The American Journal of Engineering and Technology
(ISSN – 2689-0984)
Published: September 29, 2020 | **Pages:** 136-148
Doi: https://doi.org/10.37547/tajet/Volume02Issue09-24

IMPACT FACTOR
2020: 5. 32

Journal Website: http://usajournalshub.com/index,php/tajet

Elements And Devices For Monitoring And Controlof Energy Efficiency

Siddikov Ilkhomjonkhakimovich
Dsc.Proff.Head Of The Department Power Supply Systems, Tashkent University Of Information Technologies, Tashkent, Uzbekistan

Boikhonovzailobiddinurazali Ugli
The Teacher Of Department Electrotechnics, Electromechanics And Elektrotechnologies, Andijan Machine-Building Institute,Andijan, Uzbekistan

Karimjonov Dilyorbek Doniyorbek Ugli
The Teacher Of Department Electrotechnics, Electromechanics And Elektrotechnologies, Andijan Machine-Building Institute,Andijan, Uzbekistan

ABSTRACT

In this article discusses the development of information software and intelligent measurement systems for the management and control of energy efficiency, demand for energy efficiencyб growing intelligent energy metering and monitoring systems are being developed, and new opportunities, opening up for assessing of energy efficiency of an enterprise.

KEYWORDS

Electricity, smart system, energy saving, cloud technology, energy measurement, energy audit, monitoring system, remote control.

INTRODUCTION

The article discusses the development of information software and intelligent measurement systems for management and control of energy efficiency of industrial enterprises. The demand for energy efficiency in manufacturing plants is growing. Intelligent energy metering and monitoring systems are being developed, and new opportunities are opening up for assessing energy efficiency and energy efficiency of an enterprise. Meanwhile, advanced modern solutions in this area in combination with software allow not only transmitting accurate data about each unit of energy consumption (from a specific device to all production lines and workshops), but also can warn of malfunctions about operation of electrical equipment and devices and, thus way, to notify in advance about possible failures and shutdowns [1-2].

MATERIALS AND METHODS

Traditional electricity metering and monitoring systems include meters that directly receive information about electricity consumption, as well as data transmission elements and their subsequent transfer to main power plant with the possibility of computer processing. The disadvantages of such a system are that there are many meters, data transmission devices, programmers and software manufacturers on market that are trying to "adapt" their products for integrator companies. Sometimes it happens that the protocols are incompatible with each other, and the drivers require separate software, and so on. All of this takes time and, most importantly, resources, that client must pay for. Scientific work is underway to eliminate such cases. More and more solutions appear on the market, which differ in their completeness. Software and hardware produced by one company reduces the risk of incorrect connection [3-4].

Currently, the production of intelligent electricity metering and monitoring systems is not developing in Uzbekistan. Due to difference in power supply systems of foreign countries, imported systems are not always compatible with our power supply system. Therefore, an urgent task is the development of local intelligent systems for metering and monitoring of electricity to assess the energy efficiency of an enterprise and improve efficiency. One of the means of increasing energy efficiency is organization of a system for constant monitoring of electricity consumption in shops and production premises of the enterprise, taking into account production indicators and climatic factors, as well as warnings about possible equipment malfunctions and thus make a possible forecast [1].

The implementation of such a system requires special equipment and control algorithms that allow a comprehensive study of the energy saving process, which allows developing measures to reduce wasteful energy consumption [2].

The proposed metering and control system is designed for continuous measurement of the parameters of power grid and electricity.

Measurements and calculations are carried out for the purpose of subsequent analysis and making changes aimed at reducing energy consumption.

The device measures the following parameters [4]:

1. Voltage, V;

2. Current, A;

3. Active power, P;

4. Active energy, W;

4. Reactive power, Q;

5. Reactive energy, Wh;

6. Power factor, φ;

7. Frequency, f;

8. Temperature, °C.

Communication with the accounting system is carried out via a wireless Wi-Fi nets ofthe accounting system transfers collected data to Cloud server for further analysis and visualization [4].

It is believed, that an intelligent system designed for electricity metering and monitoring has following capabilities (hereinafter referred to as a device) [5-7]:

1. Reducing a cost of paying for electricity due to automatic control of equipment operation and proper planning of maximum load. Efficiency is achieved through rational use of electricity and reduction of inefficient losses;
2. Reducing maintenance and repair costs due to early warning of equipment operation and failure;

3. Increasing a productivity of personnel through remote monitoring of equipment operation (on / off, failure of electrical equipment));
4. Help to internal automated weekly / monthly / quarterly reports, it is possible to identify "invisible" losses and non-energy costs as a result of complete metering and analysis of electricity;
5. Allows to optimize power consumption and control strategies [3, 4].

The proposed device includes the following main elements (Figure 1): measurement and interface unit (MIU), analog-to-digital converter (ADC), microcontroller (MCU), Random Access Memory (RAM), Read-only memory (ROM), Universal Serial Bus (USB), WI-FI modem (Mod), load control relay (LCR), current transformers (CT), temperature sensor (TE), impulse power block (IPB)[4].

Current signals are converted into voltage signals using current transformers and resistors. These signals are fed to the ADC inputs where they are digitized and transferred to the MCU synchronous serial port. What are the arithmetic mean values of the currents and voltages of the MCU, full, active, reactive power.

Calculates the power factor and power consumption as well as a angles and frequencies of the fundamental harmonics of voltage signals.

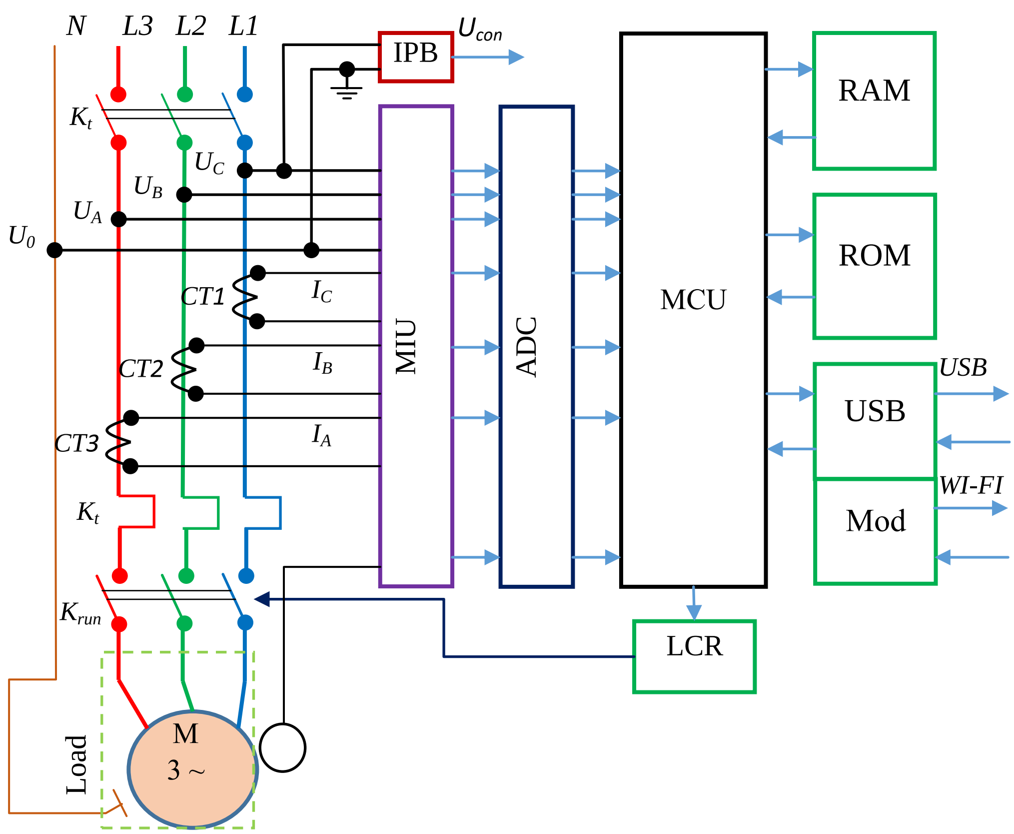

Figure 1. Block diagram of an intelligent power metering and control system.

Published: September 29, 2020 | **Pages:** 136-148
Doi: https://doi.org/10.37547/tajet/Volume02Issue09-24

To calculate the rms voltage for each voltage circuit, use the nextequation [5]:

$$U_f = K_{kU}\frac{\sqrt{\sum_{i=1}^{n} U_i^2}}{n} \qquad (1)$$

where$K_{kU}$is calibration factor for measured phase (entered during calibration);
i - the value of current sample;
n - the number of samples;
U_i - typical value of voltage i, V.
The following formula is used to calculate the rms current for each phase of the current [5]:

$$I_f = K_{kI}\frac{\sqrt{\sum_{i=1}^{n} I_i^2}}{n} \qquad (2)$$

where$K_{kI}$is the calibration factor for the phase (entered during calibration);
i - the value of the current sample;
n - the number of samples;
I_i - typical value of current, A.
The active power in each phase is calculated using the following formula [5]:

$$P_f = K_{kU}\cdot K_{kI}\frac{\sqrt{\sum_{i=1}^{n} U_i I_i}}{n} \qquad (3)$$

The total active power is determined by the following equation [5]:

$$P_\Sigma = P_{fA} + P_{fB} + P_{fC} \qquad (4)$$

Here P_{fA}, P_{fB}, P_{fC}- active power for each phase.

The apparent power in each phase of a three-phase network is calculated according to the following equation [5]:

$$S_f = I_f \cdot U_f \qquad (5)$$

Where I_f is the root-mean-square value of the current in the corresponding phase, determined by the formula (2), A; $U_f$is the value of the square root of the corresponding phase, determined by the formula (1), V.

The total total power is determined by the following equation [5]:

$$S_\Sigma = S_{fA} + S_{fB} + S_{fC} \qquad (6)$$

Where S_{fA}, S_{fB}, $S_{fC}$is the total power of each phase, determined by the equation (5), VA.
The reactive power for each phase is determined by nextequation [5]:

$$Q_f = \sqrt{S_f^2 - P_f^2} \quad (7)$$

Where S_f is the total power in each phase, determined by the formula (5), VA; P_f- active power in each phase, determined by equation (4), W.

The total reactive power is determined by the following formula [5]:

$$Q_\Sigma = Q_{fA} + Q_{fB} + Q_{fC} \quad (8)$$

here QQ_{fA}, Q_{fB}, Q_{fC}- reactive power in each phase, VAr, determined by the equation (7).

Specific energy dissipation in a three-phase circuit is calculated using the following equation [6]:

$$A = R_{fA} \cdot I_{fA}^2 + R_{fB} \cdot I_{fB}^2 + R_{fC} \cdot I_{fC}^2 \qquad (9)$$

Where I_{fA}, I_{fB}, I_{fC}- the current determined by the formula (2), A; R_{fA}, R_{fB}, R_{fC} - active resistance of power lines for each phase, Ohm.

Equation for determining active power factor [6]:

$$\cos\varphi_A = \frac{P_{fA}}{S_{fA}}, \quad \cos\varphi_B = \frac{P_{fB}}{S_{fB}}, \quad \cos\varphi_C = \frac{P_{fC}}{S_{fC}}$$

where P_{fA}, P_{fB}, P_{fC}- active power, determined by the equation (3),
W; S_{fA}, S_{fB}, S_{fC} - apparent power determined by equation (5), VA.

Reactive power factors are determined by the next equation [6]:

$$\sin\varphi_A = \frac{Q_{fA}}{S_{fA}}, \quad \sin\varphi_B = \frac{Q_{fB}}{S_{fB}}, \quad \sin\varphi_C = \frac{Q_{fC}}{S_{fC}}$$

here Q_{fA}, Q_{fB}, Q_{fC}- reactive power, determined by the equation (7), VAr.

Active and reactive energy is calculated on the base of values of active and reactive power determined during 1 second. The current and voltage are determined by the values of the active and reactive power factors based on vector diagrams. Based on the calculation of active and reactive energy, MCU sends power consumption signals to the Universal Serial Bus (USB), from where power consumption data is sent to the cloud application or client software products.

MCU collects energy parameters and stores energy parameters in a non-volatile RAM and calculates time.

In order to reduce the cost of the product, they refused to enter and display data - devices for visualizing measurement results and a keyboard for entering data. Information about network parameters, power consumption, load temperature and user parameters is displayed on the computer or on the phone of the service personnel (power engineering) via cloud technology (WI-FI). The program interface shows the graph of power consumption, the operating state of the load, the main indicators of the calculated electricity.

For configure of the device, digital coefficients are used, which are written into the non-volatile memory using the configurator program and loaded from it into the microcontroller registers when the device is started.

For add a load to the device, the device provides a standard relay with a voltage of 80 A. The relay can be controlled manually (by phone or computer) and automatically (to monitor failures, performance requirements and processes).

The device is powered by a 9 V switching power supply (IPB).

The main characteristics of the device and range of measured values are shown in table 1 [6].

Table 1

Measurementerror, nomore	1%
Voltagemeasurementrange	From 0 up 400 V
Single-phasecurrentmeasurement	From 50 mAup100 A (300 A)
Maximum power (220 V) at the regulated output (220 V)	30 kW
Powerconsumption	1,2 Vt
Wirelessprotocol	IEEE 802.11
Datarefreshrate	5 sec.
Datacollectionfrequency	60 hertz
Maximum time to collect data when there is no connection to the server	10 day
Specifiedoperatingtemperature	From -40 ºC up +70 ºC
DimensionsUxBxK	90 x 67 x 52 mm
Weight	0,1 kg

Compliance check allows you to automate controlled output or receive notifications. Several conditions can be set. States sequentially, from above, the relay assumes the last executed state. If the value of the selected data type matches the specified value and condition, the device performs one of the selected actions: send an email; turn on the relay; turn off the relay. Conditions are checked every 5 seconds. If the condition is met, the next check is performed one minute later.

Checking the situation may be limited in time. If activated a time interval, the condition is met only during the specified time.

To activate the condition, must selected the data type, select the comparison symbol ">" or "<", enter the value for comparison, select the desired action.

Example: If need to turn off the LCRrelay, when the voltage exceeds 240 V, and turn on the relay, when the voltage returns to 230 V, two conditions must be applied (Figure 2):

1) Uf> 240 LCR "off",

2) Uf<230 LCR "on".

* KBR control for voltage control

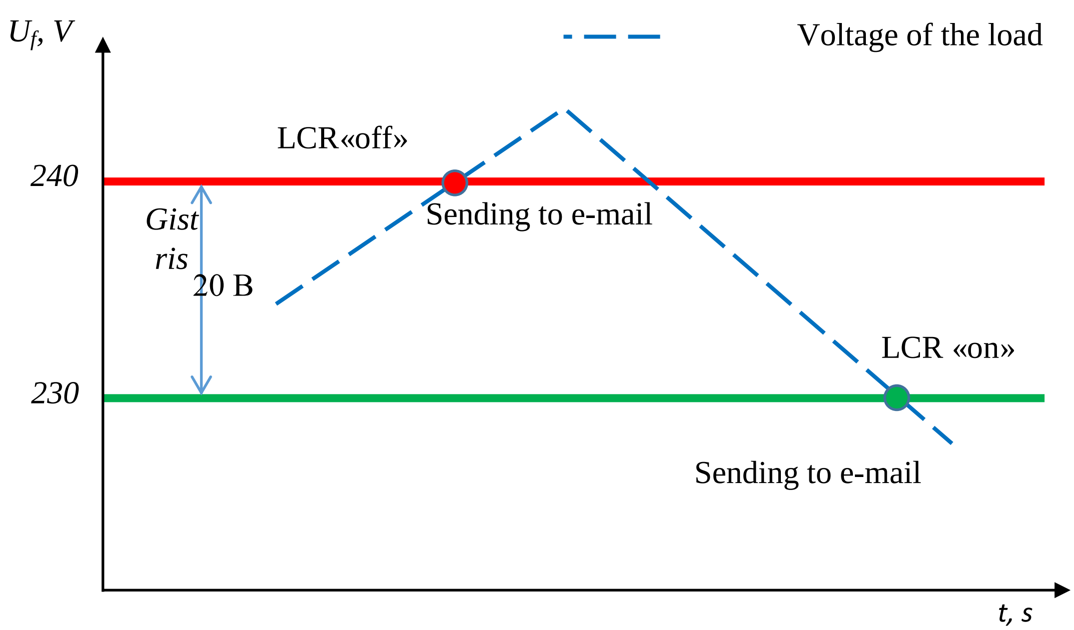

Figure 2. Block diagram of an intelligent system for metering and monitoring of power energy

The event notification feature allows you to enable the sending of emails for selected events that have occurred on the device.

Setting conditions are available in the "Conditions" section of the device web interface.

The result of the work is the formation of a report on the energy efficiency of the process of manufacturing electrical equipment (Figure 3) [6].

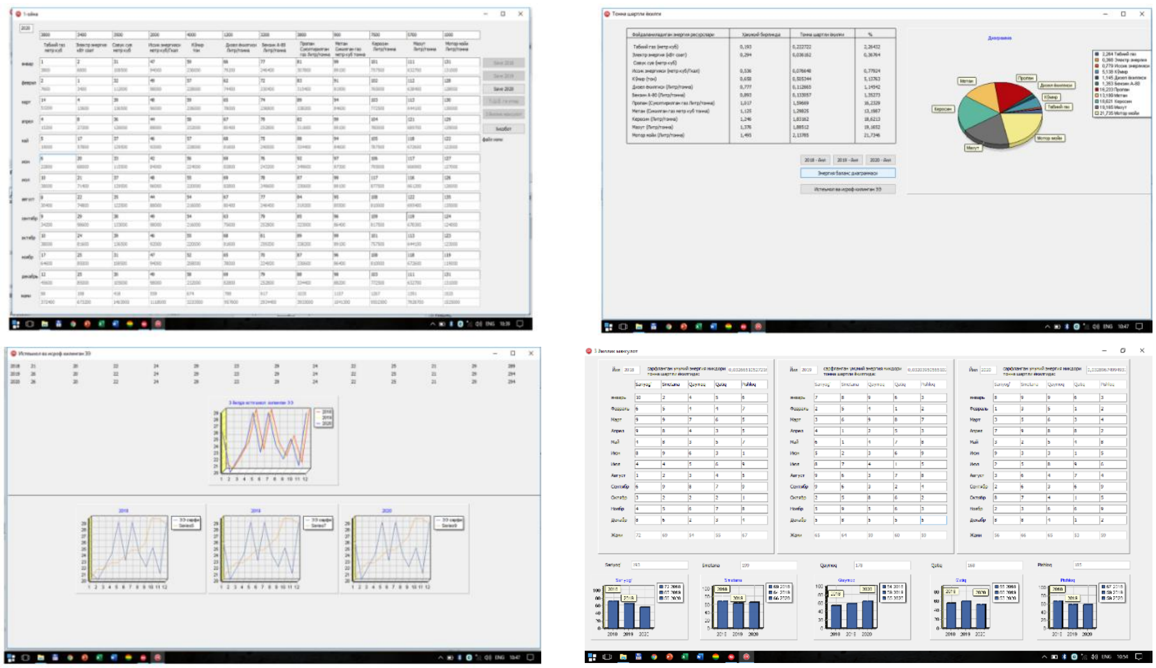

Figure 3. Automated software and information software for monitoring and managing energy efficiency.

Energomonitoring software technologies allow solving the problems of energy saving and increasing energy efficiency by balancing energy consumption, reducing transmission losses and optimizing energy production costs through comprehensive automation of power equipment. In addition, this system is suitable for power supply (heating and water supply networks), as well as for large enterprises producing and consuming various energy sources (natural gas, fuel oil, steam of various parameters, industrial water for various purposes, cold ammonia, process gases).

The automated systems implemented in the energomonitoring program perform all the standard functions required for automated control systems.

The progress of technological processes using signals from sensors that measure technological parameters, as well as transmitting information about the state of electrical devices and mechanisms (“on”, “off”, “open”, “closed”, etc.) was successful. Information appears instantly at the operator's workplace - in the form of frames that record the current values of the parameters, in the form of graphs and diagrams reflecting the values of the measured and calculated parameters. The capabilities of the system make it possible to

Published: September 29, 2020 | **Pages:** 136-148
Doi: https://doi.org/10.37547/tajet/Volume02Issue09-24

take into account the types and consumers of consumed energy sources, monitor the operating time of equipment (for planning repairs), analyze technical and economic indicators, and identify emergency modes and failures. The received data and calculated values can be used in control algorithms. In the event of a process failure, unauthorized changes and malfunctions in the equipment, a signal is issued indicating the time and reason for the operation.

RESULTS AND DISCUSSIONS

Remoting control of electrical devices and equipment's.

Turning on, off, stopping of electrical devices and equipment's is also carried out by signals of automation (protection, blocking, logical control, regulators) and direct commands of the operator [7-13].

An important task solved with the help of automation is the protection of equipment in emergency modes and ensuring the safety of personnel. Analysis of accidents occurring in boilers and other gas installations shows that they mainly occur during re-incineration and are caused by the so-called human factor. Blocking algorithms prohibit the execution of actions that violate the technological process, and protection algorithms prevent the development of emergency situations due to the timely cessation of power supply [14,15].

Automatic control of equipment is carried out using protection technology, interlocks, as well as logic control and regulators. Logic control allows turning on/off equipment and mechanisms without the participation of personnel at a given time (including automatic switching on of the backup). At the same time, automatic control ensures the optimal direction of the technological process.

Using the example of the main technological processes, we will consider how to reduce costs and losses in the consumption and distribution of energy resources.

1. Distribution to consumers. In the presence of several consumers, the distribution of energy flows between them is often made without taking into account changes in the ratio of loads during the day and during the working season. Energy efficiency can be significantly improved by constantly adjusting the distribution of energy flows. It is advisable to negotiate with a large number of consumers at several nodes, and not for each consumer. Data for the control system (flow rate, pressure, temperature of energy carriers) can be obtained from commercial and technical metering systems.
2. Computational and diagnostic processing of the values of technological parameters in pipelines and power lines at all nodes and important intermediate points helps to quickly determine:
   a. perforation in energy carriers;
   b. damage to thermal insulation;
   c. deposits in pipelines;
   d. filter clogging;
   e. Deviation of technological indicators of the quality of the energy carrier.
3. Using information on the transmission and distribution of energy resources, it is possible to timely and efficiently regulate, in emergency situations - to a safe level or completely stop the production of energy sources. The use of modern software and hardware for the automation of

production allows the implementation of automatic control systems for complex technological equipment (boilers, compressors, turbines, etc.):

a. Regulators with corrective circuits;
b. Hierarchical waterfall managers;
c. Multi-parameter regulators;
d. Fast acting regulators (eg voltage regulators for compressors).

The maximum economic efficiency from the automation of production is achieved using algorithms for group control of power plants.

For example:

- Adjustment of electric drives using frequency converters. Automated control of a group of pumps, smooth power control, automatic pump on / off;
- Power control of compressors operating in a common manifold, taking into account the individual efficiency of each compressor and the current state of the operating point;
- Change in the performance of boilers operating in a common header, taking into account the individual efficiency of each boiler and the current load.

It is advisable to create a unified control room for monitoring and controlling technological processes in power equipment. The control room should have a server that provides long-term storage of the required number of workstations and technological processes, the ability to manage them, documentation and diagnostic analysis. Communication between the control room and local automation systems should be carried out via wired or wireless lines, depending on local conditions.

The creation of a single control room allows the company to perform tasks and implement processes that give it significant advantages:

- Automated control of technological process parameters for all main equipment, displaying data on the operator's workstation, registering and archiving values, changing technological parameters and signaling trends;
- Monitoring of the operating balance;
- Optimization of load distribution between groups of equipment;
- Collecting and analyzing data from commercial and technical units of measure, identifying losses due to underreporting;
- Control of actual losses at power transmission lines;
- Remote and automatic regulation at the nodes of the transmission network (for example, at heat points);
- Presentation of diagnostic data in real time, which allows operators and technicians to localize defects in the operation of technological equipment and automation equipment and immediately take measures to eliminate them;
- Optimization of the distribution of operational and technical personnel.
- The Energomonitoring software and hardware complex includes a number of technological solutions that will reduce the total cost of creating a number of automation systems:
- High noise level and wide temperature range of controllers allows avoiding the use of intermediate converters, special rooms and expensive cabinets;
- Support for distributed objects at a low cost of the input / output channel, allows you to sharply reduce the volume of installation work and cable products;
- Allows you to simultaneously improve reliability and reduce the amount of redundancy in the system;

- Automation of the development process reduces the cost of design work;
- Multistage implementation technology accelerates return on investment and avoids the use of outdated tools.

Thanks to these solutions, the cost of implementing an automated process control system during the modernization of existing equipment is comparable to the cost of replacing the existing monitoring and control system with modern automation tools (microcontroller tuning and protection modules) with modern indicating and recording devices (sometimes even cheaper). However, the advantages of integrated automation in a single hardware and software base are undeniable.[16].

CONCLUSION

The issues of financing and implementation of automation systems to improve energy efficiency have not been resolved. In practice, manufacturers are slow to invest in activities that reduce the price or quantity of energy sources supplied to consumers. However, well-designed and well-organized integrated automation systems often fail to account for significant economic benefits. This effect occurs in the following cases:

1. Reduce costs. The automation of equipment operation (including the automation of two-position equipment and mechanisms) and the organization of a unified control room reduce the number of personnel serving power equipment. Depending on the existing structure of operational and technical personnel, the reduction can be 15-35%.
2. Reduce the number of accidents. Working under the supervision of regulatory authorities and constant monitoring of protection will prevent serious accidents. In other words, the number of starts / stops and equipment failures due to faults is reduced. The status of transmission networks is determined using data collected by the control room. Depending on the level of automation, the cost reduction is 3-7%, even if the damage from possible accidents and destruction of equipment and structures is not taken into account.
3. Improving environmental cleanliness. Exhaust fumes and emissions are significantly reduced through constant monitoring and regulation of energy production processes.
4. Implementation of voltage regulation in electric drives of mechanisms. The introduction of the VRED will reduce energy consumption. Savings on smoke exhaust and fans account for 30 to 70 percent of the electricity consumed for the operation of these mechanisms. Savings on pumps are less, from 10 to 40%. In addition, the service life of electric motors and starting equipment is increased by reducing the starting current.
5. Energy savings through precise control of production costs. Thus, precise control of combustion processes, performed in boilers according to complex algorithms, significantly reduces combustion / combustion of fuel in temporary and basic modes. Weather and daily regulation allow the transport of cooling water and feed water to maintain temperature and prevent overheating. Group regulation of boilers and boilers as a whole will prevent individual boilers from entering the economically unloaded load zone and reduce heat losses during transportation. Regulation of heat supply by groups of consumers excludes losses associated

with very strong heating for individual consumers.

In addition, the impact is achieved by improving the accuracy of measurements, planning repairs, equipment diagnostics, and extending the service life of the main and auxiliary equipment.

Creation of an intelligent system for monitoring the energy efficiency of electrical equipment of enterprises in the form of software and hardware, the purpose of which is to reduce energy costs and extend the life of electrical equipment, thereby increasing the energy efficiency of the enterprise.

An intelligent electricity metering and monitoring system has been implemented in the primary energy control system (energy audit) of power facilities of Bukharadonmakhsulotlari JSC, Kogondonmahsulotlari JSC, Korakuldonmahsulotlari JSC, Bukharagazsanoatkurilish JSC. These measures allowed to save from 12 to 30 percent in fuel, depending on the level of automation and design of heating nets and water intake.

REFERENCES

1. Zazhirko V. N., Nikiforov M. M., Pashkov D. V. [and others]. Principles of constructing an automated control system for fuel and energy resources // Railway transport. 2005. No. S11. S. 23-25.
2. Cheremisin VT, Nikiforov M.M System of control and operational management of consumption of fuel and energy resources // Railway transport. 2010. No. 11. S. 64-65.
3. Cheremisin VT, Zazhirko VN, Nikiforov MM [and others]. Development of a subsystem for analyzing and systematizing the components of electricity consumption for operational needs in a general monitoring system for electricity consumption and losses // Research of the processes of interaction of railway transport objects with the environment: collection of articles. scientific. Art. / OmGUPS. Omsk, 2003.S. 174-186.
4. Nikiforov MM, Pashkov DV Principles of development of automated control systems and electricity metering with operational management functions // Resource-saving technologies in railway transport: materials of the All-Russian scientific-technical. conf. with int. participation: in 2 volumes / Krasnoyarsk: Publishing house "Grotesk", 2005. S. 50-54.
5. Lebedev VI Microprocessor electricity meters. - M .: DMK Press, 2017 .-- 196 p.
6. Siddikov I.Kh., Abdumalikov A.A., Mirzoev N.N., Amurova N.Yu., Maksudov M.T., Khonturaev I.M. Software for the study of reliability indicators and operating state of control and control elements energy efficiency. Registered computer software Intellectual Property Agency of the Republic of Uzbekistan. DGU 08003.27.03.2020 N2020 0325.
7. Siddikov I.Kh. Advantages Energy Conversion Systems. Project tutorial "Modernization of the Curricula in sphere of smart building engineering - Green Building (GREB) 574049-EPP-1-2016-1-IT-EPPKA2-CB" of the ERASMUS + EU Program. Project web-site: https://sites.google.com/view/erasmus-greb/project-materials, TUIT web-site. https://tuit.uz/ru/energiya-taminlash-tizimlari.
8. Siddikov I.K., Sattarov Kh.A., Khujamatov Kh.E., Dekhkonov O.R. Modeling of the Processes in Magnetic Circuits of Electromagnetic Transducers //

International Conf. on ISISCT -2016, Tashkent, Uzbekistan, 2-4 November, 2016;

9. Siddikov I.K., Sattarov Kh.A. Khujamatov Kh.E. Modeling of the Transformation Elements of Power Sources Control // International Conf. on ISISCT - 2017, Tashkent, Uzbekistan, November 2-4, 2017;
10. .. Siddikov I.K., Sattarov Kh.A., Khujamatov Kh.E., Dekhkonov O.R. Agzamova M. Modeling of Magnetic Circuits of Electromagnetic Transducers of the Three-phases Current // 2018 14th International Scientific - Technical Conference On Actual Problems of Electronic Instrument Engineering (Apeie) Proceedings. In 8 Volume Part 5 Novosibirsk 2018;
11. Siddikov I., Petrova I., Zaripova V., Lejnina Yu. Automated system for synthesis ofsensors for smart cities. XXII International Scientific Conference on Advanced In Civil Engineering “CONSTRUCTION THE FORMATION OF LIVING ENVIRONMENT’ Tashkent, Uzbekistan, April 18-21, 2019 E3S Web of Conferencese ISSN: 2267-1242;
12. Azimov R.K., Siddikov I.Kh., Kurbanova M.Zh., Anarbaev M.A., Siddikov O.I., Mamatkulov A.N. Current-to-voltage converter // Patent RUz IAP0490B.I. No. 6,2014
13. Allaev K.R., Azimov R.K., Siddikov I.Kh., Kholiddinov I.Kh., Khasanov M.Yu., Akhmedov N.Zh. Electromagnetic converter of asymmetry of three-phase current into voltage // Patent RUZ IAP 2014 0463 B.I. No. 4, 2016
14. Allaev K.R., Azimov R.K., Siddikov I.Kh., Kholiddinov I.Kh., Khasanov M.Yu., Kodirov F.M., Mirzaeva M.M. Electromagnetic converter of asymmetry of three-phase current into voltage // Patent RUz IAP 2014 0509 B.I. No. 6, 2016
15. Allaev K.R., Azimov R.K., Kholiddinov I.Kh., Yulchiev M.E., Borisova E.A., Amurova N.Yu. Electromagnetic converter of asymmetry of three-phase current into voltage // Patent RUz IAP 2014 0540 B.I. No. 6, 2016
16. Allaev K.R., Azimov R.K., Kholiddinov I.Kh., Khasanov M.Yu., Akhmedov N.Zh. Electromagnetic converter of asymmetry of three-phase current into voltage // Patent RUz IAP 05383 B.I. No. 4, 2017
17. Siddikov I. Kh., Makhsudov M.T, Boikhanov Z.U, Uzaqov R,Features productions reactive power onsystems electrical supply with renewable sources energies.ACADEMICIA.An International Multidisciplinary Research JournalIssue 6, June 2020y. 292-296p