Preface

This book covers a study of underground power cables from some points of view. The field of underground power cables is very wide and the division into suitable chapters posed a number of problems one of them is that whatever in selected headings there is no sharp line of demarcation and considerable merging occurs in practices and there is sometimes overlapping may cause distraction in some chapters. This book gives a review as comprehensive as possible on the application of power cables. In order to handle this book easily, although many topics are covered, the tables and figures giving electrical constants and useful relations for various parameters affecting power cables capacity as well as explanations and information are collected from different sources. As it is known all underground electric distribution and power cables consist essentially of conductors having low resistance to carry the load current, good insulation to isolate the conductors from each other and from the their surroundings, metallic sheath or screen to make radial field, and non-metallic sheath to protect the metallic components from corrosion and to keep out moisture. Armoring is used in some cables for mechanical protection. Generally as the cable voltage increases the cable construction becomes more complex.

High, medium and low voltage cables usually have similar characteristics throughout the world. For wiring and different voltages level cables there are no differences in the design concept, but many individual countries have preferences for the materials used in the production. As example in the early stages of distribution cables development, the American systems used rubber as insulating materials while at the same time the impregnated paper was widely used as insulation for low and medium cables in Europe and other countries. Now thermoplastic and thermostet materials are used as insulation for cables around the world.

In 1950 full commercial PVC as thermostet insulation for wiring system was produced, by the end of the same year PVC power cables was in use. In 1959, 275 kV oil filled cables were in operation. The oil filled cables voltage is increased to 400 kV by the end of 1969. Since 1970 gradual extension of the use of thermostet insulation, mainly XLPE is carried out as an alternative to paper insulation. In 1980 until now rapid use of XLPE as insulation is noticed in medium cables 11kV-33 kV range with significant quantities installed for transmission voltages for voltage ranges 66 kV – 400 kV.

All distribution companies face some problems of power interruptions which cause major financial losses for utilities and the customers. One of the network components prone to breakdown is the cable. It is noticed that an increase was happened in the rate of the failure numbers in MV power cables during the years 2009 to 2013. By investigating the causes of these cumulative failures it is found that 48% of these faults are caused by breakdown of joints and terminations, 19% are happened by internal faults and 33% of the failures are carried out by others such as digging activities. Figure 1 shows the percentage rate of cumulative failures of medium voltage cables rate through years from 2009 to 2013.
These defects may occur due to inaccurate assembling of joints and terminations. Installed cables are, moreover, subject to natural aging, or due to temporary extreme circumstances overload, overvoltage degradation and under design stresses (particularly electrical and thermal) or other factors of influence (digging, water …). Once the fault occurs in the cable, the utility isolates the faulted cable from grid and starts to pinpoint the location of fault.

Figure 1. Cumulative failure rate from 2009 to 2013