5.3 Design of the earthing system

The requirements described in 5.1 and 5.2, that is, shunting of unwanted power-frequency and high-frequency currents, and lowering the voltage difference between two points of the system, are the same for:

– lightning;

– personnel safety;

– installation protection;

– EMC.

Each one of these considerations places constraints on the design:

– lightning and personnel safety dictate the design of the earth electrode;

– safety and installation protection dictate the size for the earthing conductors;

– the EMC behaviour requirements determine the layout of the earthing network.

5.3.1 Earth electrode

For the earth electrode design, the first step should be the knowledge of the resistivity of the soil. This resistivity is a function of nature and homogeneity of soil, climatic conditions etc. Soil resistivity values versus nature of soil vary on a large scale, from a few ohm·meters to 10 000 Ω·m. For more details see the documents listed in the bibliography (annex D).

The earth electrode geometry should be adapted to the importance of the installation. A limited earth electrode (such as a cable or rod) may be used only in the case of very small installations such as a room or stand-alone apparatus or system.

In general, for buildings or plants, the best solution for the electrode is a meshed network buried under and around the building or the plant. In old buildings where these objectives may be difficult to attain, other measures and more careful attention to EMC concerns will be necessary. It is important to note that this recommendation does not seek to preclude existing installation practices, when they have shown to perform satisfactorily.

The meshed network of the earth electrode is often complemented by radial cables and/or earth rods at connection points of cables coming from lightning rods, high-voltage apparatus or systems, and apparatus or systems with large fault currents returning through the earthing system.

The earth electrode as a general rule should be set in natural soil, not in backfill materials and, if possible, in damp earth. Figure 2 gives an example of an earth electrode principle diagram for a plant.

Some practical points are important because they influence the long-term electrode quality.

– Solid conductors are preferably used because they are less subject to corrosion than stranded conductors.

– For the same reason (corrosion), connections between conductors are welded and not implemented by mechanical clamping. Some buildings have a concrete-encased earth electrode. This electrode is located within, and near the bottom of a concrete foundation that is in direct contact with the soil. This solution, correct for residential or office buildings, might not, on its own, have the performances required for industrial buildings.

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