Products and technology

Uncovering the Invisible

Why the integrity of the ground grid needs to be checked

The grounding system is an important component for the correct function of a substation. When it is not in suitable condition, there is an increased safety risk for people, and control and measurement equipment may be affected as well. Different standard tests give an indication of the overall functionality of the ground grid but they cannot determine the precise internal condition of the grid itself.

The commissioning and maintenance strategy for electrical substations normally includes testing that assesses the condition of the ground grid: Measurements of the soil resistivity are done during the design stage; ground grid impedance and step and touch voltages are checked regularly. However, these tests cannot reveal the condition of the grid's connections that affect its continuity. Therefore, a ground grid integrity test should be done in order to assess it.

Invisible danger in older substations

The integrity test for the ground grid basically consists of verifying the continuity between two different points on the grid. It ensures that the internal connections within the grid are in a good enough condition to dissipate fault currents. Such a test is particularly important in older substations where the grid has been buried for a long period of time and it is not possible to verify the connections visually. In addition, soil with low resistance is often chosen for constructing substations, which can corrode the grid's metallic components over time. In the "IEEE Guide for Measuring Earth

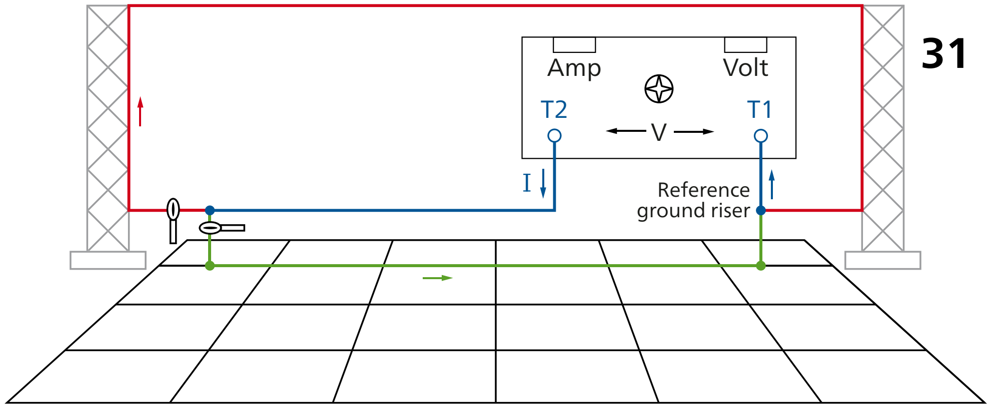

Figure 1: Measurement setup for high-current method

Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System” (IEEE 81 standard) different methods for measuring the continuity are mentioned. A 230 kV substation was examined using the ‘high-current test method’.

High-current test method

In the first step, different reference and test points are identified in the floor plan of the substation. Then the measurements are done. A DC current (ideally 50 A minimum) is injected into the ground grid from a ground riser, it then passes through the grid itself to a reference riser. One part of the current flows to the ground grid while the other part flows above ground to grounded structures. The branch current that flows to the ground grid is measured with a DC clamp meter (Figure 1) in order to determine the resistance of the conductors that are buried between the injection points. The corresponding resistance of the buried conductors is calculated based on the measured branch current and voltage values. In order to compare the resistances of different test points to each other, the distance between the two injection points has to be taken into account. Therefore, the measured resistances are divided by the distance.

A practical experience

The resistances between different reference and test points were measured in the 230 kV substation. The equipment that was used during the test was a CPC 100 for delivering the ▸

«With the CPC 100, ground impedance, step and touch voltages and integrity tests can be carried out with one test set.»

Alex Farias
Regional Application Specialist,
OMICRON

Figure 2: Only a CPC 100, a voltmeter and a clamp ammeter are used to carry out the test. ▸

300 A DC that was required, a DC voltmeter, a DC clamp ammeter and markers for identifying the test points (Figure 2). The resistances per meter were determined for several test points in the substation as shown in figure 3. The measurement showed no significant deviations between the relative resistances within the substation. All of the values were between 0.4 mΩ/m and 1.2 mΩ/m.

Further investigation is recommended if the test points show a significantly higher resistance value compared with other test points. The test point should be revealed in order to carry out a visual inspection.

In addition to measuring the impedance of the ground grid and the step and touch voltages of the substation, it is also important to be aware of the integrity of the grid itself. An integrity test for verifying the continuity of the grid at any of its points should be a standard procedure in the maintenance strategy of a substation. Thanks to the multi-functionality of the CPC 100, ground impedance, step and touch voltages and integrity tests can be carried out with one test set.

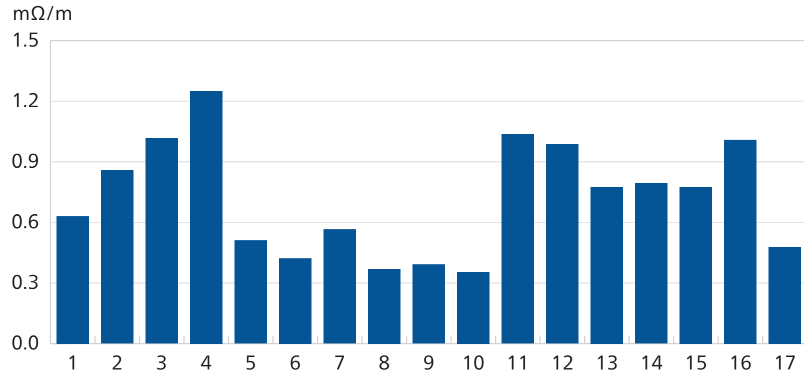

Figure 3: The diagram shows the resistances of the different test points in relation to the distance between the reference point and test point.

Raúl Comas Vargas
Specialist Consultant Engineer, Colombia

CP CU1

HGT1

CPC 100 – the multi-tool for grounding system and substation asset testing

Expanded by its accessories CP CU1 and HGT1, the multi-functional CPC 100 performs ground grid impedance and step and touch voltage measurements:

> The CPC 100 + CP CU1 reduces the power and the equipment weight needed for ground impedance measurements to a minimum. The CP CU1 ensures the galvanic isolation of the user from the object under test for enhanced protection.

> The handheld HGT1 for measuring step and touch voltages eliminates the need for a separate set of long measurement cables.

CPC 100 – The multi-tool for substation testing

With the CPC 100, you can also perform electrical tests on power transformers, current transformers, voltage transformers, rotating machines, overhead lines and cables, and circuit breakers. This makes testing with the CPC 100 a time-saving and cost-effective replacement for numerous individual testing devices.