

Preface

Low voltage unearthed AC and DC networks have been for long commonly applied for supply of power and control circuits in industry, transportation, medical objects, etc. The main reasons for their use are high reliability and numerous advantages offered by isolating the networks against ground.

Similar to other electrical systems, also in unearthed (IT) networks insulation level, is a decisive factor for operational reliability and safety. Electrical networks insulation fulfills the following main functions:

- establishing path for current flow,
- elimination of various hazards including electric shock and fire risks.

The basic technical parameter determining condition and quality of electrical insulation is its resistance. Insufficient level of this parameter can cause various disturbances. According to statistic data ground faults are the most frequent type of failures in AC and DC networks. Other common defects include line-to-line faults, breaks (broken wires), voltage loss, or its abnormal deflections. Ground faults in IT systems do not make networks operation impossible, however, they may cause severe problems with their safe functioning. Therefore, special attention should be paid to these abnormal conditions, possible threats created by them, and ways for their detection and elimination.

It has been proved that many insulation breakdown cases do not happen suddenly but are the final stage of a long degradation process. This fact is a strong argument for conducting continuous supervision over insulation condition to ensure timely detection of possible problems. The main causes of electrical insulation deterioration are aging, mechanical and thermal stresses, overvoltages, humidity, chemical factors, oil, radiation, etc. Continuous monitoring is an indispensable tool for preventive maintenance, which allows to avoid possible faults caused by insulation condition deterioration. Information about current insulation level helps users to achieve high reliability and safety of electrical systems.

AC and DC IT systems, as isolated against ground under normal operation, allow—in distinction from TN and TT systems—to fulfill continuous insulation monitoring. As a result, substantial qualities offered by these systems can be

exploited. Compared to TN and TT systems, electrical unearthed networks are featured by:

1. high safety and reliability of operation, namely
 - insulation-to-ground monitoring is possible only in networks isolated against ground,
 - networks can operate with a single ground fault,
 - it is possible to conduct preventive maintenance due to on-line insulation monitoring in live network,
 - insulation breakdowns can be detected without delay,
 - insulation monitoring can be fulfilled both in live and in de-energized networks,
2. smaller fire and explosion hazards,
3. lower shock currents and touch voltages,
4. higher permissible resistance of devices protective earthing.

Utilization of these advantages is dependent on conducting correct insulation monitoring. Importance of electrical networks insulation monitoring has been known for long, but only rapid development of electronic and microprocessor technologies has led to implementation of sophisticated methods and systems. However, for their proper application adequate knowledge of electrical systems operation is indispensable. Therefore, in this book there are described most important issues concerning normal operation and ground fault phenomena occurring there. Theoretical basis of these subjects is delivered in concise form. Numerous methods of insulation parameters measurement in live circuits are presented. Few other procedures of the parameters determination based on measurement and calculation are explained. Some of them were proposed by the author. Practically all formulas are derived. For the text understanding merely a basic knowledge of electrical circuits theory is required. Overview of selected insulation measurement devices as well as fault locating systems is included. This book is addressed to electrical engineers, technicians, and students of this specialty. The author hopes that its extended second edition will supplement scant information about the subject available in existing publications.

Insulation Measurement and Supervision in Live AC and
DC Unearthed Systems

Olszowiec, P.

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