ANALYSIS OF THE TECHNICAL CONDITION OF POWER AUTOTRANSFORMERS

https://doi.org/10.5281/zenodo.15233080

Djurayev Shuxrat Ixtiyorovich
teacher
Shamiyev Ergashjon Fayzullo o'g'li
magistrant
Eshtemirov Jamshidbek Olimjon o'g'li
student
Karshi State Technical University

Аннотация

Показатели надежности и эффективности работы электрических станций, подстанций и электрических сетей определяются уровнем надежности работы основного электротехнического оборудования, в частности силовых трансформаторов и автотрансформаторов. Поэтому крайне важно обеспечить мониторинг, прежде всего, для определения технического состояния столь важных элементов и принятия решений о дальнейшей стратегии деятельности.

Ключевые слова

мониторинг, техническое состояние трансформаторов и автотрансформаторов, электрооборудование.

Annotation

Indicators of reliability and efficiency of operation of power plants, substations and electrical networks are determined by the level of operational reliability of the main electrical equipment, in particular power transformers and autotransformers. Therefore, it is most important to provide monitoring to determine the technical condition and make decisions on the strategy for the further operation of such critical elements in the first place.

Keywords

monitoring, technical condition of the transformer and autotransformer, electrical equipment.

The technical condition of a power transformer and autotransformer is characterized by a large number of condition parameters (signs) x_i, the values of which can be obtained using both standard measuring instruments and by

AMERICAN JOURNAL OF EDUCATION AND LEARNING
ISSN: 2996-5128 (online) | ResearchBib (IF) = 9.918 IMPACT FACTOR
Volume-3| Issue-4| 2025 Published: |30-04-2025|

conducting additional tests on operating or disconnected equipment. With a large number of state parameters x_i, the task of constructing a fuzzy knowledge base of an information system representing a set of statements about the cause-and-effect relationships "state parameter – technical condition class" becomes difficult.

In [2, 3] for electrical equipment, input variables xi are classified into groups and a hierarchical multi-level knowledge base is formed, consisting of nested fuzzy knowledge bases of lower dimensionality.

Конструктивная схема масляного трансформатора

1 — выхлопная труба; 2 — газовое реле; 3 — ввод НН; 4— ввод ВН; 5— обмотки высшего и низшего напряжений; 6 — радиаторы системы охлаждения; 7 — магнитопровод; 8— кран для слива масла; 9 — тележка с катками; 10 — бак; 11 — устройство регулирования напряженмя под нагрузкой (РПН); 12 — термосифонный фильтр; 13 —воздухо-осушитель; 14 — указатель уровня масла; 15— расширитель; 16 — соединительная трубка

Fig. 1 shows the developed hierarchical structural diagram of fuzzy logical inference on the technical condition and decision-making on the strategy for further operation of a power oil transformer and autotransformer.

Information on the condition of a transformer and autotransformer, grouped by types of measurements and tests [4], has the following structure:

1. Chromatographic analysis of dissolved gases (CADG). x_{11},…x_{17}- respectively, the concentration of hydrogen (H_2), methane (CH_4), acetylene (C_2H_2), ethylene (C_2H_4), ethane (C_2H_6), carbon monoxide (CO), carbon dioxide (CO_2).

2. Physicochemical analysis of oil. x_{21},..x_{27}- respectively minimum breakdown voltage ($U_{пр}^{\min}$); dielectric loss tangent (tgδ_M); acid number (KOH), flash point ($T_{всп}$), gas content ($C_г$), presence of particles and mechanical impurities ($C_{мп}$), humidity (w).

3. Measurements to determine the state of solid insulation. x_{31},.. .x_{35}- respectively, the tangent of the dielectric loss angle (tgδ), the insulation resistance of the windings (R_{60},R_{15}), the insulation capacitance ($C_{из}$), the concentration of furans ($C_ф$).

4. Measurements in the no-load experiment. x_{41} - no-load current (I_{xx}), x_{42}- no-load losses (ΔP_{xx}).

5. Tests to measure short-circuit resistance. x_{41} - short-circuit resistance $z_к$.

6. Measuring winding resistance to direct current. x_{61} - winding resistance to direct current.

7. Other types of measurements and tests x_{71} – x_{7j}.

Having the results of each type of tests and measurements of the transformer using a certain set of features and the corresponding knowledge base Xj (j = 1,m), it is possible to assess the technical condition of the transformer and assign it to a certain class of states (normal, or faulty with a defect of a certain type), assessed based on the results of this type of tests or measurements.

REFERENCES

1. Shouket, H. A., Ameen, I., Tursunov, O., Kholikova, K., Pirimov, O., Kurbonov, N., ... & Mukimov, B. (2020, December). Study on industrial applications of papain: A succinct review. In *IOP Conference Series: Earth and Environmental Science* (Vol. 614, No. 1, p. 012171). IOP Publishing.

2. Turdiboyev, A., Aytbaev, N., Mamutov, M., Tursunov, A., Toshev, T., & Kurbonov, N. (2023, March). Study on application of electrohydraulic effect for disinfection and increase of water nutrient content for plants. In *IOP Conference Series: Earth and Environmental Science* (Vol. 1142, No. 1, p. 012027). IOP Publishing.

3. Abdullayevich, Q. N. (2023). EFFICIENCY OF USE OF FREQUENCY CONVERTER WITH SMOOTH CONTROL OF ASYNCHRONOUS MOTOR SPEED. *Galaxy International Interdisciplinary Research Journal*, *11*(5), 448-449.

4. Abdullayevich, Q. N. (2023). Ways to Reduce Losses in Power Transformers. *Texas Journal of Engineering and Technology*, *20*, 36-37.

5. Abdullayevich, Q. N., & Elmurodovich, B. O. (2023). ПРОВЕДЕНИЕ ЛАБОРАТОРНЫХ ЗАНЯТИЙ ПО ЭЛЕКТРИЧЕСКИМ СХЕМАМ. *Новости образования: исследование в XXI веке*, *1*(7), 1006-1010.

6. Abdullayevich, Q. N. (2023). REDUCING ELECTRICITY LOSSES IN ELECTRICAL DISTRIBUTION NETWORKS DUE TO MULTICRITERIA OPTIMIZATION OF LINE SECTIONS. *MODELS AND METHODS FOR INCREASING THE EFFICIENCY OF INNOVATIVE RESEARCH*, *3*(28), 275-279.

7. Mahmutxonov, S. J., Qurbonov, N., & Babayev, O. (2022). ELEKTR TARMOQLARIDA SIFAT KO ‘RSATKICHLARI VA ISROFLAR. *Innovatsion texnologiyalar*, *47*, 14-15.

8. Abdullayevich, Q. N. Muzaffar o'g'li, NT (2023). *ASSESSMENT OF THE INFLUENCED FACTORS ON THE INDICATORS OF SPECIFIC ELECTRICITY CONSUMPTION AT INDUSTRIAL ENTERPRISES. FORMATION OF*

PSYCHOLOGY AND PEDAGOGY AS INTERDISCIPLINARY SCIENCES, *2*(20), 8-10.

9. Abdullayevich, K. N., & Olimjon o'g'li, E. J. (2024). USING CONSUMER-REGULATORS TO EQUALIZATION OF ELECTRICAL ENERGY SYSTEM LOAD SCHEDULE. *JOURNAL OF MULTIDISCIPLINARY BULLETIN*, *7*(4), 25-29.

10 Abdullayevich, Q. N. Almardon o'g'li, NA, & Bahodir o'g, QOA (2024). *INFLUENCE OF ELECTRICAL ENERGY QUALITY ON ELECTRICAL ENERGY WASTE*. *Научный Фокус*, *1*(9), 786-789.

11. Abdullayevich, Q. N. (2023). REACTIVE POWER COMPENSATION. *IMRAS*, *6*(6), 506-508.

12. Abdullayevich, K. N., & Olimjon o'g'li, E. J. (2024). FUNCTIONS OF FACTS DEVICES WITH INNOVATION TECHNOLOGY IN THE ELECTRICAL ENERGY SYSTEM. *JOURNAL OF ENGINEERING SCIENCES*, *7*(5), 12-16.

13. Abdullayevich, K. N., & Olimjon o'g'li, E. J. (2024). МАТЕМАТИЧЕСКАЯ МОДЕЛЬ АВТОМАТИЧЕСКОГО РЕГУЛЯТОРА ВОЗБУЖДЕНИЯ АРВ. *SCIENTIFIC APPROACH TO THE MODERN EDUCATION SYSTEM*, *3*(25), 374-379.

14. Abdullayevich, K. N., & Olimjon o'g'li, E. J. (2024). АНАЛИЗ ТЕХНИЧЕСКОГО СОСТОЯНИЯ СИЛОВЫХ АВТОТРАНСФОРМАТОРОВ. *THE THEORY OF RECENT SCIENTIFIC RESEARCH IN THE FIELD OF PEDAGOGY*, *2*(21), 45-48.

15. Abdullayevich, K. N., & Olimjon o'g'li, E. J. (2024). АНАЛИЗ ТЕХНИЧЕСКОГО СОСТОЯНИЯ СИЛОВЫХ АВТОТРАНСФОРМАТОРОВ. *THE THEORY OF RECENT SCIENTIFIC RESEARCH IN THE FIELD OF PEDAGOGY*, *2*(21), 45-48.

16. Abdullayevich, K. N. (2024). НОРМАТИВНЫЕ ПОТЕРЬ ЭЛЕКТРОЭНЕРГИИ В РАСПРЕДЕЛИТЕЛЬНЫХ СЕТЯХ 10, 6 и 0, 4 кВ. *THE THEORY OF RECENT SCIENTIFIC RESEARCH IN THE FIELD OF PEDAGOGY*, *2*(21), 55-60.

17. Abdullayevich, Q. N., Almardon o'g'li, N. A., & Bahodir o'g, Q. O. A. (2024). INFLUENCE OF ELECTRICAL ENERGY QUALITY ON ELECTRICAL ENERGY WASTE. *Научный Фокус*, *1*(9), 786-789.

18. Abdullayevich, Q. N., Almardon o'g'li, N. A., & Bahodir o'g, Q. O. A. (2024). ENSURING ELECTRICAL ENERGY QUALITY IN TEXTILE ENTERPRISES. *Научный Фокус*, *1*(9), 794-797.

19. Курбонов, Н. А., Халикова, Х. А., & Неъматов, Б. А. О. (2024). ВОПРОСЫ ПАРАЛЛЕЛЬНЫЕ РАБОТЫ ЭНЕРГОСИСТЕМЫ

АФГАНИСТАНА, УЗБЕКИСТАНА И ТАДЖИКИСТАНА С УЧЕТОМ НОВОГО СТРОИТЕЛЬСТВА. *Eurasian Journal of Academic Research*, *4*(6-1), 37-41.

20. Usmanov, E., Rajabboeva, A., Kurbonov, N., & Kurbanova, K. (2024, June). Operational logic scheme of the sketch base for an educational simulator in the fundamentals of power supply. In *AIP Conference Proceedings* (Vol. 3152, No. 1). AIP Publishing.

21. Abdullayevich, K. N. (2024). ЭНЕРГИЯНИ ТЕЖАШ ВА ЭНЕРГИЯ САМАРАДОРЛИГИ СОҲАСИДА ИННОВАЦИОН ФАОЛИЯТНИ БОШҚАРИШДА ЛОЙИҲА ЁНДАШУВИДАН ФОЙДАЛАНИШ. *THE THEORY OF RECENT SCIENTIFIC RESEARCH IN THE FIELD OF PEDAGOGY*, *2*(25), 363-367.

22. Abdullayevich, Q. N., & Muzaffar o’g’li, N. T. (2024). NORMALIZATION MODES OF HYDROGENERATORS. *THE THEORY OF RECENT SCIENTIFIC RESEARCH IN THE FIELD OF PEDAGOGY*, *2*(25), 368-371.

23. Abdullayevich, Q. N., & Muzaffar o’g’li, N. T. (2024). FACTORS AFFECTING SPECIFIC ELECTRICITY CONSUMPTION IN INDUSTRIAL ENTERPRISES. *THE THEORY OF RECENT SCIENTIFIC RESEARCH IN THE FIELD OF PEDAGOGY*, *2*(25), 372-376.

24. Abdullayevich, K. N. (2024). ЭЛЕКТР ЭНЕРГИЯ СИФАТИНИ ЭЛЕКТР ЭНЕРГИЯ ИСРОФИГА ТАЪСИРИ. *PEDAGOG*, *7*(9), 183-188.

25. Abdullayevich, K. N. (2024). ИНТЕЛЛЕКТУАЛЬНЫЙ МОНИТОРИНГ РЕЖИМОВ ЭЛЕКТРИЧЕСКИХ СЕТЕЙ. *Новости образования: исследование в XXI веке*, *3*(26), 203-208.

26. Abdullayevich, K. N. (2024). ОЦЕНКА ВЛИЯЮЩИХ ФАКТОРОВ НА ПОКАЗАТЕЛИ УДЕЛЬНОГО РАСХОДА ЭЛЕКТРОЭНЕРГИИ НА ПРОМЫШЛЕННЫХ ПРЕДПРИЯТИИ. *PROSPECTS AND MAIN TRENDS IN MODERN SCIENCE*, *2*(13), 531-536.

27. Abdullayevich, K. N. (2024). ANALYSIS AND EVALUATION OF THE EFFECTIVENESS OF ENERGY SAVING IN INDUSTRIAL ENTERPRISES. *SCIENTIFIC APPROACH TO THE MODERN EDUCATION SYSTEM*, *3*(28), 75-81.

28. Abdullayevich, Q. N., & Abduzairovna, N. M. (2024). ЭЛЕКТР ТАЪМИНОТИ ТИЗИМИДА РАҚАМЛИ ПОДСТАНЦИЯЛАРДАН ФОЙДАЛАНИШ МАСАЛАЛАРИ. *Eurasian Journal of Academic Research*, *4*(9), 71-75.

29. Ixtiyorovich, D. S. (2023). CONDUCTING LABORATORY CLASSES ON ELECTRICAL CIRCUITS. Научный Фокус, 1(1), 84-88.

30. Джураев, Ш. И., & Махмудов, Н. Ш. (2023). ДОСТИЖЕНИЕ ЭНЕРГОЭФФЕКТИВНОСТИ МНОГОЭТАЖНЫХ ДОМОВ С ПОМОЩЬЮ ФОТОРЕЛЕ. European Journal of Interdisciplinary Research and Development, 15, 55-57.

31. Джураев, Ш. И. (2023). СМЕШАННОЕ СОЕДИНЕНИЕ РЕЗИСТОРОВ. БАЛАНСИРОВКА МОСТА. Scientific Impulse, 1(7), 859-861.

32. Mamarasulova, F., Bobojonov, Y., Djurayev, S., & Karimova, N. (2023). Stimulating environmental protection activities in the energy sector. In E3S Web of Conferences (Vol. 461, p. 01099). EDP Sciences.

33. Ixtiyorovich S. D. et al. АСИНХРОННАЯ МАШИНА С ПЕРЕКЛЮЧЕНИЕМ ПОЛЮСОВ //Новости образования: исследование в XXI веке. – 2024. – Т. 2. – №. 20. – С. 768-772.

34. Makhmutkhanov, S., Akhrom, J., Djurayev, S., & Bozorov, I. (2024, June). Stimulating environmental protection activities in the energy sector. In *AIP Conference Proceedings* (Vol. 3152, No. 1). AIP Publishing.

35. Файзиев, М. М., Ибрагимов, И. И., Джураев, Ш. И., & Мухаммадиев, А. В. У. (2023). ОПРЕДЕЛЕНИЕ ПАРАМЕТРОВ ЛИНИИ ЭЛЕКТРОПЕРЕДАЧ С ПОМОЩЬЮ ПРОГРАММНОМ ОБЕСПЕЧЕНИИ MATLAB SIMULINK. *Наука, техника и образование*, (2 (90)), 23-27.

36. Ixtiyorovich, D. S., & Abdullayevna, X. X. (2023). ANALYSIS AND EVALUATION OF ENERGY SAVING EFFICIENCY IN COCONOMOTAL INDUSTRIAL ENTERPRISES. *Scientific Impulse*, *1*(10), 2144-2149.

37. Ixtiyorovich, D. S. (2023). СТАТИЧЕСКИЕ ОПИСАНИЯ ТРЕХФАЗНОГО ТРАНСФОРМАТОРА С УЧЕТОМ ЧУВСТВИТЕЛЬНЫХ ЭЛЕМЕНТОВ. *Новости образования: исследование в XXI веке*, *2*(15), 1183-1189.

38. Ixtiyorovich, D. S., & Abdullayevna, X. X. (2023). STABILIZATION OF SINGLE-PHASE LOAD CURRENT IN THREE-PHASE CIRCUITS. *Scientific Impulse*, *1*(10), 1811-1813.

39. Beitullaeva, R., Tukhtaev, B., Norboev, A., Nimatov, K., & Djuraev, S. (2023). Analysis of pump operation in common pressure pipelines using the example of the "Chirchik" pumping station. In *E3S Web of Conferences* (Vol. 460, p. 08015). EDP Sciences.

40. Mamarasulova, F., Bobojonov, Y., Djurayev, S., & Karimova, N. (2023). Stimulating environmental protection activities in the energy sector. In *E3S Web of Conferences* (Vol.461, p. 01099). EDP Sciences.

41. Abdullayevich, K. N., O'G'Li, M. F. A., O'G'Li, E. J. O., & O'G'Li, P. A. B. (2024). MARKOV ZANJIRI USULI VA O 'LCHANGAN SHAMOL

TEZLIKLARIDAN FOYDALANGAN HOLDA YANGI SHAMOL TEZLIKLARINI BASHORAT QILISH. *Eurasian Journal of Academic Research*, *4*(11-2), 7-12.

42. Abdullayevich, K. N., & Abdullayevna, X. X. (2024). EFFECTIVENESS OF USING A FREQUENCY CONVERTER WITH SMOOTH SPEED CONTROL OF AN INDUCTION MOTOR. *Новости образования: исследование в XXI веке*, *3*(27), 151-154.

43. Abdullayevich, K. N., Shuhrat o'g'li, O. S., & Olimjon o'g'li, E. J. (2024). STRUCTURE OF LOW VOLTAGE ELECTRICAL NETWORKS. *AMERICAN JOURNAL OF MULTIDISCIPLINARY BULLETIN*, *2*(5), 112-119.

44. Markaev, N., Abdiraxmonov, I., Davletov, I., & Tukhtaev, B. (2023). Energy characteristics of electrotechnological processing of grape cuttings. In E3S Web of Conferences (Vol. 434, p. 01031). EDP Sciences.

45. Yunusov, R. F., Parmanov, A. E., Karimov, I. N., Rajabov, M. N., Tuxtayev, B. B., & Raxmonov, S. S. (2023, August). Methodology for calculating the characteristics of linear induction motors for low-speed process equipment. In IOP Conference Series: Earth and Environmental Science (Vol. 1231, No. 1, p. 012059). IOP Publishing.

46. Ixtiyorovich, D. S., & Bekmurod o'g'li, P. A. (2024). ИСПОЛЬЗОВАНИЕ ЭНЕРГИИ ВЕТРА. *Научный Фокус*, *2*(20), 830-836.

47. Ixtiyorovich, D. S., & Bekmurod o'g'li, P. A. (2025). USING WIND ENERGY. *ZAMONAVIY TA'LIM TIZIMINI RIVOJLANTIRISH VA UNGA QARATILGAN KREATIV G'OYALAR, TAKLIFLAR VA YECHIMLAR*, *7*(75), 91-97.

48. Abdullayevich K. N., Shuhrat o'g'li O. S., Olimjon o'g'li E. J. STRUCTURE OF LOW VOLTAGE ELECTRICAL NETWORKS //AMERICAN JOURNAL OF MULTIDISCIPLINARY BULLETIN. – 2024. – Т. 2. – №. 5. – С. 112-119.

49. Abdullayevich Q. N., Muzaffar o'g'li N. T. NORMALIZATION MODES OF HYDROGENERATORS //THE THEORY OF RECENT SCIENTIFIC RESEARCH IN THE FIELD OF PEDAGOGY. – 2024. – Т. 2. – №. 25. – С. 368-371.

50. Abdullayevich, K. N., Abdullayevna, X. X., & Ne'Matov Buxor Akrom, O. G. (2024). ВОПРОСЫ ПАРАЛЛЕЛЬНЫЕ РАБОТЫ ЭНЕРГОСИСТЕМЫ АФГАНИСТАНА, УЗБЕКИСТАНА И ТАДЖИКИСТАНА С УЧЕТОМ НОВОГО СТРОИТЕЛЬСТВА. *Eurasian Journal of Academic Research*, *4*(6-2), 19-23.

51. Abdullayevich, K. N., & Mansur o'g'li, C. D. (2025). МЕТОДЫ И МЕРЫ ЭНЕРГОСНАБЖЕНИЯ В СИСТЕМЕ НАРУЖНОГО ОСВЕЩЕНИЯ ГОРОДА. *INNOVATIVE DEVELOPMENTS AND RESEARCH IN EDUCATION*, *3*(35), 388-394.

52. Abdullayevich, K. N., Tulqin o'g'li, X. M., & Mansur o'g'li, C. D. (2025). УМЕНЬШЕНИЕ ПОТЕРЬ ЭЛЕКТРОЭНЕРГИИ В РАСПРЕДЕЛИТЕЛЬНЫХ

ЭЛЕКТРИЧЕСКИХ СЕТЯХ ЗА СЧЕТ МНОГОКРИТЕРИАЛЬНОЙ ОПТИМИЗАЦИИ СЕЧЕНИЙ ЛИНИЙ. *IMRAS*, *8*(3), 35-43.