

ADVANCED DESIGN of TMГ32 and TMГ35 SERIES ENERGY SAVING TRANSFORMERS of OJSC «METP NAMED AFTER V.I.KOZLOV». MAKE YOUR CHOICE!

*The problem of energy saving in Russia, step by step becomes topical. One of priorities for power network companies as well as for domestic electrical equipment manufacturers is the searching of methods for reduction of electric power process losses in the integrated power grid. From this viewpoint, the choice of energy-saving equipment by companies is not only rational, as well as the forward-looking solution. It is certain, that one of the most effective methods to reduce the electric power losses in each several section of circuit is the use of **TMГ32** and **TMГ35** power distribution energy saving transformers of OJSC «METP NAMED AFTER V.I.KOZLOV» production.*

OJSC «METP NAMED AFTER V.I.KOZLOV» is the first of CIS countries manufacturers who developed and set up the manufacturing of transformers with reduced level of no load losses and short circuit losses. Today, **TMГ 12** power saving series transformers are used widely in the Republic of Belarus, in the Russian Federation and in others CIS countries. During the period of **TMГ 12** transformers serial manufacturing, the considerable volume of sales of this equipment is achieved.

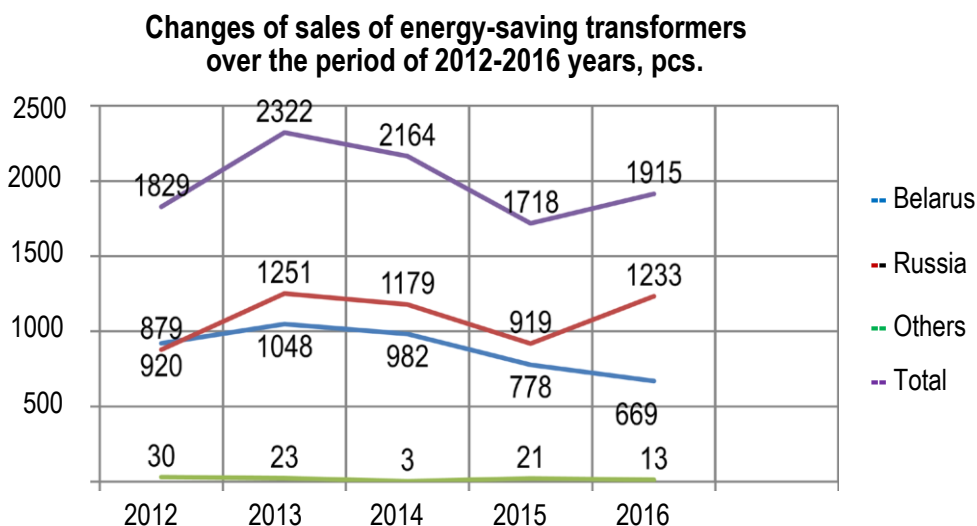


Fig. 1 – Changes of sales of energy-saving transformers over the period of 2012-2016 years, pcs.

Energy-saving transformers sales slowdown in the period of 2014 to 2015 years was due crisis developments in economics of our countries and general drop in sales of transformers in this period. As is seen from the diagram (Fig.1), levels of sales gradually are recovered. So sales of transformers to the Russian Federation now come up to pre-crisis level.

It should be reminded, to reputable experts in the area of power engineering, that the pioneer of engineering design (followed by industrial production) of energy-saving transformers in the post-Soviet territory was, in particular, Minsk Electrotechnical Plant. The conceptual and practical supervisors and really «drivers» of this process were ex-Chief Engineer of the plant, Lengin Stabrovsky and ex-Chief Designer Piotr Shumra. The relay race of innovating transformers manufacturing for national energy economy are taken up new generations of managers and specialists of the Plant. Itself TMГ12, TMГ32 and TMГ35 series name was composed in Minsk.

TMГ32 series energy-saving transformers

The next step of TMГ12 series development, on basis of technological re-equipment of the Plant and design optimization becomes the new TMГ32 series energy-saving transformers.

No load losses and short circuit losses in TMГ32 series transformers correspond to the level of losses of TMГ12 transformers. At this, TMГ32 transformers have improved (in comparison with analogue) weight-size characteristics (Table.1).

TMГ32 series transformers are of hermetical version, fully oil filled. Oil volume temperature fluctuations are balanced by means of elastic strain corrugations of tank.

Lowest voltage windings of this series transformers are made of special strip (foil), that combine technological effectiveness of coiling with high level of reliability. Application of advanced technologies, of modern winding and insulating materials enabled to make the design, wherein negative effects of outside short circuit shocks were minimized. **It also provided the opportunity to reduce materials-output ratio and, as the result, to reduce the price of product**

| Series and power of transformer | Short circuit losses kW | No-load losses kW | Overall dimensions, mm | | | Mass of transformer, kg |
|---------------------------------|-------------------------|-------------------|------------------------|-----------|------------|-------------------------|
| | | | Length (L) | Width (W) | Height (H) | |
| TMГ12-1000 | 10,5 | 1,1 | 1600 | 1000 | 1970 | 2820 |
| TMГ32-1000 | 10,5 | 1,1 | 1620 | 1070 | 1780 | 2400 |

Table 1 Specifications of TMГ32 series transformer in comparison with TMГ12 series transformer (using the example of transformers with the power of 1000 kVA).

TMГ35 series energy-saving transformers

The next step on the way of our products energy efficiency upgrading was engineering of TMГ 35 series transformers

TMГ 35 energy-saving transformers are innovative product. In the process of its design, the specialists of OJSC «MEP NAMED V.I.KOZLOV» were based on levels of no-load losses and short circuits, determined in the standard **EN 50464-1:2007** and fallen within grant tax allowance as energy-saving products, set in the Regulation of the Government of the Russian Federation №600 dd. 17.06.2015.

Structurally, TMГ35 series transformers maintained all advantages of previous series transformers – hermetic version, corrugated tanks with full oil filling, stacked magnetic circuit of core type («step-lap» stacking arrangement) made of top grade electrical steel, low voltage windings are of foil and so on.

With that, among all the serial power transformers manufactured in CIS countries, the **TMГ35 series transformers provide the lowest level of no-load losses and short circuit.**



Fig. 2 - TMГ35- 1000 power transformer of OJSC «MEP NAMED V.I.KOZLOV» production

| Series and power of transformer | Short circuit losses kW | No-load losses kW | Overall dimensions, mm | | | Mass of transformer, kg |
|---------------------------------|-------------------------|-------------------|------------------------|-----------|------------|-------------------------|
| | | | Length (L) | Width (W) | Height (H) | |
| TMГ11-1000 | 10,8 | 1,4 | 1720 | 1135 | 1860 | 2750 |
| TMГ32-1000 | 10,5 | 1,1 | 1620 | 1070 | 1780 | 2400 |
| TMГ35-1000 | 9,55 | 0,67 | 1580 | 1040 | 1890 | 3710 |

Table 2 – Specifications of TMГ32 and TMГ35 series transformers in comparison with high-volume output TMГ11 series transformer (using the example of transformers with the power of 1000 kVA).

The losses reduction effect achieved, among other, by means of additionally included in TMГ32 and TMГ35 transformers manufacturing materials, for this reason the cost of these exceeds the cost of very high-volume output TMГ11 series transformers.

However, when choosing the new type of transformer for put it into operation, is not enough to be motivated only by its price. It is necessary to take into account all elements of cost of product life cycle, including the cost of electric power losses over all operating life (not less than 30 years).

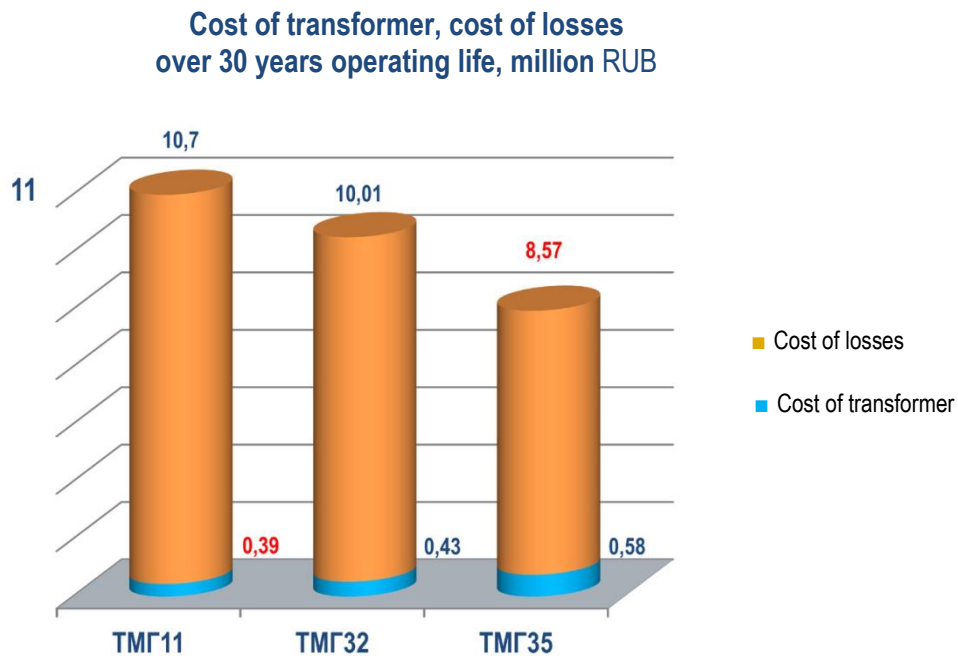


Fig. 3 - Cost of transformer, cost of losses over 30 years operating life, million RUB

It should be noted, that spending for payment of transformer electric power losses, throughout operating life, amounts a large proportion within life cycle cost and can exceed the cost of transformer more than 30-fold.

| Series and power of transformer | Capacity factor | Short circuit losses kW | No-load losses kW | Conventional cost 1 kWh, RUB | Costs of annual losses, RUB | Cost of losses per 30 years of operating life, RUB | Cost of TMГ, RUB | Cost of TMГ + cost of losses per 30 years of operating life |
|---------------------------------|-----------------|-------------------------|-------------------|------------------------------|-----------------------------|--|------------------|---|
| TMГ11-1000 | 0,7 | 10,8 | 1,4 | 6,1 | 357 593,7 | 10 727 811 | 390 750 * | 11 118 585 |
| TMГ32-1000 | 0,7 | 10,5 | 1,1 | 6,1 | 333 707,8 | 10 011 234 | 429 750 * | 10 440 984 |
| TMГ35-1000 | 0,7 | 9,55 | 0,67 | 6,1 | 285 855,8 | 8 575 674 | 585 800 ** | 9 161 474 |

Table 3 – Calculation of electric power losses cost in TMГ32 and TMГ35 transformers operation process compared with TMГ11 transformer (using the example of transformers with the power of 1000 kVA).

Notes:

- * weighted average cost of transformers (without VAT);
- ** anticipated cost of TMГ35 transformer with the power of 1000 kVA (without VAT).

For example, for TMГ11 transformers with the power of 1000 kVA and demand factor of 0,7 (Table 3) the cost of annual losses is 357 593,7 RUB by transformer sales price – 390 750 RUB, i.e. the cost of annual losses is 90% from transformer price and will exceed it in little less than 1,2 operating year. In the period of 30 years, the cost of losses exceeds this price more than 27-fold.

The difference in the cost of annual losses illustrates the effectiveness of energy-saving transformers use (see Table 4). So for TMГ35 series transformer with the power of 1000 kVA the cost of annual losses is 285 855.8 RUB, and for TMГ11 series transformer – 357 593,7 RUB, the difference is 71 737,9 RUB, at that, the difference in prices for transformers – 195 050 RUB. It means that expensed on buying additional 195 050 RUB will compensated within 2.7 years, and then, every next year, will make the saving of 71 737.9 RUB.

| Comparison | Difference of prices in % | Difference of prices, RUB | Annual losses costs difference, RUB | 30 years operating life losses cost difference, RUB | Reference of price difference to annual cost losses difference within 30 operating life |
|-------------|---------------------------|---------------------------|-------------------------------------|---|---|
| TMГ11-TMГ32 | 10 | 39 000 | 23 885,9 | 716 577 | 18,37 times |
| TMГ11-TMГ35 | 50 | 195 050 | 71 737,9 | 2 152 137 | 11,03 times |

Table 4 – Comparison of price difference and annual losses cost of TMГ32 and TMГ35 series transformers against TMГ11series transformers (using the example of transformers with the power of 1000 kVA).

So, making simple calculations it is evident that depending on power of transformer and its load (on the basis of approved cost of 1 kWh), complementary investments in TMГ32 series transformers will pay off in one year of their operation, and complementary investments in TMГ35 series transformers - in 2-4 years.

Pay-off period of TMГ35 in comparison with TMГ11, years

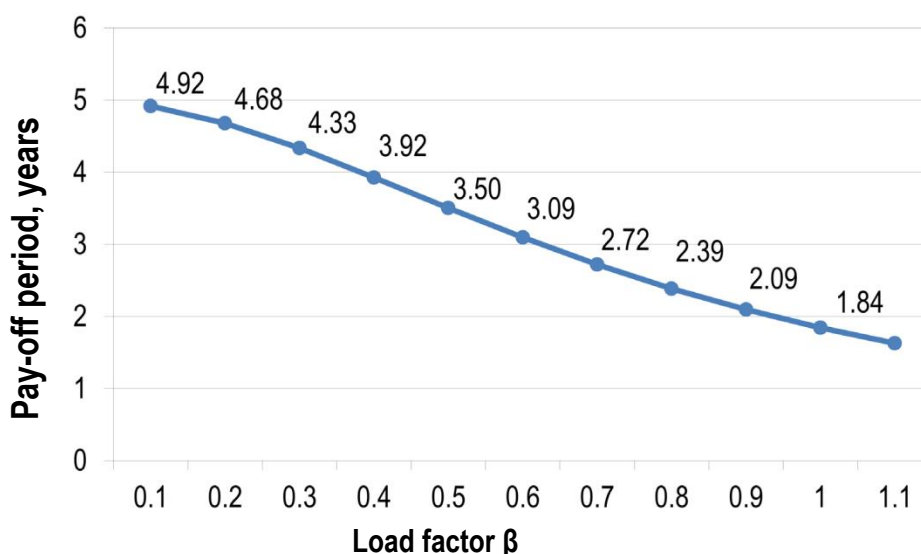


Fig.4 – Dependence of complementary investments pay-off period for TMГ35 series transformer purchase in comparison with TMГ11series transformers depending on load factor.

The economic benefit of putting into operation new energy-saving series transformers of OJSC «MEP NAMED V.I.KOZLOV» production can be significant. For example, after replacement 1000 of TMГ11 series transformers with the power of 1000 kVA, that are in operation in the electrical power system of the city Moscow, to the same quantity of TMГ35 series transformers of the same power, due to reduction of losses, will be achieved the cost saving more than 1.1 million US Dollars, will be saved more than 3.7 thousand tons of oil fuel equivalent per service year. At that, during whole service life of the transformer (not less than 30 years) – more than 33 million US Dollars and more than 112 thousand tons of oil fuel equivalent (by approved, according to CIS Electric Power Council, adaptation coefficient - 319,6 grams of oil fuel equivalent./kWh). In comparison with TMГ series transformers (*manufactured during 80-90 years of the past century*) *the saving increases by 1.5 – 2 times by known reasons.*

The current economic situation requires from power grid companies the rational approach during decision making, concerning choice and purchase of electrical equipment. The choice of power of newly put into operation transformer, its price, the load, the optimum level of losses should be economically feasible, first of all reasoning from lowest cost of product operating life. It should be remembered the ecological aspect: the lower losses are, the lower level of environmental contamination.

It should be noted that until recently the energy-saving transformers of domestic production were manufactured, generally, with no load losses levels and short circuit levels corresponding to TMГ12 series transformers, the production of these was started at the Minsk Electrotechnical Plant. But we understand full well that «all-purpose transformer» does not exist and during equipment purchase for specific object, the customer must have *alternative.*

The Minsk Electrotechnical Plant named after V.I.Kozlov, based on qualified engineering and technical potential and modern technological mode of the enterprise, designs and provides customers with transformers having the lowest level of no-load and short circuit losses. As result of our work in this direction we have designed TMГ12, TMГ15, TMГ32 series transformers and, at present, the new series of energy saving transformers – TMГ35.

OJSC «METP NAMED AFTER V.I.KOZLOV» - WE OFFER YOU SELECTION AND CARRY ENERGY OF PROGRESS!