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" Channelizing Energy "

ti Current Trends

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Introduction:

Electrical earthing systems play a critical role in ensuring the safety and reliability of electrical installations. By providing a low resistance path for fault currents to flow safely into the ground, earthing systems protect both **people and equipment from the dangers of electric shock and damage caused by electrical faults.** This report aims to provide a detailed examination of different types of earthing systems and best practices for their maintenance to ensure optimal performance and safety.

Types of Earthing Systems:

a. Rod Earthing: Rod earthing involves driving a metal rod, typically made of copper or galvanized steel, into the ground near the electrical installation. This rod serves as the primary electrode for the earthing system, providing a direct path for fault currents to dissipate into the earth.

b. Pipe Earthing: Pipe earthing is similar to rod earthing but involves using a metal pipe instead of a rod as the earthing electrode. The pipe is driven vertically into the ground, and like other earthing systems, it provides a low resistance path for fault currents.

c. Strip Earthing: Strip earthing utilizes a metal strip buried horizontally in the ground as the earthing electrode. The strip, typically made of copper or galvanized steel, is buried at a depth below the earth's surface to ensure good conductivity.

d. Plate Earthing: Plate earthing utilizes a metal plate buried in the ground as the earthing electrode. The plate, typically made of copper or galvanized steel, is buried vertically in a pit filled with a mixture of charcoal and salt to enhance conductivity.

e. Chemical Earthing: Chemical earthing, alternatively labelled as maintenance free earthing, represents an innovative approach in electrical safety infrastructure. It relies on the application of specialized chemical compounds strategically formulated to augment soil conductivity, thereby facilitating the establishment of a low resistance earthing electrode. This method stands out as a beacon of efficacy, especially in regions grappling with high soil resistivity or where conventional earthing techniques are rendered impractical due to various environmental or logistical constraints. By harnessing the power of chemical science, this methodology transcends traditional limitations, offering a reliable and sustainable solution to mitigate electrical hazards and ensure the integrity of electrical systems.

f. Mat earthing: Mat Earthing also referred to as grid or mesh earthing, significantly enhances safety in electrical installations by providing robust protection against faults, especially in areas where traditional methods may prove insufficient. Its key purpose lies in ensuring uniform grounding, mitigating the risks posed by high frequency interference, and enduring harsh environmental conditions such as moisture, chemicals, and temperature fluctuations. By adhering to industry standards and offering scalability for various applications, mat earthing

systems guarantee not only safety and reliability but also compliance, thus safeguarding personnel, equipment, and critical assets effectively.

Characteristics of an Effective Grounding System

Based on the IEEE standards, the grounding system is divided into:

1. TNS (Terre Neutral – Separate)
2. TNCS (Terre Neutral – Combined – Separate)
3. TT (Double Terre)
4. TNC (Neutral Terre – Combined)
5. IT (Isolated Terre)

Terre originates from the French language and means earth.

The first letter is the connection between ground and the power supply, while the second letter shows the connection between ground and electronic equipment supplied with electricity. The meaning of each letter is as follows:

- T (Terra) = Direct connection to ground.
- I (Isolation) = There is no connection to ground (even if there is a high impedance)
- N (Neutral) = Connection directly to neutral power supply cable (where this cable is also grounded in the power supply)

1. TNS (Terre Neutral – Separate)

TNS (TNS) earthing system is predominantly used in India to ensure the safety of an electrical installation and protect people and property from electrical hazards. This is achieved by providing a low resistance connection to the ground, which helps to dissipate electrical current and prevent electrical shocks or fires. In a TNS earthing system, the electrical supply is connected to the "neutral" conductor (N), and the earth conductor (S) is connected to a metallic structure, such as a metal water pipe or metal rod, that is buried in the ground. The electrical installation is connected to the "live" conductor (T). If there is a fault in the electrical installation (such as a short circuit), the fault current will flow through the earth conductor to the ground, rather than through the electrical installation or the people using it. This helps to prevent electrical shocks and damage to the electrical installation.

It is important to note that a TNS earthing system will not prevent a fault or short circuit from occurring, but it will help to ensure that the fault current is safely dissipated to the ground, protecting people and property from electrical hazards.

2. TNCS (Terre Neutral – Combined – Separate)

A TNCS system, has a neutral channel from the main distribution equipment (power source) connected to the earth and earthing at a certain distance along neutral channels leading to consumers, usually referred to as Protective Multiple Earthing (PME). With this system, a neutral conductor can function to restore the earth fault current that might arise on the consumer's side (installation) back to the power source. In this system, the installation of equipment in the consumer only connects the ground to the terminal (channel) provided by the power source.

3. **TT (Double Terre)**

   In the TT system, the neutral part of the electricity source is not directly connected with neutral earthing on the consumer side (equipment installation). In TT systems, consumers must provide their own connection to the earth, namely by installing an earth electrode that is suitable for the installation.

4. **TNC (Neutral Terre – Combined)**

   In the TNC system, the neutral channel of the main distribution equipment (power source) is connected directly to the consumer's neutral channel and the frame of the installed equipment. With this system, a neutral conductor is used as a protective conductor and a combination of neutral and earthing side frames of the equipment is known as a conductor of PEN (Protective Earthing and Neutral).

   This system is not permitted for conductors less than 10 mm^2 or for portable equipment. This is because if a fault occurs, then at the same time the PEN conductor carries the phase unbalance current and the third level harmonic current and its multiples.

   To reduce the impact on equipment and living things around the equipment, then in the application of the TNC system, the PEN conductor must be connected to a number of electrode rods for earthing on the installation.

5. **IT (Isolated Terre)**

   From the first letter (I) it is clear that, in this type of IT system, neutral is isolated (not connected) to the earth. The PE point is not connected to the neutral channel but directly connected to the earthing.

   In its application, the neutral point of the IT system is not really isolated from the earth but is still linked to the Zs impedance which has a very high value of around 1000 ohms to 3000 ohms. This serves the purpose of limiting the level of voltage overload when there is interference in the system.

Factors Influencing Earthing System Selection:

a. Soil Resistivity: Soil resistivity refers to the resistance of the soil to the flow of electrical current. It is a critical factor in determining the effectiveness of an earthing system, as higher resistivity soils require larger and more extensive earthing arrangements to achieve the desired level of protection.

b. Installation Environment: The installation environment, including factors such as space availability, soil conditions, and environmental factors like moisture and temperature, can influence the selection of the appropriate earthing system. For example, in corrosive environments or areas prone to flooding, corrosion resistant materials may be required.

c. Electrical Load: The magnitude and type of electrical load connected to the earthing system also influence its design and configuration. Higher loads may require larger or more robust earthing arrangements to safely dissipate fault currents and prevent damage to equipment.

Maintenance Practices:

a. Visual Inspection: Regular visual inspections of earthing components should be conducted to identify any signs of corrosion, damage, or deterioration. Inspections should include checking the condition of electrodes, connections, and any protective coatings or covers.

b. Soil Resistivity Testing: Periodic soil resistivity testing should be performed to assess the conductivity of the surrounding soil. This helps ensure that the earthing system remains effective and can dissipate fault currents safely.

c. Resistance Testing: Regular testing of the resistance of the earthing system should be conducted using specialized equipment such as earth testers or ground resistance meters. This helps verify that the system's resistance meets safety standards and remains within acceptable limits.

d. Cleaning and Maintenance: Earthing components should be kept clean and free of debris, rust, or other contaminants that may impair conductivity. Regular cleaning and maintenance help ensure optimal performance and longevity of the earthing system.

e. Rejuvenation: In cases where the earthing system has deteriorated or become ineffective, rejuvenation techniques such as chemical treatment or replacement of electrodes may be necessary. These measures help restore the conductivity of the earthing system and ensure continued protection against electrical faults.

Standards: The installations with regards to earthing should confirm IS: 3043/ 1987 Code of practice or any subsequent amendments in Indian standard specification, IEC, BSEN and IEEE *standards*.

Having understood the following:

1. Types of Earthing Systems
2. Characteristics of an Effective Grounding System
3. Factors Influencing Earthing System Selection
4. Maintenance Practices

We shall continue in next volume in the month of July which shall elaborate on:

1. The major issue in India related to effective grounding system.
2. Importance of Regular Maintenance
3. Challenges while testing of Earth Pit and its Circuits.
4. To address these challenges effectively,

To be continued in Volume.3 No.2 July 25th, 2024...