ТЕХНИКАЛЫҚ ҒЫЛЫМДАР / ТЕХНИЧЕСКИЕ НАУКИ / TECHNICAL SCIENCES

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A NEW CONCEPT OF THE ELECTRIFICATION SYSTEM

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Аңдатпа

Қазіргі уақытта жаңа технологиялар және энергия тиімділігі саласындағы жетістіктер туралы кеңінен жарияланады, олар нарықтағы инновациялық өнімдерде энергетикалық сала үшін пайда болуда. Инветорға көптеген ұсыныстарда қаржы салуға қйын болғанын көрсетеді, энергетикалық құрылымдардың жетекшілеріне келешекте жаңа технологияларды еңгізгенде ол шығындарды қайтаруын қйындауы, әсіресе алғашқы кезеңдерде. Қазіргі жағдай қосымша күрделенуі сонымен, барлық инновациялық энергетикалық нарықтағы ойыншылардың идеялар әр түрлі қызығушылық танытады.

Осындай қал-жағыдайда энергетикадағы өнімді немесе басқа жаңа технологияларды арттыру немесе еңгізу сұрақтарында өз ұстанымды анықтау мақсатында, электржабдықтар жүйенің негізгі концепциясының дамуының білуі маңызды болады, осы жүйелердің келешекте энергетика нарықтағы сегментке әсерететінін және оларды еңгізген жағыдайда негізгі тәуекелдерді анықтағанда.

Осы себептен, бұл мақалада алыс ұзамайтын келешекте қатты сезінелетін жаңа технологиялық қажеттіліктер қарастырылған, қайсысын осы кезде бар электрэнергетикалық жүйеге бейімдеуге болады, бірте-біртеп қайта қарулап және электржабдықтар және электрберіліс желісінің инфрақұрылымын модернизациялау жолымен.

Мақаланың авторлары, болжауға негіздене отырып, заманауи электрмен қамтамасыз ету жүйесі және болашақ электрмен жабдықтау жүйенің бірбірінен айырықша болатынын ескере отырып, Астана қаласы тұрғысындағы жағдайына байланысты қолданыстағы электрмен жабдықтаушы және таратушы компаниялар инфрақұрылым мысалында автозарядтау станцияларды енгізуді бағалауға тырысты.

Жаңаенгізуді тиянақтап қарау үшін, әрине, үсынылған электірлік жүйенің қайта жаңарту нұсқаның дамуына жаңа стратегия қабылдау керек.

Түйінді сөздер: Балама және жаңартылатын энергия көздері. Энергия үнемдеуші энергия көздері. Мобильдік құрылғылар, электр машиналары мен агрегаттары. Аккумуляторлық батареялар қоректендіруші станциялары. Желісі заряжающих колонок өңірде, мегаполисте және т. б. Аккумуляторлық батареялар. Автозарядты станциясы. Жүрісі. Зарядталған аккумулятор батареяларын арсеналы. Электр қуаты.

Аннотация

В настоящий момент широко освещаются новые технологии и достижения в области энергоэффективности, которые все больше появляется на рынке инновационных продуктов для энергетической отрасли. Среди всего многообразия предложений инвестору труднее стало осуществлять свой выбор по вложению капитала, руководителям энергетических организаций сложнее внедрять новые технологии и продукцию с точки зрения будущей окупаемости затрат на их внедрение, особенно на первоначальных этапах. Существующая ситуация дополнительно осложняется тем, что у всех игроков на инновационном энергетическом рынке идей разные интересы.

При таком положении вещей, с целью определения своей позиции в вопросах развития или внедрения той или иной новой технологии или продукции в энергетике, важным становится знание основной концепции развития систем электроснабжения, в разрезе будущего влияния этих систем на различные сегменты энергетического рынка, и определения основных рисков в случае их внедрения.

В связи с чем, в данной статье рассматриваются новые технологические нужды, которые будут остро ощущаться в обозримом будущем, которые можно будут адаптировать в имеющую систему электроэнергетики путем постепенного перевооружения и модернизации инфраструктуры сетей электроснабжения и электропередачи.

Авторы статьи, основываясь на предположении, что современные системы электроснабжения и системы электроснабжения будущего будут кардинально отличаться друг от друга, все же попытались оценить потенциал существующих инфраструктур электроснабжающих и передающих компаний на примере г. Астана на предмет состоятельности при введении автозарядных станций.

Для детального рассмотрения нововведения, безусловно, требуется принятие новой стратегии в развитии предлагаемого варианта реконструкции системы электрификации.

Ключевые слова: Альтернативные и возобновляемые источники энергии. Энергосберегающие источники энергии. Мобильные устройства, электромобили и агрегаты. Питающие станции аккумуляторных батарей. Сеть заряжающих колонок в регионе, мегаполисе и т.д. Аккумуляторные батареи, Автозарядная станция. Пробег. Арсенал заряженных аккумуляторных батарей. Электрическая мощность.

Annotation

At the moment, new technologies and achievements in the field of energy efficiency are widely covered, whichmore and more appears on the market of innovative products for the energy sector. Among all the variety of proposals, it became more difficult for the investor to make his choice about investing capital, the heads of energy organizations find it more difficult to introduce new technologies and products in terms of the future return on the costs of their implementation, especially in the initial stages. The existing situation is further complicated by the fact that all players in the innovative energy market have different interests.

In this situation, in order to determine its position in the development or implementation of a new technology or product in the energy sector, it becomes important to know the basic concept of the development of power supply systems, in the context of the future impact of these systems on various segments of the energy market, and identify the main risks in case of their implementation. In this connection, this article deals with new technological needs that will be acutely felt in the foreseeable future, which can be adapted to the existing electric power system, by gradually re-equipping and upgrading the infrastructure of electricity and transmission networks. The authors of the article, based on the assumption that the current power supply systems and the electricity supply systems of the future will radically differ from each other, nevertheless tried to assess the potential of existing power supply and transmission companies by the example of Astana for consistency when introducing auto – charging stations.

For a detailed consideration of the innovation, of course, it is necessary to adopt a new strategy in the development of the proposed version of the reconstruction of the electrification system.

Key words: Alternative and renewable energy sources. Energy – saving energy sources. Mobile devices, electric vehicles and aggregates. Feeding stations of storage batteries. Network of charging speakers in the region, metropolis, etc. Batteries. The autoloader station. Mileage. Arsenal of charged batteries. Electric power.

Introduction

Since the general recognition and the beginning of a large – scale application of the existing concept of the electrification system, the founder of which is the Russian electrical scientist M.O. Dolivo-Dobrovolsky [1], proposing to the world a three – phase system consisting of: a source, transmitting electric power lines, a transformer and a consumer, there were no significant changes in this aspect. The development and introduction in 1891 of three-phase generators, transformers and electric motors, which had undeniable advantages over other types of production, transmission and use of electric energy, were the beginning of the modern period of development of electrical engineering.

The further development of this system, already in the period of the Soviet Union, which included all the CIS countries, was the world's largest energy system, which was determined by a set of electric power stations, power lines, substations and heat networks linked in one piece by the generality of the regime and the continuity of production and distribution processes electrical and thermal energy, Fig. 1 [2, 3].

However, during the collapse of the Soviet Union, this unified energy system could not meet the needs of consumers, in view of the loss of the integrity of the state, and the divided countries in the initial stage of their development were dependent on it. This circumstance is an exhaustive factor of the fact that the modern way of economic activity of the world must be equipped with a sufficient arsenal of the energy resource, that is, the resource that is the primary source in any technological cycle or process.

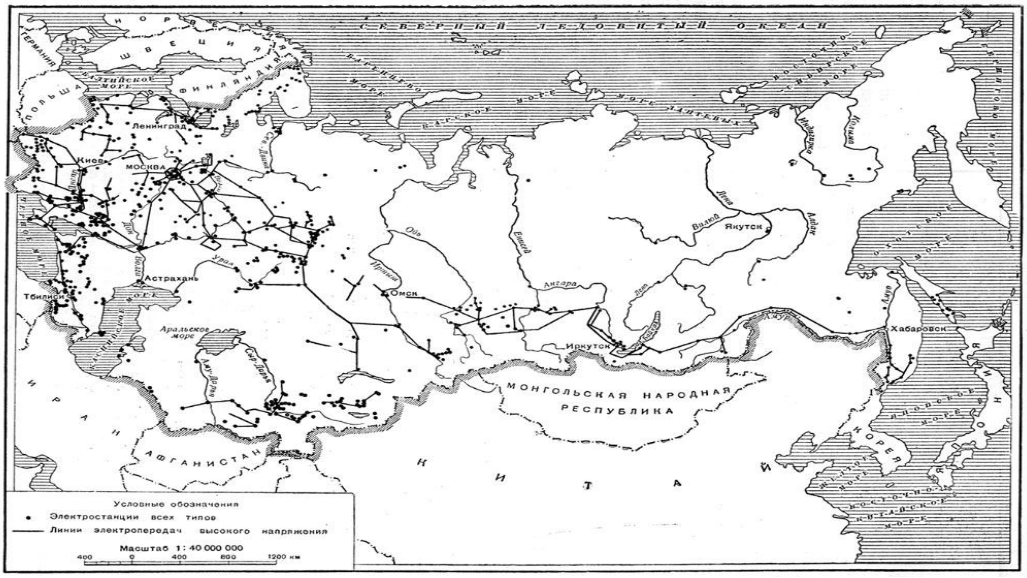

Figure 1 Map of the unified energy system of the USSR

One of the steps taken by the world community in terms of moving away from traditional ways of obtaining a primary source by the example of transport is the abandonment of internal combustion engines and the transition to electromotive vehicles. This decision is caused by the fact that: firstly, not all countries have their own fuel and raw materials resources; secondly, the world is threatened with environmental pollution by harmful effects of emissions of heavy volatile waste; well, in the third, the reserves of fuel in the bowels are depleted and are calculated tens of years before their full consumption.

At the moment, already major industrialized countries are carrying out search activities for large – scale commissioning of alternative and renewable energy sources, bypassing the traditional ones, involving safe and environmentally friendly technologies in operation. Along with the well – known ecological and energy – saving sources of energy, the need to create transport based on electric traction is simultaneously being revealed. This was announced in Paris at the World Conference on the United Nations Framework Convention on Climate Change (COP21) by countries such as the United Kingdom, Germany, the Netherlands, Norway, and several US states: in particular, a ban on the use and operation of cars on fuel fuel after 2050 [4, 5]. However, no such mobile devices have been found that supply electric power to machines and aggregates to a sufficient extent, which could be charged in time in the same way as vehicles can be refueled with fuel.

Analysis of existing energy systems allows, on the basis of the traditional method of electric power generation, to start preparing for the development of new battery feeding stations that will collect «free» power [5], which takes place during the minimum loads, instead of transporting it for long distances and providing electric power other regions or countries. Such an approach in solving the problem of providing electricity, will give independence to individual regions or countries, from the centralized supply of electrical energy. Feeding stations should include all alternative sources that are known to date, including traditional ones on fuel combustion, and also have a sufficient degree of communicability, implying the withdrawal from the cycle of the technological chain of non-current or non-conforming methods of generating electricity. Also, feeding stations should have a wide network of charging columns in the region, a metropolis, etc., and a large reserve of batteries that would be in a charged state in charging stations or columns ready to replace the discharged battery of the vehicle every minute. Figure 2 shows a network of automobile charging stations (Filling stations), where the main source of such a station is a set of different types of electrical, both traditional and renewable and alternative energy sources. A network of charging stations is distributed from the main or main station.

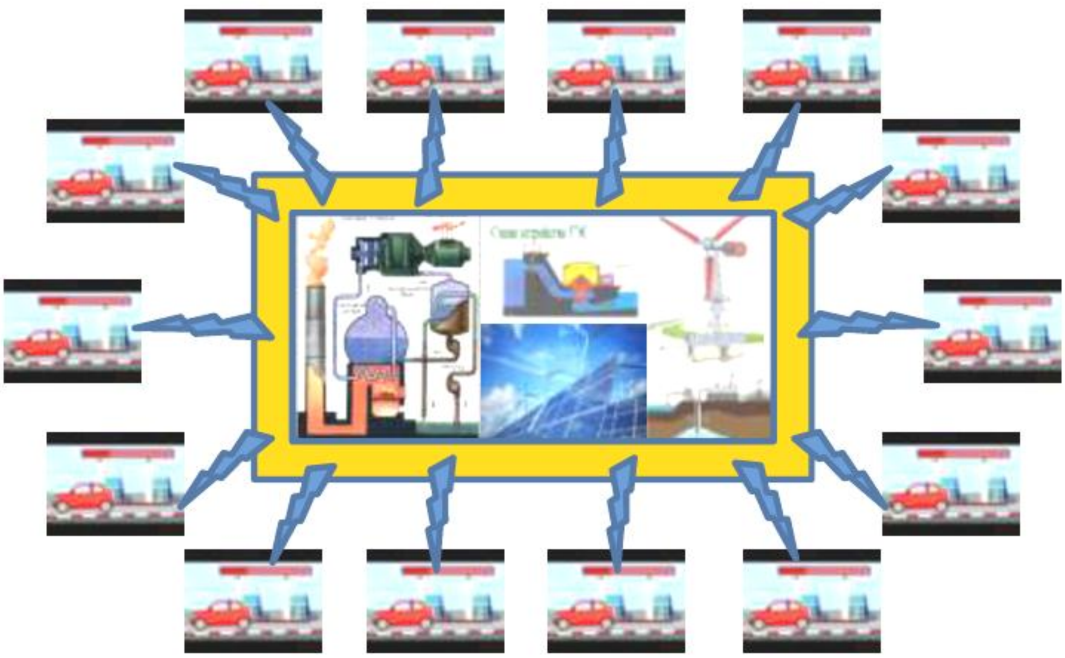

Fig. 2 Network of charging stations from the main source of electrical energy

So, if we consider as an example one of the megacities of Kazakhstan, the city of Astana, then in 2017 it was officially announced that there are 1 million people residing in this city. According to situational statistics, it can be assumed that for each person, on average, there is one vehicle each. The number of petrol stations was fixed 49 on the territory of the city [6]. If, on the average, each driver of a motor vehicle is fueled by approximately 200 km of travel, and a day travels from 30 km to 40 km, it can be assumed that he pours in the filling station 1 – 2 times per week. Consequently, all gas stations serve a week from 20,000 to 40,000 vehicles.

The same statistics can be assumed with auto – charging stations, since if we assume that the average passage time on one charge is within the same limits, i.e. 200 km of run, then a day will be driven into the charging station from 3000 to 6000 thousand electric vehicles. This means, according to the proposed theory, each autoloader should have an arsenal of charged batteries in the amount of the maximum value of the statistics given – this is 6000 ready – to – replace batteries.

Such charging stations will consume in a day from 1.1 MW to 2.2 MW of electric power P, assuming that the charging current I will be 15A, and the output voltage U at the terminals of the charging station will be 24 V:

$$P_1 = UI = 24 \cdot 15 = 360W$$

$P_1 -$ this is the power used to charge one battery.

Therefore, if 3000 to 6,000 thousand batteries are charged per day, then a day will be consumed:

$$P_n = P_1 \cdot 3000 = 360 \cdot 3000 = 1080000Bm \approx 1{,}1MW$$

$n -$ this is the number of batteries per day.

Then all the autoloading stations of the city of Astana, and there are 49 of them, will consume 50 MW to 100 MW of electric power per day. This is an average of 10 % to 20 % of the total share of the generated electric capacity of CHPP – 2 in Astana [7].

According to technical data [8], the peak demand of the city of Astana in 2010 was within 450 MW, while the minimum load could be from the entire share of the maximum load from 30 % to 60 % [5], depending on the season

Then in the summer period:

$$P_{\min}^{zummer} = \frac{P_{\max} \cdot 30}{100} = \frac{450 \cdot 30}{100} = 135MW$$

Where $P_{\min}^{zummer} -$ the minimum consumed electric power of the city of Astana in the summer.

In winter: $P_{\min}^{winter} = \frac{P_{\max} \cdot 60}{100} = \frac{450 \cdot 60}{100} = 270MW$

Where $P_{\min}^{winter} -$ the minimum consumed electric power of the city of Astana in the winter.

From the above mathematical calculations, according to the actual state of the city of Astana, according to the technical information [8] of the output, and if we take into account the fact that the current state of the produced capacity is dynamically growing, since in the long-term plans the launch of CHPP – 3 is planned, it is possible to forecast the demand for electric capacity per million population of the population. This order from 315 MW to 180 MW of the produced capacity of the city of Astana can be sent, at the minimum hours of operation, to the charging stations. Even those electric power data, given from the official sources of Akimat of Astana, can fully cover the possible needs of charging stations under the appropriate scenario of development, as proposed in this material.

For clarity of the theoretical material presented, let us consider the daily graph of electrical loads (Fig. 3), given in the literature [9], which is a typical case for a multitude of cities and regions.

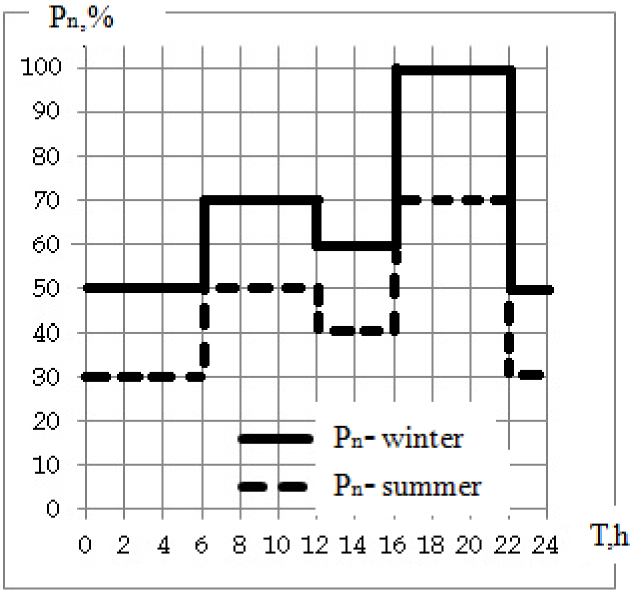

Fig. 3. Daily schedule of electrical load.

As can be seen, from the daily schedule in winter time, about 70 % of the potential capacity is consumed, and in the summer, even less than about 40 % of the total electric power production. The example given above, consumption of the city of Astana, corresponds to a typical example from a literary source [9]. From the graph it follows that the minimum winter load of up to 50%, and in summer up to 30 % of the total generated electric power, per day falls on the period from 22 pm on the day to 6 am of the day, which is 8 hours in total. If the time t is taken to fully charge one battery, the consumed electric energy of each charging station can be reduced by 4 times, alternately charging the batteries, grouping each connection of the chargers for 2 hours, for a total of 8 hours. However, we must add that the first half of the working day is also not loaded to the maximum values, which can further reduce the consumed electric energy of the charging stations and reduce it in 5, in some cases 6 or more times.

Theoretical research and review of sources of technical literature show that new technological needs that will be acutely felt in the foreseeable future can be adapted to the system of electric power industry, by gradually re – equipping and upgrading the infrastructure of electricity and transmission networks.

It should be noted that the infrastructure that is currently operated by electricity supply and transmission companies can fully be suitable for developing a new concept of electrification, implying the introduction of auto – charging stations.

For a detailed consideration of the innovation, of course, it is necessary to adopt a new strategy in the development of the proposed version of the reconstruction of the electrification system

Such supply stations, in turn, will introduce changes in the concept in engineering related to the rapid replacement of discharged storage batteries by charged ones. It is proposed to provide for the design of vehicles an automatic detachable battery device, and the batteries themselves had a single standard geometric dimension that would fit all sizes without exception, including cargo, sea, air, etc. means of transport.

Conclusion

Thus, the rising problem directly connects two completely different directions of national economy that can complement each other and solve the urgent task of stable provision of primary energy of vehicles based on electromotive force, in exchange for fuel stations on fuel.

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УДК 389.

ЗНАЧЕНИЕ СЕРТИФИКАЦИИ И СТАНДАРТИЗАЦИИ В ОБЕСПЕЧЕНИИ КАЧЕСТВА СВАРОЧНОГО ПРОИЗВОДСТВА НА ОСНОВЕ МАТЕМАТИЧЕСКОЙ МОДЕЛИ

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Аңдатпа

Бұл мақалада дәнекерлеу өндірісіне стандарттау мен сертификаттаудың әсері қарастырылады. Математикалық статистиканың шекаралық есептерінің шекараларының шартты – рұқсат етілген бағалау әдісін қолдану арқылы дәнекерлеу өндірісін сертификаттау мен стандарттау тәсілін объективті түрде іске асыру мүмкін болды. Компьютерлік модельдеуге қолданылатын математикалық статистикаға негізделген жалпы жалпы нәтижелер көрінеді. Бүгінгі күннің жұмысы маңызды және сұранысқа ие.

Түйінді сөздер: дәнекерлеу өндірісі, шекаралық есеп, сертификаттау, стандарттау, статистика.

Аннотация

В данной статье исследованы вопросы влияния стандартизации и сертификации на сварочное производство. При помощи метода условно – допустимых оценок границ краевых задач математической статистики, стало возможным более объективно осуществлять подход к процессу сертификациии и стандартизации сварочного производства. Показаны общие универсальные результаты, основанные на математической статистике применительно к компьютерному моделированию. Работа на сегодняшний день является актуальной и востребованной.

Ключевые слова: сварочное производство, краевая задача, сертификация, стандартизация, статистика.

Annotation

This paper explores the impact of standardization and certification on welding industry. Using the method of conditional – permissible boundary estimates of boundary – value problems of mathematical statistics, it became possible to more objectively implement the approach to the certification and standardization of welding industry. Shown are general universal results based on mathematical statistics applied to computer modeling. Work to date is relevant and in demand.

Key words: welding industry, boundary – value problem, certification, standardization, statistics.