Chapter 10
Mobile Measuring Complex for Conducting an Electric Network Survey

Alexander Vinogradov
Federal Scientific Agroengineering Centre VIM, Russia

Vadim Bolshev
https://orcid.org/0000-0002-5787-8581
Federal Scientific Agroengineering Centre VIM, Russia

Alina Vinogradova
Federal Scientific Agroengineering Centre VIM, Russia

Maxim Borodin
Orel State Agrarian University, Russia

Alexey Bukreev
Orel State Agrarian University, Russia

Igor Golikov
Orel State Agrarian University, Russia

ABSTRACT

An energy audit of the electrical network is required in the process of constructing new electrical networks as well as in justifying the reconstruction need of existing ones. In this chapter, the structure of a mobile measuring complex has been developed to conduct an electrical network survey without disconnecting consumers. The complex can be used to inspect 0.4 kV electrical networks and microgrids of the same voltage class and allows data collection on voltage losses and electric power losses in network elements such as a power lines (electric transmission line), and power transformers. The energy audit is conducted without disconnecting consumers in order to avoid an undersupply of electricity as well as to determine the real operating modes of power networks. Ultimately, the use of the developed measuring complex will increase the reliability of the power supply to consumers and ensure the required quality of the electricity supplied to them.

DOI: 10.4018/978-1-5225-9420-8.ch010

Copyright © 2020, IGI Global. Copying or distributing in print or electronic forms without written permission of IGI Global is prohibited.

INTRODUCTION

An energy audit of the electrical network is required in the process of construction of new electrical networks as well as in justifying the reconstruction need of existing ones. At the same time, it is necessary to obtain data on voltage losses and electric energy losses in network elements such as electric transmission lines (ETL) and power transformers. It is desirable to obtain such a survey without disconnecting consumers in order to studying the real network operating modes as well as to avoid undersupply of energy to them. Of particular relevance is the examination of microgrids containing renewable energy sources (RES) and distributed generation (DG) (Kharchenko et al., 2019). In this case, it is important to understand how the parameters of the network operating modes change at different loads and operation modes of energy sources. This will allow to correctly set up the generating equipment and to choose equipment for the storage of electricity, protective devices. Thus, the development of a mobile measuring complex is required, which allows for the examination of microgrids and networks in various operating modes without disconnecting consumers.

The issue of electrical network surveys is also closely related to the issues of ensuring the quality of the supplied electrical energy. Issues of improving power quality (PQ) as well as problems associated with PQ inconsistency time with regulation requirements have been repeatedly considered in the works of Sudnova et al. (2007), ZHelezko (2002), Kartashev (2001), Vinogradov et al. (2018), Vinogradov et al. (2019a) and Vinogradov et al. (2019b). However, they did not propose solutions for the creation of mobile measuring complexes (MIC) for energy audit of electrical networks.

Taking into account the fact that the length of electric networks of voltage class of 0.4 (0.38) kV across Russia is more than 770 thousand kilometers (Standards PJSC Rosseti, 2017), it is not possible to equip all power lines of this voltage with systems of continuous monitoring of operating modes in a short time. This is also the rationale for the development of the MIC since a MIC allows for surveys of a significant number of electrical networks. In addition, a large number of 10/0.4 of kV power transformers are operated in distribution electrical networks, many of which have already worked out the standard service life and have excessive no-load losses due to repairs and a long service life (Vinogradov et al., 2015). Periodic assessment of the level of no-load losses (steel losses) of these transformers will make it possible to make timely decisions on their replacement in case of excessive losses.

An analysis was made of existing devices and technical solutions that allow energy audit in electrical networks. The analysis showed that the technical level of the existing energy audit means does not allow the automatic collection of electrical network parameters at various locations. In addition, the existing solutions of these means are not mobile enough and are not able, in particular, to analyze the estimate of electric power losses in 10/0.4 kV power transformers without disconnecting from the load.

Automation of measuring systems allows to minimize the labor costs related to conducting surveys of electrical networks and significantly simplify the energy auditor work while improving the measurement accuracy. It becomes also possible to obtain a kind of passport of the examined electrical network due to the reading from the studied electrical network in real time. Technical solutions for creating a mobile measuring complex for inspecting electrical networks should be able to process data collected from network control points not only separately, but also as general interconnected information. Existing devices analyzing the power quality do not fully possess the necessary properties since they are used for other purposes.

23 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:
www.igi-global.com/chapter/mobile-measuring-complex-for-conducting-an-electric-network-survey/232096

Related Content

Theoretical and Experimental Evaluation of Impact on Soil by Wheel Drives of the Self-Propelled Seeder
Alexandr Vladimirovich Lavrov, Maksim Nikolaevich Moskovskiyand Natalia Sergeevna Kryukovskaya (2020). *Handbook of Research on Energy-Saving Technologies for Environmentally-Friendly Agricultural Development (pp. 139-163).*
www.irma-international.org/chapter/theoretical-and-experimental-evaluation-of-impact-on-soil-by-wheel-drives-of-the-self-propelled-seeder/232092

Cost of Capital and Methods of Charging Interest
(2018). *Agricultural Finance and Opportunities for Investment and Expansion (pp. 190-208).*
www.irma-international.org/chapter/cost-of-capital-and-methods-of-charging-interest/201766

The Influence of Social Media on Food Choices: A Bibliometric Approach
irin Gizem Köseand Ece Özer Çizer (2023). *Influences of Social Media on Consumer Decision-Making Processes in the Food and Grocery Industry (pp. 1-23).*
www.irma-international.org/chapter/the-influence-of-social-media-on-food-choices/328371

Design of an Agribusiness Innovative and Autonomous Robot System for Chemical Weed Control for Staple Food Crops Production in Sub-Saharan Africa
Jibril Abdullahi Bala, Olayemi Mikail Olaniyi, Taliha Abiodun Folorunsoand Emmanuel Daniya (2021). *Opportunities and Strategic Use of Agribusiness Information Systems (pp. 234-262).*
www.irma-international.org/chapter/design-of-an-agribusiness-innovative-and-autonomous-robot-system-for-chemical-weed-control-for-staple-food-crops-production-in-sub-saharan-africa/266584

Propagation of Stingless Bees Using a Colony Split Technique for Sustainable Meliponiculture
Shamsul Bahri Abd Razak, Muhammad Izzhan, Nur Aida Hashimand Norasmah Basari (2023). *Recent Advances in Global Meliponiculture (pp. 190-205).*
www.irma-international.org/chapter/propagation-of-stingless-bees-using-a-colony-split-technique-for-sustainable-meliponiculture/315999