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Analysis of External Effects on Heating of Existing Power Oil Transformers

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Abstract: The increase in resistance of materials due to rising ambient temperatures is taken into account. The main goal of the study is to study the most serious situations that can occur due to climate change. Under these circumstances, it can be concluded that power and distribution transformers need to be evaluated step-by-step for safe operation, which is not only cost-effective for utilities, but also a process of delivering reliable electricity to many large enterprises.

Keywords: Ambient temperature, power oil transformer, resistance change, climate change, reliability.

Introduction: The reliable and efficient operation of high voltage oil transformers depends on their level of maintenance and operation. It is known that high-voltage oil transformers consist of the following structural elements: magnetic system, winding, winding wires, insulation, tank, cooling device, voltage control mechanism, various protection and measuring devices. Each of these elements of the transformer participates in the operation process and affects its technical performance in different degrees. However, the service life of high-voltage oil transformers mainly depends on the condition of paper oil insulation [1].

Analysis of the causes of failure of high-voltage oil transformers shows that the lack of special preventive measures leads to failure of electrical devices to reach their nominal operating resources. The main reasons leading to the failure of transformers are considered to be a decrease in electrical strength of the insulation due to contamination of the oil with various impurities and increased humidity [2].

According to GOST 11677-85 [3], the service life of power oil transformers is set at 25 years. Nevertheless, the number of power oil transformers that are working longer than the specified service life is constantly increasing. A study of foreign literature shows that "obsolescence" of power oil transformers is observed in all developed countries. For example, more than 40% of high-voltage power oil transformers in Russia have a service life of more than 25 years [4]. More than 24% of total power oil transformers in Japan have been in operation for more than 30 years [5]. In Ukraine and Belarus, this indicator reaches 40% [6] and 60% [7-9], respectively. The state of "obsolescence" of the complex of power oil transformers was also observed in the USA. According to the US Electric Power Institute (EPRI), 65% of power oil transformers in the US power grid have been in operation for more than 25 years [10-15].

The current economic situation does not allow a complete renewal of the transformer complex. Therefore, maintaining the level of reliable operation of outdated electrical devices is one of the most important tasks of the electric power industry at the current stage [16-20].

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Research materials and methods

In order to increase the service life of power oil transformers, it is necessary to use new and modern methods of timely servicing of these electrical devices and early detection of possible faults. The method of research and comparison of oil temperature and external temperature of power oil transformers in long-term operation was used. Power oil transformers under investigation.

1-jadval

№	Turi	Quvvati, kVA	Kirish/chiqish kuchlanishi, U	Ekspluatatsiya vaqti
1.	TDTN	32 000	110/6	1984 yil
2.	TDTN	16 000	110/6	1982 yil

Obtained results and their discussion

As a result of the study, the influence of external ambient temperature on transformer oil in long-term operational transformers with TDN type capacity of 32 MVA and 16 MVA in June for two times of the day: between 800 and 900 in the morning, when relatively little influence of external ambient temperature on the transformer is observed and the state parameters between 1700 and 1800, which may be more affected by the external temperature, were investigated.

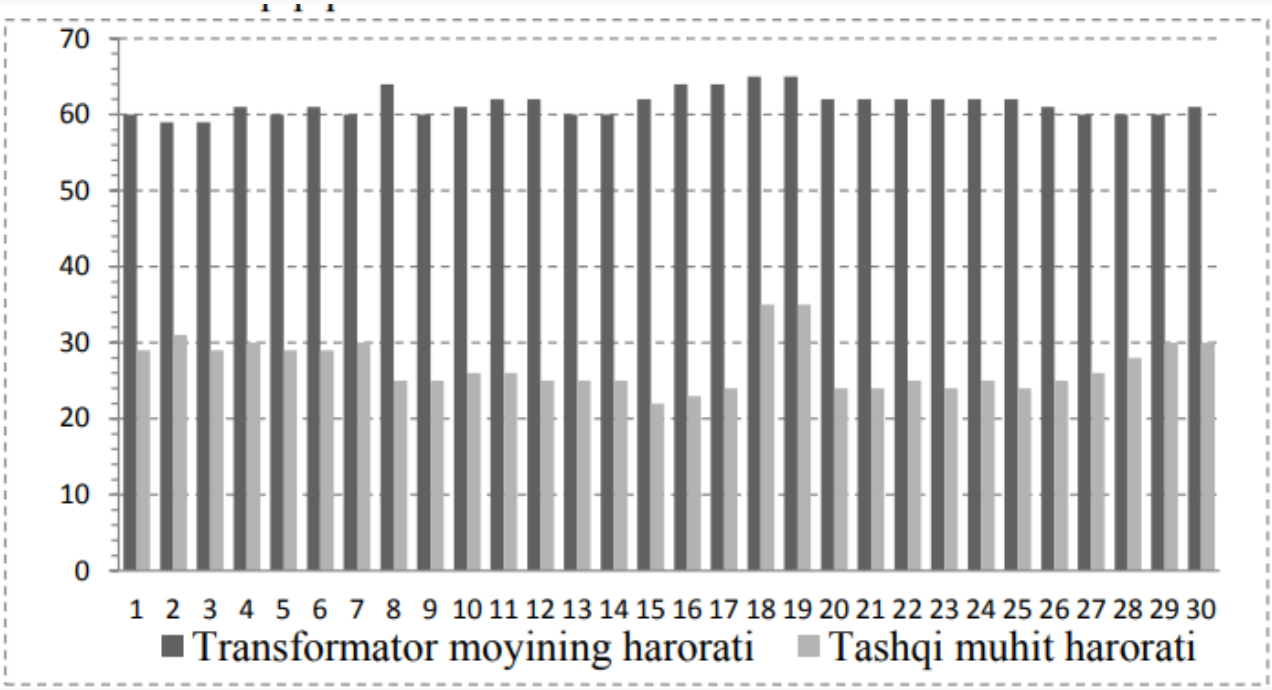

Figure 1. The influence of external temperature on the oil temperature of a TDN type transformer with a capacity of 32 MVA in the range of 800 - 900

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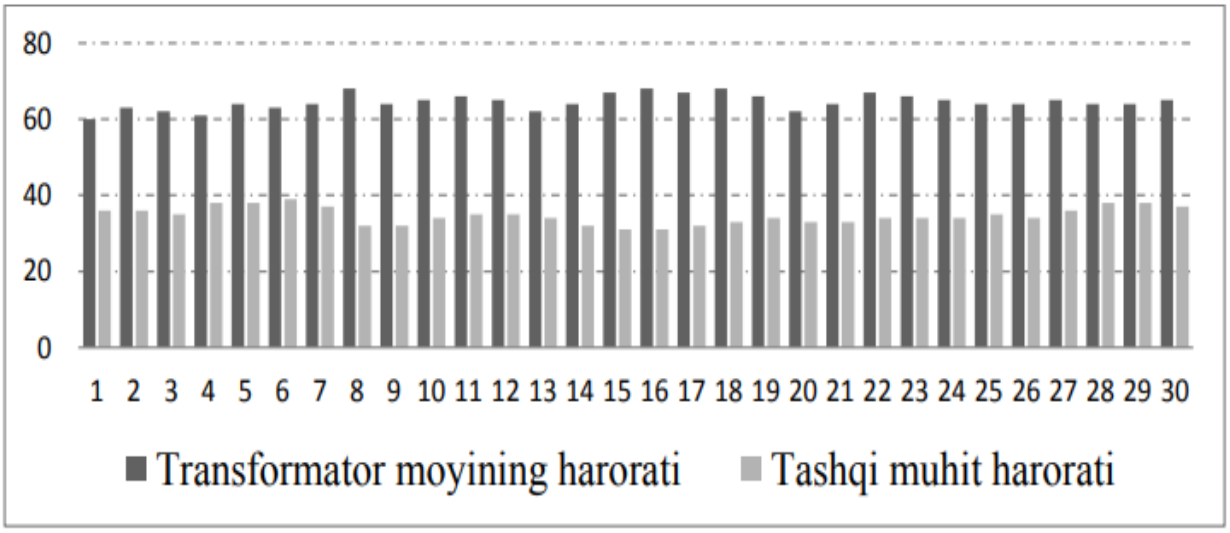

Figure 2. The effect of external temperature on the oil temperature of a TDN type transformer with a capacity of 32 MVA between 1700 and 1800

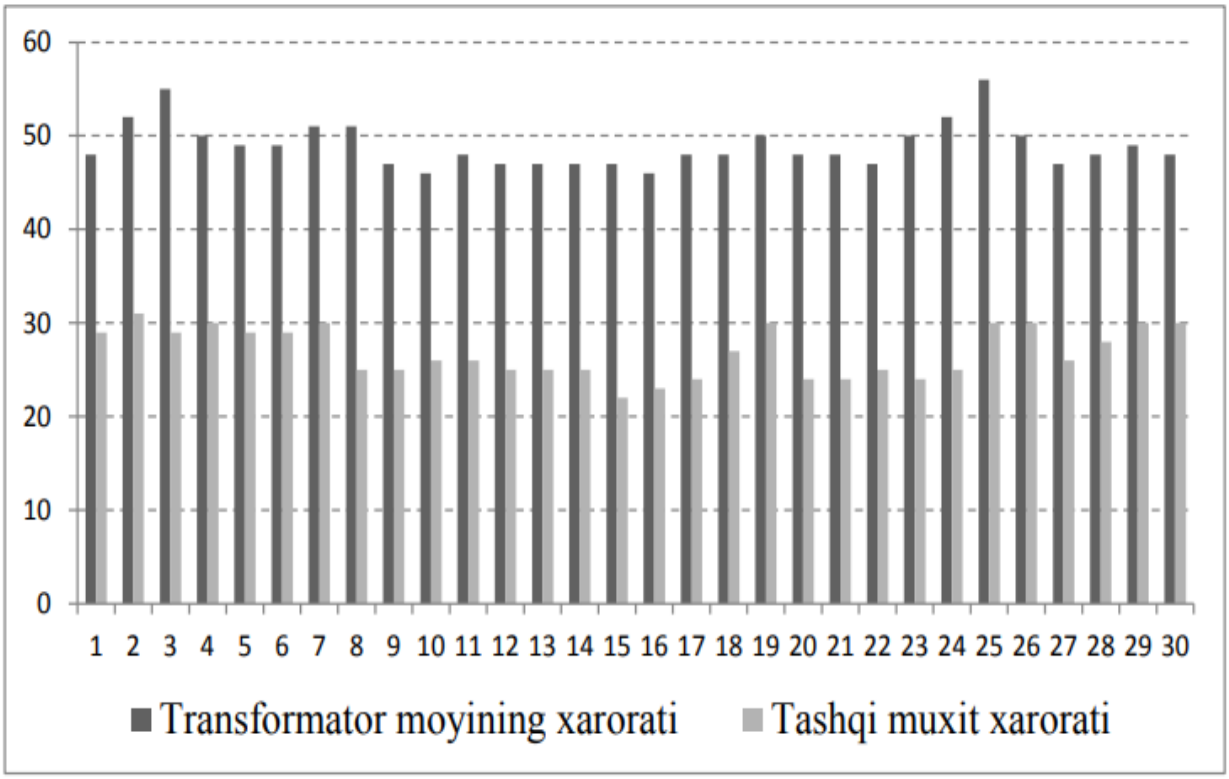

Figure 3. The effect of external temperature on the oil temperature of a TDN type transformer with a capacity of 16 MVA in the range of 800 - 900

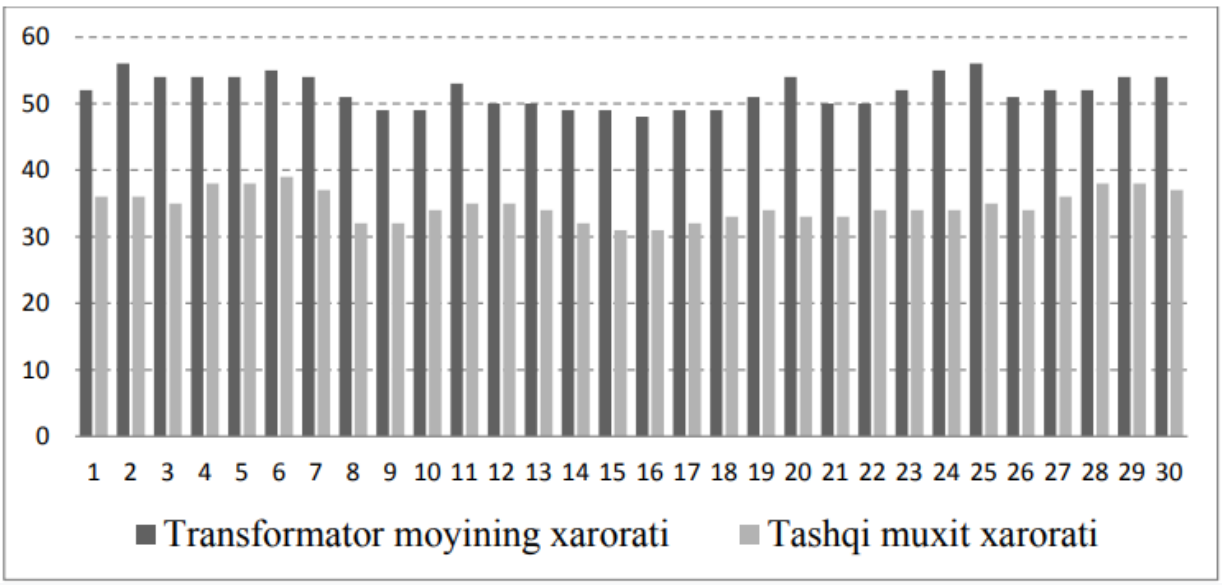

Figure 4. The effect of external temperature on the oil temperature of a TDN type transformer with a capacity of 16 MVA between 1700 and 1800

The result of the study shows that for the first power oil transformer of TDTN type with a capacity of 32 MVA, the smallest temperature difference between the external environment and the transformer oil is 280C for the period of 800-900 hours, 230C for the period of 1700-1800 hours and the most the big difference was 410C for the period of 800-900 hours, and 37oC for the period of 1700-1800 hours. For the second power oil transformer of TDTN type with a capacity of 16 MVA, the smallest temperature difference between the external environment and the transformer oil is 880C for the period of 800-900 hours, 140C for the period of 1700-1800 hours, and the largest difference is 800 - It was equal to 260C for the period of 9:00, and 210C for the period of 1700-1800.

Conclusion

As a result of the analysis of the determined values according to the results of the research, the increase of the transformer oil beyond the norm is changing depending on the temperature of the external environment. In order not to affect the production process, it is necessary to reduce the effect of external temperature on the transformer. For this, it is recommended to use special air-coolers. Transformers are recommended to use special blowers that blow air and a simple perfect and effective transformer oil cooling system, in which the forced circulation of oil equipped with pumps for forced circulation of oil allows to obtain the same temperature distribution along the height of the transformer and increases the cooling efficiency of the transformer.

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