Chapter 1
Soil Resistivity Evaluation and Grounding System Resistance

ABSTRACT
This chapter contains the factors affecting the soil resistivity and grounding resistance such as the soil moisture content, soil mineral content and soil temperature. It discusses the methods of measuring of soil resistivity and grounding resistance using Wenner method. Method to obtain the required samples for obtaining accurate site resistivity is presented. Soil resistivity measurement procedure is given in this chapter. The chapter contains three electrode method or fall-of-Potential method, dead earth method, and ground resistance testing existing systems using ‘Selective’ Clamp-on-Measuring of high voltage transmission towers feet resistance. Methods of calculating the apparent soil resistivity of Multi-Layers, apparent soil resistivity of two layers and apparent soil resistivity of three layers are presented in this chapter.

INTRODUCTION
To design the most efficient and economical grounding systems for electrical networks and substations, it is necessary to obtain accurate values of the soil resistivity on the site. The soil at the most sites is non-uniform. The first part of this chapter includes different methods of soil resistivity measurements and methods used to compute the apparent resistivity of multi-layer soil structure and comparing the calculated values with the actual measurements.

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Also, the factors affecting the apparent soil resistivity of multilayer soil are investigated. Such these factors are:

1. The number of layers of soil structure (double and three layers are considered in this chapter) and their arrangement.
2. The thickness of each layer.
3. The reflection factor between each layer.

**FACTORS AFFECTING THE SOIL RESISTIVITY AND GROUNDING RESISTANCE**

As it is known Grounding and bonding are integral part of any modern electrical protection system design. An effective, low-impedance ground system is a key element of this system. It is crucial in ensuring personnel safety, as well as providing reliable protection for vital equipment and to minimize interruptions of service and costly downtime. As shown in (Figure 1), the grounding system consists of three basic components: 1-grounding conductor, 2-the connection/bonding of the conductor to the grounding electrode and 3- the electrode itself.

The resistance of the grounding system has three basic components as follows:

1. The resistance of the grounding electrode itself and the connections to the electrode. This resistance can be ignored for its very low value in case of using electrodes and cable connections having high conductivity.
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