Recommended Instructions for Minimizing the Effect of Foreign Currents on Direct-Current Track Circuits

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A. Purpose

This Manual Part recommends instructions for the installation, maintenance and test of dc track circuits to minimize the effect of foreign currents. They set forth general requirements representing recommended practice.

B. General

1. Foreign dc current may be caused by cathodic protection systems, dc railway propulsion power systems, refineries, industrial plants, and dc transmission lines. Cathodic protection systems on metallic pipelines, storage tanks and other structures are the most common sources of foreign current.

2. The normal operation of these sources may cause little interference to signal systems, but a fault or other abnormality may cause serious, even if temporary, troubles. The presence of any such nearby sources of interference should be investigated.

3. While small amounts of foreign current can be found on most track circuits, this current can rise to excessive levels when the track circuit becomes unbalanced. Broken bonds, defective insulated joints, shorted surge protective devices, or unusual ballast conditions, can cause such conditions and should be corrected immediately in areas where cathodic protection systems are used.

4. An "unbalanced" circuit is one where the resistance to ground (through the ballast or rail fastenings) is different for one rail than the other, or where one rail is much longer or of different composition (resistivity) than the other. This could occur with a broken rail, since the track relay is now connected to two different lengths of rail.

5. The condition of a track section shall be such that the difference of potential between rails with no battery connected shall not be sufficient to prevent drop away of the track relay.

6. The interference from the external source bears a direct relation to the length and balance of the circuit. The voltage of the foreign current in the rails is due to the difference of the earth potential at different points. The length of the track circuit to keep it free from foreign current interference depends upon so many factors that no rules can be given as to the length to be used. The length should be shortened generally from the standards used in territory free from foreign current.

C. Cathodic Protection

1. A technique called cathodic protection is used to reduce or minimize the corrosion of the metal object where it is in contact with the soil. A negative voltage of 0.85 V on the metallic object relative to ground will usually provide satisfactory protection from corrosion.

2. This low voltage would normally not affect track circuits, however, to provide this 0.85 V difference at the far end of a 50 mile (80.5 km) pipeline section, it is sometimes necessary to apply up to 80 V at 50 A of half or full wave rectified dc at the feed end. The current returning through the ground can seriously affect nearby dc and type C track circuits by preventing the track relay from dropping (particularly in the case of a broken rail).

3. Two types of cathodic protection systems are used, one with externally powered rectifiers, and one using the battery effect of a metal or carbon anode in the soil to produce a small voltage. The systems using externally powered rectifiers are of greatest concern because of their high current supplying capability.

4. When a cathodic protection system is to be installed or is in operation near the railway right of way, tests should be carried out on all dc and type C track circuits. Tests as described below should be carried out before a cathodic protection system is energized.

D. Test Procedure to be Used in Determining the Effects of Foreign Current

1. Track circuit must first be properly adjusted for normal operation.

2. Disconnect the battery or supply at the battery or supply end.

3. Measure the current through the track relay when:

   a. Cathodic protection is turned off.

   b. Cathodic protection is turned on to normal level.

   c. Cathodic protection is turned on to maximum output capability of its rectifier.

   After each test reverse the ammeter to check for current of the opposite polarity.

4. Shunt the track at the battery end of a dc circuit or at diode end of a type C track circuit and repeat step D.3.

5. If during any of the above tests, a current of 10 mA or more is measured, the following additional tests shall be carried out:

a. Restore the track circuit for normal operation and remove any shunts.

b. For dc track circuits, install an insulated joint in one rail or otherwise open the circuit near the center of the track circuit and disconnect the rail bond to simulate a broken rail. For a type C track circuit, disconnect the diode at the end of the circuit and turn off the ac supply to the track.

c. Repeat step D.3.

6. If during any of the tests the relay current exceeds 50% of the minimum drop- away value, corrective action shall be taken.

E. Methods of Reducing Interference

1. Use a relay with a higher drop away value with maximum possible resistance between the relay and the track.

2. Use a biased neutral track relay connected so that pickup polarity of the relay is opposite to the polarity of the foreign current.

3. Reduce the length of the track circuit.

4. Arrange track circuit whereby relay will be farthest from the source of interference.

5. Replace dc track circuits with coded dc track circuits, ac vane track circuits, or other track circuits known to be immune to foreign current.

6. A cooperative study by representatives of the companies should be made to reduce the effects of interference to the track circuit:

   a. By locating the rectifier inducing the foreign current and its ground network farther away from the track.

   b. By locating the rectifier inducing the foreign current and its ground network on the same side of the track as the protected object.

   c. By splitting the protected object, i.e., pipeline, into two sections and using two cathodic protection systems with lower output current.

7. Replace all-rate decoding with specific rate decoding.

F. Recommended Maintenance Program to Minimize the Effects of Foreign Current

1. Insulated joints shall be maintained in good condition.

2. Ballast should be kept clear from rails and rail fastenings, and metallic connections from rail to ground should be avoided. Crushed rock ballast is preferable.

3. Bonds shall be of low resistance type and bonding should be maintained in good condition to ensure low resistance.

4. At railroad crossings at grade with a non-electrified and an electrified railroad, the electric energy for non-coded direct-current track circuits should feed away from the crossing.

5. Bonding and return circuit on electric railroads in the vicinity should be maintained in good condition.