Justification of the Economic Efficiency of Reactive Power Compensation Using the Value of the Enterprise on the Example of Jsc "Bukhoroenergomarkaz"

Babanazarova N.K.,	Bukhara Engineering - Technological Institute
Khusenov D.R	Bukhara Engineering - Technological Institute
Khafizov Kh.I.	Bukhara Engineering - Technological Institute

ABSTRACT

Recently, due to the large specific energy costs, it has become impossible to produce competitive products. Reducing the specific consumption of products requires the transfer of electricity to the power supply system with minimal losses. One of the ways to solve this problem is reactive power compensation with the definition of their type, rated power and installation locations.

Keywords: Reactive power, compensating device, economic efficiency, specific energy consumption, comparative approach, cost approach, income approach, appreciation index, accumulated wear

Introduction

The transfer of reactive power from the place of generation to the places of consumption significantly worsens the technical and economic performance of the power supply systems of an industrial enterprise. One of the effective means of improving these indicators is the rational compensation of reactive power with the help of compensating devices, i.e. determining their type, rated power and installation locations. It is advisable to install compensating devices as close as possible to the consumer, which helps to save electricity not only in power lines (TL), but also in transformers, by reducing losses.[1,2,3]

The reduction in losses in power transmission lines after compensation can be defined as:

$$\Delta P_{л} = \Delta P_{л}^{'} - \Delta P_{л.к.} = \frac{P_{л}^2 + Q_{л}^2}{U^2} \cdot R_0 \cdot l_{л} - \frac{P_{л}^2 + (Q_{л} - Q_{ку})^2}{U^2} \cdot R_0 \cdot l_{л} =$$

$$= \frac{P_{л}^2 + Q_{л}^2}{U^2} \cdot R_0 \cdot l_{л} - \frac{P_{л}^2 + Q_{л}^2}{U^2} \cdot R_0 \cdot l_{л} + \frac{2 \cdot Q_{л} \cdot Q_{ку} - Q_{ку}^2}{U^2} \cdot R_0 \cdot l_{л} =$$

$$= \frac{2 \cdot Q_{л} \cdot Q_{ку} - Q_{ку}^2}{U^2} \cdot R_0 \cdot l_{л}.$$

Reducing power losses in transformers:

$$\Delta P_{TP} = n \cdot (\Delta P_{к} \cdot \beta^2 + \Delta P_0) - n \cdot (\Delta P_{к} \cdot \beta_{ку}^2 + \Delta P_0) = n \cdot \Delta P_{к} \cdot (\beta^2 - \beta_{ку}^2).$$

Methods

Reactive power compensation, in order to improve technical and economic performance, is due at the design stage of an industrial enterprise, and we are dealing with an object whose equipment has a chronological age of more than 35 years, and then the question arises of the relevance of reactive power compensation with existing technologically obsolete equipment [1,2].

To solve this issue, the first is proposed: an assessment of the enterprise using comparative, cost, income approaches, taking into account the absence of compensating devices, the second: taking into account their installation.

Below is an example of the cost approach of the replacement cost of the steam part of the enterprise.[4,5]

Characteristics of the object of assessment

An object	steam part of the enterprise JSC "Bukhoroenergomarkaz", which is a one-story building, 8 m high. Capital group I, seismicity 7 b
Location of the object	Industrial Zone
Object area	4 032 m2
Object Volume	32 256 m3
Transport and pedestrian accessibility	to the bus stop, from which public vehicles depart in any direction of the city 1.5 km
The ecological situation of the area	average

Structural characteristics

Foundation	concrete
columns	reinforced concrete
Walls	lightweight reinforced concrete panels
Roof	profiled sheets for metal structures
overlap	metal modules
floors	concrete
Window	tape wooden
doors	metal

The actual state of the object

The monolithic reinforced concrete foundation has microcracks due to long-term operation; protruding crushed stone can be seen in the upper part of the foundation. The columns are prefabricated reinforced concrete in good condition, there is no change in geometric dimensions, the existing microcracks do not violate the bearing capacity of the columns. The walls are made of lightweight concrete panels, as a result of long-term operation there are chips and cracks, the joints of cement mortar panels are broken, rusty streaks are found. The metal structure of the roof is in good condition, corrosion and changes in geometric dimensions are not visually determined. The roof is made of metal profiled sheet in a satisfactory condition, no corrosion is visually observed, there are no signs of leakage. The windows are tape wooden, due to the long service life, the windows have dried out, the geometric dimensions are violated. The oiled coating of the windows has fallen into disrepair. Due to the long service life, metal doors, single-leaf and double-leaf, rusted in places, geometric dimensions were violated in the frames of double-leaf doors. The floors are concrete, due to the long service life, the floors have cracks, unevenness, rubble protrudes in places, the upper protective layer of the floors is broken[6,7].

The assessment object was identified on the basis of title documents.

Results

Calculation of the value of the object of assessment

There is no design and estimate documentation, the cost is calculated using the collection of "INCLUDED INDICATORS OF THE REPLACEMENT COST OF NON-RESIDENTIAL BUILDINGS AND CONSTRUCTIONS", GKKINP-18-013-04 *

In accordance with the purpose and technical characteristics of the object being assessed, according to the tables of the Collection, we select buildings (structures) - an analogue and determine the replacement cost of a unit of measurement. According to the Collection, the replacement cost of 1 m3 taken as an analogue of "BOILER FUEL - GAS, FUEL OIL" is 20.8 soums (Table 57)

The following correction factors are also applied to the calculation for:

1. capital group - 1
2. seismicity of the area -1.05
3. territorial coefficient - 1.007
4. type of exterior and interior decoration -0.5

The actual volume of the object of assessment differs from the volume of the analogue by less than 10%, therefore, adjustment for volume is not required.

We adjust the unit replacement cost for the exterior finish of the facade (0.5), then (20.8·0.005%) + 20.8 = 20.904. [8,9]

The full replacement cost of the appraisal object in base prices of 1991 is determined by the formula:

$$C_{п.б.} = V \cdot C_{е.и.} \cdot K_1 \cdot K_2 \cdot \ldots K_n$$

where: Sp.b. - full replacement cost of the appraisal object in 1991 prices.

V- volume (area, length) of the assessed object in m3, m2, l.m.

Se.i. - the cost of the estimated unit in 1991 prices. (according to the tables of the Collection of aggregated indicators of replacement cost).

*TO*1, K2…..Kp - correction factors characterizing the object of assessment

Total: Sp.b. =712 949 sum[10,11]

To bring the cost to current prices, the index of appreciation of construction and installation works is applieddesign work in construction in Bukharafrom 2023 equal to 247.1 (we will take a conditionally constant part of 30%, and a conditionally variable part of 70%), which is adjusted before the assessment date using the indices of the Ministry of Macroeconomic Statistics and changes in the minimum wage from 2004 (5,440 UZS) to 2022 (920,000 UZS) [12].

Adjustment of the index as of the assessment date, taking into account the change in the minimum wage by 169 times:

Appreciation indices

Table 1

years	
2004	1.210
2005	1.227
2006	1.340
2007	1.117
2008	1.166
2009	1.010
2010	1.208
2011	1.215
2012	1.213
2013	1.219
2014	0.956
2015	1.057
2016	1.13
2017	1.311
2018	1.396

2019	1.282
2020	1.071
total	20.128

247.1·0.3·169=12527.97 (conditionally constant part)
247.1·0.7·20.128=3480.2
The full replacement cost of reproduction at the valuation date is:
- according to conditionally constant will be 8,932,000 thousand soums
- according to the conditionally variable will be 2,481,000 thousand soums
Sitog=11 413 000 thousand soums [13]

Discussion

Accumulated wear calculation

Calculation of physical wear

The table of the specific weights of structural elements is given in the COLLECTION OF "INCLUDED INDICATORS OF THE REPLACEMENT COST OF NON-RESIDENTIAL BUILDINGS AND CONSTRUCTIONS", GKKINP-18-013-04 * under the number 57a

Specific weights of individual structural elements
(in percentages)

Constructions	*Specific gravity*	*Depreciation on KMK 2.01.16-97*	*Wear of structural elements*
Foundations	13	20	2.6
Walls	29	15.5	4.5
Floors and coatings	22	20	4.4
Roof	4	20	0.8
floors	3	30.5	0.915
openings	9	27.33	2.46
Finishing work	6	10	0.6
Internal sanitary and electrical devices	13	20	2.3
Other works	1	17.91	0.18
Total	100		18.76

The physical deterioration of the object is 18.76%.

Calculation of functional wear

The boiler house is controlled by induction devices, in view of this, the functional wear of the object of assessment is the absence of a modern automatic control unit for the boiler house.Then functional wear is 5.12%

Determining external wear

External (economic) depreciation is assumed to be equal to the refinancing rate of -15%.

Cumulative wear calculation

The calculation of accumulated wear and tear is carried out according to the multiplicative formula

$$И = 1-(1-И_{физ})\cdot(1-И_{функ})\cdot(1-И_{внеш}) = 34\%$$

Conclusion

The cost of reproduction (replacement) according to the cost approach is equal to:

Sitog- (Sitog·34%) = 7 534 000 000 sum

A similar calculation is carried out using the other two approaches and the final price is displayed.

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