Recommendation K.8

Replace by the following:

SEPARATION IN THE SOIL BETWEEN TELECOMMUNICATION CABLES AND EARTHING SYSTEM OF POWER FACILITIES

Introduction

If a buried telecommunication cable without an insulating layer around the metal sheath is located in the vicinity of a high voltage earthing system, part of the earth potential rise (EPR) in the event of an earth fault in the high voltage system can transfer to the telecommunication system through resistive coupling.

According to CCITT and CIGRE documents, EPR from high voltage power installations is recognized as a source of dangerous disturbance to telecommunication systems and a hazard to service personnel.

It is possible to calculate EPR near power installations following the methods given in the Directives (see Volumes II and III), and this is especially recommended for dealing with switchyards earthing systems.

The object of the present Recommendation is to give practical guidelines in determining safe distance between buried telecommunication cables and earthing systems of power facilities in the absence of local measurements or calculated values of EPR.

1. Scope

Earth fault in a power system causes earth currents which raise the earth potential where the fault current leaves and enters the earth. The magnitude and extension of the EPR depends on the fault current level, the earthing resistance, the soil resistivity and the layout of the earthing arrangement. The duration of an earth fault depends on the type of power network.

This Recommendation gives information about:

a) locations where EPR may occur;

b) duration of EPR in different types of power networks;

c) "safe distance" between telecommunication cables and power installations;

d) measures to be taken if safe distance is not achieved.

2. General considerations

The minimum separation in soil to be recommended between an earthing system of power installation and telecommunication cables depends on a number of factors:

- type of power network;
- fault current level;
- power earthing system;

- soil resistivity;

- local conditions.

3. Type of power network

Power networks are classified according to how the neutral point is connected to earth. The earthing system affects both the level and duration of the fault current, and hence the EPR.

3.1 Networks with the neutral point earthed directly or through a low impedance

The level of an earth-fault current is high. A relay system will clear the fault in a short time.

3.2 Networks with the neutral point earthed through an arc suppression coil

The level of an earth-fault current is small, usually not exceeding 100 amperes for each coil. The duration of an earth fault is relatively short.

Such networks may be equipped with delayed tripping to clear permanent earth faults.

3.3 Networks with the neutral point isolated from earth

The level of an earth-fault current is normally low, however, the fault duration might be very long. Networks of large extent may give rise to large capacitive fault currents.

If such networks are equipped with devices for automatic fault clearing, the fault duration is short to medium.

4. Locations where earth potential rise may occur

4.1 Power stations and sub-stations

Power stations and sub-stations are most likely to experience EPR. The size of the station, the number and construction of power lines attached to the station, and the earthing arrangement are factors influencing the level and zone of EPR. As given in Reference (4) the layout and structure of the earthing arrangement depends on regulations, size, age, purpose and location. If the power lines entering the station are provided with earth wires, they will be connected to the earthing system in the station.

4.2 Power line towers

Power line towers with footing electrodes are subjected to EPR due to earth-fault current in the power system, and currents from lightning strokes. If the power line is equipped with earth wires, these will normally be connected to the tower electrodes. The probability of high EPR decreases when a power line is equipped with earth wires.

5. Magnitude of earth potential rise

The magnitude of the EPR depends on the power system voltage, the power line construction, the fault current level and the earthing resistance.

6. Zone of earth potential rise

EPR is measured as the earth potential referred to a distant neutral earth. The zone of EPR, near an earthing system, varies from some tens to some thousands of metres, depending on soil resistivity, the layout of the earth electrode, and other local conditions. Further information is found in Reference (5). The zones of EPR in urban areas are small compared to what can be expected in rural areas. Only EPR zones having potential higher than values given in Reference (1) are considered as dangerous. Measurements and calculation of the EPR zones are made by the power distribution authorities.

7. Duration of earth potential rise

The duration of an earth fault and hence the EPR, depends on type of power network.

7.1 Networks with the neutral point earthed directly or through a low impedance

The duration of an earth fault is generally less than 0.2 - 0.5 seconds.

7.2 Networks with the neutral point earthed through an arc suppression coil

The duration of an earth fault is normally less than 0.8 second, but may in some cases last for several seconds. Such networks may be equipped with delayed (a few seconds) tripping to clear permanent earth faults.

7.3 Networks with an isolated neutral point

The duration of an earth fault can be very long, and may last until another earth fault occurs.

If such networks are equipped with automatic fault-clearing devices, the fault duration may be as short as in item 7.1.

8. Minimum separation in soil between buried telecommunication cables and power earthing systems

The EPR near a high voltage earthing system can be estimated from calculations based on idealized earth electrodes and a homogeneous soil resistivity in the EPR zone. In practice it is not possible to make an exact calculation of the potential transferred from a high voltage earthing system to an adjacent telecommunication cable. However, by feeding a current into the high voltage earthing system from a sufficiently great distance, the voltage between the cable sheath and an auxiliary electrode in the area of neutral potential can be measured. The result must be corrected proportionately to the actual earth-fault current. (On armoured cables the correction factor is not linear, but depends on the magnetic characteristic of the ferromagnetic cable screen). In the absence of other experiences, local measurements or calculated values of EPR, the following minimum separation in soil between "ordinary" telecommunication cable with a metal sheath in direct contact with the soil and a high voltage power earthing system should be observed:

TABLE 1

Separation in soil (in metres) between telecommunication cables and high voltage earthing systems beyond which no calculation nor measurement is necessary

Note 1 - Those figures are normally referring to lines and installations of which nominal voltage is equal to or higher than 132 kV.

Note 2 - The hazards due to lightning strokes on electric plants are not covered and may require to consider point 9 for high keraunic level areas.

Note 3 - In the case of tower earthing, much shorter distances can be used if the power lines include earth wires.

Note 4 - Hazard for people working on telecommunication lines inside the zone of EPR is not dealt with through such figures, and requires to consider additional measures or precautions.

9. Measures to be taken to avoid hazards from EPR

The primary method to avoid dangerous influence from EPR is to increase the distance between telecommunication cables and power earthing systems. If local conditions do not permit sufficient separation to avoid dangerous EPR, the telecommunication cables should be provided with insulation, for example by placing the cables in insulating plastic tubes.

When the magnitude of EPR is extremely high, or the zone of EPR is of extra great extension, optical fibre cables or a radio-relay systems may be used instead of metallic cables.

REFERENCES

1. CCITT Directives - Concerning the protection of telecommunication lines against harmful effects from electrified power and electrified railway lines.

2. CCITT Study GROUP V - Contribution No. 61/1979.

3. CIGRE No. 36-04/1970 - Ground potential rise and telecommunication lines.
4. ELECTRA No. 71/1980 Station grounding - Safety and interference aspects.

5. ELECTRA No. 60/1978 - Zone of influence of ground potential rise.