ECONOMICAL ASPECTS OF THE EFFICIENCY OF USAGE OF ENERGY SUPPLY SYSTEMS WITH COGENERATION HEAT PUMP INSTALLATIONS OF VARIOUS POWER LEVELS

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ЕКОНОМІЧНІ АСПЕКТИ ЕФЕКТИВНОСТІ ЗАСТОСУВАННЯ СИСТЕМ ЕНЕРГОЗАБЕЗПЕЧЕННЯ З КОГЕНЕРАЦІЙНО-ТЕПЛОНАСОСНИМИ УСТАНОВКАМИ РІЗНИХ РІВНІВ ПОТУЖНОСТІ

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Introduction. In recent years a number of investigations, dealing with the efficiency of usage cogeneration heat pump installations (CHPI) in energy supply systems (ESS) were carried out [1 – 7]. In this paper the economical aspects of usage of ESS with CHPI of various power levels is carried out, that will allow to provide reasonable determination of economically reasonable scheme solutions and operation modes of ESS with CHPI of various power levels in energy and heat supply systems.

Presentation of the material. The methodical fundamentals for energy-economic efficiency and energy-economic-ecological efficiency assessment of ESS with CHPI are presented in our studies [1 – 7]. In the research [3] it is suggested to perform the comprehensive assessment of ESS energy-economic efficiency on the base of CHPI by complex generalized dimensionless criterion of energy-economic efficiency of ESS with CHPI that has the form:

$$К_{ESS}^{en.ec.} = К_{ESS} + \Delta E_i^{ESS}, \quad (1)$$

where $К_{ESS}$ – is complex dimensionless criterion of energy efficiency of ESS with CHPI from the studies [1 – 7]; ΔE_i^{ESS} – is relative economic efficiency (in

shares) for ESS on the base of CHPI for i-th operation mode of ESS, that is determined in the following manner:

$$\Delta E_i^{ESS} = \frac{(E_{SH})_i - (E_{ESS})_i}{(E_{SH})_i}, \quad (2)$$

where $(E_{SH})_i$ – are operation costs for i-th operation mode of the substituted source of heat (SH), $(E_{ESS})_i$ – are operation costs for i-th operation mode of ESS.

As it is noted in studies [3 – 4], economically efficient operation modes of ESS with CHPI will be provided if the index of economic efficiency of ESS will be $\Delta E_i^{ESS} > 0$. According to [3], energy efficient and economically substantiated operation modes of ESS with CHPI will be provided on condition $K_{ESS}^{en.ec.} > 1$. The greater is the value of $K_{ESS}^{en.ec.}$ index, the more energy efficient, economically efficient and competitive ESS with CHPI will be.

In our study [6] it is suggested to perform the comprehensive assessment of energy-ecological-economic efficiency of ESS with CHPI according to complex generalized dimensionless criterion $K_{ESS}^{compl.}$ of energy-ecological-economic efficiency of ESS with CHPI. As it is noted in study [6], ecologically safe, energy efficient and economically substantiated operation modes of ESS with CHPI of various power levels will be provided on condition of $K_{ESS}^{compl.} > 1$. In research [6] it is determined that the greater is the value of $K_{ESS}^{compl.}$ index, the more economically efficient and competitive ESS with CHPI will be.

The specific investments in ESS with CHPI of various power levels can be determined, according to data of manufacturing companies. The specific investments in ESS with CHPI of small and average power (up to 1000 kW) will be in the range of 290 – 1000 $/kW of installed power of CHPI. The specific investments in ESS with CHPI of large power (over 1000 kW) will be in the range of 113 – 165 $/kW of installed power of CHPI. Thus, the payback period of investments in ESS with large power CHPI will be almost ten times less, than the payback period of investments in ESS with small and average power CHPI.

Conclusions. The investigated ESS with CHPI of various power levels can be recommended as high energy efficient, economically efficient ESS, that can be competitive with modern high efficient electric and fuel-fired boilers in heat supply and energy supply systems, as their energy efficiency more than two times exceeds energy efficiency of modern high efficient electric and fuel-fired boilers. This ESS

can be competitive with modern high efficient electric and fuel-fired boilers in the systems of heat and energy supply. The payback period of investments in ESS with large power CHPI will be almost ten times less, than the payback period of investments in ESS with small and average power CHPI.

The economical aspects of usage of ESS with CHPI of various power levels, analyzed in this paper, allows providing reasonable determination of economically reasonable scheme solutions and operation modes of ESS with CHPI of various power levels in the systems of heat and energy supply.

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