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STRENGTH IN INDUSTRIAL AND MANUFACTURING ENTERPRISES INVESTIGATION OF TRANSFORMERS WORKING MODES.

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Annotation: *The article deals with the analysis of loads of parallel working transformers, optimization of power transformer operating modes and study of operating transformer operating modes operating in different operating modes.The article discusses the issues of achieving energy savings through the automation of transformer substations of industrial enterprises using modern programmable logic controllers.Reliability decisions are made at each level of management of the development and functioning of electricity: in pre-design development, at all stages of power system design, installation of facilities, operation of power generation, operational and dispatch management, planning and regulatory, as well as regulatory other modes should be adopted in automated and automatic control, planning and carrying out repair work.*
Key words: *Power System, Electrical Equipment, Electricity, Generation, Remote Control, Relay Protection, Alarm, Automation, Recording, Voltage Change. P ower transformer, I dle mode, S hort circuit mode, load mode, P ower loss*

The power supply system of industrial enterprises will be built to provide electricity to consumers of enterprises. Consumers include those in the home; electric drives of various mechanisms, electric furnaces and electrothermal equipment, electrolytic punches, hardware and machines required for electric welding, lighting punches, electric filters and so on.

enterprises will be reduced and transmitted to consumers. The power supply scheme of an industrial enterprise should take into account the future development required by consumers, have minimal losses, allow for quick repairs and ensure low initial capital expenditures. Therefore, in the process of power supply design, several variants of the schemes are developed and the best technical and economic performance is adopted from them. Requirements for power supply are determined by the technological process and capacity of the enterprise . Depending on the installed capacity of consumers in the enterprise, they are divided into large (over 75 MW) , medium (5-75 MW) and small (up to 5 MW) facilities . Large and medium -sized enterprises are supplied with electricity from 35,110,220 and 330 kV substations , and small - capacity enterprises , in most cases , from 6.10 kV . Schemes with a single receiving point (BPP, MTP) are used in the power supply of small and medium-sized enterprises . Such a scheme is used at voltages of 6, 10 and 20 kV and when the enterprise is 5-10 km away from the power system . Shown If the power supply is interrupted on one of the lines, the supply is automatically restored to the second line using an inter-section switch . In this case , there are transformers between the external and internal circuits , and the system voltage is reduced to 6-20 kV. The power of the transformers and the cross-sections of the line wires are obtained so that they operate in normal mode with a load of 60-70% . When one line and transformer are disconnected, the second line and transformer operate with permissible overload and ensure uninterrupted operation of the enterprise. The use of disconnectors and q is q a connectors instead of a circuit breaker on the high-voltage side of the BPP leads to a considerable reduction in the power circuit q .

When a transformer is damaged, the short circuit is triggered by the relay protection and an artificial T mode occurs . As a result , the circuit breaker at the head of the line is disconnected and the automatic reconnection (AC) system is activated.

During a “non-toxic” break in the line, the disconnector R extends the damaged transformer. The AKU system reconnects the line after a “non-toxic” pause and q ti is complete, and the undamaged transformer is connected to the source. Medium and large power plants receive most of their electricity through high - voltage power lines . The inward power supply circuit is minimal In the range of devices and circuits of transformers is understood as circuits that have a voltage of e and maximize the high voltage (35, 110, 220,330 kV) to electrical installations .

We determine the optimal operating modes of two TM-1000/10 transformers installed at the shop transformer substation supplying electricity to the industrial enterprise. It is known that while ensuring the operation of power transformers n at the same time at the minimum value of power losses, it is necessary to take into account the active power losses in the power supply system, as additional active power losses as a result of reactive power consumption of the transformer from power plant generators to transformers occurs.

Power losses in transformers (including power supply losses)

$$\Delta P_T^{`} = \Delta P_X^{`} + K_3 \Delta P_K^{`}, \quad (1)$$

where $\Delta P_X^{`} = \Delta P_X + K_{И.П.} \Delta Q_X -$ the power dissipation of the transformer is given in the salt operating mode; K $_Z$ - load factor of the transformer; $\Delta P_K^{`} = \Delta P_K + K_{И.П.} \Delta Q_K -$ the specified power dissipation in the short-circuit operation mode of the transformer; K $_{I.P.}$ - coefficient of variation of wastes.

The description of the dependence of the load losses of transformers on the change in load capacity S is given in Figure 1: Figure 1 - description $\Delta P_T = f(S_H)$, when one transformer is operating, and description 2 - when the second transformer is operating. The load-dependent variation of the power losses reported during the simultaneous operation of both transformers is represented by Description 3.

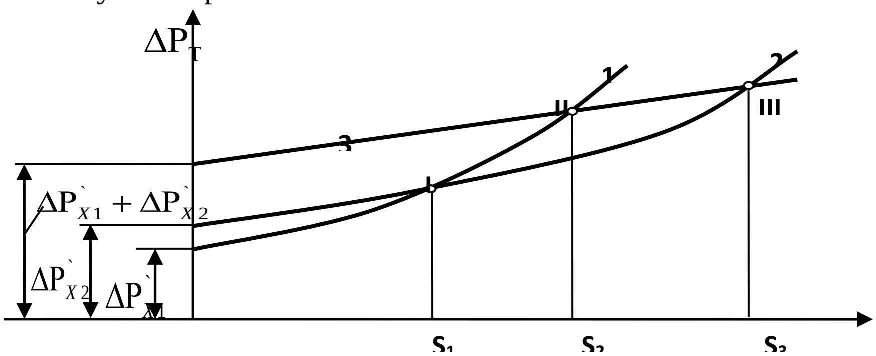

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Figure 1. Described the dependence of the active power losses of transformers on the change $\Delta P_T^`$ in load S $_n$

Equation (2) can be written as follows:

$$\Delta P_T^` = \Delta P_X^` + \frac{\Delta P_K^`}{S_{ном.T}^2} S_н^2, (2)$$

where the $S_{ном.T}$ $-$ rated power of the transformer .

We accept the following definitions: $\Delta P_X^` = a; \Delta P_K^` / S_{ном.T}^` = b.$

Then $\Delta P_T^` = a + bS_H^2. (3)$

The intersection of the calculated parabolic equations descriptions I , IIand III(see Figure 1) and these points S $_1$, S $_2$, S $_3$ of the load, respectively.corresponds to the values of These coordinates are the joint solutions of the equations, representing the power losses during the alternating and simultaneous operation of the transformers, and allowing to determine at which load values one transformer is operating, the other is connected, and finally the three transformers are connected. The indices in the equations correspond to the descriptions in the figure above.

equation $\Delta P_{T1}^` = \Delta P_{T2}^`$, then:

$$S_{H1} = \sqrt{(a_2 - a_1)(b_1 - b_2)}, (4)$$

where S_{H1} $-$ the load power for the case where the power loss of the first transformer is equal to the power loss of the second transformer (point S $_1$ in the figure).

For n transformers of the same power

$$S_{H1} = S_{ном.T}\sqrt{n(n-1)\Delta P_X^` / \Delta P_K^`}. (5)$$

1 corresponding to point $_1$ can be determined graphically or analytically. When the load value is less than S $_1$, the operation of a transformer is economically feasible, and its power dissipation corresponds to characteristic 1. With a load value of up to S $_2$, it is preferable that a second transformer with an economically acceptable capacity greater than the first is operated. When the load value is greater than S $_2$, both transformers will need to operate.

(5) can be used to determine the parallel operation of two or more transformers in low-cost mode using the expression; it is also possible to determine how cost-effective it would be to add an additional single transformer to a group of operating transformers.

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Analysis of loads of transformers operating in parallel . The use of multiple transformers connected to a single load is called parallel operation of transformers. In transformer substations, the load varies continuously over time, depending on the amount and capacity of electricity consumers : at night it is minimal, during the day or evening it is maximum, and if such a load is overloaded, one transformer can fail. To prevent this, a second transformer is connected in parallel to it, in which the load is distributed between them.

When transformers have the same number of phases, the voltages of the primary and secondary windings and, consequently, the transformation coefficients on the voltage are also the same; connecting groups of coils; the short - circuit voltage is the same (the difference is allowed to be no more than ± 10%); when the current frequency is the same; can operate in parallel when the rated power does not exceed the 3: 1 limit. When the second and third conditions are violated, equalizing currents are generated in the windings of transformers connected in parallel. If the fourth condition is violated, the load between the transformers connected in parallel is not distributed proportionally to their rated power. In order to connect transformers that meet the listed conditions to operate in parallel, it is necessary to check that their parts are properly marked under low voltage. To do this, the high-voltage winding of a three-phase transformer is connected in a star mode (Fig. 2, see *a*), *VY q* is given a low-voltage single-phase alternating current relative to the rated phase voltage, then between the parts of the transformer U_{BY}, e_{AX}, e_{CZ}, e_{AC}, U_{AB} and Ua_{VS} voltage and EYuK are measured with a voltmeter. A full magnetic flux passes through the middle rod of phase V, half of it passes through the end rods of phase *A* and C transformers, and the number of windings in all phases is the same. Therefore, the voltmeter, if its parts are correctly marked, *AX* and *SZ, show* the voltage between the parts, i.e., the voltage equal to half the voltage applied to the *VY coil.*

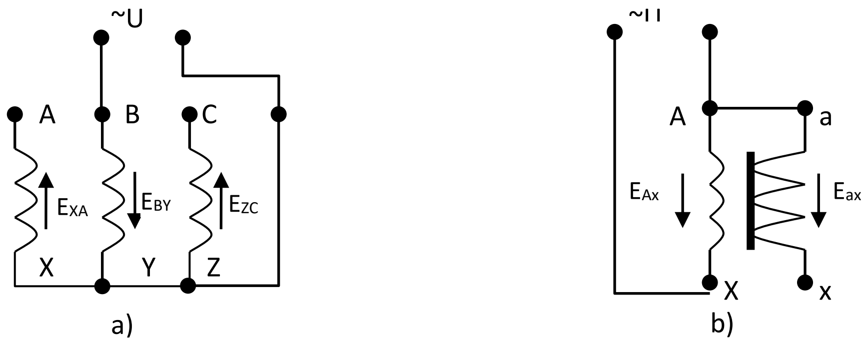

Figure 2 Check that the parts of the two-phase three-phase transformer windings are correctly marked: *a* - high voltage,
b - low voltage **.**

Voltage $U_{AB} = U_{VS} = 1.5\ U_{VY}$. If the coils are incorrectly marked, the reading of the voltmeter is determined by the difference of EYuKs, i.e. $U_{AB} = 0.5\ U_{BY}$ *A* phase marking must be changed. The marking of the low-voltage windings is checked sequentially for each phase according to the scheme shown in Figure 3, b.

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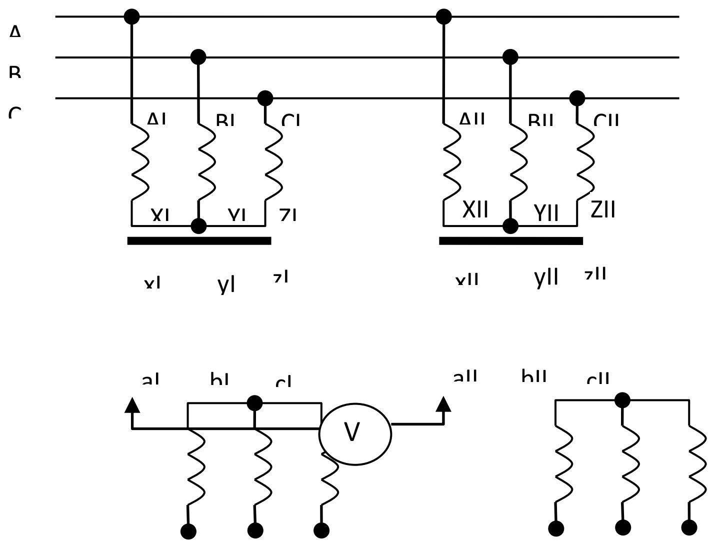

Figure 3Connecting two three-phase transformers Check the uniformity of the group h l a rin i ng .

uniformity of the winding connection groups of two three-phase transformers is checked by measuring the voltage between the one-piece parts of these transformers (Fig. 3). Transformers belong to the same group if the voltage between the parts of the same name is zero and the voltage between the parts of the same name is the same and the line voltage is zero. will be.

All phase voltages of one transformer must be equal to h each phase voltage of the other transformer. If there is no such equation, the transformers belong to different groups and it is impossible to connect them to parallel operation, because the resulting rectifying current is greater than the short-circuit current, ie many times greater than the rated current.

elements of the power supply system of industrial enterprises are substations and cableways . Improper choice of power of transformers and shortcomings in their management have a significant impact on the amount of losses in the enterprise . The main disadvantages of this are the transformerImproper selection and installation of q power is h . In the present article, the issues of development of methodological recommendations on overcoming these shortcomings will be considered. To solve this task , limiting the salt operation of transformers and replacing low - load transformers with other low- power transformers or selecting different power transformers operating in parallel can give the expected result. We will consider the selection of different power transformers operating in parallel . In addition , strict regulation of the order of calculations requires the creation of an algorithm for the selection of criteria .

Initially, the nominal capacity of different power transformers operating in parallel at the substation is determined based on the number of transformers in stock of the enterprise and how the power density is distributed in the shops. Categories of electricity consumers are selected by loading coefficients. According to it, b = 0.65-0.75 for Category 1 consumers, b = 0.75-0.85 for

Category 2 consumers and b = 0.85-0.95 for Category 3 consumers . The load factor of transformers is determined by the following expression:

$$\beta = \frac{S_{ЮК}}{S_{HT1} + S_{HT2} + \ldots} \quad (6)$$

Then the rated total power of the transformers does not exceed 3: 1

n = 2 - the number of transformers in the substation (this size is often equal to two) is found and a finally the number of transformers and the number of their phases are the same after the power is selected, the voltages of the primary and secondary windings and, consequently, the voltage transformation coefficients; connection methods and groups of coils; the short-circuit voltage is the same (the difference is allowed to be no more than ± 10%); considering that the current frequency is the same, the transformers are finally selected. Figure 4 shows the algorithm for selecting different power transformers operating in parallel in transformer substations .

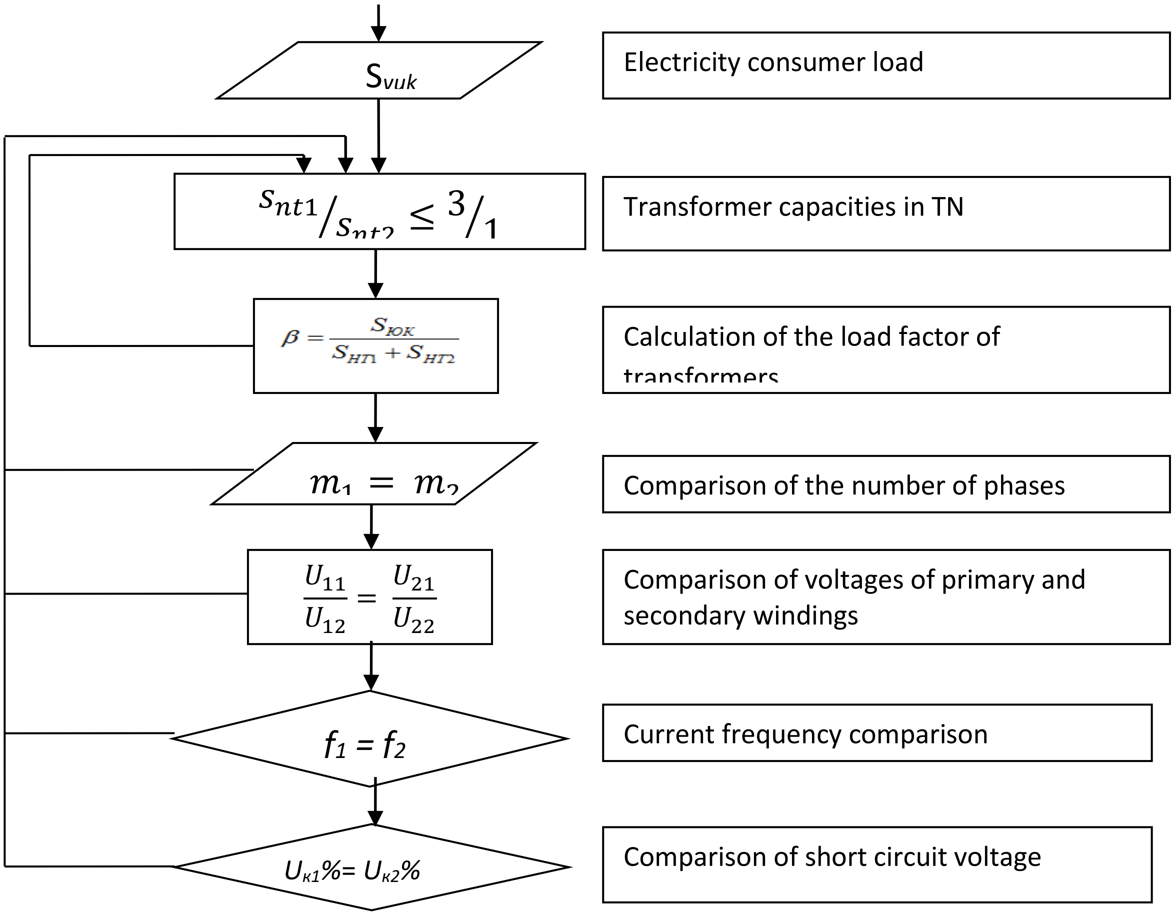

Figure 4 Algorithm for selection of power transformers of different power operating in parallel in transformer substations

Today, the objective laws of development of society require that the level of energy supply of labor is constantly growing. At the same time, many areas of technical development are aimed at increasing the efficiency of energy use in production, ie energy saving. Indeed, in the context of the current energy crisis, an additional but now the most important function placed on the power supply system is also the energy saving function. In solving these problems, the automated information system on energy saving allows to solve these problems on a scientific basis. Each decision is checked with analytical results in computer programs.

One of the effective ways to solve the problem of energy saving is the significant results in the organization of an operational monitoring service that shows the real consumption of electricity. To solve this problem, the selection of power transformers of different capacities operating in parallel in transformer substations provides optimization of power supply.

Optimization of operating modes of power transformers . During operation, it is necessary to ensure an economically rational mode of operation of the transformer. This means that the amount of active power losses in transformers and in the entire power supply system should be kept to a minimum. Such wastes are called quoted wastes and are defined by the following expression:

$$\Delta P_T' = \Delta P_{c.ш}' + K_{ю}^2 \cdot \Delta P_{KT}' \quad (7)$$

Here are $\Delta P_{cu}' = \Delta P_{cu}' + K_y \Delta Q_{cu}$ the power wastes for the salt operating mode of the transformer ; $\Delta P_{км}' = \Delta P_{км} + K_y \Delta Q_{км}$ - power losses of the transformer for QT mode; K $_o$ - coefficient of variation of wastes; ΔP $_{ssh}$ - active power dissipation in the unloaded state of the transformer (given in the references); ΔP $_{kg}$ - active power losses in short circuit mode (taken from references);

$K_{ю} = \dfrac{S_{ю}}{S_{нтп}}$ -loading co e ffi ts ienti;S $_{yu}$ is the transformer load;

S $_{ntp}$ is the power specified in the passport of the transformer ;

$\Delta Q_{к} = S_{нтп} \dfrac{I_{cu}\%}{100}$ -reactive power in the operating mode of the transformer ;

$\Delta Q_{км} = S_{нтп} \dfrac{U_k\%}{100}$ -reactive power in the short -circuit mode of the transformer ;

$I_{cu}\%$ normal operation mode (given in the references);

$U_k\%$ - voltage of the transformer in short-circuit (T) mode (given in the references).

This relationship can be written as: The dependence of ΔR' $_t$ on the load change.

ΔR' $_t$ = ΔR' $_{s.i.}$ + [(ΔR' .t $_.$) / S ^{2} $_{nom.t.}$] ·S ^{2} $_{yu}$.(8)

In order to simplify, we introduce the following definitions:

$$\Delta P_{cu}' = a; \qquad \frac{\Delta P_{KT}'}{S_{нтп}^2} = b$$

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In that case $\Delta P_T' = a + bS_{ю}^2$ (9)

we can draw a relationship between the amount of losses reported in the power supply system and the electrical load. Figure 5 shows the change graphs of active power losses in the case of transformers operating separately and in parallel .

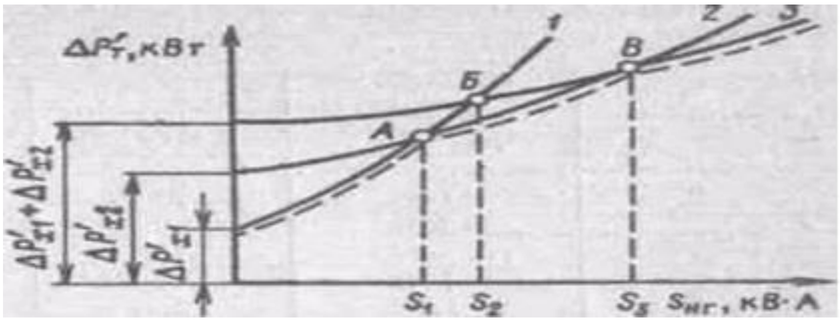

Figure 5. Active power losses in power transformers

Conclusion. Analysis of the given graphs shows that if the load is in the range 0 ÷S $_1$, the first transformer must be loaded , because in this case the specified active power losses of the first transformer will be minimal.

If the condition S $_1$ ≤S $_{yu}$ ≤S $_z$ is met, it is advisable to load the second transformer.

If Syu> Sz, the amount of losses will be small when both transformers are connected in parallel and loaded.

REFERENCES:

1 . ZhalilovR.B., The intellectual automated substation / «Science, Technology and Higher Education. Materials of the XIV international research and practice conference. Westwood, Canada, June 29th - 30th, 2017. P.103-107.

2 . Jalilov RB Komplektnaya avtomaticheskaya transformatornaya podstantsiya. Patent Agency of intellectual property of the Republic of Uzbekistan on a useful model № FAP 01303. 27.04.2018g.

3 . Zhalilov RB , Saidmurod Latipov, Aslanova Gulnoz. Using Alternative Energy SourcesWay to Intellectual-ization and Greater Energy Efficiency in Modern Industrial Enterprises // Interna- tional Journal of Trend in Scientific Research and Development (IJTSRD) Volume 5 Issue 2, January-February 2021 Available Online: www.ijtsrd. com. ISSN: 2456 - 6470, p.908-911.

4.ST Latipov, GN Aslanova. Calculation of reliability indicators of power supply systems of consumers. Scopus, Conference Paper. (2019) E 3S Web of Conferences, 139, article № 01037.

5.Jalilov RB, Latipov ST, Aslanova GN, Akhmedov AA, Shayimova SP Key directions of development of measures to improve the reliability of electrical power systems. Scopus, Conference Paper. (2019) E3SWeb of Conferences, 139, article № 01001.

6.Aslanova Gulnoz Nasriddinovna. Automation of transformer substations of industrial enterprises witnmodern programmed logical controllers.Asian Journal of Multidimensional Research (AJMR) https: //www.tarj.i , ISSN: 2278-4853 Vol 10, Issue 9, September, 2021 Impact Factor: SJIF 2021 = 7.699