special devices for making connection between copper and aluminum conductors.

Recently considerable trouble was experienced at the ties on the neutral wire (grounded) of a 7 620 volt rural line. The conductor was stranded aluminum, the ties, copper, and the neutral support brackets, galvanized iron. The cause was found to be "spitting" at some of the neutral wire ties; the lineman could hear the arc by placing his ear close to the tie. Removing the tie wire caused the radio interference to stop. This condition was occurring all along the line and was very difficult to remedy as it appeared to be due not so much to looseness of the tie as to corrosion formed by electrolytic action between the dissimilar metals.

(f) "Haywire" should always be removed when found hanging on high-voltage line wires. This should be done even if it is on the neutral wire and cannot possibly swing into contact with other wires, as radio interference will result if such pieces of scrap are rusted.

Bothersome Interference

9. In general, the most serious interference to radio reception will be caused by a discharge between two pieces of hardware when one is grounded and the other quite close to a "hot" line wire. These conditions are fulfilled, for example, when the ungrounded mounting assembly of a transformer primary switch almost touches the grounded mounting assembly of a lightning arrester, or when an arrester ground wire almost touches a steel insulator pin.

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10. On the other hand, a discharge between two ungrounded pieces of hardware may cause comparatively slight interference. An example of this sort is the arcing that takes place between the two arms of a set of loose cross arm braces or between a loose insulator pin washer and the pin itself. Note, however, that comparatively slight should not be interpreted as negligible.

11. It may be of interest to mention here that radio interference caused by the type of condition being discussed may disappear in wet weather, or may come and go with changes in temperature. During a rain, water may form a temporary "bond" between closely spaced units of hardware, literally quenching the arc. Temperature changes may cause sufficient contraction or expansion of hardware to close a small gap or widen it, causing an arc to start or stop. Ordinarily, the size of the gaps across which these troublesome arcs occur is less than 3 mm.

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