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EVALUATION OF THE EFFECTIVENESS OF THE ORGANIZATION OF AN AUTOMATED SYSTEM FOR MANAGING THE RESERVE ENERGY SUPPLY OF A MINING FARM

The popularity of digital money due to the high capabilities of digital technologies, data transmission, makes it possible to carry out fast transactions and store capital in the form of electronic, virtual funds. Mining technology allows you to mine cryptocurrencies (bitcoin, Namecoin, etc.) in real time using a large number of video cards for parallel calculations of soda (hashes), while a large amount of electricity is consumed. The boom of mining technology occurred in 2009-2015, which caused a sharp increase in electricity consumption and insufficient capacity for the development of other sectors of the economy In Kazakhstan due to the low cost of electricity, there was an increase in the number of mining farms, and therefore there were several blackouts. As a rule, a mining farm does not belong to consumers of the 1st category, for whom switching to other feeders takes place, the elimination of accidents has recently taken quite a long time and the equipment stops, causes overheating and failure of video cards, moreover, the calculation process itself is interrupted, the warranty functioning of the equipment is not provided. The presented article discusses the methodology of organizing the backup power supply of a mining farm, the selection and justification of the necessary equipment and automation.

Keywords: mining, automated control systems, backup power supply, efficiency

Introduction

In 2022, the Majilis of the Parliament adopted amendments to the draft law «On Digital Assets in the Republic of Kazakhstan» [1]. This document has brought big problems to the mining farmers of Kazakhstan. So what is the problem? The biggest problem is the licensing of activities, the next is the payment of corporate, as well as the ban. to connect to the common energy system of Kazakhstan.

At the same time, there is still no clear understanding of the functioning of mining farms in the country within the legal framework.

The blackout that occurred in 2022, against the background of increased energy consumption by manners, greatly undermined their credibility members of the government. Fig. 1 shows data on mining farms in Kazakhstan for 2022 [2].

Figure 1−Data on mining companies in Kazakhstan

According to the department [3], in October 2021, only 27 companies engaged in digital mining were registered in the country. By mid-December 2022, the number of «white» miners increased 11 times, to 297. This number includes both active crypto miners and those who have just notified the ministry about the start of their activities. By December last year, there were 60 such firms (27 of them were engaged in mining in parallel). In total, there were 330 unique participants in the industry at the end of last year. In Fig. 2 presents a map of the presence of mining farms across the country [4].

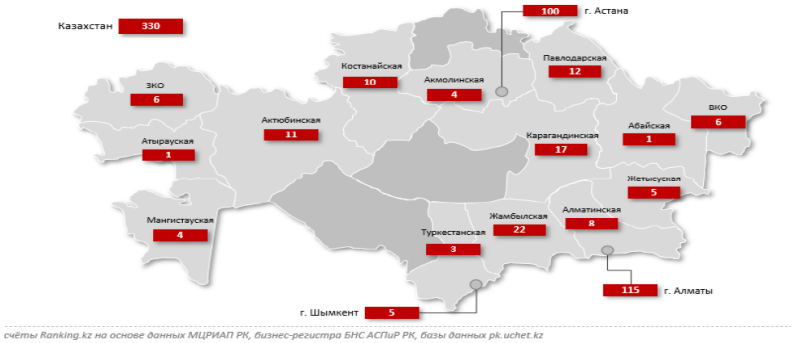

Figure 2 – Map of the presence of mining farms in Kazakhstan

As can be seen from Fig. 2, the main part of mining farms settled in Almaty and Astana (115 and 100) [4–6]. According to the proposals announced during the meeting of the Majilis of the parliament on December 26, 2022 x6], miners will be able to receive technical conditions for connection to electric networks, due to imports from other countries, from renewable sources electricity (RES) or from JSC «KORЭM» at market prices with a positive balance of electricity. Fig. 3 shows data on electricity consumption in Kazakhstan for the period 2021-22.

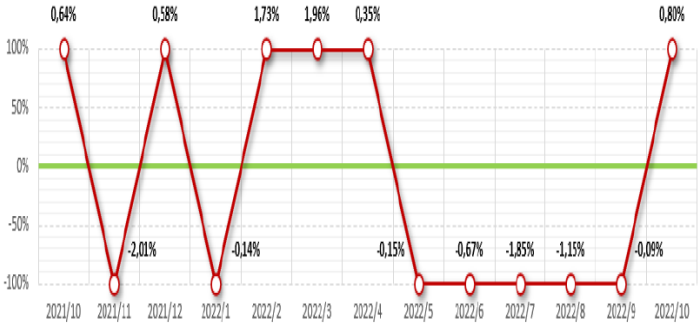

Figure 3−Electricity consumption
in Kazakhstan 2021–2022

As can be seen from Fig.3, the shortage of electricity occurred from May to September 2022, during this period there was a blackout in Kazakhstan and massive outages of consumers. In this regard, the organization of alternative energy supply to consumers is relevant.

Materials and methods

«NB-coin» LLP, located on the territory of the Akmola region, with 250 units of equipment for cryptocurrency mining, was chosen as the object of research. The purpose of the study is to increase the efficiency of the functioning of the mining farm. The objective of the research is to develop an automated control system and organization of backup power supply for mining farm equipment.

Results and discussion

In «NB-coin» LLP, the equipment of the manufacturer (asic) Antminer S9 is used. Table 1 shows the technical thermal conditions of the equipment (asic) Antminer S9.

Table 1−Technical characteristics of the Antminer S9 for thermal mode

Parameter	**Meaning**
Electrical power consumption	1400 wt
Operating temperature range	0℃÷+40℃
Cooling cooler performance	**338 м³/h**
Overall dimensions	329 x 127 x 159 мм

Fig 4 – shows the equipment (asic) Antminer S9.

Figure 4−Equipment (asic) Antminer S9

For normal maintenance of the temperature regime, heat from the room must be removed in order to avoid overheating and accidents.

When the room temperature rises above +40 ℃, there is a natural decrease in farm productivity by more than 5 %.

To maintain the temperature regime, it is necessary to ensure the normal functioning of the equipment for this purpose, an air conditioning or forced ventilation system is organized, depending on the capacity of the mining farm.

It should be borne in mind, especially in winter, the air temperature should not be below 0 ℃ and should be heated.

Ensuring proper ventilation should ensure effective cooling of the cooling system of the mining farm equipment, while the following rule must be observed: the flows of cooled air should enter the room with the equipment at the entrance, and removal should be carried out in places where hot air accumulates. In the professional environment, this term is called the «cold and hot corridor principle». Fig. 5 shows the principle of operation of this scheme.

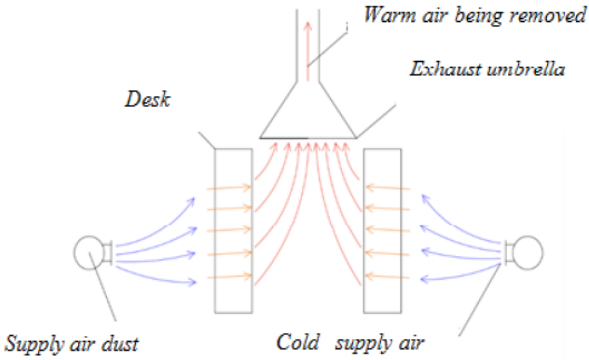

Figure 5−The principle of cold and hot corridor

We will perform the necessary calculations related to ensuring the necessary ventilation of the equipment of «NB-coin» LLP calculation and selection of equipment of optimal parameters. Table 1 shows the heat dissipation of 1 unit of equipment, respectively, as mentioned above, the number of equipment is 250 pieces. From this quantity we perform calculations.

Tent - the room is 5° ℃;

Trem– from the room is +40 ℃;

The heat release from the equipment is the formula (1):

$$Q=1400 \text{ x } 250 = 350 \text{ kWt} \quad (1)$$

The heat capacity Cp of the air is- 1005 Wt/м2×K

We calculate the amount of air to remove the entire volume of heat:

G = Q×3600/(Cp×1,2×(Tent-Trem)) = 350000 ×3600 / (1005 ×1,2 × (40 – 5)) = 29850 м3/h

It should be emphasized here that the heat removed from the equipment can be used to heat the outdoor air in winter and cool it in summer, in order to increase the efficiency of the ventilation system.

It is necessary to understand that ventilation systems are expensive equipment, therefore, either issues of equipment performance are being resolved or a ventilation system is being organized.

In our case, a forced ventilation system is organized in NB-coin LLP, which is not of the highest pricing shown in Fig. 6.

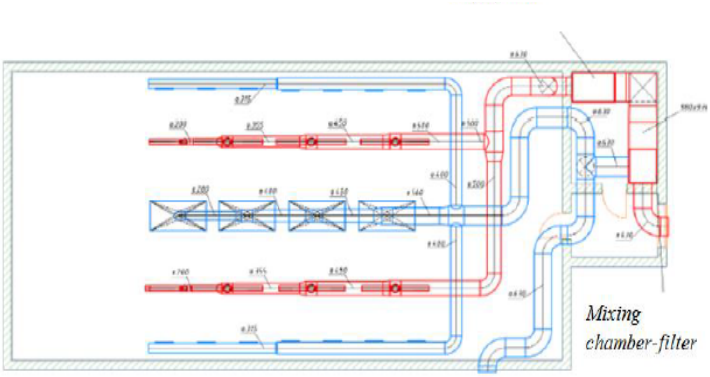

Figure 6– Ventilation system of «NB-coin» LLP

We will calculate the energy consumption of the equipment of «NB-coin» LLP. This calculation is made up of the total electricity consumption, both by the production equipment and by the administrative office [7-14].

The main equipment of for mining Me:

Me =250×1,4= 350 кW/h;

2. Ventilation equipment fig.7, consumes 4 kW/h;

Figure 7−Fan group with freon cooler

3. The administrative building, taking into account the workplaces of employees, security systems and other low-current equipment, is 15 kW/h.

Now let's calculate the total energy consumption of the entire enterprise of «NB-coin» LLP formula (2).

$$Etot= 350+4+15=369 \text{ kW/h} \quad (2)$$

The following equipment and materials are included in the reserve power supply [15-17].

1. Choose a diesel generator, according to the formula (2), the total energy consumption is 369 kW / h. Kazakhstan has a fairly wide range of diesel generator sets (diesel generator), so the choice was made by the company «AS-AI» LLP brand SDG 500S Fig. 8, the characteristics of which are shown in Table 2.

Figure 8−SDG 500S diesel generator

Table 3−Technical characteristics of SDG 500S DSU

Rated Power *kW/h*	Tank volume, *l*	Engine capacity *Cub/m*	Weight, *kg*	Overall dimensions, *m*
450	450	91,5		4,5×1,6×2,09

The diesel generator is selected with a margin for a possible increase in the number of equipment. The cost of the diesel generator of this brand

is 24000000tenge.

2. Selection Of Batteries. Here my choice stopped on batteries of the brand SVC VP12150/S12 In 150 Ah (485=172=240) 2-005498. Fig. 9 shows the appearance of the battery.

Рисунок 9−Аккумулятор марки SVC VP12150/S

Let’s calculate the number of required batteries for our system.

$$I=P/\sqrt{3}\times U \quad (3)$$

$$I=369000/\sqrt{3}\times 380=561\ A$$

In total, taking into account the fact that 1 battery gives 150A, we need 4-5 pieces. The cost of 1 battery of this brand is 157,000 tenge, respectively, for 4 batteries - 628,000 tenge.

3. Automation and accessories. Let’s choose a cable for organizing the connection of power lines. Let’s focus on the cables of the VVG brand, the number of cores is 1-5, the cross sections are different from 1.5-25. Fig. 10 shows the appearance of the VVG cable.

Figure 10−VVG cable

The cost of 1 meter of cable of this brand ranges from 1000 tenge per meter. We need more than 150 meters of cable of this brand, the cost of the cable will be 150,000 tenge.

The power cabinet. The complete set with the introductory automata is shown in Fig. 11.

Figure 11−Power cabinet

The cost of such a power cabinet is 150,000 tenge, it is produced in Kazakhstan, SK Magic Technology.

4. Installation and accessories. Only certified companies with appropriate certificates and permits should be engaged in the implementation of work on the organization of backup power supply. According to the market offers on the sites OLX, Roof, GARDEN and others, the cost of installation work will be at least 1000000tenge, obtaining permits 1000000tenge. The components not presented above, of a fairly wide range, take a sufficient amount of time to describe, so we

do not consider them. The approximate cost of all components and other works will be more than 9000000 tenge.

Fig. 12 shows the connection diagram of the diesel generator- this option when there are no additional batteries.

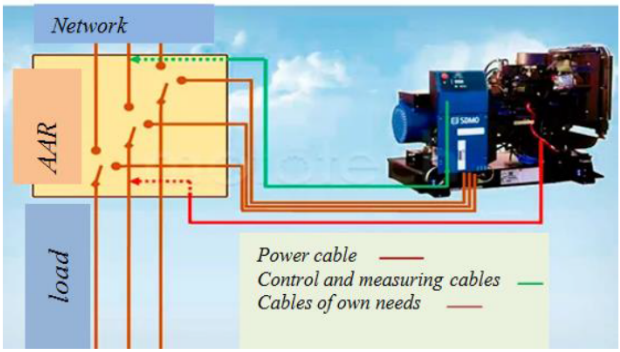

Figure 12− Connection diagram of a diesel generator

Fig. 13 shows the scheme of the AAR (automatic activation of the reserve).

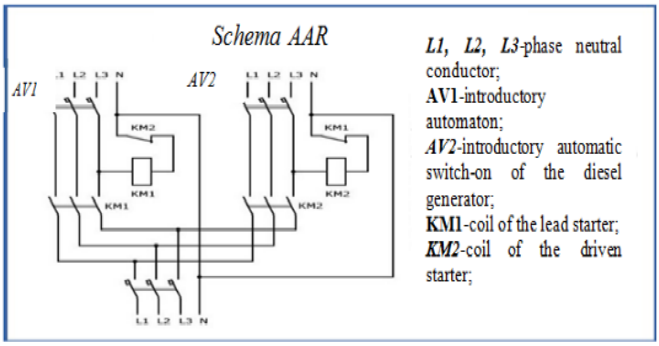

Figure 13−AAR diagram

As can be seen from Fig. 14, when the power supply from the external load is cut off, AB 2 automatically triggers the diesel generator. In Fig. 15 presents an automated system for managing the operation of the backup power supply. All connection of the equipment at which autorun of the diesel generator is provided is clearly shown, when the general power supply network of «NB-coin» LLP is

disconnected. The very fact of the presence of the AAR with the correct connection ensures the correct switching from the diesel generator to the general network and back.

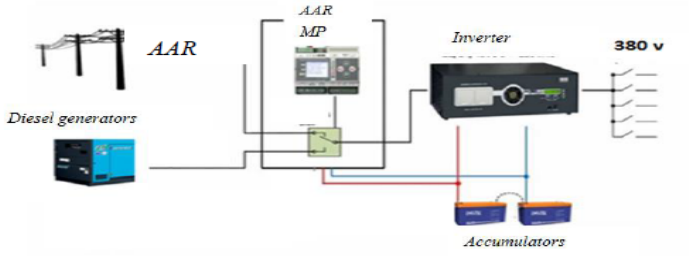

Figure 14−Automated backup power supply management system

Power supply management is carried out in automatic mode without human intervention, AAR, contactor unit allow control signals to be carried out, monitoring the current state of the power supply system. The presented automated control system provides not only the set research goal, but can be practically implemented.

Conclusions

To implement the above-mentioned backup power supply system for «NB-coin» LLP, an investment in the amount of 25928000 tenge (excluding emerging costs) or $ 54736 is required. To date, the cost of 1 bitcoin is $ 30,000 at the rate of the National Bank of the Republic of Kazakhstan. It is known from open sources that for mining 1 bitcoin with the appropriate amount of equipment, it takes from 1-1.5 months, Presumably NB-coin LLP, to get 1 bitcoin, it will take 6 months, in this case, the payback period of the project, conditional will be 1-1.6 years. With the existing problems of the Astana power grid, the organization of backup power supply of the enterprise will not only ensure trouble-free operation of equipment, but also increase the efficiency of cryptocurrency hashing.

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ОЦЕНКА ЭФФЕКТИВНОСТИ ОРГАНИЗАЦИИ АВТОМАТИЗИРОВАННОЙ СИСТЕМЫ УПРАВЛЕНИЯ РЕЗЕРНЫМ ЭНЕРГОСНАБЖЕНИЕМ МАЙНИНГОВОВЙ ФЕРМЫ

Популярность цифровых денег в связи с высокими возможностями цифровых технологий, передачи данных, дает возможность осуществления быстрых транзакций и хранения капитала в форме электронных, виртуальных средств. Технология майнинга, позволяет в режиме реального времени добывать криптовалюту (биткойн, Namecoin и др.) используя большое количество видеокард для параллельных вычислений содов (хешей) при этом расходуется большое количество электроэнергии. Бум технологии майнинга пришелся на 2009–2015года, что послужило резкому росту потребления электроэнергии и недостаточности мощностей для развития других секторов экономики В Казахстане благодаря невысокой стоимости электроэнергии, произошел рост количества майнинговых ферм, в связи с чем произошло несколько блэкаутов. Как правило майнинговая ферма, не относится к потребителям 1 категории, для которых происходит переключение на другие фидеры, устранение аварий занимает в последнее время достаточно продолжительное время и остановка оборудования, вызывает перегрев и выход из строя видеокард, более того прерывается сам процесс вычислений, как правило на майниговых фермах, установлены UPS, которые не обеспечивают гарантийное функционирование оборудования. В представленной статье рассматривается организация резервного энергоснабжения майнинговой фермы, выбор и обоснование необходимого оборудования, автоматики.

Ключевые слова: майнинг, автоматизированные системы управления, резервное энергоснабжение, эффективность

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ТАУ КЕН ФЕРМАСЫН РЕЗЕРВТІК ЭНЕРГИЯМЕН ЖАБДЫҚТАУДЫ БАСҚАРУДЫҢ АВТОМАТТАНДЫРЫЛҒАН ЖҮЙЕСІН ҰЙЫМДАСТЫРУДЫҢ ТИІМДІЛІГІН БАҒАЛАУ

Цифрлық технологиялардың, деректерді берудің жоғары мүмкіндіктеріне байланысты цифрлық ақшаның танымалдығы жылдам транзакцияларды жүзеге асыруға және капиталды электрондық, виртуалды құралдар түрінде сақтауға мүмкіндік береді. Тау-кен технологиясы нақты уақыт режимінде криптовалютаны өндіруге мүмкіндік береді(Bitcoin, Namecoin және т.б.) параллель сода (хэш) есептеу үшін көптеген видеокардтарды қолдана отырып, электр энергиясының көп мөлшері жұмсалады. Майнинг технологиясының өрлеуі 2009-2015 жылдарға келді, бұл электр энергиясын тұтынудың күрт өсуіне және электр энергиясының төмен құнының арқасында Қазақстанда экономиканың басқа секторларын дамыту үшін қуаттардың жеткіліксіздігіне, майнингтік фермалар санының өсуіне, осыған байланысты бірнеше қара түсті. Әдетте, тау-кен фермасы 1 санаттағы тұтынушыларға жатпайды, олар үшін басқа фидерлерге ауысу орын алады, апаттарды жою соңғы уақытта жеткілікті ұзақ уақытты алады және жабдықты тоқтатады, қызып кетуді және видеокардтың істен шығуын тудырады, сонымен қатар есептеу процесінің өзі үзіледі, әдетте тау-кен фермаларында ups орнатылады, олар қамтамасыз етпейді жабдықтың кепілді жұмыс істеуі. Ұсынылған мақалада тау-кен фермасын резервтік энергиямен жабдықтауды ұйымдастыру әдістемесі, қажетті жабдықтар мен автоматиканы таңдау және негіздеу қарастырылады.

Кілтті сөздер: тау-кен, автоматтандырылған басқару жүйелері, резервтік энергиямен жабдықтау, тиімділік

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