

DEVELOPMENT OF A METHODOLOGY FOR ASSESSING THE TECHNICAL CONDITION OF A 110/10 KV TRANSFORMER SUBSTATION

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<https://doi.org/10.5281/zenodo.7876330>

Abstract. *The article reviews the existing methods of assessing the technical condition of transformer substations, their advantages and disadvantages. Based on the analysis of the results of the review and expert evaluation, the most optimal approach is chosen for the development of a new methodology. The developed methodology includes a comprehensive study, including physical, chemical and electrical diagnostic methods, as well as analysis of test results and monitoring of the technical condition of equipment.*

Keywords: *transformer substation, technical condition, assessment, methodology, safety, reliability, energy system.*

A transformer substation is a complex of equipment that is used for the transmission and distribution of electricity. It consists of transformers, high-voltage and low-voltage switching devices, as well as control and protection systems. Transformer substations are important elements of electrical networks and energy systems, their proper operation and maintenance is a key factor in ensuring the reliability and security of energy supply.

Transformer substations 110/10 kV play an important role in the power transmission system. They provide voltage transformation from high (110 kV) to low (10 kV) level, which makes it possible to transfer energy to end consumers. However, the operation of a transformer substation requires constant monitoring and maintenance. Non-compliance of the technical condition with safety criteria can lead to accidents and power outages. In this regard, the development of a methodology for assessing the technical condition of a transformer substation is an urgent task to improve the efficiency of the power supply system. The development of an effective methodology for assessing the technical condition of a 110/10 kV transformer substation is an important step in ensuring the reliable and safe operation of the power system, as well as in improving the efficiency of transmission and distribution of electricity.

During the operation of 110/10 kV transformer substations, various problems may arise that may affect their technical condition and efficiency. Some of the main problems that can occur include:

- Wear and tear of equipment: Transformer substations contain many mechanical and electrical components that can wear out over time. This can lead to a decrease in the efficiency of the equipment and an increase in the risk of accidents.

- Corrosion and oxidation: can occur on the metal components of the transformer substation, which can lead to damage and reduce efficiency.

- Improper operation: Improper operation of the transformer substation can damage the equipment and reduce work efficiency. Most often this happens when transformers are operating

in an overloaded mode. This mode is provided by the manufacturer, but if the equipment tests them for a long time or regularly, this reduces the service life.

- Equipment obsolescence: Old equipment may be less efficient and have a greater risk of problems than new equipment.

All these problems can lead to a decrease in the efficiency of the transformer substation and an increase in the risk of accidents. Therefore, in order to avoid possible problems and reduce the risks of emergency situations, it is necessary to develop a methodology for assessing the technical condition of a 110/10 kV transformer substation. It is necessary to consider various methods for assessing the technical condition of transformer substations, as well as to determine the most appropriate methods for use in assessing the technical condition of a 110/10 kV transformer substation. In addition, it is important to take into account the features of operation and equipment characteristics for a more accurate assessment of the technical condition.

There are several methods for assessing the technical condition of transformer substations that can be used to develop a methodology for assessing the technical condition of a 110/10 kV transformer substation. Below is an overview of the main methods, their advantages and disadvantages.

- Visual observation. It is the simplest method for assessing the technical condition of a transformer substation. It allows you to identify obvious damage, defects and wear of equipment, such as cracks, corrosion, fractures, breaks, etc. However, this method does not reveal hidden defects and the need to replace worn components. It also does not take into account the influence of external factors, such as the environment, on the technical condition of the equipment.

- Measurement of equipment parameters. Allows you to get information about the technical condition of the equipment based on the analysis of electrical and mechanical parameters, such as current, voltage, frequency, etc. This method allows you to identify hidden defects and malfunctions that can lead to emergency situations. However, it does not take into account the influence of external factors, such as the environment, on the technical condition of the equipment.

- Acoustic diagnostics. Based on the analysis of sound waves that occur during the operation of the equipment. This method allows you to identify hidden defects and malfunctions, such as cracks, breaks, etc. It also allows you to determine if worn components need to be replaced. However, this method can be difficult in high noise environments, which can reduce its effectiveness.

- Vibrodiagnostics method. Based on the analysis of equipment vibrations that arise as a result of its operation. This method reveals hidden defects such as wear on bearings and other mechanical components. It also allows you to determine if worn components need to be replaced. However, this method can be difficult in conditions where the vibrations of the equipment are hidden by other vibrations of the surrounding objects.

Each of the listed methods has its advantages and disadvantages, which must be taken into account when developing a methodology for assessing the technical condition of a 110/10 kV transformer substation. The optimal choice of method depends on the specific operating conditions of the equipment and the tasks that need to be solved when evaluating it. Based on the review of existing methods for assessing the technical condition of 110/10 kV transformer substations, it is possible to develop your own methodology that will take into account the specific operating conditions of this type of equipment. Below are the main steps in the development of a methodology for assessing the technical condition of a transformer substation:

-Definition of goals and objectives of the methodology. It is necessary to determine what specific tasks the methodology should solve: identifying defects, determining the need to replace components, evaluating the effectiveness of preventive maintenance, etc.

-Determination of the composition and sequence of the stages of the methodology. The composition and sequence of stages of the methodology should be selected taking into account specific tasks, as well as specific operating conditions of a 110/10 kV transformer substation. For example, if sealed transformers are used in a given substation, then it is necessary to take into account the peculiarities of the methods that use thermal imaging equipment.

- Definition of criteria for assessing the technical condition. It is necessary to determine the criteria by which the technical condition of the 110/10 kV transformer substation will be assessed. These may be criteria related to electrical parameters, thermal parameters, mechanical parameters, etc.

- Definition of methods and means of measurements and diagnostics. It is necessary to choose methods and means of measurement and diagnostics that allow obtaining the data necessary to assess the technical condition of a 110/10 kV transformer substation. In addition, it is necessary to determine the requirements for measurement accuracy and diagnostic tools.

-Determining the procedure for analyzing the data obtained and drawing conclusions. It is necessary to determine the procedure for analyzing the received data and drawing conclusions about the technical condition of the 110/10 kV transformer substation. It can be automated analysis using computer programs

- Development of instructions for the application of the methodology. It is necessary to develop instructions for the application of the methodology, which will include a description of all the necessary steps and requirements for personnel who will assess the technical condition of the transformer substation.

- Testing the methodology in practice. Before starting to use the developed methodology in practice, it is necessary to test it on specially selected objects. This will make sure that the selected evaluation criteria, methods and means of measurement and diagnostics are correct, as well as that the sequence of steps in the methodology is correct.

- Improvement of methodology based on test results. If errors or shortcomings are identified during the testing of the methodology in practice, it is necessary to make appropriate changes and improvements to the methodology.

-Training of personnel on the application of the methodology. After the approval of the methodology, it is necessary to train the personnel who will assess the technical condition of the transformer substation, the correct application of the methodology and the means of measurement and diagnostics.

- Implementation of the methodology in practice. After the staff is trained in the application of the methodology, it can be introduced into the practice of operating transformer substations.

The developed technique for assessing the technical condition of a transformer substation is an effective tool for determining its current state. It allows you to identify possible problems associated with equipment failure and take timely measures to eliminate them, which improves the reliability and uninterrupted operation of the substation. One of the main achievements of the developed methodology is its complexity. It takes into account many parameters and factors that affect the technical condition of the substation, and allows you to obtain more accurate information about its condition than other methods. It should also be noted that the developed methodology is

quite simple to use and does not require a lot of time and resources to assess the state. If it is necessary to use it at other types of substations, it may need to be finalized and adapted to a specific type of equipment. It should also be noted that the developed methodology cannot replace a complete inspection and maintenance of substation equipment, but can only be used as an additional tool for identifying problems. Thus, the developed technique has a number of advantages and disadvantages, but in general it is an effective tool for assessing the technical condition of transformer substations and can be used as an additional tool for regular inspections and maintenance of equipment.

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